1622672 - R8 SDMS

Letter of Transmittal

Environmental
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Management

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DATE: 9/10/2015

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Ken Wangerud

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☐ Shop drawings ☐ Prints ☐ Plans ☐ Samples

☐ Specifications ☐ Copy of letter ☐ Change order ☒ **Submittals**

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Hard copy	Sept 2015	2	Phase 1A-B Remedial Investigation Sampling and Analysis Plan for 1) Chemicals of Potential Concern in Soil, Sediment, and Solid Wastes in PRI Areas 1 and 3 through 7; 2) Preliminary Site Characterization Mapping of PRI Areas 1 and 3 through 7; and 3) Background Chemical Assessment of Biotic Reference Areas for Sitewide Ecological Risk Assessment US Magnesium NPL Site, Tooele County, Utah. EPA Site Identification No. UTN000802704
CD	Sept 2015	5	Electronic copy of Sampling and Analysis Plan

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David J. Abranovic, P.E.
Project Coordinator

~~Rcvd 15Sep2015~~

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cc: Michael Storck, UDEQ – 1 hard copy, 1 CD
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Phase 1A-B Remedial Investigation Sampling and Analysis Plan for:

1) Chemicals of Potential Concern in Soil, Sediment, and Solid Wastes in PRI Areas 1 and 3 through 7;
2) Preliminary Site Characterization Mapping of PRI Areas 1 and 3 through 7; and
3) Background Chemical Assessment of Biotic Reference Areas for Sitewide Ecological Risk Assessment.

Prepared for:
US Magnesium LLC
and USEPA Region 8

US Magnesium NPL Site
EPA Site Identification No.
UTN000802704
Tooele County, Utah

Revision 0, September 2015

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TITLE AND APPROVAL PAGE (SAP WORKSHEET #1)

Document Title

Phase 1A-B Remedial Investigation Sampling and Analysis Plan for 1) Chemicals of Potential Concern in Soil, Sediment, and Solid Wastes in PRI Areas 1 and 3 through 7; 2) Preliminary Site Characterization Mapping of PRI Areas 1 and 3 through 7; and 3) Background Chemical Assessment of Biotic Reference Areas for Sitewide Ecological Risk Assessment

US Magnesium NPL Site, Tooele County, Utah.
EPA Site Identification No. UTN000802704

Lead Organization

U.S. EPA Region 8

Supported by

UDEQ, PWT3 and SRC

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8/31/15
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Judy Nedoff
ERM QA Manager

Judy Nedoff 8/31/15
Signature Date

PREFACE

The U.S. Environmental Protection Agency (EPA) placed the US Magnesium Site (Site) on the National Priorities List (NPL) for remedial response pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) in November 2009. The U.S. Court of Appeals for the Washington D.C. Circuit upheld EPA's action for the listing in August 2010.

The US Magnesium plant electrochemically processes magnesium chloride (derived from Great Salt Lake brine waters) in melt-reactors and electrolytic cells (adding petroleum-coke) to produce primary magnesium-metal and chlorine. The volume of by-product waste streams being produced has increased since the start of the Remedial Investigation and Feasibility Study (RI/FS) and includes: (1) acidic liquid and slurry streams containing hexachlorobenzene, polychlorinated biphenyls, and dioxins/furans, and (2) liquid and gaseous releases of chlorine and hydrogen chloride, as well as particulates/aerosols containing chlorinated organic compounds. While the entire Site is included on the NPL, which requires that the Site undergo an RI/FS and potential remedial action pursuant to CERCLA, the plant proper remains in continuous operation and is subject to various requirements under the Clean Air Act and the Resource Conservation and Recovery Act (RCRA).

Administrative Settlement Order on Consent for RI/FS

In August 2011, EPA and US Magnesium entered into an Administrative Order on Consent (AOC) for RI/FS, under which US Magnesium (supported by ERM-West, Inc. [ERM]) is to carry out the work required for RIs, data management, risk assessment (RA), and FS for consideration of remedial action. The AOC and Appendix A: Statement-of-Work (SOW) for RI/FS call for scoping meetings during which US Magnesium/ERM engages in planning and technical discussions with the EPA for EPA's consideration in developing particular phases and stages of Sampling and Analysis Plans (SAPs). Numerous planning and scoping meetings to develop a Sitewide Phase 1A SAP (described below) were held from October 2011 through March 2013. Subsequent discussions addressing the Inner Preliminary Remedial Investigation (PRI) areas (the most contaminated portions of the Site) and refinement of RI activities for the Inner PRI areas occurred between August 2014 and March 2015; final development of this Phase 1A-B RI SAP (see below) is summarized in this document. Upon EPA approval and issuance of this Phase 1A-B RI SAP, US Magnesium/ERM is required to implement the Inner PRI areas and Background Study investigations as specified in this SAP.

Phase 1A RI SAP

In accordance with the AOC SOW, the EPA issued the *Phase 1A Remedial Investigation Sampling and Analysis Plan to Identify Chemicals of Potential Concern in Soils, Sediment, Solid Waste, Water and Air, and Receptor Surveys (Revision 0) for PRI Areas 2 and 8 through 17* (EPA 2013) (Phase 1A RI SAP) (with Quality Assurance Project Plan [QAPP]) in September 2013, laying out the technical specifications to implement Phase 1A investigations (identification of chemicals of potential concern [COPCs]) across the Site. However, ERM identified technical issues (health and safety as well as sampling and laboratory method considerations for highly acidic and inundated areas of the waste ponds) associated with sampling and analysis in PRI Areas 1 and 3 through 7 (Inner PRI areas) included in the Phase 1A SAP (Revision 0) needed to be resolved prior to initiating this portion of the SAP. In order to initiate sampling and data collection activities in 2013 and begin RIs of PRI Areas 2 and 8 through 17 (Outer PRI areas), as well as reduce the need for multiple sampling plan documents, the EPA issued the Phase 1A RI SAP as Revision 0 without resolving the technical issues needed to commence sampling in the Inner PRI areas. However, the terms and conditions provided by EPA with the Phase 1A RI SAP (Revision 0) provided a framework to resolve the remaining technical issues associated with sampling the Inner PRI areas.

Upon completion of the Air Demonstration of Methods Applicability (DMA), the EPA approved the *Phase 1A Remedial Investigation Sampling and Analysis Plan for Operable Unit 2 – Ambient Air* (ERM 2014c), which finalized the basis for standard operating procedures and worksheets pertinent to commencing the air investigations in PRI Area 18.

Development of the Phase 1A-B RI SAP

While the EPA was finalizing the Phase1A RI SAP, ERM and US Magnesium (having reviewed data from DMA investigations of Inner PRI areas indicating high concentrations of numerous constituent contaminant chemicals, and presuming little chance of eliminating suites of chemicals as COPCs [therefore not eliminating analytical methods from the RI]) asserted that Phase 1A investigations of the Inner PRI areas (for COPC identification) were not necessary, and instead proposed proceeding with Phase 1B investigations to determine preliminary nature and extent (N&E). Accordingly, the EPA sent a September 2013 cover letter and accompanying Attachment 5 for issuance of the Final Phase 1A RI SAP, to accommodate the request by US Magnesium and ERM to postpone implementation of Phase 1A sampling for the most contaminated areas of the Site until 2014, allowing US Magnesium to consider an alternative offer by EPA for a more streamlined risk assessment and for accomplishing FS objectives for the Inner PRI areas.

When the Phase 1A SAP was issued, EPA offered US Magnesium an alternative, streamlined RI/FS framework using appropriate data collected during previous RCRA investigations (and limited samples collected during initial Superfund [DMA] investigations), along with “conservative” screening RAs, in order to forego detailed RIs and RA and proceed to cleanup FSs for Inner PRI areas (the most contaminated areas of the Site). EPA agreed to defer the Inner PRI area sampling scheduled under the Phase 1A SAP while ERM carried out assessment of historical data and addressed technical issues for completing a Screening-Level Risk Assessment (SLRA) for the Inner PRI areas. Under the Phase 1A SAP, US Magnesium and ERM were to decide by June 2014 whether to proceed with the streamlined RI/FS or go back to the process set out in the AOC SOW.

On 30 October 2013, ERM (for US Magnesium) accepted the EPA-proposed streamlined RI/RA approach for the Inner PRI areas, with a SLRA technical memorandum and Inner PRI data report to be provided by the end of December 2013. EPA replied on 8 November 2013, indicating ERM should have sufficient time to discuss preliminary remediation goals (PRGs; i.e., preliminary action levels) and reach a decision on EPA’s offer in June 2014, enabling RI/FS activity for Inner PRI areas to commence in 2014.

On 20 March 2014, the EPA replied to another ERM request to delay sampling of the Inner PRI areas until after waste lagoons dried out (following a RCRA settlement, after which waters would no longer be discharged into Inner PRI area ponds). With a final SLRA report for the Inner PRI areas (to include PRGs) to be delivered in May 2014, EPA reminded US Magnesium that unless it decided in June 2014 to implement the streamlined FS process, considerable Inner PRI area work pursuant to the Phase 1A SAP needed to proceed in 2014.

During June/July 2014, US Magnesium indicated it would likely discontinue pursuing the SLRA and streamlined RI/FS approach and implement the original SOW included in the AOC. In a letter dated 1 August 2014, EPA noted that reverting to the AOC SOW could be more costly and the time required for RI/FS completion and remedy selection would be extended considerably. EPA further noted that given ERM’s completion of the SLRA technical memorandum, final historical data report, and preliminary risk-estimate summaries, there was little additional effort required to complete a SLRA report as a basis for establishing PRGs for the Inner PRI areas.

In a meeting on 20 August 2014, ERM outlined a process for completing COPC refinement and PRG development for an Inner PRI areas SLRA report to be submitted by the end of December 2014, for a final decision regarding the streamlined FS approach by US Magnesium in January 2015. At this meeting, responding to EPA concerns about the Inner PRI areas investigation schedule, ERM proposed to immediately initiate data quality objective (DQO) development to complete a Phase 1B (N&E) investigation of the Inner PRI areas in 2015, and complete a Phase 2 (detailed Site characterization) investigation for baseline RA according to the schedule stipulated by the AOC. In a letter dated 3 November 2014, EPA emphasized the importance of completing PRG development as part of a COPC refinement that EPA requested be included in the draft Inner PRI areas SLRA scheduled to be completed in 2014. ERM was also to submit by December 2014 a draft agenda for an Inner PRI areas Phase 1B scoping meeting to be held in February 2015.

In a 2 December 2014 meeting, EPA reviewed ERM's draft *Preliminary Data Quality Objective Framework, OU-1 Phase 1B for Nature and Extent* and provided ERM conceptual verbal comments. ERM agreed to revise the document after US Magnesium's late January decision to either perform the streamlined RI/FS or go back to the process set out in the AOC SOW. In late 2014, the EPA agreed that US Magnesium/ERM could develop a draft Phase 1A-B RI SAP for EPA review and approval.

In late January 2015, US Magnesium declined EPA's streamlined FS offer. On 20 February 2015, ERM submitted a scoping meeting agenda and a revised DQO document. On 11-12 March 2015, ERM and EPA held a scoping meeting. A significant outcome of the scoping meeting was an agreement to combine the Phase 1A investigation goals (i.e., COPC selection) with ERM's proposed Phase 1B goal of preliminary N&E. EPA also delegated the preparation of the Phase 1A-B RI SAP to ERM and agreed to provide, in Microsoft Word format, the pertinent sections of the Phase 1A SAP worksheets, which ERM could use as a template for the Phase 1A-B SAP.

The OU-1 Phase 1A-B SAP accomplishes the objectives of the original Phase 1A SAP of 2013 and enables the investigation to be completed during the 2015 field season. The Phase 1A-B SAP also includes a major section dealing with the startup of Background Study investigations and the approach to data evaluation for initial mapping of N&E of contamination.

State and Federal Consultation

The EPA has a State Superfund Memorandum of Agreement with the Utah Department of Environmental Quality (UDEQ) Division of Environmental Response and Remediation (DERR) (per National Oil and Hazardous Substances Pollution Contingency Plan [NCP] Part 300.505). The State and the EPA have agreed that EPA Region 8 would be the lead agency for site management and remedial response actions at the Site and the EPA maintains a close working partnership with UDEQ-DERR throughout the RI/FS planning process. The EPA has also engaged in consultations with federal and state trustees for natural resources in accordance with NCP Parts 300.600 and .615.

The format of this document is generally consistent with specifications of the Intergovernmental Data Quality Task Force Uniform Federal Policy for QAPPs, *Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs, Part 1: UFP-QAPP Manual* (EPA 2005a). The manual is available at the following website: http://www.epa.gov/fedfac/pdf/ufp qapp v1 0305.pdf.

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ACRONYMS AND ABBREVIATIONS

°C	Degrees Celsius
°F	Degrees Fahrenheit
µg/kg	Micrograms per kilogram
%D	Percent difference
%R	Percent recovery
95UCL	95% Upper Confidence Limit
AET	Apparent effect threshold
amu	Atomic mass unit
AOC	Administrative Order on Consent
ASTM	ASTM International
ATSDR	Agency for Toxic Substances and Disease Registry
BFB	Bromofluorobenzene
BG	Background
bgs	Below ground surface
BLM	Bureau of Land Management
BRMBR	Bear River Migratory Bird Refuge
CA	Corrective action
$CaSO_4$	Gypsum solids
CCB	Continuing calibration blank
CCC	Calibration check compound
CCME	Canadian Council of Ministers of the Environment
CCV	Continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
Cl_2	Chlorine
Cmax	Maximum detected concentration in a dataset
COC	Chain of custody
COD	Chemical oxygen demand
COPC	Chemical of potential concern
COPEC	Chemical of potential environmental concern
CPSM	Column Performance Check Solution
CSM	Conceptual Site Model
CVAA	Cold vapor atomic absorption
CWP	Current Waste Pond
D/Fs	Dioxins/furans
DERR	Division of Environmental Response and Remediation
DFTPP	Decafluorotriphenylphosphine
DL	Detection limit
DMA	Demonstration of Methods Applicability
DMP	Data Management Plan

DQA	Data quality assessment
DQI	Data quality indicator
DQO	Data quality objective
EcoSSL	Ecological Soil Screening Level
EDD	Electronic data deliverable
EMPC	Estimated Maximum Potential Concentration
EPA	U.S. Environmental Protection Agency
ERM	ERM-West, Inc.
ESL	Ecological screening level
FS	Feasibility Study
g	Gram
GC	Gas chromatography
GC/MS	Gas chromatography/mass spectrometry
GIS	Geographic Information System
GPS	Global Positioning System
GSL	Great Salt Lake
H&S	Health and safety
HASP	Health and Safety Plan
HCB	Hexachlorobenzene
HCl	Hydrochloric acid
HQ	Hazard quotient
HRGC	High resolution gas chromatograph
HRMS	High resolution mass spectrometer
IC	Ion chromatography
ICAL	Initial calibration
ICB	Initial calibration blank
ICP	Inductively coupled plasma
ICS	Interference check standard
ICSA	Interference check standard A
ICV	Initial calibration verification
ID	Identification
IDL	Instrument detection limit
IDW	Investigation-derived waste
IMB	Intermountain basin
ISTD	Internal standard
LC	Liquid chromatography
LC/MS/MS	Liquid chromatography/tandem mass spectrometry
LCS	Laboratory control sample
LCSD	Laboratory control sample duplicate

LELs/SELs	Lowest/severe effect levels
LLC	Limited Liability Corporation
LOC	Level of chlorination
LOD	Limit of detection
LODv	Limit of detection verification
LOQ	Limit of quantitation
LRMS	Low resolution mass spectrometer
MB	Method blank
MDD	Minimum Detectable Difference
MDL	Method detection limit
mL	Milliliter
mm	Millimeter
MQO	Measurement quality objective
MS	Mass spectrometry
MSD	Matrix spike duplicate
MTCA	Model Toxics Control Act
MXS	Matrix spike
m/z	Mass to charge ratio
N&E	Nature and extent
NA	Not applicable
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NDIR	Nondispersive infrared
NDMA	N-nitrosodimethylamine
NELAP	National Environmental Laboratory Accreditation Conference
NMDS	Non-metric multi-dimensional scaling
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPL	National Priority List
OCDD	Octachlorinated dibenzo-p-dioxin
ORNL	Oak Ridge National Laboratory
OSC	On-site Coordinator
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Environmental Response
OU	Operable Unit
OWP	Old Waste Pond
PAH	Polycyclic aromatic hydrocarbon
PARCCS	Precision, accuracy, representativeness, completeness, comparability, and sensitivity
PCB	Polychlorinated biphenyl
PCDPE	Polychlorinated diphenyl ethers
perMANOVA	Permutation multivariate analysis of variance

PFK	Perfluorokerosene
PFTBA	Perfluorotributylamine
PID	Photoionization detector
ppb	Parts per billion
ppm	Parts per million
PQL	Practical quantitation limit
PRI	Preliminary Remedial Investigation
PRG	Preliminary remediation goal
PWT3	Pacific Western Technologies/Tetra Tech, Inc.
Q-Q	Quantile-quantile
QA	Quality assurance
QAM	Quality Assurance Manual
QAPP	Quality Assurance Project Plan
QC	Quality control
QL	Quantitation limit
QSM	Quality Systems Management
RA	Risk Assessment
RBC	Risk-based concentration
RBESL	Risk-based ecological screening level
RBSL	Risk-based screening level
RCRA	Resource Conservation and Recovery Act
RF	Response factor
RI	Remedial Investigation
RL	Reporting limit
RPD	Relative percent difference
RPM	Remedial Project Manager
RRF	Relative Response Factor
RSD	Relative standard deviation
RSL	Regional screening level
S/N	Signal to noise ratio
SAP	Sampling and Analysis Plan
SIM	Selective ion monitoring
Site	US Magnesium Site
SITLA	School and Institutional Trust Land Administration
SLERA	Screening-Level Ecological Risk Assessment
SLRA	Screening-Level Risk Assessment
SOP	Standard operating procedure
SOW	Statement of Work
SPCC	System performance check compound
SQuiRTs	Screening Quick Reference Tables
SRC	Syracuse Research
STD	Standard

Study Area	A 5-mile radius around the plant stack
SVOC	Semivolatile organic compound
TAT	Turnaround time
TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin
TECs/PECs	Threshold/probable effect concentrations
TEF	Toxicity equivalency factor
TELs/PELs	Threshold/probable effect levels
TEQ	Toxic equivalency quotient
TOC	Total organic carbon
TQL	Target quantitation limit
UCE	Upper confidence envelope
UDEQ	Utah Department of Environmental Quality
UFP	Uniform Federal Policy
UPL	Upper prediction limit
U.S.C.	United States Code
USFWS	U.S. Fish and Wildlife Service
UTL	Upper tolerance limit
UTTR	Utah Test and Training Range
VDTSR	Verified date and time of sample receipt
VOC	Volatile organic compound
VSP	Visual Sample Plan software
WDOE	Washington Department of Ecology
WDM	Window defining mixture
WHO	World Health Organization
WRS	Wilcoxon Rank Sum
WS	Worksheet

SECTION A: PROJECT ORGANIZATION

SAP WORKSHEETS #2-9

2.0 SAP IDENTIFYING INFORMATION (SAP WORKSHEET #2)

US Magnesium LLC (US Magnesium) is a commercial producer of magnesium and magnesium alloys and operates a facility in Rowley, Tooele County, Utah (Site; Figure 2-1). The Site includes an active primary magnesium production facility, which has been in operation since 1972. The facility includes employee offices and process buildings and other ancillary structures and facilities. Surrounding the process buildings is a series of waste evaporation ponds, a concentrator pond, a landfill, and smut and calcium sulfate (gypsum) disposal areas. A series of earthen, open-air ditches conveys liquid waste from the process facility to earthen wastewater evaporation ponds. An engineered disposal site for cast house residues containing barium sulfate and an inactive wastewater evaporation pond are located northwest and northeast of the facility, respectively.

On 4 August 2011, an Administrative Settlement Agreement and Order on Consent (AOC) for a Remedial Investigation (RI) and Feasibility Study (FS) was entered into by US Magnesium and U.S. Environmental Protection Agency (EPA) Region 8. The AOC defines the roles, responsibilities, schedule, and administration of the RI/FS to be performed.

The RI, Risk Assessment (RA), and FS include a 5-mile radius area around the plant stack. The EPA (as set forth in the 2011 AOC and Statement of Work [SOW]) anticipated US Magnesium and its contractor ERM-West, Inc. (ERM) to implement RI, RA, and FS activities for the Study Area in phases under plans issued and/or approved by the EPA. RA work being conducted by ERM and EPA is proceeding concurrently with each phase and element of the RI/FS.

During planning and scoping meetings with ERM in 2011 and early 2012, initial plans were for a Phase 1 investigation to identify chemicals of potential concern (COPCs) and evaluate preliminary nature and extent (N&E) for Site characterization covering PRI areas across the Site. ERM collected limited samples in 2012 to carry out a Demonstration of Methods Applicability (DMA) to evaluate the suitability of sampling and analytical methods. Scoping considerations by ERM during 2012 were the basis to initiate Site investigations in two phases: a Phase 1A Sampling and Analysis Plan (SAP) to ascertain COPCs, to be followed by a Phase 1B SAP to characterize the N&E of COPCs.

The initial Phase 1A RI objectives for the entire Site included the following:

- Develop preliminary Conceptual Site Model (CSM) and RI/Risk Scoping.
- Develop SAP specifications for the RI to identify COPCs in media types and pathways across all PRI areas of the Site.
- Conduct surveys to assess ecological habitats, types of human and ecological receptors, and potential exposures threatening human health and the environment, as noted in the preliminary CSM.
- Develop a Screening-Level Ecological Risk Assessment (SLERA) and refine the preliminary CSM for potential human and ecological risk.

In accordance with the AOC SOW and beginning in May 2013, EPA prepared a Phase 1A SAP (with Quality Assurance Project Plan [QAPP]) issued in September 2013, which laid out the preliminary conceptual specifications necessary to commence Phase 1A investigations (to identify COPCs) across the Site. However, ERM identified numerous technical issues (health and safety as well as sampling and laboratory method considerations for highly acidic and inundated areas of the waste ponds) associated with sampling and analysis in PRI Areas 1 and 3 through 7 (Inner PRI areas) included in the Phase 1A SAP (Revision 0) that needed to be resolved prior to initiating this portion of the SAP. In order to initiate sampling and data collection activities in 2013 and begin RIs of PRI Areas 2 and 8 through 17 (Outer PRI areas), as well as reduce the need for multiple sampling plan documents, the EPA issued the Phase 1A RI SAP as Revision 0 without resolving the technical issues needed to commence sampling in the Inner PRI areas. However, the terms and conditions provided by EPA with the Phase 1A RI SAP (Revision 0) provided a framework to resolve the remaining technical issues associated with sampling the Inner PRI areas.

In comments on the draft SAP and as EPA was finalizing the Sitewide Phase 1A SAP in August 2013, ERM and US Magnesium (having reviewed data from the DMA investigations of Inner PRI areas indicating high concentrations of numerous constituent contaminant chemicals, and presuming little chance of eliminating any chemicals as COPCs) asserted that Phase 1A investigations of the Inner PRI areas (for COPC identification) were not necessary and proposed instead to proceed to Phase 1B investigations to determine preliminary N&E. The EPA (as noted in the September 2013 Final Phase 1A SAP cover letter) accommodated US Magnesium and ERM's request to postpone implementation of Phase 1A sampling for the Inner PRI areas, the most contaminated areas of the Site, in order to provide US Mag time to decide whether to proceed with the streamlined RI/FS alternative presented by EPA (described below), or to continue to implement the AOC SOW.

When the Phase 1A SAP was originally issued in September 2013, EPA offered US Magnesium an alternative, streamlined RI/FS framework using appropriate data collected during previous Resource Conservation and Recovery Act (RCRA) investigations (and limited samples collected during initial Superfund [DMA] investigations), along with "conservative" screening RAs, in order to forego detailed RI/RA and proceed directly to cleanup FSs for Inner PRI Areas 1 and 3 through 7 (the most contaminated areas of the Site). EPA agreed to further defer the Inner PRI areas sampling scheduled under the Phase 1A SAP while ERM carried out assessment of historical data and addressed technical issues for completing a Screening-Level Risk Assessment (SLRA) for the Inner PRI areas. US Magnesium and ERM were to decide in 2014 whether to proceed with the streamlined RI/FS or go back to the process set out in the Phase 1A SAP.

In August 2014, as US Magnesium further considered EPA's streamlined FS offer, ERM, responding to EPA's concerns about continuing delay of Inner PRI area investigations, committed to carry out in 2015 an investigation that would entail the components of both Phase 1A and Phase 1B sampling investigations for the Inner PRI areas. In January 2015, US Magnesium declined EPA's streamlined FS offer.

At a scoping meeting in March 2015, EPA reviewed ERM's draft data quality objective (DQO) document and proposed sampling plans for the Inner PRI areas. ERM then began to develop DQOs for a Draft SAP for Phase 1A (COPCs) and Phase 1B (preliminary N&E) investigations of the Inner PRI areas — the subject of this document. US Magnesium and ERM have further agreed to carry out detailed Site-characterization investigations and baseline RA according to the schedule stipulated in the AOC SOW, anticipated to occur in in 2016 and 2017, respectively.

During 2014, as part of the implementation of the Phase 1A SAP, ERM completed an Ecological Habitat Survey and was near completion of a Human Exposure Survey. ERM had completed the Phase 1A solid media sampling for the Outer PRI Areas 2 and 8 through 16, groundwater sampling for PRI Area 17, and sampling for chronic COPCs in air (chlorine [Cl_2] and hydrochloric acid [HCl]). Given ongoing Inner PRI considerations by US Magnesium and ERM during 2014, the EPA again agreed to defer Phase 1A sampling of surface waters until 2015.

US Magnesium and ERM agreed in late 2013 to evaluate airborne Cl_2 and HCl as COPCs. ERM completed in 2014, pursuant to the Phase 1A SAP, air pathway sampling to obtain data to identify other potential COPCs in air. These data are currently under review by ERM and EPA. Accordingly, EPA has designated air pathway investigations as a separate Operable Unit (OU-2), and air investigations and RA of airborne Cl_2/HCl releases are proceeding on a separate and independent track from Site investigations and RA addressing contamination in the soils, sediments, wastes, and waters of OU-1 (PRI Areas 1 through 17).

In parallel with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) site investigations, US Magnesium, EPA Region 8 RCRA Program, and the US Department of Justice are in settlement negotiations to address those aspects of Site operations to be subject to RCRA Corrective Action. While EPA’s Superfund Program anticipates that certain aspects or portions of the Site will be addressed under jurisdiction of RCRA, this Phase 1A-B SAP proceeds with Site investigations pursuant to the CERCLA AOC SOW until a RCRA settlement can be reached and the parties know which portions of the Site will be addressed by RCRA. In any case, the information collected will be used to help identify chemicals of concern and understand the N&E of contamination at the Site that will be addressed under RCRA and CERCLA, respectively.

While reviewing data for the Phase 1A Outer PRI areas and during Phase 1A-B scoping discussions, ERM and EPA recognized the need for a Background Study of contaminant concentrations that may be unrelated to Site releases. This study (as part of this Phase 1A-B RI SAP) will initially evaluate abiotic chemical constituents at select ‘off-site’ locations, and is preparatory to subsequent biological chemical constituent investigations that will be conducted during Phase 2.

Phase 1A-B: Background Study of Chemical Constituents

- Identify locations (beyond the RI Study Area) as reference areas.
- Collect data to compare naturally occurring chemicals of concern to constituents within the RI Study Area.

While addressed under a separate work plan from this Phase 1A-B RI SAP, an additional aspect of RI/FS work began in 2014 in response to US Magnesium’s desire to conduct a treatability study to evaluate a “Salt Cap” as a potential remedial alternative or portion of a remedial alternative. ERM agreed with EPA to also begin a screening-level FS to identify other remedial alternatives that should be evaluated in a detailed FS along with a “Salt-Cap” alternative. In November 2014, EPA, Utah Department of Environmental Quality (UDEQ) and ERM held a scoping meeting to discuss ERM’s preparation of a Salt Cap Treatability Study (including a salt cap accumulation test, which began in June 2015). ERM committed to developing the technical memorandum documenting initial screening of technology types and process options stipulated in Section 6.2 of the AOC SOW during 2015-2016.

Phase 2: Detailed RI, Screening FS, and Baseline RA

- Develop DQOs and SAP specifications for detailed Site characterization and RA.
- Perform detailed Site characterization and biotic studies.
- Complete screening-level FS, identifying remedial action objectives and applicable and relevant or appropriate requirements.
- Complete a Baseline RA.

- Select screened alternatives to carry forward into detailed FS.

Phase 3: Detailed FS

- Establish preliminary risk-reduction goals (EPA and UDEQ).
- Develop specifications for the FS.
- Conduct FS for a range of remedial alternatives.

Phase 4: Remedial Response Decision

- Prepare a Proposed Plan and Record of Decision.

Attachment 2 is a chart that summarizes RI/FS activities to date and shows the current schedule for completing RI/FS activities and a Baseline RA, followed by development of detailed FS(s) and a Record of Decision selecting a cleanup remedy.

The Phase 1A-B investigation will identify OU-1 COPCs and determine preliminary N&E. In addition, preliminary mapping of COPCs will be conducted to characterize the potential scope and scale of contaminant distribution within the Inner PRI areas.

While reviewing data for the Phase 1A Outer PRI areas and during Phase 1A-B scoping discussions, ERM and EPA recognized the need for a Background Study of contaminant concentrations that may be unrelated to Site releases. The Phase 1A-B SAP, therefore, will evaluate abiotic chemical constituents at select “off-site” locations.

The Phase 1A-B Background Study will:

- Identify locations (beyond the RI Study Area) as reference areas; and
- Collect data to compare naturally occurring chemicals of concern to constituents within the RI Study Area.

This Phase 1A-B SAP is project-specific and pertains only to the Phase 1A-B activities and implementation. Briefing and planning sessions that have been held are identified in Worksheet (WS) #9.

Phase 1A-B activities will include acquisition of data allowing development of a refined list of chemicals in order to select COPCs; these acquired data also will be necessary to prepare a plan for more complete investigations of the Site. Additional phases of the RI will be planned after completion of the Phase 1A-B RI and SLERA by ERM/US Magnesium, and determination by EPA of any need for additional data to complete the baseline human health and ecological RAs.

Phase 1A-B activities will include sampling Site media to evaluate the N&E of contaminants within the soils, sediments, and wastes of the Inner PRI areas, and to obtain preliminary data to support initial risk calculations. Phase 2 will include additional sampling of Site media to fill data gaps and to reduce uncertainties in the Phase 1A-B datasets. In addition, Phase 2 may include biota sampling, as well as further lateral and vertical sampling of soil, sediment, water, and waste across areas subjected to the preliminary RI.

For planning purposes, the EPA divided the Site into 18 PRI areas (Figure 2-2). The Site was subsequently divided in OUs by the EPA, with OU-1 being defined as all soils, sediments, solid wastes, surface water, and groundwater within PRI Areas 1 through 17, and OU-2 being defined as PRI Area 18 or ambient air.

1. Identify guidance used to prepare SAP:

This SAP has been prepared in general accordance with the *Uniform Federal Policy for Quality Assurance Project Plans* (UFP-QAPP), EPA-505-B-04-900A (EPA 2005a) and *the EPA Requirements for Quality Assurance Project Plans*, EPA QA/R-5 (EPA 2001).

2. Identify regulatory program:

In August 2011, EPA Region 8 and US Magnesium entered into an AOC for RI/FS under Sections 104, 107, and 122 of CERCLA, as amended, 42 United States Code (U.S.C.) §§ 9604, 9607, and 9633. Under the AOC, ERM is responsible for administrations of all actions by US Magnesium (Respondent) required by the AOC.

3. Identify approval entity:

The approval entity is EPA Region 8. The EPA has a State Superfund Memorandum of Agreement with the UDEQ Division of Environmental Response and Remediation (DERR) (per National Oil and Hazardous Substances Pollution Contingency Plan [NCP] Part 300.505). The State and the EPA agreed that EPA Region 8 would be the lead agency for Site management and remedial response actions at the Site.

4. Indicate whether the QAPP is a generic or a project-specific QAPP:

This is a project-specific and phase-specific SAP.

5. List dates of scoping sessions that were held:

A Phase 1A-B RI scoping session was held 11–12 March 2015 in Salt Lake City, Utah. Outcomes from the Phase 1A-B scoping session and follow-on correspondence are summarized in this SAP in Worksheet 9 - Project Scoping Session Participants Sheet.

6. List dates and titles of QAPP documents written for previous Site work, if applicable:

Title	Approval Date
Phase 1A Remedial Investigation Sampling and Analysis Plan to Identify Chemicals of Potential Concern in Soils, Sediments, Solid Waste, Water and Air, and Receptor Surveys, Revision 0 for PRI Areas 2 and 8 through 17	September 2013

7. List organizational partners (stakeholders) and connection with lead organization:

EPA maintains a close working partnership with UDEQ-DERR throughout the RI/FS planning process. The EPA has also engaged in consultations with federal and state trustees for natural resources in accordance with NCP Parts 300.600 and .615.

8. List data users:

This SAP involves sampling of soil, sediment, and solid wastes (collectively referred to as “solids”) to support the objective of obtaining sufficient data to support:

1. Reliable identification of COPCs for human and ecological receptors within PRI Areas 1 and 3 through 7.

2. Initial risk calculations to evaluate whether sufficient data have been collected within PRI Areas 1 and 3 through 7 to support confident risk characterization.

3. Preliminary evaluation of the N&E of Site-related impacts within PRI Areas 1 and 3 through 7.

4. Estimation of background (ambient) concentrations for metals and organics including, dioxins/furans (D/Fs), total polychlorinated biphenyls (PCBs) and World Health Organization (WHO) congeners, and hexachlorobenzene (HCB).

5. Identification of suitable reference areas (i.e., non-impacted areas) for biota sampling that may be conducted during 2016 Phase 2 RI activities.

Broadly, these objectives are combined into two principal DQOs of “COPC Selection and Preliminary N&E at Inner PRI Areas” and “Evaluation of Background.” Data generated under this SAP will be for remedial decision-making by risk assessors and managers. Data generated under this SAP will be managed in accordance with requirements of the AOC and the Data Management Plan (DMP; ERM 2013b) and will become part of the Administrative Record for the project.

3.0 DISTRIBUTION LIST (SAP WORKSHEET #3)

The Distribution List below identifies those entities to whom copies of the approved SAP and any subsequent revisions will be sent.

Name of SAP Recipients	Title/Role	Organization	Telephone Number	E-mail Address or Mailing Address
EPA TEAM				
Ken Wangerud	Remedial Project Manager	EPA	Office: (303) 312-6703 Mobile: (720) 951-0955	Wangerud.ken@epa.gov
Wendy O'Brien	Human-health Risk Assessment	EPA	Office: (303) 312-6712	Obrien.wendy@epa.gov
Dan Wall	Ecological Risk Assessment	EPA	Office: (303) 312-6560	Wall.dan@epa.gov
Charlie Partridge	Health and Safety Toxicologist	EPA	Office: (303) 312-6094	Partridge.charles@epa.gov
Andrew Schmidt	Hydrogeology	EPA	Office: (303) 312-6283	Schmidt.andrew@epa.gov
Shun-Ping Chau	On-Site Coordinator (OSC), Health and Safety	EPA	Office: (303) 312-6848	Chau.shun-ping@epa.gov
Jeff Mosal	Data-Manager/Coordinator	EPA	Office: (303) 312-6802	Mosal.jeffrey@Epa.gov
Bill Brattin	Toxicologist & Risk Assessment	Syracuse Research (SRC)	Office: (303) 357-3121	brattin@srcinc.com
Michael Storck	Project Manager	UDEQ	Office: (801) 536-4179	mstorck@utah.gov
Scott Everett	Risk Assessment	UDEQ	Office: (801) 536-4117	severett@utah.gov
Christine Cline	US Fish and Wildlife Service Representative	U.S. Fish and Wildlife Service (USFWS)	Office: (801) 975-3330, x145	Chris_cline@fws.gov
Kevin Oliver	Bureau of Land Management Representative	Bureau of Land Management (BLM)	Office: (801) 977-4338 Mobile: (801) 450-3134	koliver@blm.gov
Catherine LeCours	Contractor Project Manager	Pacific Western Technologies/Tetra Tech, Inc (PWT3)	Office: (406) 457-5495 Mobile: (406) 422-6915	clecours@pwt.com
Dorthea Hoyt	Contractor Quality Assurance Manager	PWT3	Office: (303) 274-5400, x54 Mobile: (303) 482-6973	dhoyt@pwt.com
Aaron Baird	Contractor Field Team Leader / Health and Safety Coordinator	PWT3	Mobile: (435) 731-7519	abaird@pwt.com
Robert Howe	Contractor Geochemist	PWT3	Office: (303) 441-7911 Mobile: (303) 518-1083	Robert.howe@tetratech.com
ERM/US Magnesium Team				

Name of SAP Recipients	Title/Role	Organization	Telephone Number	E-mail Address or Mailing Address
David Gibby	US Magnesium Representative	US Magnesium	Office: (801) 532-1522, x1355	dgibby@usmagnesium.com
David Abranovic	Project Coordinator, US Magnesium RI/FS	ERM	Office: (480) 424-1821 Mobile: (602) 284-4917	david.abranovic@erm.com
Judy Nedoff	ERM Quality Assurance (QA) Manager and Analytical Coordinator	ERM	Office: (925) 482-8210 Mobile: (925) 209-6899	judy.nedoff@erm.com
Jennifer Holder	Lead Risk Assessor	ERM	Office: (805) 684-2801 Mobile: (805) 680-8484	jennifer.holder@erm.com
Kevin Lundmark	RI Task Lead/Field Lead	ERM	Office: (801) 595-8400 Mobile: (801) 440-8296	kevin.lundmark@erm.com
Mike Appel	Database Manager	ERM	Office: (503) 488-5282	mike.appel@erm.com
David Alltucker	Laboratory Project Manager	TestAmerica	Office: (916) 374-4383	David.Alltucker@testamericainc.com
Liz Porta	Laboratory Project Manager	Alpha Analytical	Office: (508) 844-4124	eporta@alphalab.com

4.0 PERSONNEL SIGN-OFF SHEET (SAP WORKSHEET #4)

The project Personnel Sign-Off Sheet below documents that all key project personnel performing work have read the applicable sections of this SAP and will perform the tasks as described.

Name	Organization/Title/Role	Signature/E-Mail Receipt	SAP Section(s) Reviewed	Date SAP Read
Ken Wangerud	EPA Project Manager			
Catherine LeCours	Contractor Project Manager			
David Abranovic	ERM Project Manager			
Judy Nedoff	ERM QA Manager			
Kevin Lundmark	ERM RI Task Lead/Field Lead			
Judy Nedoff	ERM Analytical Coordinator			
David Alltucker	TestAmerica - Primary Lab			
Liz Porta	Alpha Analytical – LRMS PCB Lab			

5.0 PROJECT ORGANIZATIONAL CHART (SAP WORKSHEET #5)

The Project Organizational Chart provided as Figure 5-1 identifies the reporting relationships for the Phase 1A-B RI.

6.0 COMMUNICATION PATHWAYS TABLE (SAP WORKSHEET #6)

Communication Drivers	Responsible Affiliation	Name	Phone Number or E-Mail	Procedure
EPA Team				
Project Management	EPA Remedial Project Manager (RPM)	Ken Wangerud	See Worksheet (WS) #3	The EPA RPM will manage all EPA and EPA Contractor personnel and communicate directly with the ERM Project Manager.
Phase 1A-B RI SAP Amendments	EPA RPM	Ken Wangerud	See WS#3	Any changes to approved field procedures or the Phase 1A-B RI SAP will require documentation that must be approved by the EPA RPM before the change is implemented. See Attachments 14A and 14B for modification forms. As the SAP issuer, the EPA RPM will be responsible for maintaining the official, approved SAP.
Quality Control (QC) Management	QA Manager	Ken Wangerud supported by EPA Contractor	See WS#3	The EPA Contractor QA Manager will be the point of contact with the EPA RPM for quality-related matters.
Technical Issues	EPA Project Team and ERM Project Team	Various (see WS#3)	See WS#3	When explicitly directed by the EPA RPM and accepted by the ERM Project Coordinator, EPA and/or EPA Contractor team members may communicate directly with their ERM technical counterparts to resolve technical issues. Recommendations for resolution shall be brought to the EPA and ERM Project Coordinator for approval.
Field-Investigation Oversight	EPA and/or EPA Contractor Field Team Leader	Aaron Baird	See WS#3	EPA and/or EPA Contractor Field Team Leader may communicate directly with ERM's Field Team Leader during preparation and execution of the investigation and EPA Contractor personnel may make suggestions consistent with the Phase 1A-B RI SAP to the ERM Field Team Leader, but shall not direct the work or instruct ERM.

Communication Drivers	Responsible Affiliation	Name	Phone Number or E-Mail	Procedure
ERM Team				
Project Management	ERM Project Coordinator	David Abranovic	See WS#3	The ERM Project Coordinator will serve as liaison to the EPA, and manage field personnel, project personnel, and all subcontractors. ERM Project Coordinator will report data and documents to the EPA RPM. As necessary, the ERM Project Coordinator will bring the need/request for Phase 1A-B RI SAP amendments to the attention of the EPA RPM.
Quality Assurance (QA) Management	ERM QA Manager	Judy Nedoff	See WS#3	The ERM QA Manager will ensure implementation of the Phase 1A-B RI SAP by performing on-Site field QA audits, as appropriate. The ERM QA Manager will be the point of contact with the ERM Project Coordinator for quality-related matters.
Coordination and Communication of Fieldwork Activities Related to Sampling	RI Field Team Leader[1]	Kevin Lundmark	See WS#3	The ERM RI Field Team Leader will: • Routinely (daily) communicate with the field crew during investigation, and will address field implementation issues in adherence with the Phase 1A-B RI SAP; • Communicate relevant field information to the ERM Analytical Coordinator; Ensure subcontractor activities are conducted in accordance with requirements of the Phase 1A-B RI SAP; and • In conjunction with the QA Manager, report data and field documentation to the ERM Project Coordinator.
Submittal of Samples to the Laboratory	RI Field Team Leader[1]	Kevin Lundmark	See WS#3	RI Field Team Leader will arrange for sampling personnel to package and ship samples in accordance with this Phase 1A-B RI SAP.
Daily Chain-of-Custody (COC) Records and Shipping Documentation				RI Field Team Leader will arrange for COC records and shipping documentation to be submitted via fax or e-mail to the analytical coordinator at the end of each day that samples are transmitted to the laboratory.

Communication Drivers	Responsible Affiliation	Name	Phone Number or E-Mail	Procedure
Field Data				The RI Field Team Leader will routinely communicate with the Analytical Coordinator and Database Manager regarding field activities. RI Field Team Leader will coordinate with the Air Task Leader and Water Task Leader, as appropriate, to manage field data as required by the DMP.
Deviations From Phase 1A-B RI SAP Procedures Identified during Field Activities				Prepare and submit to EPA a SAP Modification or Field Modification request, as appropriate.[2] Forms are provided in Attachment 14.
Reporting Laboratory Data, Quality Issues, and Issue Resolution	Laboratory Project Manager	David Alltucker (TestAmerica) Liz Porta (Alpha Analytical)	See WS#3	Report documents and data to the RI Field Team Leader and Analytical Coordinator in an electronic format as required by the Data Management Plan and report QA and QC issues.
Coordination of Laboratory Supplies for Field Activities	Analytical Coordinator	Judy Nedoff	See WS#3	The Analytical Coordinator or RI Field Team Leader will contact the laboratory to provide all necessary sample containers and appropriate shipping materials (such as coolers and bubble wrap) to be delivered on Site before field sampling begins and throughout the project.
Liaison between ERM and Analytical Laboratories				The ERM Analytical Coordinator will routinely communicate with the laboratory point of contact, and will address any analytical issues to the extent possible while adhering to the Phase 1A-B RI SAP.
Field QC and Analytical Corrective Actions				The ERM Analytical Coordinator will immediately notify the QA Manager, RI Field Team Leader, and Project Coordinator in writing of any field QC or analytical procedures - beyond any deviations identified by the RI Field Team Leader - that were not performed in accordance with this Phase 1A-B RI SAP. The Analytical Coordinator, in coordination with the Project Coordinator, will complete documentation of the non-conformance and corrective actions to be taken. The Analytical Coordinator will verify that the corrective actions have been implemented.

Notes:

This WS identifies lines of communication that will be used during the Phase 1A-B RI. See WS#7 for personnel responsibilities.

1. The ERM Field Team Leader will coordinate with EPA and EPA's Contractor Field Team Leader regarding oversight activities.
2. Protocol for Approval of Changes Requested During Field Sampling (from WS#14):

   During field sampling, it is sometimes necessary to make changes in sampling location and/or sampling methods compared to the specifications of the Phase 1A-B RI SAP. Either the EPA or ERM may propose such changes.

   In cases where the change is "minor" (e.g., relocating a sampling station a short distance away from the target location), and both ERM and EPA agree in "real time" that the change is appropriate, the change may be implemented and subsequently documented (i.e., later that day) by completion of a Field Modification Form. Note that agreement must be reached before implementing any such change. This may be accomplished by a consultation between the field team leader and an EPA oversight representative present at the Site, or by calling an appropriate EPA staff member by phone, as identified below:

Name	Office Phone	Cell Phone
Ken Wangerud	303-312-6703	720-951-0955
Dan Wall	303-312-6560	720-347-5520
Wendy O'Brien	303-312-6712	720-951-0970

In the event that an EPA representative cannot be reached, or if the EPA representative cannot issue a decision in "real time," then no change shall be implemented until authorization is granted.

In the event of a proposed "major" change in the Phase 1A-B RI SAP (e.g., a substantial revision to a sampling or processing method), the proposing party (either ERM or the EPA) shall complete a Field Modification Form for review and consideration by both parties. After a decision is reached and authorization for the change is approved, then the revision may be implemented.

In the event that a change is proposed and agreement between the parties cannot be reached, then the procedure for dispute resolution defined in the AOC shall be followed.

7.0 PERSONNEL RESPONSIBILITIES AND QUALIFICATIONS TABLE (SAP WORKSHEET #7)

Name	Title/Role	Organization Affiliation	Phone No. or E-mail	Responsibilities
EPA Team				
Ken Wangerud	EPA RPM	EPA	See WS#3	Responsible for providing management and technical direction to ERM's Project Management and to the EPA Team during data collection efforts. Actively participates in Project DQO process. Review and sign-off on SAPs and SAP Amendments. Responsible for coordination with other Agencies (UDEQ, BLM, USFWS). As the SAP issuer, the EPA RPM will be responsible for maintaining the official, approved SAP.
Ken Wangerud	Program QA Manager (with EPA-team consultation & advisement)	EPA	See WS#3	Responsible for overall QA and QC of EPA's work; develops and maintains a comprehensive QA program and is responsible for audits, reviews of work performed, and recommendations to project personnel regarding quality while independent of data generation. Provides QA and QC of technical work carried out at the Site; works closely with and reviews work carried out by the project team; and reviews deliverables to verify conformance with QA and QC procedures. QA Manager has authority to suspend affected project or Site activities if approved quality requirements are not adequately met.
Various (see WS#3)	EPA Project Team	EPA	See WS#3	Responsible for technical content of SAPs and SAP Amendments. Responsible for resolving technical issues that arise during implementation, and for recommending actions to the EPA Project Manager for approval.
Catherine LeCours	EPA Contractor Project Manager	PWT3	See WS#3	Responsible for managing contractor personnel, staying briefed on field activities, briefing the EPA RPM on field activities, ensuring contractor technical personnel are available to assist in resolution of technical issues, and participating in resolution of those technical issues. Responsible for distributing approved SAP Modification Forms to individuals listed in WS#3 (Distribution List).
Aaron Baird	EPA and/or EPA Contractor Field Team Leader	PWT3	See WS#3	EPA and/or EPA Contractor Field Team Leader will collaborate with ERM's Field Team Leader during preparation and execution of the investigation. EPA Contractor personnel may make suggestions consistent with the Phase 1A-B RI SAP to the ERM Field Team Leader, but shall not direct the work or instruct ERM. EPA Contractor field personnel will provide daily briefings to the EPA Contractor Project Manager. Responsible for ensuring all EPA Field Team personnel working on the project have the appropriate and current training and the documentation is present.

Name	Title/Role	Organization Affiliation	Phone No. or E-mail	Responsibilities
ERM Team				
David Abranovic	ERM Project Coordinator	ERM	See WS#3	The ERM Project Coordinator will serve as liaison to the EPA. Responsible for ensuring compliance with Phase 1A-B RI SAP requirements. As necessary, the ERM Project Coordinator will bring the need for Phase 1A-B RI SAP amendments to the attention of the EPA RPM. The ERM Project Coordinator will manage project personnel, field personnel, and all subcontractors. Oversees administrative and technical performance, and maintains compliance with schedules and budgets. The ERM Project Coordinator will report data and documents to the EPA RPM.
Judy Nedoff	QA Manager	ERM	See WS#3	The ERM QA Manager will ensure implementation of the Phase 1A-B RI SAP, including performance of on-Site field QC audits, as appropriate. QA Manager will be the point of contact with the ERM Project Coordinator for quality-related matters.
Multiple (task-specific)	Field Safety Officer	ERM		Responsible for implementing the health and safety plan; authority to correct and change Site control measures and the required level of health and safety protection; and primary on-Site enforcement authority for the policies and provisions of the health and safety program and Health and Safety Plan (HASP). Conducts safety briefings for Site and subcontractor personnel and Site visitors, and can suspend operations that threaten health and safety of workers and visitors.

Name	Title/Role	Organization Affiliation	Phone No. or E-mail	Responsibilities
Kevin Lundmark	RI Field Team Leader[1]	ERM	See WS#3	Directs the day-to-day field activities and oversees all subcontractors; verifies that field measurement and sampling procedures are conducted in accordance with the Phase 1A-B RI SAP; and is responsible for ensuring subcontractor activities are conducted in accordance with requirements of the Phase 1A-B RI SAP. Responsible for ensuring all ERM and ERM subcontract personnel working on the project have the appropriate and current training and the documentation is present. Responsible for preparing field change requests (Field Modification Approval Form – Attachment 14). These requests will be submitted to the EPA RPM, EPA oversight personnel, or EPA Contractor Field Team Leader for approval before the change is initiated. Responsible for communicating relevant field information to the ERM Project Coordinator and ERM Analytical Coordinator. Reports directly to the ERM Project Coordinator on implementation issues, planning, cost and schedule control, and data management information needs. Responsible for generating and reporting data and documents as required by the Data Management Plan along with QC reports to the ERM QA Manager. Responsible for ensuring sampling personnel package and ship samples in accordance with this Phase 1A-B RI SAP. Responsible for inspection, acceptance, and storage of field supplies and consumables.

Name	Title/Role	Organization Affiliation	Phone No. or E-mail	Responsibilities
Judy Nedoff	Analytical Coordinator	ERM	See WS#3	Coordinates analytical tests with the information required from the field activity; coordinates with laboratories to conduct required analyses; coordinates pickup and delivery schedules with laboratories; verifies that the laboratories implement the requirements of the SAP; and ensures that laboratory data are validated in accordance with the DMP and the Phase 1A-B RI SAP. Responsible for immediately notifying the QA Manager, RI Field Team Leader, and Project Coordinator in writing of any field QC or laboratory analytical procedures – beyond any deviations identified by the RI Field Team Leader – that were not performed in accordance with this Phase 1A-B RI SAP. The Analytical Coordinator, in coordination with the QA Manager and ERM Project Coordinator will complete documentation of the non-conformance and corrective actions to be taken. The Analytical Coordinator will verify that the corrective actions have been implemented.
David Alltucker	Laboratory Project Manager	TestAmerica	See WS#3	Phase 1A-B RI SAP. Responsible for reporting QA and QC issues to the ERM Analytical Coordinator in a timely manner. Responsible for reporting documents and data to the RI Field Team Leader in an electronic format as required by the DMP.
Liz Porta	Laboratory Project Manager	Alpha Analytical	See WS#3	
Mike Appel	Database Manager	ERM	Office: (503) 488-5282	Responsible for developing, monitoring, and maintaining project database in accordance with the DMP, under guidance of ERM Project Coordinator, and works with Analytical Coordinator during implementation of the Phase 1A-B RI SAP to resolve sample identification issues.

Notes:
1. The ERM Field Team Leader will coordinate with EPA and EPA's Contractor Team Leader per oversight activities.

8.0 SPECIAL PERSONNEL TRAINING REQUIREMENTS TABLE (SAP WORKSHEET #8)

Specialized Training – Title or Description of Course	Training Provider	Training Date	Personnel/ Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates
Medical Clearance for Respirator Use (Pulmonary Function Tests)	WorkCare	Within last year (Annual)	All ERM staff performing field work at US Magnesium Site	Various	ERM Files, Project H&S File, US Magnesium
Employer Respiratory Protection Training	ERM	Within last year (Annual)	All ERM staff performing field work at US Magnesium Site	Various	ERM Files
Respirator Fit Test	ERM	Within last year (Annual)	All ERM staff performing field work at US Magnesium Site	Various	ERM Files, Project H&S File, US Magnesium
OSHA 40-Hour Training per 29 CFR 1920.120(e)	ERM / Third Party	One time	All ERM staff performing sampling at US Magnesium Site	Various	ERM Files
8 Hours of Refresher Training	ERM / Third Party	Within last year (Annual)	All ERM staff performing sampling at US Magnesium Site	Various	ERM Files
8-Hour OSHA Supervisor Training	Third Party	One time	Field Lead	Kevin Lundmark / ERM	ERM Files
First Aid / CPR	Third Party	CPR within last 2 years, First Aid within last 3 years	At least one member of each field team	Various	ERM Files
US Magnesium Contractor Training	US Magnesium	Within last year (Annual), prior to field work	All ERM staff performing field work at US Magnesium Site	Various	US Magnesium

9.0 JOINT PROJECT PLANNING SESSION(S) PARTICIPANTS SHEET (SAP WORKSHEET #9)

Joint planning meetings, teleconferences, and document exchanges that resulted from the RI scoping process performed between November 2011 and July 2013 are documented in Worksheet #9 and Attachment 9A of the September 2013 Phase 1A SAP (EPA 2013). This summary of the scoping process has not been repeated in this Phase 1A-B SAP.

Scoping discussions and documentation pertinent to the Phase 1A-B RI held since the publication by EPA of the September 2013 Phase 1A SAP are summarized below. Relevant documentation from these scoping discussions is provided in Attachment 9 to this SAP.

Date / Title / Description	Attachment
25 November 2014 / Preliminary Data Quality Objective Framework OU-1 Phase 1B RI for Nature and Extent / Prepared by ERM to address N&E data gaps for all of OU-1	9A
17 December 2014 / Quarterly Project Management Meeting Summary and RIFS Status Update / EPA letter providing initial comments on ERM’s 25 November 2014 Preliminary DQO Framework for the OU-1 Phase 1B RI	9B
20 February 2015 / Data Quality Objectives Framework OU-1 Phase 1B RI / Prepared by ERM to support scoping discussions held on 11 and 12 March 2015, this DQO included data collection to support preliminary N&E and exposure point concentrations for the Inner PRIs	9C
20 February 2015 / OU-1 Phase 1B Scoping Meeting Agenda / Prepared by ERM to support scoping discussions held on 11 and 12 March 2015	9D
3 March 2015 / EPA’s Proposed Final Agenda for OU-1 Phase 1B Scoping Meeting / Revised Phase 1-B Scoping Meeting Agenda with three attachments	9E
17 March 2015 / Scoping Meeting for DQOs Addressing 2015 Inner-PRI Investigations / EPA letter providing Agencies’ comments for ERM’s consideration during revisions to the DQO	9F
24 March 2015 / Agenda and Pre-Read for 24 March 2015 Risk Assessor Call / Provides ERM proposals for LRMS analysis and Background Evaluation DQO revised per Agency comments during the March 2015 Scoping Meeting	9G

Date / Title / Description	Attachment
26 March 2015 / Project Scoping Session Outcomes Summary for OU-1 Phase 1B Remedial Investigation Data Quality Objective Scoping Meeting, 11 and 12 March 2015 / Outcomes summary from the 11–12 March 2015 scoping meeting, including as attachments the Final OU-1 Phase 1B Scoping Meeting Agenda and ERM Slides Used to Guide Technical Discussions	9H
7 April 2015 / Draft Data Quality Objectives for OU-1 Phase 1A/1B RI SAP / Draft DQOs revised per the March 2015 Scoping meeting, includes a placeholder for the background(BG) DQO due to ongoing BG-related scoping discussions with EPA	9I
8 April 2015 / Agenda and Pre-Read for 9 April 2015 Risk Assessor Call (rescheduled to 16 April 2015) / Includes responses to comments from EPA on BG DQO, a revised BG DQO proposal, and related correspondence between ERM and EPA regarding the BG DQO proposal (email from Dan Wall [EPA] 2 April 2015, email from Jennifer Holder [ERM] 1 April 2015)	9J
27 April 2015 / Agency Technical Comments on ERM’s Draft Data Quality Objectives for OU-1 Phase 1A/1B RI SAP / Agency comments on ERM’s DQO dated 7 April 2015	9K
28 April 2015 / Agency Comments on ERM Proposal for HRMS Reanalysis / EPA issue-paper regarding the LRMS-HRMS reanalysis ‘trigger’ for the Ph1A-B draft SAP	9L
29 April 2015 / EPA Technical Comments on ERM’s Phase 1B Project Scoping Session Outcomes Summary / Comments on ERM’s 26 March 2015 Outcomes Summary, dated 13 April 2015 but sent 29 April 2015	9M
4 May 2015 / ERM Response to EPA comments on the revised soil/sediment Phase 1 A-B DQO / Email from David Abranovic (ERM) providing responses to EPA’s 27 April 2015 comments on the Phase 1A-B DQO and proposal for addressing the comments	9N
7 May 2015 / Agenda, Pre-Read, and Call Notes from 7 May 2015 Risk Assessor Call / 7 May 2015 Risk Assessor Call included items relating to ERM’s response to EPA’s 28 April 2015 comments on LRMS analysis, discussion of EPA’s 27 April 2015 comments on the Phase 1A-B DQO, and scoping of the Background Areas reconnaissance field trip	9O
12 May 2015 / EPA Responses to ERM’s 4 May 2015 Responses to EPA Comments on the Phase 1A-B DQO / Email from Ken Wangerud (EPA) responding to 4 May 2015 email from David Abranovic (ERM) and reflecting outcomes from a teleconference on 7 May 2015 between Ken Wangerud, David Abranovic, and Kevin Lundmark (ERM)	9P

Date / Title / Description	Attachment
18 May 20115 / EPA Acceptance of ERM’s 7 May 2015 LRMS Analysis Proposal / Email from Wendy O’Brien (EPA) responding to call notes from 7 May 2015 Risk Assessor Call, including acceptance of ERM’s 7 May 2015 proposal for LRMS analysis	9Q
19 May 2015 / Draft Final Data Quality Objectives for OU-1 Phase 1A-B RI SAP / ERM revised Phase 1A-B DQO including Background Evaluations and incorporating 27 April 2015 EPA comments on Draft DQO, 30 April 2015 ERM responses to EPA comments, 7 May 2015 discussions between ERM and EPA, and 12 May 2015 EPA responses to ERM comments	9R
21 May 2015 / Agenda and Call Notes from 21 May 2015 Risk Assessors Call / Scoping discussions for the Background Areas reconnaissance field trip	9S
3 June 2015 / Re: Draft DQO #3 for Proposed Phase 1A-B SAP Inner PRIs and Background Study / Final EPA comments on 3 June 2015 Draft Final DQO for Inner PRI investigations (Sections 11.1 and 11.2 only)	9T
8 June 2015 / Agency Final Comments to ERM Ph1A-B DQO Section 11.3 - Background Study / EPA comments on the 18 May 2105 initial submittal of the DQO for Background Evaluation	9U
10 June 2015 / Response to EPA Letter Dated 3 June 2015; Re: Draft DQO #3 for Proposed Phase 1A-B SAP Inner PRIs and Background Study / ERM response to EPA’s 3 June 2015 letter	9V
16 June 2015 / Clarification of Terms in Final Inner PRIs DQO / Email from Ken Wangerud (EPA) clarifying terminology in EPA’s 3 June 2015 final edits to the Phase 1A-B DQO for Inner PRIs investigations in response to 11 June 2015 request from Kevin Lundmark (ERM)	9W
2 July 2015 / Response to Agency Technical Comments on ERM’s Draft Phase 1A-B DQOs Section 11.3 – Background Study (document date 8 June 2015) / ERM responses to EPA’s 8 June 2015 comments on the DQO for Background Evaluation	9X
9 July 2015 / Agency Evaluation of ERM’s RTC on Phase 1A-B Background Study DQOs / Agency responses to ERM’s 2 July 2015 RTC submittal	9Y

Date / Title / Description	Attachment
17 July 2015 / Re: US Magnesium NPL Site: Comments and Modifications to Draft Phase 1A-B SAP / Agency comments and modifications to the 2 July 2015 Draft Phase 1A-B SAP, including a letter from Ken Wangerud (EPA) and two enclosures with each enclosure including multiple parts	9Z
29 July 2015 / Response to Agency Modifications to ERM's Draft Phase 1A-B SAP (document submittal date 2 July 2015) / ERM's responses to the Agencies' 17 July 2015 suggested modifications to the Phase 1 A-B SAP	9AA
5 August 2015 / Background sample depth proposal / Email from Jennifer Holder (ERM) presenting ERM's proposal for soil sampling at depth at background areas in response to EPA request during the 30 July 2015 Risk Assessors' Call	9BB
10 August 2015 / Re: ERM's 29 July 2015 letter regarding EPA's 17 July 2015 Modifications to ERM's Draft Phase 1A-B SAP, submitted 2 July 2015 / EPA response to ERM's 29 July 2015 letter, including a letter from Steven Moores (EPA) and a transmittal of EPA's final modifications to the Phase 1A-B SAP	9CC
12 August 2015 / Agency Approval of Phase 1A-B Background Sample Locations / Email from Ken Wangerud (EPA) providing approval of proposed Phase 1A-B background sample locations	9DD
13 August 2015, 1 of 2 / Consolidated Agency Comments on ERM Document "Preliminary COPC/COPEC Screen and Preliminary Risk Calculations – Methodology and Test Case" Dated 29 July 2015 / Includes Agencies' response to ERM's 5 August 2015 proposal for background sampling at depth	9EE
13 August 2015, 2 of 2 / Followup RE: Summary of 12 August 2015 Phase 1 AB SAP Schedule Discussion / Email from Ken Wangerud (EPA) resolving all outstanding issues pertinent to ERM finalizing Ph1A-B SAP Sec. 11.3 matters regarding Background Study and associated worksheets	9FF
14 August 2015 / RE: Summary of 12 August 2015 Phase 1 AB SAP Schedule Discussion / Email from Ken Wangrud (EPA) clarifying how historical/DMA will be determined to be representative of current site conditions	9GG
14 August 2015 / Final Ph1A-B SAP preparations - resolution of remaining issues/ Email from Ken Wangerud (EPA) clarifying resolution status of pending SAP issues	9HH

Date / Title / Description	Attachment
18 August 2015 / Supporting information for ERM/EPA Consultation - 20 Aug 2015 / Letter from David Abranovic (ERM) providing ERM’s proposed modifications to the Phase 1 A-B SAP Preface and Worksheet #2 in advance of a 20 August 2015 ERM-EPA-UDEQ consultation	9II
19 August 2015 / Revised WS-16 and Text from WS-11 and 13 / Email from David Abranovic (ERM) providing a revised Phase 1 A-B SAP WS#16 and modifications to select sections of WS#11 and #13 per ERM-EPA-UDEQ discussions 20 August 2015	9JJ
20 August 2015 / RE: Revised WS-16 and Text from WS-11 and 13 / Email from Ken Wangerud (EPA) responding to 19 August 2015 email from David Abranovic, including approval of revisions to WS#11 and #13 and comments on revised WS#16	9KK
23 August 2015 / RE: Follow-up re discussion/resolution of Preface and Sec.2 language / Email from Ken Wangerud (EPA) providing comments on proposed text for the SAP Preface and WS#2	9LL
24 August 2015, 1 of 2 / Revisions to Worksheet 16/ Email from David Abranovic (ERM) clarifying final revisions to WS#16 as agreed to on 24 August 2015 ERM-EPA-UDEQ weekly RPM call	9MM
24 August 2015, 2 of 2 / Revsions to Preface and Worksheet 2 / Email from David Abranovic (ERM) clarifying final revisions to Preface and WS#2 as agreed to on 24 August 2015 ERM-EPA-UDEQ weekly RPM call	9NN
25 August 2015 / US Magnesium LLC — EPA's 10 August 2015, letter relating to the submittal review and approval process under the AOC / US Magnesium Response to 10 August 2015 letter from Steven Moores (EPA)	9OO

SECTION B: PRELIMINARY CONCEPTUAL SITE MODEL AND PROBLEM DEFINITION

SAP WORKSHEET #10

10.0 PRELIMINARY CONCEPTUAL SITE MODEL AND PROBLEM DEFINITION (SAP WORKSHEET #10)

10.1 PRELIMINARY CONCEPTUAL SITE MODEL

The EPA's preliminary conceptual site model for the N&E of impacts is provided in Section 10.3 of the September 2013 Phase 1A SAP. Comments from ERM/US Magnesium on the EPA's preliminary CSM and responses to these comments from EPA were included as Attachment 4 to the Cover Letter of the September 2013 Phase 1A SAP.

In the subsections that follow, a summary is provided for each Inner PRI area that includes a general description of the PRI area and the known sources of wastes discharged to the PRI area, and also to reflect changed Site conditions since 2013. As described in the Phase 1A SAP, PRI areas were established by EPA based on similarities to historical waste 'management' units and their previously identified contaminants, as well as locations and sizes of the areas to be studied. Based on historical data and Site processes, the primary constituents of interest in solid media have historically been considered to be PCBs,D/Fs, and HCB, and these contaminants represent the expected primary risk drivers for the Inner PRI areas (PRI Areas 1, 3, 4, 5, 6, and 7). Concentrations of these constituents appear to be highest in the wastewater ditches (PRI Area 1), the northeast ponded waste lagoon, also known as the "Old Waste Pond" (OWP) (PRI Area 7), and the active wastewater ponds (PRI Areas 5 and 6). Other constituents detected historically at the Inner PRI Areas include trace metals, volatile organic compounds (VOCs), and semivolatile organic compounds (SVOCs) such as phthalates, polycyclic aromatic hydrocarbons (PAHs), chlorinated benzenes, phenols, and N-nitrosodimethylamine (NDMA).

<u>PRI Area 1 – Ditches</u>

PRI Area 1 includes the following wastewater ditches and associated features (dimensions are approximate):

- Western Ditch: 2,000 feet long, comprising a north-south leg 1,300 feet in length, 6 to 8 feet deep, 6 feet wide at bottom, and 20 feet in top width, and an east-west leg 700 feet in length. The Western Ditch receives non-contact cooling water from the magnesium plant. Wastewater in the Western Ditch is not acidic and abundant vegetation, primarily cat tails and phragmites, are present within the ditch.

- Central Ditch: 1,300 feet long, 10 feet deep, bottom width of 33 feet, and top width of 45 feet. The Central Ditch receives wastewater from the magnesium chloride pre-heater, melt reactor building, off-gas wet scrubbers, and anode dust wash operations.

- Chlorine Ditch: 1,350 feet long, 6 feet deep, and bottom width of 12 feet. The Chlorine Ditch receives wastewater from boron stripping cells, ferric chloride, and chlorine reduction burner operations.

- Main Ditch: Currently 3,000 feet long, 9 feet deep, bottom width of 33 feet, and top width of 45 feet. The Main Ditch conveys wastewaters from the Westen, Central, and Chlorine ditches and currently discharges to the Current Waste Pond (CWP, PRI 5); however, discharge was formerly routed to the OWP (PRI 7). Approximately 800 feet of the Main Ditch are now filled and help form the isthmus between the northwest and southeast areas of the CWP (PRI Area 6 and PRI Area 5, respectively).

- Former Boron Ditch: The Boron Ditch was filled between approximately 1985 and 1990. The ditch was about 1,450 feet long. The Former Boron Ditch bottom is approximately 8 feet below ground surface (bgs).

- Dredge Spoil Areas: Areas between the ditches where material from within the ditches may have been placed.

Historical data suggest that Site concentrations of PCB, D/F, and HCB are elevated in the wastewater ditches, and that concentrations are higher in the Central and Main ditches than in the Chlorine and Western ditches.

PRI Area 3 – Sanitary Lagoon

PRI Area 3 is the Sanitary Lagoon, with an area of approximately 2 acres. It has steep sidewalls and a flat bottom. The lagoon, which functions as a leach field, was constructed during initial Site development (early 1970s) and has operated continuously. Abundant vegetation is present within the lagoon. The lagoon receives sanitary wastewater from plant operations following treatment by a bacteriological process. Dredged spoils from ditch maintenance may have washed into the sanitary lagoon.

Historical data suggest that concentrations of PCB, D/F, and HCB are lower in the sanitary lagoon than in the wastewater ditches and wastewater ponds.

PRI Area 4 – Gypsum Pile

PRI Area 4, the gypsum pile, consists of (1) calcium sulfate (gypsum) removed from the concentrated brine and derived from the desulfation process, where sulfate is removed as gypsum solids ($CaSO_4$) from the concentrated brine via addition of calcium chloride solution; (2) the unreacted calcium carbonate and other solids from calcium chloride production; and (3) raw plant water. In the desulfation process, calcium chloride solution is mixed with concentrated brine to remove sulfur from the brine, producing calcium sulfate (gypsum). After thickening, gypsum filter cake is removed using a drum filter. The calcium chloride used for desulfation is produced on Site in the calcium chloride reactor/thickener via reaction of limestone with hydrochloric acid from the reactor process. The hydrochloric acid feed to the calcium chloride reactor/thickener production process tank comes from several process areas that produce COPCs as byproducts. Unreacted calcium carbonate and other solids from the calcium chloride reactor/thickener are mixed with gypsum filter cake (from the drum filter) and raw plant water (well water from the western foot of the Stansbury Mountain range) and discharged as a slurry to the gypsum pile.

The pile expands by approximately 6 to 10 acres per year. The current footprint of the gypsum pile has expanded to within the footprint of the Northwest Ponded Waste Lagoon (PRI Area 6). The boundary between PRI Areas 4 and 6 varies over time due to fluctuating water levels in the pond and the increasing size of the gypsum pile.

Historical data suggest that concentrations of PCB, D/F, and HCB are lower in the gypsum pile than in the wastewater ditches and wastewater ponds, and concentrations within the gypsum pile show less variability than in the wastewater ditches and wastewater ponds.

PRI Area 5 – Southeast Ponded Waste Lagoon

PRI Area 5 is an active wastewater impoundment that covers approximately 330 acres. This lagoon was constructed in June 1986 in response to the Great Salt Lake (GSL) flooding the OWP and was operational in July 1986. PRI Area 5 receives acidic process wastewater potentially impacted by sediment containing

COPCs via the Main Ditch and has a surface connection to PRI Area 6. Waste magnesium oxide received from Hill Brothers was historically placed in the northwestern edge of PRI Area 5 near the inlet. A vertically buried plastic liner was installed between the active wastewater pond (PRI Areas 5 and 6) and the OWP in an attempt to prevent migration of wastewater through the berm separating the active and pond and the OWP.

A former wastewater diversion ditch traversing PRI Area 5 is evident in aerial photographs. This former wastewater diversion ditch originated at the Main Ditch and ran along the northeastern edge of the landfill to a discharge point in a former evaporation pond (northern PRI Area 14). Aerial photographs from 1985, 1987, and 1998 showing the former wastewater diversion ditch are included as Attachment 10. A ditch conveying storm water discharges from the brine evaporation holding pond (the “Star Pond”) also skirts the southwestern boundary of PRI Area 5.

Based on a review of historical aerial photographs and recent observations of Site conditions, the continuously ponded area within PRI Area 5 (and PRI Area 6) and wastewater depths within PRI Area 5 (and PRI Area 6) have increased in recent years, seemingly due to increased wastewater discharges resulting from increased magnesium production, a reduction in overall wastewater pond capacity due to gypsum in-filling of the PRI Area 6 lagoon; this has been accompanied by acid dissolution of the oolitic sand substrate within the waste lagoons. Wastewater from the PRI Area 5 lagoon has intermittently discharged to the OWP (PRI Area 7) through the formation of sinkholes and preferential flow paths through the berm separating PRI Areas 5 and 7.

Historical data from PRI Area 5 suggest that constituent concentrations in sediment are highest at the lagoon inlet, and that concentrations in the central portion of the lagoon are higher than in the southeastern portion of the lagoon.

PRI Area 6 – Northwest Ponded Waste Lagoon

PRI Area 6 is approximately 174 acres in size. Along with PRI Area 5, the PRI Area 6 lagoon was constructed in June 1986 in response to the GSL flooding the OWP and was operational in July 1986. PRI Area 6 receives acidic process wastewater and sediments potentially impacted by COPCs from PRI Area 5 and runoff from the gypsum pile (PRI Area 4). As described above, the gypsum pile is encroaching into the PRI Area 6 lagoon footprint, and the boundary between PRI Areas 4 and 6 varies over time due to fluctuating water levels in the pond and the increasing size of the gypsum pile. Based on a review of aerial photographs that show the PRI Area 6 lagoon area prior to inundation by gypsum waste, the historical inlet and deepest portion of the PRI Area 6 waste lagoon has apparently been filled with gypsum waste.

A vertically buried plastic liner was installed between the active wastewater pond (PRI Areas 5 and 6) and the OWP in an attempt to prevent migration of wastewater through the berm separating the active and pond and the OWP. A clay barrier wall was installed at the north-northeast edge of the active waste pond in PRI Area 6 as an additional attempt to reduce wastewater migration.

As described above for PRI Area 5, the continuously ponded area and wastewater depths within PRI Area 6 have also been apparently increasing in recent years. Wastewater from the PRI Area 6 lagoon has intermittently discharged to Northwest Lagoon Overflow Area (PRI Area 8) through the formation of sinkholes and preferential flow paths through the berm separating PRI Areas 6 and 8.

Historical data from PRI Area 6 suggest that chemical concentrations in the central portion of the lagoon are higher than in the northern portion of the lagoon.

PRI Area 7 – Northeast Ponded Waste Lagoon

PRI Area 7 is the former wastewater disposal pond, also referred to as the OWP. It is approximately 800 acres in size and was constructed concurrently with the initial construction of the plant in the early 1970s. The OWP was permitted by the EPA under National Pollutant Discharge Elimination System (NPDES) permit UT-0000779.[1] In 1984, it was flooded by the GSL and closed to discharges. Currently, the waste lagoon intermittently has standing water during springtime (runoff and possible related to groundwater infiltration), large rain events, and increased Site-water inflows. Groundwater seepage into the pond occurs at multiple locations along the southeastern edge of the pond. The OWP has intermittently been flooded by wastewater from PRI Area 5 due to undermining of the dike separating PRI Areas 5 and 7.

Historical data from PRI Area 7 suggest that chemical concentrations in OWP sediment are highest near the historical inlet and appear to generally decline with distance from the inlet.

10.2 PROBLEM DEFINITION

Under the RI/FS framework prescribed by the AOC, a Baseline Risk Assessment (RA) will be performed to evaluate risks to human health and ecological receptors. Prior to performing the Baseline RA, a Screening-Level Ecological Risk Assessment (SLERA) will be performed to select the chemicals of potential ecological concern (COPECs) to be carried through the risk assessment.

Site Data

For the Inner PRI areas, historical and some recent data are available (ERM 2014a); however, the available Inner PRI area data alone are not adequate for COPC selection. While historical data obtained at the Site in earlier investigations do provide insight into the chemicals likely to be of primary concern in soil/sediment and solid wastes (solid media or “solids”), these data may not accurately reflect current, near-surface Site conditions. In addition, the EPA has identified that not all solids have been well-characterized previously, and the historical data are often restricted to a subset of analytes when compared to the list of target analytes identified by EPA for the Site. Consequently, new data are needed to support selection of human and ecological COPCs for Inner PRI media.

Additionally, the N&E of impacts have not been characterized in the Inner PRI areas. This is due in part to the fact that the historical data for the Inner PRI areas in most cases did not include analyses for all current target analytes and there was either an insufficient number of samples collected or the sampling locations were not based on a suitable sample design (e.g., locations were not based on an unbiased approach and only targeted selected portions of the Site). The EPA has also identified that “vertical profile waste stratification and contaminant data are needed at key release locations and within areas where wastes have been discharged continually” (EPA 2013).

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[1] The facility operated under an NPDES permit beginning in April 1979. The State of Utah was authorized by the EPA to manage their state NPDES program in July 1987. The permit UT-0000779 was issued by the State of Utah and was a zero discharge permit, with all effluent being pumped to the old waste water evaporation pond. At the time of a 1988 inspection (DMA-04571690) the new wastewater pond was in operation and replaced the old wastewater pond. There was some question as to the occurrence of seepage from the new evaporation pond, but the facility was not cited (DMA-0457169). The NPDES permit was renewed in 1989; however, it was not renewed by the State of Utah when it expired in 1994. The Utah Division of Water Quality in the non-renewal letter stated they were not permitting 'no-discharge' facilities.

Background Data

A necessary component of the RI/FS is to define the naturally occurring or “background” concentrations of chemicals in solid media. The purpose of characterizing background is so that Site-to-background comparisons can be conducted and Site-related chemicals can be identified. The chemicals of chief interest in background samples include metals, which are natural components of the Earth’s crust, and organic compounds that are either anthropogenically produced or combustion byproducts (wildfires), which are ubiquitous in the environment due to wind dispersal and aerial deposition. For the purposes of this evaluation, both naturally occurring and ubiquitous anthropogenic chemicals will be evaluated in background samples. Two classifications of compounds are relevant to characterizing background for the US Magnesium RI/FS: metals and organics. Organics include D/F, PCBs, and HCB.

There are historical datasets in the general area of the US Magnesium Site that provide some information regarding background concentrations of metals and organics; however, none of these datasets provide sufficient information to develop relevant background for the purposes of the RI/FS. Collection of data for evaluation of background metal and organics concentrations is therefore critical for conducting RI/FS activities, including the characterization of N&E, and identification of Site-related constituents of concern. The soil data collected in background areas will support the selection of reference areas for biotic sampling by confirming that the locations are not impacted by releases from the US Magnesium Site.

SECTION C: DATA QUALITY OBJECTIVES

SAP WORKSHEET #11

11.0 PROJECT QUALITY OBJECTIVES/SYSTEMATIC PLANNING PROCESS STATEMENTS (SAP WORKSHEET #11)

Based on the conceptual site model provided in Worksheet #10 of the *Phase 1A Remedial Investigation Sampling and Analysis Plan to Identify Chemicals of Potential Concern in Soils, Sediment, Solid Waste, Water and Air, and Receptor Surveys,* Revision 0 for PRI Areas 2 and 8 through 17 (hereafter referred to as "Phase 1A SAP") (EPA 2013), this worksheet presents DQOs and associated sampling strategies and rationale for the Phase 1A-B RI for PRI Areas 1 and 3 through 7 and background reference areas.

The DQOs presented herein follow the seven-step process described in the EPA *Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G-4* (EPA 2006a).

11.1 OBJECTIVES OF THE PHASE 1A-B RI

The objective of Phase 1A-B RI is to obtain sufficient data to support:

1. Reliable identification of COPCs for human and ecological receptors within PRI Areas 1 and 3 through 7.

2. Initial risk calculations to evaluate whether sufficient data have been collected within PRI Areas 1 and 3 through 7 to support confident risk characterization.

3. Preliminary evaluation of the N&E of Site-related impacts within PRI Areas 1 and 3 through 7.

4. Estimation of background (ambient) concentrations for metals and organics including D/Fs, total PCBs and WHO congeners, and HCB.

5. Identification of suitable reference areas (i.e., non-impacted areas) for biota sampling that may be conducted during 2016 Phase 2 RI activities.

Broadly, these objectives are combined into two principal DQOs of "COPC Selection and Preliminary N&E at Inner PRI Areas," and "Evaluation of Background." The remainder of this worksheet presents the seven-step DQO process for the two principal DQOs.

11.2 DATA QUALITY OBJECTIVES FOR COPC SELECTION AND PRELIMINARY NATURE AND EXTENT AT INNER PRI AREAS

11.2.1 Step 1: State the Problem

11.2.1.1 Description of the Problem

The RI/ FS Area Boundary has been preliminarily defined by the EPA as a 5-mile radius around the US Magnesium facility. For purposes of project planning during the initial phases of the RI, the EPA initially divided the Site into 18 PRI areas, with the "Inner PRI areas" defined as PRI Areas 1 and 3 through 7, the "Outer PRI areas" defined as PRI Areas 2 and 8 through 17, and PRI Area 18 being ambient air. The Site was subsequently divided into OUs by the EPA, with OU-1 including PRI Areas 1 through 17 and OU-2 being defined as PRI Area 18.

Phase 1A provided the information necessary to select human and ecological COPCs for the Outer PRI areas. For the Inner PRI areas, historical (i.e., collected prior to the Phase 1A DMA) and Phase 1A DMA data are available (ERM 2014a); however, the EPA determined that historical and DMA data alone are not adequate for COPC selection.[2] The EPA indicated that, while historical data obtained at the Site in earlier investigations do provide insight into the chemicals likely to be of primary concern in soil/sediment and solid wastes (solid media or "solids") at the Site, these data may not accurately reflect current, near-surface Site conditions. In addition, the EPA has identified that not all solids have been well characterized previously, and the historical data are often restricted to a subset of analytes when compared to the list of target analytes identified by EPA for the Site. Consequently, new data are needed to support selection of human and ecological COPCs for Inner PRI media.

Additionally, the N&E of impacts have not been characterized in the Inner PRI areas. This is due in part to the fact that the historical data for the Inner PRI areas in most cases did not include analyses for all current target analytes and there was either an insufficient number of samples collected or the sampling locations were not based on a suitable sample design (e.g., locations were not based on an unbiased approach and only targeted selected portions of the Site). The EPA has also identified that "vertical profile waste stratification and contaminant data are needed at key release locations and within areas where wastes have been discharged continually" (EPA 2013). Based on Site operations, the Site history, a review of aerial photographs, and information from previous sampling events, the following key waste release locations are identified for the Inner PRI areas:

- Wastewater Ditches (PRI Area 1);
- The south-central portion of the Gypsum Pile (PRI Area 4) where the pile is tallest;
- The Southeast Ponded Waste Lagoon (PRI Area 5) near the outlet of the Main Ditch;
- The historical inlet to the northeast ponded Waste Lagoon (PRI Area 7); and
- The former wastewater diversion ditch traversing the Southeast Ponded Waste lagoon (PRI Area 5).

These key waste release locations are shown in Figure 11-1.

Finally, it is recognized that Phase 1A-B data will also be used to support the baseline human health and ecological risk assessments. It will be important to evaluate whether the data collected at the end of Phase 1A-B are sufficient to support confident risk characterization or if additional data collection is necessary in Phase 2.

11.2.1.2 Conceptual Site Model

Initial Sitewide CSMs for the current and future use at the Site are presented in Worksheet #10 of the Phase 1A SAP.

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[2] While the EPA has determined that the historical data (alone) are not adequate for COPC selection, the EPA has stated that, if historical data are found to be statistically similar to data collected in Phase 1A-B, it may be appropriate to combine the data to increase sample size and decrease uncertainty. If so, then the historical data may be included in the dataset used for COPC selection and risk assessment.

11.2.2 Step 2: Identify Goals of the Study

The goals of the study are:

1. To obtain sufficient data for solid media in the Inner PRI areas to reliably select human and ecological COPCs that require further quantitative evaluation in the risk assessment process;

2. To evaluate whether sufficient data have been collected at the Inner PRI areas to support confident risk characterization; and

3. To perform initial Site characterization of the N&E of impacts distributed within the Inner PRI areas to support initial chemical mapping and guide subsequent Site characterization sampling designs.

11.2.3 Step 3: Identify Information Inputs

11.2.3.1 Information Inputs

The information needed to support COPC selection is an adequate and reliable dataset to characterize the range of concentration values that occur in solid media within the Inner PRI areas. Additionally, the sample design described in Steps 6 and 7 for COPC selection will provide data concerning contamination in media at the Site. This can be used to assess whether data are sufficient for the Baseline RAs as well as planning for Phase 2 investigations, as needed.

The information needed to support preliminary N&E characterization includes chemical concentration data from surface samples distributed throughout each Inner PRI area and subsurface samples at key waste release locations, as well as waste thickness profiles. The sample design described in Steps 6 and 7 for COPC selection will provide data for preliminary N&E characterization. The preliminary N&E characterization will be used for planning additional Site characterization data collection for Phase 2, as needed.

11.2.3.2 Sampling and Analytical Methods

Sampling and analytical methods are described in Step 7, Section 11.2.7.

11.2.4 Step 4: Define the Boundaries of the Study

11.2.4.1 Spatial Boundaries

For this study, the lateral spatial boundaries are prescribed by the boundaries of the Inner PRI Areas. The vertical boundaries for the study are defined based on the sampling method. Sampling will be performed to a depth of 6 inches bgs at all surface sampling locations, consistent with the Phase 1A SAP. Subsurface sampling will be performed using 2-foot maximum sample intervals from 6 inches bgs to 2 feet below the waste/native soil interface.

At sampling locations outside of the inundated areas (e.g., PRI Areas 5, 6, and 7 as appropriate) where subsurface sampling is not performed, hand-auger borings to delineate waste thickness will extend to the waste/native soil interface or to a maximum depth of 5 feet bgs. The 5-foot maximum depth is due to practical constraints of hand-augering to greater depths under Site conditions.

11.2.4.2 Temporal Boundaries

Constituent concentrations within solid media at the Site are not expected to fluctuate substantially over the timescale of a year, provided that significant process changes have not been implemented at the facility during that time and that the solid medium has not been substantially disturbed (e.g., by earthmoving activities, flood event, etc.). Consequently, the time of year when sampling occurs is not likely to be important (EPA 2013).

It is recognized that Site-specific conditions and practical constraints may occur that affect the timing of sampling, access to sampling areas, and health and safety of field personnel. Sampling should be avoided during spring due to high water conditions in wastewater ponds, or in peak summer months when excessive heat could adversely affect the health and safety of field personnel. Because sampling within inundated areas will be performed using a helicopter, weather conditions may also limit or affect the performance of sampling in these areas (e.g., no sampling during high winds and helicopter flight is more challenging due to poor lift during hot weather). Because such conditions may hinder sample collection, the field sampling standard operating procedures (SOPs) will describe the suitable times and conditions during which such sampling will need to be conducted to ensure that a complete sample set is obtained.

11.2.5 Step 5: Develop the Analytical Approach

11.2.5.1 COPC Selection

Several factors may be considered in selecting COPCs, the first step is to compare the maximum detected concentration in a dataset (Cmax) to an appropriate risk-based concentration (RBC). If the value of Cmax for an analyte in a medium at a PRI area does not exceed the RBC, that analyte may be generally excluded as a COPC in that medium at that PRI area. Otherwise, if the value of Cmax exceeds the RBC, the analyte is retained as a COPC in that medium in that PRI area. The methods and RBCs to be used for selection of COPCs for OU-1 are described in the *Final Screening Level Risk Assessment Technical Memorandum* (ERM 2014b). Because human and ecological exposure areas have not yet been established for the Site, COPC selection for solid media at the conclusion of Phase 1A-B will occur on a PRI-area-by-PRI-area basis.

11.2.5.2 Confident Risk Characterization

To evaluate whether sufficient data have been collected to support confident risk characterization, initial risk calculations will be performed using all usable Phase 1A-B data following the methods described in risk assessment memoranda as specified in the AOC. Initial risk calculations will be limited to the COPCs identified in the OU-1 SLRA Report. The initial risk calculations will be included in the OU-1 SLRA.

11.2.5.3 Preliminary Nature and Extent

The Phase 1A-B RI Data Report will include maps showing chemical constituent concentrations for toxic equivalency quotients (TEQs), HCB, and PCBs, and may also include maps for other COPCs that are determined to be of significant interest based on the Phase 1A-B data.[3] Chemical mapping will include

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[3] Additional chemical constituent maps for Phase 2 RI scoping will be prepared for Outer PRI areas and for other Inner PRI area risk drivers based on the results of the OU-1 SLRA.

data from the Phase 1A-B RI and the historical/DMA data [4] described in the Final Inner PRI Data Report (ERM 2014a). If concentrations of a constituent in surface samples are similar across a PRI area, then additional N&E data may not be required for that constituent. However, additional N&E information may be subsequently needed to delineate specific areas to support RA or remedy decision to more clearly delineate the spatial distribution of chemicals for Site characterization or for FS evaluations. If constituent concentrations are highly variable across a PRI area, and/or additional delineation is necessary to support remedy selection, then additional sampling to characterize and delineate N&E may be performed during the Phase 2 RI.

To supplement the sample point chemical concentration maps, geostatistical modeling (e.g., kriging) will also be conducted for HCB, total PCBs, and mammal TEQs for each Inner PRI area, where the data permit. Geostatistics will provide a spatial depiction of the data that can be used to predict concentrations of HCB, total PCBs, and mammal TEQs in soil throughout a particular PRI area. More importantly, geostatistics can provide a spatial description of the level of uncertainty associated with unsampled locations, which will aid in understanding the spatial variability in HCB, total PCBs, and mammal TEQs. This will provide a fuller view of the extent of impacts and help determine areas requiring additional sampling for Site-characterization evaluation and remedy-scoping considerations. A description of the geostatistical method(s) used, results, and interpretation of the results will be included in the Phase 1A-B Data Report. The Data Report will also provide results and interpretation of statistical evaluations (e.g., scatter plots, outlier tests, quantile-quantile [Q-Q] plots) to analyze N&E of expected risk drivers.

The need for additional sampling to delineate N&E at the Site will be determined for OU-1 during the Phase 2 RI scoping process. Site-characterization DQOs for the Phase 2 RI may be identified based on waste types, PRI area or other boundaries, and/or remedy-scoping considerations (e.g., decision units). Chemical concentration maps, geostatistical modeling output, and statistical evaluations provided in the Phase 1A-B Data Report will be used to support the Phase 2 RI scoping process and associated DQO development.

If field screening identifies that waste is present at depths greater than 6 inches bgs, then additional sampling will be required to delineate the vertical extent of waste, to measure COPC concentrations in the subsurface to depths relevant to human or ecological exposure, or to support FS evaluations. Subsurface sampling will be performed during Phase 1A-B at key waste deposition locations. If subsurface concentrations are substantially higher than those in surficial samples, additional subsurface sampling may be necessary to adequately delineate the vertical extent of constituents of concern. The maximum subsurface sampling interval will be 2 feet. Subsurface sampling intervals will be adjusted in the field for the following reasons:

- Native material will be segregated from waste material for the final sample interval to allow for the evaluation of potential impacts from wastes in native soil.

- If anomalous or discrete layers of waste or sediments are observed in a boring, the sample interval will be adjusted (reduced) to target the anomalous/discrete layers; however, due to sample volume requirements, no sample interval will be less than 6 inches. Anomalous layers will be identified by the EPA, EPA Contractor, or US Magnesium/ERM field personnel based on color, texture, field screening, and comparison with other wastes/sediments within a boring.

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[4] The relevance of historical/DMA data for use in N&E mapping will be determined based on the degree to which historical data are deemed to be representative of current site conditions. To make this determination three maps will be developed and compared for chemical constituents: 1) a map based on the historical/DMA data, 2) a map based on the Ph1A-B data , and 3) a map based on the combined historical/DMA and Ph1A-B data.

11.2.6 Step 6: Specify Performance or Acceptance Criteria

11.2.6.1 COPC Selection

The performance acceptance criteria for COPC selection were established by the EPA in the Phase 1A SAP. To minimize the probability that a chemical in the soil, sediment, or solid waste of a PRI area will be excluded as a COPC when it should be retained for further evaluation, it is necessary to be confident that the observed Cmax will have a high probability of exceeding the RBC when the chemical is truly of potential concern. This, in turn, is related to the total number of samples collected, and to the methods that will be used to evaluate risk from chemicals that are retained. In accord with discussions at the March 2015 scoping meetings, the minimum sample size for each PRI area shall be 14.

The statistical basis for a minimum sample size of 14 for COPC selection was developed by the EPA in the Phase 1A SAP. The COPC selection process is founded on the concept that, given a dataset of adequate size, the maximum concentration value in that dataset will have a high probability (greater than or equal to 95 percent) of exceeding the true mean concentration across the exposure area. If the observed maximum concentration does not exceed the RBC, there is confidence that the true mean will not exceed the RBC, and hence the chemical will not contribute significant risk and may be not improperly excluded as a COPC.

However, if the dataset is not large enough, the observed Cmax value may not exceed the true mean across the exposure area. This is demonstrated as follows:

Let P equal the percentile of the distribution occupied by the mean. Then, if a single sample is drawn, the probability that the sample is lower than the mean is equal to P. If N samples are drawn, the probability that ALL the samples are below the mean is P^N. Thus, the probability that one or more samples exceed the mean is given by:

$$\text{prob}(\text{Cmax} > \text{mean}) = 1 - P^N$$

The number of samples (N) needed to ensure that the probability is at least 95% that one or more samples exceed the true mean is shown below for a range of distributions in which the true mean occurs at a percentile ranging from the 50th to 90th:

Percentile of the True Mean	N	Probability that Cmax > True Mean
50th	5	96.9%
60th	6	95.3%
70th	9	96.0%
80th	14	95.6%
90th	29	95.3%

For a dataset with a normal distribution, the mean occupies the 50th percentile (P = 0.5), and a dataset of five samples would likely be sufficient to support COPC selection. However, most environmental datasets for soil, sediment, or solid waste are right-skewed, and this results in the mean occupying a percentile higher than 0.5. Depending on the degree of skew, the mean usually falls between the 60th and 90th percentile (or even higher in extreme cases).

Consistent with the Phase 1A investigation, it is assumed for planning the Phase 1A-B investigation of solid media in Inner PRI areas that the mean will generally not be higher than the 80th percentile. This assumption is supported by historical and DMA data available for the Inner PRI areas, which indicate that, for the expected risk drivers (D/F TEQs, HCB, total PCBs), the sample mean usually occurs in the range of the 60th to 80th percentile, as shown below:

PRI Area	Percentile of the Mean			
	D/F TEQ (avian)	D/F TEQ (mammalian)	HCB	Total PCBs
1	59%	47%	64%	65%
4	68%	82%	68%	79%
5	72%	76%	76%	74%
6	77%	69%	77%	60%
7	79%	83%	79%	75%

Based on this, it is considered likely that a dataset of 14 samples is likely to suffice for most analytes. However, if the data from the Phase 1A-B investigation suggest that the distribution of some analytes is more strongly skewed than assumed (i.e., the sample mean is substantially higher than the 80th percentile of the dataset), it may be necessary to collect additional samples to ensure analytes are not improperly excluded as COPCs.

11.2.6.2 Confident Risk Characterization

The performance acceptance criteria for the evaluation of whether sufficient abiotic data have been collected will be dependent on the RA methodologies developed in the technical memoranda specified in the AOC. It is recognized that the evaluations described below may be modified once the RA methodologies are finalized.

All risk calculations for humans and mobile ecological receptors (birds, mammals) will be in accord with standard EPA guidance, and will be based on the 95% upper confidence limit (95UCL) of the mean concentration in the exposure area of concern. The 95UCL will be derived on a PRI area basis for COPCs identified in the OU-1 SLRA using the most recent version of EPA’s ProUCL software application. Use of the 95UCL minimizes the probability of a false negative decision error (deciding risk is below a level of concern when it actually is above a level of concern). However, use of the 95UCL tends to increase the probability of false positive decision errors (declaring that risk is above a level of concern when it actually is below a level of concern). If initial risk estimates based on the 95UCL are below a level of concern, or if risks are above a level of concern based on the sample mean, then it is likely that additional data will not be needed for risk management decision making. In cases where risk is below a level of concern based on the sample mean but above a level of concern based on the 95UCL, then additional data may be useful to support confident risk characterization. In this event, additional sampling needs will be planned and executed during Phase 2.

For sessile or small home range ecological receptors, an assessment of the magnitude and frequency of Hazard Quotient (HQ) values that exceed 1.0, with calculations performed on a sample-by-sample basis, may be performed. In cases where the distribution of HQ values provides a clear prediction of population-level hazard, additional abiotic data to support the HQ approach are unlikely to be necessary. However, in cases where the data are not sufficient to allow a clear assessment of HQ-based population-level hazard, additional abiotic data may be needed. In this event, the necessary abiotic sampling will be planned and performed in Phase 2, along with any biotic-based studies that may be needed.

11.2.6.3 Preliminary Nature and Extent

The need for additional sampling to delineate N&E at the Site will be determined for OU-1 during the Phase 2 RI scoping process. Site-characterization DQOs for the Phase 2 RI may be identified based on waste types and expected thickness, PRI Area boundaries or other important spatial boundaries (e.g., geologic, hydrologic, waste, etc.) and/or remedy-scoping considerations (e.g., decision units). Chemical concentration maps, geostatistical modeling output, and statistical evaluations provided in the Phase 1A-B Data Report will be used to support the Phase 2 RI scoping process and associated DQO development.

The validated and verified Phase 1A-B data will be combined with historical/DMA data deemed to be representative of current Site conditions [5] and used to prepare chemical concentration maps and perform geostatistical modeling and statistical evaluations as described in Section 11.2.5.3. The degree to which the combined datasets delineate the N&E of Site-related contamination within the Inner PRI Areas will be described by the variability of concentrations, relationship of results to risk thresholds, the spatial distribution of chemical concentrations, and level of uncertainty for unsampled locations as predicted by geostatistical modeling. The mapping, geostatistical modeling, and statistical evaluations provided for D/F TEQs, HCB, and total PCBs in the Phase 1A-B Data Report will support scoping of Phase 2 investigations for the collection of additional data to complete Site-characterization and support remedy-scoping and FS evaluations.

11.2.7 Step 7: Develop the Plan for Obtaining the Data

The data collection approach described below supports both COPC selection and preliminary N&E study goals. The data obtained during Phase 1A-B to support COPC selection and preliminary N&E will also be used to perform initial risk calculations to evaluate whether sufficient data have been collected to support confident risk characterization and adequate characterization of the N&E of areas that exceed a level of concern.

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[5] The degree to which historical/DMA data are representative of current site conditions will be determined qualitatively by comparing maps of historical/DMA data, Phase 1A-B RI data, and combined historical/DMA and Phase 1A-B RI data (per Section 11.2.5.3).

11.2.7.1 Surface Solids Sampling

In accord with the performance criteria for COPC selection described in Step 6, the basic plan for surface solids sampling is to collect surface solids samples from at least 14 unbiased locations with the addition of biased/judgmental samples at selected locations. Surface solids samples will be collected from 0 to 6 inches bgs. Surface solids sampling outside of the inundated areas (e.g., PRI Areas 5, 6, and 7 as appropriate) will be performed using a hand auger as detailed in the SOP *USM-01: Surface Soil, Sediment, and Waste Sampling*. Within the inundated areas (e.g., PRI Areas 5, 6, and 7 as appropriate), surface solids samples will be collected using a helicopter-deployed sampler as detailed in SOP *USM-12: Surface Solids Sampling within Current Wastewater Ponds*. When sampling within inundated areas (e.g., PRI Areas 5, 6, and 7 as appropriate), all reasonable efforts will be made to ensure that samples are obtained from the target locations. SOP USM-12 includes criteria for evaluating when a sample is acceptable and procedures for adjusting sampling locations based on field conditions.

The presence/absence of visible waste will be noted on sampling forms at all sampling locations, as described in SOP USM-01. When waste is visible, the depth of waste will be measured. Waste may include gypsum, smut, salts, or sludge that have a different appearance than the native soils present within the Inner PRI areas (e.g., oolitic sands, lacustrine clays, evaporate minerals). If waste is present at the bottom of a surface sample location (6 inches bgs) outside of the inundated areas (e.g., PRI Areas 5, 6, and 7 as appropriate), then the hand-auger boring will be advanced to either the waste/native soil interface or a maximum depth of 5 feet bgs. The maximum depth of 5 feet bgs is based on the impracticality of advancing a hand auger to depths below 5 feet under Site conditions (e.g., standing water, shallow depth to groundwater, unconsolidated wastes) and health and safety considerations. Field screening for waste thickness at locations within the inundated areas (e.g., PRI Areas 5, 6, and 7 as appropriate) will be to depth of penetration of the helicopter-deployed sampler.

11.2.7.2 Subsurface Solids Sampling

The role of subsurface solids sampling for COPC selection was described in the Phase 1A SAP. At most environmental sites, site-related contaminants tend to be highest in surficial soils or sediments, with decreasing concentrations as a function of depth. However, at this Site, it is considered plausible that, in at least some PRI areas, concentrations of chemicals might be higher in subsurface materials than at the current surface. This condition might occur under several alternative scenarios, as follows:

- The types of chemicals released in the past might have been different than at present due to changes in plant operation conditions.
- The level (concentration, mass loading) of contaminants released to the environment may have been higher in the past than at present, especially if plant operations were changed with the goal of reducing levels of chemical release.
- Historical wastes may have been moved or buried under less impacted or clean materials.
- Chemical fate and transport processes might act on surficial materials differently than on deep materials, potentially resulting in higher concentrations in samples collected at depth.

Because it is not known whether any of the scenarios may actually have resulted in meaningful differences between surface and subsurface samples, it is necessary to obtain some limited data to recognize if this situation may exist. This is important for COPC selection, because a Type I decision error (exclusion of an analyte as a COPC that should have been retained) could occur if surface levels of an analyte are below the RBC but concentrations at depth exceed the RBC. The Phase 1A-B investigation therefore includes a limited number of borings to evaluate potential differences between surface and subsurface samples. These samples will also help inform the preliminary vertical N&E of chemical impacts.

In identifying COPCs for a PRI area where samples at depth have been collected, the value of Cmax will be the highest of any value in the dataset for the PRI Area, including both surface and subsurface samples. If subsurface concentrations are substantially higher than those in surficial samples, some analytes may be identified as COPCs in subsurface materials that may not be of concern in surficial samples. Because only a small number of boring samples are to be collected, additional subsurface sampling will be necessary in subsequent field programs to adequately characterize the vertical extent of COPCs.

Subsurface solid sampling will be performed as detailed in SOP *USM-09: Subsurface Soil, Sediment, and Waste Sampling*. Subsurface borings with sampling using 2-foot maximum intervals for chemical analysis will be performed to evaluate chemical concentrations at depth and for characterizing vertical N&E within key waste release locations (Figure 11-1) and other locations identified by the EPA. Surface samples (0 to 6 inches bgs) will also be collected at each subsurface sampling location; therefore, the typical/default subsurface sample intervals will be 6 inches to 2 feet bgs, 2 feet to 4 feet bgs, and so on with the final sample interval extending to 2 feet below the waste/native soil interface. Native material will be segregated from waste material for the final sample interval to allow for the evaluation of potential impacts from wastes in native soil. If anomalous layers of waste or sediments are observed in a boring, the sample interval will be adjusted (reduced) to target the anomalous layers; however, due to sample volume requirements, no sample interval will be less than 6 inches. Anomalous waste/sediment layers will be identified by the EPA, EPA Contractor, or US Magnesium/ERM field personnel based on color, texture, field screening, and comparison with other wastes/sediments within a boring.

11.2.7.3 Sampling Locations

The number and approximate locations of surface and subsurface solids samples identified in this SAP were discussed and agreed to by ERM/US Magnesium and the EPA during the March 2015 OU-1 Phase 1B RI DQOs Scoping Meeting (see Attachment 9). Surface solids sampling locations were preferentially chosen using a systematic (grid) sampling design to ensure that the PRI area is fully and uniformly represented by the set of samples collected. In addition, judgmental samples are placed at known features at PRI Areas 1, 5, and 7 to support COPC selection and preliminary characterizations of N&E. The systematic grids of sampling locations at PRI Areas 3, 4, 5, and 7 include locations near areas of waste deposition or found to contain the highest concentrations of HCB, D/F TEQs, and PCBs based on historical Site data. Subsurface borings for COPC selection and vertical N&E are located within key waste deposition areas (PRI Areas 1, 4, 5, and 7; see Figure 11-1) and at locations in PRI Areas 3 and 6 as requested by the EPA during the March 2015 Scoping Meeting.

Most sampling locations include surface sampling only; however, field screening for waste thickness will be performed at all sampling locations. If field screening for waste indicates that waste material is present at depths greater than 6 inches bgs within all or a portion of a PRI area, then subsequent sampling to delineate vertical N&E would be considered during subsequent RI Phase 2. Waste thickness at subsurface sampling locations will be determined by extending the boring to below the waste/native soil interface.

Sampling locations for each PRI area are described in the subsections that follow. Sampling locations for PRI Areas 3 through 7 were developed using Visual Sample Plan software (VSP; vsp.pnnl.gov). To ensure the assumption of random sampling is met, a systematic sample grid layout was employed that utilized a randomized initial sample that serves as the origin on which the systematic grid is constructed.

US Magnesium may construct a wastewater filtration system located on PRI Areas 1 and 3. The EPA has instructed US Magnesium that if a RCRA settlement is reached prior to implementation of this phase of the RI, the Phase 1A-B samples that are located in areas included within a RCRA settlement area will be revised in an appropriate Record of Modification to the Phase 1A-B RI SAP.

PRI Area 1

Surface solids sampling will be performed at 14 locations in PRI Area 1 as shown on Figure 11-2. Twelve locations are within active wastewater ditches, one location (1-13) is within an inactive reach of the Main Ditch, and one location (1-14) is within the alignment of the Former Boron Ditch. Because the wastewater ditches are linear features, all sampling locations in PRI Area 1 were judgmentally selected instead of using a systematic grid. For the 13 sampling locations not within the former Boron Ditch, locations were divided between the active wastewater ditches based on the relative approximate length of each ditch: three samples at the Western Ditch (2,000-foot length), two samples at the Central Ditch (1,300-foot length); two samples at the Chlorine Ditch (1,350-foot length), and six samples at the Main Ditch (4,200-foot length, including historical ditch alignment to the outlet at PRI Area 7). The distribution of samples between ditches results in one sample per approximately 700 feet. Samples were distributed along the wastewater ditches taking into account accessibility by placing samples at each of three bridges crossing the active wastewater ditches. The rationale for each Phase 1B sample at PRI Area 1 is provided below.

ID	Rationale
1-01	Near head of Western Ditch (surface)
1-02	Approximate midpoint of north-south segment of Western Ditch (surface)
1-03	West of bridge at confluence of Western and Main ditches (surface and subsurface)
1-04	Near head of Central Ditch (surface)
1-05	Central Ditch downstream of Sanitary Lagoon (surface)
1-06	Near head of Chlorine Ditch (surface)
1-07	Chlorine Ditch downstream of Boron Plant discharge and south of bridge (surface and subsurface)
1-08	Main Ditch after confluence with Chlorine Ditch and east of bridge (surface and subsurface)
1-09	Main Ditch adjacent to Landfill (surface)
1-10	Main Ditch below Landfill (surface)
1-11	Main Ditch near current outlet to PRI Area 5 waste pond (surface)
1-12	Main Ditch alignment adjacent to PRI Area 5 waste pond (surface)
1-13	Former Main Ditch near historical outlet to PRI Area 7 waste pond (surface and subsurface)
1-14	Former Boron Ditch (surface and subsurface)

Surface solids sampling will be performed at all locations (1-01 through 1-14). Subsurface sampling will be performed at five locations, including the three bridges over wastewater ditches (1-03, 1-07, and 1-08), the former Main Ditch near the historical outlet to the Northeast Ponded Waste Lagoon (1-13), and within the alignment of the former Boron Ditch (1-14).

PRI Area 3

Surface solids sampling will be performed at 14 locations in PRI Area 3, which include 13 evenly distributed grid sampling locations and one biased/judgmental sampling location. PRI Area 3 sampling locations are shown on Figure 11-3. Locations 3-01 through 3-13 were generated as a systematic grid. Location 3-14 is a biased/judgmental location for surface and subsurface sampling to characterize conditions at the presumed inlet to lagoon.

PRI Area 4

Surface solids sampling will be performed at 14 evenly distributed grid sampling locations in PRI Area 4 as shown in Figure 11-4. Subsurface sampling will be performed at a sampling location within the top-center of the Gypsum Pile, where historical gypsum waste is expected to be present at depth (location 4-05 on Figure 11-4). This sampling location is within a key waste release area (see Figure 11-1).

PRI Area 5

Surface solids sampling will be performed at 20 locations in PRI Area 5, which include 15 evenly distributed grid sampling locations and five biased/judgmental sampling locations. The base number of gridded sampling locations at PRI Area 5 was increased from 14 to 15 based on (1) the elevated variability in D/F, PCB, and/or HCB concentrations exhibited in historical PRI Area 5 solids data, and (2) agreements between ERM/US Magnesium and the EPA during the March 2015 OU-1 Phase 1B RI DQOs Scoping Meeting. PRI Area 5 sampling locations are shown on Figure 11-5. Locations 5-01 through 5-15 for PRI Area 5 were generated as a systematic grid and include locations in both Upland (terrestrial) and mudflat/waste pond areas.

Subsurface sampling will be performed at the location nearest the inlet to the waste lagoon from the Main Ditch (location 5-14 on Figure 11-5) and at a location within a former wastewater diversion ditch (location 5-16 in Figure 11-5). These locations were selected for subsurface sampling because they are within key waste release areas (see Figure 11-1). The lagoon inlet (location 5-14) is the location where the greatest amount of waste deposition occurs, as apparent in aerial photographs. The former diversion ditch location was selected by EPA to investigate accumulated sediment/wastes within the ditch and potential subsurface impacts from leachate from the landfill. Drill rig access to location 5-14 will be attained by the construction of an earthen ramp into the wastewater pond.

The rationale for each of the five biased/judgmental sampling locations in PRI Area 5 is provided below.

ID	Sample Type	Rationale
5-16	Surface and Subsurface	Former Wastewater Diversion Ditch - Evaluate potentially impacted sediments from historical wastewater diversions and potential leachates from the landfill, located near/at an inlet of the ditch into the PRI Area 5 waste lagoon.
5-17	Surface	Former Wastewater Diversion Ditch - Evaluate potentially impacted sediments from the lower reach of the Former Wastewater Diversion Ditch (representing the eastward leg draining into the PRI Area 5 waste lagoon).
5-18	Surface	Star Pond Ditch - Evaluate potentially impacted sediments downgradient of the discharge point from the Star Pond.

5-19	Surface	Skull Valley Diversion - Evaluate potentially impacted sediments in an area of influent seepage.
5-20	Surface	Star Pond Ditch - Evaluate potentially-impacted sediments within a downstream (east) reach where Star Pond discharges appear to have comingled with Former Diversion Ditch and PRI Area 5 waste lagoon waters.

PRI Area 6

Surface solids sampling will be performed at 16 locations in PRI Area 6, which include 15 evenly distributed grid sampling locations and one biased/judgmental sampling location. As described above for PRI Area 5, the base number of gridded sampling locations at PRI Area 6 was increased to 15 based on the variability exhibited in historical PRI Area 6 solids data and agreements reached during the March 2015 OU-1 Phase 1B RI DQOs Scoping Meeting. PRI 6 sampling locations are shown on Figure 11-6. Locations 6-01 through 6-15 were generated as a systematic grid and include locations in both Upland (terrestrial) and mudflat/waste pond areas. Subsurface sampling to characterize historically deposited wastes/sediments in the PRI Area 6 waste lagoon will be performed at a biased/judgmental location within the current PRI Area 4 (location 6-16 on Figure 11-6). Location 6-16 is within the historical inlet and deepest portion of the PRI Area 6 waste lagoon based on aerial photographs that show the PRI Area 6 lagoon area prior to inundation by gypsum waste. Over time, this area has filled with gypsum waste; therefore, drilling though gypsum waste at location 6-16 will allow access and sampling of historically deposited wastes/sediments in the PRI Area 6 waste lagoon. Subsurface sampling location 6-16 is co-located with surface solids sampling location 4-11 in PRI Area 4 (see Figure 11-4). Subsurface samples from location 6-16 composed of gypsum waste may be appropriate to include with the PRI Area 4 dataset for COPC selection.

PRI Area 7

Surface solids sampling will be performed at 17 locations in PRI Area 7, which include 15 evenly distributed grid sampling locations and two biased/judgmental sampling locations. As described above, the base number of gridded sampling locations at PRI Area 7 was increased to 15 based on the variability exhibited in historical PRI Area 7 solids data and agreements reached during the March 2015 OU-1 Phase 1B RI DQOs Scoping Meeting. PRI Area 7 sampling locations are shown on Figure 11-7. Locations 7-01 through 7-15 for PRI Area 7 were generated as a systematic grid and are evenly distributed throughout the floor of the OWP. Subsurface sampling will be performed at the location nearest the historical inlet to the OWP (location 7-04 in Figure 11-7). This location was selected for subsurface sampling because it is within a key waste release area (see Figure 11-1) that received wastewater discharges during the early operations of the magnesium plant and the inlet is the location where the highest concentrations of HCB, D/F TEQs, and PCBs were detected during historical investigations. Two biased/judgmental surface solids samples will be collected from within the barrow ditch north of the OWP (locations 7-16 and 7-17 on Figure 11-7) due to the potential for ecological receptor exposures within the barrow ditch.

11.2.7.4 Laboratory Analysis

Laboratory analytical data used for COPC selection, initial risk calculations, and preliminary N&E characterization will meet applicable criteria for definitive data as defined under EPA guidance (2005a) and the measurement performance criteria for sampling and analysis defined in the Phase 1A-B SAP.

Laboratory analyses will be performed following the analytical SOPs and project-specific Work Instructions included in the Phase 1A-B SAP. All Phase 1A-B surface and subsurface solid samples will be analyzed for the target analytes listed in Worksheet #15, which include the following:

- PCBs
- D/Fs
- SVOCs including HCB
- PAHs
- VOCs[6]
- Metals
- Cyanide
- Perchlorate

In addition to analysis for candidate COPCs, all solids samples will be analyzed for total organic carbon (TOC), pH, and grain size. TOC, pH, and grain size data will not be used to select COPCs; however, these data will be collected to provide context for subsequent risk assessment characterizations.

Due to the very high levels of PCBs and D/Fs expected to be present within some areas in the Inner PRI areas, analysis of Phase 1A-B solids samples from the Inner PRI areas for PCBs and D/Fs will be performed using a combination of high-resolution mass spectroscopy and low-resolution mass spectroscopy methods. The identification of samples for low-resolution mass spectroscopy analysis and the criteria that will be used to decide if a sample must be reanalyzed using high-resolution mass spectroscopy method will be included in the project-specific laboratory Work Instructions described in SAP Worksheet #23 and included in SAP Appendix 19B.

11.2.7.5 Bulk versus Fines Fractions Analyses

Consistent with the Phase 1A RI for Outer PRI areas, the Phase 1A-B RI for the Inner PRI areas will include an investigation to determine (1) if constituent concentrations significantly differ between bulk and fine fractions, and (2) whether a large-enough proportion of coarse material is present in bulk samples to result in a substantial difference between the constituent concentrations measured in the bulk and the fine fractions. For the purpose of this study, “bulk fraction” is defined as all material passing a 0.25-inch mesh sieve and “fine fraction” is defined as material passing a 0.25-millimeter (mm) (60 US Mesh) sieve. Evaluating bulk versus fines fractions is important for COPC selection because a Type I decision error (excluding a COPC that should be retained) could occur if concentrations of an analyte in bulk (unsieved) samples are below a level of concern but concentrations in fine-grained material are above a level of concern (EPA 2013).

The sieving and analysis strategy for Phase 1A-B RI samples is illustrated in the flow diagram shown on Figure 11-8. To facilitate the bulk versus fines evaluation, three splits will be collected for each Phase

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[6] VOC analysis will be performed for all surface solids samples and all subsurface solids samples.

1A-B surface solids sample. Each split will be composed of the bulk sample (passing 0.25-inch mesh) after homogenization.

1. Split sample 1 will be analyzed as a bulk fraction sample.

2. Split sample 2 will be analyzed for grain size by ASTM International (ASTM) Method C-136. The result from the grain size analysis of split sample 2 will be used to determine whether to analyze split sample 3 as a fines fraction sample.

3. If the percent passing 0.25 mm in split sample 2 is greater than 75, then no analysis for fines is required.

4. If the percent passing 0.25 mm in split sample 2 is less than 75, then split sample 3 will be dried, sieved through a 0.25 mm mesh, and the fines-fraction material (passing 0.25 mm) will be analyzed for PCBs, D/Fs, SVOCs, PAHs, metals, and TOC.

The cutoff specification is set at 75% because in samples with mass of the fine fraction at greater than or equal to 75% of the bulk, the maximum possible ratio of the concentration in the fine fraction to the bulk fraction is 1.33 (when the concentration in the coarse fraction is zero). Because the analytical variability of most methods is usually about 30%, the ratio of concentration values in the fine fraction to those values in the bulk fraction is expected to fall inside the normal range of analytical variability for all samples with more than 75% fine material.

The relationship between the paired results of the bulk and corresponding fine fractions will be evaluated using regression analysis. This approach allows development of a quantitative relationship between the bulk fraction and the fine fraction, so that if a meaningful difference is evident, the concentration in the fine-grained fraction may be calculated from the bulk fraction.

11.3 DATA QUALITY OBJECTIVES FOR BACKGROUND EVALUATIONS

The DQOs for background evaluations presented below are provisionary and are repeated from the Draft DQO document transmitted by ERM to EPA on 18 May 2015. EPA's comments on the 18 May 2015 draft background evaluations DQO were received by ERM on 8 June 2015 are included in Attachment 9 of this SAP.

11.3.1 Step 1: State the Problem

A necessary component of the RI/FS is to define the naturally occurring or "background" concentrations of chemicals in solid media. The purpose of characterizing background is so that Site-to-background comparisons can be conducted and Site-related constituents can be identified. These chemicals include metals, which are natural components of the Earth's crust, and organic compounds that are either anthropogenically produced or combustion byproducts (wildfires), which are ubiquitous in the environment due to wind dispersal and aerial deposition. For the purposes of this evaluation, both naturally occurring and anthropogenic ambient will be defined as "background." Two classifications of compounds are relevant to characterizing background for the US Magnesium RI/FS: metals and organics. Organics include D/F, total PCBs, and HCB. PAHs are also a constituent with a ubiquitous background signature in the environment. Based on the Phase 1A RI data, PAHs do not appear to be a significant risk driver. Concentrations detected at the PRIs sampled during the Phase 1A were low and exceeded an RBC in only one PRI Area (the landfill), and do not rank as human or ecological COPCs in any of the outer buffer areas. Based on the Phase 1A data, characterizing PAHs in background is unnecessary.

Background concentrations of naturally occurring metals in soils and sediments are influenced by the underlying soil types and lithologies. Figures 11-9 and 11-10 summarize the different lithologies and soil types present in the general area of US Magnesium, respectively. Understanding the influence of soil and lithology on metals concentrations is a critical aspect of the background characterization sample design.

There are historical datasets in the general area of US Magnesium that provide some information regarding background concentrations of metals and organics. These include:

1. Parametrix 2004: A limited background dataset for a subset of metals (arsenic, barium, cadmium, chromium, lead and selenium), D/Fs, coplanar PCBs, and HCB was collected to support a focused ecological risk assessment at US Magnesium. This dataset is small (n=6) and does not include all the metals of interest.

2. Phase 1A RI soil data: A full suite of metals, D/Fs, HCB, and total PCBs were collected as part of Phase 1A data collected in 2014 (ERM 2014a). PRIs that represent areas where aerial deposition from the stack is the potential contaminant source (PRIs 11-16) provides a dataset from which an estimate of the variability in concentrations representative of background may be made.

3. Other regional datasets: A number of regional datasets exist that can be used to further inform regional background concentrations for metals, D/Fs, and/or PCBs. Examples of these datasets include but are not limited to:

    a. Utah Test and Training Range – North: Soil data collected for evaluating background metals levels in an area north and west of the US Magnesium Site (URS 2004);

    b. Former Defense Depot Ogden: Background concentrations of metals developed for the Defense Depot Ogden NPL Site as presented in an Agency for Toxic Substances and Disease Registry (ATSDR) Public Health Assessment Report (ATSDR 1992).

    c. Wetland Sites around the GSL: Characterization of sediment, water and biota data from 30 wetland sites around the GSL (USFWS 2009).

While there are historical data available, none of these datasets provide sufficient information to develop relevant background for the purposes of the RI/FS. However, these datasets can be used to inform the design of a background dataset for the RI/FS. Additionally, they may provide context for comparisons for data that are collected as part of this background evaluation.

While not the specific objective of this background soil characterization study design, the baseline ecological RA will likely require characterization of COPCs in biotic tissue samples from non-impacted reference sites. The soil data collected in background areas will support the selection of reference areas for biotic sampling by confirming that the locations are not impacted by either the US Magnesium Site or other point sources.

In summary, background metals and organics concentrations have not been adequately characterized. These data are critical for conducting RI/FS activities, including the characterization of N&E, identification of Site-related constituents of concern, and identifying candidate reference locations for the collection of biotic tissue samples.

11.3.2 Step 2: Identify Goals of the Study

The goal of the study is:

1. To obtain sufficient data to reliably define and use background concentrations to identify elevated (Site-related) metals and organics (D/Fs, total PCBs, and HCB); and
2. To identify non-impacted background soil/sediment reference locations keeping in mind that the same locations may be revisited in Phase 2 to characterize tissue burdens at reference locations.

11.3.3 Step 3: Identify Information Inputs

The information needed to support background evaluation is an adequate and reliable dataset to characterize the range of metals and organics concentrations that occurs in solid media within non-impacted soils/sediments (solid media) that are representative of soils/sediments found at the US Magnesium Site. Additionally, habitat and species information from the Site and the background locations are needed so that the background locations sampled are likely to provide the biotic reference samples during Phase 2 sampling.

11.3.4 Step 4: Define the Boundaries of the Study

11.3.4.1 Spatial Boundaries

The initial study boundary for the background characterization includes areas located:

1. Outside of the 5-mile radius RI/FS Study Area;
2. Away from any other known point-source areas of impacts;
3. In areas where species of interest would not be expected to forage in RI/FS Study Area;
4. In similar lithologies and soil types as those found at the Site; and
5. In habitats where species expected to be at the Site are also found.

11.3.4.2 Temporal Boundaries

Within media such as soils and sediments, metal and organics concentrations are not expected to fluctuate seasonally, so the time of year when sampling of these media occurs is not an important variable.

11.3.5 Step 5: Develop the Analytical Approach

The primary objective of the background characterization is to obtain sufficient data to reliably define and use background concentrations to identify elevated (Site-related) metals and organics. Once background concentrations are characterized, these data will be used to compare to Site data to evaluate whether concentrations of metals and organics detected on Site are within the range of background or are elevated. The study data will be used to confirm that the background sampling locations are: (1) not impacted by either the US Magnesium Site or another potential point-source area; and (2) suitable for future collection of biological samples. Based on these objectives, the decision rules for the background evaluation are as follows:

1. If detected concentrations of metals, D/Fs, total PCBs, and HCB do not show Site influence, then conclude that the data are appropriate for background evaluations (see 11.3.5.1); and

2. If detected concentrations of metals and D/Fs, total PCBs, or HCB detected at the Site are within the range of background, then conclude that the presence of these compounds is not related to releases or other activities at the Site (see 11.3.5.2).

To address the above decision rules, a multi-line of evidence approach is proposed and discussed in detail below.

11.3.5.1 Characterization of Background Dataset

Once the background datasets are collected, it will be important to evaluate the data and ensure that samples or areas (if any) that appear to be impacted by Site-related contamination are identified and excluded. The methodology to identify such samples or areas is described in the Data Quality Assessment (Worksheet #37), and will include the following evaluations:

1. Statistical outlier tests;

2. Graphical evaluations including geochemical bivariate plots and Q-Q plots (see below for more details on these methodologies);

3. Statistical comparison of D/F TEQ and total PCB concentrations between background data and regional background datasets (where available); and

4. Comparison of D/F congener and PCB fingerprint signatures between background samples, other regional background datasets (where available) and US Magnesium Site data.

Results of these tests will be used to determine if additional evaluation is needed.

Based on the outcomes of these evaluations, samples that are concluded to contain concentrations of a specific metal or organic that are elevated, indicating potential impacts, will be identified. For these samples, a decision will be made as to whether the specific compound concentration is removed from the dataset, or whether the entire sample should be removed from the dataset. The decision as to whether individual compound(s) or the entire sample is removed from the background dataset will depend on: (1) the number of individual compounds that are elevated in the sample, (2) the spatial distribution of samples with elevated concentrations, and (3) observations made in the field regarding specific samples.

Once the background dataset(s) is finalized, the dataset will be used to: (1) compare Site data against background data, and (2) identify those locations that are not impacted and are potential candidate locations for reference biota sampling. The background comparison methodologies that will be conducted are presented below.

11.3.5.2 Background Comparison Analyses

A holistic approach will be used that considers multiple lines of evidence to determine whether a compound is elevated above background. Comparisons to background will be conducted on a PRI area basis. These lines of evidence will include a comparative statistical analysis, a geochemical analysis, and a graphical evaluation using Q-Q plots. As data permit, a decision framework that incorporates the various lines of evidence will be used for determining if a compound is elevated above background. The framework for metals and organics differ as shown below:

Metals:

Step 1 – Hypothesis tests (WRS/Gehan and quantile tests)
Step 2 – Q-Q plot evaluation
Step 3 – Geochemical analysis

Organics:

Step 1 – Hypothesis tests (WRS/Gehan and quantile tests)
Step 2 – Q-Q plot evaluation
Step 3 – Signature fingerprinting (D/F and co-planar PCBs congeners and PCB homologs).

The framework above is hierarchical. The evaluation will terminate if, at any step, the conclusion of the evaluation concludes the Site is not elevated above background. A final determination of a Site analyte being elevated above background will be made at the conclusion of Step 3. The analytical approach for each of these lines of evidence is described below.

Hypothesis Testing

The statistical comparison method employs a series of tests to compare Site sampling data against data sampled from a comparable population known to be not impacted (background). Statistical hypothesis tests are used to determine whether concentrations at the Site are statistically similar to background concentrations or elevated. Two statistical tests will be conducted during the background evaluation. One compares the central tendency of data distributions, and the second compares the upper tails of distributions. Depending on the distribution of the datasets, parametric or nonparametric methods will be used. The central tendency and tails tests are described further below.

Central Tendency Testing

Central tendency testing will be employed in both metal and organics[7] background evaluations. The central tendency of the Site and background datasets will be compared using a Wilcoxon Rank Sum (WRS) test (or a Gehan test, where datasets have multiple detection limits). The null hypothesis (H_0) for the WRS/Gehan tests will assume that Site concentrations are greater than background (Background Test Form 2 as described in EPA 2002b). The alternative hypothesis (H_A) for this test form is that Site concentrations are not greater than background. Central tendency testing requires establishing values for α and β as acceptable probability thresholds for potential decision errors. These values are discussed further as performance criteria in Section 11.3.6.1.

Quantile Testing

The quantile test is a nonparametric test that is designed to compare the upper tails of the distributions (EPA 2002b) and will be employed in both metal and organics background evaluations. The quantile test will be used to compare the upper tails of the Site and background datasets. This test detects whether a site's upper tail (highest concentrations) is shifted higher than the upper tail of background concentrations, i.e., tests if a PRI area's highest concentrations are higher than the highest concentrations in the background dataset. Statistical test values calculated during the quantile test are r, k and α. These values are discussed further as performance criteria in Section 11.3.6.2.

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[7] For the statistical comparisons, D/Fs will be evaluated as tetrachlorodibenzo-p-dioxin TEQs.

Geochemical Evaluation

Metals will be evaluated by examining geochemical relationships between trace metals and reference metals. Geochemical correlations of trace versus major elements are predicated on the natural elemental associations in soil. Linear trends with positive slopes are expected for scatter plots of specific trace versus major elements in non-detect samples. Individual samples that may contain detections are identified by their positions off the trend formed by non-detect samples. In addition to pinpointing which samples may be contaminated, this technique provides mechanistic explanations for naturally elevated element concentrations (Myers and Thornbjornsen 2004).

Trace metal distributions in soil tend to span a wide range of concentrations and are highly right-skewed, approximating lognormal distributions, and background datasets are frequently too small to capture this range. The distribution of reference metals in soils depends primarily on the source rock, weathering processes, geochemical environment, and sorption and precipitation processes. These are broad terms that refer to the physical and geochemical processes that result in metal immobilization through: (1) adsorption processes where a metal is bound or “sticks” to soil materials; and (2) precipitation processes where metals form new minerals. Furthermore, these processes can work concomitantly.

One of the factors controlling metals distribution is speciation, which dictates their charge and affinity for different types of soil minerals. Table 11-1 provides: (1) a summary of metals/inorganics and their likely speciation in natural systems; (2) the key constituents that are broadly responsible for their immobilization and distribution; and 3) a description of predominant immobilization processes.

As an example of a geochemical correlation, arsenic in most uncontaminated oxic soils is commonly associated with iron oxide minerals (Myers and Thornbjornsen 2004). This association of arsenic with iron oxides is a result of the adsorptive behavior of this particular trace metal in an oxic soil environment. Arsenic is present in oxic soil pore fluid as negatively charged oxyanions. These oxyanions have strong affinities to adsorb on the surfaces of iron oxides, which maintain a strong positive surface charge for this reason, if a soil sample has a high percentage of iron oxides, then it is expected to have a proportionally higher concentration of arsenic (Myers and Thornbjornsen 2004).

The absolute concentrations of arsenic and iron can vary by several orders of magnitude at a site, but the arsenic/iron ratios in each sample are usually quite constant at a given site as long as no contamination is present (Myers and Thornbjornsen 2004). If a sample has some naturally occurring arsenic plus additional arsenic from an anthropogenic source, then it will have an anomalously high ratio relative to the other uncontaminated samples. These ratios thus serve as a powerful technique for identifying contaminated samples.

In order to utilize the geochemical method approach outlined above, potential geochemical associations as defined by those in Table 11-1 will be evaluated against one another for their relative strength. Geochemical plots will be used to assess how strongly individual sample concentrations from a PRI area hold to the linear relationship created by the reference metal-to-trace metal concentration ratio defined by the background dataset. Bivariate scatter plots will be constructed with the “reference” metal concentration on the x-axis, and the “trace” metal of interest concentrations on the y-axis.

A least squares regression line will be drawn from the scatter plot to illustrate the linear trend exhibited between reference and trace metal for the background dataset. A 95% predictive interval on the regression will be drawn to provide a confidence interval on the background population. The 95% predictive interval provides the range within which the trace metal concentration value (y-axis value) is expected to fall based on the corresponding reference metal concentration (x-axis value) 95% of the time. Samples that fall above this line are suspected to be elevated above background concentrations. An example geochemical plot is provided on Figure 11-11 using fictitious data, along with an explanation of plot interpretation.

In summary, the geochemical evaluation provides a line of evidence that is not constrained by statistical and computational requirements. This provides a check against potential decision errors stemming from statistical methods.

Q-Q Plot Evaluation

As another line of evidence, Q-Q plots of metals and organics will be generated and reviewed. In a Q-Q plot, the x-axis is arranged such that a dataset's theoretical quantiles will plot (ideally) as a straight line with relatively flat tails. A curve with an apparent inflection point (a point on the curve where a change in direction occurs) is commonly produced when the plotted dataset contains multiple populations (either multiple background populations from different geological units, or background plus anomalous populations due to Site releases). Q-Q plots will be developed for each PRI area and the background dataset. Inflection points in the Q-Q plot can represent the transition between different geologic units or it can represent the background "threshold" concentration (i.e., the value that marks the transition between background concentrations and concentrations resulting from Site operations).

Like the geochemical evaluation, the Q-Q plot evaluation provides a line of evidence that is not constrained by statistical and computational requirements, and provides a check against potential decision errors stemming from statistical methods.

D/F and PCB Fingerprinting

In addition to the statistical evaluation, Site D/Fs and PCBs will be compared to background D/Fs and PCBs by using fingerprinting techniques. Site and background fingerprint signatures will be developed for D/F and co-planar PCB congeners and PCB homologs. This will include, but is not limited to, calculating the relative proportions of congener in each sample, and comparing the patterns in proportions exhibited by the Site and background datasets (EPA 2004), and/or more quantitative techniques—e.g., regression analysis, principal component analysis, and/or non-metric multi-dimensional scaling (NMDS).

11.3.6 Step 6: Specify Performance or Acceptance Criteria

The primary objective of specifying performance criteria is to minimize the probability that a metal or organic constituent in soil or sediment at a PRI area will be identified as being within the range of background when it should be identified as being above the range of background and is likely Site-related. Therefore, it is necessary to be confident that the observed PRI area dataset has a high probability of exceeding the background dataset when the concentration of the chemical at the PRI area is truly elevated above the range of background. In addition, care should also be taken to minimize the probability of concluding that a metal or organic in soil or sediment at a PRI area will be identified as being elevated above background, when it should be identified as being within the range of background.

To minimize the probability of committing either decision error, multiple lines of evidence will be used. These multiple lines of evidence include both quantitative statistical evaluations, as well as geochemical and graphical methods.

Specific performance and acceptance criteria for each line of evidence are presented below.

11.3.6.1 Central Tendency Testing

The central tendency testing requires establishing performance criteria for hypothesis testing. These include:

Type I Error – The probability of rejecting a true null hypothesis (H_0) is referred to as a Type I or false positive error (α) and is commonly called the significance level of the test. Because H_0 is that Site concentrations are greater than background, a Type I error would be erroneously concluding the Site concentrations are not greater than background, when in reality they are. For this evaluation, the confidence level is set at 90%, or α=0.1. This performance criterion means there is a 10% chance of a Type I error.

Type II Error – The probability of accepting a false null hypothesis is referred to as a Type II or false negative error (β). For this evaluation, a Type II error would erroneously conclude the Site concentrations are greater than background concentrations, when in reality they are not. For this evaluation and consistent with EPA guidance (2002b), the Type II error is set at 20% (β=0.20). This performance criterion means there is a 20% chance of a Type II error.

Performance criteria for the central tendency testing (α=0.1, and β=0.2) are used to establish appropriate background sample sizes. Sample size estimation is described in Step 7, Section 11.3.7.2.

11.3.6.2 Quantile Testing

The Quantile Test is a test that determines whether the values in the right-tail of the Site dataset are generally larger than the values in the right-tail of the Site dataset. This test consists of considering the largest *r* measurements in the pooled datasets and counting the number of those measurements that are from the dataset of interest (e.g., Site dataset). If *k* or more of the *r* measurements are Site measurements, the Site dataset is considered to be elevated relative to background. The values for *r* and *k* are typically obtained from a look-up table for a specified significance level (α) and power (1-β). Consistent with convention, the significance level is 0.05 (α =0.05) and the power is 80% (β=0.2).

11.3.6.3 Geochemical Evaluation

Examining geochemical relationships will be used to qualitatively compare Site and background datasets. Plots will be examined for similar trace metal-reference metal correlations between Site and background datasets. In order to quantify the predictive relationship between references and trace metal, geochemical bivariate plots require there be a clearly defined correlation between the two. To determine which reference metal possesses the strongest correlation with a given trace metal, Pearson correlation tests will be performed on all common trace-to-reference metal combinations in background data, as defined in Table 11-1. The strongest correlation between possible parings for a given metal will then be used in developing the plot. A minimum Pearson correlation coefficient (r) of 3 will be required for a geochemical relationship to be considered strong enough for use in the evaluation. If the highest available r is less than 3, that trace metal will be excluded from the geochemical evaluation.

11.3.6.4 Q-Q Plot Evaluation

Formal quantitative acceptance criteria for comparing Site and background datasets are not defined for Q-Q plots. Q-Q plots will be used to qualitatively compare Site and background datasets. Interpretation of Q-Q plots will be based on professional judgment, with the objective of identifying significant breaks or inflection points in the curve. Significant breaks and inflections points are potentially indicative of multiple populations in a dataset.

11.3.6.5 Dioxin Fingerprinting

Formal quantitative acceptance criteria are not defined for dioxin fingerprinting. Interpretation of fingerprinting plots will be based on professional judgment, with the objective of identifying similarities and differences in congener profiles between Site samples, background samples and off-Site regional background samples. Following an initial review, if statistical methods (e.g., regression analysis, NMDS) are judged to be useful in distinguishing patterns, then performance criteria (e.g., significance levels) will be proposed.

11.3.6.6 General Data Adequacy

Besides quantitative criteria and using multiple lines of evidence to mitigate against decision errors, data of adequate quality will also be required. Laboratory analytical data used for the characterization of background will meet applicable criteria for definitive data as defined under EPA guidance (2005a) and the measurement performance criteria for sampling and analysis defined in the Phase 1A-B RI SAP (WS#12 and WS#15).

11.3.7 Step 7: Develop the Plan for Obtaining the Data

To develop a sample design that addresses the DQOs defined in Steps 1 through 6, the following design aspects are required: (1) definition of background populations(s) that need to be characterized, (2) the number of samples required to characterize each population(s); (3) the locations that will be sampled, and (4) the methodologies for sampling and analysis. The design aspects are described in more detail below.

11.3.7.1 Definition of Background Population(s)

In Step 1, it was recognized that soil types and lithology may influence background metal concentrations. Establishing Site-specific background concentrations for each combination of soil and lithology could result in an overly complex process, where background populations are so specific that the corresponding Site sample sizes would decrease and result in low statistical power for background comparisons. It is therefore critical to appropriately define the background population(s) to allow meaningful comparison to Site data.

The degree to which soil types and lithology influence metals concentrations was evaluated using recent Site data from the Phase 1A DMA and the Phase 1A RI (collectively referred to as “Phase 1A samples”). Data were only used from PRI areas that could be assumed to not be directly impacted by waste releases from the Site, i.e., PRI Areas 11 through 16. The first step in the evaluation is to identify the soil and lithologic factors so that meaningful physical characteristics can be used to delineate Site-specific background sampling groups. As identified on Figure 11-9, the lithology of the Site falls into three main categories:

Ql – Surficial Quaternary Lake Bonneville deposits

Qs – Surficial Quaternary mud and salt flat deposits, associated with the lake bed of the GSL

Other[8] - Quaternary alluvium and colluvium (Qa) and consolidated rock in the Lakeside Mountains (C1, C2, C3, D, O, and S)

The main soil types at the Site are identified on Figure 11-10 and include:

Playas-Saltair – associated with the Lakebed of the GSL

Amtoft-Rock

Dynal – Oolitic sand deposits

Skumpah

Yenrab

Other[9]

Understanding how soil and lithology are co-located is meaningful so that background Sampling Areas can be established. To this end, the number of Phase 1A samples that were collected in each lithology and soil type were tallied across PRI Areas 11 through 16. As samples were randomly located with respect to any underlying pattern in soil type/lithology, the number of samples serves as a proxy for the prevalence of each soil type (Table 11-2) and lithology (Table 11-3) type in areas of interest for risk assessment. The intersection of soil and geologic types is provided in Table 11-4.

These tallies show that the Qs geologic type largely comprises the Playas-Saltair soil type and falls primarily into PRI Areas 13 and 14. These PRI areas are within the “Lakebed” setting of the bed of the GSL. The Dynal, Skumpah and Yenrab soil types fall primarily or entirely within the Ql geologic type which largely corresponds to PRI Areas 11, 12, and 15. These PRI areas are considered to be in an “Upland” setting, as they are located outside of the bed of the GSL. The “Other” soil and geologic types tend to be associated with the Lakeside Mountains in PRI Area 16, and are therefore also considered to be in an “Upland” setting. Based on these tallies, the distinct lithologic/soil groupings at the Site can be generally divided into two settings, Lakebed and Upland, with Lakebed corresponding to PRI Areas 13 and 14 and Upland corresponding to PRI Areas 11, 12, 15, and 16.

Statistical Support for Site-Specific Background Areas

Ordination and multivariate statistical techniques can be used to determine whether the metals composition differs significantly based on grouping variables (e.g., soil type, lithology, or PRIs). These techniques describe the relative similarity of metals composition for samples from similar versus different groups. To mitigate other confounding factors associated with the use of the Phase 1A data from PRI Areas 11-16, samples with known anomalies and/or Site-related impacts were removed from these analyses. Excluded locations were as follows:

- Phase 1A RI samples PRI12-010 and -011 were collected on salt waste piles, not in soil; and
- Phase 1A RI samples PRI14-002 through -008 had suspected Site-related impacts, as evidenced by elevated concentrations of D/Fs, total PCBs, and/or HCB.

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[8] Insufficient samples were collected from each of these geologic types for them to be considered individually.

[9] The “other” soil types include the Checkett, Hiko Peak, Medburn, Puts, and Timpie-Tooele. Insufficient samples were collected from each of these soil types for them to be considered individually.

NMDS is a non-parametric ordination technique that plots sampling locations relatively closer together if they have similar metals composition or farther apart if they are more dissimilar. The groupings on an NMDS plot can then be further defined by plotting 95% confidence ellipses around the centroid of each group of interest (McCune and Grace 2002). Overlapping confidence ellipses suggest metals composition between groups is indistinguishable, whereas non-overlapping confidence ellipses suggest that groups are distinct.

An NMDS plot was generated on a PRI Area basis since these groups seem to best capture both soil and geology (Figure 11-11). The Lakebed background population (PRI Area 13 and PRI Area 14) clusters together. Similarly, the Upland background population (PRI Areas 11, 12, 15, and 16) clusters together. The Upland and Lakebed background populations are supported by visual assessment with an NMDS plot (Figure 11-12) as well as with multivariate hypothesis testing[10] (perMANOVA F-statistic = 33.0, R^2 = 0.30, p-value = 0.001).

<u>Characterization of Upland and Lakebed</u>

While the NMDS and perMANOVA demonstrate that the Lakebed and Upland settings have distinct metals composition, they do not describe how background populations are different on a metal-by-metal basis. A t-test (used for normally distributed data) or Wilcoxon Rank Sum test (used for all other distribution types) was used to compare the metals concentrations in the Lakebed and Upland samples (EPA 2010). Comparison results are presented in Table 11-5. A Bonferroni correction (Zar 1999) was made to control for the family-wise Type I error rate[11] since multiple comparisons were made on the same set of samples. The accompanying boxplots (Attachment 1) show that the Upland area has significantly higher beryllium, chromium, iron and lead compared to the Lakebed. The two groups do not significantly differ for any other metals concentrations.

<u>Conclusions</u>

Multiple lines of evidence including ordinations, multivariate tests, and pair-wise test, support characterizing background using Lakebed and Upland settings to capture variability due to soil and lithology type: A summary of each setting's dominant characteristics are presented in Table 11-6. Based on these results, two background populations will be characterized: Upland setting and Lakebed setting. Each background population will then be compared to the appropriate PRI area. For example, the Upland background dataset will be compared to PRI Areas 1 through 6, 8 through 12, and 15 and 16, while the Lakebed background dataset will be compared to PRI Areas 7, 13, and most of 14.

Characterizing Upland and Lakebed background populations will also be relevant to the biotic sampling. As both Upland and wetland species will likely be targeted for biotic sampling in Phase 2, characterizing both Lakebed (relevant to wetland) and Upland background populations will support the identification of relevant candidate reference locations for the Upland and wetland biotic sampling effort.

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[10] perMANOVA (<u>per</u>mutation <u>m</u>ultivariate <u>an</u>alysis <u>o</u>f <u>va</u>riance) is a non-parametric version of a MANOVA that complements the descriptive NMDS plots. While samples from certain groups may visually segregate on an NMDS plot, the perMANOVA helps determine whether these groups are statistically distinct and how much variance they explain. Thus, the perMANOVA can more rigorously test for differences among groups by offering a p-value, F-statistic, and R^2.

[11] The desired significance level for the whole family of tests was $\alpha = 0.05$, so the Bonferroni correction tests each individual hypothesis at a significance level of α/n. In this case, 21 metals are compared, with a desired $\alpha = 0.05$, so the Bonferroni correction tests each individual hypothesis at $\alpha = 0.05/21 = 0.0024$.

11.3.7.2 Background Sample Size Estimation

Background dataset sample sizes need to be large enough to ensure sufficient power in the comparative statistical testing. Sample sizes were calculated using VSP v7.2 (http://vsp.pnnl.gov/). Details on this procedure are presented below.

Data Treatment

The Phase 1A data were used as proxies to characterize anticipated variability and statistical distribution expected in background data. For metals, the standard deviation, mean, and the distribution of the Phase 1A data were calculated for each metal in the Lakebed and Upland datasets (as described in Section 11.3.7.1). For organics, the standard deviation, mean and the distribution of the TEQ, total PCBs and HCB datasets from PRI Areas 11 through 16 were used to represent conditions in the background population. The following additional data treatments were used for organic data from PRI Areas 11 through 16:

- Consistent with the metals approach, samples assumed to be impacted in PRI Area 14 were excluded (PRI Area 14-002 through 008) as were salt pile samples from PRI Area 12 (PRI Area 12-010 and 011).

- In addition to the above, any sample result that exceeded refined risk-based ecological screening levels from the Revised Draft Inner PRI SLRA Report (ERM 2015) were excluded, to eliminate other samples that were potentially impacted by organics (performed for each organic compound independently).

- HCB had a high proportion of non-detect values (59%), which was disproportionately influencing variability. Non-detect values were removed from the dataset to better represent natural variability. D/F TEQs and total PCBs were both 100% detected.

- The remaining PRI Area data were pooled into a single dataset (Upland and Lakebed segregation is not applicable to organics).

- D/F TEQs were calculated excluding dioxin-like co-planar PCB congeners and HCB, as PCBs and HCB were evaluated independently.

Standard deviations were calculated using ProUCL to represent the natural variability in background metals and organics. Each dataset's distribution was also tested using ProUCL and identified as being normal, lognormal, gamma, or nonparametric. These parameters are presented in Tables 11-7, 11-8 and 11-9 and were used to calculate sample sizes in VSP.

Sample Size Calculations

VSP was used to calculate samples sizes using the "Comparison Average to Reference Average" module. For each metal sample, sizes were calculated for Lakebed and Upland datasets independently, and for organics using the PRI Areas 11 through 16 pooled dataset. Sample sizes were calculated based on the following performance criteria to ensure that future statistical evaluations using the background datasets have acceptable power:

- $\alpha = 0.05$ – The probability of committing a Type I error was set to one-half of the performance criteria described in Section 11.3.6.1. This was selected to add an additional level of conservatism to the sample size calculation.

- β = 0.2 – The probability of committing a Type II error was set equal to the performance criteria described in Section 11.3.6.1.

- S (Minimum Detectable Difference [MDD] or Δ) –The MDD is the smallest difference of interest that the test is intended to detect. For this evaluation the MDD is set at 50% of the mean concentration of Phase 1A and DMA data from PRIs assumed to not be impacted by the facility (See Section 11.3.7.1). A MDD of 50 percent of the mean was selected to balance conservatism with preventing the generation of large sample size that are infeasible to collect and is consistent with EPA (2002b) guidance.

The choices of α and β presented above are needed to estimate sample size, but do not guarantee that the risk of Type I and Type II decision errors will be within tolerance limit goals. This determination can only be made during the data adequacy assessment after the data are collected (see Worksheet #37).

It was recognized that the datasets contain a broad range of variability, and that this variability drives a broad range of potential sample sizes. Some of the variability in metals data appeared to be driven by the presence of outliers. Statistical outlier testing using ProUCL was conducted to determine if individual metals contained suspect samples that may not be representative of background concentrations. In the Upland dataset, metals that had the highest variability also tended to have more statistical outliers (Table 11-8). This pattern was not observed in Lakebed samples (Table 11-7). High levels of non-detects also appear to drive variability in the Upland dataset (Table 11-8), but not the Lakebed dataset (Table 11-7). While the presence of outliers and high frequency of non-detects impact variability, to be conservative, no outliers were removed from the datasets used to calculate standard deviations.

Potential metal sample sizes for Lakebed and Upland media were tabulated and ranked from lowest to highest (Tables 11–7 and 11-8). The range of metal sample sizes was also plotted as bar charts for visual inspection (Figure 11-14). The sample size calculations for organics were tabulated separately from metals (Table 11-9), as background D/Fs, PCBs, and HCB are not expected to be influenced by soil type or lithology. However, once the data are collected, this assumption will be evaluated by comparing the levels of organic COPCs in Lakebed and Upland background samples. If there are differences, and if the existing datasets are not sufficient to allow reliable comparison of the Site to the appropriate background dataset, then additional sampling may be required in Phase 2.

To address the broad range of variability in compounds and its effect on potential sample sizes, the sample size that falls to the right of the median of the distribution of potential metal sample sizes calculated by VSP was selected as a reasonable number of background metal samples to collect during Phase 1A-B. Because there were only three sample sizes for organics, the median sample size was selected.

As shown in Table 11-7, the Lakebed dataset had potential sample sizes ranging from 8 to 92, with a median of 25 to 26 samples. The sample size above the median is 29 samples. The Upland dataset had potential sample sizes ranging from 5 to 599, with a median between 14 and 17 samples (Table 11-8). Thus, 17 samples was chosen as a reasonable sample size for the Upland setting.

To add an additional level of conservatism and make sample collection consistent across the Lakebed and Upland datasets, the higher of the two datasets (29) was rounded to 30 and selected as the number of samples that will be collected from each setting (i.e., 30 Lakebed and 30 Upland samples). These 30 samples will be spread among the locations identified in the next section.

As noted in Table 11-9, the organics dataset had potential sample sizes ranging from 24 to 51, with a median of 34 samples. This median value was rounded up to 36, so that it could be divided equally between three Lakebed and three Upland Sampling Areas (six samples per area; Section 11.3.7.4).

11.3.7.3 Background Sampling Locations

Reference locations for background sampling will be selected based on their appropriateness for characterizing naturally occurring concentrations of metals and ambient concentrations of organic chemicals in abiotic and biotic media. Background soil and sediment samples will be collected during the Phase 1A-B sampling effort in three locations of Upland and Lakebed habitats, respectively. The reference locations will also support the Phase 2 biotic sampling effort.

It is envisioned that biota collections will likely focus on bird eggs, plants, invertebrates, and small mammals that are found both within the Site boundaries and in reference locations. Based on historical survey data and conversations with biologists familiar with the Site, bird egg collections will likely focus on the horned lark for the Upland habitat and snowy plover and/or American avocet for Lakebed habitat (John Cavitt, Ph.D., pers. comm.). Using literature-based foraging ranges, reference locations will be located far enough from the Site to ensure nesting birds in the reference locations are not foraging within the 5-mile radius of the plant that defines the RI/FS Study Area. For Upland habitats, the territory size for the horned lark was reported as 1.3 to 2.7 hectares[12]; territories for this species are used for courtship, nesting, and feeding (Wiens et al. 1986). For Lakebed habitats, American avocet was observed foraging 130 meters from the nest (Gibson 1971), while the snowy plover forages an average of 272 meters[13] from the nest[14] (Paton 1995).

<u>Selection Criteria</u>

Candidate reference locations for Upland habitat will be evaluated using the following criteria: (1) located beyond the 5-mile radius of the Site (at least 500 feet from the edge of the 5-mile radius to ensure the horned lark is not foraging within the RI/FS Site boundary), (2) contains minimally disturbed intermountain basin (IMB) greasewood flat or annual invasive grassland land cover, (3) collection of bird eggs (e.g., horned lark), small mammals, plants, and invertebrates is very likely; and (4) accessible for sampling.

Candidate reference locations for Lakebed habitat will be evaluated using the following criteria: (1) located beyond the 5-mile radius of the Site (located at least 1,000 feet from the edge of the 5-mile radius to ensure the snowy plover and American avocet are not foraging within the RI/FS Site boundary), (2) contains minimally disturbed IMB playa land cover, (3) collection of bird eggs (e.g., snowy plover and/or American avocet), plants, and invertebrates is very likely; and (4) accessible for sampling.

<u>Preliminary Selection of Candidate Locations</u>

Preliminary candidate areas were selected based on an understanding of Site conditions and conversations with local biologists (John Cavitt, Ph.D., pers. comm.). These areas are located on the west side of GSL to the north, south, and east of the Site as shown on Figure 11-15. The two Upland areas (Upland North and

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[12] Radius of a 2.7-hectare circle is 93 meters or 305.1 feet. Rounded to 500 for additional conservatism.

[13] Rounded to 1,000 feet for additional conservatism.

[14] The average distance reported in Paton (1995) is similar to site-specific observations from Cavitt (2010).

Upland South) contain IMB greasewood flat/annual invasive grassland and are located 500 feet from the Site boundary, which provides a conservative distance for horned lark to forage outside the Site. The three Lakebed areas (Lakebed North, Lakebed South, and Lakebed Southeast) contain IMB playa and are located 1,000 feet from the Site boundary, which provides a conservative distance for snowy plover and American avocet to forage outside the Site. The area to the north of the Site contains both Upland and Lakebed habitat that are bordered by the Utah Test and Training Range site boundary. Upland and Lakebed habitats to the south are located between the Site and Interstate 80. The candidate area to the east of the Site contains IMB playa on Badger Island, Stansbury Island, and along the southern portion of Stansbury Bay near the Timpie Springs Waterfowl Management Area. Three locations for Upland and Lakebed background samples were selected within these candidate areas.

A field trip was conducted in June 2015 during the 2015 bird nesting season (May–June) to evaluate the accessibility and likelihood of collecting biota samples within the Upland and Lakebed candidate areas shown in Figure 11-15. Whenever feasible, sampling locations were identified in candidate locations along the borders farthest from the Site. This was done to maximize the distance between Site and reference tissue organisms, and in particular birds.

The results from the field trip are documented in a Background/Reference Area Identification Technical Memorandum included as Attachment 11 to the Phase 1A-B SAP. The Technical Memorandum includes the following information:

- A narrative summary of the field trip and the findings.
- Final background locations for sediment and soil samples. Selected background locations will be shown in maps and coordinates will be provided.
- Copies of field notes.
- A photograph log.

11.3.7.4 Contingency Reference Location Samples

In the event that biological data cannot be collected from the six candidate reference locations described above (either from the absence of sufficient biological tissue or impacts traceable to the Site) a contingency reference tissue area may be utilized. The Bear River Migratory Bird Refuge (BRMBR) was identified as the contingency reference location (Figure 11-16). To confirm the contingency reference location is not impacted by Site-related contaminants, five samples will be collected from the BRMBR. These data will be assessed to confirm that they do not contain elevated concentrations of metals or organics. The contingency reference location will only be utilized during Phase 2 if insufficient reference tissue data can be collected from the candidate GSL reference locations.

The field trip to identify background locations included a visit to the BRMBR. The five sampling locations at BRMBR were identified during the field trip and these locations are included in the Background/Reference Area Identification Technical Memorandum included as Attachment 11 to the Phase 1A-B SAP.

11.3.7.5 Sample Collection and Laboratory Analysis Methodology

11.3.7.5.1 Surface Soil Sample Collection

As described above, background will be characterized for two populations: Lakebed and Upland. A sample size of 30 for metals and 18 for organics will be used for each population. The 30 and 18 samples will be distributed across three different locations in each population characterized (Upland and Lakebed). The three locations that will be selected will be representative of potential candidate reference areas where biotic sampling will be conducted in spring 2016. Therefore, there will be 10 metals and six organics sampling locations in each of the candidate areas.

Sampling will be performed following Site-specific SOPs for surface solids sampling (SOP *USM-01: Surface Soil, Sediment, and Waste Sampling*). Laboratory analyses will be performed following the SOPs and Project-Specific Work Instructions included in the Phase 1A-B SAP.

Specifically for the background characterization study, bulk surficial soils from 0 to 2 inches bgs will be targeted. As there is no reason to believe that metals concentrations vary significantly with soil depth, and the shallowest soil horizon is relevant to measure aerially deposited anthropogenic compounds such as D/Fs, PCBs, and HCB, shallow soils will be sampled. This sample depth is consistent with the Phase 1A SAP, which specified that surface samples be collected from the top 2 inches of material in PRI Areas where the only pathway for contaminant deposition is air deposition.

Characterization of background soils will only focus on the bulk fraction. If there is no important difference observed between Site and background bulk datasets, there is no reason to suppose an important difference might occur at the level of the fine fractions. For the Lakebed and Upland setting areas, all background surface soil samples will be analyzed for:

- Metals (EPA Methods 6010/6020/7471); and
- pH (EPA Method 9045D).

A subset of Lakebed and Upland setting areas background surface soil samples will also be analyzed for:

- D/Fs (EPA Method 8290);
- PCBs (EPA Method 1668);
- HCB (EPA Method 8270 with SIM confirmation); and
- TOC (EPA Method 9060).

All background soil samples from the BRMBR will be analyzed for metals, pH, D/Fs, PCBs, HCB, and TOC following the methods identified above. This will result in a total of 65 samples that will have metals and pH results (30 in Lakebed, 30 in Upland, and 5 at BRMBR) and 41 background samples (18 in Lakebed, 18 in Upland, and 5 at BRMBR) that will also include D/Fs, PCBs, HCB, and TOC results. As previously noted, the sample results will also provide confirmation that the candidate reference locations are not impacted by US Magnesium Site-related constituents.

11.3.7.5.2 Subsurface Soil Sampling and Analysis

In addition to the surface soil sampling described in the previous section, some soil sampling at depth will be performed at the reference locations to provide some Site-specific evidence that the reference locations do not have subsurface contamination. These subsurface samples are intended to help confirm that subsurface soil at reference locations does not contain anthropogenic contamination that is not present in surface soil (e.g., due to waste dumping or burial).

At each Sampling Area, including BRMBR, a subsurface sample will be collected from 2 inches to 3 feet bgs for analysis of HCB, PCBs, D/F, and total metals. The sample would be collected following SOP *USM-09, Subsurface Soil, Sediment, and Waste Sampling* using a portable flighted auger with soil sampling probe or a compressed-gas powered direct push corer. The subsurface sample would be co-located with a sample location near the center of each of the Sampling Areas, as identified in Attachment 11. The 3-foot sample depth was selected based on the shallow depth to groundwater within Lakebed areas and to be representative of the soil horizon over which most ecological receptors would be exposed.

Table 11-1. Geochemical Correlations

Metal/ Inorganic	**Potential Aqueous/Soluble Forms in the Environment**[a]	**Primary Sorptive Association**[b]	**Other Common Associations**[c]	**Association Description**
Predominantly Anionic Inorganics				
Antimony	Reduced Form - $Sb(OH)_3$ Oxidized Form - $Sb(OH)_6^-$	Fe	Mn, Al, S^{2-}	Sorption to iron, manganese and aluminum oxides and hydroxides, noncrystalline aluminosilicates. Precipitation of sulfide mineral under reducing conditions.
Vanadium	$VO_3(OH)^{2-}$, $VO_2(OH)_2^-$, $VO(OH)_3$, VO^{2+},	Fe	Mn, Al	Complexation with iron and manganese minerals, and formation of oxide minerals. Sorption to soil minerals
Arsenic	Reduced Form - $H_3AsO_3^o$, Oxidized Form - H_2AsO_4, $HAsO_4^{2-}$	Fe	Mn, Al, Ca, and S^{2-}	Sorption to iron and aluminum hydroxides, noncrystalline aluminosilicates, Fe and Ca precipitates. Precipitation of arsenic sulfides (AsS, As_2S_3 , As_4S_4) under reducing conditions.
Selenium	HSe^-, $HSeO_3^-$	Fe	Mn, Al, Ca, and S^{2-}	Sorption to iron and aluminum hydroxides, noncrystalline aluminosilicates, Fe and Ca precipitates. Precipitation of selenium sulfide mineral under reducing conditions.
Predominantly Cationic Inorganics				
Barium	Ba^{2+}	Al, SO_4^{2-}	Fe, Ca, Mn, SO_4^{2-}, CO_3^{2-}	Cationic sorption to soil minerals (clays), Precipitation of sparingly soluble sulfate ($BaSO_4$), and carbonate minerals ($BaCO_3$).
Cadmium	Cd^{2+}	Al	Fe, Ca, Mn, CO_3^{2-} , S^{2-}, PO_4^{3-}	Sorption to Fe/Mn/Al hydroxides and carbonate minerals; precipitation of sparingly soluble carbonates ($CdCO_3$), phosphate, and sulfide minerals.
Lead	Pb^{2+}, $PbCO_3$	Al	Fe, Mn, Ca, S^{2-}, SO_4^{2-}, PO_4^{3-}	Sorption to iron hydroxides, organic matter, noncrystalline aluminosilicates, carbonate minerals; formation of sparingly soluble carbonates ($PbCO_3$), phosphates, sulfides (PbS), sulfate ($PbSO_4$) minerals.
Zinc	Zn^{2+}	Al	Fe, Mn, Ca, CO_3^{2-}, S^{2-}	Sorption to Fe/Mn/Al hydroxides, noncrystalline aluminosilicates and carbonate minerals ($ZnCO_3$); formation of sulfide (ZnS) minerals under reducing conditions.
Copper	Cu^{2+} , Cu^+, $Cu(OH)^+$	Al	Fe, Mn, OM, Ca, CO_3^{2-}, S^{2-}	Sorption to Al/Fe/Mn oxides, noncrystalline aluminosilicates, organic matter and silicate clays; sparingly soluble carbonate, hydroxide, and sulfides (CuS, Cu_2S).

Iron	Fe^{+2}	OH and O	Ca, CO_3^{2-}, S^{2-}	Precipitation as oxidized ferrihydrite minerals (FeOOH), iron carbonates, precipitation as reduced iron sulfide (FeS)
Manganese	Mn^{2+}	OH and O	Ca, CO_3^{2-}	Formation of sparingly soluble oxide, hydroxide, and carbonate complexes
Mercury	Hg	Al	S^{2-}, Cl, OM	Formation of sparingly soluble sulfides (HgS); sorption to soil minerals and organic matter.
Beryllium	Be^{2+}, $BeOH^+$	Al	Fe, Mn	Sorption to negatively charged sites of clays and other soil minerals
Silver	Ag^+	Al	Fe, Mn, S^{2-}, SO_4^{2-}, CO_3^{2-}, PO_4^{3-}	Forms strong complexes with sulfides (AgS), halides, cyanides, and thiosulfates. Weaker complexes with arsenates, phosphates, sulfates, carbonates, and organic ligands
Thallium	Tl^{3+}, Tl^+	Al	Fe, Mn	Thallium oxide formation (Tl_2O_3) and sorption to soil minerals.
Inorganics that May Be Both Predominantly Cationic and Anionic				
Cobalt	Co^{2+} $HCoO^{2-}$	Al, Fe	Mn, CO_3^{2-}, Ca, Ni, OM	Sorption to Al/Mn/Fe hydroxides, organic matter, carbonate minerals ($CoCO_3$).
Nickel	Ni^{2+}, $Ni(OH)_3^-$, $Ni(OH)_2$	Fe, Al,	Mn, Co, Mn, S^{2-}	Sorption to Fe/Mn/Al hydroxides and noncrystalline aluminosilicates; precipitation of nickel sulfide. Nickel also has similar properties to cobalt and may be associated with cobalt in areas of weathered basalt or similar rocks.
Chromium	Oxidized Forms - CrO_4^{2-}, $HCrO_4^-$ Reduced forms - $CrOH^{2+}$ Cr^{3+}	Fe, Al	Mn	Sorption to Fe/Al/Mn hydroxides, organic matter, noncrystalline aluminosilicates; formation of sparingly soluble hydroxides

Table 11-2. Number of Samples from PRIs 11 - 16 in each Soil Class

PRI	Amtoft-Rock	Dynal	Playas-Saltair	Skumpah	Yenrab	Other
PRI-11	0	0	0	9	5	0
PRI-12	0	9	0	0	3	0
PRI-13	0	0	14	0	0	0
PRI-14	0	3	5	0	0	1
PRI-15	0	1	0	3	5	6
PRI-16	9	0	0	0	0	5

Table 11-3. Number of Samples from PRIs 11 - 16 in each Geologic Type

PRI	Ql	Qs	Other
PRI-11	14	0	0
PRI-12	12	0	0
PRI-13	0	14	0
PRI-14	1	8	0
PRI-15	12	3	0
PRI-16	6	0	8

Table 11-4. Number of Samples that Appear in each Soil-Geologic Type Combination

Soil Type	**Ql**	**Qs**	**Other**
Amtoft-Rock	2	0	7
Dynal	10	3	0
Playas-Saltair	0	19	0
Skumpah	11	1	0
Yenrab	13	0	0
Other	9	2	1

Table 11-5. Pair-wise Tests Comparing Individual Metals Concentrations between Upland and Lakebed Areas

Analyte	N	Distribution	Test Method	p-value	Significant[a]
Aluminum	78	Lognormal	WRS	0.171	
Antimony	78	Lognormal	WRS	0.055	
Arsenic	78	NDD	WRS	0.029	
Barium	78	Normal	t-test	0.055	
Beryllium	78	Normal	t-test	0.000	Significant
Calcium	78	Lognormal	WRS	0.059	
Cadmium	78	NDD	WRS	0.113	
Chromium	78	Normal	t-test	0.000	Significant
Cobalt	78	Lognormal	WRS	0.033	
Copper	78	Normal	t-test	0.079	
Iron	78	Normal	t-test	0.000	Significant
Lead	78	Normal	t-test	0.000	Significant
Manganese	78	Lognormal	WRS	0.135	
Mercury	78	NDD	WRS	0.227	
Molybdenum	78	Lognormal	WRS	0.113	
Nickel	78	Lognormal	WRS	0.174	
Selenium	78	NDD	WRS	0.153	
Silver	78	NDD	WRS	0.094	
Thallium	78	NDD	WRS	0.016	
Vanadium	78	Normal	t-test	0.004	
Zinc	78	Normal	t-test	0.093	

Notes

[a] Significance is based on a Bonferroni-corrected p-value of 0.0024

Table 11-6. Summary of Characteristics of each Background Area

Characteristic	**Lakebed**	**Upland**
PRIs	13 & 14	11, 12, 15 & 16
Dominant Geology	Qs	Ql & ‘Other’
Dominant Soil type	Playa-Saltair	Dynal, Skumpah, Yenrab, & ‘Other’
Beryllium, chromium, iron and lead	Lower concentrations	Higher concentrations

Table 11-7. Summary of Calculated Datasets for Lakebed Soil

Metal	**Percent not detected**	**Mean (mg/kg)**	**Standard Deviation (mg/kg)**	**CV**	**Number of outliers**	**□[a] (mg/kg)**	**Distribution**	**Sample Size[b] (n)**	**Rank**
Barium	0%	227	84.9	0.37	1	114	Normal	8	1
Cadmium	65%	0	0.0	0.37	0	0.0	Normal	9	2
Lead	0%	9	3.9	0.45	0	4.4	Normal	11	3
Arsenic	0%	9	4.2	0.47	1	4.5	Gamma	14	4
Antimony	17%	0	0.2	0.56	1	0.2	Gamma	16	5
Mercury	65%	0	0.0	0.47	0	0.0	Lognormal	16	6
Selenium	70%	0	0.1	0.51	0	0.1	Normal	16	7
Zinc	0%	31	18.4	0.60	0	15.5	Normal	21	8
Vanadium	0%	13	8.4	0.65	0	6.5	Lognormal	24	9
Copper	0%	6	3.6	0.62	0	2.9	Normal	25	10
Manganese	0%	138	97.9	0.71	0	69.2	Lognormal	29	12
Chromium	0%	7	4.9	0.76	0	3.3	Lognormal	31	13
Beryllium	0%	0	0.2	0.82	0	1.3E-01	Lognormal	33	14
Calcium	0%	209000	161606.0	0.77	1	104500	NP	34	15
Cobalt	0%	2	1.7	0.74	0	1.1	Lognormal	34	16
Aluminum	0%	5415	4299.0	0.79	0	2708	Lognormal	35	17
Iron	0%	5445	4276.0	0.79	0	2723	Lognormal	35	18
Nickel	0%	6	4.6	0.81	0	2.8	Lognormal	38	19
Molybdenum	43%	0	0.5	1.23	1	0.2	Lognormal	92	20
Silver	100%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Thallium	100%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Notes

[a] Grey area (equivalent to the maximum detectable difference) is defined as 50% of the mean

[b] Calculated in VSP using the “Compare Average to Reference Average”

The median potential sample sizes is highlighted in blue

The calculated sample size directly to the right of the median is highlighted in purple

N/A = Not applicable because metal was not detected

Table 11-8. Summary of Calculated Datasets for Upland Solid Media

Metal	**Percent not detected**	**Mean (mg/kg)**	**Standard Deviation (mg/kg)**	**CV**	**Number of outliers**	**☐[a] (mg/kg)**	**Distribution**	**Sample Size[b] (n)**	**Rank**
Vanadium	0%	17.6	5.1	0.29	1	8.8	Lognormal	5	1
Beryllium	0%	0.44	0.15	0.35	0	0.2	Normal	7	2
Chromium	0%	10.8	3.78	0.35	0	5.4	Normal	7	3
Iron	0%	9605	3270	0.34	0	4803	Normal	7	4
Lead	0%	14.5	5.6	0.39	0	7.3	Normal	8	5
Nickel	0%	8.35	3.37	0.40	1	4.2	Normal	9	6
Aluminum	0%	9397	3454	0.37	0	4699	NP	10	7
Cobalt	0%	3.4	1.4	0.42	1	1.7	Normal	10	8
Barium	0%	186	86.7	0.47	0	92.8	Normal	12	9
Cadmium	4%	0.31	0.14	0.45	0	0.2	NP	14	10
Manganese	0%	297	137	0.46	0	148.6	Lognormal	14	11
Arsenic	0%	5.36	2.81	0.52	2	2.7	NP	17	12
Calcium	0%	91809	48632	0.53	1	45905	Lognormal	17	13
Zinc	0%	49.1	49.4	1.01	1	24.5	NP	49	15
Mercury	22%	0.02	0.02	1.02	4	0.0	NP	54	16
Selenium	49%	0.15	0.15	1.01	0	0.1	Gamma	58	17
Copper	0%	16.5	28.5	1.73	2	8.2	NP	154	18
Silver	78%	0.02	0.04	2.13	1	0.0	NP	199	19
Thallium	80%	0.03	0.06	2.08	0	0.0	NP	446	20
Antimony	45%	0.34	1.15	3.39	4	0.2	NP	599	21
Molybdenum	13%	1.12	3.83	3.40	2	0.6	NP	599	22

Notes

[a] Grey area (equivalent to the maximum detectable difference) is defined as 50% of the mean

[b] Calculated in VSP using the “Compare Average to Reference Average”

The median potential sample sizes is highlighted in blue

The calculated sample size directly to the right of the median is highlighted in purple

Table 11-9. Summary of Calculated Datasets for Organics in Solid Media

Metal	**Percent not detected**	**Mean (mg/kg)**	**Standard Deviation (mg/kg)**	**CV**	**☐[a] (mg/kg)**	**Distribution**	**Sample Size[b] (n)**	**Rank**
D/F TEQs [c]	0%	6.3E-04	4.4E-04	6.9E-01	3.2E-04	Normal	24	1
Total PCBs	0%	862	668.3	0.78	431	Lognormal	34	2
Hexachlorobenzene	0%	21.7	20.98	0.97	10.8	Gamma	51	3

Notes

[a] Grey area (equivalent to the maximum detectable difference) is defined as 50% of the mean

[b] Calculated in VSP using the “Compare Average to Reference Average”

[c] Avian TEQ used as it had higher variability than the mammalian TEQ

D/F TEQ = Dioxin/Furan Toxic Equivalency

The median potential sample size is highlighted in blue

SECTION D: SAMPLING AND ANALYSIS

SAP WORKSHEETS #12-21

12.0 MEASUREMENT PERFORMANCE CRITERIA TABLE (SAP WORKSHEET #12)

QC Sample	Analytical Group	Minimum Frequency	Data Quality Indicators (DQI)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Field Duplicate	PCB, D/F, SVOC, PAH, TOC, VOC, Perchlorate, Metals, pH, Cyanide	10%	Precision-Overall	Metals, cyanide, TOC: Relative percent difference (RPD) ≤ 35% if results > 5 x Practical quantitation limit (PQL) ±2 x PQL if results < 5 x PQL Organics: RPD ≤ 50% if results > 5 x PQL ±2 x PQL if results < 5 x PQL	S&A
Matrix Spike (MXS) and Matrix Spike Duplicate (MSD) [a]	Cyanide, Perchlorate, Metals	5%	Precision and Accuracy	Percent recoveries (%R) and RPDs are identified in the laboratory SOPs. If no RPD is specified, a default RPD of ≤ 50 shall be used. If no %R is specified, a default %R of 70-130 shall be used	S&A
Lab Duplicate	PCB, D/F, SVOC, PAH, VOC, Perchlorate, Metals, TOC, pH, Cyanide	5%	Precision	Metals, cyanide, TOC: RPD ≤ 35% if results > 5 x PQL ±2 x PQL if results < 5 x PQL Organics: RPD ≤ 50% if results > 5 x PQL ±2 x PQL if results < 5 x PQL	A
Lab Control Sample (LCS)	PCB, D/F, SVOC, PAH, VOC, Perchlorate, Metals, Cyanide, TOC	5%	Accuracy	Metals, cyanide, perchlorate, SVOC, PAH, VOC, TOC: per Method PCB, D/F, HCB: Percent recovery 50%-150%	A

QC Sample	Analytical Group	Minimum Frequency	Data Quality Indicators (DQI)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Equipment Rinsate Blank[b,e]	PCB, D/F, SVOC, PAH, VOC, Perchlorate, Metals, Cyanide	1 per week per type of non-dedicated equipment used	Accuracy/ Contamination	No target compounds > PQL, except for methylene chloride, acetone, and 2-butanone, which must be less than 2 times (2x) their respective PQLs and bis(2-ethylhexyl)phthalate, which must be less than five times (5x) its PQL	S
Source Blank[c,e]	PCB, D/F, SVOC, PAH, VOC, Perchlorate, Metals, Cyanide	1 per source of water	Accuracy/ Contamination	No target compounds > PQL, except for methylene chloride, acetone, and 2-butanone, which must be less than 2 times (2x) their respective PQLs and bis(2-ethylhexyl)phthalate, which must be less than five times (5x) its PQL	S
Method Blank	PCB, D/F, SVOC, PAH, VOC, Perchlorate, Metals, Cyanide	1 per laboratory batch	Accuracy/ Contamination	No target compounds > PQL, except for methylene chloride, acetone, and 2-butanone, which must be less than 2 times (2x) their respective PQLs and bis(2-ethylhexyl)phthalate, which must be less than five times (5x) its PQL	A
Trip Blank[d,e]	VOC	1 per cooler	Accuracy/ Contamination	No target compounds > PQL, except for methylene chloride, acetone, and 2-butanone, which must be less than 2 times (2x) their respective PQLs and bis(2-ethylhexyl)phthalate, which must be less than five times (5x) its PQL	S

Notes:

a. Matrix spike (MXS) and matrix spike duplicate (MSD) samples will be analyzed for inorganics only. Per the UFP-QAPP QA/QC Compendium (EPA 2005b), MXS are for useful for inorganics but not for organics. Surrogate spikes identify matrix effects for organic analyses.
b. Equipment rinsate samples will be collected at a frequency of one per week per type of non-dedicated sample collection equipment used. Deionized water will be poured over or through the equipment into a sample container and sent to the laboratory for analysis. The equipment rinsate will allow for verification that the decontamination procedures were appropriately performed. Equipment rinsates are not needed for samples collected using dedicated equipment.
c. One source water blank will be collected for each source of deionized water used to decontaminate the soil and groundwater equipment and collect rinsate blank samples. The source-water blank sample will verify that the water used for decontamination was analyte free. If an analytical group is not detected in an equipment blank > PQL [or two times (2x) the PQL for methylene chloride, acetone, or 2-butanone or five times (5x) the PQL for bis(2-ethylhexyl) phthalate], then source blank analysis for that analytical group is not required.
d. A trip blank demonstrates that contamination is not originating from sample containers or from any factor during sample transport. A trip blank originates at the laboratory as a 40-milliliter vial typically used for analysis for VOCs. The vial is filled at the laboratory with reagent-grade, organic-free water. The trip blanks are then transported to the Site with the empty containers that will be used for sample collection. The trip blanks are stored at the Site until the proposed field samples have been collected. One trip blank will accompany back to the laboratory each sample transport container that holds samples for analysis for VOCs. The trip blank is not opened until it is returned to the laboratory.
e. See September 2013 Phase 1A SAP (EPA 2013) for measurement performance criteria for aqueous samples.

13.0 SECONDARY DATA CRITERIA AND LIMITATIONS (SAP WORKSHEET #13)

Secondary data consist of information generated historically at the Site by past investigators or data from other sources that are relevant to attainment of project objectives. Secondary data considered in the development of the Phase 1A-B Study design are summarized below, along with an assessment of the potential limitations to reliance on the data.

Type of Source (reports, databases, articles)	Data Source (report title, and date)	Data Generator(s) (originating organization, data types, data generator and collection dates)	How Data Were/Will Be Used	Limitations on Data Use
Historical environmental concentration data	Multiple - see September 2013 Phase 1A RI SAP WS10	Multiple - see September 2013 Phase 1A RI SAP WS10	Historical data were used to provide an initial list of the primary types of Site-related contaminants that may be released on Site, and the approximate spatial pattern of contamination.	Some historical data are not well documented. In addition, even if the data are well documented and of adequate analytical quality, they may not be representative of current Site conditions. Also, data are limited or absent for some chemicals of potential interest. Consequently, COPC selection will be based on Phase 1A-B data.
Current project environmental data	Phase 1A Laboratory DMA (ERM 2013a) and Draft Phase 1A Data Report for PRI Areas 2 and 8–17 (ERM 2014d)	US Magnesium: metals and organic chemistry	Used to estimate the variability and distribution of background metals and organics (D/Fs, PCBs, and HCB)	Data were collected on Site. While the data were filtered to remove samples obviously impacted by the Site, these data may exhibit higher variability than actual background concentrations collected off Site.

Type of Source (reports, databases, articles)	Data Source (report title, and date)	Data Generator(s) (originating organization, data types, data generator and collection dates)	How Data Were/Will Be Used	Limitations on Data Use
Regional background datasets and studies	Hill Air Force Base Utah Test and Training Range (UTTR) background dataset (URS 2004); Historical Site background dataset (Paramatrix 2004); and Front Range Ambient Dioxin study (EPA 2002a)	US Air Force; US Magnesium; and EPA	Data will be used provide context to, and evaluate the data collected for the Background DQO.	Data are not available for many metals. Front range study is dioxin fingerprint data, which can be subjective.
Report	Presence and Relative Abundance of Birds at the Old Waste Pond and Vicinity, Breeding Season. 2006.	BIO-Logic Environmental, observations of biota	Observations of horned lark, American avocet, and snowy plover nests at the US Magnesium facility were used to determine target bird species for background biota sampling.	Observations were made in 2006 and may not be representative of nesting birds currently at the Site.
Report	US Magnesium Avian Studies 2008. US Magnesium Avian Studies 2010.	Avian Ecology Lab, Weber State University (authored by J. Cavitt), observations of biota	Observations of horned lark, American avocet, and snowy plover nests at the US Magnesium facility were used to determine target bird species for background biota sampling.	Observations were made in 2008 and 2010 and may not be representative of nesting birds currently at the Site.
Article	A lesson in the limitations of field experiments: shrubsteppe birds and habitat alteration. 1986.	Ecological Society of America (authored by J. Wiens, J. Rotenberry, and B. Van Horne), foraging range observations	Foraging range of horned lark was used to determine minimum distance between reference area and RI/FS Study Area.	Observations of the horned lark foraging range were made in central Oregon and may not be representative of the foraging range around the western side of the GSL.
Article	The breeding biology of the American Avocet (*Recurvirostra americana*) in central Oregon. 1971.	The Condor (authored by F. Gibson), foraging range observations	Foraging range of American avocet was used to determine minimum distance between reference area and RI/FS Study Area.	Observations of the American avocet foraging range were made in central Oregon and may not be representative of the foraging range around the western side of the GSL.

Type of Source (reports, databases, articles)	Data Source (report title, and date)	Data Generator(s) (originating organization, data types, data generator and collection dates)	How Data Were/Will Be Used	Limitations on Data Use
Article	Breeding biology of snowy plovers at Great Salt Lake (GSL), Utah. 1995.	The Wilson Bulletin (authored by Paton), foraging range observations	Foraging range of snowy plover was used to determine minimum distance between reference area and RI/FS Study Area.	Observations of the snowy plover foraging range were made in areas along the eastern side of GSL and may not be representative of the conditions along the western side of the GSL.
Report	Final Inner PRI Data Report (ERM 2014a)	Compilation of available chemistry data for Inner PRI areas	Historical Inner PRI area data will be included in chemical concentration maps and geostatistical evaluations for preliminary N&E evaluation in Phase 1A-B Data Report.[1]	Limitations of historical data are described in the report.

1. Relevance of historical data maps will be determined based on the degree to which historical data are deemed to be representative of current Site conditions.

14.0 SUMMARY OF PROJECT TASKS (SAP WORKSHEET #14)

As stated in WS#11, the objective of the Phase 1A-B RI is to obtain sufficient data to support:

1. Reliable identification of COPCs for human and ecological receptors within PRI Areas 1 and 3 through 7.
2. Initial risk calculations to evaluate whether sufficient data have been collected within PRI Areas 1 and 3 through 7 to support confident risk characterization.
3. Preliminary evaluation of the N&E of Site-related impacts within PRI Areas 1 and 3 through 7.
4. Estimation of background (ambient) concentrations for metals and organics including D/Fs, total PCBs and WHO congeners, and HCB.
5. Identification of suitable reference areas (i.e., non-impacted areas) for biota sampling that may be conducted during 2016 Phase 2 RI activities.

Specific project tasks required in order to achieve this objective are described below. Project tasks include:

- Sampling
- Analysis
- Quality control
- Secondary data
- Data management
- Documentation and records
- Assessments/audits
- Data review
- Reporting

The general sampling rationale and the required analytical testing are discussed in WS#11. Detailed rationale for the Phase 1A-B sampling locations is described in WS#11 and WS#17. Sampling locations are shown inWS#11 Figures 11-2 through 11-7.

The EPA will conduct independent split sampling as described in their oversight-planning document(s). The collection and analysis of split samples by EPA are not discussed in this SAP.

14.1 SAMPLING TASKS

Pre-sampling startup tasks include a background/reference Sampling Area reconnaissance, cultural resources survey, and subsurface utilities clearance. Tasks associated with sampling include surface solids sampling, subsurface solids sampling, sampling location surveying, management of investigation-derived waste (IDW), and equipment decontamination.

14.1.1 Background/Reference Sampling Area Reconnaissance

A field trip was conducted during the 2015 bird nesting season (1 to 4 June 2015) to evaluate the accessibility and likelihood of collecting biota samples within the Upland and Lakebed candidate areas shown in WS#11, Figure 11-15. Whenever feasible, sampling locations were identified in candidate locations along the borders farthest from the Site. This was done to maximize the distance between Site and reference tissue organisms, and in particular birds. The results from the field trip will be documented in a Background/Reference Area Identification Technical Memorandum, which will be included as Attachment 11 to the Phase 1A-B SAP. The Technical Memorandum will be submitted for EPA review and approval as an SAP Modification and will include the final background locations for sediment and soil samples, including sampling locations at the BRMBR.

14.1.2 Cultural Resources Survey

Pursuant to Title 36, Section 800 of the Code of Federal Regulations (CFR) and Utah Code Annotated 9-8-404, a cultural resources survey will be completed for any sampling locations located on United States Bureau of Land Management (BLM) or State of Utah School and Institutional Trust Land Administration (SITLA) lands. This requirement is potentially applicable for background/reference area sampling locations only; all sampling locations at Inner PRI Areas are located on property owned by US Magnesium. The cultural resources survey will be conducted by a BLM-certified professional archaeologist of Logan Simpson Design, Inc., under subcontract to ERM. The archaeologist will be accompanied by ERM during the cultural resources surveying field activities. A report documenting the cultural resources survey will be submitted to the BLM (lead agency) and the Utah State Historic Preservation Office for review. Approval to proceed from BLM is required before performing any ground disturbance on BLM or SITLA lands.

14.1.3 Underground Utilities

Subsurface utilities will be cleared at all ground disturbance locations before performing intrusive sampling activities. All clearances needed for borehole drilling will be obtained in accordance with ERM’s Global Subsurface Clearance Policy, which is included in Attachment 21.

14.1.4 Sampling Location Surveying

Samples will be collected at the precise pre-determined locations for all systematic grid sampling locations outside of inundated areas of PRI Areas 5, 6, and 7, as appropriate, including systematic grid sampling locations at background/reference areas. A Global Positioning System (GPS) unit will be used to navigate to the locations specified in SAP WS#18 (plus or minus 3 feet due to GPS accuracy) at the time of sample collection.

Judgmental/biased sampling locations will be determined in the field at the time of sampling based on the sampling rationale (provided in WS#11 and WS#17) and the approximate northing and easting provided in SAP WS#18. The actual sampling locations will be documented using GPS, to an accuracy of plus or minus 3 feet.

Sampling locations within inundated areas of PRI Areas 5, 6, and 7, as appropriate, will be located and recorded using on-board helicopter GPS as described in SOP USM-12.

Samples collected below ground surface should be measured and recorded within plus or minus 0.1 foot.

14.1.5 Surface Solids Sampling

Inner PRI area surface solids sampling locations are shown on Figures 11-2 through 11-7 and are listed in WS#18. Sampling locations for background/reference areas are identified in SAP Attachment 11. Surface solids sampling will be performed as follows:

- Within PRI Areas 1, 3, and 4, and non-inundated areas of PRI Areas 5, 6, and 7 (as appropriate) surface solids sampling will be performed using a hand auger to a depth of 6 inches bgs as described in SOP USM-01.

- Within inundated areas of PRI Areas 5, 6 and 7 (as appropriate), surface solids sampling will be performed using a helicopter-deployed sediment sampler with a target sampling depth of 6 inches bgs as described in SOP USM-12.

- At all background/reference areas, surface sampling will be to a depth of 2 inches bgs using a flat-bottom scoop or shovel as described in SOP USM-01.

The presence/absence of visible waste will be noted on sampling forms at all sampling locations, as described in SOP USM-01. When waste is visible, the depth of waste will be measured. Waste may include gypsum, smut, salts, or sludge that have a different appearance than the native soils present within the Inner PRI Areas (e.g., oolitic sands, lacustrine clays, evaporate minerals). If waste is present at the bottom of a surface sampling location (6 inches bgs) outside of the inundated areas (i.e., PRI Areas 5, 6, and 7 as appropriate), then the hand-auger boring will be advanced to either the waste/native soil interface or a maximum depth of 5 feet bgs. Field screening for waste thickness at locations within the inundated areas (i.e., PRI Areas 5, 6, and 7 as appropriate) will be to depth of penetration of the helicopter-deployed sampler.

14.1.6 Subsurface Solids Sampling

Subsurface sampling will be performed at one or more locations in each Inner PRI area as shown on Figures 11-2 through 11-7 and listed in WS#18. Subsurface soil sampling will also be performed as part of the background evaluation. Subsurface sampling will be performed as detailed in SOP *USM-09: Subsurface Soil, Sediment, and Waste Sampling* and using 2-foot maximum sample intervals from 6 inches bgs to 2 feet below the waste/native soil interface. Subsurface sampling will be performed using a sonic drill rig or similar equipment equipped with a 6-inch (minimum) coring barrel to help ensure adequate material is available for collecting the required sample volume from targeted intervals as short as 6 inches.

Surface samples (0 to 6 inches bgs) will also be collected at each subsurface sampling location; therefore, the typical/default subsurface sample intervals will be 6 inches to 2 feet bgs, 2 feet to 4 feet bgs, and so on with the final sample interval extending to 2 feet below the waste/native soil interface, unless field conditions warrant adjustments to the sampling intervals. Native material will be segregated from waste material for the final sample interval to allow for the evaluation of potential impacts from wastes in native soil. Subsurface sampling intervals will be adjusted in the field for the following reasons:

- Native material will be segregated from waste material for the final sample interval to allow for the evaluation of potential impacts from wastes in native soil.

- If anomalous or discrete layers of waste or sediments are observed in a boring, the sample interval will be adjusted (reduced) to target the anomalous/discrete layers; however, due to sample volume requirements, no sample interval will be less than 6 inches. Anomalous layers will be identified by the EPA, EPA Contractor, or ERM field personnel based on color, texture, field screening, and comparison with other wastes/sediments within a boring.

At each background Sampling Area, including BRMBR, a subsurface sample will be collected from 2 inches to 3 feet bgs for analysis of HCB, PCBs, D/Fs, and total metals. The sample will be collected following SOP *USM-09, Subsurface Soil, Sediment, and Waste Sampling* using a portable flighted auger with soil sampling probe or a compressed-gas powered direct push corer. The subsurface sample will be co-located with a sample location near the center of each of the Sampling Areas, as identified in Attachment 11.

14.1.7 Management of Investigation Derived Waste

IDW, both solid and liquid, will be generated during this investigation. IDW will be handled as follows:

- Used personal protective equipment or dedicated/disposable sampling equipment will be disposed of in dumpsters at the plant;
- Decontamination water will be disposed of either to the central Wastewater Ditch in the plant or to the current wastewater ponds (PRI Areas 5 and 6);
- Excess soil from surface soil sample collection will be left in place; and
- Excess soil from subsurface borings will be containerized in drums, pending characterization for disposal.

14.1.8 Equipment Decontamination

All equipment will be decontaminated according to SOP USM-03 (Attachment 21). In general, all sampling tools will be decontaminated before sampling begins and after sampling at each location. Sampling tools will be decontaminated by scrubbing in a solution of potable water and detergent (Alconox or Liquinox). The tools will then be double-rinsed with deionized water. Sampling tools not used immediately after decontamination will be allowed to air dry and stored wrapped in plastic or aluminum foil.

14.2 ANALYTICAL TASKS

Laboratory analyses will be performed following the analytical SOPs and project-specific Work Instructions listed in WS#23. All Phase 1A-B surface and subsurface solid samples from Inner PRI areas will be analyzed for the target analytes listed in WS#15, which include:

- PCBs
- D/Fs
- SVOCs including HCB
- PAHs
- VOCs

- Metals
- Cyanide
- Perchlorate
- TOC
- pH
- Grain size

As described in WS#11 and shown on Figure 11-8, three splits will be collected for each Phase 1A-B Inner PRI Area surface solids sample to facilitate an evaluation of chemical concentrations in bulk and fines fractions. Each split will be composed of the bulk sample (passing 0.25-inch mesh) after homogenization as described in SOP USM-01.

1. Split sample 1 will be analyzed as a bulk fraction sample.
2. Split sample 2 will be analyzed for grain size. The result from the grain size analysis of split sample 2 will be used to determine whether to analyze split sample 3 as a fines fraction sample.
3. If the percent passing 0.25 mm in split sample 2 is greater than 75, then no analysis for fines is required.
4. If the percent passing 0.25 mm in split sample 2 is less than 75, then split sample 3 will be dried, sieved through a 0.25 mm mesh, and the fines-fraction material (passing 0.25 mm) will be analyzed for PCBs, D/Fs, SVOCs, PAHs, metals, and TOC.

All surface solids samples from background/reference areas will be analyzed for metals target analytes listed in WS#15. A subset of samples from background sampling locations will be also analyzed for the following subset of target analytes listed in WS#15:

- PCBs
- D/Fs
- HCB
- TOC

All solids samples collected during Phase 1A-B will be archived at the laboratory and may be reanalyzed up to a year after collection or extraction, depending on the analytical suite and preservation steps employed.

14.3 QUALITY CONTROL TASKS

US Magnesium/ERM and EPA will assess the quality of data through regular collection and analysis of field QC samples and the analysis of laboratory QC samples. WS#12 discusses the types and purposes of field QC samples that will be collected for this project. Laboratory QC samples are discussed in WS#28.

QC will also be evaluated through project assessments (WS#31), data validation (WS#36), and data usability assessment (WS#37).

14.4 SECONDARY DATA

Secondary data will be used for preliminary N&E evaluations and potentially for background dataset evaluations:

- The Phase 1A-B RI Data Report will include maps showing chemical constituent concentrations for the primary risk drivers in each Inner PRI area. Maps will include historical/DMA data presented in the Final Inner PRI Data Report (ERM 2014a). Worksheet 13 identifies limitations on use of secondary data.

- Historical background datasets in the general area of the US Magnesium Site may provide some information regarding background concentrations of metals and organics: ATSDR 1992, Parametrix 2004, USFWS 2009, URS 2004. These datasets will not be used to develop relevant background for the purposes of the RI/FS; however, they may offer context for data that are collected as part of this background investigation.

14.5 DATA MANAGEMENT TASKS

All data generated during the Phase 1A-B RI will be managed in accordance with the DMP (ERM 2013b).

14.6 DOCUMENTATION AND RECORDS

Documentation and records will be managed as described in WS#29 and in the DMP (ERM 2013b). Deviations from this SAP or the attached SOPs will be documented by the following protocol for approval of changes requested during field sampling:

- During field sampling, it is sometimes necessary to make changes in sampling location and/or sampling methods compared to the specifications of the Phase 1A-B RI SAP. Either the EPA or ERM may propose such changes.

- In cases where the change is “minor” (e.g., relocating a sampling station a short distance away from the target location), and both ERM and EPA agree in “real time” that the change is appropriate, the change may be implemented and subsequently documented (e.g., later that day) by completion of a Field Modification Form. Note that agreement must be reached before implementing any such change. This may be accomplished by a consultation between the field team leader and an EPA oversight representative present at the Site, or by calling an appropriate EPA staff member by phone, as identified below:

Name	Office Phone	Cell Phone
Ken Wangerud	303-312-6703	720-951-0955
Dan Wall	303-312-6560	720-347-5520
Wendy O’Brien	303-312-6712	720-951-0970

- In the event that an EPA representative cannot be reached, or if the EPA representative cannot issue a decision in "real time," then no change shall be implemented until authorization is granted.

- In the event of a proposed "major" change in the Phase 1A-B RI SAP (e.g., a substantial revision to a sampling or processing method), the proposing party (either ERM or the EPA) shall complete a Field Modification Form for review and consideration by both parties. After a decision is reached and authorization for the change is approved, then the revision may be implemented.

- In the event that a change is proposed and agreement between the parties cannot be reached, then the procedure for dispute resolution defined in the AOC shall be followed.

SAP Modification and Field Modification Request Forms are included as Attachments 14A and 14B of this SAP.

14.7 ASSESSMENT/AUDIT TASKS:

Assessment and audit tasks include field readiness reviews, field sampling surveillance, laboratory surveillance, and the evaluation of data adequacy.

- A field readiness review will be completed by ERM prior to initiation of Phase 1A-B Sampling (see WS#31 and WS#32).

- Field sampling surveillance will be performed by ERM and EPA (or their contractor) at least twice, or as needed, during the Phase 1A-B sampling (see WS#31 and WS#32).

- Laboratory surveillance will be performed by ERM and EPA (or their contractor) once, or as needed based on laboratory performance or other data quality issues, during the laboratory program (see WS#31 and WS#32).

- The evaluation of data adequacy will be performed as described in WS #11 and WS#37. Data adequacy evaluations will include an assessment of whether sampling locations and intervals satisfied the sample design criteria, and whether the analytical data achieved project quality objectives for precision, accuracy, representativeness, completeness, comparability, and sensitivity (PARCCS).

14.8 DATA REVIEW TASKS

All analytical results will be validated by a third-party independent validation contractor. All data will undergo a cursory data review. In addition, a full data validation (Stage 4) will be performed on 10 percent of the data packages for the Phase 1A-B RI. Data verification and validation are described in WS#35 and WS#36.

14.9 REPORTING

Results from this investigation will be summarized by ERM in a Draft Phase 1A-B RI Data Report. The draft data report will be provided to EPA for review and will include information regarding the six PRI Areas included in this Phase 1A-B RI SAP. The Draft Phase 1A-B RI Data Report will:

- Describe tasks completed and procedures followed during the investigation, including sampling, analyses, QC procedures, and data management;

- Summarize samples collected, including sampling locations and coordinate data;

- Include tables presenting analytical results for Phase 1A-B samples;

- Include statistical summaries for each Sampling Area (e.g., each Inner PRI area, background/reference Sampling Area, and/or background/reference sampling setting);

- Include laboratory analytical reports and data validation reports;

- Include copies of field notes, sampling forms, and other relevant sample collection and tracking information;

- Identify any discrepancies between the actual procedures followed and the Phase 1A-B RI SAP;

- Summarize and include as an attachment all EPA-approved field modification and SAP modification forms;

- Include maps and interpretations of chemical constituent concentrations appropriate to the range of concentrations for HCB, total PCBs, and mammal TEQs in each Inner PRI area, incorporating data from the Phase 1A-B RI and the historical/DMA data described in the Final Inner PRI Data Report (ERM 2014a);

- Include results and interpretation of geostatistical modeling (e.g., kriging) conducted for HCB, total PCBs, and mammal TEQs for each Inner PRI area;

- Provide results and interpretation of statistical evaluations (e.g., scatter plots, outlier tests, Q-Q plots) to analyze preliminary N&E of expected risk drivers within Inner PRI areas;

- Include an attachment presenting results of bulk versus fines analyses for Inner PRI Area surface solids;

- Include an attachment presenting the data usability assessment for Inner PRI Area samples, including comparisons to measurement quality objectives (MQOs) and an evaluation of data adequacy for COPC selection; and

- Include an attachment presenting the data usability assessment for background/reference samples, including (1) comparisons to MQOs; (2) the identification and rationale for selected datasets for potential use in identifying elevated (Site-related) metals and organics (D/Fs, total PCBs and HCB); (3) an evaluation of data adequacy; and (4) the identification of non-impacted background soil/sediment reference locations that may be suitable for subsequent sampling (during Phase 2 RI) to characterize tissue burdens at reference locations.

15.0 REFERENCE LIMITS AND EVALUATION (SAP WORKSHEET #15)

15.1 OVERVIEW

WS#15 identifies the Target Quantitation Limit (TQL) for each analyte in each medium, and provides the anticipated laboratory Method Detection Limit (MDL) or Practical Quantitation Limit (PQL) for each analyte in each medium. This allows a comparison of the TQL to the MDL/PQL in order to judge whether the analytical method selected for use is sufficiently sensitive to measure each analyte at concentrations of potential concern.

The process for identifying a TQL consists of the following steps:

1. Select an RBC for each analyte for human and ecological receptors for each Site medium (soil and sediment for this Phase 1A-B SAP) to which each receptor is exposed. For human receptors, the RBC for carcinogenic chemicals is equal to the 1E-06 risk level. For non-carcinogenic chemicals, the human health RBC is set equal to an HQ of 0.1 to account for potential additivity across chemicals. For ecological receptors, the RBC is set equal to an HQ of 1.0.
2. For most analytes, the RBCs derived as above were used as the human health and ecological TQLs. However, for D/Fs and co-planar PCB congeners, risk evaluation is based on the calculated TEQ. For this reason, the TQL for each D/F and coplanar PCB congener was calculated from the human or ecological TQL for TCDD using the following equation:

   $$TQL_i = TQL(TCDD) / (TEF_i \cdot N)$$

   where TEF_i is the toxicity equivalency factor for congener i and N is the total number of congeners included in the sum. Likewise, the MDL and PQL for TEQ were calculated as follows:

   $$MDL(TEQ) = \sum (MDL_i * TEF_i)$$

   $$PQL(TEQ) = \sum (PQL_i * TEF_i)$$

For the purposes of the Phase 1A-B investigation, the RBCs adopted as TQLs for WS#15 were those identified in the SLRA Technical Memorandum (ERM 2014b). Updates to RBCs identified in ERM 2014b were made if the underlying source documents were updated by the author. A brief description of these source documents is provided in the next section.

15.2 RBC SOURCES AND SELECTION

This section presents the sources of RBCs for solid media used for WS#15 and describes the procedure used for RBC selection. Solid media of potential concern at the Site include soil, sediment, and solid waste. Screening level RBC values were provided for both human and ecological receptors, and derived from a variety of federal and state sources as described in the SLRA Technical Memorandum (ERM 2014b). Human health TQLs were taken from a single source. Ecological risk TQLs were selected from various sources based on a hierarchy. The sources of the soil and sediment screening values are presented below.

15.2.1 Human Health

EPA Regional Screening Table. EPA has developed regional screening levels (RSL) for residents and workers exposed to soil (EPA 2015). RSLs are developed using risk assessment guidance from the EPA Superfund program. They are risk-based concentrations derived from standardized equations combining exposure information assumptions with EPA toxicity data. RSLs are considered by the EPA to be protective for humans (including sensitive groups) over a lifetime. RSLs are considered generic as these are calculated without Site-specific information. For the Phase 1A-B RI, human RSLs for exposure to solid media were based on industrial RSLs.

15.2.2 Ecological Risk

TQLs for ecological risk were developed for soil, freshwater sediment and saltwater sediment. Risk-based ecological screening levels (RBESLs) were selected from among recognized, reputable sources of environmental benchmarks protective of biota. A hierarchical approach was used to select RBESLs based on:

- Applicable or relevant and appropriate requirements;
- State, regional, or national application;
- Transparency in documentation and/or derivation;
- Account for exposure via ingestion of food items (i.e., food web exposures); and
- Regularly used (standard) practices in screening-level ecological risk assessments (SLERAs).

The ecological TQLs are described by solid media below.

Soil

The hierarchy for soil RBESLs presented in ERM 2014b, and adopted for WS#15 TQLs is presented below:

1. EPA Ecological Soil Screening Levels (EcoSSL). (EPA 2005-2007) http://www.epa.gov/ecotox/ecossl/.
2. Oakridge National Laboratory (ORNL) Preliminary Remediation Goals (PRG) for Ecological Endpoints. (Efroymson et al. 1997) http://rais.ornl.gov/documents/tm162r2.pdf
3. EPA Region 5 RCRA Ecological Screening Levels (ESLs). http://www.epa.gov/Region5/waste/cars/esl.htm.
4. EPA Region 6 Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities (EPA 1999). http://www.epa.gov/osw/hazard/tsd/td/combust/eco-risk/volume3/appx-e.pdf
5. Model Toxics Control Act (MTCA) Ecological Indicator Soil Concentrations for Protection of Terrestrial Plants and Animals. (Department of Ecology 2007) https://fortress.wa.gov/ecy/publications/publications/9406.pdf

Freshwater Sediment

The hierarchy for freshwater sediment RBESLs presented in ERM 2014b, and adopted for WS#15 TQLs is presented below.

1. Consensus-based threshold/probable effect concentrations (TECs/PECs). (MacDonald et al. 2000)
2. Canadian Council of Ministers of the Environment (CCME) threshold/probable effect levels (TELs/PELs). (CCME 1999, 2003)
3. Ontario Ministry of the Environment lowest/severe effect levels (LELs/SELs). (Persaud et al. 1993)
4. EPA Region 5 RCRA Ecological Screening Levels (ESLs). http://www.epa.gov/Region5/waste/cars/esl.htm

Saltwater Sediment

The hierarchy for saltwater sediment RBESLs presented in ERM 2014b, and adopted for WS#15 TQLs is presented below.

1. Effect response low/median (ER-L/ER-M). (Long and Morgan 1991)
2. Canadian Council of Ministers of the Environment (CCME) threshold/probable effect levels (TELs/PELs). (CCME 1999, 2003)
3. EPA Region 6 Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities (EPA 1999). http://www.epa.gov/osw/hazard/tsd/td/combust/eco-risk/volume3/appx-e.pdf
4. State of Washington apparent effect thresholds (AETs). (as listed in National Oceanic and Atmospheric Administration [NOAA] 2008 Screening Quick Reference Tables [SQuiRTs]) http://response.restoration.noaa.gov/sites/default/files/ SQuiRTs.pdf

16.0 PROJECT SCHEDULE / TIMELINE (WORKSHEET #16)

The Phase 1A-B RI schedule for completion of specific tasks and deliverables in the following table is commensurate with joint discussions between ERM, EPA, and UDEQ during a project manager's meeting held on 15 April 2015. This section establishes the key project milestones and deliverables for Phase 1A-B completion in order to maintain progress consistent with overall project RI/FS objectives.

Completion dates provided herein may change with EPA approval. If EPA approves any changes in completion dates, ERM will provide, in monthly progress reports, an enforceable updated detailed Gantt chart schedule with completion dates for specific tasks and an explanation of how changed completion dates will affect the overall timeline for completing the Phase 1 A-B RI, as required by Section VIII Paragraph 37 of the AOC. Because of the interdependency of many of these tasks, ERM shall advise EPA as early as possible of task delays that may necessitate adjustments to completion and dependent milestones. These adjustments will not require EPA approval, and will be accounted for in updated Gantt charts, which will include adjusted milestones for future/dependent tasks that are affected by approved changes in completion dates.

No.	Activity	Organization	Start Date *	Completion Date *	Deliverable	Deliverable Due Date *
1	Phase 1A-B RI SAP Issued *	EPA	--	7 Sept 2015	Phase 1A-B RI SAP, Rev 0	7 Sept 2015
2	Cultural Resources Survey for BG Locations on State/Federal lands	ERM, Logan Simpson Design	Upon EPA approval of BG/Reference sampling locations	September 2015	Cultural Resources Report to BLM	September 2015
3	Surface solids sampling at Inner PRI areas (excluding inundated areas at PRI Areas 5, 6, and 7 as appropriate)	ERM	September 2015	October 2015	Daily Report with notice of completion	October 2015
4	Subsurface solids sampling (drilling) at Inner PRI areas	ERM, Drilling Subcontractor (to be determined)	October 2015	October 2015	Daily Report with notice of completion	October 2015

No.	Activity	Organization	Start Date *	Completion Date *	Deliverable	Deliverable Due Date *
5	Surface solids sampling at Background/Reference Areas	ERM	Upon BLM/USFWS approval for ground disturbance – Expected October 2015	October 2015	Daily Report with notice of completion	October 2015
6	Inundated waste area sampling (helicopter)	ERM, Reeder Flying Service	October 2015	November 2015	Daily Report with notice of completion	November 2015
7	Daily Progress Reports (per WS#33)	ERM	Upon initiation of Phase 1A-B Sampling Activities	Completion of Phase 1A-B Sampling Activities (expected November 2015)	Daily Reports	Completion of Phase 1A-B Sampling Activities (expected November 2015)
8	Monthly Progress Reports, including all results of sampling and all other data received by ERM/US Magnesium unless otherwise provided to EPA (per AOC Paragraph 37)	ERM	Ongoing monthly	Ongoing monthly	Monthly Report, including: • Updated laboratory progress (Sample Delivery Group) tracking table showing completion status of laboratory analytical work; • List of Phase 1A-B RI sample data uploaded to EQuIS Project Database and available to EPA; and • Sampling results and other data that have not been uploaded to the EQuIS Project Database.	By the 15th Day of the Following Month

No.	Activity	Organization	Start Date *	Completion Date *	Deliverable	Deliverable Due Date *
9	Background/Reference Areas field data and Unvalidated analytical data	ERM	November 2015	December 2015 (approximate – assumes 5-week TAT for HRMS analyses)	Data uploaded to EQuIS per DMP: • Copies of hard copy field sheets will be provided to the EPA on a weekly basis (DMP Page 9); • Analytical data available as Draft/Unverified in EQuIS after EDD passes quality check (DMP Page 14); • Analytical data available as Final/Verified in EQuIS At the conclusion of the verification process (DMP Page 16)	January 2016
10	Inner PRI field data and Unvalidated analytical data	ERM	September 2015	January 2016 (approximate – assumes 6-week TAT for HRMS analysis, including drying for fines analysis and no re-extraction/re-analysis)	Data uploaded to EQuIS per DMP: • Copies of hard copy field sheets will be provided to the EPA on a weekly basis (DMP Page 9); • Analytical data available as Draft/Unverified in EQuIS after EDD passes quality check (DMP Page 14); • Analytical data available as Final/Verified in EQuIS At the conclusion of the verification process (DMP Page 16)	January 2016
11	Data validation	LDC	October 2015	January 2016	Data Validation Reports and EDDs	January 2016

No.	Activity	Organization	Start Date *	Completion Date *	Deliverable	Deliverable Due Date *
12	Data uploads to EPA Scribe Database	ERM	Per Data Management Plan: • Publish data to "Draft" Scribe database within 4 weeks of the receipt of the final delivered sampling data (EDDs and laboratory reports) for each phase of data collection (DMP page 16); and • Publish validated data to the "Final" Scribe database via Scribe.net at the completion of each phase of data collection after data validation is completed (DMP Page 17).			
13	Prepare Draft Phase 1A-B RI Data and Preliminary Nature and Extent Report	ERM	January 2016	February 2016	Draft Phase 1A-B RI Data and Preliminary Nature and Extent Report	February 2016
14	Review Draft Phase 1A-B RI Data and Preliminary Nature and Extent Report **	EPA	March 2016	March 2016	EPA Comment Letter	March 2016
15	Prepare responses to EPA comments on Draft Phase 1A-B RI Data and Preliminary Nature and Extent Report	ERM	April 2016	April 2016	ERM Response to Comment Letter	April 2016
16	Review ERM Responses to Comments **	EPA	April 2016	May 2016	EPA Approval of Responses to Comments	May 2016
17	Prepare Final Phase 1A-B RI Data and Preliminary Nature and Extent Report	ERM	May 2016	May 2016	Final Phase 1A-B RI Data and Preliminary Nature and Extent Report	May 2016

* Final WS#16 dates to be adjusted (plus or minus) to reflect actual Final SAP issuance date by EPA and approval by BLM and USFWS to perform ground disturbance (sampling) on Federal lands.
** Subsequent ERM deliverables will be extended in accordance with Agency comment transmittal.

17.0 SAMPLING DESIGN AND RATIONALE (SAP WORKSHEET #17)

This WS describes the technical approach used to develop the sample designs for the Phase 1A-B RI. The sample designs described below were developed to collect data designed to satisfy the DQOs identified for the project (as described in WS#11). The objective of Phase 1A-B RI is to obtain sufficient data to support:

1. Reliable identification of COPCs for human and ecological receptors within PRI Areas 1 and 3 through 7.

2. Initial risk calculations to evaluate whether sufficient data have been collected within PRI Areas 1 and 3 through 7 to support confident risk characterization.

3. Preliminary evaluation of the N&E of Site-related impacts within PRI Areas 1 and 3 through 7.

4. Estimation of background (ambient) concentrations for metals and organics including D/Fs, total PCBs and WHO congeners, and HCB.

5. Identification of suitable reference areas (i.e., non-impacted areas) for biota sampling that may be conducted during 2016 Phase 2 RI activities.

Broadly, these objectives are combined into two principal DQOs of “COPC Selection and Preliminary N&E at Inner PRI Areas,” and “Evaluation of Background.” The sample design and rationale for these two principal DQOs differ, thus are discussed separately in the following sections.

17.1 SAMPLE DESIGN FOR COPC SELECTION AND PRELIMINARY N&E AT INNER PRI AREAS

The sample design described in this section supports both COPC selection and preliminary N&E study goals. The data obtained during Phase 1A-B to support COPC selection and preliminary N&E will also be used to perform initial risk calculations to evaluate whether sufficient data have been collected to support confident risk characterization and adequate characterization of the N&E of areas that exceed a level of concern. To achieve these goals, the sample design was developed that incorporated statistical and spatial elements. The approach for the sample design was applied to each PRI area independently.

For COPC selection, a minimum of 14 surface samples are required for each PRI area. The statistical basis for a minimum sample size of 14 for COPC selection is described in WS#11, Section 11.2.6.1 and is founded on the concept that, given a dataset of adequate size, the maximum concentration value in that dataset will have a high probability (greater than or equal to 95 percent) of exceeding the true mean concentration across the PRI area. Actual numbers of surface samples for the Inner PRI areas range from 14 to 20, and include a combination of systematic/gridded locations and biased/judgmental locations:

	Systematic Grid Surface Sample Locations	Biased/Judgmental Surface Sample Locations	Total Number of Surface Sample Locations
PRI Area 1	0	14	14
PRI Area 3	13	1	14
PRI Area 4	14	0	14
PRI Area 5	15	5	20
PRI Area 6	15	0	15
PRI Area 7	15	2	17

The rationale for the increased number of gridded sampling locations within PRI Areas 5, 6, and 7 and the rationale for all biased/judgmental sampling locations are provided in WS#11, Section 11.2.7.3. Gridded sampling locations for PRI Areas 3 through 7 were generated using the software program VSP v7 (http://vsp.pnnl.gov/). The "pre-determined number of samples" module was used in conjunction with project Geographic Information System (GIS) files of PRI area boundaries to generate target sample coordinates. A systematic grid (triangular) was used to project target sampling locations. To preserve the assumption of random sample placement, the coordinates of the starting node upon which the grid was projected was selected at random by VSP. Surface solids sampling locations are shown in Figures 11-2 through 11-7 and are listed in WS#18. The rationale for each biased surface solids sampling location is provided in in WS#11, Section 11.2.7.3 and is repeated in WS#18.

Subsurface solids sampling will be performed to evaluate chemical concentrations at depth and for characterizing vertical N&E within key waste release locations (shown in Figure 11-1) and other locations identified by the EPA. Subsurface solids sampling will be performed at one or more locations in each Inner PRI area. Subsurface solids sampling locations are shown in Figures 11-2 through 11-7 and are listed in WS#18. The rationale for each subsurface solids sampling location is provided in WS#11, Section 11.2.7.3, and is repeated in WS#18.

17.2 SAMPLE DESIGN FOR EVALUATION OF BACKGROUND

This section presents the sample design to estimate background (ambient) concentrations for metals and selected organics and for the identification of suitable reference areas (i.e., non-impacted areas) for biota sampling. As described in WS#11, two general classes of compounds are relevant to characterizing background for the US Magnesium RI/FS: "metals" and "organics." Organics include D/Fs, total PCBs, WHO co-planar PCB congeners, and HCB.

During the DQO development process, it was recognized that surface soils within the RI/FS Study Area vary by lithology and soil classification. Metals data collected from different lithologies and soil classes were evaluated statistically to identify similarities and differences between soil lithology and classification. From these evaluations, two metal background populations, "Upland" and "Lakebed," were identified for the background comparisons.

It is expected that location (Lakebed versus Upland) is not an important distinction for organics. This assumption will be tested once the data are collected. If there is no important difference, then comparisons of Site to background for organics will use the combined background dataset. If there is an important difference, then the background dataset for Upland and Lakebed will be treated independently and used for comparisons to the corresponding Upland and Lakebed site samples. Details on the procedure used to investigate and classify Upland and Lakebed populations are presented in WS#11.

The statistical design for background/reference area sampling was based on anticipated analyte-by-analyte comparisons of Site to background concentration data. In addition, the design will also support the identification of suitable (non-impacted) areas for anticipated future tissue sampling. Site-to-background comparisons will include statistical hypothesis testing. The minimum number of background samples needed to ensure that statistical testing will have adequate power (ability to discern elevated concentrations at the Site as compared to background) was calculated based on estimates of natural variability (using Site-specific data) in solid media concentrations. The "Compare Average to Reference Average" module in VSP v7 was used to calculate minimum number of samples. Details on the calculations method, as well as the source data and statistical assumptions employed, are presented in WS#11. For metals, a sample size of 30 samples per background population was derived to help ensure adequate statistical power, and a total of 60 metals samples will be collected (30 samples in Upland and 30 in Lakebed). A sample size of 36 samples was selected for organics. As this chemical class is not expected to be influenced by lithology or soil type, the 36 samples will be divided equally between metals populations (18 samples in Upland and 18 in Lakebed).

In addition to the 60 metals and 36 organic background samples discussed above, five “contingency” background samples will be collected in the BRMBR. The BRMBR contingency Background Sampling Area will only be utilized for tissue collection if the Lakebed or Upland Background Sampling Areas are found to be impacted.

The background/reference sampling locations for Upland, Lakebed, and BRMBR areas are presented in Attachment 11 to this SAP. Multiple off-Site candidate areas for collecting background samples were identified for Upland and Lakebed solid media types during the DQO process (WS#11). Selection of final areas for collecting background samples will be determined based on the findings from a reconnaissance survey conducted in June 2015. The goal of the field trip was to identify candidate Background Sampling Areas where reference biological tissue could likely be collected at a later date (e.g., during Phase 2 RI sampling in 2016). Attachment 11 to this SAP presents the results of the June 2015 candidate Background Sampling Areas survey.

Observations on field forms and photologs from the reconnaissance survey were used to select three Upland Background Sampling Areas, three Lakebed Background Sampling Areas, and one contingency Background Sampling Area in the BRMBR, as described in Attachment 11. As it is assumed that biological samples will be collected in these Background Sampling Areas during Phase 2 of the RI, it is important to confirm the Background Sampling Areas are suitable for collection of biota, in particular bird eggs, at a later date. It is also critical to confirm the reference areas are a sufficient distance from the RI/FS Study Area to ensure nesting birds are not foraging within the study area.

Criteria for selection of Background Sampling Areas for Upland habitat include:

1. Located beyond the 5-mile radius of the Site and at least 500 feet from the edge of the 5-mile radius to ensure the horned lark is not foraging within the RI/FS Site boundary;

2. Contains minimally disturbed IMB greasewood flat or annual invasive grassland land cover;

3. Collection of bird eggs (likely horned lark), small mammals, plants, and invertebrates is very likely; and

4. The location was accessible for sampling.

Criteria for selection of Background Sampling Areas for Lakebed habitat include:

1. Located beyond the 5-mile radius of the Site and at least 1,000 feet from the edge of the 5-mile radius to ensure the snowy plover and American avocet are not foraging within the RI/FS Site boundary;

2. Contains minimally disturbed IMB playa land cover;

3. Collection of bird eggs (likely snowy plover and/or American avocet), plants, and invertebrates is very likely; and

4. Location was accessible for sampling.

Phase 1A-B sample coordinates, the rationale for sample placement, and the methods used to develop the sampling locations are presented in Attachment 11.

17.3 QUALITY CONTROL MEASURES FOR PHASE 1A-B SAMPLE DESIGNS

QC measures conducted in the field will include collection of field duplicate samples (one per 10 samples collected), equipment blanks (one per week per type of equipment used), and trip blanks (one per cooler containing samples for VOC analysis). The number of equipment blanks collected will depend on the number of days in the field and the types of equipment being used. The number of trip blanks will depend on the number of coolers used to ship samples to the analytical laboratories. Specifics regarding field QC measures are presented in WS#12. Chain of custody (COC) will be maintained throughout the transition between field and analytical phases as described in WS#27.

QC measures for the analytical program will be performed by the contract laboratories. These measures will include instrument calibration, maintenance, testing and inspection described in WS#24 and WS#25. The analytical program also will include a regiment of QC samples (e.g., method blanks, laboratory duplicates, laboratory control samples/blank spikes, matrix spikes, etc.) as described in WS#12 and WS#28.

All analytical data will verified and validated in accordance with WS#34, WS#35, and WS#36. Data produced in Phase 1A-B will be subject to a data usability assessment (WS#37) that will confirm data precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS) relative to project MQOs.

18.0 SAMPLING LOCATIONS AND METHODS/SOP REQUIREMENTS TABLE (SAP WORKSHEET #18)

Area	Location (a)	UTM Zone 12 NAD 1983		Utah State Plane Central		Sample Type: SS = Surface SB = Sub-surface	Location Basis	Rationale for Biased or Subsurface Locations	Analytical Group (b)
		m N	m E	X feet	Y feet				
PRI Area 1 - Ditches	1-01	4530985	353753	1298598	7505121	SS	Biased	Near head of Western Ditch	A
	1-02	4531210	353757	1298606	7505859	SS	Biased	Approx. midpoint of N-S segment of Western Ditch	A
	1-03	4531398	353931	1299174	7506479	SS and SB	Biased	W of bridge at confluence of Western and Main ditches	B
	1-04	4531019	353970	1299309	7505236	SS	Biased	Near head of Central Ditch	A
	1-05	4531267	353967	1299294	7506050	SS	Biased	Central Ditch downstream of Sanitary Lagoon	A
	1-06	4530986	354071	1299641	7505130	SS	Biased	Near head of Chlorine Ditch	A
	1-07	4531158	354078	1299661	7505695	SS and SB	Biased	Chlorine Ditch downstream of Boron Plant discharge and S of bridge	B
	1-08	4531389	354148	1299886	7506454	SS and SB	Biased	Main Ditch after confluence with Chlorine Ditch and E of bridge	B
	1-09	4531396	354309	1300415	7506478	SS	Biased	Main Ditch adjacent to Landfill	A
	1-10	4531513	354486	1300992	7506868	SS	Biased	Main Ditch below Landfill	A
	1-11	4531658	354634	1301477	7507346	SS	Biased	Main Ditch near current outlet to PRI Area 5 waste pond	A
	1-12	4531793	354769	1301915	7507792	SS	Biased	Main Ditch alignment adjacent to PRI Area 5 waste pond	A
	1-13	4531961	354947	1302496	7508347	SS and SB	Biased	Former Main Ditch near historical outlet to PRI Area 7 waste pond	B
	1-14	4531241	354122	1299802	7505968	SS and SB	Biased	Former Boron Ditch	B

Area	Location (a)	UTM Zone 12 NAD 1983		Utah State Plane Central		Sample Type: SS = Surface SB = Sub-	Location Basis	Rationale for Biased or Subsurface Locations	Analytical Group (b)
PRI Area 3 - Sanitary Lagoon	3-01	4531162	353998	1299398	7505705	SS	Grid	n/a	A
	3-02	4531162	354023	1299479	7505705	SS	Grid	n/a	A
	3-03	4531162	354047	1299560	7505705	SS	Grid	n/a	A
	3-04	4531183	354010	1299438	7505776	SS	Grid	n/a	A
	3-05	4531183	354035	1299520	7505776	SS	Grid	n/a	A
	3-06	4531205	353998	1299398	7505846	SS	Grid	n/a	A
	3-07	4531205	354023	1299479	7505846	SS	Grid	n/a	A
	3-08	4531205	354048	1299560	7505846	SS	Grid	n/a	A
	3-09	4531226	354011	1299438	7505916	SS	Grid	n/a	A
	3-10	4531226	354035	1299520	7505916	SS	Grid	n/a	A
	3-11	4531248	353998	1299398	7505987	SS	Grid	n/a	A
	3-12	4531248	354023	1299479	7505987	SS	Grid	n/a	A
	3-13	4531247	354048	1299560	7505987	SS	Grid	n/a	A
	3-14	4531152	354023	1299479	7505672	SS and SB	Biased	Presumed inlet to lagoon	B
PRI Area 4 - Gypsum Pile	4-01	4531590	353784	1298687	7507105	SS	Grid	n/a	A
	4-02	4531581	354034	1299508	7507082	SS	Grid	n/a	A
	4-03	4531580	354291	1300351	7507082	SS	Grid	n/a	A
	4-04	4531805	353907	1299086	7507812	SS	Grid	n/a	A
	4-05	4531803	354164	1299930	7507812	SS and SB	Grid	Subsurface sample at top-center of the Gypsum Pile, where historical gypsum waste is expected to be present at depth	B
	4-06	4531802	354421	1300773	7507812	SS	Grid	n/a	A
	4-07	4531796	354679	1301621	7507799	SS	Grid	n/a	A
	4-08	4532028	353780	1298664	7508543	SS	Grid	n/a	A
	4-09	4532027	354037	1299508	7508543	SS	Grid	n/a	A
	4-10	4532025	354294	1300351	7508543	SS	Grid	n/a	A
	4-11	4532023	354551	1301195	7508543	SS	Grid	n/a	A

Area	Location (a)	UTM Zone 12 NAD 1983		Utah State Plane Central		Sample Type: SS = Surface SB = Sub-	Location Basis	Rationale for Biased or Subsurface Locations	Analytical Group (b)
	4-12	4532250	353909	1299086	7509273	SS	Grid	n/a	A
	4-13	4532248	354167	1299930	7509273	SS	Grid	n/a	A
	4-14	4532247	354424	1300773	7509273	SS	Grid	n/a	A
PRI Area 5 - Southeast Ponded Waste Lagoon	5-01	4530915	355052	1302861	7504917	SS	Grid	n/a	A
	5-02	4530913	355373	1303914	7504917	SS	Grid	n/a	A
	5-03	4530911	355693	1304966	7504917	SS	Grid	n/a	A
	5-04	4530910	356014	1306018	7504917	SS	Grid	n/a	A
	5-05	4530908	356335	1307071	7504917	SS	Grid	n/a	A
	5-06	4531194	354893	1302335	7505828	SS	Grid	n/a	A
	5-07	4531192	355214	1303388	7505828	SS	Grid	n/a	A
	5-08	4531190	355535	1304440	7505828	SS	Grid	n/a	A
	5-09	4531188	355855	1305492	7505828	SS	Grid	n/a	A
	5-10	4531186	356176	1306545	7505828	SS	Grid	n/a	A
	5-11	4531473	354735	1301809	7506739	SS	Grid	n/a	A
	5-12	4531471	355055	1302861	7506739	SS	Grid	n/a	A
	5-13	4531469	355376	1303914	7506739	SS	Grid	n/a	A
	5-14	4531749	354897	1302335	7507651	SS and SB	Grid	Subsurface sampling at location nearest the inlet to the waste lagoon from the Main Ditch	B
	5-15	4531748	355217	1303388	7507651	SS	Grid	n/a	A
	5-16	4531049	354881	1302299	7505352	SS and SB	Biased	Former Wastewater Diversion Ditch near/at an inlet of the ditch into the PRI Area 5 waste lagoon.	B
	5-17	4530728	355151	1303190	7504304	SS	Biased	Lower reach of the Former Wastewater Diversion Ditch (representing the eastward leg draining into the PRI Area 5 waste lagoon).	A

Area	Location (a)	UTM Zone 12 NAD 1983		Utah State Plane Central		Sample Type: SS = Surface SB = Sub-	Location Basis	Rationale for Biased or Subsurface Locations	Analytical Group (b)
	5-18	4530707	355136	1303142	7504234	SS	Biased	Star Pond Ditch downgradient of the discharge point from the Star Pond.	A
	5-19	4530741	355416	1304058	7504353	SS	Biased	Skull Valley Diversion at area of influent seepage.	A
	5-20	4530749	355360	1303875	7504377	SS	Biased	Star Pond Ditch at downstream (east) reach where Star Pond discharges appear to have comingled with Former Diversion Ditch and PRI Area 5 waste lagoon waters.	A
PRI Area 6 - Northwest Ponded Waste Lagoon	6-01	4532087	353711	1298439	7508736	SS	Grid	n/a	A
	6-02	4532077	354636	1301474	7508720	SS	Grid	n/a	A
	6-03	4532071	354859	1302206	7508704	SS	Grid	n/a	A
	6-04	4532292	353599	1298065	7509406	SS	Grid	n/a	A
	6-05	4532279	353812	1298766	7509366	SS	Grid	n/a	A
	6-06	4532274	354511	1301059	7509366	SS	Grid	n/a	A
	6-07	4532483	353464	1297619	7510028	SS	Grid	n/a	A
	6-08	4532481	353697	1298384	7510028	SS	Grid	n/a	A
	6-09	4532480	353930	1299148	7510028	SS	Grid	n/a	A
	6-10	4532478	354163	1299913	7510028	SS	Grid	n/a	A
	6-11	4532477	354396	1300677	7510028	SS	Grid	n/a	A
	6-12	4532682	353814	1298766	7510690	SS	Grid	n/a	A
	6-13	4532681	354047	1299530	7510690	SS	Grid	n/a	A
	6-14	4532679	354280	1300295	7510690	SS	Grid	n/a	A
	6-15	4532882	354165	1299913	7511352	SS	Grid	n/a	A

Area	Location (a)	UTM Zone 12 NAD 1983		Utah State Plane Central		Sample Type: SS = Surface SB = Sub-	Location Basis	Rationale for Biased or Subsurface Locations	Analytical Group (b)
	6-16	4532023	354551	1301195	7508543	SB	Biased	Within the historical inlet of the PRI Area 6 waste lagoon, co-located with surface solids sampling location 4-11 in PRI Area 4	C
PRI Area 7 - Northeast Ponded Waste Lagoon	7-01	4531237	356527	1307696	7506002	SS	Grid	n/a	A
	7-02	4531674	355781	1305238	7507422	SS	Grid	n/a	A
	7-03	4531671	356280	1306877	7507422	SS	Grid	n/a	A
	7-04	4532111	355034	1302779	7508841	SS and SB	Grid	Subsurface sampling at the location nearest the historical inlet	B
	7-05	4532108	355534	1304418	7508841	SS	Grid	n/a	A
	7-06	4532105	356033	1306057	7508841	SS	Grid	n/a	A
	7-07	4532545	354787	1301960	7510260	SS	Grid	n/a	A
	7-08	4532542	355286	1303599	7510260	SS	Grid	n/a	A
	7-09	4532539	355786	1305238	7510260	SS	Grid	n/a	A
	7-10	4532536	356285	1306877	7510260	SS	Grid	n/a	A
	7-11	4532979	354540	1301141	7511680	SS	Grid	n/a	A
	7-12	4532976	355039	1302779	7511680	SS	Grid	n/a	A
	7-13	4532973	355539	1304418	7511680	SS	Grid	n/a	A
	7-14	4532970	356038	1306057	7511680	SS	Grid	n/a	A
	7-15	4532972	356525	1307655	7511693	SS	Grid	n/a	A
	7-16	4533145	355386	1303913	7512241	SS	Biased	Barrow ditch N of the OWP due to the potential for ecological receptor exposures	A
	7-17	4533159	356196	1306571	7512303	SS	Biased	Barrow ditch N of the OWP due to the potential for ecological receptor exposures	A
Lakebed Background/ Reference Areas	See SAP Attachment 11					SS and SB	Grid	n/a	D

Area	**Location (a)**	**UTM Zone 12 NAD 1983**	**Utah State Plane Central**	**Sample Type: SS = Surface SB = Sub-**	**Location Basis**	**Rationale for Biased or Subsurface Locations**	**Analytical Group (b)**
Upland Background/ Reference Areas	See SAP Attachment 11			SS and SB	Grid	n/a	D
Bear River Migratory Bird Refuge	See SAP Attachment 11			SS and SB	Grid	n/a	E

Notes:

Surface samples will be collected as described in SOPs USM-01 (outside of inundated areas of PRI Areas 5, 6, and 7 as appropriate) or USM-12 (within inundated areas of PRI Areas 5, 6, and 7 as appropriate). Subsurface solids samples will be collected as described in SOP USM-09. See WS#21 for sample collection SOP references.

(a) Sampling locations are shown in WS#11 Figures 11-2 through 11-7 for PRI Areas 1 and 3 through 7. See SAP Attachment 11 for background/reference area sampling locations. Biased sampling locations will be determined in the field at the time of sampling based on the sampling rationale (provided in WS#11 and WS#17) and the approximate coordinates provided above. See WS#14 for sampling location surveying requirements.

(b) Analytical groups include the following:

Group A = Inner PRI area surface solids sampling locations. Analyses include: VOCs, SVOCs, PCBs, D/Fs, PAHs, metals, cyanide, perchlorate, pH, TOC, and grain size. Extra volume collected for possible fines analysis (SVOCs, PCBs, D/Fs, PAHs, metals, TOC) based on grain size results.

Group B = Inner PRI area surface and subsurface solids sampling locations. Surface solids analyzed for Group A. Subsurface solids analyzed for: VOCs, SVOCs, PCBs, PCDDs/PCDFs, PAHs, metals, cyanide, perchlorate, pH, TOC, and grain size.

Group C = Inner PRI Area subsurface sampling location. Analyses include: VOCs, SVOCs, PCBs, D/Fs, PAHs, metals, cyanide, perchlorate, pH, TOC, and grain size.

Group D = Background/reference sampling location from Lakebed or Upland areas. All background/reference samples will be analyzed for metals and pH. A subset of samples will also be analyzed for PCBs, D/Fs, HCB, and TOC. Subsurface samples will be analyzed for metals, PCBs, D/Fs, and HCB. See SAP Attachment 11.

Group E = Background/reference sampling location at BRMBR. All BRMBR surface samples will be analyzed for metals, pH, PCBs, D/Fs, HCB, and TOC. The subsurface sample from BRMBR will be analyzed for metals, PCBs, D/Fs, and HCB. See SAP Attachment 11.

19.0 ANALYTICAL SOP REQUIREMENTS TABLE (SAP WORKSHEET #19)

Matrix	Analytical Group	Analytical and Preparation Method/SOP Reference [1]	Containers (Number, Size, and Type)	Sample Preparation/ Analysis Volume	Preservation Requirements (Chemical, Temperature, Light Protected)	Maximum Holding Time (Preparation/ Analysis) [2]
Solids	HRMS PCB	EPA Method 1668A WS-IDP-0013 WS-ID-0013	1x4-ounce glass jar with Teflon®-lined lid	10 g	Cool to 4 ± 2 °C in field and for transport; Cool to < -10 °C upon receipt at lab [6]	1 year (frozen at -20°C)/ 45 days (1 year stored at -10°C) [3]
Solids	LRMS PCB	EPA Method 3570 SOP 2172 EPA Method 680 SOP 2162	1x4-ounce glass jar with Teflon®-lined lid	10 g	Cool to 4 ± 2 °C in field and for transport; Cool to < -10 °C upon receipt at lab [6]	1 year (frozen at -20°C)/ 40 days [3]
Solids	VOC	EPA Method 5035 / 8260B WS-MS-0007	3-EnCore® devices or equivalent	5 g	Cool to 4 ± 2 °C	48 hours for unpreserved, 14 days for preserved (can be frozen upon receipt for 7 days)
Solids	SVOC	EPA Method 3550B / 8270C WS-OP-0001, WS-MS-0005	1x8-ounce glass jar with Teflon®-lined lid [4]	30 g	Cool to 4 ± 2 °C [6]	14 days at 4 ± 2 °C (1 year frozen at -20°C)/ for extraction /40 days for analysis [3]
Solids	PAH	EPA Method 3550B / 8270C WS-OP-0001, WS-MS-0008	1x8-ounce glass jar with Teflon®-lined lid [4]	30 g	Cool to 4 ± 2 °C [6]	14 days at 4 ± 2 °C (1 year frozen at -20°C)/14 days for extraction/40 days for analysis [3]
Solids	HRMS D/F	EPA Method 8290 WS-IDP-0005 WS-ID-0005	1x8-ounce glass jar with Teflon®-lined lid [4]	30 g	Cool to 4 ± 2 °C [6]	30 days for extraction and 45 days for analysis [3]
Solids	LRMS D/F	EPA Method 8280 WS-IDP-0011 WS-ID-0011	1x8-ounce glass jar with Teflon®-lined lid [4]	10 g	Cool to 4 ± 2 °C [6]	30 days for extraction and 45 days for analysis [3]
Solids	ICP Metals	EPA Method 3050B/6010B WS-IP-0002, WS-MT-0003	1x8-ounce glass jar with Teflon®-lined lid [4]	30 g	Cool to 4 ± 2 °C [6]	180 days

Matrix	Analytical Group	Analytical and Preparation Method/SOP Reference [1]	Containers (Number, Size, and Type)	Sample Preparation/ Analysis Volume	Preservation Requirements (Chemical, Temperature, Light Protected)	Maximum Holding Time (Preparation/ Analysis) [2]
Solids	ICP MS Metals	EPA Method 3050B/6020 WS-IP-0002, WS-MT-0001	1x8-ounce glass jar with Teflon®-lined lid [4]	30 g	Cool to 4 ± 2 °C [6]	180 days
Solids	Mercury	EPA Method 7471A WS-MT-0007	1x8-ounce glass jar with Teflon®-lined lid [4]	30 g	Cool to 4 ± 2 °C [6]	28 days
Solids	TOC	EPA Method 9060 DV-WC-0048	1x8-ounce glass jar with Teflon®-lined lid [4]	10 g	Cool to 4 ± 2 °C [6]	28 days
Solids	Cyanide	EPA Method 9012A SOP SA-GE-040	1x8-ounce glass jar with Teflon®-lined lid [4]	10 g	Cool to 4 ± 2 °C	14 days
Solids	Perchlorate by IC	EPA Method 314 WS-WC-0010	1x4-ounce amber glass jar with Teflon®-lined lid[5]	50 g	Leave approximately 1/3 volume headspace, Cool to 4 ± 2 °C	28 days
Solids	Perchlorate by LC MS (confirmation analysis)	EPA Method 6850 WS-LC-0012	1x4-ounce amber glass jar with Teflon®-lined lid [5]	50 g	Leave approximately 1/3 volume headspace, Cool to 4 ± 2 °C	28 days
Solids	pH	EPA Method 9045D WS-WC-0044	1x8-ounce glass jar with Teflon®-lined lid [4]	20 g	Cool to 4 ± 2 °C	As soon as possible, not to exceed 28 days
Solids	Grain Size	Grain Size Analysis: percent passing 0.25 mm (#60) sieve) (based on ASTM C135/C117)	1x8-ounce glass jar	8 ounces	None	None
Solids	Fines Analysis	WS-WI-0040	2x16-ounce glass jar with Teflon®-lined lid	As needed for Methods (SVOCs, PCBs, D/F, PAHs, metals, TOC)	Fines samples will be dried and sieved prior to analysis [6]	Due to the time required for sample drying, fines samples may not meet some holding times for extraction [6]

Matrix	Analytical Group	Analytical and Preparation Method/SOP Reference [1]	Containers (Number, Size, and Type)	Sample Preparation/ Analysis Volume	Preservation Requirements (Chemical, Temperature, Light Protected)	Maximum Holding Time (Preparation/ Analysis) [2]
Aqueous (Field QC Sample)	See September 2013 Phase 1A SAP					

[1] See WS#23.

[2] Maximum holding time is calculated from the time the sample is collected to the time the sample is prepared/extracted (not VDTSR).

[3] Assumes samples are stored at 4 ± 2 °C. Samples stored at -20°C do not show significant loss of target analytes for PAHs, SVOCs, and PCBs (EPA 2005c). Assumes PCB extracts are stored at room temperature. PCB extracts stored at -10°C (frozen) can be analyzed up to 1 year after extraction (EPA 2007, 2009).

[4] Two 8-ounce glass jars should be collected for analyses for SVOCs, PAHs, dioxins, ICP metals, ICP-MS metals, mercury, TOC, pH, and cyanide.

[5] One 4-ounce jar should be collected for perchlorate analysis of solids; both IC and LC-MS analytical methods can be performed using the same sample container.

[6] Samples for fines (< 0.25 mm) analysis per WS#11 will be preserved at 4 ± 2 °C until air drying begins. Air drying will be performed at 80° F (27° C); therefore, samples for fines analysis cannot be preserved at 4 ± 2 °C continuously prior to preparation (extraction or digestion). In addition, due to time needed to determine whether analysis of the fines fraction is necessary and then the time required for drying, the hold time for some methods may not be met (for example, 14 days for SVOCs and PAHs).

20.0 FIELD QUALITY CONTROL SAMPLE SUMMARY TABLE (SAP WORKSHEET #20)

Matrix	Analytical Group (Method)	No. of Samples Collected	No. of Field Duplicates[a]	No. of MXS/MSDs Inorganic Only[b]	No. of Equip. Blanks[c]	No. of Trip Blanks[d]	Approximate/ Estimated Total No. of Samples[e]
Inner PRIs							
Solids	PCB, D/F, SVOC, PAH, pH, TOC, grain size	138 (approx.) [f]	14 (approx.) [f]	0	5 (estimated)	0	157
Solids	VOC	138 (approx.) [f]	14 (approx.) [f]	0	5 (estimated)	10 (estimated)	167
Solids	Metals, cyanide, perchlorate	138 (approx.) [f]	14 (approx.) [f]	14/14 (approx.) [f]	5 (estimated)		185
Background/Reference Areas							
Solids	Metals	72	8	8/8	3 (estimated)	0	99
Solids	PCB, D/F, HCB, TOC	48	5	0	3 (estimated)	0	56

Notes:

[a] Per WS#12, field duplicates will be collected at a frequency of 10% (minimum).

[b] MXS/MSD will be performed for inorganic analyses only: metals, cyanide, and perchlorate. Per WS#12, MXS/MSD for inorganic analyses will be performed at a frequency of 10% (minimum).

[c] The number of equipment blanks will depend on the number of weeks and/or sampling teams, as indicated in WS#12. Values shown are for estimating purposes only. Equipment blank (water) samples will be analyzed as described in the September 2013 Phase 1A SAP.

[d] Trip blanks will be analyzed for VOCs only. The number of trip blanks will depend on the number of coolers containing samples for VOC analysis, as indicated in WS#12. The values shown are for estimating purposes only. Trip blank (water) samples will be analyzed as described in the September 2013 Phase 1A SAP.

[e] The total number of samples will be a function of the number of subsurface sampling intervals (affects number of samples collected, number of field duplicates, and number of MXS/MSD), the number of sampling teams/duration of sampling (affects number of equipment blanks), and the number of coolers shipped containing samples for VOC analysis (affects number of trip blanks). The actual number of subsurface sampling intervals will be a function of waste thickness and the presence/absence of inhomogeneities within subsurface borings.

[f] Values shown assume 94 surface solids sampling locations and 4 sampling intervals at each of 11 subsurface sampling locations.

21.0 PROJECT SAMPLING SOP REFERENCES TABLE (SAP WORKSHEET #21)

The following is a reference list of all relevant ERM SOPs to be used in support of sampling activities at the Site. The SOPs are found in Attachment 21.

SOP Reference Number	Title, Revision Date and/or Number	Equipment Type	Modified for Project Work?
USM-01	SURFACE SOIL, SEDIMENT, AND WASTE SAMPLING, Rev 4, July 2015	Hand Auger, Flat-bottom Scoop/Shovel	Yes
USM-03	EQUIPMENT DECONTAMINATION, Rev 2, September 2013	Refer to SOP	Yes
USM-04	SAMPLE MANAGEMENT, Rev 2, September 2013	Refer to SOP	Yes
USM-06	FIELD DOCUMENTATION, Rev 2, September 2013	Refer to SOP	Yes
USM-09	SUBSURFACE SOIL, SEDIMENT, AND WASTE SAMPLING, Rev 0, September 2013	Refer to SOP	Yes
USM-11	GLOBAL POSITIONING SYSTEM (GPS) FIELD DATA COLLECTION, Rev 0, September 2013	Refer to SOP	Yes
USM-12	SURFACE SOLIDS SAMPLING WITHIN CURRENT WASTEWATER PONDS, Rev 0, July 2015	Ponar and Box Corer Samplers	Yes
S1-ERM-007-WI	ERM GLOBAL SUBSURFACE CLEARANCE PROCESS, Version 3.2, May 2015	Refer to SOP	No

SECTION E: QUALITY ASSURANCE

SAP WORKSHEETS #22-37

22.0 FIELD EQUIPMENT CALIBRATION, MAINTENANCE, TESTING, AND INSPECTION TABLE (SAP WORKSHEET #22)

MiniRae 3000 Photoionization Detector (PID)
Parameters: The MiniRAE 3000 is a battery powered, microcomputer controlled, photoionization detector suitable for measuring concentrations of VOC vapor in ambient air. The instrument is capable of continuously monitoring for over 200 VOC gases at parts per million (ppm) concentrations ranging from 0.1 to 15,000 ppm with a resolution of 0.1 ppm.
Calibration: Calibration should be performed daily prior to use, or if any maintenance has been performed on the unit. Calibration procedures are outlined in the MiniRAE 3000 PID user's guide, included as an attachment to SOP USM-09 for calibration procedures. Calibration should be documented daily and performed in accordance with MiniRAE 3000 PID procedures. Ensure that the sample intake and exhaust are free of obstructions before performing calibrations. All calibration activities should be appropriately documented in the field logbook.
Maintenance: The rechargeable battery should be fully charged prior to use. If the battery can no longer function while in the field, four AA batteries can be inserted into the unit to continue operation. Internal components of the PID are sensitive to moisture; therefore, care should be taken to make sure liquid does not enter the inlet probe. If internal components become wet or soiled, they will require cleaning or replacement in accordance with the MiniRAE 3000 PID user's guide. Indications that cleaning or replacement is required include: inaccurate readings after calibration, readings sensitive to air moisture or liquid has entered the inlet probe. Common replacement parts that will be immediately available during MiniRAE 3000 PID use are a 10.6 eV Lamp, a sensor detector, or AA batteries. The MiniRAE 3000 PID digital display should be kept from overexposure to water and sunlight to maximize display longevity. All maintenance activities should be appropriately documented in the field logbook.
Testing: Battery voltage indicator on the LCD screen should be monitored throughout the day to ensure operation in appropriate levels. Calibration should be performed before conducting any field work and following any maintenance activities to ensure accurate readings are recorded. These checks should be performed to ensure that the unit is functioning properly. All testing activities should be documented in the field logbook.
Inspection: Visually inspect the contacts at the base of the instrument, on the battery, and on the charging cradle to make sure they are clean. The external surfaces, buttons, and the display screen on the unit should be inspected and kept clean of debris and liquids. Additionally, the sample intake and exhaust ports should be inspected for objects that could prevent airflow. Occasional cleaning of the unit with a soft cloth is recommended for longevity.
Frequency: Calibration should be performed daily prior to conducting any field work, and following any maintenance activities on the unit.
Acceptance: Acceptable readings will be within ±3% at the calibration point using isobutylene as a reference gas.
Corrective Action: Recalibration is required if readings are outside acceptance criteria outlined above and in the MiniRAE 3000 PID user's guide. Batteries will be replaced in the field, as needed. Error code prompts on the LCD screen will direct the user to the user's manual. A copy of the MiniRAE 3000 PID user's guide should be kept on-Site by field personnel to assist with corrective actions and troubleshooting. The user's guide is included as an attachment to SOP USM-09. All corrective actions should be appropriately documented in the field logbook
Responsible Person: Field Team Leader
SOP Reference: USM-09

23.0 ANALYTICAL SOP REFERENCES (SAP WORKSHEET #23)

Table 23-1 provides a list of analytical SOPs for solid media. In addition, Table 23-1 provides a summary of project-specific work instructions that are discussed in more detail in attachments to the Project-Specific Work Instructions (WS-WI-0037).

Table 23-1. Analytical SOP References for Solid Media

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix	Analytical Group	Instrument	Organization Performing Analysis	Summary of Project-Specific Work Instructions (refer to Lab SOP for details)
WS-WI-0037	Project-Specific Work Instructions for Phase 1A-B Investigation, Revision 2.2, Effective 07/28/2015	Definitive	Solid	Multiple	Multiple	TestAmerica Sacramento	• Special sample preparation instructions for high level samples for selected methods; specific cleanup methods for selected methods; SVOC-SIM analysis for selected analytes.
WS-WI-0040	Project-Specific Work Instructions for Determination of the Percent (%) Fines (FP) in Soil/Sediment Samples, Revision 1, Effective 06/30/2015	Definitive	Solid	Multiple	NA	TestAmerica Sacramento	• Per WS11, samples with <75% fines will be dried, sieved, and then the fines (<0.25 mm) fraction will be analyzed for D/F, PCB, SVOC, PAH, metals, and TOC.
WS-IDP-0005	Preparation of Samples for Analysis of Polychlorinated Dioxins and Furans for HRGC/HRMS, Method 8290, 8290A, & TO-9A, Revision 2.2, Effective 05/28/2015	Definitive	Solid	PCDD/ PCDF	NA	TestAmerica Sacramento	• Note whether sample is designated as high-level or low-level per COC form, based on criteria in Attachment 1 to WS-WI-0037. Samples will be prepared and analyzed as indicated in Attachment 1 to WS-WI-0037. • As appropriate for high-level samples, some reduction in sample extraction mass is allowed so as to reduce the mass of the target analytes in the initial extracts. Additional dilutions should be prepared as described in Attachment 1 to WS-WI-0037.

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix	Analytical Group	Instrument	Organization Performing Analysis	Summary of Project-Specific Work Instructions (refer to Lab SOP for details)
WS-ID-0005	Analysis of Samples for Polychlorinated Dioxins and Furans by HRGC/HRMS (Methods 8290, 8290A & TO-9A), Revision 7.6, Effective 6/6/2014	Definitive	Solid	PCDD/ PCDF	HRGC/HRMS	TestAmerica Sacramento	• As appropriate for high-level samples, dilute extracts to the degree necessary, provided the analyses still meet project data use requirements and retain quantitation by isotope dilution as described in Attachment 1 to WS-WI-0037. • If results for a high-level sample for one or more congeners is greater than 400 micrograms per kilogram (µg/kg), re-extract for analysis using LRMS method, as described in Attachment 1 to WS-WI-0037. • If results from high-level sample analysis are less than the sample specific practical quantitation limits, the analysis should be performed using a lower-level approach as described in Attachment 1 to WS-WI-0037.
WS-IDP-0011	Extraction of Polychlorinated Dibenzo-p-dioxins and Dibenzofurans for Low Resolution GC/MS Analysis (Method 8280A and 8280B), Revision 2.6, Effective 4/21/2015	Definitive	Solid	PCDD/ PCDF	GC/MS	TestAmerica Sacramento	• If results for a high-level sample indicate one or more congener concentrations greater than 400 µg/kg, then re-extract for analysis using LRMS method (SOP WS-IDP-0011), as described in Attachment 1 to WS-WI-0037.
WS-ID-0011	Analysis of Polychlorinated Dibenzo-p-dioxins and Dibenzofurans (Method 8280A & 8280B), Revision 4.4, Effective 03/08/2013	Definitive	Solid	PCDD/ PCDF	GC/MS	TestAmerica Sacramento	• As appropriate for high-level samples that exceed 400 µg/kg for one or more congeners in the HRMS analysis, re-extract and reanalyze the samples by LRMS method, as described in Attachment 1 to WS-WI-0037.

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix	Analytical Group	Instrument	Organization Performing Analysis	Summary of Project-Specific Work Instructions (refer to Lab SOP for details)
WS-IDP-0013	PCB Preparation for Analysis by HRGC/HRMS, (Method 1668A, 1668C, & CBC01.2), Revision 3.1, Effective 10/17/2014	Definitive	Solid	PCB	HRGC/HRMS	TestAmerica West Sacramento	• Log sample for low-level analysis as indicated on the associated chain-of-custody, which is based on criteria in Attachment 2 to WS-WI-0037. • If results for any low-level samples indicate that concentrations are higher than expected and the high-level protocol is more appropriate, re-extract and analyze the sample following the high-level HRMS protocol as described in Attachment 2 to WS-WI-0037. Re-extraction and analysis for the high-level HRMS protocol is indicated if detector response for any analyte exceeds the linear response range of the detector (i.e., detector saturation) at the maximum possible dilution (approximately 10X).
WS-ID-0013	PCB Analysis by HRGC/HRMS (Method 1668A and 1668C), Revision 4.4, Effective 5/07/2014	Definitive	Solid	PCB	HRGC/HRMS	TestAmerica Sacramento	• As appropriate, dilute extracts to the maximum extent possible while still retaining quantitation by isotope dilution as described in Attachment 2 to WS-WI-0037. • For sample extracts with concentrations greater than the calibration range at maximum dilution, re-extract the samples at a minimum 10X dilution based on original results, as described in Attachment 2 to WS-WI-0037. • After re-extraction at dilution, if results are greater than the calibration range at the maximum dilution, qualify results as estimated.

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix	Analytical Group	Instrument	Organization Performing Analysis	Summary of Project-Specific Work Instructions (refer to Lab SOP for details)
2172-MSEPrep	Microscale Solvent Extraction (MSE), Revision 9, Effective 02/17/2015	Definitive	Solid	PCB	HRGC/LRMS	Alpha Analytical	• Log sample for high-level analysis as indicated on the associated chain-of-custody, which is based on criteria in Attachment 2 to WS-WI-0037. • As appropriate for high-level samples, some reduction of sample volume or mass of sample to be extracted is allowed so as to reduce the mass of the target analytes in the initial extracts.
2162-SOP	Determination of PCB Homologs, 136/209 Individual Congeners, and Pesticides Confirmation by GC/MS-SIM, Revision 12, Effective 02/23/2015	Definitive	Solid	PCB	HRGC/LRMS	Alpha Analytical	• As appropriate, dilute extracts to the degree necessary, provided the analyses still meet project data use requirements and retaining quantitation by isotope dilution. • For high-level results greater than the calibration range or the linear response range of the detector, re-extract the samples at a more appropriate dilution. • If LRMS sample has no congener detected above 20 µg/kg, then ERM will request TestAmerica to analyze sample by HRMS.
2169	Sulfuric Acid Cleanup (EPA Method 3665A), Effective 3/2/2012	Definitive	Solid	PCB	NA	Alpha Analytical	• Cleanup of extracts for high-level samples.

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix	Analytical Group	Instrument	Organization Performing Analysis	Summary of Project-Specific Work Instructions (refer to Lab SOP for details)
WS-OP-0001	Extraction of Semivolatile Organic Compounds for Analysis by Method 8270C, Based on SW-846 3500 Series and 3600 Series, and PAH-SIM by Internal Standard and Isotope Dilution Procedures, Method 8270C, Revision 4.1, Effective 08/22/2014	Definitive	Solid	SVOC / PAH	NA	TestAmerica Sacramento	• Log sample for high-level or low-level analysis as indicated on the associated chain-of-custody, which is based on criteria in Attachments 3 and 8 of WS-WI-0037. • Perform an initial 10X dilution to expected high-level solid samples. • As appropriate for high-level samples, some reduction of sample volume or mass of sample to be extracted is allowed so as to reduce the mass of the target analytes in the initial extracts. However, multiple dilutions and analyses may be required to meet project specific requirements. Additional dilutions should be prepared as described in WS-OP-0001 and WS-MS-0005. • Apply appropriate number of sample extract cleanup techniques (cleanups may include, but not necessarily limited to the following: polymeric reversed-phase cartridge and silica gel cleanup per WS-OP-0001 and gel permeation chromatography cleanup per WS-OP-0012.
WS-OP-0012	Gel Permeation Cleanup (Method 3640A), Revision 4.2, Effective 05/10/2013	Definitive	Solid	SVOC / PAH	NA	TestAmerica Sacramento	None

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix	Analytical Group	Instrument	Organization Performing Analysis	Summary of Project-Specific Work Instructions (refer to Lab SOP for details)
WS-MS-0005	Semivolatile Organic Compounds (Base/Neutral and Acids) by GC/MS (Methods 8270C, 8270D, 625, and TO-13A), Revision 5.1, Effective 03/20/2015	Definitive	Solid	SVOC	GC/MS	TestAmerica Sacramento	• If select SVOCs are not detected above adjusted practical quantitation limits or method reporting limits during analysis in Full Scan mode, perform confirmation analysis using SIM for the following SVOCs: 2,4,6-trichlorophenol, hexachlorobenzene, hexachlorobutadiene, N-nitrosodimethylamine, and pentachlorophenol. • As appropriate for high-level samples, dilute extracts to the degree necessary, provided the analyses still meet project data use requirements and retaining quantitation by isotope dilution as described in Attachment 3 to WS-WI-0037. • For high-level results greater than the calibration range or the linear response range of the detector, reanalyze the samples at a more appropriate dilution as described WS-MS-0005. • If results from high-level sample analysis are less than the sample specific practical quantitation limits, the analysis should be performed using a lower-level approach as described.
WS-MS-0007	Determination of Volatile Organics and Total Purgeable Petroleum Hydrocarbons by GC/MS (Methods 8260B, 8260C, 624, CA-LUFT, and AK101), Revision 5.1, Effective 9/5/2014	Definitive	Solid	VOC	GC/MS	TestAmerica Sacramento	None

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix	Analytical Group	Instrument	Organization Performing Analysis	Summary of Project-Specific Work Instructions (refer to Lab SOP for details)
WS-MS-0008	Determination of Polycyclic Aromatic Hydrocarbons (PAH) by GC/MS-SIM Internal Standard Technique (Method 8270C and 8270D), Revision 2.6, Effective 03/20/2015	Definitive	Solid	PAH	GC/MS	TestAmerica Sacramento	• When silica gel cleanup is used, the surrogate nitrobenzene-d5 is not reported. Extraction efficiency is monitored using 2-fluorobiphenyl and terphenyl-d14 as surrogates.
WS-IP-0002	Acid Digestion of Soils, SW-846 Method 3050B, Revision 5.3, Effective 01/19/2012	Definitive	Solid	ICP / ICP MS Metals	NA	TestAmerica Sacramento	• Based on previous results, salinity levels will necessitate designating all samples as high-level samples. As appropriate for high-level samples, increase final digestate volume to 500 mL equivalent (5X dilution) for ICP and 200 mL equivalent (2X dilution) for ICP MS (for solid samples).
WS-MT-0001	Analysis of Metals by Inductively Coupled Plasma/Mass Spectrometry (Methods 200.8, 6020, and 6020A), Revision 3.8, Effective 12/12/2014	Definitive	Solid	ICP MS Metals	ICP MS	TestAmerica Sacramento	• Perform all ICPMS analyses using Collision Cell Technology. • The nominal starting dilution for high level samples will be 2X. • If results from the 2X dilution are < PQL for all analytes and no matrix interferences are evident, analysis should be performed using the low-level approach as described in Attachment 4 to WS-WI-0037.
WS-MT-0003	Inductively Coupled Plasma-Atomic Emission Spectroscopy, Spectrometric Method for Trace Element Analyses, SW-846, Methods 6010B, 6010C, & EPA Method 200.7, Revision 5.5, Effective 12/05/2014	Definitive	Solid	ICP Metals	ICP	TestAmerica Sacramento	• If diluted sample results are < PQL for all analytes and no matrix interferences are evident, analysis should be performed using the low-level approach as described in Attachment 4 to WS-WI-0037.
WS-MT-0007	Preparation and Analysis of Mercury in Solid Samples by Cold Vapor Atomic Absorption (Method 7471A & 7471B), Revision 5.3, Effective 01/07/2014	Definitive	Solid	Mercury	CVAA	TestAmerica Sacramento	None

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix	Analytical Group	Instrument	Organization Performing Analysis	Summary of Project-Specific Work Instructions (refer to Lab SOP for details)
WS-WC-0010	Determination of Perchlorate by Ion Chromatography [Method 314.0], Revision 5.1, Effective 05/30/2014	Definitive	Solid	Perchlorate	Ion chromatography (IC)	TestAmerica Sacramento	• Apply cleanup using Ba/Ag/H cartridge up to two times. • Apply dilutions as appropriate to comply with maximum conductivity requirements. • Use MXS/MSD aliquots to verify cleanup method performance. • Confirm all detections above the method detection limit via Method 6850.
WS-LC-0012	Determination of Perchlorate by Liquid Chromatography-Coupled with Tandem Mass Spectrometry (LC/MS/MS) by Method 6850, Revision 6.3, Effective 02/10/2014	Definitive	Solid	Perchlorate	High-performance liquid chromatography /MS/MS	TestAmerica Sacramento	• Use method 6850 for solid samples with positive detections above the method detection limit using Method 314.0. • Apply cleanup using Ba/Ag/H cartridge up to two times. • Use MXS/MSD aliquots to verify cleanup method performance.
DV-WC-0048	Carbon in Soil (TOC, TC, TIC) [SW846 9060, 9060A], Revision 6, Effective 5/31/14	Definitive	Solid	TOC	Carbonaceous Analyzer	TestAmerica Denver	None
WS-WC-0044	EPA Method 9045C, 9045D pH Soils and Manual pH Aqueous (Method 9045C, 9045D, SM4500H+ -B and 9040B); Revision 6.4, Effective 08/07/2014	Definitive	Solid	pH	Autotitrator	TestAmerica Sacramento	None
SA-GE-040	Cyanide: Total, Amenable, and Weak Acid Dissociable (SW-846 9012A), Revision 11, Effective 12/01/14	Definitive	Solid	Cyanide	Lachat Autoanalyzer	TestAmerica Savannah	None
Grain Size Analysis	Grain Size Analysis: percent passing 0.25 mm (#60) sieve) Final 01, Effective 06/25/2015	Definitive	Solid	Physical Parameters	Sieve	GeoStrata	None
WS-OP-0013	Determination of Percent Moisture, (ASTM D2216), Revision 4.2, Effective 03/29/2013	Definitive	Solid	Physical Parameters	Balance	TestAmerica Sacramento	None

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix	Analytical Group	Instrument	Organization Performing Analysis	Summary of Project-Specific Work Instructions (refer to Lab SOP for details)
WS-QA-0018	Subsampling and Compositing of Samples, (ASTM D6323-98), Revision 4.0, Effective 04/04/2014	NA	Solid	Multiple	NA	TestAmerica Sacramento	None
WS-QA-0003	Sample Receipt and Procedures (Quality Assurance Procedure), Revision 11.9, Effective 09/30/2014	NA	NA	NA	NA	TestAmerica Sacramento	• As appropriate, sample fractions for SVOCs, PCBs, Dioxins, and metals will be identified based on historical information as high- or low-level samples. When samples are designated as high-level, special sample processing will be required as discussed above and in the appropriate SOPs.
WS-QAM	Quality Assurance Manual, TestAmerica Sacramento, Revision 5.3, Effective 02/02/2015	NA	NA	NA	NA	TestAmerica Sacramento	None
TAL Denver QAM	Quality Assurance Manual, TestAmerica Denver, Revision 6, Effective 7/31/2014	NA	NA	NA	NA	TestAmerica Denver	None
SA-QAM	Quality Assurance Manual, TestAmerica Savannah, Revision 4, Effective 07/18/2014	NA	NA	NA	NA	TestAmerica Savannah	None
1558 QSM	Quality Systems Manual, Revision 7, Effective 04/01/2015	NA	NA	NA	NA	Alpha Analytical	None

24.0 ANALYTICAL INSTRUMENT CALIBRATION TABLE (SAP WORKSHEET #24)

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
Autotitrator	Soil pH	Minimum three point calibration with buffers of known pH.	Initial calibration prior to sample analysis	r ≥ 0.995	Evaluate buffers and instrument response. If problem found with above, correct as appropriate, then repeat initial calibration.	Lab Manager / Analyst [b]	WS-WC-0044
Autotitrator	Soil pH	Initial calibration verification (ICV, Second Source) buffer solution	Immediately following ICAL.	Result within ± 0.1 pH unit.	Evaluate data. If problem (e.g., concentrated buffer, autosampler error) found, correct, then repeat second source verification. If still fails, repeat initial calibration.	Lab Manager / Analyst [b]	WS-WC-0044
Autotitrator	Soil pH	Daily calibration verification	Prior to sample analysis, after every 10 field samples, and at the end of the sequence.	Result within ± 0.1 pH unit.	Evaluate buffer and instrument response. If problem found with above, correct as appropriate, then repeat CCV. If still fails, repeat initial calibration. Reanalyze all samples since the last successful calibration verification	Lab Manager / Analyst [b]	WS-WC-0044
Carbonaceous Analyzer	TOC	Demonstrate instrument stability and low background with reagent blanks.	Daily, prior to use	3 consecutive blanks show less than 1000 counts.	Repeat until criterion is met. If difficulty in meeting criterion (high background), evaluate reagents.	Lab Manager / Analyst [b]	WS-WC-0017
Carbonaceous Analyzer (Solid Analysis Only)	TOC	Minimum five-point initial calibration for target analytes, with one point at or below the reporting limit.	Initial calibration prior to sample analysis	Correlation coefficient, r, ≥ 0.995	Evaluate standards and detector response. If problem found with above, correct as appropriate then repeat initial calibration.	Lab Manager / Analyst [b]	WS-WC-0017

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
Carbonaceous Analyzer	TOC	Initial calibration verification (ICV, Second Source)	Immediately following ICAL.	Measured response within ± 10% of the expected value based on the ICAL.	Evaluate data. If problem (e.g., concentrated standard, blocked sparger, plugged gas line) found, correct, then repeat second source verification. If still fails, repeat initial calibration.	Lab Manager / Analyst [b]	WS-WC-0017
Carbonaceous Analyzer	TOC	Calibration Blanks (ICB/CCB)	ICB: Immediately following ICV, CCB: Immediately following CCV.	Measured response within ± reporting limit from zero.	NA	Lab Manager / Analyst [b]	WS-WC-0017
Carbonaceous Analyzer	TOC	Daily calibration verification (CCV)	After every 10 field samples, and at the end of the sequence.	Solid Analysis: Measured response within ± 15% of the expected value based on the ICAL.	Evaluate standard and detector response. If problem found with above, correct as appropriate, then repeat CCV. If still fails, repeat initial calibration. Reanalyze all samples since the last successful calibration verification	Lab Manager / Analyst [b]	WS-WC-0017
CVAA	Mercury	IC per manufacturer's instructions, with a minimum of five standards and a calibration blank	Initial calibration prior to sample analysis	Correlation coefficient >0.995; accepted if the ICV passes	Evaluate standard and instrument response. If problem with instrument (autosampler failure, response poor, etc.) or standards, correct as appropriate, then repeat initial calibration.	Lab Manager / Analyst [b]	WS-MT-0007
CVAA	Mercury	Second-source ICV, prepared at the calibration midpoint	Once per initial calibration	Less than 10% difference from IC for all target analytes	Evaluate standards and instrument response. If standard issue, repeat or remake then repeat standard as appropriate. If still fails, repeat initial calibration.	Lab Manager / Analyst [b]	WS-MT-0007

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
CVAA	Mercury	CCV, same source as IC	Following IC, after every 10 samples and the end of the sequence	Less than 20% difference from IC for all target analytes	Evaluate standard and instrument response. If problem with instrument (autosampler failure, response poor, etc.) or standards, correct as appropriate, then repeat. If still fails, repeat initial calibration. Reanalyze all samples since the last successful calibration verification.	Lab Manager / Analyst [b]	WS-MT-0007
HRGC/HRMS	Dioxins	Tune / Mass Resolution Check (PFK)	At the beginning and the end of each 12-hour period of analysis.	Resolving power ≥ 10,000 at mass to charge ratio m/z=304.9842 & m/z=380.9760 + 5 parts per million (ppm) of expected mass. Lock-mass ion between lowest and highest masses for each descriptor and level of reference ≤ 10% full-scale deflection.	Retune instrument & verify. Assess data for impact if end resolution is less than 10,000 narrate or reinject as necessary.	Lab Manager / Analyst [b]	WS-ID-0005

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
HRGC/HRMS	Dioxins	GC Column Performance Check Solution (CPSM/WDM per method)	Prior to ICAL or calibration verification.	Peak separation between 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) and other TCDD isomers result in a valley of ≤ 25%; and identification of all first and last eluters of the eight homolog retention time windows and documentation by labeling (first/last) on the chromatogram; and absolute retention times for switching from one homologous series to the next ≥ 10 seconds for all components of the mixture.	1) Readjust windows. 2) Evaluate system. 3) Perform maintenance. 4) Reanalyze CPSM. 5) No corrective action is necessary if 2,3,7,8-TCDD is not detected and the % valley is greater than 25%.	Lab Manager / Analyst [b]	WS-ID-0005
HRGC/HRMS	Dioxins	Minimum five-point initial calibration for target analytes, lowest concentration standard at or near the reporting limit. (ICAL)	ICAL prior to sample analysis, as needed by the failure of calibration verification, and when a new lot is used as a standard source for calib verification, internal standard (ISTD) or recovery standard solutions.	Relative standard deviation (RSD) ≤ 20% for response factors for 17 unlabeled isomers & 9 labeled isomers, and ion abundance ratios within limits specified in SOP; and signal to noise ratio (S/N) ≥ 10:1 for target analytes.[c]	Evaluate standard and instrument response. If problem with instrument (autosampler failure, response poor, etc.) or standards, correct as appropriate, then repeat initial calibration.	Lab Manager / Analyst [b]	WS-ID-0005

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
HRGC/HRMS	Dioxins	Second-source calibration verification	Immediately following ICAL.	All project analytes within ± 30% of the expected value from the ICAL.	Evaluate standards and instrument response. If standard issue, repeat or remake then repeat standard as appropriate. If still fails, repeat initial calibration	Lab Manager / Analyst [b]	WS-ID-0005
HRGC/HRMS	Dioxins	Calibration Verification (CCV)	At the beginning of each 12-hour period, and at the end of each analytical sequence.	Ion abundance ratios in accordance with SOP; and response factor (RF) (unlabeled standards) within ± 20%D of average RF from ICAL; and RF (labeled standards) within ± 30%D of average RF from ICAL.	Correct problem, repeat calibration verification. If fails, repeat ICAL and reanalyze all samples analyzed since last successful CCV End of Run CCV: If RF (unlabeled standards) > ± 20%D and ≤ ± 25%D and/or RF (labeled standards) > ± 30%D and ≤ ± 35%D of the average RF from ICAL, use mean RF from bracketing CCVs to quantitate impacted samples. If bracketing CCVs differ by more than 25% RPD (unlabeled) or 35% RPD (labeled), run a new ICAL within 2 hours, and requantitate samples. Otherwise, reanalyze samples with positive detections.	Lab Manager / Analyst [b]	WS-ID-0005
LRMS	Dioxins	Tuning	Prior to analyzing calibration standards	Verify MS calibration per the method	Retune instrument and verify. Rerun affected samples.	Lab Manager / Analyst [b]	WS-ID-0011

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
LRMS	Dioxins	GC Column Performance Check (CPSM/WDM per method)	Prior to ICAL or calibration verification.	Peak separation between 2,3,7,8-TCDD and other TCDD isomers result in a valley of ≤ 25%; and identification of all first and last eluters of the eight homolog retention time windows and documentation by labeling (F/L) on the chromatogram; and absolute retention times for switching from one homologous series to the next ≥ 10 seconds for all components of the mixture.	1) Readjust windows. 2) Evaluate system. 3) Perform maintenance. 4) Reanalyze CPSM. 5) No corrective action is necessary if 2,3,7,8-TCDD is not detected and the % valley is greater than 25%.	Lab Manager / Analyst [b]	WS-ID-0011
LRMS	Dioxins	Minimum five-point initial calibration for target analytes, lowest concentration standard at or near the reporting limit (ICAL)	ICAL prior to sample analysis, as needed by the failure of calibration verification, and when a new lot is used as a standard source for calib verification, ISTD or recovery standard solutions.	RSD ≤ 15% for response factors for 17 unlabeled isomers & 9 labelled IS, and ion abundance ratios within limits specified in SOP; and S/N ≥ 10:1for target analytes.	Evaluate standard and instrument response. If problem with instrument (autosampler failure, response poor, etc.) or standards, correct as appropriate, then repeat initial calibration.	Lab Manager / Analyst [b]	WS-ID-0011

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
LRMS	Dioxins	Second-source calibration verification	Immediately following ICAL.	All project analytes within ± 30% of the expected value from the ICAL.	Evaluate standards and instrument response. If standard issue, repeat or remake then repeat standard as appropriate. If still fails, repeat initial calibration	Lab Manager / Analyst [b]	WS-ID-0011
LRMS	Dioxins	Calibration Verification (CCV)	At the beginning of each 12-hour period.	RF % difference within +/- 20%. S/N > 2.5 for unlabeled analytes and >10:1 for internal and recovery standards. All ion ratios must meet method criteria.	Correct problem, repeat calibration verification. If fails, repeat ICAL and reanalyze all samples analyzed since last successful CCV.	Lab Manager / Analyst [b]	WS-ID-0011
LRMS	Dioxins	Sensitivity check	At the end of the 12-hour sample analysis period or the end of analysis (whichever comes first).	Retention times, ion ratios and S/N must meet method criteria.	Repeat analysis.	Lab Manager / Analyst [b]	WS-ID-0011
HRGC/HRMS	PCBs	Tune / Mass Resolution Check (PFK)	At the beginning and the end of each 12-hour period of analysis.	Resolving power ≥ 10,000 at m/z=304.9842 & m/z=380.9760 + 5 ppm of expected mass. Lock-mass ion between lowest and highest masses for each descriptor and level of reference ≤ 10% full-scale deflection. End of run check must be ≥ 5,000.	Retune instrument & verify. Assess data for impact—if end resolution is less than 10,000, narrate or reinject as necessary.	Lab Manager / Analyst [b]	WS-ID-0013

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
HRGC/HRMS	PCBs	GC Column Performance Check (CPSM/WDM per method)	Prior to ICAL or calibration verification.	The congener pairs 23/34 and 182/187 are checked for chromatographic resolution. The valley between each pair must be less than 40% of the shorter of the two peaks. The CS-3 (CCV) is used to define chromatographic windows. First and last eluter must be present in each window.	1) Readjust windows. 2) Evaluate system. 3) Perform maintenance. 4) Reanalyze CPSM.	Lab Manager / Analyst [b]	WS-ID-0013
HRGC/HRMS	PCBs	Minimum five-point initial calibration for target analytes, lowest concentration standard at or near the reporting limit (ICAL)	ICAL prior to sample analysis, as needed by the failure of calibration verification, and when a new lot is used as a standard source for calib verification, ISTD or recovery standard solutions.	RSD ≤ 20% for response factors for Toxic/level of chlorination (LOC) compounds [a]	Evaluate standard and instrument response. If problem with instrument (autosampler failure, response poor, etc.) or standards, correct as appropriate, then repeat initial calibration.	Lab Manager / Analyst [b]	WS-ID-0013
HRGC/HRMS	PCBs	Second-source calibration verification	Immediately following ICAL.	All project analytes within ± 30% of the expected value from the ICAL.	Evaluate standards and instrument response. If standard issue, repeat or remake then repeat standard as appropriate. If still fails, repeat initial calibration	Lab Manager / Analyst [b]	WS-ID-0013

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
HRGC/HRMS	PCBs	CCV	At the beginning of each 12-hour period.	Ion abundance ratios in accordance with SOP; and RF (unlabeled standards) within ± 30%D of average RF from ICAL for Toxic/LOC compounds; and RF (labeled standards) within ± 50%D of average RF from ICAL.	Correct problem, repeat calibration verification. If fails, repeat ICAL and reanalyze all samples analyzed since last successful CCV	Lab Manager / Analyst [b]	WS-ID-0013
LRMS	PCBs	Decafluorotri-phenylphosphine (DFTPP) tune	Prior to each ICAL; At the beginning of analytical sequence; Every 12-18 hrs	Maximum Sensitivity criteria (See SOP)	Perform instrument/injection port maintenance as necessary; Retune instrument	Lab Manager / Analyst [b]	2162
LRMS	PCBs	Initial Calibration (ICAL) Minimum of 5 standards; Low standard must be ≤ RL;	Initial instrument setup; After non-routine instrument service; CCV/ICV criteria are not met	%RSD ≤20 Up to 10% of compounds may exceed criteria of 20%, but must be <30%	Review integrations and calculations; Perform and document remedial action as required; Repeat calibration	Lab Manager / Analyst [b]	2162
LRMS	PCBs	Initial Calibration Verification (ICV)	Immediately after each ICAL	+/- 30% of true value Prepared using standard source different than used for initial calibration	Re-analyze ICV if analytical error is suspected; Recalibrate as needed;	Lab Manager / Analyst [b]	2162
LRMS	PCBs	Continuing Calibration Verification (CCV)	At the beginning of every analytical sequence; Every 12-18 hours	%D ≤ 20 Up to 20% of compounds may exceed 20%, but must be <30%	Review integrations and calculations; Evaluate samples bracketed by failing CCV for obvious matrix interference; Re-analyze samples as needed	Lab Manager / Analyst [b]	2162

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS	PAHs	Check of mass tuning	Prior to ICAL and at the beginning of each 12-hour period.	Values for masses 69, 219, and 264 (if using perfluorotributylamine [PFTBA]) within ± 0.50 atomic mass unit (amu) of the target mass.	Retune instrument and verify.	Lab Manager / Analyst [b]	WS-MS-0008
GC/MS	PAHs	Minimum five-point initial calibration for target analytes, lowest concentration standard at or near the reporting limit (ICAL)	Initial calibration prior to sample analysis	a) RSD for each analyte ≤ 15%; or b) linear least squares regression r ≥ 0.995; or c) non-linear regression chemical oxygen demand (COD) r-sq ≥ 0.99, min 6 points for second order.	Evaluate standards, chromatography, and MS response. If problem found with above, correct as appropriate, then repeat initial calibration.	Lab Manager / Analyst [b]	WS-MS-0008
GC/MS	PAHs	Second-source calibration verification	Once after each ICAL	All project analytes within ± 20% of true value.	Evaluate data. If problem (e.g., concentrated standard, plugged syringe) found, correct; then repeat second source verification. If it still fails, then repeat initial calibration.	Lab Manager / Analyst [b]	WS-MS-0008
GC/MS	PAHs	Retention Time Window Position Establishment	Once per ICAL, for each analyte and surrogate.	Set position using the mid-point standard of the ICAL when ICAL is performed. On days when ICAL is not performed, use initial CCV.	NA	Analyst	WS-MS-0008
GC/MS	PAHs	Daily calibration verification	Daily, prior to sample analysis and every 12 hours of analysis time.	%Difference/%Drift for all target compounds and surrogates: %D ≤ 20%	Evaluate standard, chromatography, and MS response. If problem found with above, correct as appropriate, then repeat CCV. If still fails, repeat initial calibration.	Lab Manager / Analyst [b]	WS-MS-0008
GC/MS	PAHs	ISTD	During acquisition of calibration standard.	Areas within -50% to +100% of last ICAL mid-point for each CCV	Inspect MS and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning	Lab Manager / Analyst [b]	WS-MS-0008

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS	Semivolatiles	Check of mass spectral ion intensities (tuning procedure) using decafluorotriphenylphosphine (8270C)	Prior to ICAL and at the beginning of each 12-hour period.	Refer to method/SOP for specific ion criteria.	Retune instrument and verify.	Lab Manager / Analyst [b]	WS-MS-0005
GC/MS	Semivolatiles	Minimum five-point initial calibration for target analytes, lowest concentration standard at or near the reporting limit. (ICAL)	Initial calibration prior to sample analysis	1) Average Response factor (RF) for system performance check compounds (SPCCs): > 0.050 2) RSD for RFs for calibration check compounds (CCCs): <30% and one option below: a) RSD for each analyte <15%, b) linear least squares regression r > 0.995; c) non-linear regression COD r-sq > 0.99, min 6 points for second order.	Correct problem, then repeat initial calibration	Lab Manager / Analyst [b]	WS-MS-0005
GC/MS	Semivolatiles	Second-source calibration verification	Once after each ICAL	All project analytes within ± 20% of true value.	Correct problem, and verify second source standard. Rerun verification. If still fails, repeat initial calibration.	Lab Manager / Analyst [b]	WS-MS-0005
GC/MS	Semivolatiles	Retention Time Window Position Establishment	Once per ICAL, for each analyte and surrogate.	Set position using the mid-point standard of the ICAL when ICAL is performed. On days when ICAL is not performed, use initial CCV.	NA	Analyst	WS-MS-0005

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS	Semivolatiles	Daily calibration verification	Daily, prior to sample analysis and every 12 hours of analysis time.	1. Min relative RF for SPCCs: >0.050 2. %Difference/%Drift for all target compounds and surrogates: %D < 20%	Correct problem, then repeat. If still fails, repeat initial calibration. Reanalyze all samples since last successful calibration verification.	Lab Manager / Analyst [b]	WS-MS-0005
GC/MS	Semivolatiles	ISTDs	During acquisition of calibration standard.	Areas within -50% to +100% of last ICAL mid-point for each CCV	Inspect MS and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning	Lab Manager / Analyst [b]	WS-MS-0005
GC/MS	Volatiles	Check of mass spectral ion intensities (tuning procedure) using bromofluorobenzene (BFB) (8260B)	Prior to ICAL and at the beginning of each 12-hour period.	Refer to method/SOP for specific ion criteria.	Retune instrument and verify.	Lab Manager / Analyst [b]	WS-MS-0007
GC/MS	Volatiles	Minimum five-point initial calibration for target analytes, lowest concentration standard at or near the reporting limit (ICAL)	Initial calibration prior to sample analysis	1) Average RF for SPCCs: VOCs > 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane, > 0.10 for chloromethane, bromoform, and 1,1-dichloroethane 2) RSD for RFs for CCCs: <30% and one option below: a) RSD for each analyte <15%, b) linear least squares regression r > 0.995; c) non-linear regression COD r-sq > 0.99, min 6 points for second order.	Evaluate standards, chromatography, and MS response. If problem found with above, correct as appropriate, then repeat initial calibration.	Lab Manager / Analyst [b]	WS-MS-0007

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS	Volatiles	Second-source calibration verification	Once after each ICAL	All project analytes within ±20% of true value.	Evaluate data. If problem (e.g., concentrated standard, plugged purge line) found, correct; then repeat second source verification. If it still fails, then repeat initial calibration.	Lab Manager / Analyst [b]	WS-MS-0007
GC/MS	Volatiles	Retention Time Window Position Establishment	Once per ICAL, for each analyte and surrogate.	Set position using the mid-point standard of the ICAL when ICAL is performed. On days when ICAL is not performed, use initial CCV.	NA	Analyst	WS-MW-0007
GC/MS	Volatiles	Daily calibration verification	Daily, prior to sample analysis and every 12 hours of analysis time.	1. Min relative RF for SPCCs: relative RF > 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane, > 0.10 for chloromethane, bromoform, and 1,1-dichloroethane. 2. %Difference/%Drift for all target compounds and surrogates: %D < 20%	Evaluate standard, chromatography, and MS response. If problem found with above, correct as appropriate, then repeat CCV. If still fails, repeat initial calibration.	Lab Manager / Analyst [b]	WS-MS-0007
GC/MS	Volatiles	ISTDs	During acquisition of calibration standard.	Areas within -50% to +100% of last ICAL mid-point for each CCV	Inspect MS and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning	Lab Manager / Analyst [b]	WS-MS-0007
ICP	ICP Metals	Initial calibration per manufacturer's instructions, with a minimum of one standard and a calibration blank	Initial calibration prior to sample analysis	Correlation coefficient >0.995 (if more than one point); accepted if the ICV passes.	Evaluate standard and instrument response. If problem with instrument (autosampler failure, response poor, etc.) or standards, correct as appropriate; then repeat initial calibration.	Lab Manager / Analyst [b]	WS-MT-0003

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
ICP	ICP Metals	Low concentration standard at or near the reporting limit	Daily, after one point calibration	Within ± 20% of the true value for all target analytes.	Evaluate standard and instrument response. If problem with instrument (autosampler failure, response poor, etc.) or standards, correct as appropriate, then repeat. If still fails, repeat initial calibration.	Lab Manager / Analyst [b]	WS-MT-0003
ICP	ICP Metals	Second-source ICV, prepared at the calibration midpoint	Once per initial calibration	Within ± 10% of the true value for all target analytes.	Evaluate standards and instrument response. If standard issue, repeat or remake then repeat standard as appropriate. If still fails, repeat initial calibration.	Lab Manager / Analyst [b]	WS-MT-0003
ICP	ICP Metals	CCV, same source as initial calibration	Following IC, after every 10 samples and the end of the sequence	Within ± 10% of the true value for all target analytes.	Evaluate standard and instrument response. If problem with instrument (autosampler failure, response poor, etc.) or standards, correct as appropriate; then repeat. If still fails, repeat initial calibration. Reanalyze all samples since the last successful calibration verification.	Lab Manager / Analyst [b]	WS-MT-0003

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
ICP	ICP Metals	Interference check standard (ICS)	At the beginning of an analytical run	Interference check standard A (ICSA-A): Absolute values of concentration for all non-spiked analytes < limit of detection (LOD) (unless they are a verified trace impurity from one of the spiked analytes); ICS-AB: Within ±20% of true value in accordance with National Functional Guidelines requirements.	Terminate analysis, then reanalyze ICS and all affected samples in accordance with National Functional Guidelines requirements.	Lab Manager / Analyst [b]	WS-MT-0003
ICP MS	ICP MS Metals	Tuning	Prior to initial calibration	Mass calibration ≤ 0.1 amu from true value; Resolution < 0.9 amu full width at 10% peak height; For stability, RSD ≤ 5% for at least four replicate analyses.	Correct problem, then repeat tuning.	Lab Manager / Analyst [b]	WS-MT-0001
ICP MS	ICP MS Metals	Instrument Detection Limit (IDL) Study	At initial set-up, and after significant change in instrument type, personnel, test method, or sample matrix.	Calculated IDLs < LOD	NA	Lab Manager / Analyst [b]	WS-MT-0001

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
ICP MS	ICP MS Metals	Initial calibration per manufacturer's instructions, with a minimum of one standard and a calibration blank	Initial calibration prior to sample analysis	Correlation coefficient >0.995 (if more than one point).	Evaluate standard and instrument response. If problem with instrument (autosampler failure, response poor, etc.) or standards, correct as appropriate; then repeat initial calibration.	Lab Manager / Analyst [b]	WS-MT-0001
ICP MS	ICP MS Metals	Low concentration standard at or near the reporting limit	Daily, after one point calibration	Within ±20% of the true value for all target analytes.	Evaluate standard and instrument response. If problem with instrument (autosampler failure, response poor, etc.) or standards, correct as appropriate; then repeat. If still fails, repeat initial calibration.	Lab Manager / Analyst [b]	WS-MT-0001
ICP MS	ICP MS Metals	Linear dynamic range or high-level check standard	Every 6 months	Within ±10% of the true value for all target analytes.	Adjust dynamic range downward and repeat.	Lab Manager / Analyst [b]	WS-MT-0001
ICP MS	ICP MS Metals	Second-source ICV, prepared at the calibration midpoint	Once per initial calibration	Within ±10% of the true value for all target analytes.	Evaluate standards and instrument response. If standard issue, repeat or remake then repeat standard as appropriate. If still fails, repeat initial calibration.	Lab Manager / Analyst [b]	WS-MT-0001
ICP MS	ICP MS Metals	CCV, same source as initial calibration	Following initial calibration, after every 10 samples and the end of the sequence	Within ±10% of the true value for all target analytes.	Evaluate standard and instrument response. If problem with instrument (autosampler failure, response poor, etc.) or standards, correct as appropriate; then repeat. If still fails, repeat initial calibration. Reanalyze all samples since the last successful calibration verification.	Lab Manager / Analyst [b]	WS-MT-0001

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
ICP MS	ICP MS Metals	ISTDs	Every CCV/CCB.	ISTD intensity within 80-120% of the ISTD in the initial calibration blank.	Evaluate analyses prior to failing ISTD to determine if matrix carryover or instrument failure. If instrument, correct as appropriate and repeat initial calibration. Reanalyze all samples since the last successful calibration verification.	Lab Manager / Analyst [b]	WS-MT-0001
Ion Chromatograph	Perchlorate	Minimum five-point initial calibration for target analytes, lowest concentration standard at or near the reporting limit	Initial calibration prior to sample analysis	Linear least squares regression: $r \geq 0.995$.	Evaluate standards, chromatography, and detector response. If problem found with above, correct as appropriate, then repeat initial calibration	Lab Manager / Analyst [b]	WS-WC-0010
Ion Chromatograph	Perchlorate	Initial calibration verification (ICV, Second Source)	Immediately following ICAL.	All project analytes within ± 10% of the expected value from the ICAL.	Evaluate data. If problem (e.g., concentrated standard, plugged injector needle) found, correct, then repeat second source verification. If still fails, repeat initial calibration.	Lab Manager / Analyst [b]	WS-WC-0010
Ion Chromatograph	Perchlorate	Daily calibration verification	Prior to sample analysis, after every 10 field samples, and at the end of the sequence.	All project analytes within ± 15% of the expected value from the ICAL.	Evaluate standard, chromatography, and detector response. If problem found with above, correct as appropriate, then repeat CCV. If still fails, repeat initial calibration. Re-analyze all samples since the last successful calibration verification	Lab Manager / Analyst [b]	WS-WC-0010
LC/MS/MS	Perchlorate	Tuning (Mass Calibration Verification)	Prior to ICAL and after any mass calibration or maintenance is performed.	Quantitation ions within 0.3 m/z of expected mass.	Perform mass calibration on the MS/MS. If required, consult with instrument engineer for further maintenance.	Lab Manager / Analyst [b]	WS-LC-0012

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
LC/MS/MS	Perchlorate	Minimum six-point initial calibration for target analytes, lowest concentration standard at or below the reporting limit	Initial calibration prior to sample analysis	Linear: $r^2 > 0.990$ ($r>0.995$) with intercept ≤ LOD, or Average Response Factor: RSD≤ 20%.	Evaluate standards, chromatography, and MS. If problem found with above, correct as appropriate, then repeat initial calibration.	Lab Manager / Analyst [b]	WS-LC-0012
LC/MS/MS	Perchlorate	Second-source calibration verification	Once per six-point initial calibration	Perchlorate within ±15% of the true value	Evaluate data. If problem (e.g., concentrated standard, plugged transfer line) found, correct, then repeat second source verification. If it still fails, then repeat initial calibration.	Lab Manager / Analyst [b]	WS-LC-0012
LC/MS/MS	Perchlorate	Daily calibration verification	Mid-range standard analyzed before sample analysis, after every 10 samples, and at the end of the sequence.	Perchlorate within ±15% of the true value	Correct problem, then repeat. If still fails, repeat initial calibration	Lab Manager / Analyst [b]	WS-LC-0012
LC/MS/MS	Perchlorate	Limit of Detection verification (LODv) (per batch)	Prior to sample analysis and at the end of the analysis sequence.	Perchlorate within ± 30% of the true value	Correct problem. Evaluate samples. Samples with results > RL (limit of quantitation [LOQ]) may be reported. Samples since the last passing LODv with results ≤ RL (LOQ) must be reanalyzed.	Lab Manager / Analyst [b]	WS-LC-0012
LC/MS/MS	Perchlorate	Laboratory Reagent Blank	Prior to ICAL, following samples with overrange concentration of perchlorate, and at the end of the analytical sequence.	No perchlorate detected > quantitation limit (QL)	Reanalyze reagent blank (until no carryover seen), and any samples with perchlorate detections since the contaminated blank.	Lab Manager / Analyst [b]	WS-LC-0012

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
LC/MS/MS	Perchlorate	ISTD	Every Calibration Standard	ICAL: ISTD for each standard must be within ± 50% of the average area of the ICAL. ICV, CCV: Within ± 50% of the average area of the ICAL or within ± 50% of the 1st CCV of the run, if the ICAL is not run the same day.	Evaluate the system. Reanalyze/repeat the calibration.	Lab Manager / Analyst [b]	WS-LC-0012
Lachat Autoanalyzer	Cyanide	ICAL	Daily, prior to sample analysis. - Minimum 6 standards and blank	r $\geq$ 0.995	Re-calibrate instrument	Analyst	SA-GE-040
Lachat Autoanalyzer	Cyanide	Distilled Standards (Low and High)	After each ICAL	Within ±15% of true value	Reanalyze ICV; Re-calibrate instrument	Analyst	SA-GE-040
Lachat Autoanalyzer	Cyanide	ICV	After each ICAL, prior to sample analysis - Second Source	Within ±15% of true value	Reanalyze ICV; Re-calibrate instrument	Analyst	SA-GE-040
Lachat Autoanalyzer	Cyanide	CCV	After every 10 field samples and at the end of the sequence	Within ±10% of true value	Reanalyze CCV; Re-calibrate & re-analyze affected samples	Analyst	SA-GE-040
Lachat Autoanalyzer	Cyanide	Calibration Blank (ICB/CCB)	After ICV and CCV	<MDL	Reanalyze affected samples	Analyst	SA-GE-040

[a] The toxics/level of chlorination (LOC) are the 27 congeners that are calibrated by a multipoint curve. They encompass the WHO list of toxic congeners and the first and last eluter for each LOC. All other congeners are quantified off of a daily single point standard.

[b] The analyst initiates the corrective action and the lab manager and analyst are responsible for the corrective action.

[c] % recovery for each ISTD in the original sample (prior to dilutions) must be within limits in table per method.

25.0 ANALYTICAL INSTRUMENT AND EQUIPMENT MAINTENANCE, TESTING, AND INSPECTION TABLE (SAP WORKSHEET #25)

Instrument/ Equipment	Analytical Group	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Carbonaceous Analyzer	TOC	Replace indicating drying tube	Sensitivity check	Verify color of indicating desiccant	Daily or as needed	CCV pass criteria	Recalibrate	TestAmerica Chemist	WS-WC-0016 WS-WC-0017
Carbonaceous Analyzer	TOC	Check nondispersive infrared (NDIR) baseline adjustment, tubing in pump housing, inspect digestion vessel and condensation chamber; clean or replace permeation tube.	Sensitivity check	Instrument performance and sensitivity	Every 3 months (NDIR), 6 months for other items.	CCV pass criteria	Recalibrate	TestAmerica Chemist	WS-WC-0016 WS-WC-0017
CVAA	Mercury	Replace disposables, flush lines	Sensitivity check	Instrument performance and sensitivity	Daily or as needed	CCV pass criteria	Recalibrate	TestAmerica Chemist	WS-MT-0005 WS-MT-0007
HRGC/HRMS/ LRMS	Dioxins, HRGC/HRMS PCBs	Parameter Setup	Physical check	Physical check	Initially; prior to daily calibration check	Correct Parameters	Reset if incorrect	TestAmerica Chemist	WS-ID-0005 WS-ID-0013 WS-ID-0011
HRGC/HRMS/ LRMS	Dioxins, HRGC/HRMS PCBs	Tune Check	Instrument performance	Conformance to instrument tuning.	Initially; prior to daily calibration check	Compliance to ion abundance criteria	Correct the problem and repeat tune check	TestAmerica Chemist	WS-ID-0005 WS-ID-0013 WS-ID-0011

Instrument/ Equipment	Analytical Group	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
LRMS	LRMS PCBs	Inlet maintenance; column	Passing tune/CCAL/ ICAL/ICV; overall chromate-gram	Instrument performance and sensitivity	Frequency is dependent on degree of contamination and standard recovery	See SOP	See SOP	Alpha Analytical Chemist	2162
LRMS	LRMS PCBs	Source cleaning: filaments, insulators	Tuning	Instrument performance and sensitivity	Frequency is dependent on degree of contamination and standard recovery	See SOP	See SOP	Alpha Analytical Chemist	2162
LRMS	LRMS PCBs	Pump	Complete MS pump down	Air and water check	Frequency is dependent on vacuum within instrument	See SOP	See SOP	Alpha Analytical Chemist	2162
GC/MS	Semivolatiles, Volatiles, PAHs	Clean sources, maintain vacuum pumps	Tuning	Instrument performance and sensitivity	Service vacuum pumps twice per year, other maintenance as needed	Tune and CCV pass criteria	Recalibrate instrument	TestAmerica Chemist	WS-MS-0005 WS-MS-0007 WS-MS-0008
GC/MS	Semivolatiles, Volatiles, PAHs	Change septum, clean injection port, change or clip column, install new liner, change trap	Sensitivity check	Instrument performance and sensitivity	Daily or as needed	Tune and CCV pass criteria	Reinspect injector port, cut additional column, reanalyze CCV, recalibrate instrument	TestAmerica Chemist	WS-MS-0005 WS-MS-0007 WS-MS-0008

Instrument/ Equipment	Analytical Group	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
ICP	ICP Metals	Replace disposables, flush lines, clean injector and torch	Intensity of 1 ppm manganese standard (STD) within criteria	Check connections	Daily or as needed	Intensity of 1 ppm manganese STD within criteria	Replace, investigate injector, reanalyze	TestAmerica Chemist	WS-MT-0003
ICP	ICP Metals	Replace pump windings	Monitor ISTD counts for variation	Instrument performance and sensitivity	As needed	Monitor ISTD counts for variation	Replace windings, recalibrate and reanalyze	TestAmerica Chemist	WS-MT-0003
ICP MS	ICP MS Metals	Clean sample and skimmer cones	Sensitivity check	Instrument performance and sensitivity	Daily or as needed	Intensity of Daily performance check for Rh at least 200,000 counts	Check pump tubing, clean lenses as needed.	TestAmerica Chemist	WS-MT-0001
ICP MS	ICP MS Metals	Replace pump windings	Monitor ISTD counts for variation	Instrument performance and sensitivity	As needed	Monitor ISTD counts for variation	Replace windings, recalibrate and reanalyze	TestAmerica Chemist	WS-MT-0001
Ion Chromatograph	Perchlorate	Check plumbing/leaks, eluent, gases, pump pressure & conductivity meter.	Sensitivity check	Instrument performance and sensitivity	Daily	CCV pass criteria	Recalibrate	TestAmerica Chemist	WS-WC-0010r5
Ion Chromatograph	Perchlorate	Clean micromembrane suppressor, change column or degas pump head.	Sensitivity check	Instrument performance and sensitivity	As needed	CCV pass criteria	Recalibrate	TestAmerica Chemist	WS-WC-0010r5

Instrument/ Equipment	**Analytical Group**	**Maintenance Activity**	**Testing Activity**	**Inspection Activity**	**Frequency**	**Acceptance Criteria**	**Corrective Action**	**Responsible Person**	**SOP Reference**
LC/ MS / MS	Perchlorate	Replace columns as needed, check eluent reservoirs	Sensitivity check	Instrument performance and sensitivity	Daily or as needed	CCV pass criteria	Recalibrate	TestAmerica Chemist	WS-LC-0012
Lachat Autoanalyzer	Cyanide	Inspect flow cell, pump tubes, pump oil, and tubing	Detector signals	Instrument performance and sensitivity	Daily	CCV passes criteria	Re-perform as needed; reanalyze CCV; recalibrate instrument	Analyst	SA-GE-040

26.0 SAMPLE HANDLING SYSTEM (SAP WORKSHEET #26)

This worksheet describes the sample handling system requirements for samples. WS#3 contains full contact information for key personnel listed below and Attachment 21 contains field SOPs, specifically USM-04, Sample Management.

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT:

Sample Collection (Personnel/Organization): Field Crew Leader/ERM, Salt Lake City, UT (see WS#3)

Sample Packaging (Personnel/Organization): Field Crew Leader/ERM, Salt Lake City, UT (see WS#3)

Coordination of Shipment (Personnel/Organization): Field Crew Leader/ERM, Salt Lake City, UT (see WS#3)
Type of Shipment/Carrier: Courier and overnight shipping

SAMPLE RECEIPT AND ANALYSIS:

Sample Receipt (Personnel/Organization):
Jeremy Sadler/TestAmerica, West Sacramento, CA
Marilyn Kicklighter / Todd Baumgarner/TestAmerica, Savannah, GA
Mike Dedio/TestAmerica, Denver, CO
Kim Bailey/Alpha Analytical, Mansfield, MA

Sample Custody and Storage (Personnel/Organization):
Jeremy Sadler/TestAmerica, West Sacramento, CA
Marilyn Kicklighter / Todd Baumgarner/TestAmerica, Savannah, GA
Mike Dedio/TestAmerica, Denver, CO
Kim Bailey/Alpha Analytical, Mansfield, MA

Sample Preparation (Personnel/Organization):
Manager of Extractions/TestAmerica, West Sacramento, CA
Celia Vasques/TestAmerica, Savannah, GA
Drew Allen/TestAmerica, Denver, CO
Wayne Reid/Alpha Analytical, Mansfield, MA

Sample Determinative Analysis (Personnel/Organization):
Robert Hrabak/TestAmerica, West Sacramento, CA
Josh Kellar/TestAmerica, Savannah, GA
Drew Allen/TestAmerica, Denver, CO
Nathan Sorelle/Alpha Analytical, Mansfield, MA

SAMPLE ARCHIVING:

Field Sample Storage (No. of days from sample collection):
TestAmerica and Alpha Analytical: Field samples are typically disposed of 30 days past invoice date unless otherwise directed. All Phase 1A-B samples will be archived for one year.

Sample Extract/Digestate Storage (No. of days from extraction/digestion):
TestAmerica and Alpha Analytical: Sample extracts/digestates are kept for 40 days after analysis.

Biological Sample Storage (No. of days from sample collection): N/A

SAMPLE DISPOSAL

Personnel/Organization:
Jeremy Sadler/TestAmerica, West Sacramento, CA
Charlton Riegner/TestAmerica, Savannah, GA
Adam Alban/TestAmerica, Denver, CO
Jay Troy/Alpha Analytical, Mansfield, MA

Number of Days from Analysis:
TestAmerica and Alpha Analytical: Field samples are disposed of 30 days past invoice date unless otherwise directed.

27.0 SAMPLE CUSTODY REQUIREMENTS (SAP WORKSHEET #27)

This worksheet describes sample custody requirements for Site and background solid media samples.

27.1 FIELD SAMPLE CUSTODY PROCEDURES

Sample custody procedures are described in SOP USM-04 along with detailed field sample management procedures (including sample packaging and shipment to the laboratory). Generally, field sample management procedures for solids samples include the following:

- Collect sample into laboratory-provided containers and tightly cap.
- Wrap glass sample jars in bubble-wrap to protect from breakage.
- Place samples upright in a waterproof cooler with inert cushioning material lining the cooler bottom.
- Place wet ice into double plastic bags (to prevent leakage) and place bagged ice around, among, and on top of the sample containers. Enough ice will be used so that the samples will be chilled and maintained at 4 degrees Celsius (°C) ± 2 °C prior to and during transport to the laboratory.
- Fill any remaining space in cooler with inert cushioning material.
- Tape the original copy of the completed COC Record to the cooler lid inside a waterproof plastic bag.
- Place custody seals across the cooler closure in two locations.
- Label the cooler with the shipping address and return address. Do not attach shipping label to cooler handle; tape securely to cooler lid.

COC procedures require a written record of the possession of individual samples from the time of collection through laboratory analyses. A sample is considered to be in custody if it is:

- In a person’s possession;
- In view after being in physical possession;
- In a secured condition after having been in physical custody; or
- In a designated secure area, restricted to authorized personnel.

A COC Record will be used to document the samples collected, sample custody, and the required analyses. A COC Record will be used to document the samples collected, sample custody, and the required analyses. Information recorded by field personnel on the COC Record will include the following:

- Client name (ERM) and ERM project number (1032320);

- Signature of sampler(s);
- Sample identification numbers;
- Date and time of sample collection;
- Signature of individuals involved in custody transfer (including date and time of transfer);
- Airbill number;
- Number of samples collected for each analysis;
- Type of analysis and laboratory method number; and
- Any comments or special instructions regarding individual samples.

All COC entries will be made using waterproof, indelible, black ink and will be legible. Any errors will be corrected by drawing a single line through the incorrect entry, entering the correct information, and then initialing and dating the change. If multiple coolers are sent in one shipment to the laboratory, one cooler will have the original COC Record and the other coolers will have copies. The plastic bag in which the COC Records are placed will be marked “ORIGINAL” or “COPY,” as appropriate. In addition, the outside of the coolers will be marked to indicate how many coolers are in the shipment. The COC Record will also indicate the number of coolers and/or the specific cooler identification number covered under the chain of custody.

Coolers will be delivered to the Federal Express shipping center in Salt Lake City on an as-needed basis to ensure that holding times listed in WS#19 are met. Custody seals will be used on each shipping container to ensure custody and will consist of security tape with the date and initials of the sampler. Shipping addresses for the laboratories are provided in WS #30. The sampler will retain copies of the COC Record and Federal Express airbill. Hard copies of COC Records and airbills/bills of lading will be provided to the Field Team Leader and will be managed in accordance with the DMP (ERM 2013b).

27.2 SAMPLE IDENTIFICATION PROCEDURES

Each sample collected will have a unique sample identification (ID) number. A sample label will be affixed to each sample container. The sample label, at a minimum, will be completed with the following information:

- Client name (ERM) and ERM project number (0132320)
- Sample ID number
- Date and time of sample collection
- Initials of sampler
- Analysis to be performed

Field QC samples are identified in WS #20 and include field duplicates, trip blanks, and equipment rinsate blanks. Field QC samples should have a sequential numbers so they are blind to the laboratory, rather than appending with a "D" or an "FB."

Sample ID numbers will conform to the following format:

Surface Solids Samples

LOC-SS-YY-MMDDYY

where:

LOC is the location ID. These are identified in WS#18 for Inner PRI Area samples and SAP Attachment 11 for background/reference area samples.

SS denotes the sample as "surface solids."

YY is a sequential number for the sample type:
Primary sample – 01
Field Duplicate (Field QC Sample) – 11
Trip Blank (Field QC Sample) – 21
Equipment Rinsate Blank (Field QC Sample) – 31

MMDDYY is the date the sample was collected.

Subsurface Solids Samples

LOC-SB-YY-SD-ED-MMDDYY

where:

LOC is the location ID. These are identified in WS#18 for Inner PRI area samples. Subsurface samples will not be collected at background/reference areas.

SB denotes the sample as "subsurface solids."

YY is a sequential number for the sample type:
Primary sample – 01
Field Duplicate (Field QC Sample) – 11
Trip Blank (Field QC Sample) – 21
Equipment Rinsate Blank (Field QC Sample) – 31

SD is the starting depth of the sample interval (feet bgs).

ED is the ending depth of the sample interval (feet bgs).

MMDDYY is the date the sample was collected.

27.3 LABORATORY SAMPLE CUSTODY PROCEDURES

Each analytical laboratory has internal SOPs describing custody procedures. For example, TestAmerica SOP WS-QA-0003 describes the procedures for laboratory COC, including receipt and acceptance of sample shipments, storage requirements, generation of computer records, and corrective actions for sample receipt anomalies. Laboratory sample custody procedures will follow the laboratories' internal SOPs. Sample handling procedures, including receipt, archival, and disposal of samples, are described in WS#26.

28.0 LABORATORY QC SAMPLES TABLE (SAP WORKSHEET #28)

Matrix	Solid
Analytical Group	HRMS PCBs
Analytical Method/ SOP Reference	EPA Method 1668A WS-ID-0013

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank (MB)	One per preparation batch	No target analytes ≥ QL or 1/10 the concentration in the sample, whichever is greater	Verify instrument clean (evaluate calibration blank & samples prior to MB); then reanalyze. Evaluate to determine if systematic issue within laboratory, correct, then reprep and reanalyze the MB and all samples processed with the contaminated blank in accordance with Quality Systems Management (QSM) requirements. “Totals” are not considered “target analytes” – no corrective action or flagging is necessary for "totals".	Chemist	Accuracy/Bias Contamination	Same as Method / SOP QC Acceptance Limits
ISTD Spike	Every field sample, standard and QC sample	% recovery for each ISTD in the original sample (prior to dilutions) must be limits in Table VIII of SOP.	Correct problem, then reprep and reanalyze the samples with failed ISTD.	Lab Manager / Analyst	Precision and Accuracy/BiasLab Manager / Analyst	Same as Method / SOP QC Acceptance Limits
LCS	One per sample preparation batch	Recovery 50-150%	Reanalyze LCS once. If acceptable, report. Otherwise, evaluate and reprep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Lab Manager / Analyst	Accuracy/Bias Contamination	Same as Method / SOP QC Acceptance Limits

Matrix	Solid
Analytical Group	LRMS PCBs
Analytical Method/ SOP Reference	EPA Method 680 2162

QC Sample	**Frequency / Number**	**Method / SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Method Blank	One per preparatory batch of up to 20 samples	No analyte at or above the reporting limit.	Identify source and attempt to eliminate. Re-extract and/or reanalyze blank and affected samples (if sufficient sample remains). Qualify data as needed. Report data if sample results >5x blank or sample results ND. If contamination is widespread or reoccurring, analyses must be stopped and the source of contamination must be eliminated or reduced before analyses can continue.	Analyst/ Laboratory Quality Assurance Officer	Accuracy/Bias Contamination	Same as Method / SOP QC Acceptance Limits
Field Duplicate	One per preparatory batch of up to 20 samples. Per Client's Request	RPD ≤ 30% for compounds > than 5x the RL	Evaluate during data validation.	Data validation staff	Precision	Same as Method / SOP QC Acceptance Limits
LCS/LCSD	One each per preparatory batch of up to 20 samples.	40-140% Recovery. 30% RPD	Correct problem, reprep and reanalyze LCS/LCSD and all samples in associated batch for failed analytes. If problem persists, contact Project Manager.	Analyst/ Laboratory Quality Assurance Officer	Accuracy	Same as Method / SOP QC Acceptance Limits

Matrix	Solid
Analytical Group	Volatiles
Analytical Method/ SOP Reference	EPA Method 8260B WS-MS-0007

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
Check of mass spectral ion intensities (tuning procedure) using BFB (8260B)	Prior to initial calibration and calibration verification	Must meet the method requirements before samples are analyzed	Retune instrument and verify the tune acceptability.	Lab Manager / Analyst	Sensitivity	Meets all EPA Method requirements
ISTDs	During acquisition of calibration standard, samples, and QC check samples	Areas within -50% to +100% of midpoint of the last ICAL for each sample and QC	Inspect mass spec and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning.	Lab Manager / Analyst	Precisions and Accuracy/Bias	Meets all EPA Method requirements
MB	One per analytical batch (8260B)	No target analytes ≥ QL or 1/10 the concentration in the sample, whichever is greater	Verify instrument clean (evaluate calibration blank & samples prior to MB), then reanalyze. Evaluate to determine if systematic issue within laboratory, correct, then reprep and reanalyze the MB and all samples processed with the contaminated blank.	Lab Manager / Analyst	Accuracy/Bias Contamination	Same as Method / SOP QC Acceptance Limits
LCS	One LCS per analytical/preparation batch	Laboratory control limits are statistically derived for each analyte and subject to periodic updates[1]	Reanalyze LCS once. If acceptable, report. Otherwise, evaluate and reprep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Lab Manager / Analyst	Precision and Accuracy/Bias	Same as Method / SOP QC Acceptance Limits
Surrogate standards	All field and QC samples	Laboratory control limits are statistically derived for each analyte and subject to periodic updates[1]	Evaluate matrix, then analytical data, then re-extract and reanalyze all affected samples as appropriate. Qualify outliers.	Lab Manager / Analyst	Accuracy/Bias	Same as Method / SOP QC Acceptance Limits

Matrix	Solid
Analytical Group	Semivolatiles
Analytical Method/ SOP Reference	EPA Method 8270C WS-MS-0005

QC Sample	**Frequency / Number**	**Method / SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**DQI**	**Measurement Performance Criteria**
ISTDs	During acquisition of calibration standard, samples, and QC check samples	Areas within -50% to +100% of midpoint of the last ICAL for each sample and QC	Inspect mass spec and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning	Lab Manager / Analyst	Precisions and Accuracy/Bias	Meets all EPA Method requirements
MB	One per batch	No target analytes ≥ QL or 1/10 the concentration in the sample, whichever is greater	Verify instrument clean (evaluate calibration blank & samples prior to MB), then reanalyze. Evaluate to determine if systematic issue within laboratory, correct, then reprep and reanalyze the MB and all samples processed with the contaminated blank.	Lab Manager / Analyst	Accuracy/Bias Contamination	Same as Method / SOP QC Acceptance Limits
LCS	One LCS per batch	Recovery 50 -150% for HCB. For other constituents, laboratory control limits are statistically derived for each analyte and subject to periodic updates[1]	Reanalyze LCS once. If acceptable, report. Otherwise, evaluate and reprep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Lab Manager / Analyst	Precision and Accuracy/Bias	Same as Method / SOP QC Acceptance Limits
Surrogate standards	All field and QC samples.	Laboratory control limits are statistically derived for each analyte and subject to periodic updates[1]	Evaluate data; if preparation problem noted, reextract and reanalyze. Otherwise, qualify data in accordance with method requirements.	Lab Manager / Analyst	Accuracy/Bias	Same as Method / SOP QC Acceptance Limits

Matrix	Solid
Analytical Group	PAHs
Analytical Method/ SOP Reference	EPA Method 8270C WS-MS-0008

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
ISTDs	During acquisition of calibration standard, samples, and QC check samples	Areas within -50% to +100% of midpoint of the last ICAL for each sample and QC	Inspect mass spec and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning	Lab Manager / Analyst	Precisions and Accuracy/Bias	Meets all EPA Method requirements
MB	One per analytical batch	No target analytes ≥ QL or 1/10 the concentration in the sample, whichever is greater	Verify instrument clean (evaluate calibration blank & samples prior to MB), then reanalyze. Evaluate to determine if systematic issue within laboratory, correct, then reprep and reanalyze the MB and all samples processed with the contaminated blank.	Lab Manager / Analyst	Accuracy/Bias Contamination	Same as Method / SOP QC Acceptance Limits
LCS	One LCS per analytical/preparation batch	Laboratory control limits are statistically derived for each analyte and subject to periodic updates[1]	Reanalyze LCS once. If acceptable, report. Otherwise, evaluate and reprep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Lab Manager / Analyst	Precision and Accuracy/Bias	Same as Method / SOP QC Acceptance Limits
Surrogate standards	All field and QC samples.	Laboratory control limits are statistically derived for each analyte and subject to periodic updates[1]	Evaluate data; if preparation problem noted, reextract and reanalyze. Otherwise, qualify data in accordance with method requirements.	Lab Manager / Analyst	Accuracy/Bias	Same as Method / SOP QC Acceptance Limits

Matrix	Solid
Analytical Group	HRMS Dioxins
Analytical Method/ SOP Reference	EPA Method 8290 WS-ID-0005

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
MB	One per preparation batch	No target analytes ≥ QL or 1/10 the concentration in the sample, whichever is greater (Octachlorinated dibenzo-p-dioxin [OCDD] is considered a common laboratory contaminant and treated accordingly).	Verify instrument clean (evaluate calibration blank & samples prior to MB), then reanalyze. Evaluate to determine if systematic issue within laboratory, correct, then reprep and reanalyze the MB and all samples processed with the contaminated blank in accordance with method requirements. "Totals" are not considered "target analytes" – no corrective action or flagging is necessary for "totals."	Chemist	Accuracy/Bias Contamination	Same as Method / SOP QC Acceptance Limits
ISTD Spike	Every field sample, standard and QC sample	% recovery for each ISTD in the original sample (prior to dilutions) must be limits in Table per method.	Correct problem, then reprep and reanalyze the samples with failed ISTD.	Lab Manager / Analyst	Precisions and Accuracy/Bias	Meets all EPA Method requirements (40-135% Recovery)
LCS	One per sample preparation batch	Recovery 50-150%	Reanalyze LCS once. If acceptable, report. Otherwise, evaluate and reprep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Lab Manager / Analyst	Accuracy/Bias Contamination	Same as Method / SOP QC Acceptance Limits

Matrix	Solid
Analytical Group	LRMS Dioxins
Analytical Method/ SOP Reference	EPA Method 8280A WS-ID-0011

QC Sample	**Frequency / Number**	**Method / SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**DQI**	**Measurement Performance Criteria**
MB	One per preparation batch	Project specific criteria, if available. Otherwise, no target analytes detected ≥ RL or ≥ 20% of the associated regulatory limit or ≥ 5% of the sample result for the analyte, whichever is greater. (OCDD is considered a common laboratory contaminant and treated accordingly).	Verify instrument clean (evaluate calibration blank & samples prior to method blank), then reanalyze. Evaluate to determine if systematic issue within laboratory, correct, then re-prepare and reanalyze the method blank and all samples processed with the contaminated blank. “Totals” are not considered “target analytes” – no corrective action or flagging is necessary for "totals".	Chemist	Accuracy/Bias Contamination	No target analytes ≥ RL.
ISTD Spike (Isotope Dilution Analytes)	Every field sample, standard and QC sample	% recovery for each ISTD in the original sample (prior to dilutions) must be within limits per method (Section 7.15.5.2).	Evaluate impact on data. If negligible, or a result of matrix effects, narrate. If a result of laboratory error, correct problem, then reprep and reanalyze the samples with failed IS.	Lab Manager / Analyst	Precisions and Accuracy/Bias	Meets all EPA Method requirements (25-150% Recovery)
LCS	One per sample preparation batch	Laboratory statistically derived control limits	Reanalyze LCS once. If acceptable, report. Otherwise, evaluate for impact (high bias and non-detects, or sporadic marginal exceedence may be narrated and reported). If impact too great, reprep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Lab Manager / Analyst	Accuracy/Bias Contamination	Laboratory statistically derived control limits

Matrix	Solid
Analytical Group	ICP Metals
Analytical Method/ SOP Reference	EPA Method 6010B WS-MT-0003

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
Calibration blank	After IC, after CCV calibration, after every 10 samples, and at the end of the sequence	No target analytes detected > QL.	Evaluate blank to determine if instrument or solution caused, then correct. Reprep and reanalyze the blank. All samples following the last acceptable calibration blank must be reanalyzed.	Lab Manager / Analyst	Accuracy	No target analytes > QL
MB	One per digestion batch	No target analytes ≥ QL or 1/10 the concentration in the sample, whichever is greater	Verify instrument clean (evaluate calibration blank & samples prior to MB), then reanalyze. Evaluate to determine if systematic issue within laboratory, correct, then reprep and reanalyze the MB and all samples processed with the contaminated blank.	Lab Manager / Analyst	Accuracy/Bias Contamination	Same as Method / SOP QC Acceptance Limits
LCS	One LCS per each preparation batch	Recovery 80-120%	Evaluate LCS data and reanalyze if bias appears instrument related. If bias appears preparation related, determine if trend requires correction prior to reprep and reanalysis of the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Lab Manager / Analyst	Precisions and Accuracy/Bias	Same as Method / SOP QC Acceptance Limits
MXS/MSD for all analytes	One MXS/MSD pair per preparation batch	Recovery 80-120%; RPD ≤ 20	Examine the project specific DQOs. Evaluate the data, and reprep and reanalyze the native sample and MXS/MSD pair as indicated.	Lab Manager / Analyst	Precision and Accuracy/Bias	Same as Method / SOP QC Acceptance Limits
Dilution test	Each new sample matrix	1:5 dilution must agree within ±10% of the original determination	Perform post-digestion spike addition in accordance with SOP requirements	Lab Manager / Analyst	Accuracy	Same as Method / SOP QC Acceptance Limits
Post-digestion spike addition	When dilution test fails or analyte concentration in all samples < 50 x MDL.	Recovery within 75-125% of expected results	Flag	Lab Manager / Analyst	Accuracy	Same as Method / SOP QC Acceptance Limits

Matrix	Solid
Analytical Group	ICP MS Metals
Analytical Method/ SOP Reference	EPA Method 6020 WS-MT-0001

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
Calibration blank	After IC, after CCV calibration, after every 10 samples, and at the end of the sequence	No target analytes detected > QL.	Evaluate blank to determine if instrument or solution caused, then correct. Reprep and reanalyze the blank. All samples following the last acceptable calibration blank must be reanalyzed.	Lab Manager / Analyst	Accuracy	No target analytes > QL
MB	One per digestion batch	No target analytes ≥ QL or 1/10 the concentration in the sample, whichever is greater	Verify instrument clean (evaluate calibration blank & samples prior to MB), then reanalyze. Evaluate to determine if systematic issue within laboratory, correct, then reprep and reanalyze the MB and all samples processed with the contaminated blank.	Lab Manager / Analyst	Accuracy/Bias Contamination	Same as Method / SOP QC Acceptance Limits
ICS	At the beginning of the analytical run and every 12 hours.	ICSA-A: Absolute values of concentration for all non-spiked analytes < QL (unless they are a verified trace impurity from one of the spiked analytes); ICS-AB: Within ±20% of true value	Terminate analysis, correct problem, then reanalyze ICS and all affected samples	Lab Manager / Analyst	Accuracy	Within ±20% of expected value
LCS	One LCS per each preparation batch	Recovery 80-120%	Evaluate LCS data and reanalyze if bias appears instrument related. If bias appears preparation related, determine if trend requires correction prior to reprep and reanalysis of the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Lab Manager / Analyst	Precisions and Accuracy/Bias	Same as Method / SOP QC Acceptance Limits
MXS/MSD for all analytes	One MXS/MSD pair per preparation batch	Recovery 80-120%; RPD ≤ 20	Examine the project-specific DQOs. Evaluate the data, and re-extract and reanalyze the native sample and MXS/MSD pair as indicated.	Lab Manager / Analyst	Precision and Accuracy/Bias	Same as Method / SOP QC Acceptance Limits
Dilution test	Each new sample matrix	1:5 dilution must agree within ±10% of the original determination	Perform post-digestion spike addition	Lab Manager / Analyst	Accuracy	Same as Method / SOP QC Acceptance Limits
Post digestion spike addition	When dilution test fails or analyte concentration in all samples < 50 x LOD.	Recovery within 75-125% of expected results	Flag.	Lab Manager / Analyst	Accuracy	Same as Method / SOP QC Acceptance Limits
ISTDs	Every sample.	ISTD intensity within 30-120% of the ISTD in the ICAL	Reanalyze sample at a 5X dilution with the addition of appropriate amounts of ISTDs.	Lab Manager / Analyst	Accuracy/Bias	ISTD outside limits is an indicator of matrix effects.

Matrix	Solid
Analytical Group	Mercury
Analytical Method/ SOP Reference	EPA Method 7470A/7471A WS-MT-0005 / WS-MT-0007

QC Sample	**Frequency / Number**	**Method / SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**DQI**	**Measurement Performance Criteria**
Calibration blank	After IC, after CCV calibration, after every 10 samples, and at the end of the sequence	Measured value within ± QL from zero.	Evaluate blank to determine if instrument or solution caused, then correct. Re-prep and reanalyze the blank. All samples following the last acceptable calibration blank must be reanalyzed.	Lab Manager / Analyst	Accuracy	Measured value within ± QL from zero.
MB	One per digestion batch	No target analytes ≥ QL or 1/10 the concentration in the sample, whichever is greater	Verify instrument clean (evaluate calibration blank & samples prior to MB), then reanalyze. Evaluate to determine if systematic issue within laboratory, correct, then re-prep and reanalyze the MB and all samples processed with the contaminated blank.	Lab Manager / Analyst	Accuracy/Bias Contamination	Same as Method / SOP QC Acceptance Limits
MXS/MSD	One MXS/MSD pair per preparation batch	Laboratory control limits are statistically derived for each analyte and subject to periodic updates[1]	Examine the project-specific DQOs. Evaluate the data, and re-extract and reanalyze the native sample and MXS/MSD pair as indicated.	Lab Manager / Analyst	Precisions and Accuracy/Bias	Same as Method / SOP QC Acceptance Limits
LCS	One LCS per each preparation batch	Laboratory control limits are statistically derived for each analyte and subject to periodic updates[1]	Terminate analysis, identify and correct the problem, then re-prep and reanalyze all affected samples and QC checks.	Lab Manager / Analyst	Precisions and Accuracy/Bias	Same as Method / SOP QC Acceptance Limits

Matrix	Solid
Analytical Group	Inorganics TOC
Analytical Method/ SOP Reference	EPA 9060 WS-WC-0016 (water) WS-WC-0017 (solids)

QC Sample	**Frequency / Number**	**Method / SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**DQI**	**Measurement Performance Criteria**
MB	One per batch	No target analytes ≥ QL or 1/10 the concentration in the sample, whichever is greater	Correct problem, then repeat blank. Once instrument demonstrated clean, restart analysis sequence with MB, and continue analysis.	Lab Manager / Analyst	Accuracy/Bias Contamination	Same as Method / SOP QC Acceptance Limits
LCS	One LCS per preparation batch	Recovery 90-110% for water samples; based on provider's recovery limits for solid samples. (Solids are a reference material from an outside vendor, due to the nature of the analysis)	Reanalyze LCS once. If acceptable, report. Otherwise, evaluate and re-prep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Lab Manager / Analyst	Precisions and Accuracy/Bias	Same as Method / SOP QC Acceptance Limits
MXS/MSD for all analytes	One MXS/MSD pair per preparation batch	Recovery 75-125% RPD ≤ 25	Examine the project-specific DQOs. Evaluate the data, and re-prep and reanalyze the native sample and MXS/MSD pair as indicated.	Lab Manager / Analyst	Precision and Accuracy/Bias	Same as Method / SOP QC Acceptance Limits

Matrix	Solid
Analytical Group	Perchlorate by IC
Analytical Method/ SOP Reference	EPA Method 314.0 WS-WC-0010

QC Sample	**Frequency / Number**	**Method / SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**DQI**	**Measurement Performance Criteria**
MB	One per batch	No target analytes ≥ QL or 1/10 the concentration in the sample, whichever is greater	Correct problem, then reprep and reanalyze the method blank and all samples processed with the contaminated blank.	Lab Manager / Analyst	Accuracy/Bias Contamination	Same as Method / SOP QC Acceptance Limits
LCS	One LCS per preparation batch	Recovery 75-125% for solid samples	Reanalyze LCS once. If acceptable, report. Otherwise, evaluate and reprep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Lab Manager / Analyst	Precisions and Accuracy/Bias	Same as Method / SOP QC Acceptance Limits
MXS/MSD for all analytes	One MXS/MSD pair per preparation batch	Recovery 75-125% for solid samples; RPD ≤ 20 between MXS and MSD	Examine the project specific DQOs. Evaluate the data, and reprep and reanalyze the native sample and MXS/MSD pair as indicated.	Lab Manager / Analyst	Precision and Accuracy/Bias	Same as Method / SOP QC Acceptance Limits

Matrix	Solid
Analytical Group	Perchlorate
Analytical Method/ SOP Reference	EPA Method 6850 WS-LC-0012

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
MB	One per preparation batch	No target analytes ≥ QL or 1/10 the concentration in the sample, whichever is greater	Correct problem, then re-extract and reanalyze MB and all samples processed with the contaminated blank.	Lab Manager / Analyst	Accuracy/Bias Contamination	Same as Method / SOP QC Acceptance Limits
ICS	One per preparation batch	70% -130%	Reanalyze once. If still outside the acceptance limits, evaluate to determine if cleanup filters or column degradation are suspect, replace appropriate materials and reprep (filters) or reanalyze (column). Repeat the Interference Threshold Study to deter. If problem still exists, recalibrate.	Lab Manager / Analyst	Accuracy/Bias	70-130%
ISTD	During acquisition of calibration standard, samples, and QC check samples	Areas within -50% to +100% of the midpoint of the last ICAL for each sample and QC	Inspect LC mass spec for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning.	Lab Manager / Analyst	Accuracy/Bias	Meets all EPA Method requirements
Isotope Ratio ^{35}CL/^{37}CL	Every sample, batch QC sample and standard	Monitor for either the parent ion at masses 99/101 or the daughter ion at masses 83/85 depending on which ions are quantified.	Re-extract, re-clean, and/or reanalyze affected sample(s). If problem persists, perform post-spike or dilution as appropriate to confirm presence of perchlorate.	Lab Manager / Analyst	Accuracy/Bias	Theoretical ratio approx. 3.06 Must fall within 2.3 to 3.8
LCS	One LCS per analytical/preparation batch, spiked at the QL.	Recovery 80-120%;RPD ≤ 15	Reanalyze LCS once. If acceptable, report. Otherwise, evaluate and reprep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Lab Manager / Analyst	Accuracy/Bias	Same as Method / SOP QC Acceptance Limits
MXS/MSD	One MXS/MSD per batch, spiked at the QL.	Recovery 80-120%;RPD ≤ 15	Identify problem; if not related to matrix interference, re-extract and reanalyze MXS/MSD in accordance with QSM requirements.	Lab Manager / Analyst	Precision and Accuracy/Bias	Same as Method / SOP QC Acceptance Limits

Matrix:	Solid
Analytical Group:	Cyanide
Analytical Method / SOP Reference:	EPA 9012A SOP SA-GE-040

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
MB	1 / prep batch	No target analytes ≥ QL or 1/10 the concentration in the sample, whichever is greater	Reprep batch.	Analyst	Laboratory Contamination	Same as Method / SOP QC Acceptance Limits
LCS	1 / prep batch	Water: Recovery 85 - 115% Solid: Recovery 75 - 125%	Correct problem; then reprep and reanalyze LCS and all affected samples.	Analyst	Accuracy	Same as Method / SOP QC Acceptance Limits
LCSD	1 / prep batch, if insufficient sample provided for MXS/MSD	Water: Recovery 85 - 115% RPD ≤ 20 Solid: Recovery 75 - 125% RPD ≤ 30	Correct problem; then reprep and reanalyze LCS and all affected samples.	Analyst	Accuracy Precision	Same as Method / SOP QC Acceptance Limits
MXS	1 / sample	Water: Recovery 85 - 115% Solid: Recovery 75 - 125%	Evaluate for matrix interferences. Report and qualify, if LCS is acceptable.	Analyst	Accuracy	Same as Method / SOP QC Acceptance Limits
MSD	1 / sample	Water: Recovery 85 - 115% RPD ≤ 20 Solid: Recovery 75 - 125% RPD ≤ 30	Evaluate for matrix interferences. Report and qualify, if LCS is acceptable.	Analyst	Accuracy Precision	Same as Method / SOP QC Acceptance Limits
Lab Duplicate	1/ sample	Water: RPD ≤ 20 Solid: RPD ≤ 30	Evaluate for matrix interferences. Report and qualify, if LCS is acceptable.	Analyst	Precision	Same as Method / SOP QC Acceptance Limits
Sample Duplicate	0	No target analytes ≥ QL or 1/10 the concentration in the sample, whichever is greater	Reprep batch	Analyst	Laboratory Contamination	Same as Method / SOP QC Acceptance Limits

Matrix:	Solid
Analytical Group:	pH
Analytical Method / SOP Reference:	EPA 9045D WS-WC-0044

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
LCS	One LCS per preparation batch	Within 0.1 pH unit of true value.	Reanalyze LCS once. If acceptable, report. Otherwise, reanalyze the LCS and all samples in the associated batch, if sufficient sample material is available.	Lab Manager / Analyst	Accuracy/Bias	Same as Method / SOP QC Acceptance Limits
Sample Duplicate	One duplicate per analysis batch	Difference ≤ 0.1 pH units	Evaluate instrument stability, then reanalyze once. Narrate if still out of control.	Lab Manager / Analyst	Precision	Same as Method / SOP QC Acceptance Limits

[1] Unless otherwise noted in table, laboratory control limits for LCS and MXS/MSD QC aliquots are statistically derived for each analyte and subject to periodic updates in accordance with SOPs that are identified in the analytical procedures in Attachment 19. Each laboratory data report provides the control limits in effect at the time of sample analysis. Current control limits for precision and accuracy of LCS and MXS/MSD aliquots are available upon request.

29.0 PROJECT DOCUMENTS AND RECORDS (SAP WORKSHEET #29)

Documentation and records will be managed as described in this worksheet and in the DMP (ERM 2013b).

29.1 STORAGE OF PROJECT-RELATED DOCUMENTS

Table 29-1 indicates where project-related documents will be stored and how they will be filed.

Table 29-1. Storage of Project-Related Documents

Document	Where Maintained
SAP, Work Plan, and Health and Safety Plan	ERM Scottsdale
Field records/data	ERM Salt Lake City. All hard copy forms will also be scanned and will be retained in the electronic project file located on the Scottsdale server as backup.
Chain-of-custody records	ERM Salt Lake City
Field forms	ERM Salt Lake City
Laboratory data packages	ERM Scottsdale and EQuIS database
Audit/assessment checklists/reports	ERM Scottsdale
Corrective action forms/reports	ERM Scottsdale
Laboratory calibration/maintenance logs	Included in Laboratory Data Packages
Sample preparation logs	Included in Laboratory Data Packages
Run logs	Included in Laboratory Data Packages
Sample disposal records	Laboratory
Electronic data deliverables (EDD)	ERM Scottsdale
Validated Scribe database	EPA Region 8
Data validation and QA reports	ERM Scottsdale
Survey and GIS data	EQuIS database
Correspondence and meeting notes	ERM Scottsdale
Project reports	ERM Scottsdale

29.2 REQUIREMENTS FOR LABORATORY DATA PACKAGES

Full (Level IV) data packages, including raw data, will be provided by the laboratories for all analyses performed for the Phase 1A-B RI. Table 29-2 identifies the requirements for laboratory data packages for organic and inorganic analyses. Not all items listed in Table 29-2 are applicable for all analytical methods to be used for the Phase 1A-B RI.

Table 29-2. Requirements for Laboratory Data Packages

Requirements for Data Packages – Organic Analysis (as appropriate per method)	Requirements for Data Packages – Inorganic Analysis (as appropriate per method)
1. Case narrative	1. Case narrative
2. Copies of nonconformance and corrective action forms	2. Copies of nonconformance and corrective action forms
3. Chain-of-custody forms	3. Chain-of-custody forms
4. Copies of sample receipt notices	4. Copies of sample receipt notices
5. Internal tracking documents, as applicable	5. Internal tracking documents, as applicable
6. Sample results for environmental samples, including dilutions and reanalysis, reported on a dry-weight basis	6. Sample results for environmental samples, including dilutions and reanalysis, reported on a dry-weight basis
7. System monitoring compound and surrogate recoveries	7. Initial and continuing calibration verifications
8. Blank spike or LCS recoveries	8. Method blanks, continuing calibration blanks, and preparation blanks
9. Method blanks	9. Inductively coupled plasma (ICP) interference-check samples
10. Performance check	10. MXS and MSD recoveries and RPD, and post-digestion spikes
11. Initial calibrations with retention time information	11. Sample duplicates
12. Continuing calibrations with retention time information	12. LCSs
13. Internal standard areas and retention times	13. Method of standard additions
14. Analytical sequence	14. ICP serial dilution
15. Single component analyte identification	15. ICP inter-element correction factors
16. Multicomponent analyte identification	16. ICP linear working range
17. Raw data for the following, where applicable:	17. Raw Data for the following, where applicable:
a. Analytical results, including dilutions and reanalysis	a. Environmental samples, including dilutions and reanalysis
b. Method blanks	b. Initial calibration
	c. Initial and continuing calibration verifications
c. Blank spikes or LCSs	d. Detection limit standards
d. Performance check	e. Method blanks, continuing calibration blanks, and preparation blanks
e. Initial calibrations, with retention-time information	f. ICP interference check samples
f. Continuing calibrations, with retention-time information	g. MXS, MSD, and post-digestion spikes
g. Quantitation-limit standard	h. Sample duplicates
h. Percent moisture for solids	i. LCSs
i. Sample extraction and cleanup logs	j. Method of standard additions
j. Instrument analysis log for each instrument used	k. ICP serial dilution

Requirements for Data Packages – Organic Analysis (as appropriate per method)	Requirements for Data Packages – Inorganic Analysis (as appropriate per method)
k. Standard preparation logs, including initial and final concentrations for each standard used	l. Percent moisture for solids samples
l. Formula and a sample calculation for the initial calibration	m. Sample digestion, distillation, and preparation logs, as necessary
m. Formula and a sample calculation for solids sample results	n. Instrument analysis logs for each instrument used
	o. Standard preparation logs, including initial and final concentrations for each standard used
	p. Formula and a sample calculation for the initial calibration
	q. Formula and a sample calculations for solids sample results

29.3 GIS DATA DELIVERY REQUIREMENTS

As prescribed by EPA Region 8, GIS data, maps, and figures to be provided as deliverables by US Magnesium/ERM will adhere to a specific format. Establishment of this format is intended to specify file delivery formats for all materials developed in support of CERCLA-related Site work within EPA Region 8.

EPA Region 8 intends to acquire all GIS work products produced in support of project work in order to catalog and manage all Site-specific GIS files comprehensively across all active CERCLA sites. The attached GIS Guidance in Attachment 29 specifies the format in which all GIS data, maps, and figures deliverables will be presented to EPA Region 8.

30.0 ANALYTICAL SERVICES TABLE (SAP WORKSHEET #30)

Matrix	**Analytical Group** [1]	**Sampling locations/ ID Number**	**Analytical Method**	**Data Package Turnaround Time**	**Laboratory / Organization** [2] **(name and address, contact person and telephone number)**
Solid	HRMS PCB	Refer to WS#18	EPA Method 1668A WS-ID-0013	Standard	TestAmerica - West Sacramento 880 Riverside Parkway West Sacramento, CA 95605 David Alltucker (916) 374-4383
Solid	LRMS PCB	Refer to WS#23	EPA Method 680 Modified 2162-SOP	Standard	Alpha Analytical, Inc. – Woods Hole Lab Facility 320 Forbes Blvd Mansfield, MA 02048 Liz Porta (508) 844-4124
Solid	HRMS PCDD/ PCDF	Refer to WS#18	SW846 8290 WS-ID-0005	Standard	TestAmerica - West Sacramento 880 Riverside Parkway West Sacramento, CA 95605 David Alltucker (916) 374-4383
Solid	LRMS PCDD/ PCDF	Refer to WS#23	SW846 8280 WS-ID-0011	Standard	TestAmerica - West Sacramento 880 Riverside Parkway West Sacramento, CA 95605 David Alltucker (916) 374-4383
Solid	VOC	Refer to WS#18	SW846 8260B WS-MS-0007	Standard	TestAmerica- West Sacramento 880 Riverside Parkway West Sacramento, CA 95605 David Alltucker (916) 374-4383
Solid	SVOC	Refer to WS#18	SW846 8270C WS-MS-0005	Standard	TestAmerica - West Sacramento 880 Riverside Parkway West Sacramento, CA 95605 David Alltucker (916) 374-4383
Solid	PAH	Refer to WS#18	SW846 8270C WS-MS-0008	Standard	TestAmerica - West Sacramento 880 Riverside Parkway West Sacramento, CA 95605 David Alltucker (916) 374-4383
Solid	ICP Metals	Refer to WS#18	SW846 6010B WS-MT-0003	Standard	TestAmerica - West Sacramento 880 Riverside Parkway West Sacramento, CA 95605 David Alltucker (916) 374-4383
Solid	ICPMS Metals	Refer to WS#18	SW846 6020 WS-MT-0001 (solid)	Standard	TestAmerica- West Sacramento 880 Riverside Parkway West Sacramento, CA 95605 David Alltucker (916) 374-4383

Matrix	Analytical Group [1]	Sampling locations/ ID Number	Analytical Method	Data Package Turnaround Time	Laboratory / Organization [2] (name and address, contact person and telephone number)
Solid	Mercury	Refer to WS#18	SW846 7471A WS-MT-0007 (solid)	Standard	TestAmerica - West Sacramento 880 Riverside Parkway West Sacramento, CA 95605 David Alltucker (916) 374-4383
Solid	pH	Refer to WS#18	SW846 9045D WS-WC-0044	Standard	TestAmerica - West Sacramento 880 Riverside Parkway West Sacramento, CA 95605 David Alltucker (916) 374-4383
Solid	TOC	Refer to WS#18	SW846 9060 DV-WC-0048 (solid)	Standard	TestAmerica – Denver [3] 4955 Yarrow Street Arvada, CO 80002 David Alltucker (916) 374-4383
Solid	Cyanide	Refer to WS#18	SW846 9012A SA-GE-040	Standard	TestAmerica – Savannah [3] 5102 LaRoche Avenue Savannah, GA 31404 David Alltucker (916) 374-4383
Solid	Perchlorate by IC	Refer to WS#18	EPA Method 314 WS-WC-0010	Standard	TestAmerica - West Sacramento 880 Riverside Parkway West Sacramento, CA 95605 David Alltucker (916) 374-4383
Solid	Perchlorate by LCMS/MS	Refer to WS#18	SW846 6850 WS-LC-0012	Standard	TestAmerica - West Sacramento 880 Riverside Parkway West Sacramento, CA 95605 David Alltucker (916) 374-4383
Solid	Grain Size	Refer to WS#18	Grain Size Analysis based on ASTM C135/C117	Standard	GeoStrata 14425 South Center Point Way Bluffdale, UT 84065 Sy Winkelman (801) 501-0583

[1] The laboratories contracted to provide analytical services have the appropriate accreditation or certification (National Environmental Laboratory Accreditation Program [NELAP] or State of Utah) for each analytical method. Some specialized analytical methods employed to attain greater sensitivity and/or accuracy for selected analytes are not yet included in NELAP or State of Utah accreditation/certification programs. Laboratory accreditations, where available, are provided in Attachment 30. Certifications will be updated in ERM files as needed upon renewal.

[2] The selected laboratories are active, commercial laboratories with current demonstration of proficiency in the analytical methods identified for analysis of Phase 1A-B Samples. Backup laboratories are not available. Only laboratories listed are approved for project samples, based in part on Phase 1A DMA studies. Laboratory contact information, including address, contact person, and telephone number, are provided in WS#3.

[3] Analyses performed by TestAmerica Denver and Savannah will be performed under subcontract to TestAmerica West Sacramento. All samples for analysis by any TestAmerica lab will be shipped to the West Sacramento, CA laboratory.

31.0 PLANNED PROJECT ASSESSMENTS TABLE (SAP WORKSHEET #31)

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Responding to Assessment Findings	Person(s) Responsible for Identifying and Implementing Corrective Action	Person(s) Responsible for Monitoring Effectiveness of Corrective Action
Field Readiness Review	Prior to field sampling	Internal	ERM	ERM QA Manager	ERM Field Team Leader	ERM Field Team Leader	ERM QA Manager
Field Sampling Surveillance	2X during the field sampling	Internal	ERM	ERM QA Manager	ERM Field Team Leader	ERM Field Team Leader	ERM QA Manager
Field Sampling Surveillance	Per Oversight QAPP	External	EPA	EPA RPM or QC staff	ERM Field Team Leader	ERM Field Team Leader	EPA RPM or QC staff
Laboratory Surveillance	Once during laboratory program	Internal	ERM	ERM Analytical Coordinator	Laboratory Project Manager	Laboratory Project Manager	ERM QA Manager/Analytical Coordinator
Laboratory Surveillance	Per Oversight QAPP	External	EPA	EPA RPM or QC staff	Laboratory Project Manager, ERM QA Manager	Laboratory Project Manager, ERM QA Manager	EPA RPM or QC staff

32.0 ASSESSMENT FINDINGS AND CORRECTIVE ACTION RESPONSES TABLE (SAP WORKSHEET #32)

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Timeframe of Notification	Nature of Corrective Action (CA) Response Documentation	Individual(s) Receiving CA Response	Timeframe for Response
Field Readiness Review (Internal by ERM QA Manager)	Email documentation from ERM QA Manager	ERM Project Coordinator, ERM Field Team Leader	2 days	Email documentation from ERM Field Team Leader	ERM Project Coordinator, ERM QA Manager	2 days
Field Sampling Surveillance (Internal, by ERM QA Manager)	Email documentation from ERM QA Manager	ERM Project Coordinator, ERM Field Team Leader	2 days	Email documentation from ERM Field Team Leader	ERM Project Coordinator, ERM QA Manager	2 days
Field Sampling Surveillance (External, by EPA RPM or QC staff)	Email documentation and audit report from EPA RPM or QC staff	ERM Project Coordinator, ERM Field Team Leader	2 days	CA memorandum from ERM Field Team Leader	EPA RPM, ERM Project Coordinator	2 days
Laboratory Surveillance (Internal, by ERM Analytical Coordinator)	Email documentation from ERM Analytical Coordinator	ERM Project Coordinator, Laboratory Project Manager	5 days	Email documentation from Laboratory Project Manager	ERM Project Coordinator, ERM QA Manager/ Analytical Coordinator,	5 days
Laboratory Surveillance (External, by EPA RPM or QC staff)	Email documentation and audit report from EPA RPM or QC staff	ERM Project Coordinator, ERM QA Manager, Laboratory Project Manager	5 days	Email documentation and CA memorandum from laboratory project manager	EPA RPM, ERM Project Coordinator, ERM QA Manager	5 days

[1] Documentation of ERM's internal surveillances, deficiencies, and/or corrective action response will be available for EPA review upon request.

33.0 QA MANAGEMENT REPORTS TABLE (SAP WORKSHEET #33)

Type of Report	Frequency	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation	Report Recipient(s)
Daily Progress Report	Daily	At the end of each field day	ERM RI Field Team Leader	US Magnesium Contact, ERM Project Coordinator, EPA RPM
Monthly Status Report	Monthly	At the end of each month	ERM Project Coordinator	EPA RPM
QC Summary Report	With Report Submittal	Submitted in Final Report	ERM RI Field Team Leader	EPA RPM

34.0 VERIFICATION (STEP I) PROCESS TABLE (SAP WORKSHEET #34)

Verification Input	Description	Internal/ External	Responsible for Verification (Name, Organization)
Audit reports	When each audit report is complete, a copy will be placed in the project file. If corrective actions are required, a copy of the documented corrective action taken will be attached to the appropriate audit report in the project file. At the beginning of each week and at the completion of the Site work, project file audit reports will be reviewed internally to ensure that all appropriate corrective actions have been taken and that corrective action reports are attached. If corrective actions have not been taken, the project manager will be notified to ensure action is taken.	I	ERM Project Coordinator, ERM QA Manager
Field notes/logbook	Field notes will be reviewed internally and placed in the project file. Field notes will be scanned on a weekly basis and placed into the online data management system, or otherwise provided to the EPA, on a weekly basis. A copy of the field notes will also be attached to the final report.	I	ERM Field Team Leader
Sample Receipt	For samples shipped via commercial carrier, the analytical coordinator will verify receipt of samples by the laboratory the day following shipment.	I	ERM Analytical Coordinator
Sample Logins	Sample login information will be reviewed and verified for completeness in accordance with the chain-of-custody forms.	I, E	ERM Analytical Coordinator Laboratory Project Manager
Chain-of-Custody Records	Chain-of-custody forms will be reviewed internally when they are completed and verified against the packed sample coolers they represent. A copy of the chain-of-custody form will be retained in the project file, and the original and remaining copies will be taped inside the cooler for shipment.	I	ERM Field Team Leader
Laboratory Data Prior to Release	Laboratory data will be reviewed and verified for completeness against analyses requested on the chain-of-custody forms.	E	Laboratory Project Manager
Laboratory Data due at Turnaround Time Listed on Chain of Custody	Laboratory data will be verified for consistency of analyses reported with the analytical suite requested on the chain-of-custody forms.	I	ERM Analytical Coordinator
Laboratory Data	All laboratory data packages will be verified for completeness by the laboratory performing the work. Data packages will then be reviewed by the analytical coordinator for completeness. Subsequently, data packages will be evaluated externally by undergoing data validation according to the procedures specified in WS#36.	I, E	Laboratory Project Manager ERM Analytical Coordinator Third-party data validator
Field and Electronic Data	One hundred percent of manual entries will be reviewed against the hard copy information, and 100 percent of electronic uploads will be checked against the hard copy.	I	ERM Database Manager

Note:

Project data will undergo the verification procedure described in this worksheet in order to ensure it is both legally and technically defensible.

35.0 VALIDATION (STEPS IIA AND IIB) PROCESS TABLE (SAP WORKSHEET #35)

Step IIa / IIb[1]	Validation Input	Description	Responsible for Validation (name, organization)
IIa	Field logbook	Field logbooks will be reviewed weekly for accuracy associated with each sampling event and completeness with the minimum documentation requirements described in the Phase 1A-B RI SAP and applicable SOPs. The inspection will be documented by uploading field notes to the project database.	ERM Field Team Leader
IIa	COC Records	COC Records will be reviewed daily to ensure that project information, sample identifiers, sample analyses requested, and field QC samples are accurate and completed in accordance with the requirements in this Phase 1A-B RI SAP and Data Management Plan.	ERM Analytical Coordinator or ERM Field Team Leader
IIa	Sample receipt	The sample cooler will be checked for compliance with temperature and packaging requirements, sample security, and custody seals.	Laboratory Project Manager
IIa	Sample logins	Sample login will be reviewed for accuracy against the chain-of-custody form.	ERM Analytical Coordinator, Laboratory Project Manager

Step IIa / IIb[1]	Validation Input	Description	Responsible for Validation (name, organization)
IIa	Laboratory data prior to release	Laboratory data will be reviewed to ensure that the data are accurate and meet the requirements in this Phase 1A-B RI SAP. Before laboratory data are released, the data will be validated as follows: • Results will be reviewed to confirm that the data meet analytical method and Phase 1A-B RI SAP requirements, and were collected in accordance with EPA-approved SOPs. • 100 percent of the data will be checked for completeness of deliverables. 10 percent of the data will be fully validated (Level 4). 90 percent of the results will undergo a Level 3 validation. A validation report will summarize results and include qualified results.100 percent of manual entries will be reviewed to assure that they are free of transcription errors and manual calculations are accurate; computer calculations will be spot-checked.	Laboratory Project Manager
IIa	Laboratory data due at turnaround time listed on COC Record	Laboratory data will be reviewed to ensure that the data reported include the required chemicals and meet laboratory practical quantitation limits listed in WS#15. Laboratory practical quantitation limits that vary from the WS#15 requirements should be documented in the verification/validation reports along with the reason for the deviation.	ERM Analytical Coordinator
	Laboratory data packages	All laboratory data packages will be validated by the laboratory performing the work for technical accuracy before they are submitted.	Laboratory Project Manager
		Data packages will then be reviewed for accuracy against the laboratory data that were faxed or e-mailed at the turnaround time listed on the chain of custody.	ERM Analytical Coordinator
		Data packages will be evaluated externally by undergoing data validation.	Third-party data validator
IIb	Data validation reports	Data validation reports will be reviewed in conjunction with the project DQOs and data quality indicators (DQIs).	ERM QA Manager

Notes:

[1] IIa = compliance with methods, procedures, and contracts (Table 10, page 117, UFP-QAPP manual, V.1, March 2005).
IIb = comparison with measurement performance criteria in the Phase 1A-B RI SAP (Table 11, page 118, UFP-QAPP manual, V.1, March 2005).

36.0 ANALYTICAL DATA VALIDATION (STEPS IIA AND IIB) SUMMARY (SAP WORKSHEET #36)

This section describes the minimum procedures that US Magnesium/ERM will use to review, verify, and validate field and laboratory data. This section also discusses procedures for verifying that the data are adequate to meet project quality objectives and measurement quality objectives (MQOs) for the project. Validation and verification of the data generated during field and laboratory activities are essential to obtaining defensible data of acceptable quality. Verification and validation methods for field and laboratory activities are presented below.

36.1 FIELD DATA VERIFICATION

Project personnel will verify field data through reviews of datasets to identify inconsistencies or anomalous values. Any inconsistencies discovered will be resolved as soon as possible by seeking clarification from field personnel responsible for data collection. All field personnel will be responsible for following the sampling and documentation procedures described in this Phase 1A-B RI SAP so that defensible and justifiable data are obtained.

Data values that are significantly different from the population are called “outliers.” A systematic effort will be made to identify any outliers or errors before field personnel report the data. Outliers can result from improper sampling or measurement methodology, data transcription errors, calculation errors, or natural causes. Outliers that result from errors found during data verification will be identified and corrected; outliers that cannot be attributed to errors in sampling, measurement, transcription, or calculation will be clearly identified in project reports.

36.2 LABORATORY DATA VERIFICATION

Laboratory personnel will verify analytical data at the time of analysis and reporting and through subsequent reviews of the raw data for any nonconformances to the requirements of the analytical method and any project specific adjustments required by this SAP. Laboratory personnel will make a systematic effort to identify any outliers or errors before reporting the data. Outliers that result from errors found during data verification will be identified, corrected, and documented by corrective action procedures; outliers that cannot be attributed to errors in analysis, transcription, or calculation will be clearly identified in the case narrative section of the analytical data package.

36.3 LABORATORY DATA VALIDATION

An independent third-party contractor will validate all laboratory data in accordance with current EPA National Functional Guidelines (EPA 2011a, 2014a, 2014b). Ninety percent of the data for the Phase 1A-B RI will undergo cursory verification/validation, and 10 percent of the data for the Phase 1A-B RI will undergo full validation for this project. Requirements for cursory and full validation are listed below.

36.3.1 Cursory Data Validation

Cursory verification/validation (Stage 2B) will be completed on 90 percent of the summary data packages for the Phase 1A-B RI. This verification/validation requires a completeness review of the data packages for all deliverables required in WS#29 with particular attention to the confirmation by the laboratory contained in the case narrative that the methods were performed according to this Phase 1A-B RI SAP. The Stage 2A verification/validation will confirm the QC portion of the package meets the stated performance ranges or are specifically cited in the narrative. (The remaining 10 percent of the packages will be subjected to full validation.) The third-party data reviewer will request any missing information needed from the laboratory. Missing information will be saved in the project files and incorporated as addenda to the laboratory data packages stored on the ERM Scottsdale server. Elimination of the data from the review process is not allowed. All data will be qualified as necessary in accordance with established criteria. Data summary packages will consist of sample results and QC summaries, including calibration and internal standard data. EDD verification with the laboratory package data will be consistent with the DMP (ERM 2013b). Results that have validation qualifiers added will also have an associated reason code recorded in the EDD at validation (cursory and full). These reason codes will be stored in the EQuIS project database and are listed in Table 36-2.

36.3.2 Full Data Validation

Full validation (Stage 4) will be completed on 10 percent of the full data packages for the Phase 1A-B RI. The third-party data reviewer will request any missing information needed from the laboratory. Missing information will be saved in the project files and incorporated as addenda to the laboratory data packages stored on the ERM Scottsdale server. Elimination of data from the review process is not allowed. All data will continue through the validation process and will be qualified in accordance with established criteria. Data packages will consist of sample results, QC summaries, and all raw data associated with the sample results and QC summaries.

36.4 DATA VALIDATION CRITERIA

Data validation criteria are presented in Table 36-1. WSs #12, #24, #25, #28, and #36, along with the analytical methods and laboratory SOPs, list the QC checks and criteria that will be reviewed for both cursory and full data validation. The data validation criteria selected from Table 36-1 will be consistent with the project-specific analytical methods referenced in WS#19. A list of the reason codes associated with precision and accuracy qualifiers is included in Table 36-2.

Table 36-1. Data Validation Criteria

Step	Matrix	Analytical Group	Validation Criteria	Data Validator (title and organizational affiliation)
IIa	Solids	PCBs	In accordance with this SAP, the method SOP, and Work Instructions established through the DMA	Laboratory QA Manager
IIa	Solids	Dioxins	In accordance with this SAP, the method SOP, and Work Instructions established through the DMA	Laboratory QA Manager
IIa	Solids	Semi-volatiles	In accordance with this SAP, the method SOP, and Work Instructions established through the DMA	Laboratory QA Manager
IIa	Solids	PAHs	In accordance with this SAP, the method SOP, and Work Instructions established through the DMA	Laboratory QA Manager

Step	Matrix	Analytical Group	Validation Criteria	Data Validator (title and organizational affiliation)
IIa	Solids	Volatiles	In accordance with this SAP, the method SOP, and Work Instructions established through the DMA	Laboratory QA Manager
IIa	Solids	ICP Metals	In accordance with this SAP, the method SOP, and Work Instructions established through the DMA	Laboratory QA Manager
IIa	Solids	ICP/MS Metals	In accordance with this SAP, the method SOP, and Work Instructions established through the DMA	Laboratory QA Manager
IIa	Solids	Mercury	In accordance with this SAP and the method SOP	Laboratory QA Manager
IIa	Solids	Cyanide	In accordance with this SAP and the method SOP	Laboratory QA Manager
IIa	Solids	Perchlorate by LCMS	In accordance with this SAP, the method SOP, and Work Instructions established through the DMA	Laboratory QA Manager
IIa	Solids	Perchlorate by IC	In accordance with this SAP, the method SOP, and Work Instructions established through the DMA	Laboratory QA Manager
IIa	Solids	pH	In accordance with this SAP and the method SOP	Laboratory QA Manager
IIb	Solids	HRGC/HRMS PCBs	In accordance with this SAP, EPA Method 1668A (SOP WS-ID-0013), and EPA National Functional Guidelines (2011a). See note [1]	Data Validation Contractor Project Manager
IIb	Solids	Dioxins	In accordance with this SAP, the EPA Method 8290 (SOP WS-ID-0005), and EPA National Functional Guidelines (2011a). See note [1]	Data Validation Contractor Project Manager
IIb	Solids	Semi-volatiles	In accordance with this SAP, EPA Method 8270C (SOP WS-MS-0005), and EPA National Functional Guidelines (2014b)	Data Validation Contractor Project Manager
IIb	Solids	PAHs	In accordance with this SAP, EPA Method 8270-SIM (SOP WS-MS-0008), and EPA National Functional Guidelines (2014b)	Data Validation Contractor Project Manager
IIb	Solids	Volatiles	In accordance with this SAP and EPA Method 8260B (SOP WS-MS-0007) and EPA National Functional Guidelines (2014b)	Data Validation Contractor Project Manager

Step	Matrix	Analytical Group	Validation Criteria	Data Validator (title and organizational affiliation)
IIb	Solids	ICP Metals	In accordance with this SAP and EPA Method 6010 (SOP WS-MT-0003), and EPA National Functional Guidelines (2014a)	Data Validation Contractor Project Manager
IIb	Solids	ICP/MS Metals	In accordance with this SAP and EPA Method 6020 (SOP WS-MT-0001), and EPA National Functional Guidelines (2014a)	Data Validation Contractor Project Manager
IIb	Solids	Mercury	In accordance with this SAP and EPA Methods 7470/7471 (SOP WS-MT-0005, SOP WS-MT-0007), and EPA National Functional Guidelines (2014a)	Data Validation Contractor Project Manager
IIb	Solids	Cyanide	In accordance with this SAP and EPA Method 9012 (SOP SA-ME-040), and EPA National Functional Guidelines (2014a)	Data Validation Contractor Project Manager
IIb	Solids	Perchlorate by LCMS	In accordance with this SAP and EPA Method 6850 (SOP WS-LC-0012) and EPA National Functional Guidelines (2014a)	Data Validation Contractor Project Manager
IIb	Solids	Perchlorate by IC	In accordance with this SAP and EPA Method 314 (SOP WS-WC-0010) and EPA National Functional Guidelines (2014a)	Data Validation Contractor Project Manager
IIb	Solids	pH	In accordance with this SAP and EPA Method 9045D (SOP WS-WC-0044) and EPA National Functional Guidelines (2014a)	Laboratory QA Manager

[1] Validation of Estimated Maximum Potential Concentration (EMPC) Results - PCB and D/F data qualified by the laboratory as an EMPC will be qualified during data validation as not-detected, with the detection limit reported as the EMPC concentration. EMPC results will be assigned a "UQ" qualifier to differentiate them from other not-detected results. The qualification of EMPC results as not-detected is based on the following considerations:

- There is no consistent guidance available from EPA on the validation/qualification of EMPC values or the use of EMPC values in the calculation of TEQ values;
- The absence of a clear understanding of how the "out of control" ion abundance ratios may be related to matrix effects and how this affects EMPC calculations; and
- A review of the Phase 1A-B DMA data which found that the potential contribution of EMPC data to overall calculated TEQ for both PCBs and dioxins/furans for samples is low, generally about 10 percent or less, which is within the normal method variability.

EMPC qualification of concentration data was formulated to account for the potential presence of D/F isomers in circumstances where the criteria for positive identification were not met. EMPC qualification has been extended to PCBs; however, there is no guidance on how to qualify PCB concentrations as EMPC. The term EMPC was reportedly created by Triangle Labs to indicate the detected presence of a compound above zero but not meeting QA/QC reporting level criteria. EPA has confirmed the EMPC data may be conservatively high because they do not meet the usual high degree of QA/QC. A summary of the available procedures for handling EMPC data available from analytical methods and data review/validation guidance documents is provided below.

Analytical Methods

- SW-846 Dioxin/Furan Methods 8280B revision 7, February 2007 and 8290A revision 1 February 2007 include directions for the calculation of EMPCs for 2,3,7,8-dioxin and -furan isomers that meet all identification criteria except ion abundance ratio criteria or when polychlorinated diphenyl ethers (PCDPE) have been detected in the sample. Method 8280B states, "*Do not include EMPC values in the TEQ calculation;"*
- Method 8290A does not indicate whether EMPC values are to be included in TEQ calculations.
- EPA Method 1613 for the analysis of Tetra- through Octa-chlorinated Dioxins and Furans by Isotope Dilution HRGC/HRMS does not include the calculation of EMPC concentrations.
- EPA’s Method 1668C for the analysis of Polychlorinated Biphenyl Congeners in Water, Soil, Sediment, Biosolids and Tissue by HRGC/HRMS does not contain directions for qualifying data from analyses using qualifiers such as EMPC. If the criteria for identification in Sections 16.1-16.5 are not met, the PCB has not been identified and the result for that congener may not be reported or used for permitting or regulatory compliance purposes. If interferences preclude identification, a new aliquot of sample must be extracted, further cleaned up, and analyzed (EPA Method 1668C Section 16.6).

Data Review / Data Validation Guidance

- The *National Functional Guidelines for Chlorinated Dibenzo-p-Dioxin (CDDs) and Dibenzofurans (CDFs) Data Review* states that use of EMPC data will depend on Regional Policies. EPA Region 8 has not issued validation guidelines for EMPC data. EPA Region 2 Validation Guidelines indicate that EMPCs are to be calculated in cases where ion abundance and other quality assurance criteria (such as the presence of PCDPE) are not met. The Region 2 Guidance does however, indicate that only positive data are to be included in TEQ calculations and the guidance specifically instructs the validator to ensure the EMPC values were not included in the TEQ. Region 3 Validation Guidance also indicates that EMPC values are not to be included in TEQ calculations.
- The EPA National Functional Guidelines for SOM Data Review Chapter on Aroclor Data Review does not include use of the EMPC qualifier.
- The User Guide for the UFP-QAPP Template for Soils Assessment of Dioxin Sites (EPA 2011b) notes that the Contract Laboratory Program SOW excludes EMPC values from the TEQ. It also provides a possible method for incorporating nondetect congeners into the TEQ in cases where the congener may be influential (high concentration EMPC, high-toxicity/TEF close to 1), using the Kaplan-Meier mean instead of using 1/2 the detection limit (DL).
- There are no National Functional Guidelines for PCB Congener Review. EPA Region 2 has Guidance on Validation of PCB Congeners using Method 1668, and these guidelines do not include use of the EMPC qualifier. EPA Region 3 has a PCB Congener Data Review Guideline that indicates that if the ion abundance ratio for a particular congener is greater than 25 percent, the concentration of that congener should be reported as EMPC. However, there is no guidance on using the EMPC value in TEQ calculations.

Table 36-2. Data Validation Reason Codes

Validation Reason Code	Definition
1	The sample preparation and/or analytical holding time was exceeded.
2	The analyte was detected below the quantitation limit but above the detection limit.
3	The analyte was detected in an associated laboratory blank sample.
4	The MS/MSD recovery was outside of control limits.
5	The LCS recovery was outside of control limits.
6	The MS/MSD RPD was outside of control limits.
7	The LCS RPD was outside of control limits.
8	The surrogate recovery was outside of control limits.
9	Result identified as an EMPC.

Validation Reason Code	Definition
10	The sample chromatogram did not resemble the standard hydrocarbon pattern.
11	The sample concentration was greater than the instrument's calibration range.
12	The calibration criterion of RRF, %D, and/or %RSD was not met.
13	The analyte was detected in field blank, rinsate blank, and/or trip blank sample.
14	The internal standards did not meet control criteria.
15	The serial dilution did not meet control criteria.
16	The difference between columns did not meet control criteria.
17	Field duplicates did not meet the 50% RPD control criterion.
18	Sample receipt temperature exceeded the acceptable range of from 4 to 6 °C.
19	Analytical duplicate precision did not meet control criteria.
20	Headspace in vials containing water samples to be analyzed for volatiles.
99	Other

37.0 USABILITY ASSESSMENT (SAP WORKSHEET #37)

The evaluation of data usability of the Phase 1A-B data will include comparison of results to MQOs with subsequent evaluation against the DQOs, as described in the following sections.

37.1 MEASUREMENT QUALITY OBJECTIVES FOR COPC SELECTION

All analytical results will be evaluated in accordance with precision, accuracy, representativeness, completeness, comparability, and sensitivity (PARCCS) parameters to document the quality of the data and to ensure that the data are of sufficient quality to meet the project objectives. Of these PARCCS parameters, precision and accuracy will be evaluated quantitatively by collecting the QC samples at the frequencies listed in WS#12. Precision and accuracy MQO goals for the project are listed in WS#12.

The following subsections describe each PARCCS parameter and how it will be assessed within this project.

37.1.1 Precision

Precision is the degree of mutual agreement between individual measurements of the same property under similar conditions. Combined sampling and analytical precision are evaluated by collecting and analyzing field duplicates and then calculating the variance between the samples, typically as an RPD:

$$RPD \quad = \quad \frac{|A-B|}{(A+B)/2} \quad x \quad 100\%$$

where:

A = First duplicate concentration
B = Second duplicate concentration

Laboratory analytical precision is evaluated by comparing analytical results of laboratory duplicates, or by analyzing MXS of field samples along with MSD. For this project, MXS/MSD samples will be generated for inorganic analytes only. Laboratory duplicates will be used to assess precision for organic and inorganic analytes. The results of the analysis of each MXS/MSD or duplicate pair will be used to calculate an RPD for evaluating precision. WS#12 presents the precision MQO goals for this project.

Tables will be included in the data report to summarize the number of results that did not meet MQOs by analyte by PRI Area /background area, with one table for each validation reason code pertaining to precision MQOs (see WS#36).

37.1.2 Accuracy

Accuracy is the degree of agreement between an observed value (sample result) and an accepted reference value. Field accuracy (bias) will be assessed by collecting and analyzing equipment rinsate blank, source water blank, and trip blank QC samples. These QC samples will be used to evaluate the potential for target analytes to enter samples as a result of sampling processes.

A program of sample spiking will be conducted to evaluate laboratory accuracy. This program includes analysis of the MXS samples (inorganic analyses only), LCS or blank spikes, and method blanks. MXS samples will be prepared and analyzed at a frequency of 5 percent for samples that will require analysis for inorganic chemicals. LCS or blank spikes are also analyzed at a frequency of 5 percent or per extraction batch, whichever is most frequent. System monitoring compounds (surrogate standards) or internal standards are added to every sample analyzed for organic constituents.

The results of the spiked samples are used to calculate percent recovery (%R) for evaluating accuracy.

$$\%R = \frac{S - C}{T} \; x \; 100$$

where:

S = Measured concentration in the spiked water or soil sample
C = Unspiked water or soil sample concentration
T = True or actual concentration of the spike

WS#12 presents accuracy MQO goals for this investigation based on percent recovery of laboratory, matrix, and surrogate spikes. Results that fall outside the accuracy goals will be evaluated further on the basis of the results of other QC samples, and appropriate data qualifiers will be applied. QC acceptance limits for system monitoring compounds and internal standards for organic analyses are presented in WS#28.

Tables will be included in the data report to summarize the number of results that did not meet accuracy MQOs by analyte by PRI Area/background area, with one table for each validation reason code pertaining to accuracy MQOs.

37.1.3 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent the characteristics of a population, variations in a parameter at a sampling point, or an environmental condition that they are intended to represent. For this project, representative data will be obtained through careful selection of sampling locations and analytical parameters. Representative data will also be obtained through proper collection and handling of samples to avoid interference and minimize contamination.

Representativeness of data will also be ensured through consistent application of established field and laboratory procedures. Laboratory blank samples will be evaluated for presence of contaminants to aid in evaluating representativeness of sample results.

37.1.4 Completeness

Completeness is a measure of the percentage of project-specific data that are valid. Valid data are obtained when samples are collected and analyzed in accordance with QC procedures outlined in this Phase 1A-B RI SAP, and when results are found to be usable (with or without qualification) based on comparison to QC criteria. When all data validation is completed, the percent completeness value will be calculated by dividing the number of useable sample results by the total number of sample results planned for this investigation.

As discussed further in Section 37.2, completeness will also be evaluated as part of the data quality assessment (DQA) process (EPA 2006b). This evaluation will help determine whether any limitations are associated with the decisions to be made based on the data obtained.

37.1.5 Comparability

Comparability expresses the confidence with which one dataset can be compared with another. Comparability of data will be achieved by consistently following standard field and laboratory procedures and by using standard measurement units in reporting analytical data. Field procedures are standardized to help ensure comparability. Comparability of laboratory data will be assured by use of established and approved analytical methods, consistency in the basis of analysis (wet weight, volume, or similar units), and consistency in reporting units (ppm, ppb, and so forth).

37.1.6 Sensitivity

Sensitivity is the ability of the method or instrument to detect the target analytes at the level of interest. As defined in the UFP-QAPP Manual (EPA 2005a):

- "The quantitation limit (QL) is the minimum concentration of an analyte that can be routinely identified and quantified above the MDL by a laboratory."
- "The MDL is a statistically derived detection limit that represents a 99 percent confidence level that the reported signal is different from a blank sample. The MDL is lower than the concentration at which the laboratory can quantitatively report."
- Sample quantitation limits are QLs that are adjusted for dilutions, percent moisture, and cleanup procedures, sample size, or extract /digestate volumes.

QLs are typically several times higher than the MDL to allow for matrix effects. Project QLs and MDLs shown in WS #15 represent the expected sensitivity the laboratory can achieve for specific analytical methods in a typical solid matrix. Analytical methods have been selected for this project so that the QL for each target analyte is below the applicable comparison criteria wherever practical. WS#15 compares the QLs and MDLs reported by the project-specified laboratories for the selected analytical methods with comparison criteria. The comparison criteria are generally RBCs as compiled in the SLRA Technical Memorandum (ERM 2014b). This comparison shows that the associated QLs for the analytical methods selected are generally less than the applicable ecological and human health RBCs, in most cases. If a reported value is less than the QL but greater than the sample detection limit (DL), the result will be reported as an estimated value. This procedure is being adopted to help ensure that analytical results can effectively be compared with comparison criteria for certain compounds if the screening criteria are near or below the QL. RBCs are calculated values and may be lower than the QL and, in some cases, also the MDL, due to the limitations of analytical technology. This reporting procedure will help to ensure that subsequent statistical evaluations of the data will not be biased by high-value nondetect results. Because results will be reported to the DL, for this project, sensitivity will be assessed based on DLs of laboratory analytical results.

37.2 DATA QUALITY ASSESSMENT APPROACH

After environmental data have been reviewed, verified, and validated in accordance with the procedures, the data must be further evaluated to determine whether DQOs have been met. To the extent possible, US Magnesium/ERM will follow EPA's DQA process to verify that the type, quality, and quantity of data obtained are appropriate for their intended use. The DQA methods and procedures outlined in EPA's *Data Quality Assessment: Statistical Methods for Practitioners* (EPA 2006b) will be used for evaluating quantitative DQOs. This DQA process includes five steps: (1) review the DQOs and sampling design; (2) conduct a preliminary data review; (3) select a statistical test; (4) verify the assumptions of the statistical test; and (5) draw conclusions from the data. Quantitative, i.e. statistically based, DQOs for the Phase 1A-B RI include:

- Reliable identification of COPCs for human and ecological receptors within PRI Areas 1 and 3 through 7; and

- Estimation of background (ambient) concentrations for metals and organics including, D/Fs, total PCBs and WHO congeners, and HCB.

The DQA procedures to determine data adequacy for COPC selection and background (ambient) concentration DQOs are described in Sections 37.3 and 37.4, respectively.

US Magnesium/ERM will systematically assess data quality and data usability when the five-step DQA process cannot be completely followed because the DQOs are qualitative. This assessment will include the following elements, as appropriate:

- A review of the sampling design and sampling methods to verify that these were implemented as planned and are adequate to support project objectives

- A review of project-specific data quality indicators for PARCCS to evaluate whether MQO goals have been met

- A review of project-specific DQOs to determine whether they have been achieved by the data obtained

- An evaluation of any limitations associated with the decisions to be made based on the data obtained.

Qualitative DQOs for which data quality will be assessed systematically using the elements listed above include the following:

- Initial risk calculations performed in the OU-1 SLRA to evaluate whether sufficient data have been collected within PRI Areas 1 and 3 through 7 to support confident risk characterization.

- Preliminary evaluation of the N&E of Site-related impacts within PRI Areas 1 and 3 through 7.

- Identification of suitable reference areas (i.e., non-impacted areas) for biota sampling that may be conducted during 2016 Phase 2 RI activities.

The Phase 1A-B RI data report will discuss any potential impacts of data quality assessments on data usability, and will clearly define any limitations associated with the data. Laboratory managers are responsible for day-to-day identification of laboratory data issues and resolution of those issues, as identified in WS #6 and WS#7. Data collected under this Phase 1A-B RI SAP shall be reported by US Magnesium/ERM; therefore, the Project Manager and Field Team Leader (WS#3) will ensure proper documentation of data usability through the final reports and subsequent meetings as needed.

37.3 DATA ADEQUACY FOR COPC SELECTION

The data adequacy assessment protocol for COPC selection is summarized in Figure 37-1. The number of samples to collect per PRI area was determined as described in WS#11. If the maximum detected concentration exceeds the lowest risk-based screening level (RBSL)/risk-based ecological screening level (RBESL), the dataset will be deemed adequate for COPC selection. If the maximum detect does not exceed the lowest RBSL/RBESL and if at least 50 percent of the results are detected concentrations, the distribution will be tested by comparing the mean concentration of the results for an analyte in a PRI area to the 80th percentile concentration. The mean will be calculated using one-half the DL for non-detect results. If the mean concentration is less than or equal to the 80th percentile concentration, the dataset will be deemed adequate for COPC selection. If the mean is greater than the 80th percentile concentration, the dataset is skewed and there will be uncertainty regarding adequacy for COPC selection. In this case, the uncertainty may be addressed by selecting the analyte as a COPC and/or chemical of potential environmental concern (COPEC) (depending whether the DL exceeds the RBSL or lowest RBESL, or both) in the SLRA, or collection of additional data.

If less than 50 percent of the results are detected concentrations, DLs for non-detect results will be compared to RBSLs/RBESLs for each analyte dataset. If the maximum DL is less than the lowest of the RBSL/RBESLs, the dataset will be deemed adequate for COPC selection. If the maximum DL is greater than the lowest of the RBSL/RBESLs, the DLs in each analyte dataset will be reviewed to determine how frequently the DL in undiluted samples exceeds the lowest of the RBSL/RBESLs. Samples are diluted due to either high concentrations of one or more analytes and/or a challenging matrix that contains interfering compounds or would cause damage to the analytical instrument; the DL is adjusted for the dilution factor. For some analytes, many samples may have low dilutions, and the adjusted DLs may be less than the lowest RBSL/RBESL. In these cases, sensitivity is adequate; this will be evaluated on a case-by-case basis. The MQO for sensitivity will be evaluated as follows:

- If the DL is less than the lowest RBC in more than 50 percent of the undiluted samples, the MQO for sensitivity will have been met, and the dataset will be deemed adequate for COPC selection.

- If the DL exceeds the lowest RBC in more than 50 percent of undiluted samples, the sensitivity MQO will not have been met, and uncertainty remains regarding adequacy for COPC selection. The uncertainty may be resolved by:

    - Selection of the analyte as a COPC and/or COPEC (depending whether the DL exceeds the RBSL or lowest RBESL, or both) in the SLRA; or

    - Collection of additional data if deemed valuable.

37.4 BACKGROUND DATA USABILITY ASSESSMENTS

In addition to the PARCCS data usability evaluations described in Section 37.1, Phase 1A-B analytical data collected from background locations will undergo additional assessment to confirm that 1) soil sampling locations are not impacted by Site activities, 2) an adequate number of background samples were collected to support background evaluations. The first step of the DQA will be to conduct a preliminary data review to confirm high values are not the result of transcription or reporting errors. The remainder of the DQA for metals will be conducted on Lakebed and Upland datasets separately (see WS#11). The sample population of organics collected from Lakebed areas will be compared to the population collected from Upland using nonparametric hypothesis testing[15]. If there is not a statistically significant different between the two populations for D/F TEQ, Total PCBs and HCB, then the DQA for each organic will conducted on the entire background dataset. Otherwise, the DQA for organics will be conducted on the Lakebed and Upland datasets separately.

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[15] WRS or Gehan test will be used depending on which test data support.

There are a number of methods that may be used to evaluate whether background samples have been impacted by Site activities. The exact methods that will have the highest reliability and utility cannot be identified with certainty prior to collecting the data. However the following data evaluations are proposed to confirm background samples have not been impacted by the Site, and will include the following DQA elements:

- Metals Evaluations
  - Identify statistical outliers
  - Evaluate outliers using Q-Q plots
  - Evaluate outliers in relation to geochemical associations
- Organics Evaluations
  - Identify statistical outliers
  - Compare outliers to regional background datasets (if available)
  - Evaluate HCB outliers using Q-Q plots
  - Evaluate D/F and PCB congener and PCB homolog fingerprint signatures of outliers

These elements will be used in background data retention decision making (i.e. whether or not a sample should be excluded from the background dataset.) In general, none of these elements will be used to exclude background data on its own. Instead, these elements will be utilized holistically and applied using a decision framework.

Once data retention decision making is complete, the final datasets will be evaluated to confirm the background sample sizes (metals and organics) are large enough to support statistical background evaluations. The DQA elements and decision making methodologies that will be used for establishing the metals and organics background datasets are presented below in Sections 37.4.1 and 37.4.2, respectively. The DQA for confirming adequate background area sample sizes is presented in Section 37.4.3.

37.4.1 Evaluation of Metals in Background Datasets

Metals are a natural component of the earth’s crust. As such, it is critical to differentiate between naturally occurring concentrations, and those that are elevated as a result of Site operations. The following sections describe the DQA elements and data retention decision making methodology that will be used to evaluate the background metal datasets for Lakebed and Upland settings. The basis for evaluating metals separately for Lakebed and Upland setting is described in WS#11.

37.4.1.1 Identify Statistical Outliers

Outliers in background sample results will identified statistically. EPA software ProUCL (http://www2.epa.gov/land-research/proucl-software) will be used to performed the Rosner test (sample sizes will have n>25) to identify outliers in the background datasets. Rosner’s test assumes data are approximately normally distributed. As environmental data are frequently lognormally distributed, it may be necessary to log-transform the data prior to performing the outlier test. The distribution of background data will be tested to determine whether log-transformation is appropriate prior to performing Rosner’s test. Statistical outliers will be considered anomalous concentrations, as they are elevated relative to the population in general. However, anomalous results will not necessarily be excluded from the background dataset; additional lines of evidence will be considered (as presented in the following sections) before deciding to exclude an anomalous result. Outliers will be tabulated and used in conjunction with the results of the other DQA investigations presented below.

37.4.1.2 Evaluate Q-Q Plots Graphical

The background DQA will utilize Q-Q plots to examine populations of individual metals and organics. In a Q-Q plot, the x-axis is arranged such that a dataset's theoretical quantiles will plot (ideally) as a straight line with relatively flat tails. A curve with an apparent inflection point (a point on the curve where a change in direction occurs) is commonly produced when the plotted dataset contains multiple populations (either multiple background populations from different geological units, or background plus anomalous populations due to Site releases). Q-Q plots will be developed for each compound in the background dataset. The plots will also include 95% upper confidence envelopes (UCEs).

In the DQA, Q-Q plots will be examined, with apparent discontinuities in the plot and 95% UCE used to refine conclusions about statistical outliers (Section 37.4.1.1). As with the outlier testing, the findings of the Q-Q plot graphical evaluation will be evaluated in conjunction with the other lines of evidence presented in Section 37.4.1 to determine if results should be excluded from the background dataset.

37.4.1.3 Evaluate Geochemical Associations

The geochemical DQA methods only apply to metals, because organic compounds are generally not expected to exhibit linear relationships with metals. Geochemical correlations of trace versus major elements are predicated on the natural elemental associations in soil. Linear trends are expected for scatterplots of specific trace versus reference metals in uncontaminated samples. Individual samples that may contain contamination are identified by their positions off the trend formed by uncontaminated samples. A complete description of the geochemical evaluation process is presented in WS#11.

The DQA for background will use geochemical evaluations to identify samples results that do not follow the geochemical relationship between a trace and reference metal. The geochemical relationship between reference and trace metal will be established using correlation analysis (see WS#11). For those metals that have a quantifiable geochemical correlation, a linear regression model will be developed with a 95% upper prediction limit (UPL) constructed on the regression (see WS#11). Samples that do not follow the predicted relationship will be candidates for removal from the background dataset if they fall outside the upper 95% UPL.

37.4.1.4 Background Metal Data Retention Decision Framework

The DQA elements above will be integrated to decide which data, if any, should potentially be excluded from the background dataset for metals. Figure 37-2 presents the decision framework that summarizes how data retention decision making will be performed for metals. The approach will be applied on a metal-by-metal basis, independently for Lakebed and Upland background datasets. This approach is stepwise and described below.

1. In Step 1, a preliminary data review will be conducted to confirm high values are not the result of transcription or reporting errors.

2. In Step 2, outlier concentrations will be identified statistically (Section 37.4.1.1). If statistical outliers are identified, the outliers will move to Step 3 of the DQA.

3. In Step 3, a Q-Q plot with a 95% UCE will be generated for the metal's data and examined (Section 37.4.1.2). If a statistical outlier from Step 2 falls outside the 95% UCE and and is not likely to be the result of curvature in the plot, the data point will be excluded. Otherwise, the outlier will move to Step 4.

4. In Step 4, a geochemical relationship will be established if a quantifiable correlation is present (Section 37.4.1.3). If a geochemical relationship is present, the DQA for that metal will move to

Step 5. If a geochemical relationship is not present, the outlier(s) for that metal will be excluded from the background dataset.

5. In Step 5, a geochemical evaluation will be performed (Section 37.4.1.3). If an outlier does not follow the geochemical relationship for that metal, that outlier will be excluded from the background dataset.

The Phase 1A-B RI data report will present the results of the background metal data evaluation. The evaluation will present the selected background metals datasets for Lakebed and Upland settings and will identify any metals results that are excluded and the rationale for exclusion.

37.4.2 Evaluation of Organics in Background Datasets

The organic compounds D/F, PCBs, and HCB in background may be the result of either anthropogenically produced or combustion byproducts (wildfires), both of which are ubiquitous in the environment due to wind dispersal and aerial deposition. Because these organic compounds are by-products of magnesium production at the Site, proposed background samples will be evaluated for Site impacts. Four approaches will be used to evaluate whether background samples are impacted by Site operations. These include: (1) identifying outlier concentrations, (2) statistical comparison of outliers to regional background datasets, (3) graphical evaluation using Q-Q plots; and (4) comparison of D/F and co-planar PCB congener and PCB homolog fingerprint signatures between background samples, Site data, and other regional background datasets (where available). The approaches used will vary depending on organic compound. The following sections describe the DQA elements and data retention decision making methodology that will be used to evaluate the background organics dataset.

37.4.2.1 Identify Statistical Outliers

The identification of outliers will use the same outlier testing procedure discussed in Section 37.4.1.1 for metals. This evaluation will be applied to mammalian D/F TEQs[16], total PCBs and HCB.

37.4.2.2 Comparison of Outliers to Regional Background Datasets

Regional background datasets will be identified for D/F TEQs, total PCBs and HCB if available. A D/F and co-planar PCB dataset has already been identified (EPA 2004). Regional datasets for Total PCBs and HCB have not yet been identified. If datasets for these to organics cannot be located, the step of comparing outliers from these organics to regional background will be excluded from the data retention decision framework (Section 37.4.2.6).

The comparison of outliers to regional background datasets will be statistical. The statistical method by which this comparison will be conducted will be identified based on what the regional background dataset(s) support. However, it is likely this will be in the form of comparing outliers to a threshold value such as a 95/95 upper tolerance limit (UTL).[17]

37.4.2.3 Evaluate Q-Q Plots

The Q-Q plot graphical evaluation for organic background sample results will be performed and used in the same manner as discussed in Section 37.3.1.2 for metals. This evaluation will be applied to HCB only. Q-Q plot evaluations will not be performed for D/F TEQs, D/F and co-planar PCB congeners, and PCB homologs because results for these constituents will be assessed using fingerprint signatures.

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[16] The DQA will focus on mammalian TEQs, because the avian TEQ incorporate HCB as a component constituent. HCB is evaluated independently in the DQA.

[17] A 95/95 UTL is the 95% confidence limit calculated on the 95 percentile of the regional background dataset.

37.4.2.4 Evaluate D/F and PCB Congener and PCB Homolog Fingerprint Signatures

Background D/F, coplanar PCB congener and PCB homolog results from outlier samples will be compared to a Site fingerprint signature and if available, signatures from regional reference data (e.g. EPA 2002a) using fingerprinting techniques. Fingerprinting will include calculating the relative proportions of congeners or homologs in each outlier sample from the background dataset, and comparing the patterns of proportions exhibited by a Site data signature and, if available regional reference signature(s). This methodology is described in EPA (2004). If regional reference datasets for PCB homologs cannot be located, the fingerprint evaluation will be limited to comparing background outlier signatures to the Site signature (Section 37.4.2.6).

In addition to applying the fingerprint methodology described in EPA (2004), ordination and other statistical approaches (supportable by the data) will also be used to compare background outlier signatures to Site and regional reference signatures. These fingerprinting approaches will be used to determine if an outlier should be retained or excluded from the background dataset.

37.4.2.5 Organics Background Data Retention Decision Framework

The DQA elements above will be integrated to decide which data, if any, should be excluded from the background dataset for organics. Figure 37-3 presents the decision tree that summarizes how data retention decision making will be performed for organics in the background dataset. The approach will be applied on an organic-by-organic basis. This approach is stepwise and described below.

1. In Step 1, a preliminary data review will be conducted to confirm high values are not the result of transcription or reporting errors.

2. In Step 2, Lakebed and Upland organic populations of each analyte will be compared independently. The organic results from the Lakebed population will be compared to the Upland population using nonparametric statistics (WRS or Gehan Test) to determine if the populations are significantly different. If populations are significantly different, the remaining DQA steps will be performed on Lakebed and Upland populations separately. Otherwise, the remaining steps will be conducted on the organic population as a whole.

After Step 2, organic data will be segregated into one of three tracks based on the compound:

- D/F and coplanar PCB congener data will move to DQA Track A;
- Total PCB and PCB homolog data will move to DQA Track B; and
- HCB data will move to DQA Track C

Each track is described below.

Track A (D/F and coplanar PCB congeners)

3A. In Step 3A, the mammalian TEQ calculated from D/F and coplanar PCBs will be tested for statistical outlier concentrations (Section 37.4.2.1). If outliers are identified, the outliers will move to Step 4A.

4A. In Step 4A, TEQ outliers identified in Step 3A will be compared statistically to regional reference data (Section 37.4.2.2). If an outlier is statistically different from regional reference data, the outlier will move to Step 5A of the DQA.

5A. In Step 5A, outliers remaining after Step 4A will be evaluated using fingerprinting (Section 37.4.2.4). If the outlier fingerprint is similar to the Site signature and/or is not similar to the regional reference signature, the outlier will be excluded from the background dataset.

Track B (Total PCBs)

3B. In Step 3B, the Total PCBs dataset will be tested for statistical outlier concentrations (Section 37.4.2.1). If outliers are identified, the outliers will move to Step 4B.

4B. In Step 4B, Total PCB outliers identified in Step 3B will be compared statistically to regional reference data, if available (Section 37.4.2.2). If no regional Total PCB reference data are identified, or if an outlier is statistically different from available regional reference data, the outlier will move to Step 5B of the DQA.

5B. In Step 5B, outliers remaining after Step 4B will be evaluated using fingerprinting (Section 37.4.2.4). If the outlier fingerprint is similar to the Site signature and/or is not similar to an available regional reference signature, the outlier will be excluded from the background dataset.

Track C (HCB)

3C. In Step 3C, the HCB dataset will be tested for statistical outlier concentrations (Section 37.4.2.1). If outliers are identified, the outliers will move to Step 4C.

4C. In Step 4C, HCB outliers identified in Step 3C will be compared statistically to regional reference data, if available (Section 37.4.2.2). If no regional HCB reference data are available, or if an outlier is statistically different from available regional reference data, the outlier will move to Step 5C.

5C. In Step 5C, a Q-Q plot with a 95% UCE will be generated for HCB and used to examine statistical outliers remaining after Step 4C (Section 37.4.1.2). If a statistical outlier falls outside the 95% UCE and is not likely to be the result of curvature in the plot, the data point will be excluded. from the dataset.

The Phase 1A-B RI data report will present the results of the background organics data evaluation. The evaluation will present the selected background organics dataset and will identify any results that are excluded and the rationale for exclusion.

37.4.3 Confirmation of Background Sample Size Adequacy

The next step in the background DQA will be confirming that adequate power under a Form II hypothesis is achievable by the background dataset sample size. This will be conducted on the final Phase 1A-B dataset, following the elimination of metal and organic results that are not consistent with background (Sections 37.4.1 and 37.4.2).

This DQA step will utilize the following procedure:

1. The standard deviation and mean will be calculated for each metal and organic dataset.

2. The “Compare Site Average to Reference Average” module in Visual Sample Plan (VSP) v7.2 (http://vsp.pnnl.gov/) will be used to calculate sample sizes using the following assumptions:

    a. Samples do not follow a normal distribution

    b. Alpha = 0.1

c. Beta = 0.2

d. S (detectable difference) = 50% of the mean of background data

If the calculated sample size is less than or equal to the sample size of the Phase 1A-B dataset, then the Phase 1A-B dataset is assumed to have adequate power with respect to a Type II error. If the calculated samples size is greater than the sample size of the Phase 1A-B dataset, then there may be reduced power to reject a false null and an increased probability of committing a Type II error. In this case, either more samples could be collected with the aim of increasing power, or the null Form II hypothesis could be accepted and the metal or organic would not be eliminated based on background (ambient) concentrations.

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FIGURES

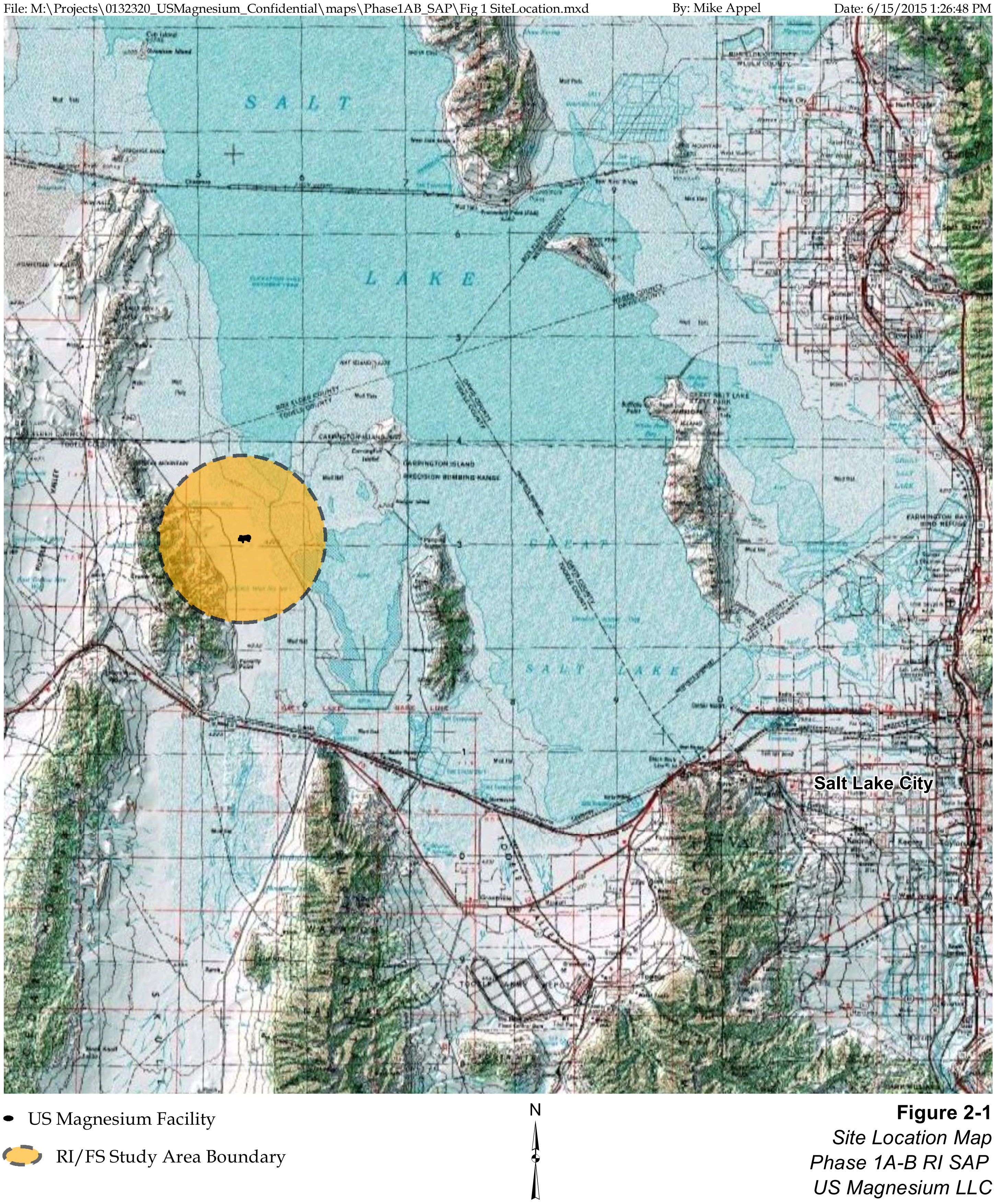


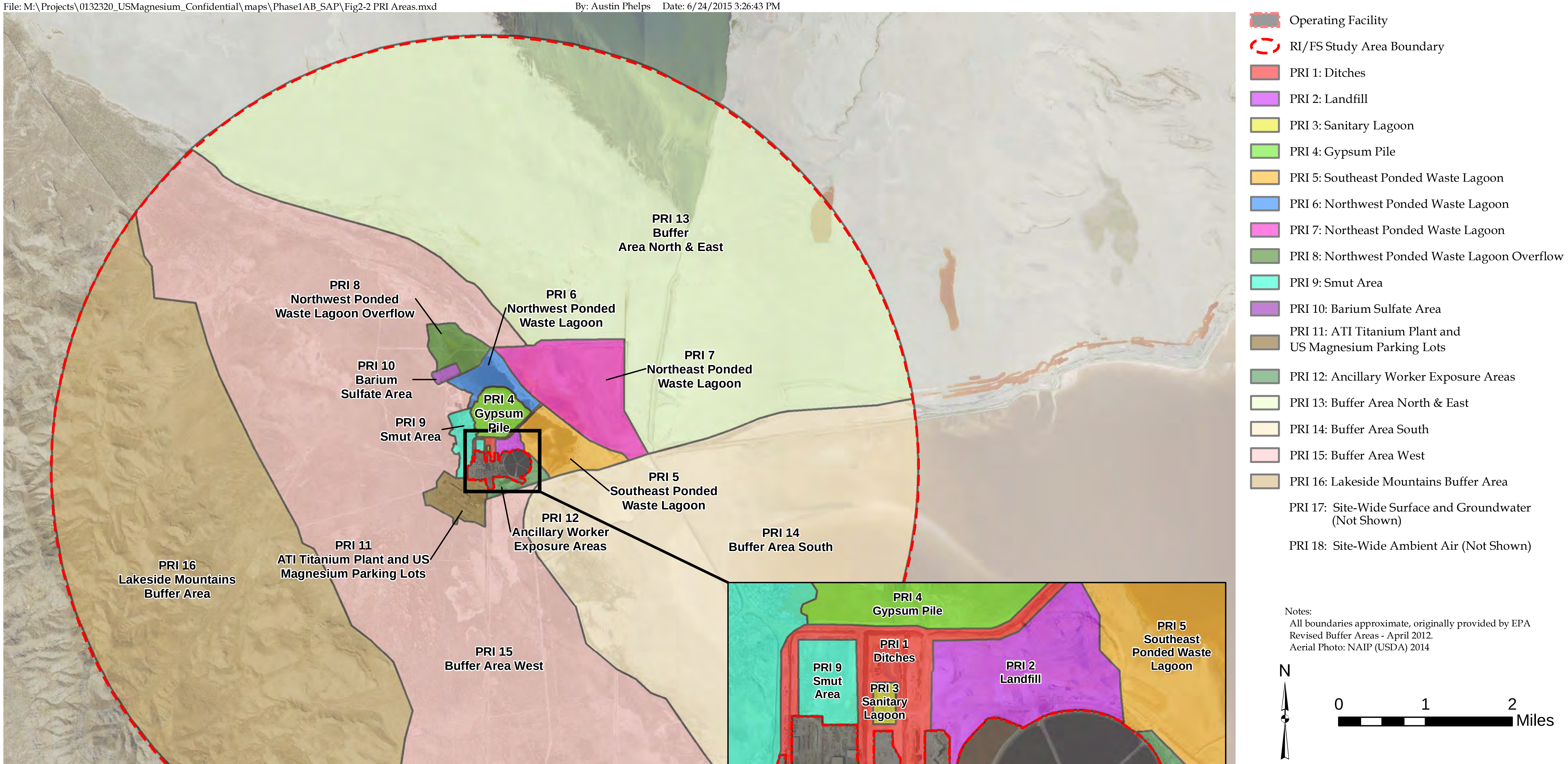
Figure 2-1

Site Location Map
Phase 1A-B RI SAP
US Magnesium LLC
Tooele County, Utah

USmag®

Environmental Resources Management
136 East South Temple, Suite 2150
Salt Lake City, UT 84111
ERM

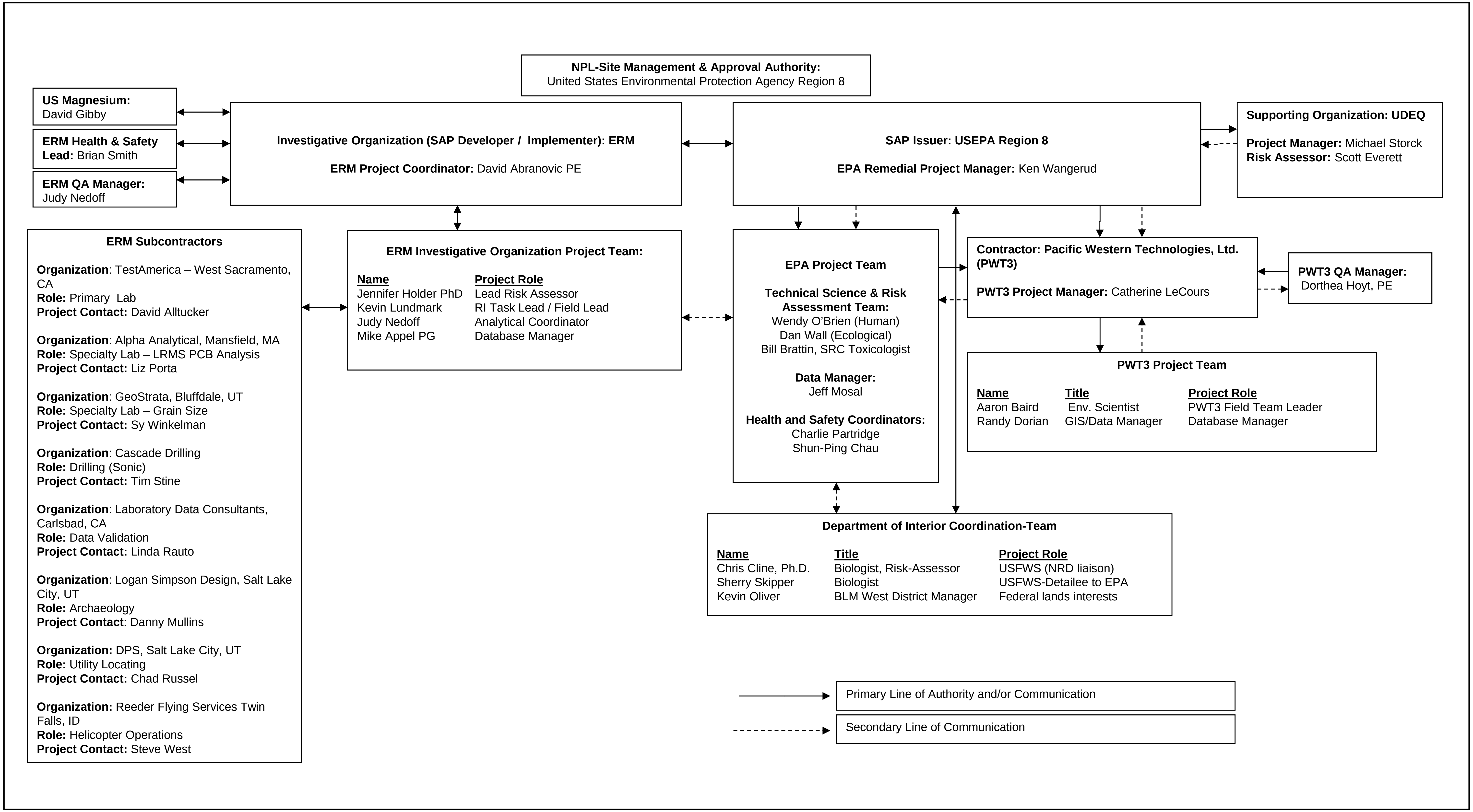
File: M:\Projects\0132320_USMagnesium_Confidential\maps\Phase1AB_SAP\Fig2-2 PRI Areas.mxd By: Austin Phelps Date: 6/24/2015 3:26:43 PM



Notes:
All boundaries approximate, originally provided by EPA
Revised Buffer Areas - April 2012.
Aerial Photo: NAIP (USDA) 2014

Figure 2-2
Preliminary Remedial Investigation Areas
Phase 1A-B RI SAP
US Magnesium LLC
Tooele County, Utah

Environmental Resources Management
7272 East Indian School Road, Suite 108
Scottsdale, Arizona 85251



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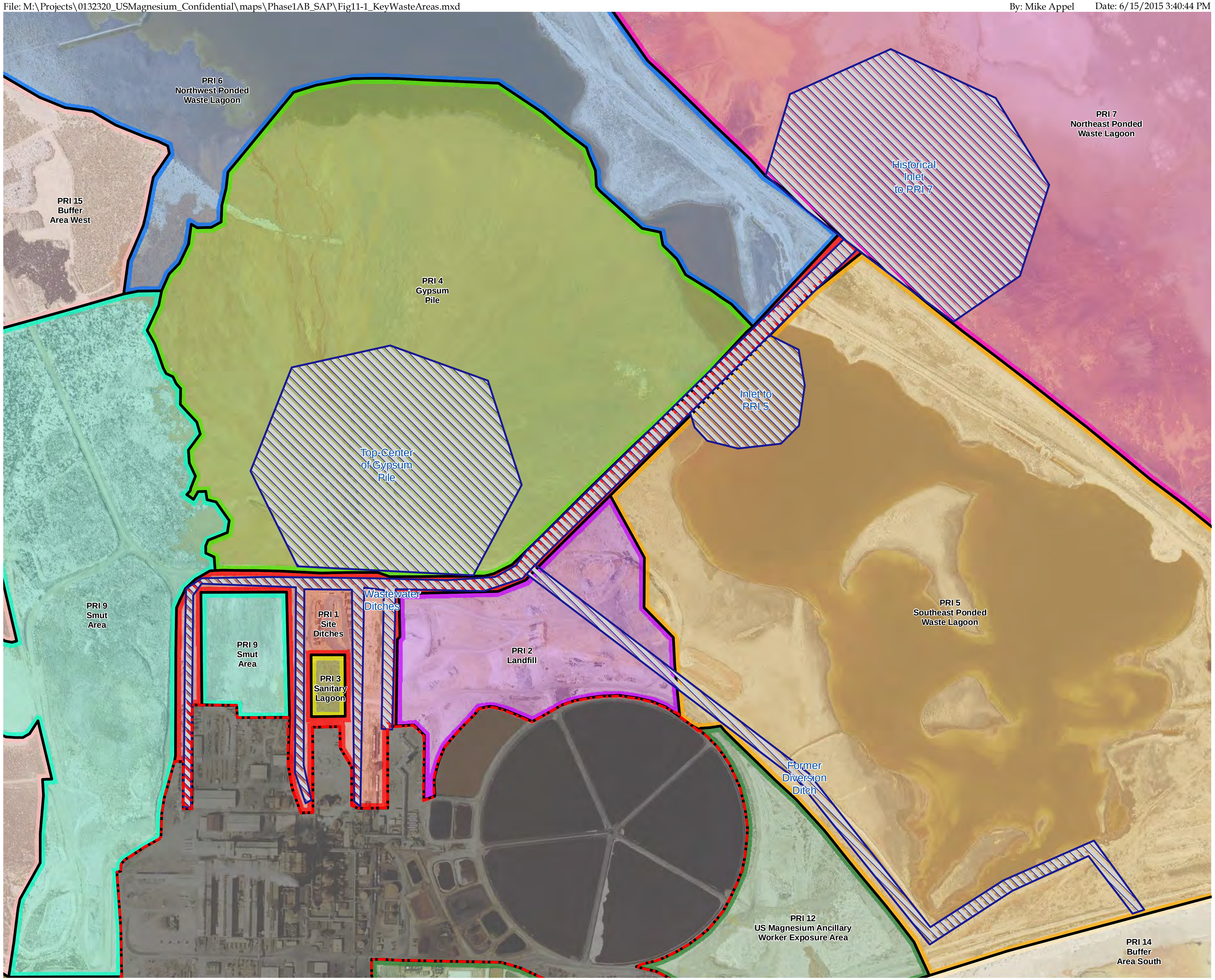
Name	Title	Project Role
Chris Cline, Ph.D.	Biologist, Risk-Assessor	USFWS (NRD liaison)
Sherry Skipper	Biologist	USFWS-Detailee to EPA
Kevin Oliver	BLM West District Manager	Federal lands interests

Primary Line of Authority and/or Communication

Secondary Line of Communication

Figure 5-1
Project Organizational Chart
Phase 1A-B RI SAP
US Magnesium LLC
Tooele County, Utah

File: M:\Projects\0132320_USMagnesium_Confidential\maps\Phase1AB_SAP\Fig11-1_KeyWasteAreas.mxd   By: Mike Appel   Date: 6/15/2015 3:40:44 PM



▨ Key Waste Release Areas
▨ Operating Facility

Preliminary Remedial Investigation Areas

- PRI 1: Ditches
- PRI 2: Landfill
- PRI 3: Sanitary Lagoon
- PRI 4: Gypsum Pile
- PRI 5: Southeast Ponded Waste Lagoon
- PRI 6: Northwest Ponded Waste Lagoon
- PRI 7: Northeast Ponded Waste Lagoon
- PRI 8: Northwest Ponded Waste Lagoon Overflow
- PRI 9: Smut Area
- PRI 10: Barium Sulfate Area
- PRI 11: ATI Titanium Plant and US Magnesium Parking Lots
- PRI 12: Ancillary Worker Exposure Areas
- PRI 13: Buffer Area North & East
- PRI 14: Buffer Area South
- PRI 15: Buffer Area West
- PRI 16: Lakeside Mountains Buffer Area

Notes:
All boundaries approximate, provided by EPA.
Aerial Photo: NAIP (USDA) June 30, 2014

N

0 600 1,200
Feet

Figure 11-1
Key Waste Release Areas
Phase 1A-B RI SAP
US Magnesium LLC
Tooele County, Utah

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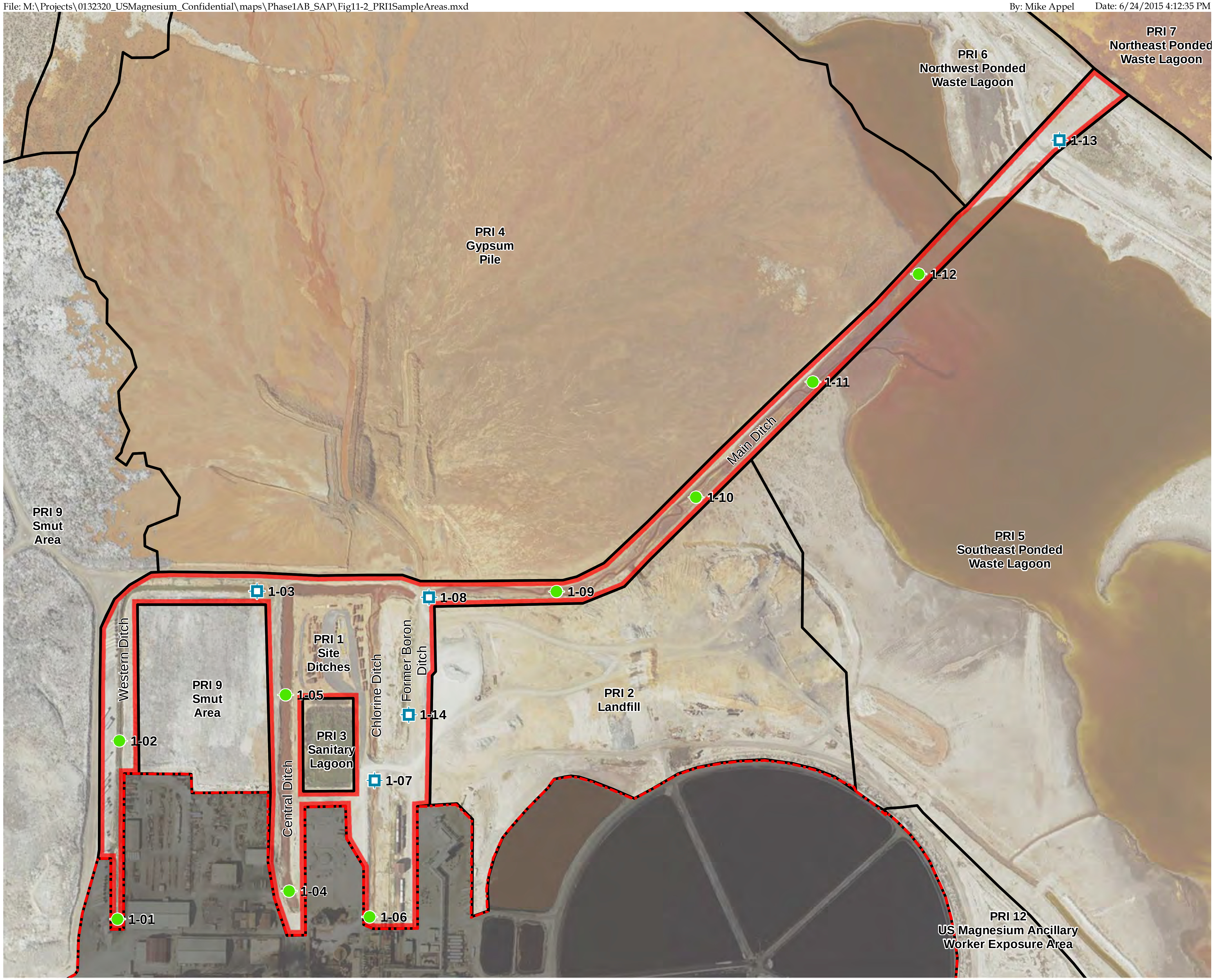
File: M:\Projects\0132320_USMagnesium_Confidential\maps\Phase1AB_SAP\Fig11-2_PRI1SampleAreas.mxd By: Mike Appel Date: 6/24/2015 4:12:35 PM



Phase 1A-B Preliminary Sample Location

- ● Surface Sample
- ▣ Surface and Subsurface Sample (Biased)
- ▨ Operating Facility
- 🟥 PRI 1: Ditches
- ☐ Preliminary Remedial Investigation Areas

Notes:
All boundaries approximate, provided by EPA.
Aerial Photo: NAIP (USDA) June 30, 2014

N

0 400 800
Feet

Figure 11-2
Phase 1A-B Sample Locations for
PRI Area 1 Ditches
Phase 1A-B RI SAP
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File: M:\Projects\0132320_USMagnesium_Confidential\maps\Phase1AB_SAP\Fig11-3_PRI3SampleAreas.mxd By: Mike Appel Date: 6/18/2015 11:07:07 AM

Phase 1A-B Preliminary Sample Location

- ● Surface Sample
- ▣ Surface and Subsurface Sample (Biased)
- ▨ Operating Facility
- 🟨 PRI 3: Sanitary Lagoon
- ☐ Preliminary Remedial Investigation Areas

Figure 11-3

Phase 1A-B Sample Locations for PRI Area 3
Sanitary Lagoon
Phase 1A-B RI SAP
US Magnesium LLC
Tooele County, Utah

N

0 60 120 Feet

Notes:
All boundaries approximate, provided by EPA.
Aerial Photo: NAIP (USDA) June 30, 2014

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File: M:\Projects\0132320_USMagnesium_Confidential\maps\Phase1AB_SAP\Fig11-4_PRI4SampleAreas.mxd

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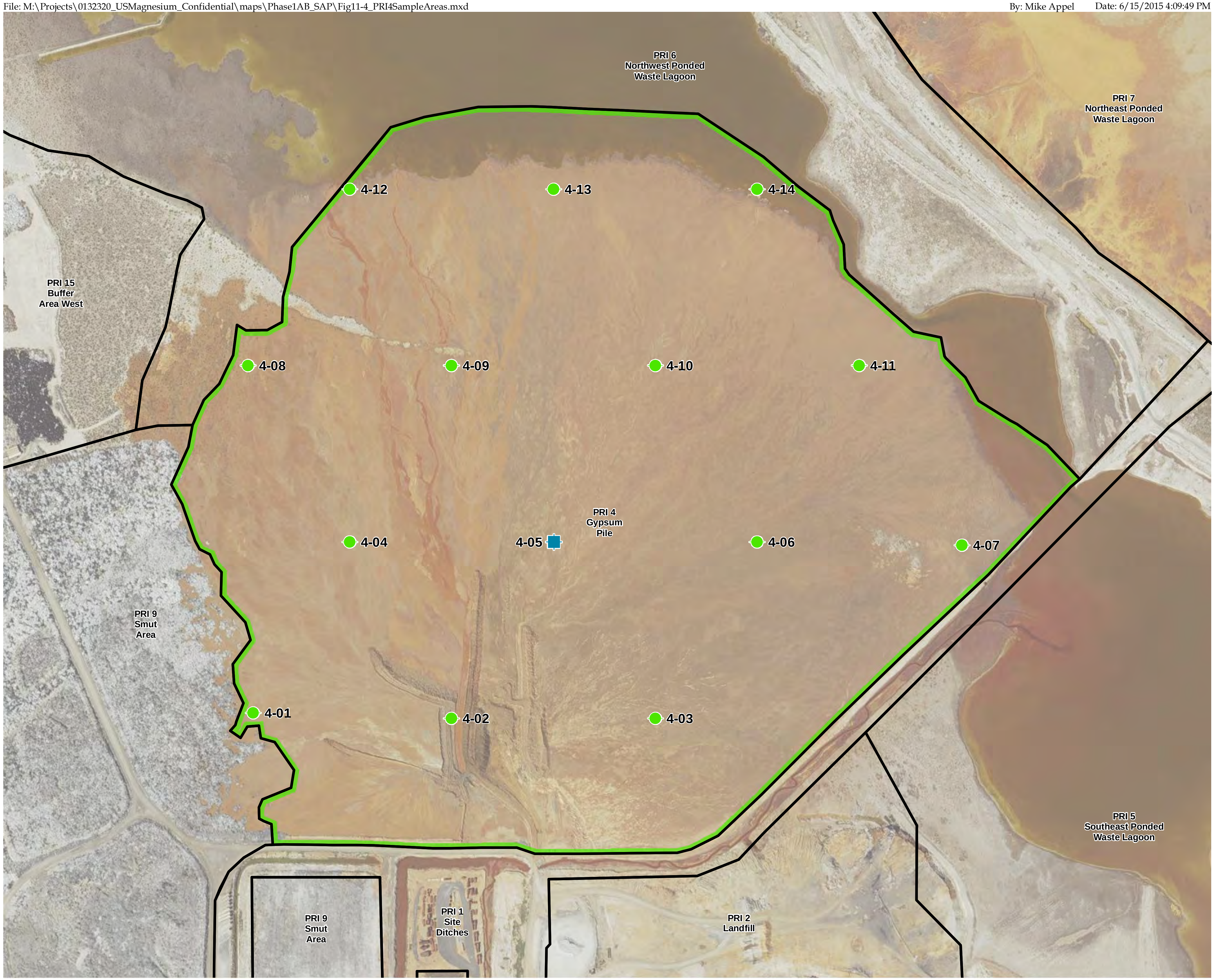

Phase 1A-B Preliminary Sample Location

- ● Surface Sample
- ■ Surface and Subsurface Sample
- ▨ Operating Facility
- 🟩 PRI 4: Gypsum Pile
- ☐ Preliminary Remedial Investigation Areas

Notes:
All boundaries approximate, provided by EPA.
Aerial Photo: NAIP (USDA) June 30, 2014

N

0 400 800 Feet

Figure 11-4

Phase 1A-B Sample Locations for PRI Area 4
Gypsum Pile
Phase 1A-B RI SAP
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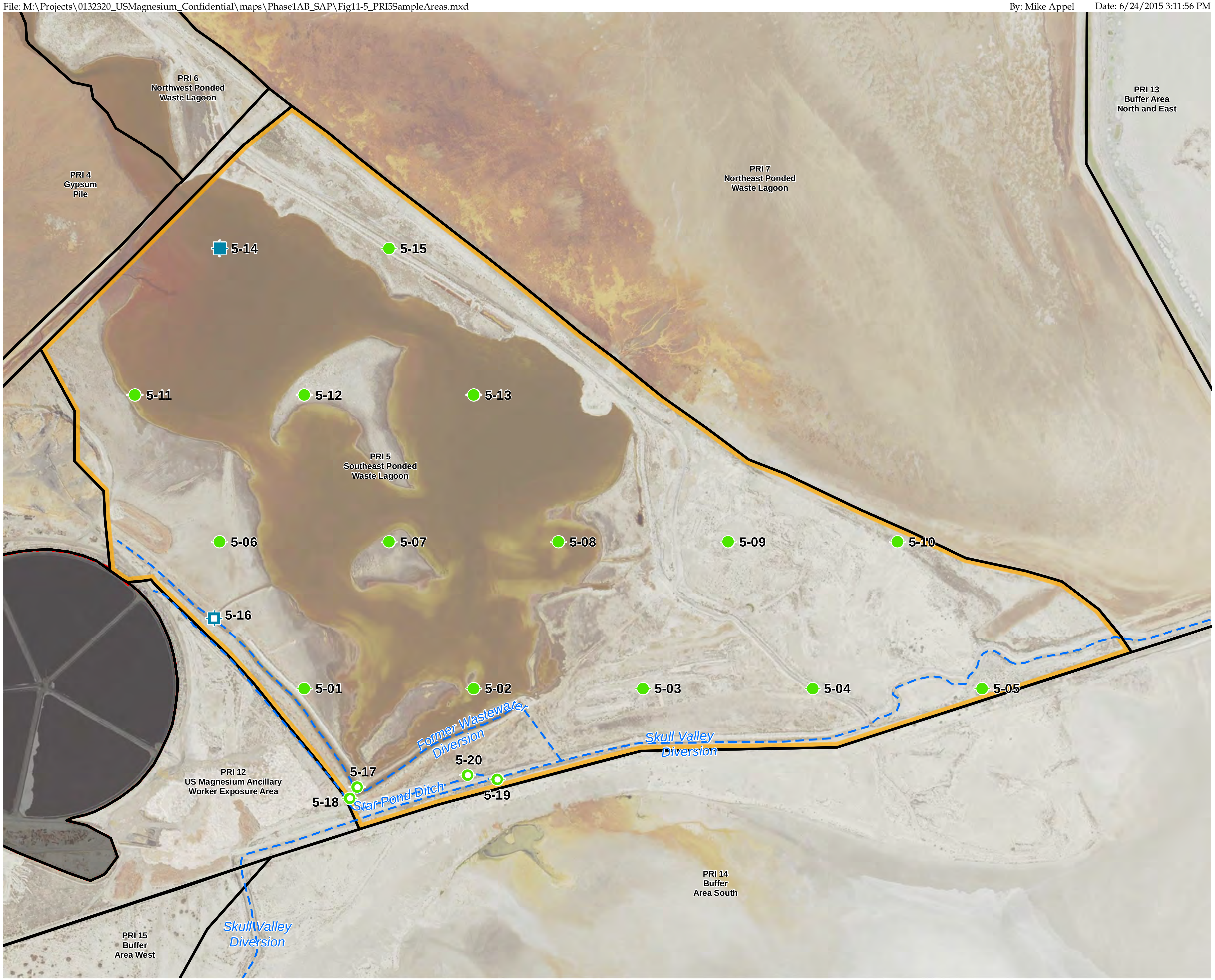
By: Mike Appel

Date: 6/24/2015 3:11:56 PM



Phase 1A-B Preliminary Sample Location

- ● Surface Sample
- ○ Surface Sample (Biased)
- ■ Surface and Subsurface Sample
- □ Surface and Subsurface Sample (Biased)
- - - Ditch Feature
- ▨ Operating Facility
- ▭ PRI 5: Southeast Ponded Waste Lagoon
- ▭ Preliminary Remedial Investigation Areas

Notes:
All boundaries approximate, provided by EPA.
Aerial Photo: NAIP (USDA) June 30, 2014

N

0 600 1,200
Feet

Figure 11-5
Phase 1A-B Sample Locations for PRI Area 5
Southeast Ponded Waste Lagoon
Phase 1A-B RI SAP
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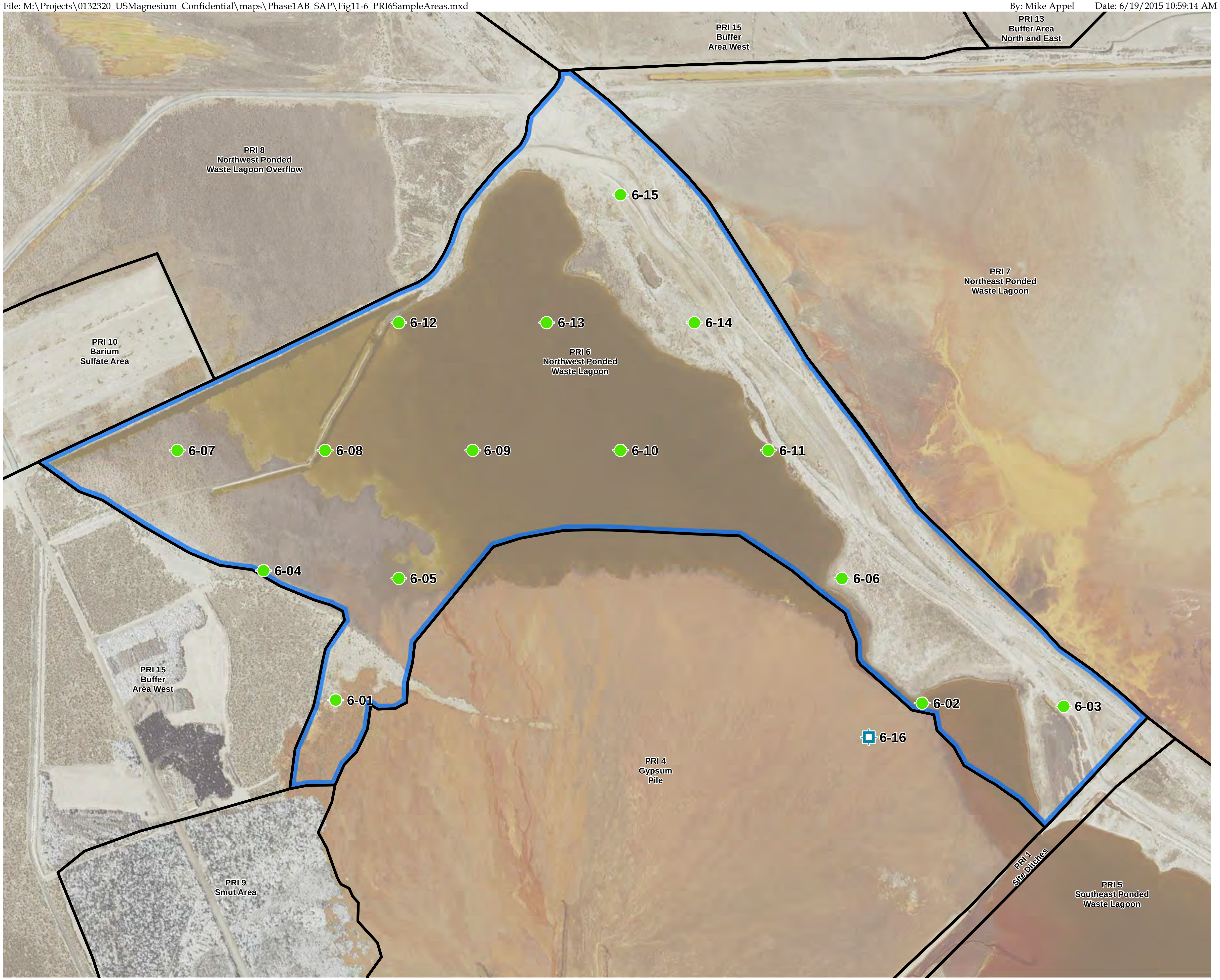

Phase 1A-B Preliminary Sample Location

- ● Surface Sample
- ▣ Subsurface Sample (Biased)
- ▨ Operating Facility
- ▬ PRI 6: Northwest Ponded Waste Lagoon
- ☐ Preliminary Remedial Investigation Areas

Notes:
All boundaries approximate, provided by EPA.
Aerial Photo: NAIP (USDA) June 30, 2014

N

0 600 1,200 Feet

Figure 11-6
Phase 1A-B Sample Locations for PRI Area 6
Northwest Ponded Waste Lagoon
Phase 1A-B RI SAP
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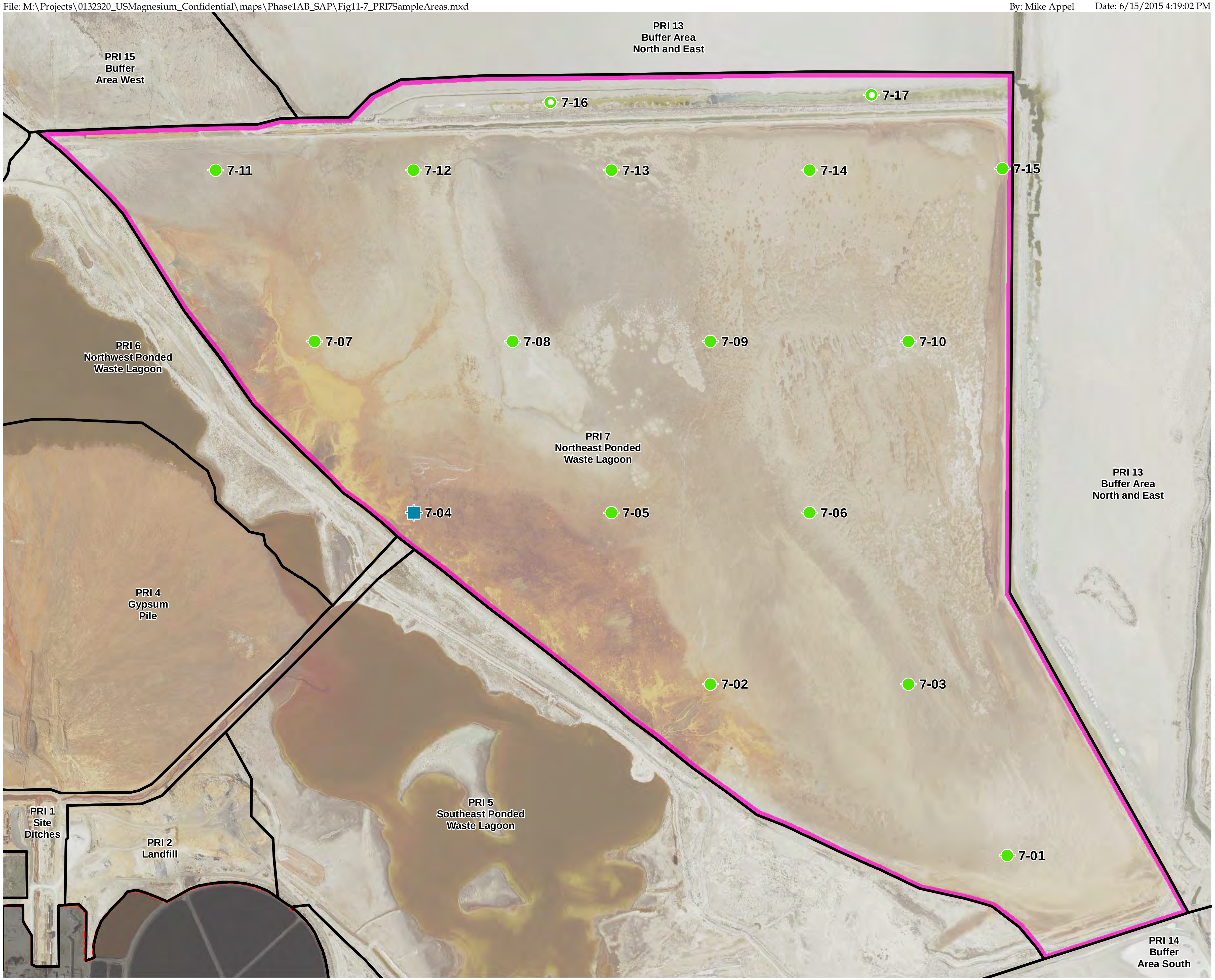
File: M:\Projects\0132320_USMagnesium_Confidential\maps\Phase1AB_SAP\Fig11-7_PRI7SampleAreas.mxd By: Mike Appel Date: 6/15/2015 4:19:02 PM



Phase 1A-B Preliminary Sample Location

- ● Surface Sample
- ○ Surface Sample (Biased)
- ■ Surface and Subsurface Sample
- ▨ Operating Facility
- ▬ PRI 7: Northeast Ponded Waste Lagoon
- ☐ Preliminary Remedial Investigation Areas

Notes:
All boundaries approximate, provided by EPA.
Aerial Photo: NAIP (USDA) June 30, 2014

Figure 11-7
Phase 1A-B Sample Locations for PRI Area 7
Northeast Ponded Waste Lagoon
Phase 1A-B RI SAP
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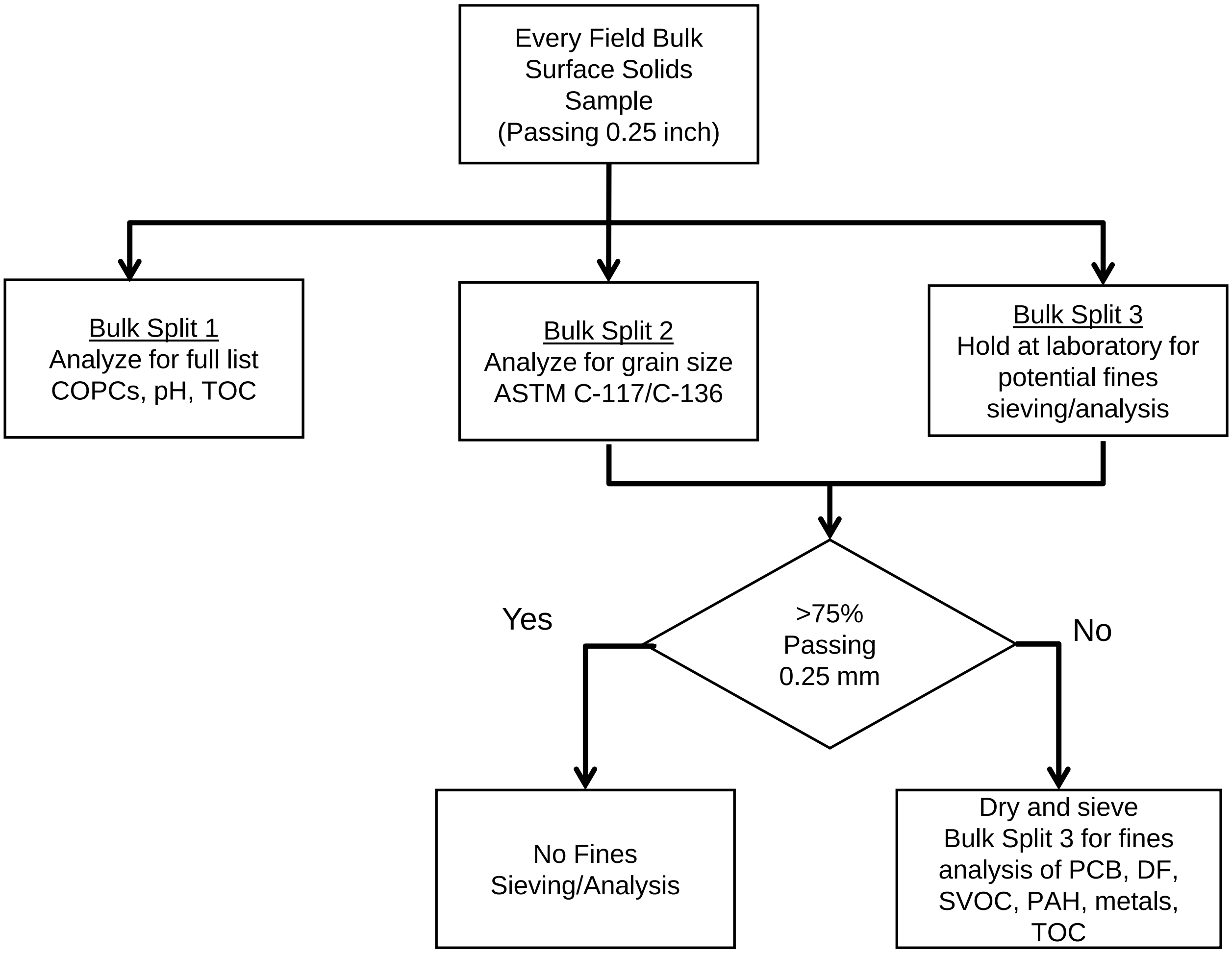

Figure 11-8
Fines Fraction Sieving and Analysis Strategy
Phase 1A-B RI SAP
US Magnesium LLC
Tooele County, Utah

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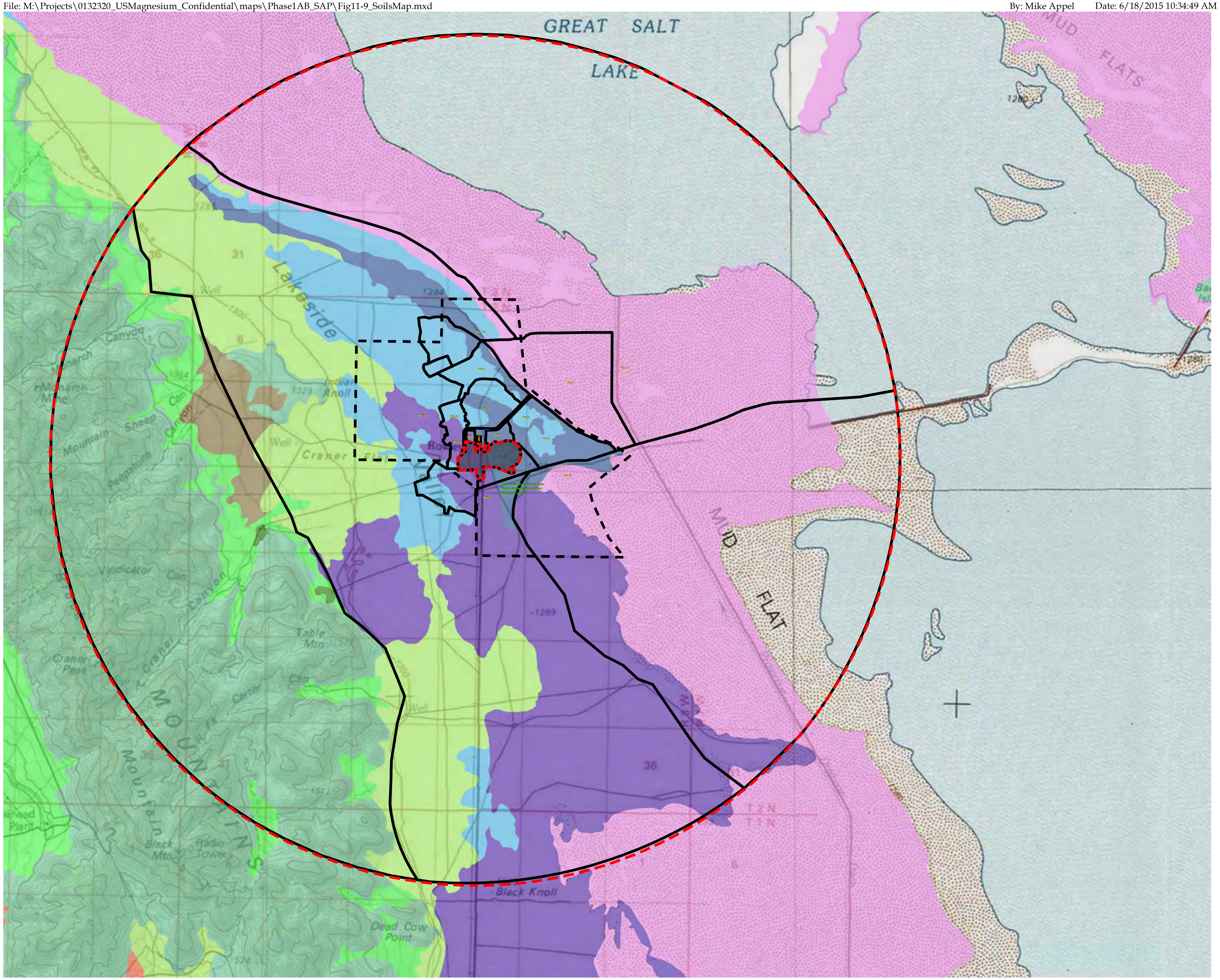

Operating Facility

US Magnesium Property

Preliminary Remedial Investigation Areas

RI/FS Study Area Boundary

General Soil Class

Amtoft-Rock

Checkett

Cliffdown

Dynal

Hiko Peak

Medburn

Pits

Playas-Saltair

Skumpah

Timpie-Tooele

Yenrab

Notes:
All boundaries approximate, provided by EPA.
Soil information from the Natural Resource Conservation Service.

N

0 6,000 12,000
Feet

Figure 11-9

General Soil Class Map
Phase 1A-B RI SAP
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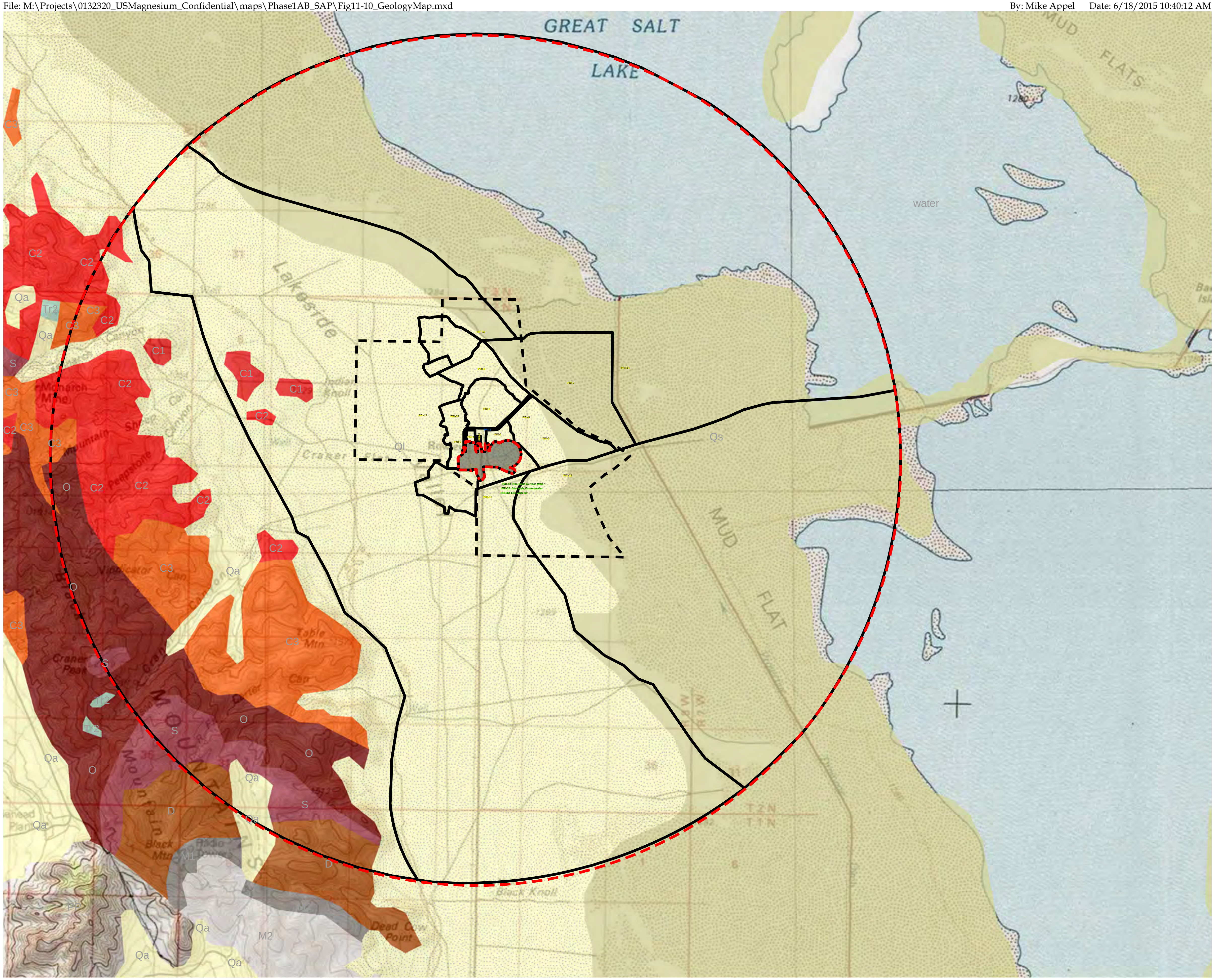

Operating Facility

US Magnesium Property

Preliminary Remedial Investigation Areas

RI/FS Study Area Boundary

Surface Geology

Qs - surficial mud and salt flat deposits

Ql - surficial Lake Bonneville deposits

Qa - surficial alluvium and colluvium

Tr2 - Chinle, Ankareh Fms

S - Laketown, Bluebell Dolomite

O - Fish Haven, Swan Peak, Garden City, Eureka and other Fms

M2 - Great Blue, Humbug, Deseret and other Fms

M1 - Redwall, Madison, Gardison, Ludgepole and other Fms

D - Devonian Formations

C3 - St. Charles, Nounan, Bloomington and other Upper Cambrian Fms

C2 - Middle Cambrian Fms

C1 - Prospect Mountain, Tintic, Ignacio, Geertsen Canyon and other Fms

Notes:
All boundaries approximate, provided by EPA.
Geology information from the Utah Geological Survey.

N

0 6,000 12,000
Feet

Figure 11-10
Surface Geology Map
Phase 1A-B RI SAP
US Magnesium LLC
Tooele County, Utah

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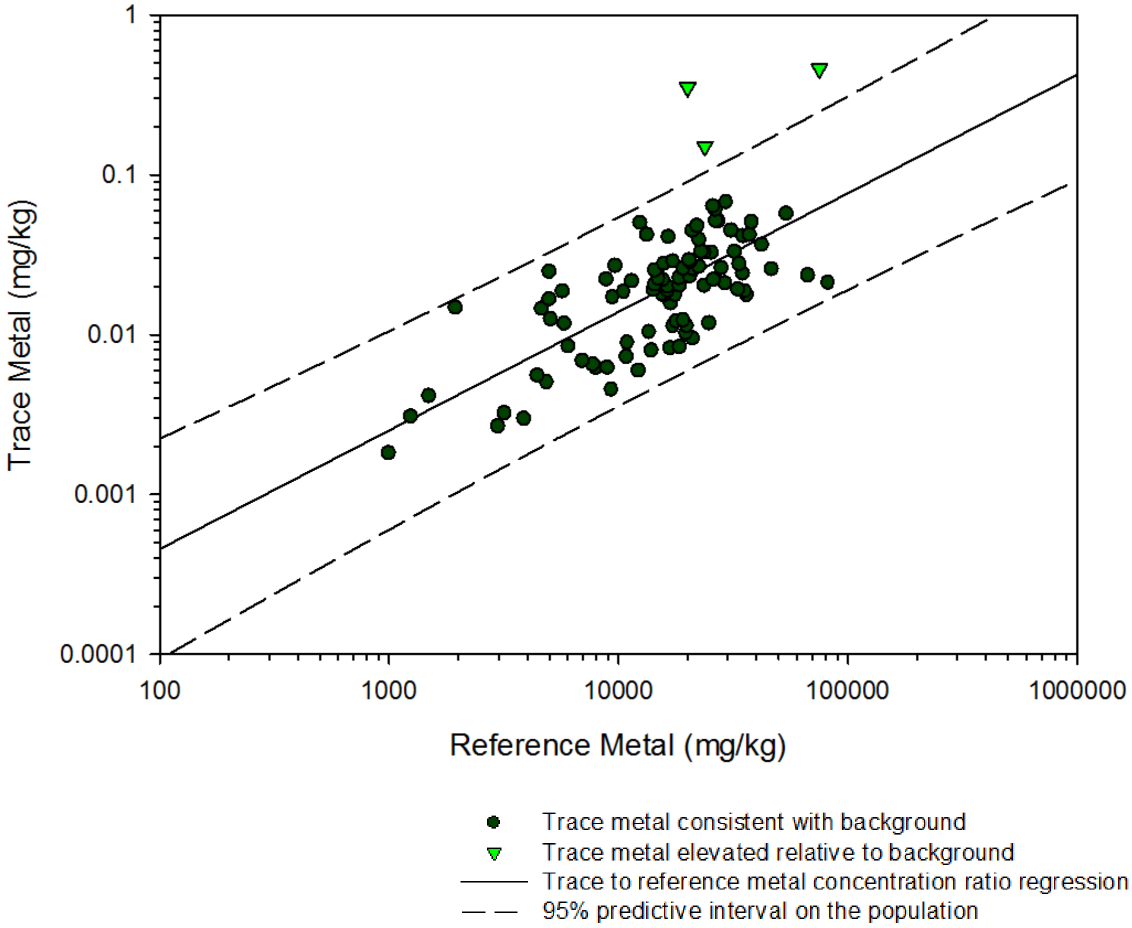


Plot Explanation

The reference metal concentration composes the x-axis in log scale. The y-axis is composed of the log-scale concentration of the trace metal. The bivariate plot is a simple scatter plot of these two metal concentrations reported from the each sample location. The regression line is used to predict the approximate concentration of a trace metal that is expected to correspond to a given reference metal concentration based on the relationships found in the background dataset. In this example, a reference metal concentration of 10,000 mg/kg should correspond to a trace metal concentration of 0.02 mg/kg. Because other naturally occurring conditions will undoubtedly influence the concentration ratio, the 95 percent predictive interval is used to provide a reasonable boundary on the population that adheres to the geochemical relationship shown by the regression line. Bivariate points that fall outside the upper predictive interval line have trace metal with concentration ratios that are artificially enriched, thus considered elevated. In this example, three points fall outside the 95 percent predictive interval. This represents three sample locations that appear elevated relative to background.

Figure 11-11
Hypothetical Geochemical Relationship Plot Example
Phase 1A-B RI SAP
US Magnesium LLC
Tooele County, Utah

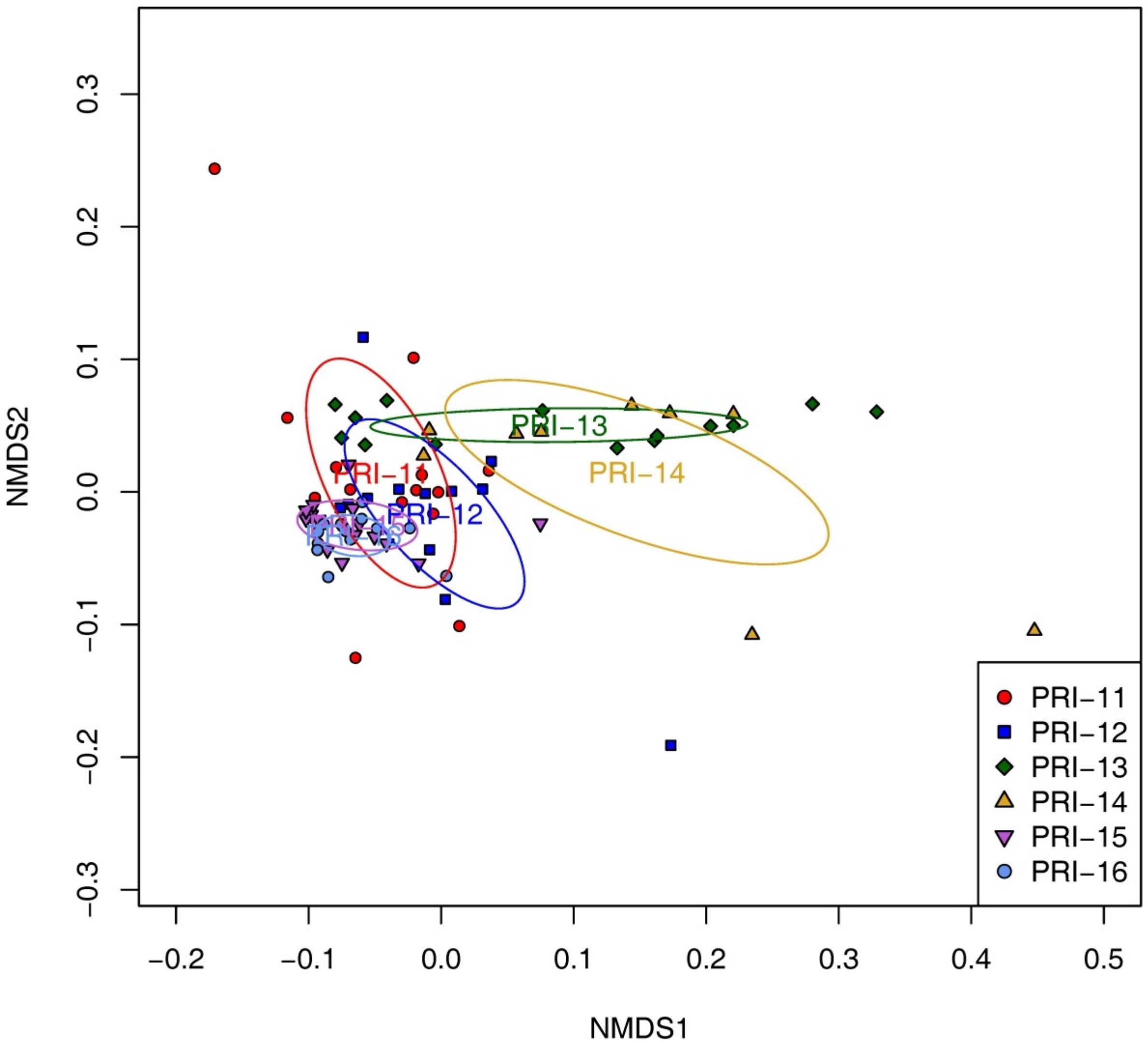


Figure 11-12
NMDS Comparing Metals of PRIs 11, 12, 13, 14, 15 and 16
Phase 1A-B RI SAP
US Magnesium LLC
Tooele County, Utah

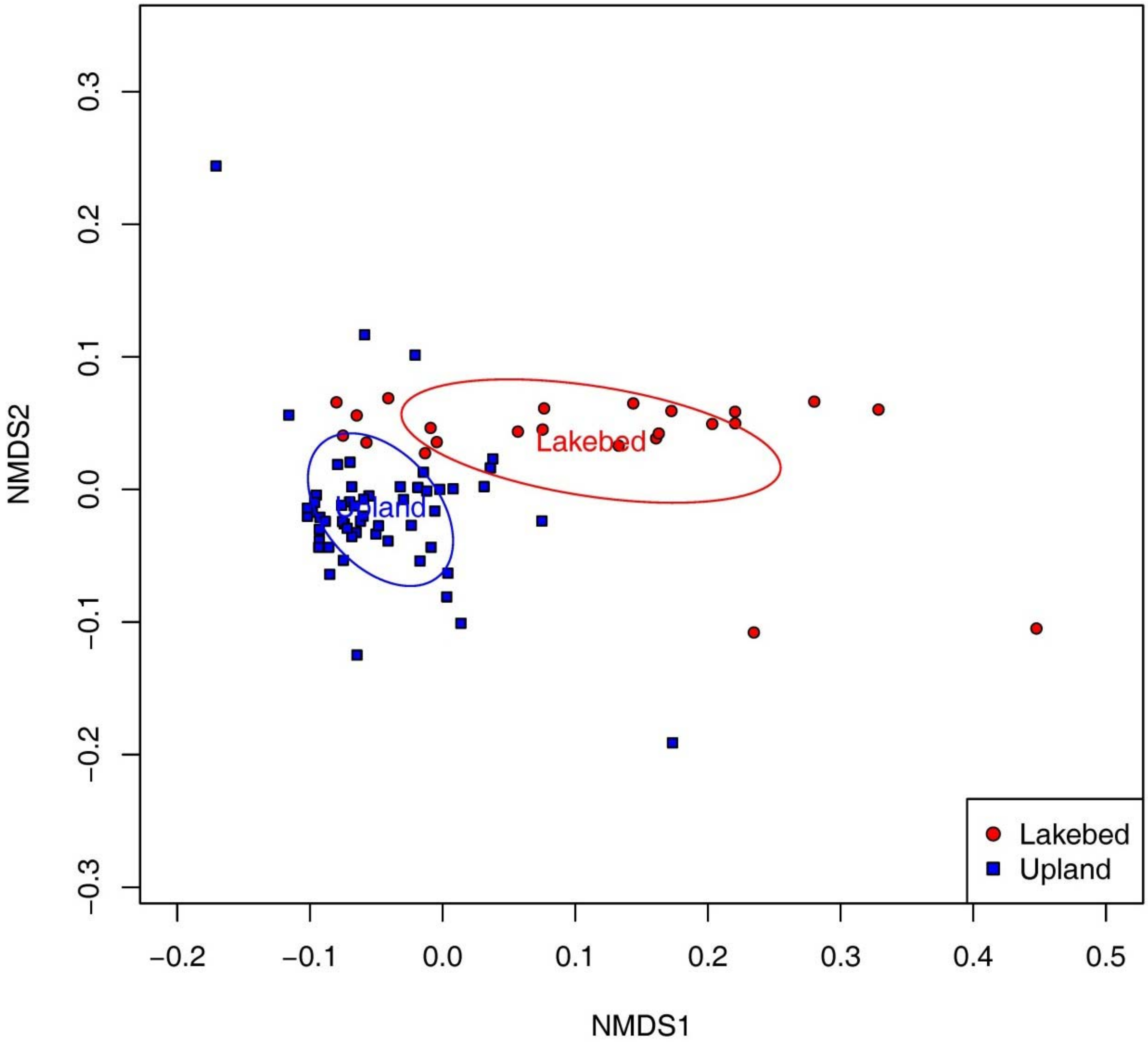
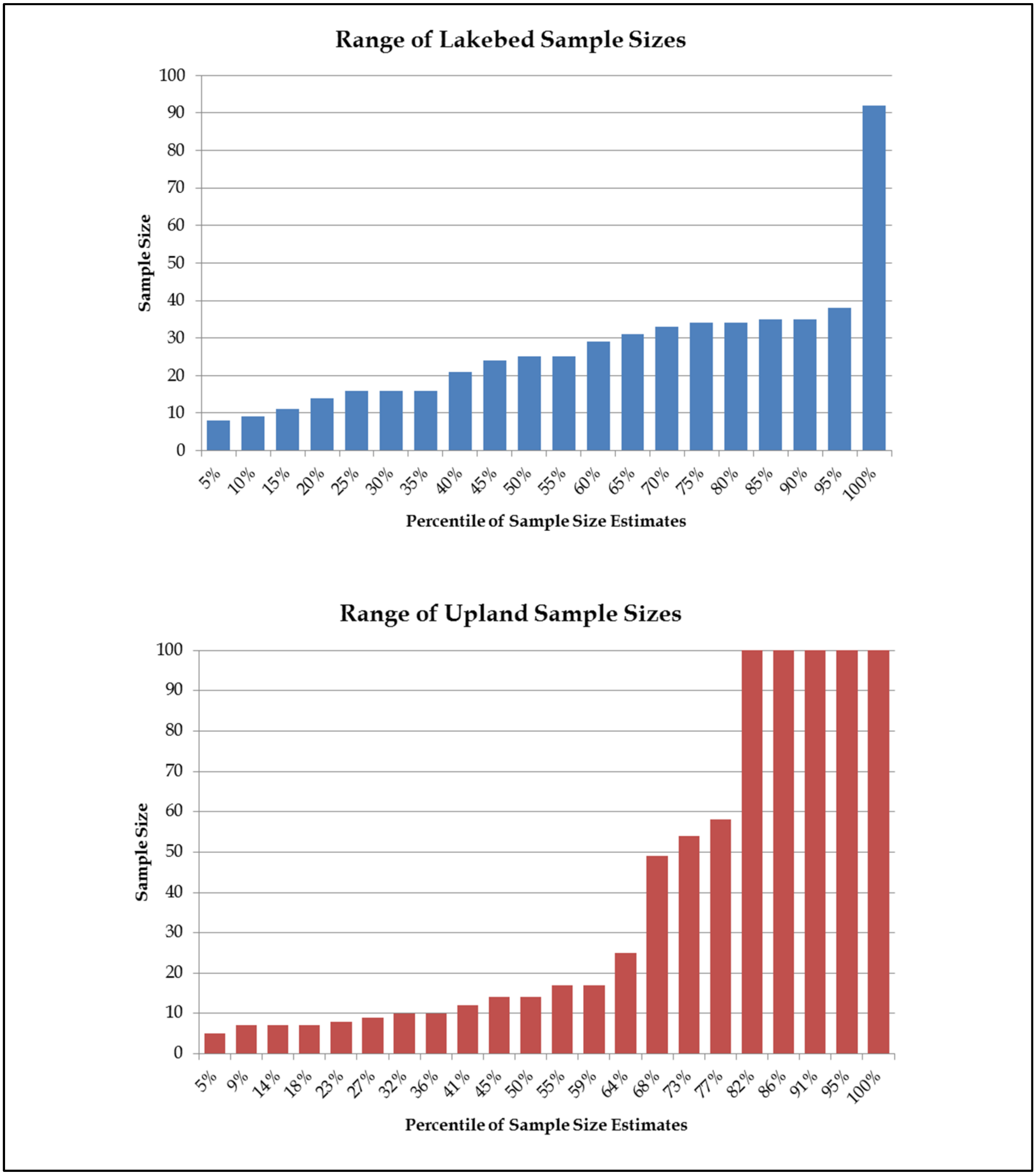


Figure 11-13
NMDS Comparing Metals for Lakebed and Upland Settings
Phase 1A-B RI SAP
US Magnesium LLC
Tooele County, Utah


Range of Lakebed Sample Sizes

Range of Upland Sample Sizes

Figure 11-14
Distribution of Calculated Datasets for Lakebed and Upland Settings
Phase 1A-B RI SAP
US Magnesium LLC
Tooele County, Utah

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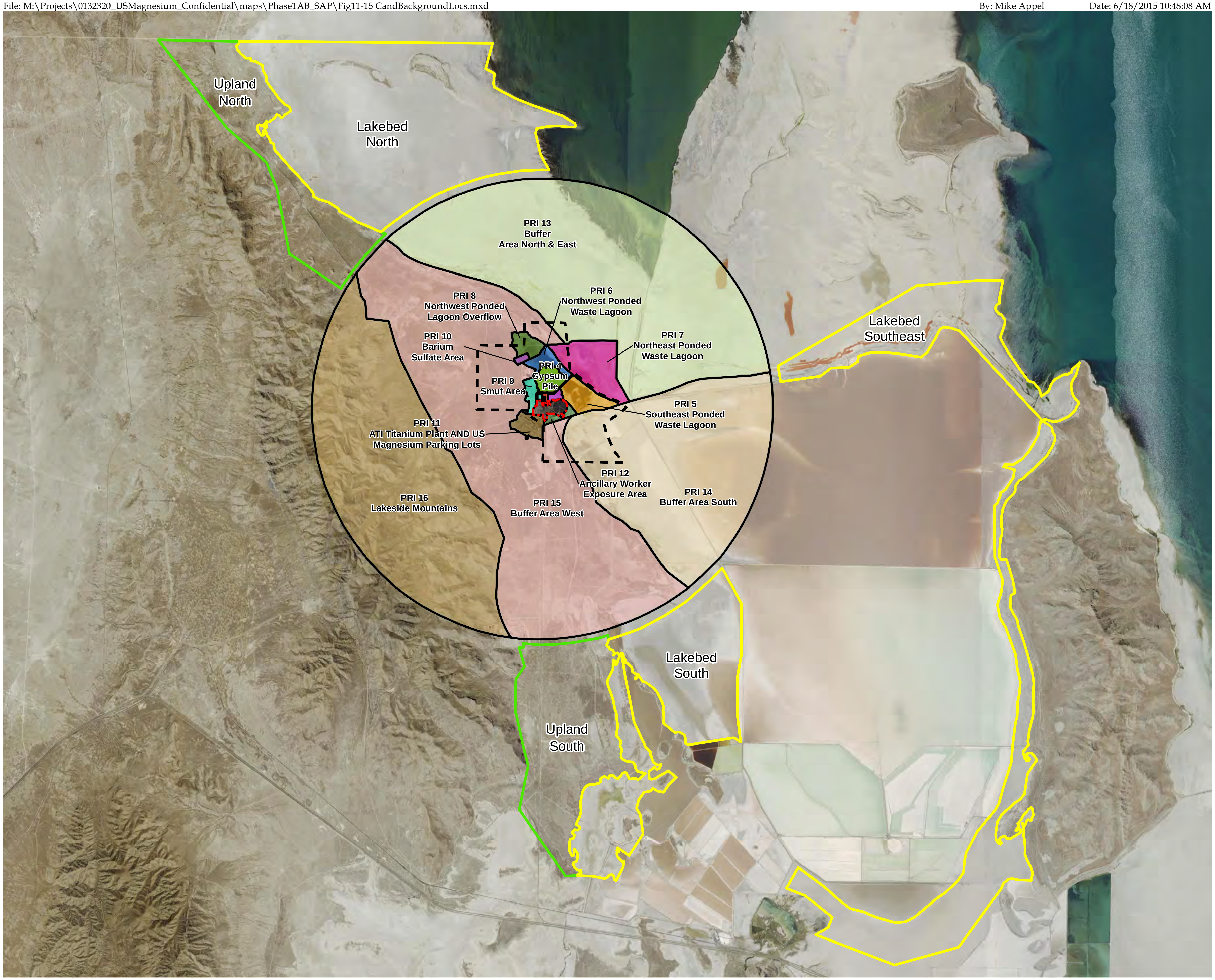
By: Mike Appel

Date: 6/18/2015 10:48:08 AM



🟩 Preliminary Candidate Area for Upland

🟨 Preliminary Candidate Area for Lakebed

▨ Operating Facility

⌜⌟ US Magnesium Property

Preliminary Remedial Investigation Areas

- 🟥 PRI 1: Ditches
- 🟪 PRI 2: Landfill
- 🟨 PRI 3: Sanitary Lagoon
- 🟩 PRI 4: Gypsum Pile
- 🟧 PRI 5: Southeast Ponded Waste Lagoon
- 🟦 PRI 6: Northwest Ponded Waste Lagoon
- 🟪 PRI 7: Northeast Ponded Waste Lagoon
- 🟩 PRI 8: Northwest Ponded Waste Lagoon Overflow
- 🟦 PRI 9: Smut Area
- 🟪 PRI 10: Barium Sulfate Area
- 🟫 PRI 11: ATI Titanium Plant and US Magnesium Parking Lots
- 🟩 PRI 12: Ancillary Worker Exposure Areas
- ⬜ PRI 13: Buffer Area North & East
- ⬜ PRI 14: Buffer Area South
- ⬜ PRI 15: Buffer Area West
- 🟫 PRI 16: Lakeside Mountains Buffer Area

Notes:
All boundaries approximate, provided by EPA
Aerial Photo: NAIP (USDA), June 30, 2014

N

0 2 4 Miles

Figure 11-15
Candidate Background Sampling Areas
Phase 1A-B RI SAP
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File: M:\Projects\0132320_USMagnesium_Confidential\maps\Phase1AB_SAP\Fig11-16 Bear River Bird Refuge.mxd

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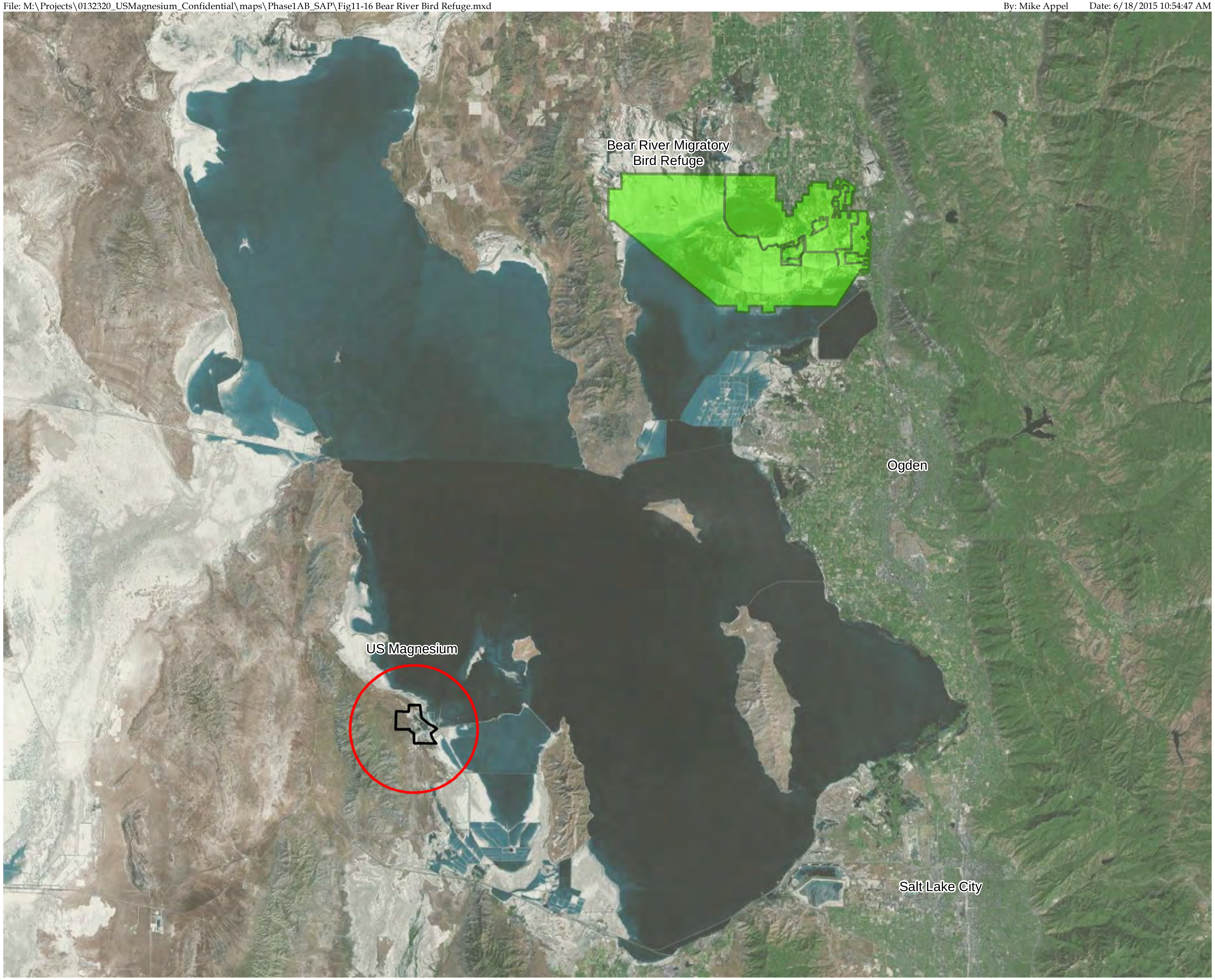

🟩 Bear River Migratory Bird Refuge

○ RI/FS Study Area Boundary

☐ US Magnesium Property

Notes:
Bear River Migratory Bird Refuge layer provided by United States Fish and Wildlife Service.
Aerial Photo: Provided by ESRI web mapping service.

Figure 11-16

Bear River Migratory Bird Refuge

Phase 1A-B RI SAP

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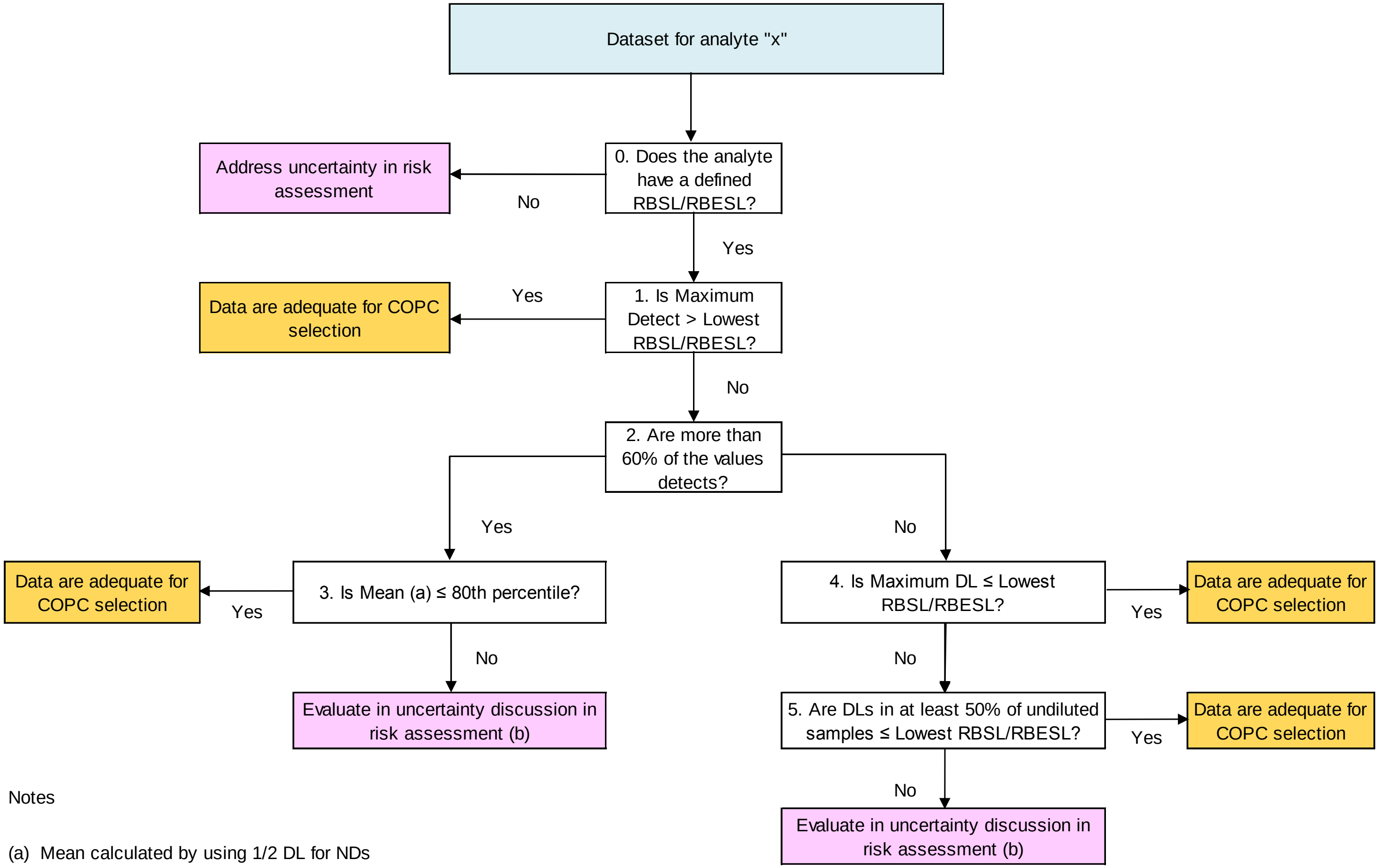
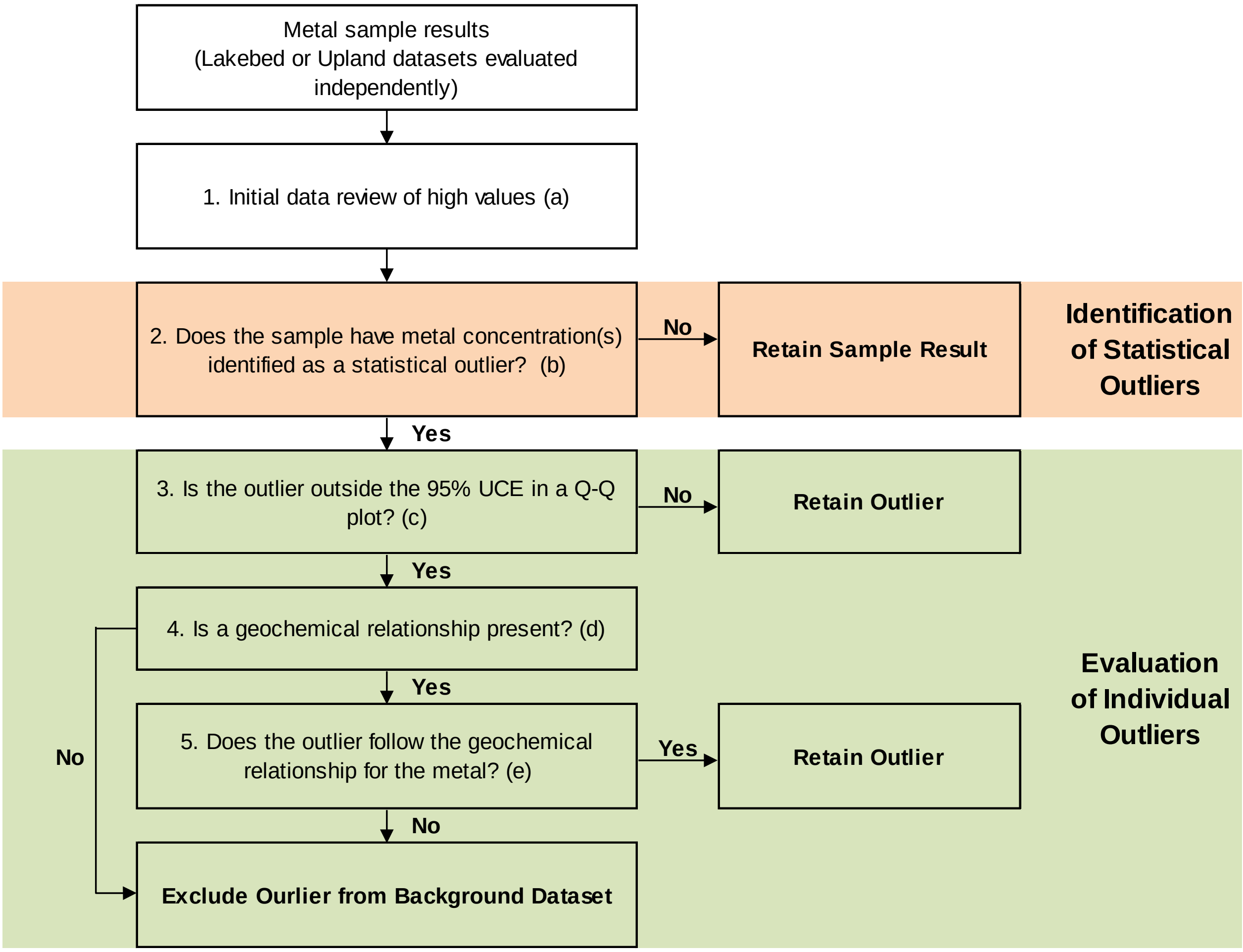


Notes

(a) Mean calculated by using 1/2 DL for NDs
(b) Additional detail provided in data adequacy memorandum text.

COPC = Constituent of potential concern
DL = Detection limit
RBSL = Risk-based screening level
RBESL = Risk-based ecological screening level

Figure 37-1
Data Adequacy Assessment Protocol for COPC Selection
Phase 1A-B RI SAP
US Magnesium LLC
Tooele County, Utah



Notes

(a) An initial data review of background data will be conducted to confirm anomalous or high results are not the result of transcription or other error.

(b) Statistical outliers are identified using the Rosner test in ProUCL.

(c) Statistical outliers that fall outside the 95% UCE and are not likely to be the result of curvature in the plot will be conside anomalous.

(d) Geochemical relationships will be established by correlation analysis (see WS#11) between trace metal (metal being evaluated) and reference metal (aluminum, calcium, iron, or magnesium).

(e) Geochemical evaluations will be developed between trace and reference metals using regression analysis (see WS#11). Concentrations that fall outside the 95% Upper Prediction Limit do not follow the geochemical relationship.

UCE - Upper Confidence Envelope

Figure 37-2
Framework for Background Metals Data Evaluation
Phase 1A-B RI SAP
US Magnesium LLC
Tooele County, Utah

Notes

(a) An initial data review of background data will be conducted to confirm anomalous or high results are not the result of transcription or other error.

(b) The organic results from the Lakebed population will be compared to the Upland population using nonparametric statistics (Wilcoxon Rank Sum or Gehan Test) to determine if the populations are significantly different. If populations are significantly different, the remaining DQA steps will be performed on Lakebed and Upland populations separately. Otherwise, the remaining steps will be conducted on the organic population as a whole.

(c) Statistical outliers will be identified using the Rosner test in ProUCL. TEQs will be calculated using mammalian TEFs.

(d) The statistical method that will be used to compare outliers to regional datasets will be determined based on what the regional reference data support.

(e) TEQ concentrations and congener pattern signatures from regional reference data will be from the Front Range Dioxin Study (USEPA 2002) and/or other studies if available.

(f) Congener and homologue pattern signatures will be calculated as the relative proportions of each congener (dioxin, furan and coplanar PCB) or PCB homologue samples. Ordination and statistical evaluations will be used to examine individual outliers relative to the congener and homologue signatures of the site population and available regional reference populations.

(g) Regional reference data for total PCB concentrations and homologue pattern signatures will be identified and utilized if available. If regional reference data are not available, the decision process will skip Step 4B and advance to Step 5B, where background homologue signatures will be compared to site homologue signatures only.

(h) Site signatures for congener patterns (dioxin, furan and coplanar PCB) and PCB homologue patterns will be developed using data collected from the site.

(i) Regional reference data for HCB will be identified and utilized if available. If regional reference data are not available, the decision process will skip Step 4C and advance to Step 5C, where statistical outliers will be evaluated using Q-Q plots.

(j) Q-Q plots with a 95% confidence envelope will be generated in the statistical software R. If the statistical outlier falls outside the 95% UCE and is not likely to be the result of curvature in the plot, the data point will be excluded.

DQA - Data Quality Assessment
HCB - Hexachlorobenzene
PCB - Total Polychlorinated Biphenyls
PCDD/PCDF - Polychlorinated dibenzo-p-dioxin/polychlorinated dibenzofuran
TEF - Toxic Equivalency Factor
TEQ - Toxic Equivalents
UCE - Upper Confidence Envelope

USEPA. 2002. Denver Front Range Study of Dioxin in Surface Soil. Prepared for and jointly by: U.S. Environmental Protection Agency, Region 8; Remediation Venture Office of the Rocky Mountain Arsenal; Colorado Department of Public Health and Environment; SRC; and Gannett Fleming Inc. July.

Figure 37-3
Framework for Background Organics Data Evaluation
Phase 1A-B RI SAP
US Magnesium LLC
Tooele County, Utah

ATTACHMENT 2:
SITE MANAGEMENT AND PROJECT PLAN

ATTACHMENT 2 US Magnesium NPL Site: Site Management & Project Plan (EPA, July 2015)

		REMEDIAL INVESTIGATION(s) & FEASIBILITY STUDY(s)						
TIMELINE		OU1 - Outer & Inner PRIs (incl. surface- and ground-water)					OU2 - Sitewide Air Contamination	
Year	Months	REMEDIAL INVESTIGATIONS - FEASIBILITY STUDIES						
		Outer PRIs 8 -16 (+ Hydro PRI17)	Inner PRIs 1-7	Sitewide Hydrology (SW & GW)	Screening-FS & Treatability Study(s)		Air-Pathway Chronic-COPCs	
2012		Field-&-Lab DMA for Soil, Sediments, Waste, & Water					DMAs for Air Samplers & Lab	
2013	Jan-Mar	Ph1A Scoping, DQOs, & SAP development						
	Apr-Jun						AERMOD-analysis of seasonal air-distribution	
	Jul-Sep	EPA issued Sitewide Ph1A SAP for COPCs: w/offer of SLRA-AltFS for InnerPRIs		Wells-Piezometers Installed				
	Oct-Dec	Ph1A sampling of Outer PRIs	*Historic data & SLRA development for AltFS-fastrack*					
2014	Jan-Mar			GW-chemistry samples			SAP for Chronic-COPCs	
	Apr-Jun	Data validation		Water-levels (wells & staff-guages)				
	Jul-Sep	ERM Draft OuterPRIs Data-Report					Ph1A - Sampling for Chronic-COPCs	
	Oct-Dec		*SLRA draft* *AltFS offer declined*		Salt-Cap TS scoping		EPA Draft DQO for Cl_2-HCl	
2015	Jan-Mar	EPA review Draft Data-Report	Ph1A-B scoping & DQO-SAP for Detailed-BRA & Site-Characterization				ERM-EPA consults re Cl2-HCl scoping/sampling	AERMOD & DQO for Cl2-HCl stations
	Apr-Jun			Surface-water samples/chemistry	Accumul. Test Plan	SCAT-cell		
	Jul-Sep	Ph1A OuterPRI Report	Ph1A-B sampling for COPCs & Backgrnd	SW-data Addend Hydro-CSM	SCTS Workplan	Leach-test design	Gastronics Cl_2-HCl DMA	Cl_2-HCl Ph2 SAP for N&E
	Oct-Dec	Problem Formulation	& Prel N&E Valid. & Prel. data-report	Scope add'l SW-GW investig.	ScreeningFS: ARARs & Remedy Goals		Ph1A Chronic-COPCs Report	Collect sitewide Cl2-HCl data
2016	Jan-Mar	Ph2 Biotic-sampling DQOs & SAP Ph2 N&E DQOs	Ph2 scoping & DQOs for N&E	Ph2 Hydro-DQOs for N&E	Implement Salt-Cap Treatability Study	ScreeningFS Plan	ID Air-Chronic COPC(s)	
	Apr-Jun	Ph2 Biotic-SAP sampling Ph2 N&E Dft SAP	Ph2 N&E Fnl SAP	Ph2 Hydro-SAP		Dft ScreenFS TM		
	Jul-Sep	Sitewide Ph2 N&E Sampling				Fnl ScreenFS Rpt		
	Oct-Dec						Validate Cl_2-HCl data	
2017	Jan-Mar	ERM data-validation & site-characterization mapping					Draft Air-RI Report	
	Apr-Jun	ERM prepare Draft data-report(s)				Pre-FS Scoping	AIR Risk Evaluation	
	Jul-Sep	Agency rev & ERM finalize data/mapping			SCTS Report			
	Oct-Dec	Remedial Investigation & Site Characterization Final Report and BASELINE RISK ASSESSMENT REPORT					Air-Findings into RI & BRA Reports	
2018	Jan-Mar	ARARs & Risk-Based RAOs for FS-development					(as appropriate) CAA & CERCLA deliberations re risk-reduction	
	Apr-Jun	Select response-alternatives for Draft FS Workplan						
	Jul-Sep	Agency rev/approve Detailed-FS workplan						
	Oct-Dec	Develop Detailed-FS						
2019	Jan-Mar							
	Apr-Jun	Draft-FS for Agency review						
	Jul-Sep	Detailed-FS Final Report						
	Oct-Dec	Remedial Investigation & Feasibility Study draft report						
2020	Jan-Mar	Agency review of Draft RIFS report						
	Apr-Jun	Final RIFS Report for Agency approval						
	Jul-Sep	EPA-Reg8 & UDEQ develop draft Proposed Plan & Fact-Sheets						
	Oct-Dec							
2021	Jan-Mar	EPA-HQ briefing & consultations re draft Proposed Plan						
	Apr-Jun	EPA-Reg8 prepare Final Proposed Plan for public release						
	Jul-Sep	Issue Proposed Plan for public & stakeholder comment						
	Oct-Dec	EPA-UDEQ review/reconcile comments to Proposed Plan						
2022	Jan-Mar	EPA-UDEQ prepare draft Record-of-Decision						
	Apr-Jun	Internal-agency ROD review						
	Jul-Sep	EPA/UDEQ Issue CERCLA Record-of-Decision for OU1 Site-Cleanup						
	Oct-Dec							
2023	Jan-Mar	Public briefings re ROD						
	Apr-Jun	Negotiate RD/RA (Remedial-Design & Remedial-Action) Consent Decree						
	Jul-Sep	Remedial design development - Phased Implementation						
	Oct-Dec							
2024	Jan-Mar	Implement Remedy-Construction						
	Apr-Jun							
	Jul-Sep							
	Oct-Dec							
2025	Jan-Mar							
	Apr-Jun							
	Jul-Sep							
	Oct-Dec							

ATTACHMENT 9:
PHASE 1A-B RI SCOPING DOCUMENTATION

Attachment 9A

25 November 2014 Preliminary Data Quality Objective Framework OU-1 Phase 1B RI for Nature and Extent

DRAFT 25 November 2014

Preliminary Data Quality Objective Framework
OU-1 Phase 1B RI for Nature and Extent

This document provides a preliminary DQO framework for the Phase 1B RI at OU-1 of the US Magnesium NPL Site. The DQOs presented in this framework will be refined prior to and during the Phase 1B Scoping session to be convened in 2015. These DQOs will provide the basis for the development of a Phase 1B Sampling and Analysis Plan, to be implemented during field season 2015.

The DQO framework presented herein follows the 7-step process described in the 2006 USEPA *Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G-4*.

Step 1: State the Problem

Nature and extent of COPCs have not been characterized at the Site. Historical (pre-CERCLA) data and/or DMA data are available for PRI Areas 1 and 3 through 7 (the "Inner PRIs"), as presented in the Inner PRI Data Report and the Draft Inner PRI SLRA; however, the historical data in most cases did not include analyses for all COPCs. In addition, USEPA has raised concerns about the usability of historical data for Risk Assessment. Additional data may also be required to characterize extent of impacts within PRI14. The Phase 1A RI for Outer PRIs included sampling within PRI14 for COPC selection, as described in the Phase 1A SAP. The Phase 1A RI data for PRI14 indicate elevated COPCs concentrations near the discharge point from a former diversion ditch from the Main Ditch. The extent of COPC impacts at PRI14 has not been defined and additional delineation may be required for the Baseline Risk Assessment (BRA) or for FS planning. Additional data collection for other Outer PRIs (e.g., PRI8) may also be identified based on the findings from Outer PRI SLRA.

The Conceptual Site Model for COPC transport at the PRIs 1, 3 – 7, and 14 includes primary and secondary transport pathways. Primary pathways include direct discharge of process wastes. Secondary pathways include migration of contaminants via surface water/groundwater flow or air deposition. For PRIs 1, 3 – 7, and 14, air deposition is generally considered to be a negligible secondary transport pathway compared to surface water/groundwater migration. The Conceptual Site Model for COPC transport at the PRIs 1, 3 – 7, and 14 is summarized in Table 1.

Preliminary Data Quality Objective Framework
OU-1 Phase 1B RI for Nature and Extent

Table 1. Conceptual Site Model for COPC Transport within PRIs 1, 3 – 7, and 14

PRI	Potential Primary Transport Pathway(s)	Potential Secondary Transport Pathway(s)
1 - Ditches	Direct discharge of wastewater	None or negligible
3 - Sanitary Lagoon	Discharge of treated sanitary wastewater to Sanitary Lagoon	Erosion of ditch spoils into Sanitary Lagoon
4 - Gypsum Pile	Discharge of gypsum slurry	None or negligible
5 / 6 - Current Waste Ponds	Waste pond footprint: Discharge of process wastewater from Main Ditch (PRI 5 / 6), direct discharge of gypsum slurry (PRI 6) Berm between PRIs 5/6 and 7: No primary transport pathway	Waste pond footprint: Runoff from Gypsum Pile (PRI 6) Berm between PRIs 5/6 and 7: Air deposition, surface water flows, or groundwater discharge
7 - Old Waste Pond	Historical discharge of process wastewater at the former Inlet	Groundwater discharges from the west berm of the PRI 7, periodic inundation by wastewater from PRI 5 /6 through breaches in the west berm, and surface water flows within PRI 7
14 - North of P11 Canal	Historical discharges from a former wastewater diversion ditch	Surface water flows and groundwater discharges

Background concentrations of metals, PCBs, and D/F have not been established for the Site. Results from the Phase 1A RI for Outer PRIs suggest that metals, PCBs, and D/F are present at low concentrations within the RI/FS study area (e.g., within Buffer Areas). Due to their nature, metals, PCBs, and D/F may be either naturally occurring or present due to background (off-site) anthropogenic sources.

Step 2: Identify Goals of the Study

The over-arching objective of the Phase 1B RI is to perform a preliminary nature and extent evaluation for the Inner PRIs. Key questions that the Phase 1B RI attempts to address include:

1. What are the nature and extent of COPCs at Inner PRI Areas (PRI Areas 1, 3, and 4 – 7)?
2. What is the extent of COPC impacts in select Outer PRI Areas (e.g., PRI14)

3. What are the ambient concentrations for metals, PCBs, and D/F in background soil reference areas?

Step 3: Identify Information Inputs

The information inputs required for the Phase 1B RI include:

1. PRI-specific or general Screening Levels, e.g., risk-based screening levels (RBSLs) and risk-based ecological screening levels (RBESLs), are required to delineate the presence of impacts and extent of impacts within PRIs.
2. Information on the presence/absence and thickness of waste materials present within Inner PRIs are required delineate vertical extent of COPC impacts.
3. Surface sample analytical data are required to delineate lateral nature and extent of COPCs within PRI areas. Data will include both screening-level and definitive data types.
    - Screening data include analysis for HCB, PCB-209, and OCDF using the Indicator Chemicals analytical methods developed in connection with the Phase 1A DMA. Screening data will delineate the extent of COPCs across PRIs 5 through 7 and PRI14 (and potentially other Outer PRIs, if investigated under Phase 1B.) Screening data will also be used to inform the selection of sample locations for definitive analysis at these PRIs. (Triad approach)
    - Definitive analytical data are required at PRIs 4 through 7 and 14 to corroborate screening method results and to provide data sets of suitable quality for subsequent use in Risk Assessment.
    - Definitive data will provide the basis for COPC nature and extent delineation at PRIs 1, 3, and 4; screening methods are not proposed at these PRIs.
4. Subsurface sample analytical data are required to delineate the vertical nature and extent of COPCs within PRIs 1, 4, and 7.
5. Suitable data sets for background reference area(s) are required for calculating background concentrations for metals, PCBs, and D/F.

The information inputs will be refined and revised, as necessary, during the Phase 1B Scoping session.

Step 4: Define the Boundaries of the Study

Spatial Boundaries

The Study Area Boundary has been preliminarily defined by USEPA as a 5-mile radius around the facility. Sampling areas investigated during the Phase 1B will be generally consistent with PRI Area boundaries established by USEPA for the Phase 1A SAP for PRIs 1 and 3 through 7. The spatial boundary for sampling within PRI14 is proposed to include the former evaporation pond bed to just south of the P11 canal.

The exposure unit boundaries will be defined in the BRA Problem Formulation. Exposure Unit boundaries may or may not be consistent with PRI boundaries.

Temporal Boundaries

The timing of sampling is critical to ensure maximum access with sampling areas and for health and safety of field personnel. Sampling should not be performed during spring (due to high water conditions in wastewater ponds) or winter (limited access to the Western Ditch and wastewater ponds and for worker health and safety).

Health and Safety Boundaries

Due to the unique conditions present at the Site, there are significant health and safety boundaries that preclude sampling at certain locations. Health and safety boundaries include:

1. Sampling within active wastewater ponds and wastewater ditches will be limited to locations that can be safely accessed from shore or bank areas. Open-water samples will not be collected at the Current Waste Ponds (PRIs 5 and 6).
2. Sampling on the Gypsum Pile (PRI 4)will be limited to areas that can safely be accessed by foot; active gypsum discharge areas/saturated gypsum areas will not be sampled.
3. Sampling within the Old Waste Pond (PRI 7) will not be performed in any areas where acidic wastewater (pH < 2) is present or in areas where standing water is deeper than approximately 4 inches.

All Phase 1B RI sampling activities will be performed under a site-specific Health and Safety Plan.

Step 5: Develop the Analytic Approach

The Analytic Approaches for Nature and Extent include:

- Horizontal nature and extent will be evaluated by comparing analytical data from surface samples to Screening Levels.
- Horizontal extent will be evaluated by sampling within PRIs along transects or grids oriented along COPC transport pathways, and comparing COPC concentrations as a function of distance from source areas.
- Vertical nature and extent will be evaluated by comparing analytical data from sub-surface samples to Screening Levels.
- Vertical extent will be evaluated by visually identifying the presence/absence of waste and measuring the thickness of waste present.

The Analytic Approach for Background Determination includes:

- Background concentrations for metals, PCBs, and D/F will be calculated statistically using analytical data collected from reference areas.

The analytic approaches for nature and extent and for background determination will be refined during the Phase 1B Scoping session.

Step 6: Specify Performance or Acceptance Criteria

Performance or acceptance criteria will be defined during the Phase 1B Scoping session. If upon completion of the Phase 1B RI additional nature and extent data are required, these data will be collected during a subsequent RI phase under a revised or new set of DQOs.

Step 7: Develop the Plan for Obtaining the Data

The plan for obtaining the data is summarized in Table 2. A synopsis of the investigation tasks identified in Table 2 is provided below.

Screening Sampling/Analysis (Triad Approach)

Surface solids samples collected and analyzed using screening methods to under a Triad data collection approach. Screening sampling will include collection of samples as grab samples with limited in-field homogenization. Laboratory analysis will be performed using the HCB-IC method developed during the Phase 1A DMA. Analytes will include HCB, PCB-209, and OCDF, consistent with the Indicator Chemicals identified in the Phase 1A SAP. Screening sample results will not be used for Risk Assessment calculations. Analyses will be performed at an off-site laboratory under rush turn-around-time.

Screening sampling/analysis will be performed at PRIs 5 – 7 and 14. Screening sample locations will be oriented along transects or grids designed to evaluate COPC concentrations as a function of distance from source area along COPC transport pathways.

Definitive Sampling/Analysis

Surface samples for definitive analyses will be collected following the existing project-specific SOPs (i.e., 5-point composite, sieving, rigorous homogenization) to provide adequate sample support for data uses in Risk Assessment or other decisions. Laboratory analyses would be performed in accordance with the Phase 1A SAP, with the addition of the use of LRMS methods for PCB and D/F analysis of select high-level samples from ditches or other waste management areas.

Definitive sampling locations will be at pre-determined locations for PRIs 1, 3, and 4 and at Background Reference Area(s). At PRIs where screening sampling/analysis are performed, the locations for definitive sampling/analysis would be performed at a subset of screening locations selected based on the screening analysis results (Triad approach).

Field Screening for Waste Thickness

The presence/absence of visible waste will be noted at all screening and definitive sample locations. When waste is visible, the depth of waste will be measured. If waste is present at the bottom of a surface sample boring PRIs 3, 7, or 14, then the hand auger boring will be advanced to either the waste/native soil interface or a maximum depth of 6 feet bgs.

Subsurface Borings

Subsurface boring with sampling at 2-foot intervals for definitive/full suite chemical analysis will be performed to evaluate COPC concentrations at depth and for characterizing vertical nature and extent. Subsurface borings will be performed at the following SUs:

- PRI 1 Ditches – Four total borings, to be completed at bridges (3 locations) and the Former Boron Ditch (1 location); similar to Phase 1A SAP.
- PRI 4 Gypsum Pile – One boring to be completed at the top of the Gypsum Pile (same as Phase 1A SAP)
- PRI 7 Old Waste Pond – Two subsurface borings; locations will be identified based on field screening of waste thickness (Triad approach).

Additional Investigation Tasks

Additional Phase 1B RI tasks will be identified based on the Inner PRI SLRA, Outer PRI SLRA, and Phase 1B Scoping Session. Additional potential tasks include bulk versus fines fraction analyses within Inner PRIs or the delineation of additional areas or sub-areas within existing PRIs.

Preliminary Data Quality Objective Framework
OU-1 Phase 1B RI for Nature and Extent

Table 2. Phase 1B RI Investigation Tasks

PRI	Phase 1B Study Objectives	Triad Approach	Definitive Sample/Analysis Locations	Field Screening for Waste Thickness	Subsurface Borings for Definitive Analysis
1 - Ditches	Horizontal and Vertical Nature & Extent	No	Accessible locations along Active WW ditches and Former Boron Ditch (Similar sample design to Phase 1A SAP)	Yes (Limited to 6 inches max)	Yes – Located within active ditches at three bridges and at one location along the former Boron Ditch (Similar to Phase 1A SAP)
3 - Sanitary Lagoon	Horizontal Nature & Extent, Vertical Extent	No	Grid nodes (Similar sample design to Phase 1A SAP)	Yes	No
4 - Gypsum Pile	Horizontal and Vertical Nature & Extent	No	Grid or radial transects (Similar sample design to Phase 1A SAP)	Yes (Limited to 6 inches max)	Yes (Similar to Phase 1A SAP)
5 / 6 - Current Waste Ponds [a]	Horizontal Nature & Extent, Vertical Extent	Yes – Screening samples would be collected along transects/grid to evaluate COPC impacts as a function of distance from the wastewater inlet (Main Ditch). Samples from the pond footprint would be collected from the shoreline only. Samples within the berm area between the current waste pond footprint and PRI 7 would be collected at grid nodes or along transects.	Selected based on screening results	Yes (Limited to 6 inches max)	No
7 - Old Waste Pond	Horizontal and Vertical Nature & Extent	Yes – Screening samples would be collected along transects/grid to evaluate COPC impacts as a function of distance from the historical inlet and from secondary sources along the west berm	Selected based on screening results	Yes	Yes – Locations selected based on field screening
14 – Area North of P11 Canal	Horizontal Nature & Extent, Vertical Extent	Yes – Screening samples would be collected along transects/grid to evaluate COPC impacts as a function of distance from the historic wastewater diversion ditch outlet.	Selected based on screening results	Yes	
Background Reference Area(s)	Background Evaluation	No	Grid or Random	No	No

Notes:

[a] PRIs 5 and 6 would be combined for Phase 1B and would include the historical Main Ditch right of way that was included in PRI 1 in the Phase 1A SAP.

Attachment 9B

17 December 2014 Quarterly Project Management Meeting Summary and RIFS Status Update

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8
1595 Wynkoop Street
Denver, CO 80202-1129
Phone 800-227-8917
www.epa.gov/region08

Via electronic-mail

December 17, 2014

Ref: EPR-SR

David Abranovic, P.E.
Environmental Resources Management
7272 E. Indian School Rd., Suite 100
Scottsdale, AZ 85251

Re: Quarterly Project Management Meeting Summary and RIFS Status Update for the US Magnesium Superfund Site

Dear Mr. Abranovic:

Thank you for the December 2, 2014, discussions with the Environmental Protection Agency (EPA) and Utah Department of Environmental Quality UDEQ (the Agencies) project management and technical staff (see enclosed meeting agenda and participant list). The discussions primarily were in response to EPA's November 3, 2014, letter to US Magnesium (USM), and to Environmental Resource Management's (ERM) reply to that letter, on behalf of USM, dated November 10, 2014. For purposes of this correspondence, the term ERM shall also incorporate USM, since ERM is the designated agent acting on behalf of USM.

Our discussions focused largely on agenda items 1.a-d and 4, which are the issues most pertinent to ERM's August 2014 commitment to implement a remedial investigation of the Inner Preliminary Remedial Investigation (PRI) areas in 2015. None of the issues raised by ERM, however, were identified as matters ERM wished to bring to dispute resolution under Section VI of the August 4, 2011, Administrative Settlement Agreement and Order on Consent for Remedial Investigation and Feasibility Study between EPA and USM (Settlement Agreement).

Prior to the December 2nd meeting, ERM provided a preliminary draft Phase-1B Data Quality Objectives (DQO) and conceptual Sampling and Analysis Plan (SAP) document for an Inner PRIs investigation, which ERM proposed to complete in 2015. ERM presented this Phase-1B DQO and SAP document as a proposal to replace the EPA-issued, September 2013, Phase-1A DQO and SAP. The Agencies agree that defining DQOs is necessary for preparing a scientifically and legally defensible SAP, which in turn will provide accurate data on contamination in the Inner PRIs and enable effective environmental decision making. Unfortunately, neither the issues discussed during the December 2nd meeting nor the ERM preliminary draft Phase-1B DQO and SAP document addressed the critical issue of whether and to what extent the Inner-PRI investigations will be predicated on DQOs to support a feasibility-study or DQOs to support a baseline risk assessment, as required in EPA's November 3, 2014, letter, in numbered paragraphs 1, 2, and 3a. EPA's amendments to the December 2nd meeting agenda, provided prior to the meeting, identified this as a matter requiring further discussion. EPA's November 3, 2014, letter to Mr. David Gibby also explained that:

> *"COPC refinement and PRG development are prerequisite to USMag having the necessary information upon which to base a decision regarding whether the Inner PRIs may proceed to a Feasibility Study in the absence of further data collection and risk assessment."*

EPA also notes that, until this key decision is made, the multiple remedial investigation (RI) and feasibility study (FS) DQOs of ERM's draft Phase-1B SAP cannot be determined and clarified for appropriate SAP planning. The RI sampling plans for site characterization to support a baseline risk assessment (e.g., exposure, toxicity, and biological data) can differ markedly from the types of data needed to support an evaluation of remedial alternatives under an FS (e.g., waste physical and chemical characteristics, distribution and volumes). Both types of data will be necessary to complete a comprehensive RIFS that fully characterizes the site, assesses risk to human health and the environment, and evaluates cleanup and risk-reduction alternatives.

EPA and ERM risk assessors discussed the steps necessary to complete the Inner-PRI Contaminant of Potential Concern (COPC) refinement and Preliminary Remedial Goal (PRG) development for ERM's draft Screening Level Risk Assessment (SLRA) of the Inner-PRIs. ERM agreed to prepare tables of the ratios of refined, risk-based screening levels to appropriate analytical results for the Inner-PRIs, for submittal to EPA no later than December 19, 2014. The Agencies' risk assessors will provide ERM consolidated comments on these tables no later than January 16, 2015. ERM will then deliver to EPA a complete draft Screening Level Risk Assessment Report (including recommended PRGs) for the Inner-PRIs, with a decision on ERM's preferred track (i.e., move forward to the FS or move forward to the baseline risk assessment) for the Inner-PRIs by January 30, 2015. In recognition of these discussions, EPA hereby amends the dates in numbered paragraph 1 of its November 3, 2014, letter, to the extent that the Agency now approves and accepts January 30, 2015, rather than December 21, 2014, as the date for ERM's decision regarding the path forward for the Inner-PRIs.

During the December 2nd meeting, ERM agreed with the January 30, 2015, deadline for the ERM decision regarding the path forward for the Inner-PRIs. ERM and EPA further agreed that, regardless of the path ERM chooses to pursue, it is important that the Agencies and ERM convene a scoping meeting for the Phase-1B DQOs and SAP in February 2015, so that there is adequate time for Agency review and approval of the Phase-1B SAP and to permit fair-weather sampling in 2015.

Numbered paragraph 2 of EPA's November 3, 2014, letter discussed whether ERM would be permitted to make decisions on a PRI-by-PRI basis regarding the path forward for the RIFS process (i.e., expedite to the FS or proceed to further risk assessment). EPA's letter was clear in disapproving this decision making process for the Inner-PRIs. ERM stated in its November 10, 2014, reply letter that: "The response actions for several Inner PRIs can be developed more efficiently together rather than individually." ERM, however, conditioned this apparent agreement by further stating that they wished to

retain the option to expedite Inner-PRIs to the FS on a PRI-by-PRI basis. While ERM is currently obligated to proceed in the manner set out in EPA's November 3, 2014, letter, EPA offered to discuss this idea further with ERM in late-January.
In the December 2nd meeting, the Agencies offered initial observations on the draft 'Preliminary Data Quality Objective Framework, OU1 Phase-1B RI for Nature and Extent,' dated November 25, 2014, and highlighted a number of inconsistencies in the document and the lack of a clear DQO rationale. The Agencies agreed to review an updated Phase-1B DQO proposal after ERM's late-January decision deadline for the Inner-PRIs. The Agencies' review will help inform the Phase-1B scoping meeting, which is to be scheduled for February 2015.

One specific example of a Phase-1B DQO and SAP deficiency discussed during the December 2nd meeting is the manner in which ERM addressed sampling of water-laden lagoons in PRIs 5, 6, and 7. Step 3, Item 2 of ERM's draft plan states that "Information on the … thickness of waste materials present within the Inner PRIs are required [to] delineate the vertical extent of COPC impacts." EPA agrees that such sampling is necessary, and samples from inundated locations are called for in EPA's Phase-1A SAP. Unfortunately, ERM's plan also stated that health and safety concerns precluded sampling where acidic water with a pH of less than 2 is present or in areas where standing water is more than four inches deep. Under such constraints, large portions of the Inner-PRIs would not be sampled, and the full vertical extent and potential volumes of contamination would not be known, thus making evaluation of remedial alternatives for those areas problematic.

EPA also pointed out that accessing and sampling such areas can be safely accomplished by a number of methods, including amphibious-tracked vehicles, shallow-draft floating platforms, or earthen roads or ramps built into water-covered areas (as was done by USM in 2014 to secure safe transit routes across water-covered portions of PRIs 6 and 8). Accordingly, EPA requests that ERM submit Standard Operating Procedures (SOPs) for achieving sampling in acid lagoon areas by January 30, 2015, the date specified in EPA's November 3, 2014, letter. This will then permit discussion of specific sample acquisition plans during the Phase-1B scoping meeting in February 2015.

During the December 2nd meeting, the Agencies also discussed ERM's interest in merging Phase-1B investigations for both the Outer- and Inner-PRIs of OU1, so that a single Phase-1B SAP and comprehensive field-investigation might be carried out for all PRIs. The Agencies recognized that certain efficiencies might be obtained if such comprehensive planning could be completed for site-wide 2015 Phase-1B investigations. Nonetheless, there are a range of baseline risk assessment issues and Phase-1B planning elements that would first have to be resolved for the Outer-PRIs including, but not limited to, evaluation of the Phase-1A findings, COPC refinement and preparation of a SLRA for COPC selection, before Phase-1B investigations for both the Outer- and Inner-PRIs could be merged. Accordingly, the Agencies and ERM agreed that, because baseline risk assessment discussions for the Outer-PRIs could require significant scoping and planning during 2015, the Phase-1B investigation of the Inner-PRIs should not be delayed and should be implemented in 2015.

The Agencies also agreed that a background chemicals concentration investigation could be a valuable component of ERM's planned RI work in 2015, because it would establish what chemicals are naturally occurring and might provide an indication of appropriate cleanup levels for other areas of the RI area. A background study need not be directly linked to the Phase-1B Inner-PRI investigations.

Another topic discussed during the December 2nd meeting was ERM's desire to investigate a possible Salt-Cap remedy. As noted in EPA's May 1, 2014, letter covering this matter, ERM agreed to develop draft DQOs and plans for a Salt-Cap Treatability Study (SCTS) for Agency review and approval. This topic also was discussed at a November 19, 2014, project meeting in Salt Lake City. ERM proposed to develop an initial Salt-Cap Accumulation Test (SCAT), which would be a component of the treatability study. ERM also committed to revise plans for a SCAT, to be sited in the PRI-7 lagoon, for EPA review and approval, so that the test cell could be activated by May 1, 2015. ERM further agreed to develop comprehensive SCTS plans in 2015 incorporating the SCAT component.

In parallel with the SCTS, ERM also agreed to develop a plan for Screening of Remedial Alternatives, as required by Sections 6.1-6.5 of the Statement of Work attached to the Settlement Agreement. The Agencies agreed to initiate development in 2015 of <u>Preliminary</u> Remedial Action Objectives for site-wide risk reduction. ERM and the Agencies further agreed that ERM should begin to assemble Federal and State Applicable or Relevant and Appropriate Requirements (ARARs), as required by the National Contingency Plan, 40 CFR, Sections 300.430(2)(b)(9) and (e)(2)(i)(A.

In summary, based on prior EPA correspondence and the agreements and understandings reached during the December 2nd meeting, EPA hereby approves and incorporates the following submittals and due dates into Section 10 – Schedule of Deliverables, of the Statement of Work attached to the Settlement Agreement:

- December 19, 2014 - Draft COPC-refinement tables (for EPA review and comment by January 16, 2015);
- January 30, 2015 - Draft Inner-PRI Screening Level Risk Assessment Report (including recommended PRGs)
- January 30, 2015 – Statement of intent regarding a path forward for the Inner-PRIs (i.e., expedite to FS or proceed to baseline risk assessment);
- January 30, 2015 – Draft SOPs for sampling all areas of Inner-PRI lagoons
- February 2015 – ERM submits revised Phase-1B proposal no less than two weeks prior to the Phase-1B scoping meeting;
- February 2015 – ERM convenes a scoping meeting to discuss ERM's revised Phase-1B Inner-PRIs sampling plan (with required pre-meeting agenda/materials);
- June-2015 – ERM submits a plan to investigate background contaminant concentrations;
- 2015 – ERM submits baseline risk assessment-based DQOs for Outer-PRIs investigations in 2016;
- May 1, 2015 – ERM implements EPA-approved Salt-Cap Accumulation Test;
- July 2015 – ERM develops and obtains EPA-approval of a workplan for the Salt-Cap Treatability Study; and
- July 2015 – ERM develops and obtains EPA approval of a workplan for Screening of Remedial Alternatives.

Thank you again for your time and dedication toward moving the RIFS forward for this Site. EPA looks forward to reviewing the materials ERM will be submitting and holding substantial discussions during January and February to fulfill the commitments made by ERM and USM for RIFS work in 2015. If you have questions regarding this letter or any of the points I have raised, please feel to contact Ken Wangerud, Remedial Project Manager, at 303-312-6703 or email, at wangerud.ken@epa.gov.

Sincerely,

Steve Wharton

Steve Wharton, Unit Chief
Superfund Remedial Response Program

Enclosure: December 2, 2014, Annotated Meeting Agenda and Participant List

cc: Tom Tripp, US Magnesium
David Gibby, US Magnesium
Lindsay Ford, PBL
Mark Ransom, ERM
Michael Storck, UDEQ-DERR

US Magnesium RIFS
Quarterly Project Meeting
EPA Office Denver Colorado
2 December, 2014

Meeting Agenda - *[with noted EPA agenda mods]*

9:00 AM to 3:00 PM

1. OU-1 RI (soil, sediment, water) *[with concurrent Agenda 4.a-f. discussion]*
    a. Process diagram (ERM August 28 e-mail *& Nov 10-12 letter/Gantt*)
        i. Development of PRGs for Inner PRIs – verify completion date
        ii. Alt-FS vs. BRA Decision & Applicable-Area(s) – discuss roles (ERM, USM, EPA) and timing
        iii. Implications for Ph1B DQOs & SAP development
    b. Gantt schedule review
        i. Incompleteness issues (@ lines 65-58 re SAP scoping/planning)
    c. Phase 1B scoping process and DQOs/SAP development
        i. Re ERM's Nov 30th Prelim. DQOs & SAP-Concept (TBD & refined per Scoping-Meeting agenda development & EPA review)
        ii. clarify scoping process and discuss DQOs that would be required to allow the Phase 1B effort to supplant to originally scoped Phase 1A effort
    d. Conceptual Phase 1 B sample design
2. OU-2 RI (air)
    a. Phase 1B scoping process and DQO/SAP development
    b. Selection of new chlorine monitor
        i. *Completion of EPA's BM25 'investigation' & potential for corrective actions.*
3. Salt cap treatability study
    a. Implementation schedule
    b. Additional scoping meetings?
4. Risk assessor items *[these subtopics need addressing as part of Agendas 1.a-d.]*
    a. COPC Refinement *[at 1.a. re COPC selection for both Inner- and Outer-PRIs]*
    b. Modification of PRI boundaries or alternate groupings *[at 1.d]*
    c. Background study
    d. Options to screen out PRIs in the SLRA *[regarding? – outer reaches of OuterPRIs?]*
    e. HH Survey

    f. Critical path risk assessment items – next 6 months

5. Phase 1A split data comparison
6. *RI tracks for Inner vs. Outer PRIs (i.e., can/should they merge? via Ph1B SAP amendments)*
7. Initial remedial technology and process option screen *(SOW Sec. 6 – Development & Screening of Remedial Alternatives)*
    a. Scope of TM (i.e. PRIs/media specific)
    b. *Preliminary RAOs and ARARs*
    c. AOC requirements *(per SOW Section 6 (sub 1.5.)*
8. EPA oversight
    a. 2015 EPA budget discussion (labor/direct cost)
    b. Split samples/purpose and quantity
9. Next steps / action items

__Meeting participants__

David Abranovic, ERM
Mark Ransom, ERM
Jennifer Holder, ERM via teleconference
Steven Wharton, EPA
Ken Wangerud, EPA
Dan Wall, EPA
Wendy Obrien, EPA
Michael Storck, UDEQ via teleconference

Attachment 9C

20 February 2015 Data Quality Objectives Framework OU-1 Phase 1B

Memorandum

Environmental
Resources
Management

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(480) 998-2401
(480) 998-2106 (fax)

http://www.erm.com

To:

From: David Abranovic (ERM), Kevin Lundmark (ERM)

Date: 20 February 2015

Subject: Data Quality Objectives Framework OU-1 Phase 1B RI

11.0 INTRODUCTION

This document provides a scoping-level Data Quality Objectives (DQOs) Framework for the Phase 1B Remedial Investigation (RI) at Operable Unit 1 (OU-1) of the US Magnesium National Priorities List Site. The DQOs presented in this Worksheet may be refined during the OU-1 Phase 1B RI Scoping Session to be convened in March 2015. These DQOs will provide the basis for Worksheet 11 in the OU-1 Phase 1B Sampling and Analysis Plan (SAP), to be implemented during the 2015 field season (May to October). Accordingly, this document has been formatted consistently with Worksheet 11 as it will appear in the Phase 1B SAP.

The DQOs presented herein follow the 7-step process described in the 2006 United States Environmental Protection Agency (USEPA) *Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G-4.*

11.1 STEP 1: STATE THE PROBLEM

11.1.1 Description of the Problem

The RI/ Feasibility Study Area Boundary has been preliminarily defined by USEPA as a 5-mile radius around the facility. For purposes of project planning during the initial phases of the RI, the USEPA has divided the site into 18 Preliminary Remedial Investigation (PRI) Areas (or "PRIs"), with the "Inner PRIs" defined as PRIs 1 and 3 through 7.

Phase 1A of the OU-1 RI provided the information necessary to prepare individual screening level risk assessments (SLRAs) for the Inner and Outer PRIs. For the Outer PRIs (PRIs 2 and 8 through 17), data were collected in Phase 1A that represent current conditions and these data will be used in a forthcoming Outer PRIs SLRA. Results of the Outer PRIs SLRA will be used to select human and ecological chemicals of potential concern (COPCs) for further quantitative evaluation in the baseline risk assessment (BRA) process. For the Inner PRIs, the SLRA was based on historical (pre--Comprehensive Environmental Response, Compensation and Liability Act [CERCLA]) and Phase 1A Demonstration of Method Applicability (DMA) data (ERM-West, Inc. [ERM] 2015). No constituents were eliminated from further evaluation as COPCs in the Inner PRIs SLRA; therefore, the COPCs to be considered for Inner PRIs for the Phase 1B RI include the complete list of constituents identified in the Phase 1A RI SAP (USEPA 2013b): polychlorinated biphenyl (PCBs), dioxins/furans, semi-volatile organic compounds (SVOCs) (including hexachlorobenzene [HCB] and polycyclic aromatic hydrocarbons), volatile organic compounds, metals, cyanide, and perchlorate.

The Inner PRIs SLRA identified concentrations of COPCs above risk-based screening levels (RBSLs), and based on the Inner PRI SLRA results, certain COPCs are identified as preliminary risk drivers. The COPCs most prevalently above RBSLs include HCB, dioxin/furan toxicity equivalency quotient (TEQ), total PCBs, and select metals. Table 11-1 provides a summary of preliminary risk drivers for the Inner PRIs based on screening ratios, which are the ratios of the highest detected concentration in each PRI to the lowest RBSL. The preliminary risk drivers listed in Table 11-1 have screening ratios greater than 10 at one or more of the Inner PRIs.

Table 11-1 COPCs with Screening Ratios >10 for Inner PRIs

Prevalence	Human Health	Ecological
Screening Ratio > 10 in five or six Inner PRIs	HCB Dioxin/Furan TEQ	HCB Dioxin/Furan TEQ Total PCBs Aluminum *, Barium *, Mercury *, Thallium
Screening Ratio > 10 in two to four Inner PRIs	Total PCBs Arsenic *	SVOCs: Hexachlorobutadiene, Pentachlorophenol, Dimethylphthalate Metals: Antimony *, Selenium *
Screening Ratio > 10 in one PRI	None	SVOCs: 1,2,4-Trichlorobenzene, 2,4,5-Trichlorophenol, 2,4,6-Trichlorophenol, 2-Methylnaphthalene, Benzylbutylphthalate, Bis(2-ethylhexyl)phthalate, Hexachlorocyclopentadiene, N-Nitrosodi-N-methylamine Metals: Arsenic *, Cadmium *, Molybdenum *, Lead *

* Metals may be within the range of background concentrations and are not likely to be risk drivers at the Site.

It is recognized that metals that exceed RBSLs may be within the range of background concentrations and that an ambient data set may be collected during future studies. Preliminary statistical evaluations suggest that a

Site-specific background dataset may be extracted from the pooled Phase 1A RI dataset for the Outer PRIs; therefore, identifying a background reference area and collecting samples for analysis to determine background concentrations is not necessary at this time. If it is determined that sampling at background reference area(s) is required, then that will be incorporated as a new study goal or included in a subsequent RI phase.

Per Section 5 of the Administrative Settlement Agreement and Order on Consent, after completing the SLRA and upon notification by USEPA that sufficient data are available, a Baseline Human Health Risk Assessment and Ecological Risk Assessment, collectively referred to as "Baseline Risk Assessments" (BRAs), will be performed to evaluate site risks to human and ecological receptors. The scope and methodologies of the BRAs will be identified in the Problem Formulation, Baseline Human Health Risk Assessment Technical Memorandum, and Baseline Ecological Risk Assessment Technical Memorandum, collectively referred to as Problem Formulation Documents, to be developed by ERM with input, review, and approval by USEPA and the State of Utah. While the Problem Formulation Documents have not been completed, an element that will be required for the BRAs is an estimate of the exposure point concentration (EPC) for use in risk calculations. Per the USEPA *Risk Assessment Guidance for Superfund* (USEPA 1989), the EPC is defined as the 95 percent Upper Confidence Limit (95UCL) of the mean or the maximum concentration, whichever is less.

The existing set of historical (pre-CERCLA) Inner PRI data have been judged by USEPA as not adequate for use in risk assessments, including selection of COPCs and calculating 95UCLs. Limitations of the historical dataset for the Inner PRIs are described in the *Final Inner PRI Data Report* (ERM 2014) and the *Final Inner PRI SLRA Report* (ERM 2015). The historical data in most cases did not include analyses for all COPCs. In addition, USEPA has raised concerns about the usability of historical data for Risk Assessment primarily because these data may not be representative of current site conditions. The DMA data set included analyses for all COPCs but there were a limited number of samples (two or three) collected at PRIs 1 and 4 through 7 and no DMA samples were collected at PRI 3.

Additionally, the nature and extent (N&E) of COPCs have not been characterized at the Site. This is due in part to the fact that the historical Inner PRI data in most cases did not include analyses for all COPCs and there were an insufficient number of samples collected. The USEPA has also identified that "vertical profile waste stratification and contaminant data are needed at key release locations and within areas where wastes have been discharged continually" (USEPA 2013b). Based on Site operations, the Site history, a review of aerial photographs, and information from previous sampling events, the following key waste release locations are identified for the Inner PRIs:

- Wastewater Ditches (PRI 1);
- The south-central portion of the Gypsum Pile (PRI 4) where the pile is tallest;
- The Southeast Ponded Waste Lagoon (PRI 5) near the outlet of the Main Ditch;
- The historical inlet to the northeast ponded Waste Lagoon (PRI 7); and
- The former wastewater diversion ditch traversing the Southeast Ponded Waste lagoon (PRI 5).

These key waste release locations are shown in Figure 11-1.

The Outer PRIs SLRA has not been completed; therefore, COPCs have not yet been selected for the Outer PRIs (i.e., PRIs 2 and 8 through 17). The Phase 1A RI dataset for the Outer PRIs is a robust dataset including at least 14 surface sample locations in each Outer PRI and subsurface samples at key waste release/deposition locations. For these reasons, no Phase 1B RI sampling will be performed at the Outer PRIs. After completion of Phase 1B RI sampling at the Inner PRIs, the data needs to support BRAs for OU-1 in its entirety (i.e., including both Inner and Outer PRIs) will be identified in the Problem Formulation Documents and addressed by the Phase 2 RI. A key element of the Problem Formulation Documents and/or BRAs will be the establishment of exposure areas.

11.1.2 Conceptual Model

Initial Site-wide conceptual site models (CSMs) for the current and future use at the Site are presented in the Phase 1A RI SAP. Based on these CSMs, human receptors may be exposed to constituents in surface solids; however, they are not exposed to constituents in subsurface solids. Surface dwelling biota and shallow-rooted plants may be [a] directly exposed to constituents in surface solids and [b] indirectly exposed to constituents in deeper solids via the food chain. Burrowing wildlife and deeper rooted plants may also be directly exposed to constituents in subsurface solids. The Site-wide CSMs will be updated in the Problem

Formulation Documents and the BRAs as additional information becomes available.

11.2 STEP 2: IDENTIFY GOALS OF THE STUDY

The primary and secondary study goals and the associated study questions are provided in Table 11-2.

Table 11-2 Study Goals

Study Goals	Study Questions
1. Calculate reliable EPCs for COPCs in Inner PRIs	What is the 95UCL for COPCs in each of the Inner PRIs? (Principal Study Question)
2. Preliminarily evaluate nature and extent (N&E) of COPCs within the Inner PRIs	How do COPC concentrations vary laterally (horizontally) across Inner PRIs?
	How deep is waste present across the Inner PRIs?
	How do COPC concentrations vary with depth at key waste release locations?

11.3 STEP 3: IDENTIFY INFORMATION INPUTS

11.3.1 Information Inputs

Given past surface releases at the Inner PRIs and review of Facility-specific CSMs, the information needed to answer the principal study question is an adequate and reliable data set to characterize an upper bound average (95UCL) concentration for COPCs within the surface solids (soil/sediment/waste). This information will be obtained by collecting surface solids samples from 0 to 6 inches below ground surface (bgs) at the Inner PRIs and analyzing the samples for COPCs.

The information needed to address the study questions related to preliminary N&E will be obtained in part through the characterization of Inner PRI COPC concentrations for the principal study question. Additional information to address the N&E study questions includes waste thickness and vertical profiles of COPC concentrations in the subsurface at key waste release locations.

11.3.2 Sampling and Analytical Methods

Sampling will be performed following site-specific Standard Operating Procedures (SOPs) for surface solids sampling (SOP USM-01: Surface Soil, Sediment, and Waste Sampling) and subsurface solids sampling (SOP USM-09: Subsurface Soil, Sediment, and Waste Sampling), with appropriate modifications for access issues associated with sample collection from submerged locations. Laboratory analyses will be performed following the SOPs and Project-Specific Work Instructions from the Phase 1A SAP (USEPA 2013b) with the addition of analysis of select high concentration level solids samples for PCBs and dioxin/furan congeners using low-resolution mass spectrometry (LRMS) methods as described in the *Addendum to Phase 1A Demonstration of Method Applicability Work Plan for Low Resolution Mass Spectrometry Analyses of Solids* (ERM 2013).

11.4 STEP 4: DEFINE THE BOUNDARIES OF THE STUDY

11.4.1 Spatial Boundaries

For this study, sampling units are defined by the OU-1 PRI boundaries. The exposure unit boundaries for human health and ecological risk assessments will be defined in the Problem Formulation documents. Exposure Unit boundaries may or may not be consistent with PRI boundaries.

The vertical boundaries for the study are defined based on the sampling method. Sampling will be performed to a depth of 6 inches bgs at all surface sampling locations to be consistent with the Phase 1A SAP. Subsurface sampling will be performed using 2-foot sample intervals from 6 inches bgs to 2 feet below the waste/native soil interface. Hand auger borings to delineate waste thickness will extend to the waste/native soil interface or to a maximum depth of 5 feet bgs. The 5-foot maximum depth is due to practical constraints on hand augering to greater depths under Site conditions.

11.4.2 Temporal Boundaries

COPC concentrations within solids at the Site are not expected to fluctuate substantially over the time scale of a year (provided that significant process changes have not been implemented during that time), so the time of year when sampling of these media occurs is not likely to be an important variable (USEPA 2013b). The timing of sampling may affect access with sampling areas and health and safety of field personnel. Sampling should ideally not be performed during spring due to high water conditions in wastewater ponds, nor in the middle of the summer months when excessive heat could adversely affect the health and safety of field personnel.

11.5 STEP 5: DEVELOP THE ANALYTIC APPROACH

For the primary study goal of calculating reliable EPCs for COPCs at the Inner PRIs, the 95UCL will be used as an estimator for the EPC. The 95UCL was selected as an estimator for the EPC based on the USEPA *Risk Assessment Guidance for Superfund* (USEPA 1989). A 95UCL of a mean represents an acceptable upper limit such that one can be 95 percent confident that the true (but unknown) population mean will be less than that upper limit. Calculations of 95UCLs will be performed in accordance with USEPA guidance (USEPA 1989, USEPA 1992, USEPA 2002, USEPA 2013a).

The analytic approach for the secondary study goal of preliminary N&E includes elements to address the study questions relating to lateral (horizontal) N&E of COPCs, the vertical extent of wastes, and the vertical N&E of COPCs at key waste deposition locations. The decision rules for interpreting preliminary N&E study questions are as follows:

Horizontal N&E

The Phase 1B RI Data Report will include maps showing COPC concentrations detected in each Inner PRI. If concentrations of a COPC in surface samples are similar across a PRI then additional N&E data would not be required for that COPC. However, additional N&E sampling may be required during subsequent RI phases to target specific features (judgmental sampling) or to delineate the extent of impacts requiring remediation after constituents of concern (COCs) are identified in the RI. If COPC concentrations are variable across a PRI, then data requirements for further delineation of N&E to support the BRAs will be evaluated in the Problem Formulation Documents based on exposure areas and these data would be collected during the Phase 2 RI. Additional sampling to delineate the extent of COC impacts, including the use of screening methodologies if relevant to further delineate impacted areas, would be included in subsequent RI phases after COCs have been identified.

Vertical N&E

Based on field screening for waste by visual observation, if waste is not present or the depth of waste does not exceed 6 inches bgs, then surface samples are appropriate for evaluating surface exposure scenarios and could be conservatively used for evaluating subsurface exposure scenarios. If waste is present at depths greater than 6 inches bgs, then additional sampling may be required in subsequent RI phases to delineate the vertical extent of waste or to evaluate COPC concentrations in the subsurface to depths relevant to human or ecological exposure or to support Feasibility Study evaluations.

At key waste deposition locations, subsurface samples will be collected and analyzed for COPCs. If concentrations in subsurface solids are consistently similar to or less than concentrations in surface solids, then these findings would suggest that surface solid data may be considered for use as a proxy for calculating protective EPCs for a deeper soil horizon to which some wildlife and/or deeper rooted plants may be exposed. If not, then additional subsurface sampling may be necessary in subsequent RI phases to more fully characterize subsurface solids.

11.6 STEP 6: SPECIFY PERFORMANCE OR ACCEPTANCE CRITERIA

For Study Goal #1, the study problem is one of estimation (i.e. what is the EPC?) rather than a decision problem (i.e. hypothesis testing), the acceptance criteria is based on the estimation uncertainty rather than the study's ability to accept or reject a null hypothesis (USEPA 2006). Precision of the 95UCL, as characterized by the margin of error (MOE), is a function of the confidence level, sample size, and variability in the data.

For normally-distributed data, the number of samples required to yield a specified MOE may be calculated using Cochran's formula for sample size:

$$n = \frac{{t_{\propto}}^2 \cdot s^2}{\delta^2}$$

where n is the sample size, t is the critical t-value, s^2 is the variance, and δ is the acceptable MOE for the attribute of interest. All analytes are not anticipated to have data that are normally distributed. However, use of Cochran's formula is common practice when conducting precision analysis as evidenced in its use in USEPA's ProUCL v5.0.00 and United States Department of Energy's Visual Sample Plan (VSP). For the purposes of this evaluation, Cochran's formula was considered to provide satisfactory approximations of Phase 1B sample size. Precision achieved by the Phase 1B sampling will be reported in the Phase 1B Data Report.

To facilitate use across analytes with different means, Cochran's formula can be normalized by the mean to calculate the relative MOE, $\delta(\%)$, where the relative MOE is expressed as the percent of the mean and calculated as a function of the sample size and the coefficient of variation (CV):

$$\delta(\%) = CV \cdot \sqrt{\frac{{t_{\propto}}^2}{n}}$$

A plot of the relative MOE versus sample sizes produces a precision curve that describes how the relative MOE decreases (i.e., increased precision) with increasing sample size. Figure 11-2 provides precision curves for assumed CVs of 100%, 150%, 200%, and 250%. Inspection of the precision curves in Figure 11-1 shows that initially the relative MOE decreases rapidly with increasing sample size. However, as the sample size increases there is a diminishing return in increased precision. The functions approximating the precision curves are included in the plots in Figure 11-2.

The first derivative of a precision curve yields an expression relating the change in relative MOE to the change in sample size. A plot of the first derivatives of the precision curves for CVs of 100%, 150%, 200%, and 250% is provided in Figure 11-3. Using 5 percent as performance criteria for a diminishing return in precision, the plot in Figure 11-3 shows that an acceptable diminishing return is achieved in the range of 10 to 15 samples for the range of CVs evaluated. For the purposes of this evaluation, a 5% diminishing return criterion was selected to provide an objective guide as opposed to a purely visual-based approximation for the point-of-diminishing return. The sample sizes yielding a diminishing return for relative MOE (and 95UCL precision) are listed in Table 11-3.

Table 11-3 – Sample Sizes Yielding a 5% Reduction in Relative MOE

CV	n
100%	9
150%	11
200%	13
250%	15

Based on the historical and DMA data for Inner PRIs, the CVs for COPCs range from 15% for dioxin/furan TEQs at PRI 1 (based on 17 samples) to 249% for dioxin/furan TEQ at PRI 6 (based on 13 samples). The CVs from historic and DMA data for Inner PRIs as presented in the *Inner PRI Data Report* are included as Attachment 1.

Sample sizes for the Phase 1B RI were selected based on the CVs of historical and DMA data for dioxin/furan TEQs, total PCBs, HCB, and arsenic. Dioxin/furan TEQs, total PCBs, and HCB were selected because these COPCs tended to have the highest screening ratios in the Inner PRI SLRA and are among constituents having the highest variance. Arsenic was chosen as a proxy for metals because arsenic is the only metal with a screening ratio greater than 10 relative to both human health and ecological screening levels. For each PRI, the maximum CV for these analytes rounded to the nearest 50% was used to determine the sample size from Table 11-3. Proposed Phase 1B sample sizes are presented in Table 11-4, and range from nine samples at PRI 3 to 15 samples at PRIs 5, 6, and 7. PRIs 1 and 4 have sample sizes of 11 and 13, respectively.

Table 11-4 – Phase 1B RI Inner PRI Sample Sizes

PRI Area	Mammal TEQ (ND=0) CV	Total PCBs CV	HCB CV	Arsenic CV	Max. Rounded CV [1]	Phase 1B RI Sample Size [2]
PRI 1	15%	104%	133%	65%	150%	**11**
PRI 3	68%	77%	119%	27%	100%	**9**
PRI 4	205%	151%	97%	79%	200%	**13**
PRI 5	233%	140%	185%	66%	250%	**15**
PRI 6	244%	126%	219%	59%	250%	**15**
PRI 7	223%	158%	233%	73%	250%	**15**

[1] Maximum CV among TEQ, Total PCBs, HCB, and arsenic, rounded to nearest 50%

[2] Sample size from Table 11-3 for Max Rounded CV

If the data from the Phase 1B investigation show COPC variability within a PRI (expressed as the CV) is consistent with the CV assumed for the sample design, then it can be concluded that additional sampling within that PRI would not significantly improve the precision of 95UCLs. However, if the Phase 1B data show COPC variability within a PRI is substantially greater than the CV assumed for the sample design or significantly departs from a normal distribution, then subsequent precision analysis will be performed to determine the degree to which additional sampling would result in improved estimates of the 95UCL and whether these improvements would likely affect overall conclusions of the BRAs. Findings will be reported in the Phase 1B Data Report.

Maps showing COPC concentrations included in the Phase 1B RI Data Report will provide an indication of the spatial correlation of COPC concentrations. If CVs are greater than expected and concentration levels appear spatially correlated, then potential follow up actions to account for spatial variability would be evaluated in the Problem Formulation Documents for the BRAs or during scoping for subsequent RI phases. These follow up actions could include subdividing (stratifying) a PRI for purposes of estimating EPCs and for planning subsequent investigation phases, developing area-weighted averages instead of 95UCLs, or other appropriate measures.

11.7 STEP 7: DEVELOP THE PLAN FOR OBTAINING THE DATA

The data collection approach, which includes sampling at discrete locations using a systematic grid and performing definitive analyses samples for the full list of COPCs, was chosen to support both study goals, i.e., calculating EPCs and preliminary N&E. Incremental-composite sampling or other forms of composite sampling that may be advantageous for calculating a 95UCL were eliminated because they would not provide N&E information and because the exposure areas to be evaluated for the BRAs have not yet been defined. A triad sampling approach using screening methods to delineate N&E was eliminated because screening-method data may not meet USEPA's requirements for use in risk assessment. While not included in Phase 1B, both incremental-composite sampling and triad sampling approaches may be suitable for subsequent RI phases.

11.7.1 Surface and Subsurface Solids Sampling

Surface solids sampling will be performed as detailed in SOP *USM-01: Surface Soil, Sediment, and Waste Sampling*. Surface solids samples will be collected from 0 to 6 inches bgs. Subsurface borings with sampling at 2-foot intervals for chemical analysis will be performed to evaluate COPC concentrations at depth and for characterizing vertical N&E. Subsurface solid sampling will be performed as detailed in SOP *USM-09: Subsurface Soil, Sediment, and Waste Sampling*.

The presence/absence of visible waste will be noted at all sample locations. When waste is visible, the depth of waste will be measured. Waste may include gypsum, smut, salts, or sludge that have a different appearance than the native soils present within the Inner PRIs (e.g., oolitic sands, lacustrine clays, evaporite minerals). If waste is present at the bottom of a surface sample boring (6 inches bgs), then the hand auger boring will be advanced to either the waste/native soil interface or a maximum depth of 5 feet bgs. The maximum depth of 5 feet bgs is based on the impracticality of advancing a hand-auger to depths below 5 feet under Site conditions (e.g., standing water, shallow depth to groundwater, unconsolidated wastes, etc.).

11.7.2 Sampling Locations

Surface solids sampling locations were preferentially chosen using a systematic (grid) sampling design to ensure that the sampling unit (i.e., the PRI) is fully and uniformly represented by the set of samples collected. In addition, judgmental samples placed at known features at PRIs 1 and 5 to support preliminary characterizations of N&E. To avoid introducing bias when characterizing PRI-wide EPCs, judgmental (biased) samples are not included in the sample design to support 95UCL calculation; however, it should be noted that the systematic grids of sample locations at PRI s 4, 5, and 7 include locations near areas of waste deposition or found to contain the highest screening ratios of HCB, dioxin/furan TEQs, and PCBs based on the findings from the *Inner PRI SLRA*. Subsurface borings for vertical N&E are located within key waste deposition areas, which are identified in PRIs 1, 4, 5, and 7 (see Figure 11-1).

Most sample locations include surface sampling only; however, field screening for waste thickness will be performed at all sample locations. If field screening for waste indicates that waste material is present at depths greater than 6 inches bgs within all or a portion of a PRI, then subsequent sampling to delineate vertical N&E would be considered during subsequent RI phases.

Sample locations for each PRI are described in the subsections that follow. Sample locations for PRIs 3 through 7 were developed using VSP (http://vsp.pnnl.gov/). To ensure the assumption of random sampling is met, a systematic sample grid layout was employed that utilized a randomized initial sample that serves as the origin on which the systematic grid is constructed.

PRI 1

Sample locations for PRI 1 are shown in Figure 11-4. The selected sample size for PRI 1 as per the historical CV is 11 (see Table 11-3). Because the wastewater ditches are linear features, sample locations were selected based on ditch lengths instead of using a systematic grid. The 11 samples were divided between the active wastewater ditches based on the relative approximate length of each ditch: three samples at the Western Ditch (2,000 feet length); two samples at the Central Ditch (1,300 feet length); two samples at the Chlorine Ditch (1,350 feet length), and four samples at the Main Ditch (3,000 feet length). The distribution of samples between ditches results in one sample per approximately 700 feet. Samples were distributed along the wastewater ditches taking into account accessibility by placing samples at each of three bridges crossing the active wastewater ditches. A judgmental sample for characterizing N&E is located within the alignment of the Former Boron Ditch. The rationale for each Phase 1B sample at PRI 1 is provided below.

ID	Rationale
1-01	Near head of Western Ditch (Surface)
1-02	Approximate midpoint of north-south segment of Western Ditch (Surface)
1-03	West of bridge at confluence of Western and Main Ditches (Surface and Subsurface)
1-04	Near head of Central Ditch (Surface)
1-05	Central Ditch downstream of Sanitary Lagoon (Surface)
1-06	Near head of Chlorine Ditch (Surface)
1-07	Chlorine Ditch downstream of Boron Plant discharge and south of bridge (Surface and Subsurface)
1-08	Main Ditch after confluence with Chlorine Ditch and east of bridge (Surface and Subsurface)
1-09	Main Ditch downstream of Landfill (Surface)
1-10	Main Ditch near current outlet to PRI 5 waste pond (Surface)
1-11	Former Main Ditch near historical outlet to PRI 7 waste pond (Surface and Subsurface)
1-12	N&E location at Former Boron Ditch (Subsurface only – surface material is road fill)

Surface solids sampling will be performed at locations 1-01 through 1-11. Subsurface sampling will be performed at 5 locations, including the three bridges over wastewater ditches (1-03, 1-07, and 1-08), the former Main Ditch near the historical outlet to the northeast ponded waste lagoon (01-11), and within the alignment of the former Boron Ditch. No surface sample will be collected at the Former Boron Ditch N&E sample location (1-13 in Figure 11-4) because the ground surface at this location is a roadway constructed of imported gravel fill. A significant portion of PRI-1 is included in the pending RCRA settlement; therefor a portion of sampling may not be done if a settlement is reached prior to implementation of the Phase 1B work.

PRI 3

The selected sample size for PRI 3 as per the historical CV is 9 (see Table 11-3). There are fewer samples within PRI 3 than other PRIs; however, the 9 samples provide a relatively high sample density due to the small size of PRI 3 (less than 2 acres). Sample locations for PRI 3 were generated as a systematic grid and are shown in Figure 11-5. Only surface samples will be collected within PRI 3. All of PRI 3 is included in the pending RCRA settlement; therefor this sampling may not be done if a settlement is reached prior to implementation of the Phase 1B work.

PRI 4

The selected sample size for PRI 4 as per the historical CV is 13 (see Table 11-3). Sample locations for PRI 4 were generated as a systematic grid and are shown in Figure 11-6. Subsurface sampling for vertical N&E will be performed at the sample location nearest the top of the Gypsum Pile where the gypsum waste is expected to be thickest (location 4-04 in Figure 11-6). This sample location is within a key waste release area (see Figure 11-1). Vertical N&E sampling will not be performed at other PRI 4 sampling locations; however, if the subsurface data from location 4-04 suggest that COPC signature or concentration levels vary substantially with depth, then additional subsurface sampling at PRI 4 would be performed during subsequent RI phases.

PRI 5

The selected sample size for PRI 5 as per the historical CV is 15 (see Table 11-3). Sample locations for PRI 5 were generated as a systematic grid and are shown in Figure 11-7. The sampling grid at PRI 5 includes locations in both upland (terrestrial) and mudflat/waste pond areas. Subsurface sampling for vertical N&E will be performed at the location nearest the inlet to the waste lagoon from the Main Ditch (location 5-14 in Figure 11-7). This location was selected for vertical N&E sampling because it is within a key waste release area (see Figure 1-1) and the inlet is the location where the greatest amount of waste deposition occurs, as apparent in aerial photographs. An additional sample for N&E will be collected from within the former wastewater diversion ditch that traverses PRI 5 (location 5-16 in Figure 11-7).

PRI 6

The selected sample size for PRI 6 as per the historical CV is 15 (see Table 11-3). Sample locations for PRI 6 were generated as a systematic grid and are shown in Figure 11-8. The sampling grid at PRI 6 includes locations in both upland (terrestrial) and mudflat/waste pond areas. Only surface samples will be collected at PRI 6. If field screening for waste indicates waste material is present at depths greater than 6 inches bgs in PRI 6, then subsequent RI phases may include subsurface sampling in this PRI.

PRI 7

The selected sample size for PRI 7 as per the historical CV is 15 (see Table 11-3). Sample locations for PRI 7 were generated as a systematic grid and are shown in Figure 11-9. Subsurface sampling for vertical N&E will be performed at location 7-04 because this sample is nearest the historical inlet to the waste lagoon, which is a key waste release location (Figure 11-1). This location was selected for vertical N&E sampling because the inlet is the location where historically the highest concentrations of HCB, PCBs, and dioxins/furans have been detected within PRI 7 and because this area received wastewater discharges during the early operations of the Magnesium Plant.

11.7.3 Laboratory Analysis

As specified in Step 3 – Information Inputs (Section 11.3), laboratory analyses for COPCs will be performed following the SOPs and Project-Specific Work Instructions from the Phase 1A SAP with the addition of analysis of select high concentration level solids samples for PCBs and dioxin/furan congeners using LRMS methods. *Note: Additional information on the use of LRMS methods will be provided prior to the OU-1 Phase 1B RI scoping meeting.*

In addition to analysis for COPCs, all samples will be analyzed for total organic carbon (TOC), pH, and grain size. TOC, pH, and grain size data will not be used to calculate 95UCLs; however, these data will be collected to provide context for BRA risk characterizations.

11.7.4 Additional Investigation Tasks

Bulk versus Fines Fractions Analyses

To be determined. This topic will be discussed during the OU-1 Phase 1B RI Scoping Meeting.

Implementation Plan

Due to the unique conditions and associated hazards present within the Inner PRIs, additional planning is required prior to implementation of the Phase 1B RI sampling activities. Implementation planning activities will include:

- Development of a SOP for accessing Phase 1B RI surface and subsurface sampling locations within active wastewater ponds (PRIs 5 and 6);
- Establishing a protocol for identification and modification of wastewater ditch (PRI 1) sampling locations based on access; and
- Establish a protocol for modification of sampling locations within active wastewater ponds based on access or field conditions (PRIs 5 and 6).

In order to ensure that Phase 1B RI samples are successfully and safely collected within the Inner PRIs, the access SOP and relevant Phase 1B SAP Worksheets (e.g., Worksheet 14 – Project Tasks and Worksheet 16 – Project Schedule) include task sequencing or scheduling provisions to allow sampling activities to be performed within specific timeframes when Site conditions are more favorable.

It is also recognized that Site conditions will change significantly upon implementation of actions included under the pending Resource Conservation and Recovery Act (RCRA) settlement. For example, all wastewater discharges to the current wastewater ditches and ponds would cease upon construction of a wastewater filtration plant and new wastewater evaporation pond. Depending on the date that the RCRA settlement is finalized and implemented, the schedule and sequencing of Phase 1B RI activities could be adjusted to improve access and reduce hazards to field sampling staff. If the RCRA settlement is finalized in early- to mid- 2015, the implications of the settlement on Site conditions would be factored into the Phase 1B RI implementation planning.

11.8 REFERENCES

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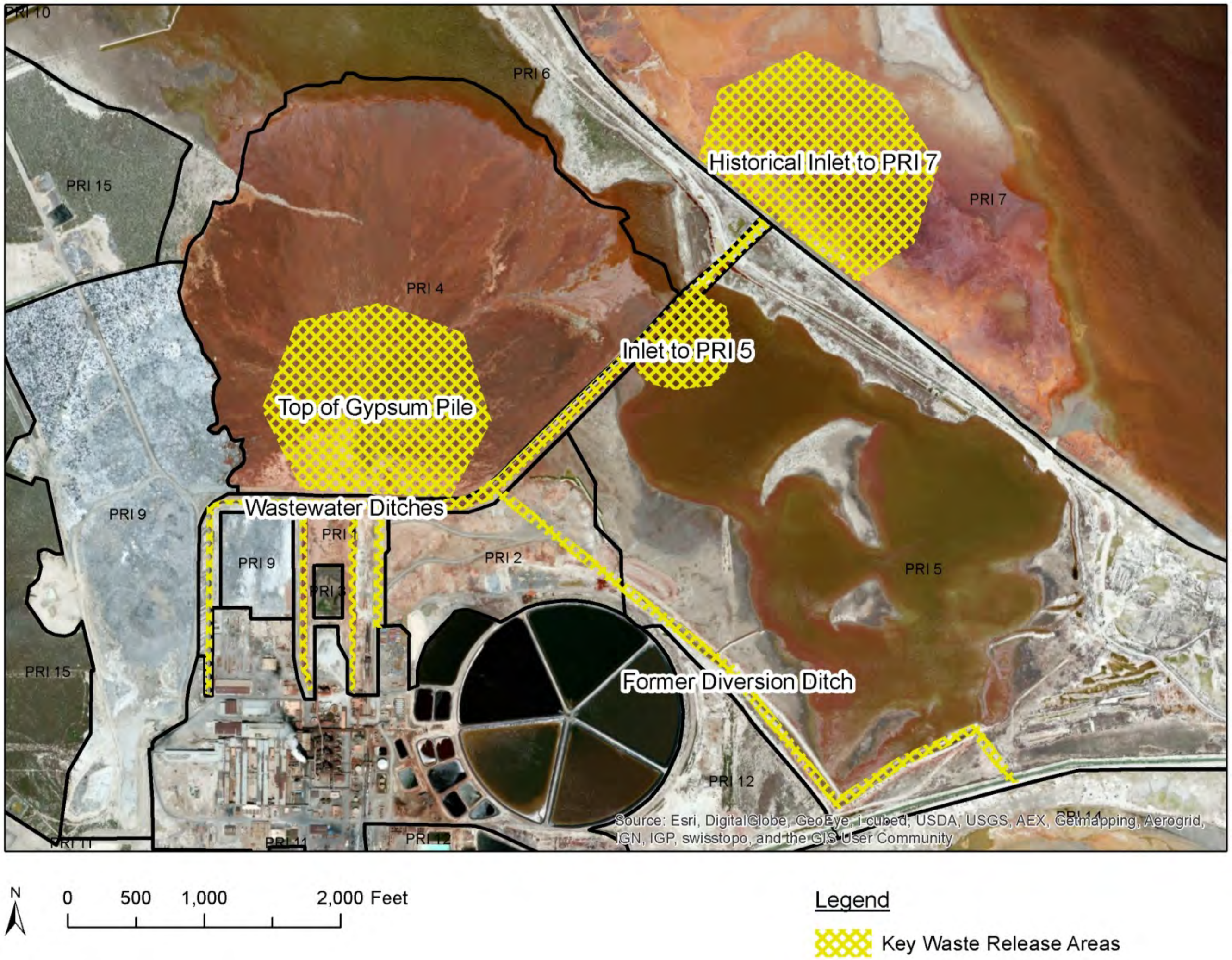
USEPA. 2013b. *Phase 1A Remedial Investigation Sampling and Analysis Plan to Identify Chemicals of Potential Concern in Soils, Sediment, Solid Waste, Water and Air, and Receptor Surveys*. US Magnesium NPL Site, Tooele County, Utah. Revision 0 for PRI Areas 2 and 8 through 17. September.

Figures

Figure 11-1 Key Waste Release Areas



Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 11-2 Precision Curves for Assumed Coefficients of Variation

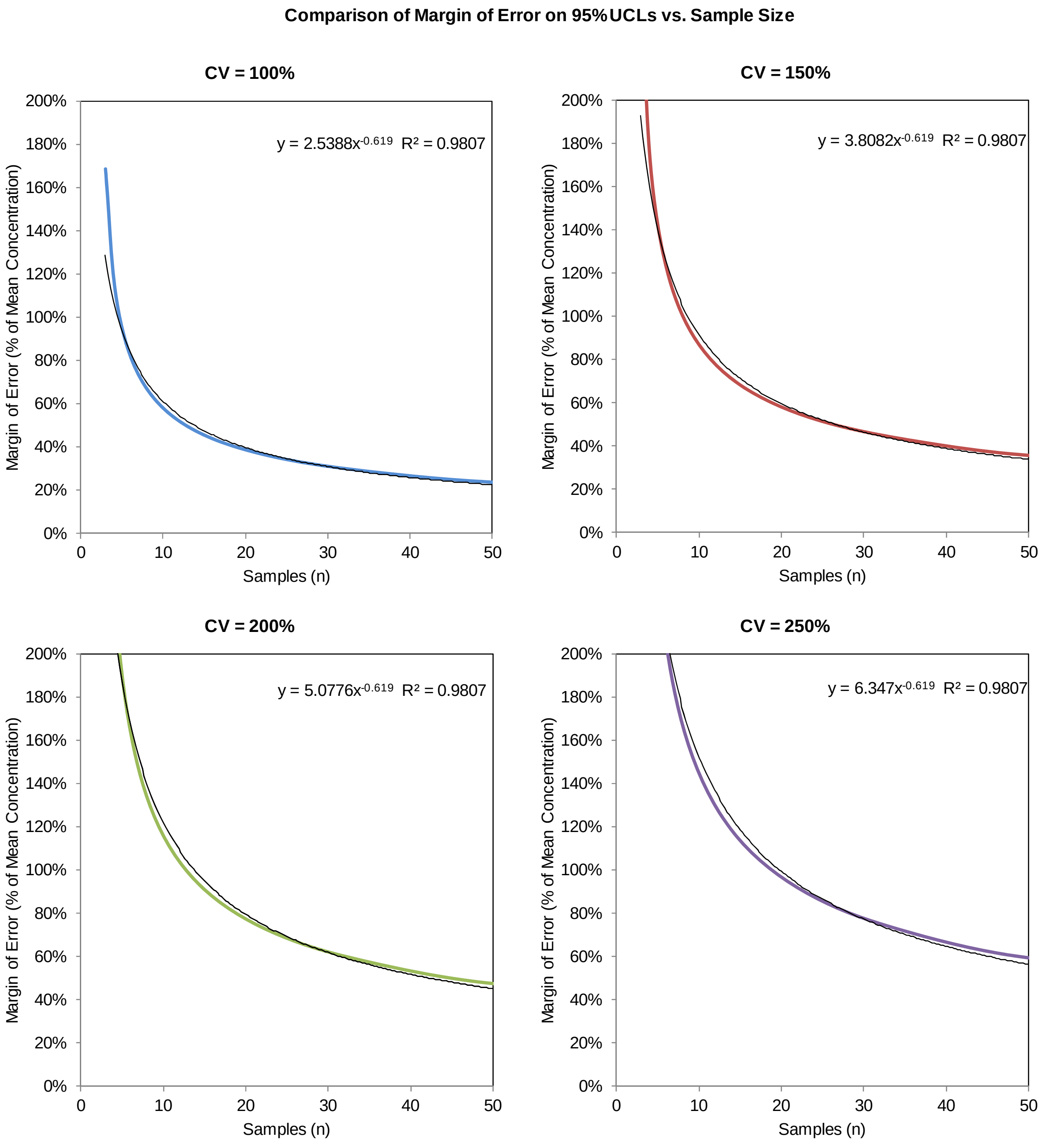


Figure 11-3 Diminishing Returns (Slope) from Sample Size Increase

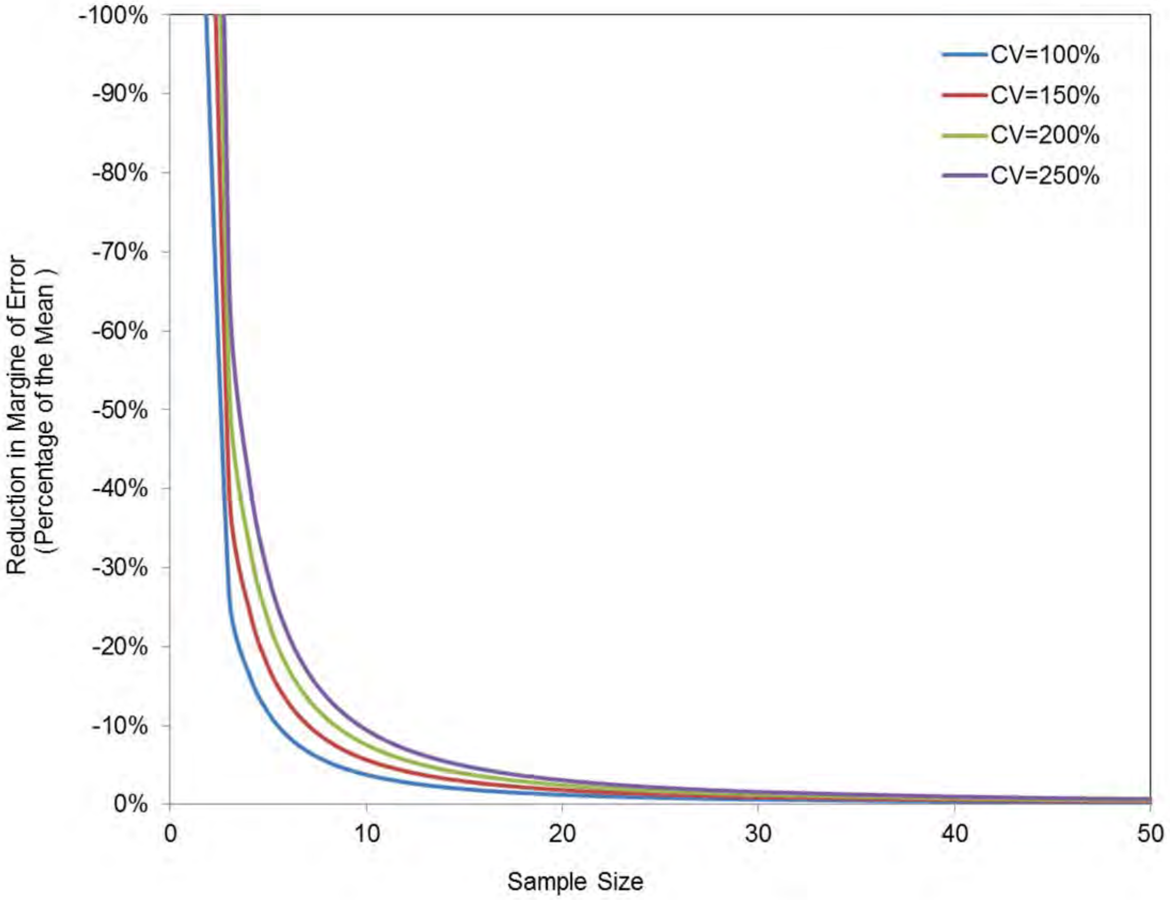
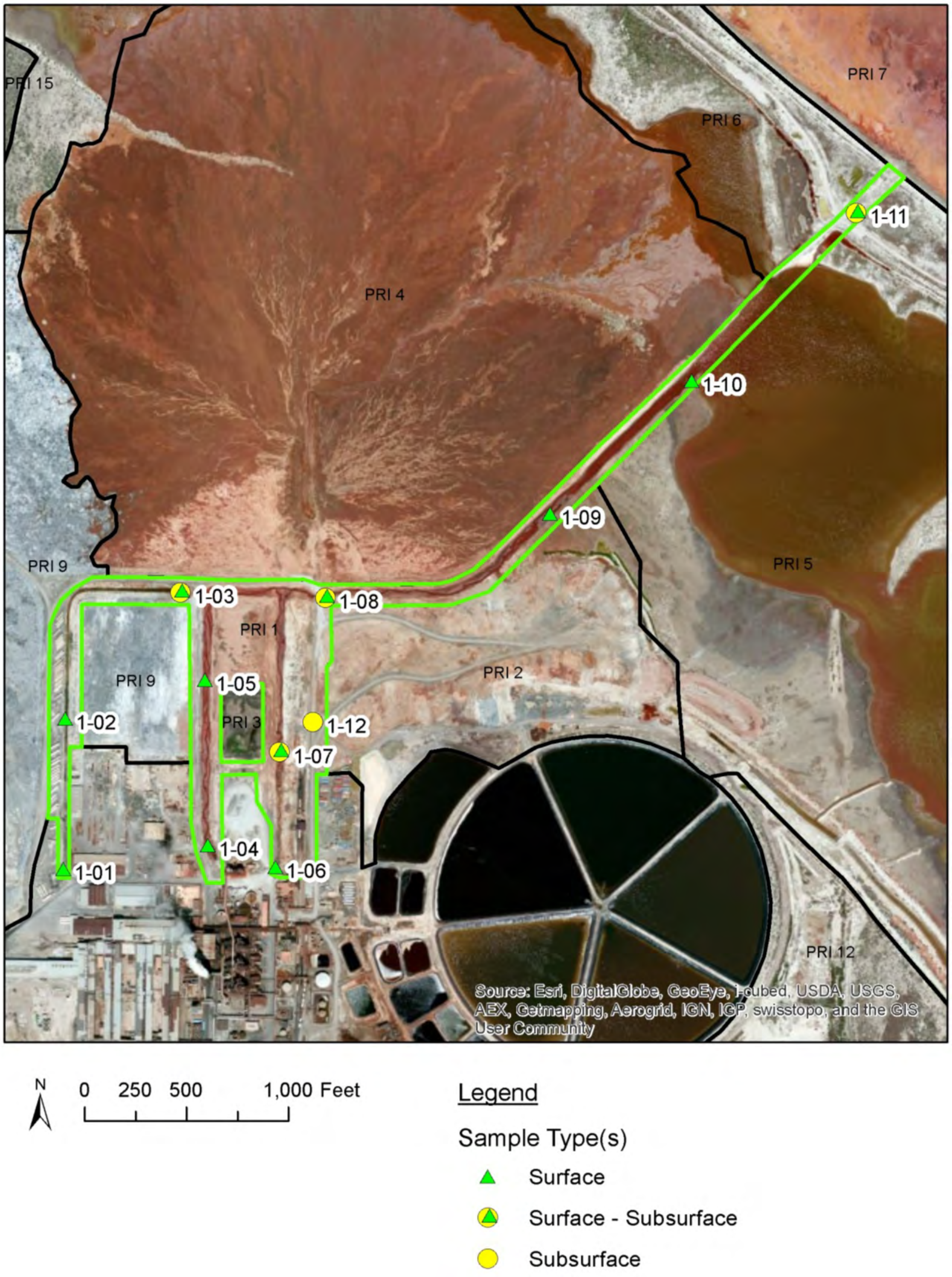


Figure 11-4 Phase 1B Sample Locations for PRI Area 1 – Ditches

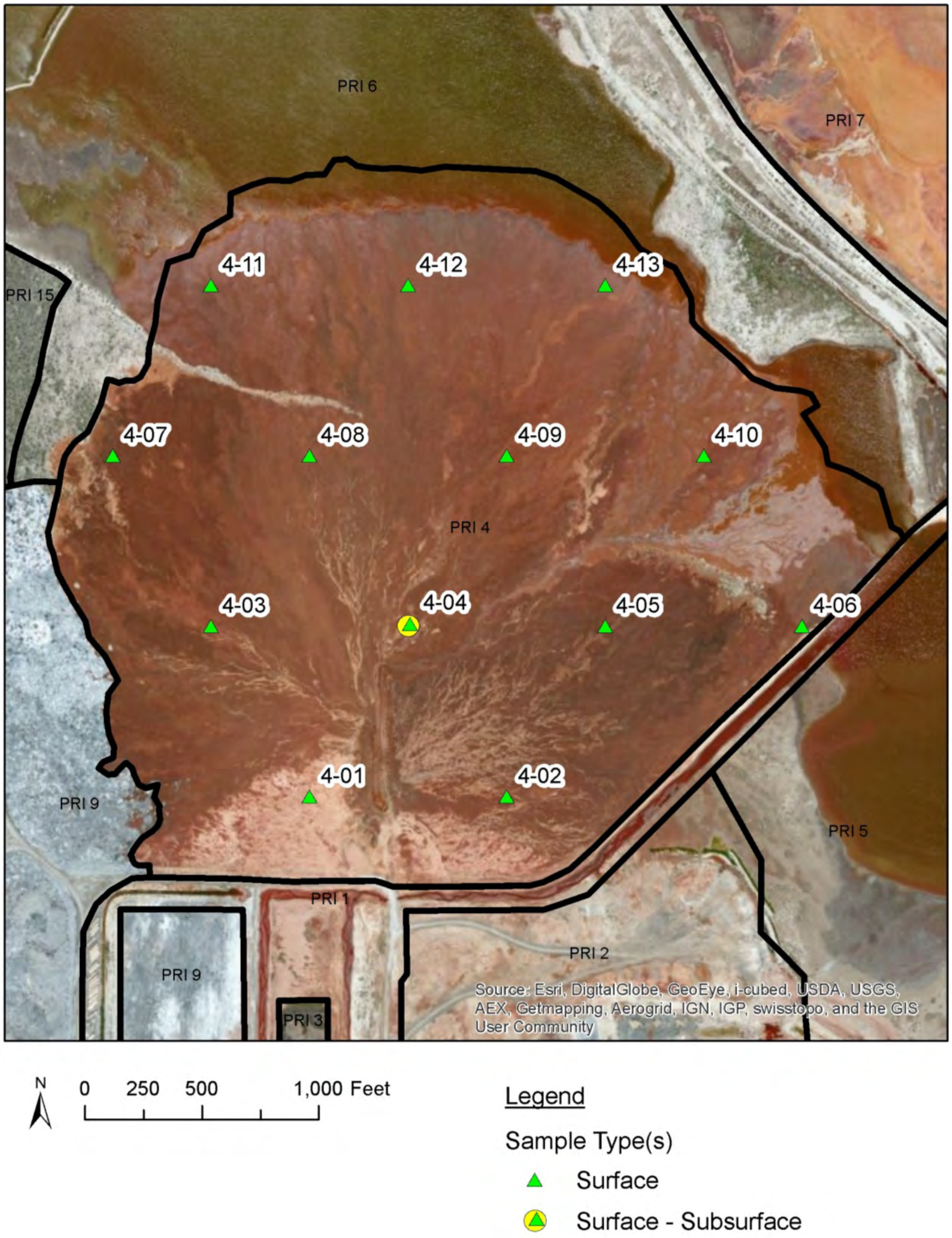


Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 11-5 Phase 1B Sample Locations for PRI Area 3 – Sanitary Lagoon

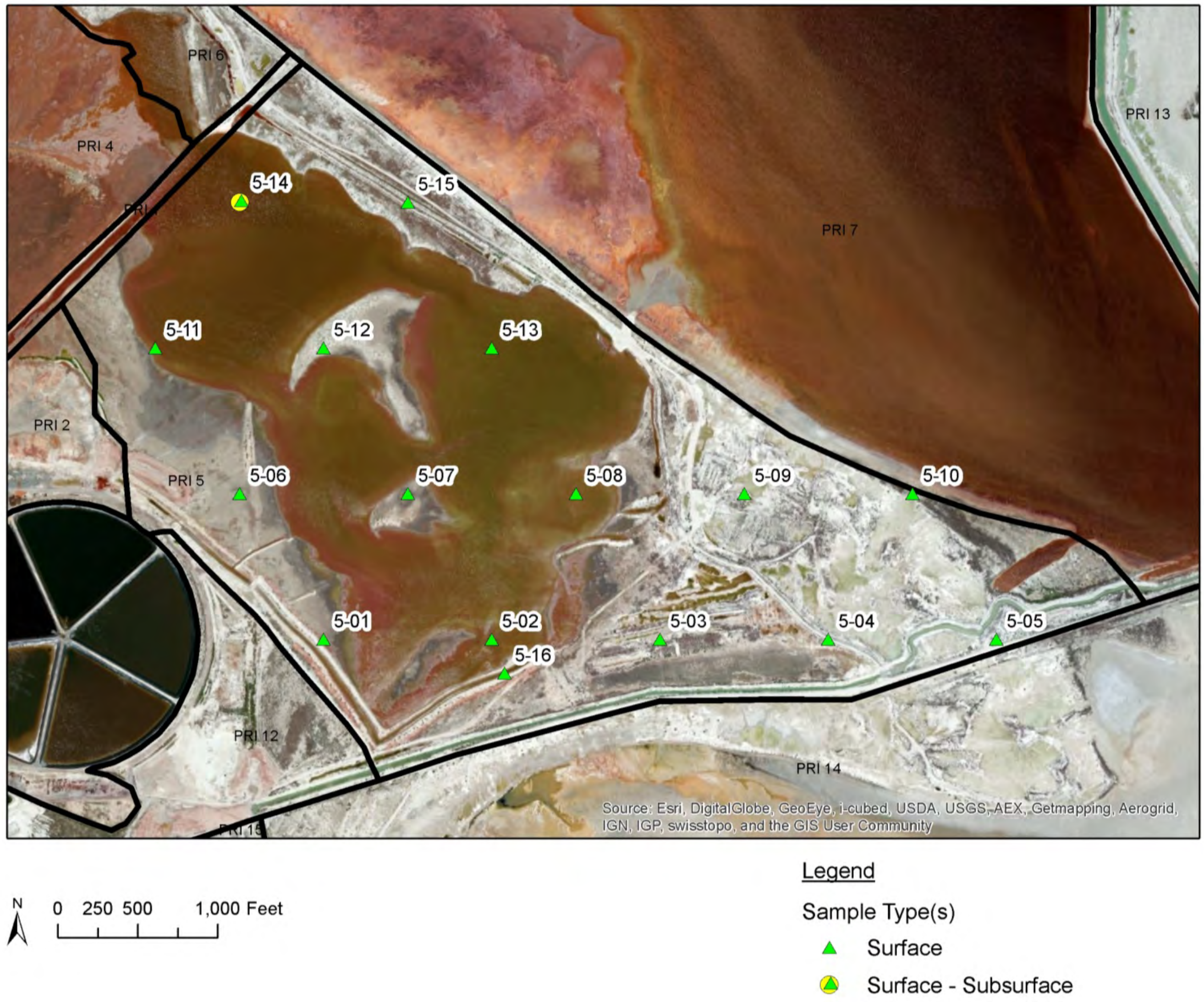
Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 11-6   Phase 1B Sample Locations for PRI Area 4 – Gypsum Pile



Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 11-7 Phase 1B Sample Locations for PRI Area 5 – Southeast Ponded Waste Lagoon



Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 11-8 Phase 1B Sample Locations for PRI Area 6 – Northwest Ponded Waste Lagoon

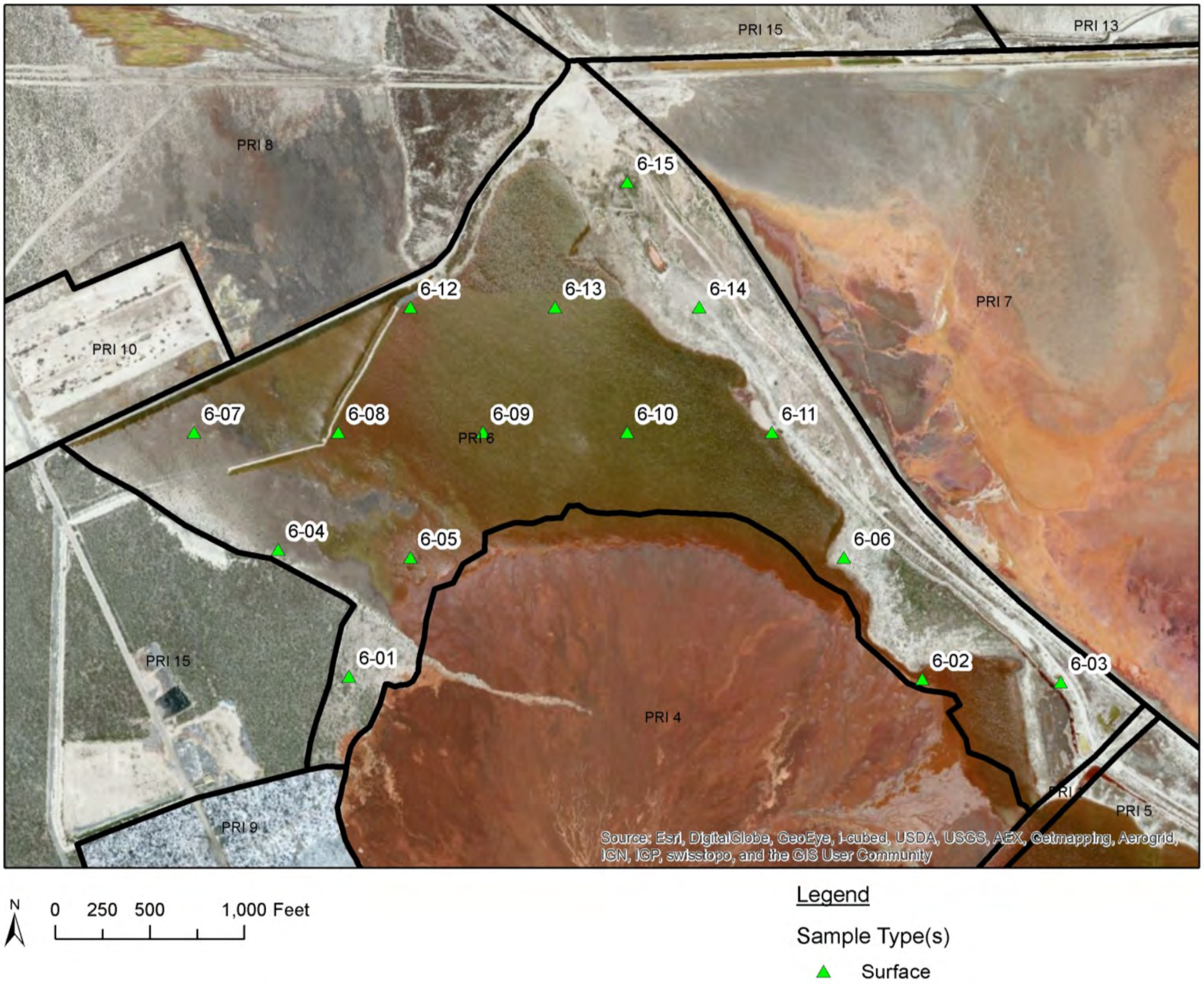


Figure 11-9 Phase 1B Sample Locations for PRI Area 7 – Northeast Ponded Waste Lagoon

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Attachment 1
Coefficients of Variation for Inner PRI Data

Attachment 1 *Coefficients of Variation for Inner PRI Data*

	PRI Area 1		PRI Area 3		PRI Area 4		PRI Area 5		PRI Area 6		PRI Area 7	
COPC	**Samples n (n Det.)**	**CV**	**Samples n (n Det.)**	**CV**	**Samples n (n Det.)**	**CV**	**Samples n (n Det.)**	**CV**	**Samples n (n Det.)**	**CV**	**Samples n (n Det.)**	**CV**
D/F												
Calculated TEQ (ND=0), Mammalian	17 (17)	0.15	3 (3)	0.68	34 (34)	2.05	25 (25)	2.33	13 (13)	2.44	24 (24)	2.23
Calculated TEQ (ND=1/2 DL), Mammalian	17 (17)	0.72	3 (3)	0.68	34 (34)	2.05	25 (25)	2.25	13 (13)	2.49	24 (24)	2.21
PCB												
Total PCBs	17 (17)	1.04	3 (3)	0.77	29 (27)	1.51	19 (16)	1.40	10 (7)	1.26	24 (23)	1.58
Metals												
Total Aluminum	6 (6)	0.75	--	--	4 (4)	0.70	5 (5)	0.81	--	--	--	--
Total Antimony	6 (6)	0.41	--	--	4 (4)	0.43	--	--	--	--	--	--
Total Arsenic	6 (6)	0.65	3 (3)	0.27	9 (9)	0.79	11 (11)	0.66	5 (5)	0.59	14 (14)	0.73
Total Barium	6 (6)	1.87	3 (3)	0.28	9 (9)	0.72	11 (10)	0.26	5 (5)	0.31	14 (14)	0.52
Total Beryllium	6 (6)	2.07	--	--	4 (4)	0.61	5 (5)	0.97	--	--	--	--
Total Cadmium	--	--	3 (3)	0.76	9 (7)	1.09	11 (9)	1.28	5 (5)	0.35	14 (13)	0.72
Total Calcium	6 (6)	1.04	--	--	4 (4)	0.16	5 (5)	1.27	--	--	--	--
Total Chromium	6 (6)	0.80	3 (3)	0.66	9 (8)	0.55	11 (11)	0.73	5 (5)	0.28	14 (14)	0.84
Total Cobalt	6 (5)	0.89	--	--	--	--	--	--	--	--	--	--
Total Copper	6 (6)	2.23	--	--	4 (3)	0.64	5 (5)	1.00	--	--	--	--
Total Iron	6 (6)	0.75	--	--	4 (4)	0.77	5 (5)	0.82	--	--	--	--
Total Lead	6 (5)	1.14	3 (3)	0.71	9 (7)	1.19	11 (9)	0.72	5 (5)	0.51	14 (14)	0.63
Total Magnesium	6 (6)	1.90	--	--	4 (4)	0.66	5 (5)	1.16	--	--	--	--
Total Manganese	6 (6)	1.14	--	--	4 (4)	0.83	5 (5)	1.26	--	--	--	--
Total Mercury	6 (4)	0.79	--	--	--	--	5 (5)	0.44	--	--	--	--
Total Molybdenum	--	--	--	--	--	--	3 (3)	1.48	--	--	--	--

COPC	PRI Area 1 Samples n (n Det.)	PRI Area 1 CV	PRI Area 3 Samples n (n Det.)	PRI Area 3 CV	PRI Area 4 Samples n (n Det.)	PRI Area 4 CV	PRI Area 5 Samples n (n Det.)	PRI Area 5 CV	PRI Area 6 Samples n (n Det.)	PRI Area 6 CV	PRI Area 7 Samples n (n Det.)	PRI Area 7 CV
Metals												
Total Nickel	6 (6)	1.29	--	--	4 (3)	0.72	5 (4)	1.19	--	--	--	--
Total Potassium	6 (6)	0.70	--	--	4 (4)	0.54	5 (5)	0.89	--	--	--	--
Total Selenium	--	--	3 (3)	0.75	--	--	11 (8)	0.91	5 (5)	0.58	14 (14)	0.65
Total Sodium	6 (6)	0.57	--	--	4 (4)	0.91	5 (5)	0.81	--	--	--	--
Total Vanadium	6 (6)	0.82	--	--	4 (3)	0.68	5 (5)	0.73	--	--	--	--
Total Zinc	6 (6)	1.63	--	--	--	--	4 (4)	1.00	--	--	--	--
SVOCs												
Bis(2-ethylhexyl)phthalate	6 (4)	2.43	3 (3)	1.38	--	--	--	--	--	--	--	--
Dimethylphthalate	--	--	3 (3)	0.29	--	--	--	--	--	--	--	--
Hexachlorobenzene	33 (32)	1.33	3 (3)	1.19	34 (34)	0.97	25 (21)	1.85	13 (11)	2.19	24 (22)	2.33
Hexachlorocyclopentadiene	6 (4)	2.41	--	--	--	--	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--	--	--	--	--	7 (5)	0.79

Notes:

Results shown are for chemicals with at least three samples and a frequency of detection of at least 60 percent.

Attachment 9D

20 February 2015 OU-1 Phase 1B Scoping Meeting Agenda

Environmental
Resources
Management

US MAGNESIUM – OU-1 PHASE 1B SCOPING MEETING AGENDA

11-12 March 2015
Salt Lake City Utah

1. RI Process Overview
2. RCRA Settlement Update
    a. Progress in developing plans for RCRA carve-out
    b. Figure illustrating facility changes under the settlement
3. Phase 1B DQOs
    a. Sample design for 95UCL
    b. Sample design for Preliminary N&E
    c. Key waste release areas/subsurface boring locations
    d. Biased/judgmental sample locations
    e. Review of historical aerial photographs
4. Groundwater/Surface water (PRI-17)
    a. Collection of Phase 1A samples in the Inner PRIs
    b. Completion of Hydrologic CSM
5. Technical Topic 1 - Background
    a. Role of Background in BRAs, i.e., discuss when/how data will be used in the HH and Eco RA
    b. Statistical evaluation of Phase 1A RI results
        – Identify COPCs associated with background (metals, D/F)
        – Present Q-Q plots to extract background datasets from Phase 1A data, geochemical correlation plots, etc.
    c. Other background dataset
        – Background metals results from UTTR-North, Region 8 (As only), and Paramatrix 2003 Focused ERA reference areas.
    d. Proposal for developing OU-1 background data
        – Extract background from Phase 1A Data (present preliminary evaluation)
6. Technical Topic 2 – Bulk vs. Fines Fractions Analysis
    a. Role of fines results in BRAs
    b. Phase 1A Outer PRIs Bulk vs. Fines Results
    c. Relevance to Phase 1B DQO
7. Technical Topic 3 – Laboratory Analytical Methods
    a. Outstanding issues from Phase 1A SAP associated with sampling in ditches/ponds
    b. LRMS Methods for PCB and D/F
8. Technical Topic 4 – Accessing Sampling Locations in Wastewater Ponds

    a. Potential methods for collecting samples in saturated areas of PRIs 5 and 6
    b. Sampling schedule constraints and considerations
        – Weather conditions
        – Surface water presence/elevation

9. **Next Steps & Action Items**

Attachment 9E

3 March 2015 EPA's Proposed Final Agenda for OU-1 Phase 1B Scoping Meeting

US MAGNESIUM – EPA/ERM FINAL SCOPING MEETING AGENDA
PHASE 1B INNER PRI AREAS & BACKGROUND INVESTIGATIONS
2015 INVESTIGATION ACTIVITIES

11-12 March 2015
UDEQ Offices, Salt Lake City, Utah

[ERM's proposed agenda items appear cross-referenced in brackets herein]

1. **RCRA Settlement Update [2.]**
   a. Progress and/or relevance of developing plans for RCRA carve-out [2.a.]
   b. Figure illustrating facility changes under the settlement [2.b.]
2. **RI Process Overview [1.]**
   a. Recap Inner PRI areas RI Progress & Scoping-Meetings (SM):
      - SM #1 Objective for Phase 1 Investigations: Identify COPCs and preliminary N&E of contamination (Nov '11 – April '12)
      - SM #2: ERM undertake DMA's; EPA develop Phase 1A SAP for COPC identification (14(+) samples per PRI area) (May '12 – June '13)
      - EPA deferred (Jul '13 – Dec '14) Inner-PRI Phase 1A SAP per ERM's stated intents to undertake 'all-chemicals' investigation & preliminary N&E of contamination in 2015
      - EPA agreed (Dec '14) to need for background investigation in 2015
      - ERM submitted DQO Framework (Feb '15); comparison of Inner PRIs plans-to-date: (Attachment 1)
        - ERM's SM #2 initial Phase 1 proposal (Oct '12)
        - EPA's post-SM #2 Phase 1A SAP (Sept '13)
        - ERM's Phase 1B proposal (Feb '15)
      - ERM committed in 2014 to achieve the Phase 1 objectives and complete BRA investigations by end-2016.
3. **Background Study [5.]**
   a. Role of Background in BRAs, i.e., discuss when/how data will be used in the HH and Eco RA [5.a.]
   b. Statistical evaluation of Phase 1A RI results [5.b.]
      - Identify COPCs associated with background (metals, D/F)
      - Present Q-Q' plots to extract background datasets from Phase 1A data, geochemical correlation plots, etc.
   c. Other background dataset [5.c.]
      - Background metals results from UTTR-North, Region 8 (As only), and Paramatrix 2003 Focused ERA reference areas.
   d. Proposal for developing OU-1 background data [5.d.]
      - Extract background from Phase 1A Data (present preliminary evaluation)
   e. Reference areas for BRA biological collection
4. **Phase 1B DQOs [3.] – Considerations for Site-Characterization and BRA Investigations**
   a. EPA will oversee final development and approval/issuance of Worksheet 11 (DQOs) for any SAP
   b. Define Terms: Clarify ERM's context and use of 'all-chemicals' and 'COPCs' in DQOs

5. **Step 1, State the Problem**
    a. Prepare separate DQOs for
        - Study Goal #1: Identify COPCs and EPCs (initial risk-estimation); and
        - Study Goal #2: Delineate preliminary N&E of contamination
6. **Step 2, Identify the Goals of the Study**
    a. Study Goal #1
        - Calculate reliable EPCs for contaminants in Inner PRI areas
        - With ‘all-chemicals’ considered to be ‘COPCs’ for Inner PRI areas, will EPCs be calculated for each/every chemical?
    b. Study Goal #2
        - Delineate nature and extent of contaminants for Inner PRI areas for site characterization and forward-planning of remedial scoping.
7. **Step 3, Identify Information Inputs**
    a. Study Goal #2

    Hydrology CSM for Site-Characterization [4.b.]: (essentially Inner PRIs areas of Sitewide PRI 17)
        - Surface waters: completion of Phase 1A data collection [4.a.] and subsequent COPC screen
        - Groundwater COPC screen from Phase 1A data
        - Identify data gaps for groundwater COPC N&E investigation
        - Propose approach/methods to evaluate groundwater migration

    Preliminary contaminant distribution
        - Initial priority-chemical mapping based on QA’d historic data-set
        - Supplemental sampling-plans to clarify areal extent and variability (Triad)
8. **Step 4, Define the Boundaries of the Study**
    a. Study Goal #2
        - From Phase 1A information, determine for PRI Areas 8 and 14 what portion of those areas should now become part of the “Inner” PRI areas investigation
        - Maximum depth of subsurface sample collection (refer to Phase 1A SAP, WS #14)
        - Temporal sampling of surface water
9. **Step 5, Develop the Analytic Approach**
    a. Study Goal #1:
        - Sample design (calculation) for 95UCL [3.a.] (Attachment 2)
    b. Study Goal #2:
        - Discuss how historic data (ERM June 2014) may be used in sampling design for N&E mapping
        - Discuss approaches to preliminary N&E investigation [3.b.] (follow-up scoping meeting)
10. **Step 6, Specify Performance or Acceptance Criteria**
    a. Establish ‘acceptance’ outcomes.

11. **Step 7, Develop the Plan for Obtaining the Data**
    a. Study Goal #1
        - Sample design for 95UCL [3.a.]
        - Will COPC/EPCs be based solely on surface (0-6 inch) data?
        - Key waste release areas/subsurface boring locations [3.c.]
        - Biased/judgmental sample locations [3.d.]

    b. Study Goal #2
        - Key waste release areas/subsurface boring locations [3.c.]
        - Biased/judgmental sample locations [3.d.]
        - Utilize Triad for priority-contaminant mapping

    c. Data Collection and Analysis Considerations
        - Reconciling laboratory analytical method issues
            - DMA ditches/ponds samples [7.a.]
            - Phase 1A SAP surface water samples (low pH, stabilization and preservation) [7.a.]
        - LRMS Methods for PCB and D/F [7.b.] (Attachment 3)
        - Potential methods for collecting samples in saturated areas of PRIs 5, 6, 7, 8 and 14 [8.a.]
        - Wastewater pond sampling schedule constraints and considerations [8.b.]
            - Weather conditions
            - Surface water presence/elevation
        - Bulk vs. Fines Fractions Analysis [6.]
            - Relevance to Phase 1B DQO [6.c.]
            - Role of fines results in BRAs [6.a.]
            - Phase 1A Outer PRI areas Bulk vs. Fines Results [6.b.]
12. **ERM's plan for completing the Phase 1B DQO prior to Phase 2 (BRA final data-details) investigation in 2016**
13. **Delineation of Phase 1B Inner PRIs investigation area (defined on a map)**
14. **Next Steps & Action Items [9.]**

LIST OF ATTACHMENTS

Attachment 1: Inner PRI Areas Plans Comparison

Attachment 2: Comparison of Sample Size Estimates

Attachment 3: LMRS DMA TM: EPA comments (11 April 2014) and ERM response to comments (16 May 2014)

EPA Attachment 1

for
Inner-PRI Ph1B
Scoping Meeting

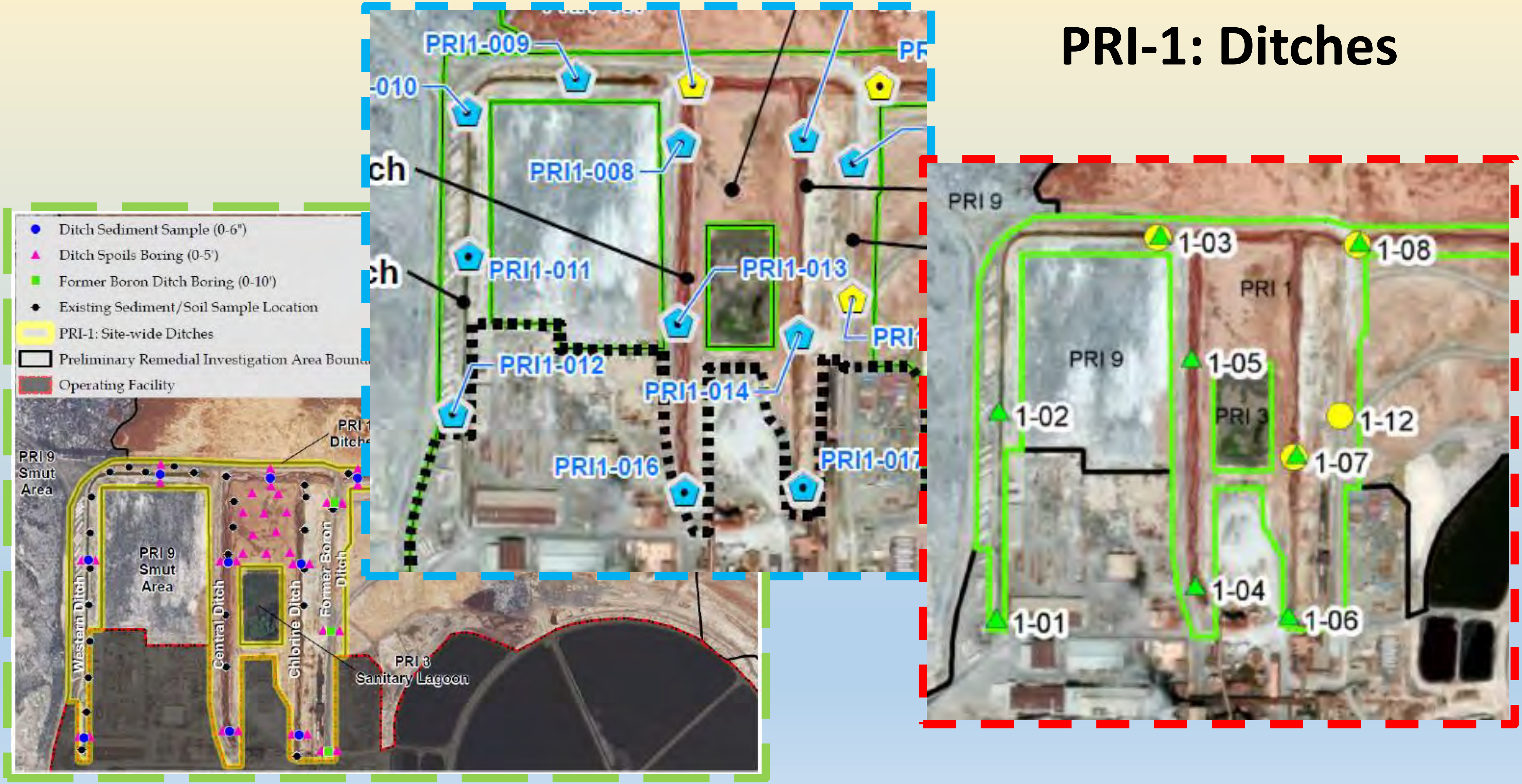
Development of Inner PRI Plans

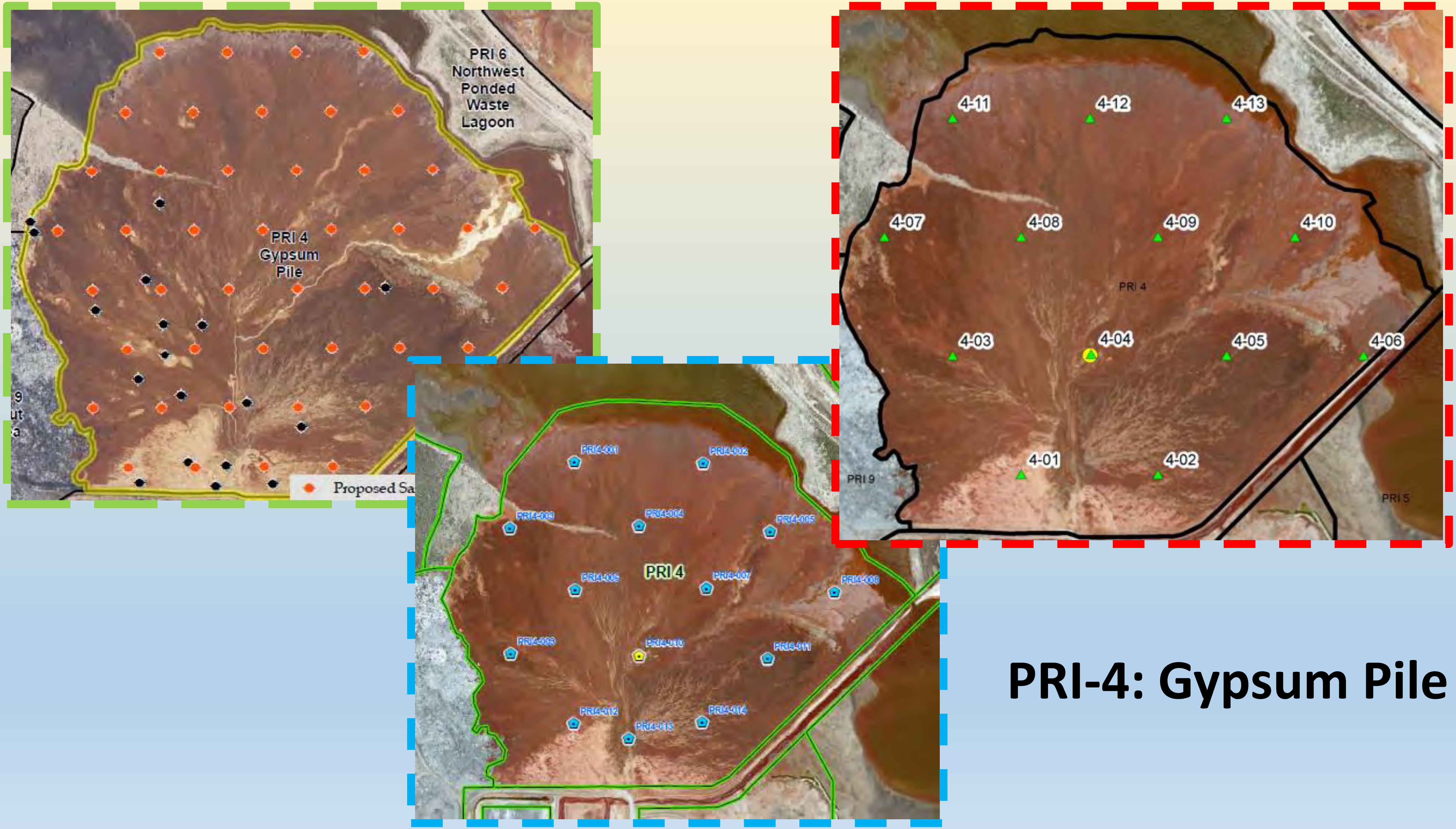
EPA Ph1A SAP: to identify COPCs (ERM's preference per Scoping Meeting #2)
September 2013

ERM Original Plan for Phase 1: COPCs & Prelim. N-&-E
October 2012

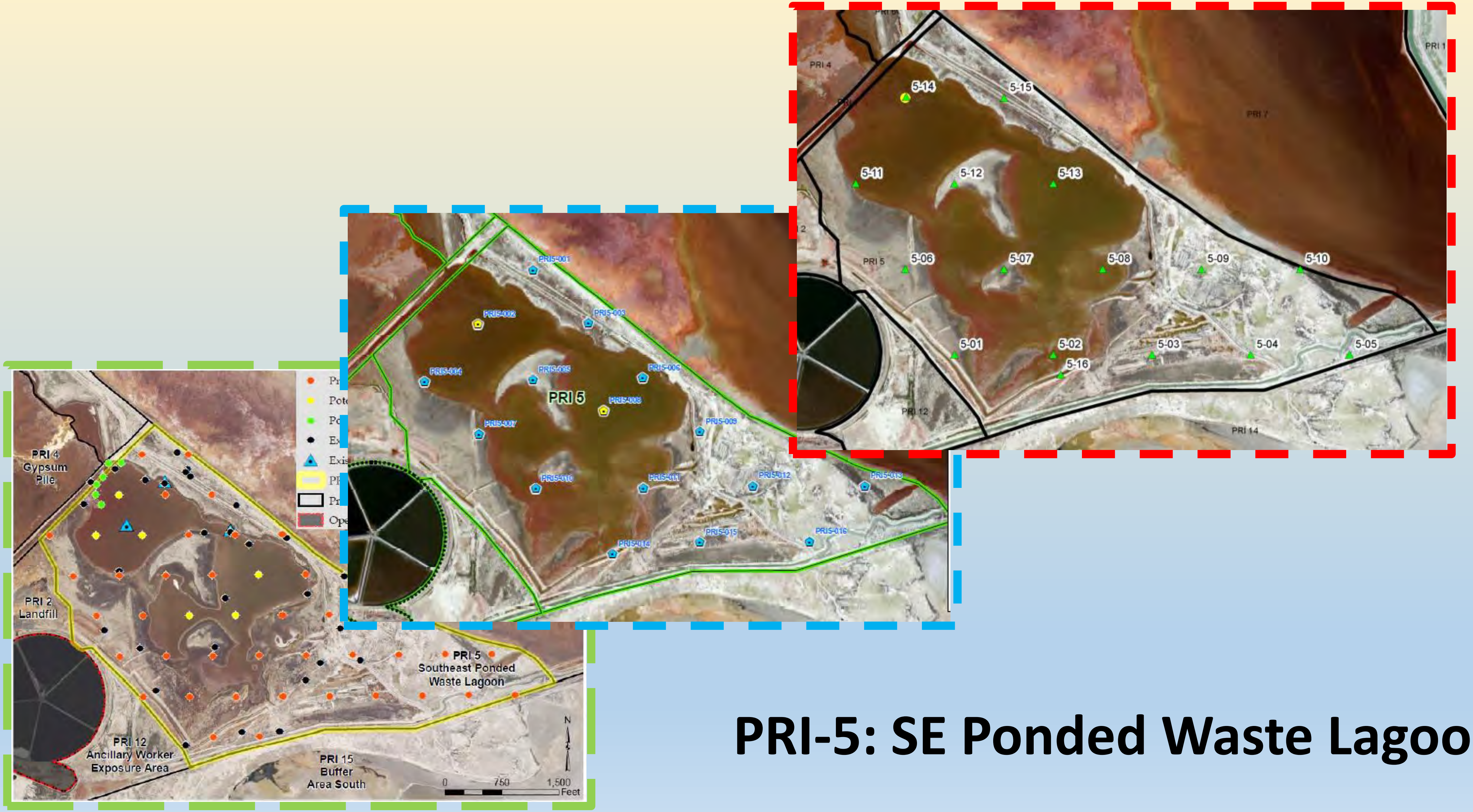
ERM 'New' Ph1B Proposal: Less COPC sampling and No N-&-E investig's
February 2015

PRI-1: Ditches



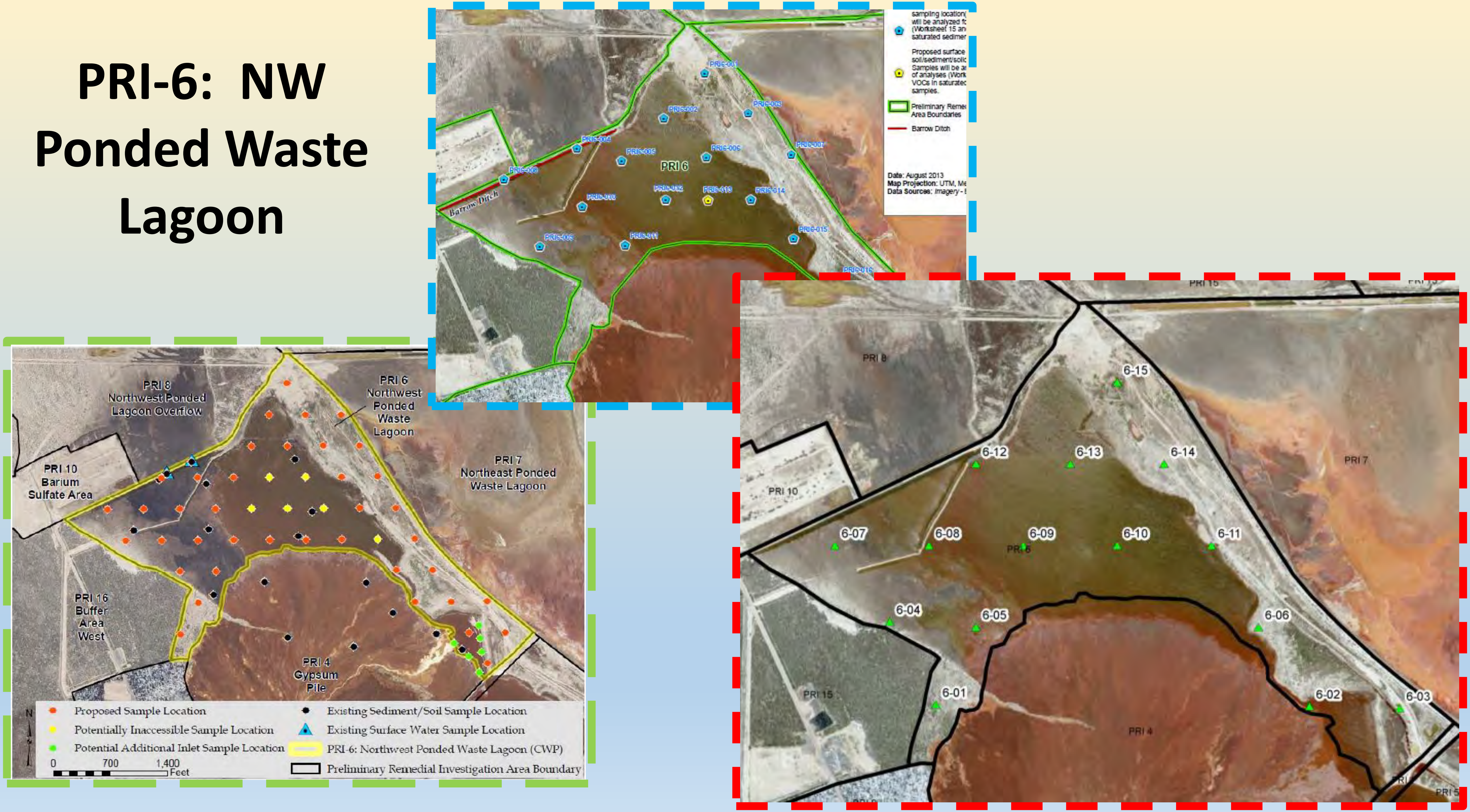


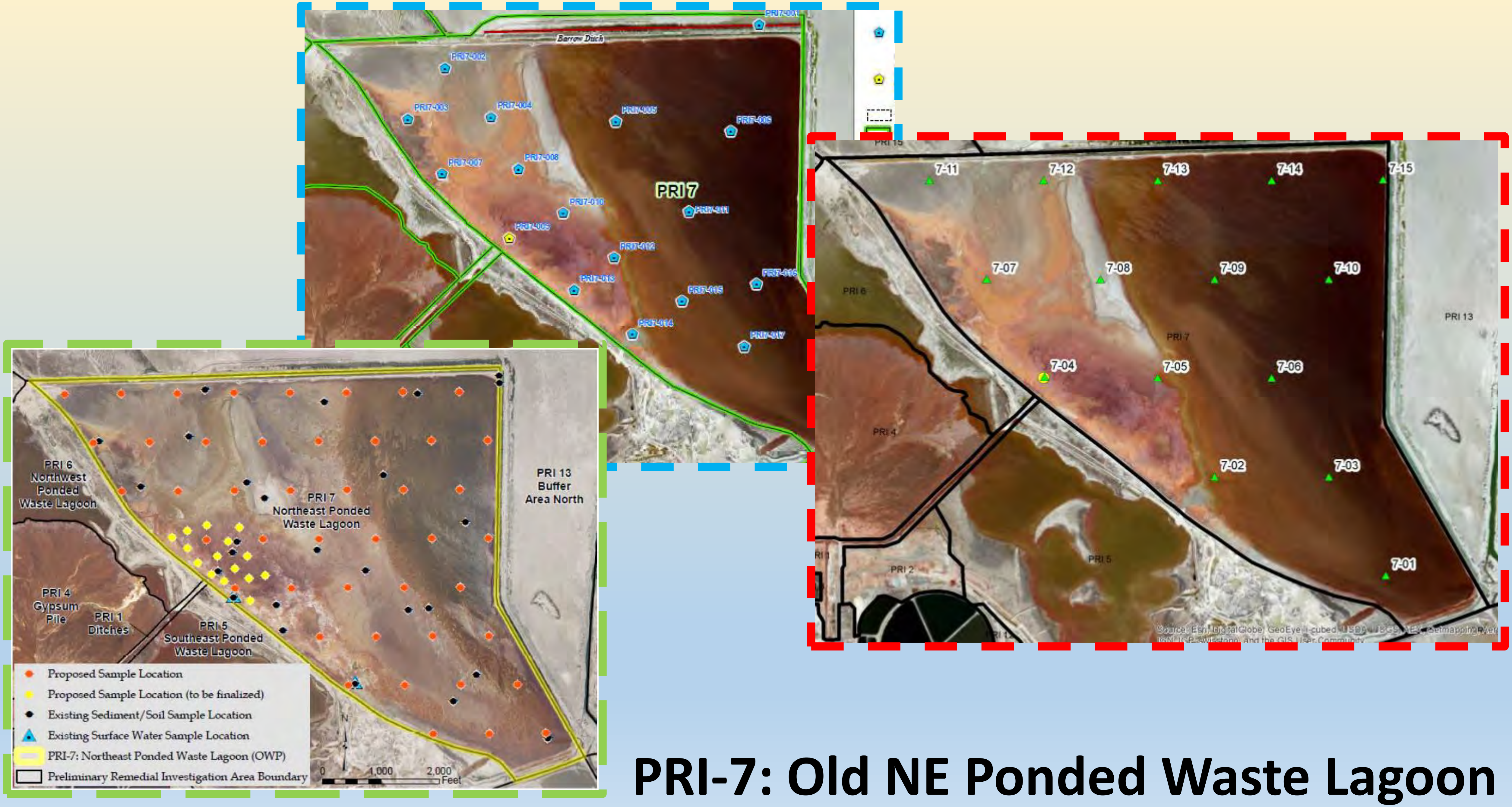
PRI-4: Gypsum Pile



PRI-5: SE Ponded Waste Lagoon

PRI-6: NW Ponded Waste Lagoon





PRI-7: Old NE Ponded Waste Lagoon

EPA - ATTACHMENT 2
COMPARISON OF SAMPLE SIZE ESTIMATES

Type	Distribution	Method	Goal	CV (= stdev / mean)						Notes
				1.0	**1.5**	**2.0**	**2.5**	**3.0**	**4.0**	
Grab	Normal	ERM	"Diminishing return"	9	11	13	15	16	19	a,b
		ERM Fig 11-2	MOE for N in yellow	62%	82%	99%	114%	132%	159%	
		ERM Fig 11-2	MOE = 50%	13	27	46	70	100	177	
		VSP	20% FP at RBC/2	8	16	27	40	57	101	a
	Skewed	VSP	20% FP at RBC/2	14	25	43	64	91	159	c
		+20% extra	20% FP at RBC/2	17	32	52	77	110	191	d
	Lognormal	MC sim	20% FP at RBC/2	20	38	54	72	87	116	e
		COPC calc	Cmax > mean	8	9	10	11	12	14	f
5 pt Comp.	Lognormal	MC sim	20% FP at RBC/2	7	10	13	17	20	26	g

Notes

a. Authentic data sets are almost never normal. Very likely to underestimate N.
b. Not based on goal of controlling FP error rate. Does not consider random sampling variation.
c. Based on UCL of median, not mean. Biased low.
d. Adding 20% helps account for use of median
e. Assuming lognormal will rarely underestimate N.
f. COPC N = ln(0.05) / ln(ptile of mean)
g. Use of compositing can reduce sample number a lot, depending on spatial patterns.

Basic Principles

a. Underestimating N results in increased uncertainty, increased chances of FP decisions, and likely increased cleanup cost
b. Calcs above do not consider relation of mean to RBC. Decreased sample size can be used if mean << RBC or >= RBC

Optimum Approach

a.. Use VSP assuming skewed data set with 20% margin
b. Use compositing (*optimum scheme TBD*)
c. Consider ratio of mean to RBC, at least for main risk drivers

EPA COMMENTS ON THE
DRAFT DEMONSTRATION OF METHOD APPLICABILITY
FOR LOW-RESOLUTION MASS SPECTROMETRY ANALYSES OF SOLIDS
TECHNICAL MEMORANDUM
(ERM Document date: 12 March 2014)
US MAGNESIUM NPL SITE, TOOELE COUNTY, UTAH

April 11, 2014

Introduction

After considering results of the October 2012, Demonstration of Methods Applicability (DMA) study of significantly contaminated media within Operable Unit (OU) 1 (inner-PRIs) of the US Magnesium site (Site), Rowley, Utah, Environmental Resources Management (ERM) proposed that modified analytical methods could be utilized within the highly-contaminated PRIs of the Site which would be: a) substantially less-costly; and b) provide data of sufficient precision and accuracy for site-characterization and risk assessment. Questions remained about whether the *modified* procedures for Method 680 [for polychlorinated biphenyls (PCBs)] and Method 8280 (for dioxins/furans) could attain the analytical precision and accuracy that may be needed for risk assessment to address low-threshold target quantitation limits (TQLs) and toxicity equivalence factors (TEFs). ERM developed, and the US Environmental Protection Agency (EPA) approved in July 2013, an amended DMA Work Plan to address these questions.

The following comments are provided by the EPA in response to the draft DMA for Low-Resolution Mass Spectrometry (LRMS) Analyses of Solids Technical Memorandum (TM) prepared by ERM, submitted to the EPA March 14, 2014. The LRMS TM discusses the results of an assessment of the use of a *Modified* Method 680 for analyzing PCBs and Method 8280 for dioxins/furans at the Site. ERM is proposing the potential use of low resolution methods in OU1 at the Site where PCBs and dioxins/furans occur at high concentrations.

General Comment

The LRMS DMA provides sufficient data on method performance to conclude that the uncertainties and potential biases in data generated by either LRMS method are usually too great to be useful for most risk assessment purposes. However, in certain circumstances, the data from the LRMS methods might be suitable for use, subject to the following conditions:

- Existing data are not sufficient to support reliable risk management decision-making and new data are needed.
- The levels of PCBs and/or dioxins/furans are expected to be well above (e.g., 100-fold or more) the applicable risk-based thresholds (either human and/or ecological). Such samples are expected to occur primarily within OU1, but may not include all samples from all areas of OU1.
- In the case of any sample that was expected to contain high contaminant concentration levels, but in fact is found to have levels that are at or below the useful detection range of the LRSM methods, the sample shall be reanalyzed by more sensitive and accurate methods (if needed for risk assessment and decision-making purposes).
- The useful detection range of the LRMS methods cannot be defined with certainty at present, because final risk-based concentrations (RBCs) cannot yet be specified for either human or ecological receptors. However, once these final RBCs are established, the useful detection range of the LRMS methods will likely comprise concentrations that are well above the RBC (e.g., a factor of 100-fold or more). In this event, the magnitude of the potential errors or biases in the data would likely not create

sufficient uncertainty to prohibit reliable risk management decision-making. Conversely, as concentrations approach or fall below final RBC values, the potential errors or biases in the data are likely to be too great to allow reliable risk assessment and risk management decision-making, and re-analysis of such samples by methods with greater accuracy and sensitivity are likely to be required.

Revisions to the Draft Technical memo

EPA recommends the following changes to the March 12, 2014, draft of the LRMS TM.

1. Nomenclature

The *Modified* Method 680 is referred to as Method 8270 or Method 608 throughout the validation summaries and Method 680 in the body of the text. The standard operating protocols for the laboratory references Methods 8081B, 8082A, 8270D, and 680. To refer to this hybrid *Modified* Method 680 simply as Method 680 is confusing. Please refer to the low resolution PCB method in a consistent fashion, such as "*Modified* Method 680".

2. Stratification of Results by Method

In several places (e.g., the data table at the bottom of page 6 and in Figure 1), metrics of performance from *Modified* Method 680 and Method 8280 are combined. It is more useful to present information on method performance stratified according to method.

3. Data Comparability

It would be helpful if the data summary included more discussion and summary statistics on the direction and magnitude of differences between paired high-resolution mass spectrometry (HRMS) and LRMS data. Based on an initial inspection, the EPA notes that PCBs and dioxins/furans using low resolution methods tended to be biased high, with some notable exceptions for less chlorinated congeners. This information will be valuable in making determinations as to when the LRMS data fall into the "unacceptable uncertainty" range.

Likewise, some expanded discussion and summary statics on precision (as judged by relative percent differences) would be helpful. Although this information can be derived from Figure 1, a tabular format would facilitate the evaluation and interpretation of these data.

4. Limitations of Use

The text of the LRMS TM (Section 5, bullet 5) should be modified to clearly state the circumstances in which data from LRMS methods may be considered acceptable for risk assessment and risk-management decision-making (as discussed above).

5. QC Data

Salient quality control (QC) results should be summarized in the LRMS TM and used to support any conclusions presented. For example matrix spike/matrix spike duplicate results, internal standard, recovery standards, surrogate recoveries, and performance evaluation sample results should be discussed.

6. Regression vs Correlation

On page 7, the LRMS TM discusses regression analysis as one way to evaluate the performance of two methods. However, what is presented is simply a correlation analysis. The EPA agrees with ERM's opinion stated in footnote 2 that regression analysis is not needed here, and that the results of the correlation analysis are adequate. However, the nomenclature should be corrected.

Environmental
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ERM

DRAFT 16 May 2014

Via Electronic Mail

Mr. Ken Wangerud
Remedial Project Manager
Superfund Remedial Program
USEPA Region 8 – EPR-SR
1595 Wynkoop Street
Denver, CO 80202-1129

Subject: Response to USEPA Comments on Draft Demonstration of Method Applicability for Low-Resolution Mass Spectrometry Analyses of Solids Technical Memorandum, March 2014

Dear Mr. Wangerud:

The Draft Demonstration of Method Applicability (DMA) for Low-Resolution Mass Spectrometry (LRMS) Analyses of Solids Technical Memorandum (Tech Memo) was submitted via email to the United States Environmental Protection Agency (USEPA) on 12 March 2014. USEPA comments on the Draft Inner PRI Data Report were received on 11 April 2014. This letter presents ERM-West, Inc.'s (ERM's) responses to USEPA's comments on the Draft LRMS DMA Tech Memo.

Response to USEPA's General Comment

ERM agrees with EPA that the LRMS analytical methods may produce definitive data, depending on the data quality objectives (DQOs) for the specific investigation. However, we feel that it is not appropriate to select criteria for analytical method performance prior to development of DQOs. The working ranges of the LRMS methods are known, these methods have been demonstrated to perform satisfactorily for solid-matrix samples from the Site, and the data quality indicators (DQIs) of precision and accuracy have been shown to meet measurement performance criteria that are consistent or identical to HRMS methods.

The usability of LRMS methods is therefore not limited by "uncertainties and potential biases" of the analytical data; these methods simply have higher detection limits and quantitation limits than the HRMS analogs. Consistent with the Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP) guidance, the DQI of Accuracy/Bias was evaluated in the LRMS DMA through LCS (both methods), surrogate spikes (both methods), matrix spikes (Method 8280), and PE samples (both methods). The LRMS DMA has demonstrated that the LRMS methods may performed on Site samples while meeting quality control criteria for accuracy/bias and precision; therefore, the LRMS methods have been shown to produce definitive data of know precision and accuracy.

Therefore ERM strongly disagrees with USEPA's determination that the data generated by either LRMS method are not useful for most risk assessment purposes. A determination of data usability can only be made relative to the DQO for which the data are collected.

It appears that the USEPA has misinterpreted the objective of the LRMS DMA and ERM's recommendations in the Tech Memo. ERM has not proposed the whole scale replacement of high-resolution mass spectrometry (HRMS) methods by LRMS methods, nor has a specific application of the LRMS methods to future investigation phases been proposed. The Recommendations section of the Tech Memo states:

> "Based on the above conclusions, ERM recommends that the subject LRMS analytical methods be considered suitable candidates during subsequent investigations at the Site, depending on the specific Data Quality Objectives of the investigation. ERM recognizes any method used for analyzing site samples collected under a Sampling and Analysis Plan would first require approval by the USEPA per Section IX of the AOC."

This recommendation is consistent with the primary purpose for the LRMS DMA. The 15 November 2013 ERM letter "Revised DMA Work Plan Addendum for Method 680 and 8280 and ERM/US Magnesium Response to USEPA/PWT3 Technical Comments on the DMA Work Plan Addendum for Method 680 and 8280 Received 29 October 2013"stated:

> "From its onset, the LRMS DMA was proposed as an initial screen whereby site samples would be analyzed by these

standard laboratory methods as a step in determining whether these methods may be suitable for use during subsequent investigations at the Site."

Responses to USEPA Recommended Revisions to the Draft Technical Memo

Each of the USEPA recommended revisions is provided below in italic font, followed by ERM's response. As explained in the responses below, no revisions to the Tech Memo are warranted based on the comments received from USEPA. If there are supporting evaluations or data interpretation guidance documents that provided the basis for the recommended revisions but were not included or cited in the USEPA comment letter, ERM respectfully requests that USEPA provide these to ERM to help gain a better understanding of USEPA's concerns.

1. *Nomenclature - The Modified Method 680 is referred to as Method 8270 or Method 608 throughout the validation summaries and Method 680 in the body of the text. The standard operating protocols for the laboratory references Methods 8081B, 8082A, 8270D, and 680. To refer to this hybrid Modified Method 680 simply as Method 680 is confusing. Please refer to the low resolution PCB method in a consistent fashion, such as "Modified Method 680".*

   ERM Response: In the future, the LRMS PCB method will be referred to as "Modified Method 680."

2. *Stratification of Results by Method - In several places (e.g., the data table at the bottom of page 6 and in Figure 1), metrics of performance from Modified Method 680 and Method 8280 are combined. It is more useful to present information on method performance stratified according to method.*

   ERM Response: The points plotted in Figure 1 are stratified by method already. Dioxin/Furan points (Method 8280A) are shown by blue diamonds, while points corresponding to Total PCBs, PCB Homolog Totals, and PCB Congeners by Modified Method 680 are show using different symbols and colors. The stratification of metrics of performance for the inter-method comparison of LRMS and HRMS results is provided below; however, the comparability between LRMS and HRMS methods was similar for PCBs and D/F.

Scenario	Inter-Method Comparison Measurement Performance Criteria (MPC)	Number of Paired LRMS/HRMS Results		
		Scenario Total	Meet MPC	Do Not Meet MPC
1. Both Results > 5X QL	RPD < 50	89 Total 79 PCB 10 D/F	44 Total 39 PCB 5 D/F	45 Total 40 PCB 5 D/F
2. Both Results > QL, One or Both < 5X QL	± 2X Max QL	33 Total 18 PCB 15 D/F	27 Total 14 PCB 13 D/F	6 Total 4 PCB 2 D/F
3. Both Results ND	Both Results ND	30 Total 24 PCB 6 D/F	30 Total 24 PCB 6 D/F	0 Total 0 PCB 0 D/F
4. Both Results Det < QL	Both Results Det < QL	5 Total 0 PCB 5 D/F	5 Total 0 PCB 5 D/F	0 Total 0 PCB 0 D/F
5. All Other Combinations	None	163 Total 63 PCB 100 D/F	--	--

3. *Data Comparability - It would be helpful if the data summary included more discussion and summary statistics on the direction and magnitude of differences between paired high-resolution mass spectrometry (HRMS) and LRMS data. Based on an initial inspection, the EPA notes that PCBs and dioxins/furans using low resolution methods tended to be biased high, with some notable exceptions for less chlorinated congeners. This information will be valuable in making determinations as to when the LRMS data fall into the "unacceptable uncertainty" range.*

Likewise, some expanded discussion and summary statics on precision (as judged by relative percent differences) would be helpful. Although this information can be derived from Figure 1, a tabular format would facilitate the evaluation and interpretation of these data.

ERM Response: It is the opinion of ERM that USEPA is being over-reliant on the comparison of results between HRMS and LRMS methods. The HRMS methods struggled to accommodate the high concentrations and severe matrices of some Phase 1A

DMA samples, and as a result there were some quality control limitations associated with the HRMS data (for example, large dilutions were required for HRMS methods that resulted in the "diluting-out" of surrogates and/or internal standards). A more rigorous evaluation of differences between HRMS and LRMS results is not necessary to identify the "uncertainty" ranges for the LRMS methods. As with any other analytical method, the LRMS methods have method detection limits (DLs) and quantitation limits (QLs) that define the concentration levels at which analytes can be differentiated from noise (the DL) and at which a concentration can be reliably measured within specified limits of precision and accuracy (the QL).

The calculated RPDs for all paired sample results where both results were detected at concentrations greater than the QL are presented in Table 3 of the Tech Memo. As stated in the Tech Memo, the comparison between split samples analyzed by different methods provides little value, because if the results do not agree then it is not certain which value is more accurate, and the USEPA has identified that acceptance criteria are not available for differences between analytical methods. For these reasons, expanded discussion about RPDs between HRMS and LRMS methods would not contribute to the demonstration that LRMS methods produce definitive data of know accuracy and precision.

4. *Limitations of Use - The text of the LRMS TM (Section 5, bullet 5) should be modified to clearly state the circumstances in which data from LRMS methods may be considered acceptable for risk assessment and risk-management decision-making (as discussed above).*

   ERM Response: As stated above in ERM's response to USEPA's General Comment, it would be premature to identify when the LRMS methods would or would not be acceptable prior to developing the DQOs for the specific investigation phase.

5. *QC Data - Salient quality control (QC) results should be summarized in the LRMS TM and used to support any conclusions presented. For example matrix spike/matrix spike duplicate results, internal standard, recovery standards, surrogate recoveries, and performance evaluation sample results should be discussed.*

ERM Response: Salient quality control results are already summarized in the data validation reports (included as Attachment 2 of the Tech Memo) and the Performance Evaluation Sample Scoring Report (included as Attachment 3). Surrogate and/or internal standard recoveries are discussed in Section 4.2 of the Tech memo and PE sample results are discussed in Section 4.1. Please provide specific questions about the QC data included in the Tech memo, so ERM can prepare specific responses as appropriate.

6. *Regression vs Correlation - On page 7, the LRMS TM discusses regression analysis as one way to evaluate the performance of two methods. However, what is presented is simply a correlation analysis. The EPA agrees with ERM's opinion stated in footnote 2 that regression analysis is not needed here, and that the results of the correlation analysis are adequate. However, the nomenclature should be corrected.*

ERM Response: The r^2 values presented in the Tech Memo were calculated from least-squares linear regression analyses, not a correlation analyses. The coefficient of determination, or "r^2," is practically interpreted to be a measure of the goodness of fit for a statistical model (such as a linear regression) and may range from 0 to 1. The coefficient of determination presented in the Tech Memo is different than the Pearson product-moment correlation coefficient, also referred to as the "correlation coefficient" or "r," presumably referred to in the comment, which is computed from a correlation analysis to quantify the degree to which two variables are related, and may range from -1 to +1. The text of the Tech Memo is therefore correct as written.

If you have any questions, please contact me at (480) 998-2401, or Kevin Lundmark at (801) 595-8400.

Sincerely,

David J. Abranovic, P.E.
Project Coordinator (ERM)

DJA/jcb/0132320
Attachments

cc: David Gibby (US Mag)

Attachment 9F

17 March 2015 Scoping Meeting for DQOs Addressing 2015 Inner-PRI Investigations

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8
1595 Wynkoop Street
Denver, CO 80202-1129
Phone 800-227-8917
www.epa.gov/region8

Via electronic mail

March 17, 2015

Ref: 8EPR-SR

Mr. David Abranovic, P.E.
Environmental Resources Management West, Inc.
7272 E. Indian School Road, Suite 100
Scottsdale, AZ 85251

Re: Scoping Meeting for DQOs Addressing 2015 Inner-PRI Investigations,
US Magnesium Superfund Site

Dear Mr. Abranovic:

Thank you for meeting with the EPA and Utah Department of Environmental Quality (the Agencies) to discuss ERM's draft Data Quality Objectives (DQO) document, which was submitted to the EPA on February 20, 2015. The DQO addressed the initial investigation and characterization of the Inner-PRIs, as well as development of a background study for the site. As the EPA stated in the meeting, the Agencies believe the DQO document is incomplete and presents significant issues. Nonetheless, our discussions during the meeting helped the Agencies better understand some of ERM's proposed approaches, and we hope that questions and comments from Agency staff helped ERM recognize and better understand some of our concerns.

Based on our understanding at the end of the meeting, the Agencies have prepared a short list of comments we feel are most important for ERM to consider as you revise the initial draft DQO document for the Inner PRIs. These comments are provided as Enclosure 1 to this letter.

With the benefit of the scoping meeting discussions and the enclosed Agencies' comments, ERM shall modify and resubmit a new DQO document for detailed Agency review. Under Section 39(d) of the August 4, 2011 Administrative Order on Consent, ERM has an opportunity to cure the DQO deficiencies within twenty (20) days of receipt of this letter (April 6, 2015, per AOC Section 10.b). The EPA and UDEQ will then complete a review of the submittal in accordance with Section 39(a), (b), (c) or (e).

The EPA recognizes that certain details pertinent to finalizing Step 7 of the DQO document may require additional discussion of data-collection and analysis considerations. Some of these points were discussed during the meeting (e.g., bulk-fines evaluation, lab-analyses issues, LRMS methods for PCB and D/F analysis), for which ERM presented explanatory overhead-materials. These additional materials raised points that will need to be resolved before final DQOs and a Sampling and Analysis Plan can be approved. Please include the overhead materials in your meeting outcome notes.

The following additional activities concerning the 2015 site investigations and SAP development appeared on the meeting agenda and will need to be addressed in the re-submitted DQO and final SOPs:

- Developing a SOP to obtain the 6-inch sediment samples within the lagoons. ERM needs to immediately prepare a tech-memo addressing the testing of a sampling device that ERM intends to deploy from a helicopter for health and safety considerations. ERM's tech-memo should include a testing-schedule that can ensure the SOP for this sample-collection effort will be finalized by July 1, 2015.

- In addition to the DQO for the background study, it was agreed that completing the groundwater and surface water aspects of the site hydrologic conceptual model are a necessary aspect of site characterization and background considerations.

I look forward to receiving ERM's scoping meeting outcome-notes, the re-drafted DQO document, and ERM's schedule for addressing the Sediment Sampling SOP and Hydrologic-CSM completion.

Sincerely,

Ken Wangerud

Ken Wangerud
Remedial Project Manager
Superfund Remedial Program

Enclosure 1: Agency Comments

cc: David Gibby, US Magnesium
Michael Storck, UDEQ-DERR

CONSOLIDATED AGENCY COMMENTS ON ERM DOCUMENT
"Data Quality Objectives Framework OU-1 Phase 1B RI"
Dated February 20, 2015

NOTE: These comments on the draft Phase 1B DQO document reflect discussions and clarifications reached during scoping meetings held in Salt Lake City on March 11-12, and reflect the main changes that the Agencies feel are necessary to ensure that the revised DQO document is in accord with the discussions at the meetings. EPA reserves the right to provide additional comments on the revised draft of the DQO document.

Major Comments

1. The DQO document uses an inconsistent and confusing nomenclature, often misusing the term "COPC." For example, stating that samples will be analyzed for COPCs is incorrect, because contaminants of potential concern have not yet been selected. The DQO document should be re-written to clearly state that all samples collected in Phase 1B will be analyzed for the full list of chemicals provided in Worksheet #15 of the Phase 1A SAP. The list of COPCs for the inner PRIs will be determined based on the results obtained from the samples collected during the Phase 1B program.

2. As written, the DQO document implies that data sets of size 10-15 will provide UCL values that will be adequate. This is not correct, and the text must be revised to clarify that UCL values calculated from the data sets of this size MAY OR MAY NOT be adequate for well-informed risk management decision making. Accordingly, the goals of the DQO presented in Table 11-2 should be revised as follows:

   Obtain sufficient data to allow for:
   - reliable identification of COPCs (human and ecological) in each PRI
   - calculation of 95% UCL values to support an initial assessment of human and ecological risks
   - initial characterization of the nature and extent of site-related contamination

   Do not use a phrase such as "reliable" or "acceptable" UCLs. All 95% UCLs (if calculated correctly) are reliable and acceptable, in that they identify a value that has a 95% probability of exceeding the true mean. Whether any specific UCL value is adequate for well-informed risk-based decision-making can only be determined by performing the initial risk calculations and identifying cases in which the risk conclusion based on the UCL is substantially different from the conclusion based on the sample mean. In the absence of this process, the only way to ensure that UCLs are adequate for decision making is to substantially increase the number of samples collected.

Accordingly, and in accord with discussions at the scoping meetings, the sample size for each PRI should be revised to be a minimum of 14. The statistical justification for this sample size should be revised to reflect the original COPC-based statistical assessment used in the Phase 1A SAP, rather than an assessment of cost effectiveness ("diminishing return" in the margin of error (MOE) between the UCL and the sample mean).

While not required, the DQO may also include an evaluation of the expected MOE between the UCL and the sample mean for data sets of size 14, as a function of the expected range of CVs. If presented, this should be based on an assumption that most data sets will be skewed rather than normal. This is necessary because the historic data clearly demonstrate that nearly all data sets from the inner PRIs are skewed, and many are well-approximated by a lognormal distribution. A simple calculation of the expected MOE is not sufficient, because this ignores the fact that both the sample mean and the sample standard deviation are random variables, and hence the MOE is also a random variable. For example, if the true distribution is assumed to be lognormal with a mean of 100 and a standard deviation of 250 (CV = 2.5), the expected MOE is 2.94. However, if sampling variability is accounted for, the actual distribution of MOE values is as shown in Figure 1. As seen, actual MOE values may be much higher than the expected value. The rate of false positive decision errors is also quite high for any COPC with a true mean greater than 0.1 times the RBC, as shown below:

Mean/RBC	False Positive Rate
0.1	16%
0.2	37%
0.3	54%
0.4	66%
0.5	75%
0.6	82%

These calculations demonstrate and emphasize why data sets of size 14 may or may not be adequate to support reliable risk management decision making, depending on the actual ratio of the mean to the RBC and of the actual standard deviation.

3. The revised DQO document should include an independent 7-step DQO for a background study of selected COPCs in soil. The goal of the study should be to identify one or more upland and wetland habitat locations that are suitable for characterization of abiotic and biotic concentration values of naturally-occurring or ubiquitous anthropogenic chemicals that would be expected at the site in the absence of site-related contamination. The DQOs should include a clear presentation of the null hypothesis (site > bkg), the statistical approach that will be used to test the null hypothesis, and a demonstration that the sample size selected will be sufficient to minimize the risk of decision errors. EPA recommends that the guidance provided in EPA (2002) be followed. EPA expects that it should be possible to complete the

text of DQO Steps 1-6 based on the discussions at the meeting. While Step 7 cannot present final decisions about sampling locations, the text of Step 7 should discuss how suitable candidate locations will identified and evaluated.

Also note that a background study of water (surface water and groundwater) is also needed. EPA has agreed to provide initial thoughts on the DQOs and design of such a study during one or more calls between the EPA and ERM toxicologists and during upcoming risk assessor's conference calls. A background water study should proceed according to a timeline that informs Phase 2 collection of data in 2016 but implementation schedules are still being contemplated.

Minor Comments

1. Page 3, middle paragraph. Use of the maximum value or the 95%UCL (whichever is lower) as the EPC is no longer Agency policy. Selection of EPC values must follow current EPA recommendations (see Section 1.10.2 of ProUCL Version 5.0.00 Technical Guide).
2. Page 3, last full paragraph. The following sentence is incorrect: "The existing set of historical (pre-CERCLA) Inner PRI data have been judged by USEPA as not adequate for use in risk assessments, including selection of COPCs and calculating 95UCLs." While EPA has determined that the historic data (alone) cannot be used for COPC selection or UCL calculations, EPA has stated that, if historic data are found to be sufficiently statistically similar to data collected in Phase 1B, it may be appropriate to combine the data to increase sample size and decrease uncertainty. If so, then the historic data may be included in the data set used for COPC selection and risk assessment.
3. Page 6, Section 11.3.2. When discussing the use of the LRMS method, include a brief description (presumably detailed in the SOP) that summarizes when the method is expected to be appropriate, and the triggers for re-analysis by HRMS (if needed). As per discussions during the scoping meeting, criteria for reanalysis should be based on reliable quantification of risk drivers, not high concentration low toxicity analytes. Refer to EPA's letter of April 11, 2014, for EPA's recommendations.
4. Page 8, Section 11.6. The use of the word "precision" to characterize the relation between a sample mean and the 95% UCL of the sample mean is not correct. Precision is a measure of the reproducibility between repeat analyses, while the relation between UCL and sample mean is a measure of uncertainty. The document should be revised to use the term "uncertainty" rather than "precision" to describe this relation.

SUPPLEMENTAL COMMENTS ON THE PHASE 1A/B SAP AND ASSOCIATED SOPS

Although the following comments are not specifically relevant to the draft DQO submitted by ERM, these comments are relevant to the Phase 1A/B SAP and associated SOPs that will be required to achieve the DQOs.

1. When sampling sediment from water-covered locations in the lagoons, every effort must be made to ensure that samples will be obtained from the target locations. Moving a sample to a location that is accessible from the shoreline requires EPA approval.

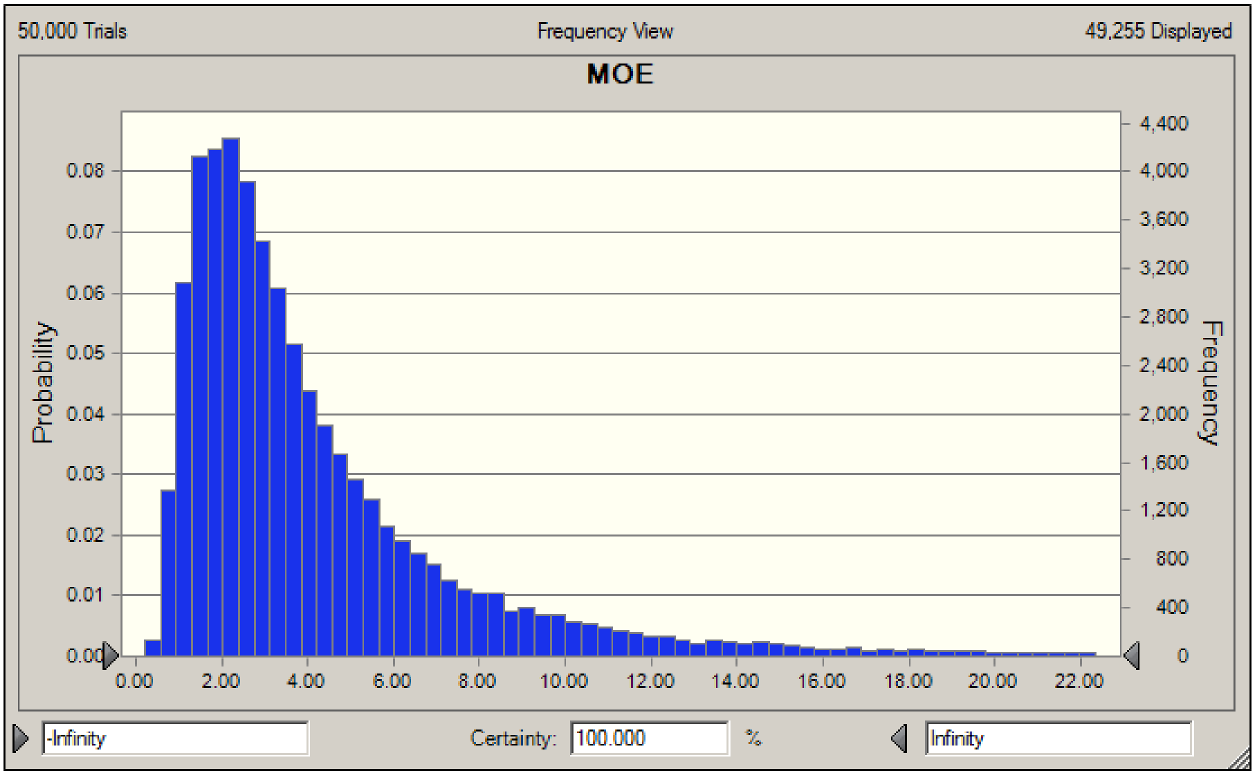
2. The SAP for this project must establish a schedule that will ensure that all samples specified in the DQOs for both the inner PRI study and the background study for soil and water (if appropriate) will be collected, analyzed, and validated in time to allow thoughtful assessment of the data in order to inform the requirements on any Phase 2 sampling or studies that may be required in 2016.

CITATIONS

EPA. 2002. Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response. 540-R-01-003, OSWER 9285.7-41. September 2002.

ProUCL Version 5.0.00 Technical Guide
http://www.epa.gov/osp/hstl/tsc/ProUCL_v5.0_tech.pdf

FIGURE 1
DISTRIBUTION OF MOE VALUES FOR DATA SETS OF SIZE 14
DRAWN FROM A LOGNORMAL DISTRIBUTION WITH
MEAN 100 and STANDARD DEVIATION 250



Attachment 9G

24 March 2015 Agenda and Pre-Read for 24 March 2015 Risk Assessor Call

From: Jennifer Holder
To: Dan Wall (wall.dan@epa.gov); Wendy O"Brien (obrien.wendy@epa.gov); brattin@srcinc.com; Scott Everett (SEVERETT@utah.gov); mstorck@utah.gov; Chris Cline (Chris_Cline@fws.gov); dcox@blm.gov; Sherry Skipper (sherry_skipper@fws.gov); Mark Jones; Mark Shibata; Judy Nedoff; Kevin Lundmark; Karen Cejas; George Weber
Subject: US Mag Risk Assessor"s Biweekly Call
Date: Tuesday, March 24, 2015 7:18:25 PM
Attachments: BG DQO Overview US Mag Risk Call 032415.pdf
Proposal for Low Resolution US Mag Risk Call 032415.pdf

Hi all,

I preparation for our call on 3/26, I am proposing the following agenda.

1) Calculation of exposure concentrations using Ten Berge: Short discussion of the USEPA comments on the DQOs for acute air contaminants dated 3/23
2) Eco RBCs for Cl and HCL: Short discussion on the development of RBCs over the last 2 years
3) Low Resolution D/F analysis: See proposal attached
4) BG
    a. Soil/Sediment: See proposal attached
    b. GW/SW: Discuss whether these media need to be characterized in 2015 or if it is better to wait until Phase 2.
5) Other?

Please provide comments or alternative agenda items if you have additional suggestions.

-Jen

Jennifer Holder, Ph.D.
Partner
Sediments and Watershed Integrated Management (SWiM)
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Overview of Background DQO
US Mag Risk Assessment Call
03/26/15

Objective:

- Develop a background dataset(s) for soils/sediments for inorganic and dioxin/furan (D/F) constituents[1].
- Identify candidate reference locations[2] suitable for tissue collection in Phase 2. This will include both upland and wetland habitat types.

Methodology:

Define BG Population(s) and Sample Size Estimation

- Use Phase 1A data from PRIs 11-16 to inform the sample design for BG.
  - Evaluation of Phase 1A data indicates that two BG populations should be characterized: (1) upland, and (2) lakebed. These 2 populations are defined based on statistical evaluations including ANOVA and cluster analyses that evaluated the potential impact of soil type and lithology on BG metals concentrations. These upland and lakebed populations are synonymous with the upland and wetland habitats that will be characterized for candidate reference locations.
  - Phase 1A data were evaluated for each metal and D/Fs:
    - The distribution of each dataset was identified and the appropriate VSP module was run to identify sample sizes based on:
      - Alpha = 0.05.
      - Beta = 0.2
      - Delta (or MDD) was set at 50% of mean
      - H_0 = site > background
    - Sample sizes for all compounds were then ranked from lowest to highest, and the sample size to the right of center was selected as a reasonable target sample size for BG.
      - Upland = 17
      - Lakebed = 29

Define Locations to Collect BG Samples

- Identify locations outside of the 5 mile radius that present suitable habitat for biota sampling

---

[1] PAHs are not proposed at this time as concentrations detected during Phase 1A do not exceed RBSLs/RBESLs at most PRIs, and detection limits are very sensitive due to SIM analysis.

[2] A candidate reference location is defined as: (1) an area with no point-source contamination and where metals concentrations are within the range of naturally occurring background, and D/Fs are within anthropogenic ambient, and (2) where relevant species (e.g., the same species found at US Mag) are likely to be present in the Spring of 2016.

- Minimally disturbed upland and lakebed habitats
    - Inter-mountain basins (IMB) greasewood flat and invasive annual grassland for upland
    - IMB playa for lakebed
- Focus on the western side of the Great Salt Lake
    - North of facility– between 5 mile radius and UTTR
    - South of facility– between 5 mile radius and Interstate 80
    - East of facility – Stansbury Island, Badger Island
- Use selection criteria to identify specific areas within the larger areas identified in the north, south, and/or east for sample collection (see Figure 1). A target of 3 candidate reference locations each for upland and lakebed is proposed. This should provide adequate coverage geographically of the area outside of the 5 mile radius as well as provide flexibility for the Phase 2 RI biological sampling scheduled for Spring 2016.
    - Upland Selection Criteria – Presence of species known to nest or are resident within the US Mag 5 mile radius, and specifically at the facility (based on RCRA sampling and surveys, recent ecological survey, and discussions with Dr. Cavitt[3])
        - Likelihood of nesting horned lark
        - Abundance and diversity of small mammals, invertebrates, plants
        - Accessible
    - Lakebed Selection criteria – Presence of species known to nest or are resident within the US Mag 5 mile radius, and specifically at the facility (based on RCRA sampling and surveys, recent eco survey, and discussions with Dr. Cavitt)
        - Likelihood of nesting snowy plover and/or nesting American avocet
        - Abundance and diversity of invertebrates
        - Accessible
- Conduct a field trip to identify specific candidate locations based on Spring 2015 conditions
    - ERM staff, Dr. Cavitt, and Agency biologists (if interested) to visit locations
    - Field trip would not include ecological surveys, but a short visit to each of the candidate sites to ensure that the conditions present would likely result in collection of the species of interest in Spring of 2016.
- Once 3 specific candidate locations are identified for upland and lakebed, the sample size identified for each population will be split among the locations. To be conservative and to provide sufficient samples within each candidate reference location, we propose to round

---

[3] Notes from call with John Cavitt (3/23/15)

- Long-billed curlews are nesting around Badger Island, but he is unsure about nesting within 5 mile radius.
- Shorebirds are mainly tied to freshwater sources, not to lake water. They will move around with water availability.
- 2-3 day field trip will be needed to confirm nesting in areas north, south, and east of 5 mile radius.
- Optimum time for surveying nests is mid to late May.

up the estimated sample size from 17 (upland) and 29 (lakebed) to 30 samples for each of the upland and lakebed populations.

- Upland – Split 30 samples among 3 candidate sites for 10 locations per site. Randomly locate the 10 samples within each candidate reference area.
- Lakebed - Split 30 samples among 3 candidate sites for 10 locations per site. Randomly locate the 10 samples within each candidate reference area.
- Analyze for metals and D/Fs in all samples

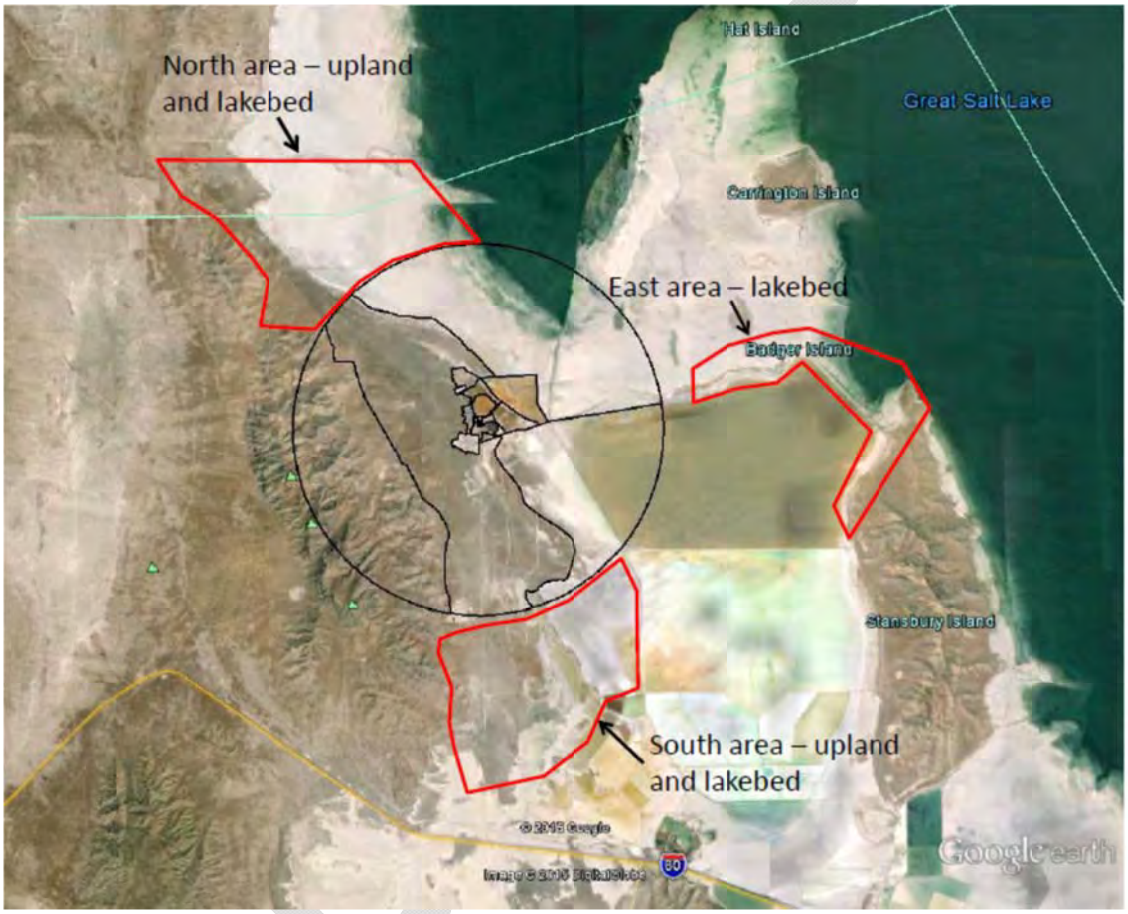


Figure 1: Candidate Areas for BG sample locations

Proposal for Low Resolution D/F Analysis
US Mag Risk Assessment Call
03/26/15

Phase 1B Scoping Meeting proposal:

Re-analyze LRMS sample by HRMS methods:

- If results from LRMS analysis are ND for all analytes; or
- If the highest concentration constituent is within the HRMS calibration range and no potentially damaging matrix interferences are evident.

Revised proposal:

Reanalyze LRMS sample by HRMS if maximum detected DF congener by LRMS is < 10 X HRMS maximum calibration range (approximately 40 µg/kg)

Supporting discussion points:

- DF congeners present above 10 X HRMS calibration range would result in HRMS detector saturation, significant potential instrument carryover, and are inappropriate for preparation (extraction) by the HRMS method. The maximum HRMS calibration range is 4 µg/kg; therefore, 10 X the maximum HRMS calibration range is 40 µg/kg.
- An OCDF concentration of 40 µg/kg would have a TEQ of 0.004 µg/kg (bird) or 0.012 µg/kg (mammal). The minimum RBC for DF TEQ is 0.00012 µg/kg (RBESL for freshwater sediment). Hazard quotients based on 40 µg/kg OCDF (only) would equal 33.3 (bird) or 100 (mammal).
- Based on available historical data for Inner PRI solids samples, the DF congeners with greatest contribution to TEQ are 1,2,3,4,6,7,8-HpCDF, 1,2,3,6,7,8-HxCDF, 1,2,3,4,7,8-HxCDF, and 2,3,4,7,8-PeCDF. A plot of these congeners versus OCDF for all Inner PRI D/F samples is provided in the attachment. These congeners are present at the following approximate proportions relative to OCDF:

1,2,3,4,6,7,8-HpCDF	0.082
1,2,3,6,7,8-HxCDF	0.019
1,2,3,4,7,8-HxCDF	0.011
2,3,4,7,8-PeCDF	0.0023

- Assuming that the low working range of the LRMS method is 0.5 µg/kg, if the concentration of OCDF is > 40 µg/kg, then 1,2,3,4,6,7,8-HpCDF, 1,2,3,6,7,8-HxCDF, and 1,2,3,4,7,8-HxCDF would be detected and 2,3,4,7,8-PeCDF would be sometimes detected and sometimes not detected. This is consistent with quadrants B and D in the attached plot, respectively.
- The situation where a sample has OCDF > 40 µg/kg but concentrations of risk-driver CDFs less than the LRMS DL of 0.5 µg/kg is represented by quadrant D in the attached plot. Only PeCDF (TEF = 1) falls into this quadrant; however, the detected congeners would result in a HQ of greater than 10.
- While the highest concentration congener (OCDF) typically does not have the highest contributions to TEQ, the scatter plot shows that when OCDF is > 40 ppb, the risk-driver congeners are typically present above the LRMS DL (0.5 ppb) so they would be expected to be

detected. Using 40 ppb OCDF as a cutoff, we would expect the risk-driver HxCDF and HpCDF congeners to be detected by LRMS in all samples and PeCDF to be detected in some (but not all) samples.

- In summary, the revised proposal for reanalyzing LRMS samples by HRMS when the max detected DF concentration is < 40 µg/kg would result in acceptable uncertainty because:
  - Samples with OCDF concentrations within the HRMS working range would be analyzed by the more sensitive HRMS methods (quadrants A and C);
  - In samples with OCDF > 40 ug/kg, other risk-driver CDFs would be also detected by the LRMS analysis (quadrant B); or
  - Even if selected risk-driver CDFs (e.g., PeCDF) are not be detected by LRMS (Quadrant D), the HQ would be >10 due to CDFs detected by the LRMS method (quadrant B).

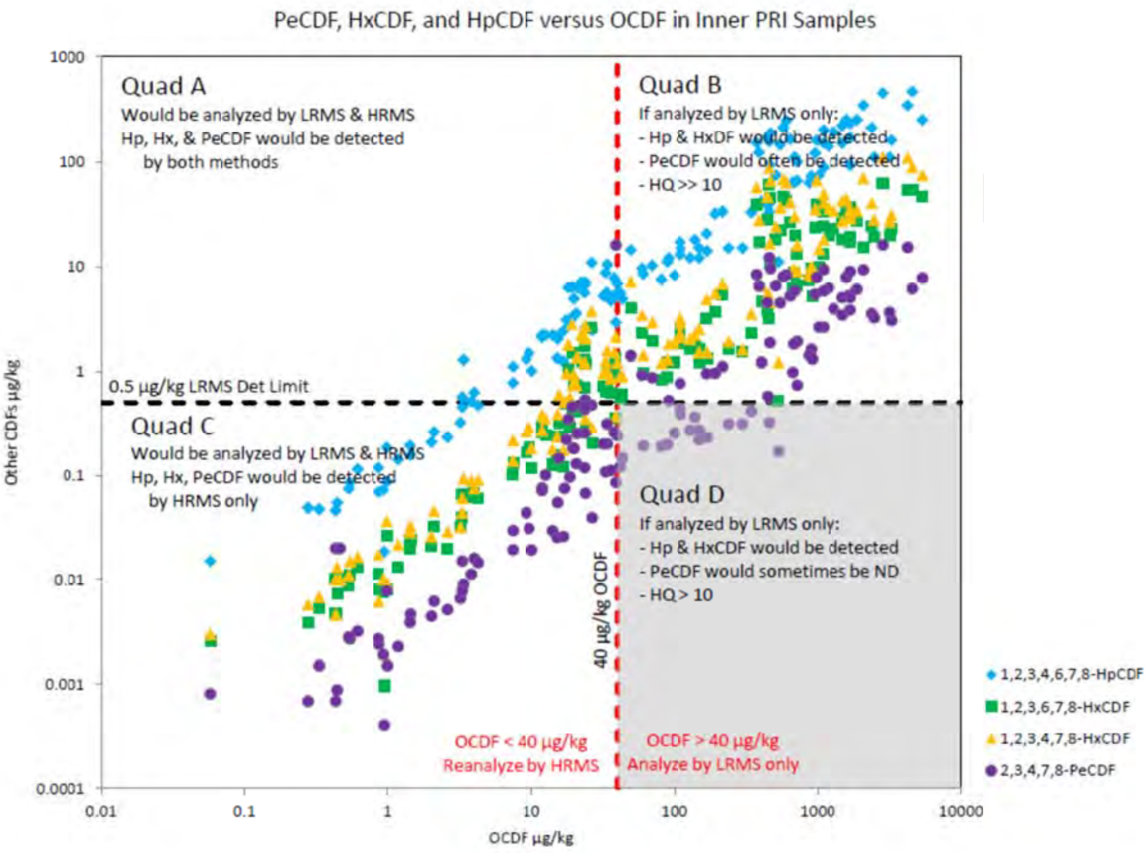


Figure 1: OCDF vs Other CDFs in Inner PRI Data

Attachment 9H

26 March 2015 Project Scoping Session Outcomes Summary for OU-1 Phase 1B Remedial Investigation Data Quality Objective Scoping Meeting, 11 and 12 March 2015

Project Scoping Session Outcomes Summary

Meeting Date	11 and 12 March 2015	**Project No.**	0132320.003
Location	Salt Lake City	**Prepared by**	David Abranovic 26 March 2015
Subject	US Magnesium OU-1 Phase 1B Remedial Investigation Data Quality Objective Scoping Meeting	**Signature**	

Attendees

Ken Wangerud (USEPA)
Wendy Obrien (USEPA)
Dan Wall (USEPA)
Andrew Schmidt (USEPA)
David Duster (USEPA)
Catherine LeCours (PWT)
Michael Storck (UDEQ)
Scott Everett (UDEQ)
Jon Parry (UDEQ)
Chris Cline (USFWS)
Sherry Skipper (USFWS/USEPA)
Bill Brattin (SRC/PWT)
Robert Howe (Tetratech/PWT)
Dave Williams (BLM) – phone
Doug Cox (BLM) – phone
David Abranovic (ERM)
Kevin Lundmark (ERM)
Jennifer Holder (ERM)
Mark Ransom (ERM
David Gibby (US Mag)

Comments/Decisions

This scoping session was convened by Environmental Resources Management (ERM) in accordance with the Administrative Order on Consent (AOC) and as recommended by the United States Environmental Protection Agency (USEPA) in its 17 December 2014 letter that provided initial comments on ERM's preliminary draft data quality objective (DQO) for the OU-1 Phase 1B Remedial Investigation (RI). A revised OU-1 Phase 1B DQO and scoping meeting agenda was provided by ERM on 20 February 2015. The USEPA then provided revisions to the scoping meeting agenda to ERM on 3 March 2015 and ERM distributed a final agenda on 5 March 2015, included as Attachment 1. ERM also prepared a series of informational slides, included as Attachment 2, to guide technical discussions during the scoping meeting held on 11 and 12 March 2015. This outcome summary refers to a Phase 1A/1B DQO and RI which represents a combination of elements of the 2013 USEPA Phase 1A DQO, a portion of which was implemented in fall of 2014, and ERM's revised Phase 1B DQO (20 February 2015).

The following list provides key discussions, action items, and consensus decisions for each major agenda item addressed during the scoping meeting:

RI Process Overview

1) ERM presented an RI process overview that illustrated each phase of the RI and the associated reporting tasks. The USEPA suggested that Phase 1A/1B Inner Preliminary Remedial Investigation (PRI) area data be included in an OU-1 screening-level risk assessment (SLRA) including Inner and Outer PRI areas. ERM agreed to the modification and further suggested that the OU-1 SLRA could include additional refinements used to focus the baseline risk assessment (BRA) on those PRI areas requiring additional evaluation. The USEPA was not prepared to evaluate the details associated with a refined SLRA for the Outer PRI areas, but was in general agreement that this approach may be used to focus the RI prior to implementing Phase 2 of the RI. ERM agreed to prepare a

revised RI process flow chart, which is included herein as Attachment 3.

2) The USEPA stated that the Phase 1A/1B RI Sampling and Analysis Plan (SAP) must be finalized no later than 1 July 2015, as stipulated in the 18 February 2015 letter from Steve Wharton (Re: Remedial Investigation Progress: Inner PRI Areas, US Magnesium Superfund Site). ERM stated that the conditions in July and August are not optimum for conducting fieldwork due to excessive heat and large accumulations of water in the evaporation ponds. The USEPA stated that the Phase 1A/1B RI must be initiated by this date in order to receive the data in time to plan and implement the Phase 2 RI in 2016. ERM agreed to develop a Phase 1A/1B SAP preparation schedule with a completion date of no later than 1 July 2015 so that fieldwork could commence at that time. This agreement was based on all parties abiding by the rigorous schedule that would allow completion of all documents and pre-RI planning prior to the start of fieldwork.

RCRA Settlement Update

1) ERM presented a conceptual diagram of the proposed wastewater filtration system that would be constructed as part of a forthcoming Resource Conservation and Recovery Act (RCRA) agreement. Construction of this system would require that all or portions of PRIs 1 and 3 be removed from the OU-1 Phase1A/1B RI. The meeting attendees discussed the boundaries of the “RCRA carve-out” that would be included in the agreement and USEPA suggested that some portion of the main ditch, east of the chlorine ditch, should remain in the Phase 1A/1B RI. ERM suggested that this eastern portion of the main ditch be combined with PRI 5 to avoid having to include a statistically representative sample design for this portion of the ditch in the Phase1A/1B RI. The USEPA suggested that, given the small area, collecting six samples from the main ditch east of the chlorine ditch would be sufficient; ERM agreed.

2) The USEPA asked where the new sanitary system would be sited and where the non-contact cooling water stream would be discharged. US Magnesium (US Mag) stated that a final design had not been completed, so these details were not yet available.

3) The USEPA stated that there may need to be additional sampling in PRI-14 if a new evaporation pond is sited in the former solar pond east of the plant.

4) The USEPA stated that groundwater within the “RCRA carve-out” would remain in the remedial investigation/feasibility study (RI/FS) of the CERCLA project.

Phase 1A/ 1B DQOs

1) The meeting attendees debated the pros and cons between the DQO presented in the USEPA 2013 Phase 1A SAP and the revised Phase 1B DQO presented by ERM on 20 February 2015. The meeting attendees decided that both approaches have merit and that an acceptable path forward would be to develop a hybrid Phase 1A/1B DQO that incorporates elements of the USEPA 2013 Phase 1A DQO and ERM’s Phase 1B DQO into a combined Phase 1A/1B DQO that will be implemented in 2015. A consensus was reached to include the following three study questions in the Phase 1A/1B DQO:

   - What are the COPCs?
   - What is the preliminary nature and extent of COPCs?
   - What are background concentrations of metals, dioxin/furans (D/Fs), and polycyclic aromatic hydrocarbons in soils and sediments?

2) The meeting attendees reviewed the revised Phase 1B sample designs presented in

ERM's 20 February 2015 DQO submittal, and USEPA stated that they had concerns with the methodology used to derive the sample sizes because they were derived using a power analysis (with an assumption that the data were normally distributed) and a diminishing return argument. ERM disagreed with the USEPA's evaluation, but acknowledged that the sample sizes estimated for COPC selection using USEPA methodology in the 2013 Phase 1A SAP were very similar to the samples sizes that ERM presented in their 20 February DQO for a preliminary estimate of a 95 percent upper confidence limit concentration. The meeting attendees agreed to disagree on the merits of the statistical basis for the sample sizes, but agreed to review the sample designs for each Inner PRI area and select an approach adequate for the hybrid Phase 1A/1B DQO based on the sample size necessary for selecting COPCs (i.e. a minimum of 14 samples from each PRI).

3) The meeting attendees reviewed sample designs for each Inner PRI area included in ERM's Phase 1B RI, and agreed that the following modifications to sampling locations would be adequate for the Phase 1A/1B RI:

   - PRI-1 – No change to ERM Phase 1B design. (however two samples will be added in Main Ditch east of the Chlorine Ditch if "RCRA carve out" eliminates a portion of PRI-1 from the Phase 1A/1B SAP).
   - PRI-3 – Increase the number of sampling locations in ERM Phase 1B design to 12 surface samples and 1 subsurface boring at a south central location.
   - PRI-4 – No change to ERM Phase 1B design.
   - PRI-5 – No change to ERM Phase 1B design.
   - PRI-6 – No change to ERM Phase 1B design, but add 1 subsurface boring at the northeast corner of the Gypsum Pile (PRI4).
   - PRI-7 – No change to ERM Phase 1B design, but add 2 surface samples in the north barrow ditch.

4) A consensus was reached that the surface samples in non-inundated areas will be collected with a hand auger and, if possible, the hand auger boring will be advanced to the native material or to a maximum depth of 5 feet below ground surface to provide a preliminary delineation of the vertical extent of waste material.

5) Based on the RCRA discussion (Item 1 under RCRA Settlement), eight of the 14 planned sediment samples in PRI 1 and all of the PRI 3 samples would be eliminated if the RCRA settlement AOC is finalized before 1 July 2015. These six samples would be located along the main ditch (east of the chlorine ditch).

6) ERM agreed that modification of the September 2013 Phase 1A SAP (Version 0) is the most efficient approach to development of a combined Phase 1A/1B SAP. The USEPA and ERM will share SAP development responsibilities as follows:

   - The USEPA will revise the Phase 1A SAP (Version 0) to omit completed and irrelevant scope and incorporate the Phase 1A Outer PRI SAP modifications as appropriate. The USEPA will then provide a redline version for ERM review and use as a template for the combined Phase 1A/1B SAP.
   - ERM will develop a revised Phase 1A/1B DQO and submit to the USEPA for review.
   - Upon USEPA approval of the revised Phase 1A/1B DQO, ERM will incorporate it into

the Phase 1A/1B SAP and make other appropriate revisions to SAP worksheets (provide redline to the USEPA).

- The USEPA will then approve and issue the final Phase 1A/1B SAP.

Groundwater/Surface Water (PRI 17)

1) The meeting attendees agreed that data adequacy for Phase 1A groundwater would be evaluated separately from surface water.
2) ERM stated that the 12 months of groundwater/surface water gauging stipulated in the Phase 1A SAP have been completed, and the USEPA gave approval to discontinue the PRI 17 monitoring program.
3) ERM stated that there are 20 Phase 1A surface water samples that have not been collected. One of these samples (in PRI 7) was not collected during the Phase 1A RI due to insufficient water, and 19 samples (in PRIs 1, 3, 5, and 6) were postponed pending the RCRA settlement (per 20 November 2013 email from Ken Wangerud). The USEPA stated that these samples must be collected; however, the sampling required within PRIs 1 and 3 may be modified if the RCRA settlement is finalized by 1 July 2015.
4) The USEPA suggested that if the RCRA settlement is finalized before 1 July 2015, then collecting three surface water samples would be sufficient in the portion of the Main Ditch not included in the “RCRA carve-out” and that surface water sampling would not be required in PRI 3. ERM agreed. Therefore, 8 of the 11 Phase 1A surface water samples in PRIs 1 and 3 would be eliminated if the RCRA settlement is finalized before 1 July 2015.
5) The meeting attendees agreed that the remaining Phase 1A surface water samples would be collected according the 2013 Phase 1A SAP, with appropriate modifications, and the Phase 1A/1B DQO would not include surface or groundwater.
6) The USEPA suggested that a hydrologic conceptual site model (CSM) be completed for the RI study area. ERM noted that the current salt cap treatability test work plan includes a hydrologic CSM, and that the objective is to refine the understanding of groundwater-surface water interactions within and adjacent to the Current Waste Ponds and the Old Waste Pond. The USEPA requested that this CSM be a standalone document, so it could be utilized and expanded to include fate and transport of contaminants and ultimately integrated into the RI report. ERM agreed with this approach.

Technical Topic 1 – Background

1) ERM presented an approach to establish background concentrations in soil/sediment from the Outer PRI Phase 1A dataset, based on methodology in the August 2014 USEPA Region 3 and 4 Background Issue Paper. The USEPA stated that although they instructed ERM previously that it may be appropriate to utilize the methodology provided in this guidance for the US Mag RI, this is no longer an option due to a USEPA policy decision regarding this document.
2) ERM presented an evaluation of the Outer PRI Phase 1A data that suggests background should be established based on setting rather than site soil types and/or geology (see Technical Topic 1 slides, Attachment 2). The USEPA agreed that the analysis supports that there are two distinct settings within the RI study area that are likely to exhibit unique background characteristics (i.e., Lakebed and Upland), and that these settings are consistent with the two major habitat types in the RI/FS study area that are relevant to the ecological risk assessment (ERA).

3) The USEPA agreed that ERM should develop a DQO for a background study of Upland and Lakebed settings, and the sample design should be partially based on a statistical analysis of the Phase 1A data. Preliminary results presented by ERM suggested a sample design consisting of 10 to 20 samples collected from two or three reference areas per setting would be appropriate. USEPA indicated that the preliminary sample design seemed reasonable, but several other factors, such as habitat types and quality in candidate reference areas, must also be considered. Consensus was reached that a seven-step DQO be developed for incorporation into the Phase 1A/1B SAP; however, the details of the sampling design (DQO Step 7) would be discussed during future breakout sessions and may not be presented in the draft Phase 1A/1B background DQO submittal to the USEPA prior to SAP development.
4) The USEPA stated that it is essential that the soil/sediment sampling locations are conducted in areas that are also appropriate for biota sampling that may be conducted during the Phase 2 RI to demonstrate that reference areas are suitable for biota sampling. ERM agreed with this approach.

Technical Topic 2 – Bulk vs. Fines Fractions Analysis

1) ERM presented a revised approach for determining when analysis of the fines fraction of Inner PRI surface solids samples must be analyzed (see Technical Topic 2 slide, Attachment
2) The USEPA agreed that the revised approach—based on collecting split samples for full analysis, grain size analysis, and fines analysis—would be more efficient than the reconnaissance approach used during the Phase 1A RI.

Technical Topic 3 –– Laboratory Analytical Methods

1) The USEPA agreed that many of the unresolved comments on TestAmerica analytical standard operating procedures (SOPs) (provided in a comment letter from PWT dated 20 October 2013) did not need to be addressed in the Phase 1A/1B SAP. The USEPA acknowledged that “foaming” water samples for volatile organic compound (VOC) analysis resulted in relatively minor dilutions; however, ERM agreed to continue discussions with TestAmerica to identify potential anti-foaming agents to help minimize water VOC sample dilutions. The USEPA requested that ERM/TestAmerica evaluate adding pentachlorobenzene and 1,4-dioxane to the Method 8270 semivolatile organic compound analyte list, and that the procedures used to determine when a sample extract needs to be re-analyzed at dilution should be refined to reduce the probability that holding times would be exceeded. ERM agreed with these requests and would coordinate with PWT on the appropriate modifications to the laboratory work instructions for the Phase 1A/1B SAP.
2) A decision framework to use low-resolution analytical methods for dioxins/furans (D/Fs) and polychlorinated biphenyls was presented by ERM along with an illustration of the working ranges and concentration ranges expected in the Inner PRI areas (see Technical Topic 3 slides, Attachment 2).
3) The USEPA was in agreement that there would likely be samples collected during the Phase 1A/1B RI that should be analyzed for polychlorinated biphenyls and D/Fs by the low-resolution methods. The USEPA suggested that decision criteria be developed to determine when samples should be analyzed with the high-resolution method that is based on a toxicity equivalency rather than the concentration of the highly chlorinated constituents (i.e., OCDF). ERM agreed to evaluate this approach with the laboratory and provide a refined proposal for EPA review.

Technical Topic 4 –– Accessing Sampling Locations in Wastewater Ponds

1) The meeting attendees discussed 15 potential alternatives presented by ERM for collecting surface sediment samples from submerged locations in the active acid ponds. The discussion was focused on eliminating alternatives that were considered to be unsafe and/or not technically feasible. The meeting attendees agreed that it would not be safe to send a sampling crew into inundated areas of the acid ponds without access to immediate egress. The meeting attendees also agreed that the very low pH pond environment would likely cause rapid mechanical failures to motorized equipment. This discussion resulted in the elimination of Options 1, 2, 5, 6, 7, 9, 10, 11, 12, 13, and 15 (see Technical Topic 4 slide, Attachment 2).
2) A consensus was reached that the preferable surface sample collection methodology in submerged areas of current ponds would be a helicopter-deployed dredge, and the following protocol was formulated as a potential methodology to be included in the Phase 1A/1B SAP:
    - First, attempt to collect a sample at the planned location with a grab sampler deployed from a helicopter (two to three attempts per location).
    - Second, attempt to collect a sample by helicopter at a nearby location (e.g., approximately 100 feet from the original; two to three attempts per location).
    - Third, relocate the sampling location to the vicinity of a submerged sample that was successfully collected (two to three attempts per location).
    - Finally, obtain USEPA approval to relocate sampling location to the nearest shoreline.
3) The meeting attendees discussed the feasibility of conducting a demonstration of method applicability (DMA) to refine the helicopter-deployed sediment grab sampling methodology to aid in selection of the sampling equipment and development of SOPs.US Mag stated that it may be possible to deploy a man-lift to an accessible pond shore area and test different size and configuration samplers to inform the development of the Phase 1A/1B SOPs.
4) ERM will prepare a brief technical memorandum summarizing the dredge test methods that would be used to develop an SOP for surface sediment collection from inundated areas of the evaporation ponds using a helicopter-deployed dredge.

Action Items

1. ERM to prepare draft Scoping Session Outcomes for review by the USEPA and Utah Department of Environmental Quality and approval by the USEPA.
2. ERM to prepare a technical memorandum summarizing dredge test methods for surface sediment collection from inundated areas of the evaporation ponds.
3. ERM to prepare a revised Phase 1A/1B DQO for USEPA review.

Consensus Decisions

1) If the RCRA settlement is finalized by 1 July 2015, then no solids or surface water sampling would be performed in PRI 3 and sampling within PRI 1 would be reduced to six solids and three wastewater locations from the portion of the Main Ditch that remains outside of the “RCRA carve-out.”

2) Modification of the September 2013 Phase 1A SAP (Version 0) is the most efficient approach to development of the combined Phase 1A/1B SAP, and the USEPA and ERM will share SAP development responsibilities for the document as noted above.
3) The revised bulk/fines decision logic based on collecting split samples for full analysis, grain size analysis, and fines analysis will be adopted for surface solids sampling in the Phase 1A/1B RI.
4) It would not be safe to send a sampling crew into inundated areas of the acid ponds without access to immediate egress.
5) ERM will prepare a detailed document preparation schedule based on the AOC and the revised RI process diagram provided as Attachment 3.

Attachments

Attachment 1 – Final OU-1 Phase 1B Scoping Meeting Agenda

Attachment 2 – ERM Slides Used to Guide Technical Discussions

Attachment 3 – Revised RI Process Flow Chart

Environmental
Resources
Management

US MAGNESIUM – OU-1 PHASE 1B FINAL SCOPING MEETING AGENDA

11 March 2015 – Items 1-4
12 March 2015 - Items 5-8
Salt Lake City Utah

1. RI Process Overview
    a. RI Process Flow Chart
    b. Recap of Inner PRI Scoping Meetings (EPA Attachment 1)
    c. Inner/Outer PRI Designation
    d. COPC Selection
    e. Current RI Schedule
2. RCRA Settlement Update
    a. Progress in developing plans for RCRA carve-out
    b. Figure illustrating facility changes under the settlement
3. Phase 1B DQOs
    a. Sample design for 95UCL (EPA Attachment 2)
    b. Sample design for Preliminary N&E
        – Purpose/goal of preliminary contaminant distribution in Phase 1B
        – Use of historical data
        – Use of screening/Triad sampling approaches
    c. Key waste release areas/subsurface boring locations and sample depths
    d. Biased/judgmental sample locations
4. Groundwater/Surface water (PRI-17)
    a. Collection of Phase 1A samples in the Inner PRIs (temporal sampling)
    b. Completion of Hydrologic CSM
    c. Groundwater/Surface water PRI COPC selection
5. Technical Topic 1 - Background
    a. Role of Background in BRAs, i.e., discuss when/how data will be used in the HH and Eco RA
    b. Statistical evaluation of Phase 1A RI results
        – Identify COPCs associated with background (metals, D/F)
        – Present Q-Q plots to extract background datasets from Phase 1A data, geochemical correlation plots, etc.
    c. Other background dataset
        - Background metals results from UTTR-North, Region 8 (As only), and Paramatrix 2003 Focused ERA reference areas.
    d. Proposal for developing OU-1 background data

    - Extract background from Phase 1A Data (present preliminary evaluation)
  e. Reference Areas for BRA biological collection

6. Technical Topic 2 – Bulk vs. Fines Fractions Analysis
    a. Role of fines results in BRAs and relevance to Phase 1B DQO
    b. Phase 1A Outer PRIs Bulk vs. Fines Results
    c. Bulk vs. Fines analysis for Phase 1B
7. Technical Topic 3 – Laboratory Analytical Methods
    a. Outstanding issues from Phase 1A SAP associated with sampling in ditches/ponds
    b. LRMS Methods for PCB and D/F (EPA Attachment 3)
8. Technical Topic 4 – Accessing Sampling Locations in Wastewater Ponds
    a. Potential methods for collecting samples in saturated areas of PRIs 5 and 6
    b. Sampling schedule constraints and considerations
        – Weather conditions
        – Surface water presence/elevation
9. **Next Steps & Action Items**

EPA Attachment 1

for
Inner-PRI Ph1B
Scoping Meeting

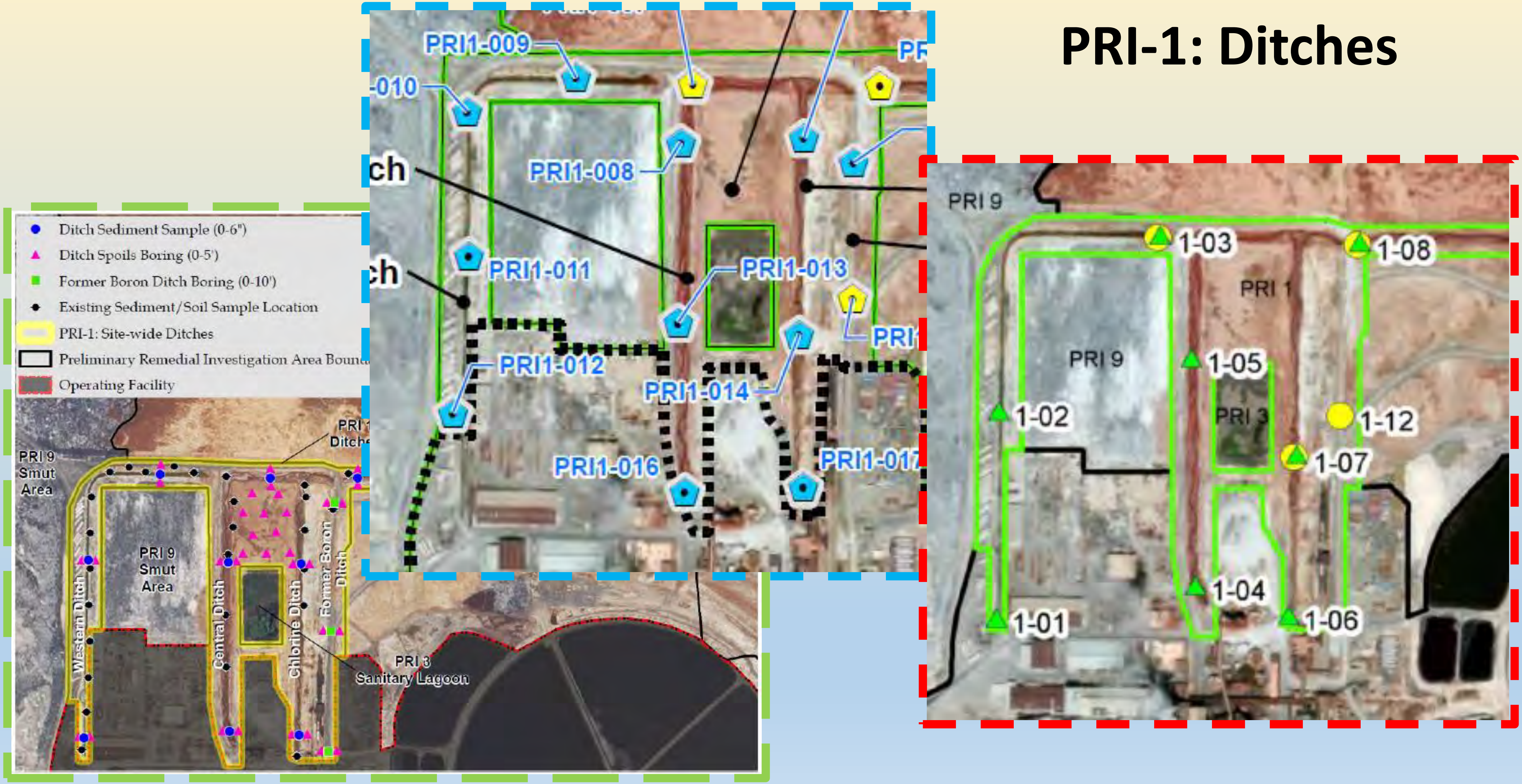
Development of Inner PRI Plans

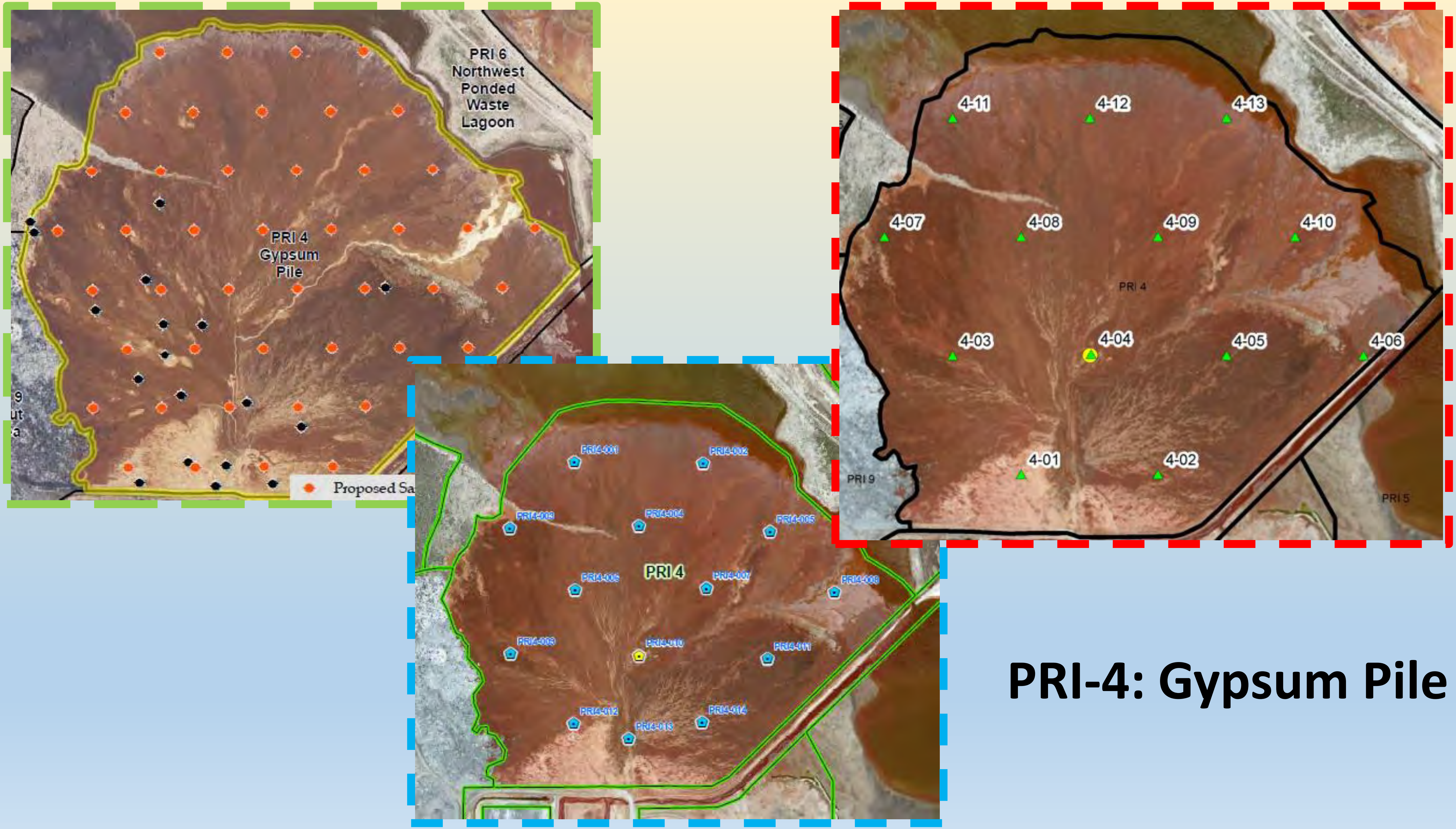
EPA Ph1A SAP: to identify COPCs (ERM's preference per Scoping Meeting #2)
September 2013

ERM Original Plan for Phase 1: COPCs & Prelim. N-&-E
October 2012

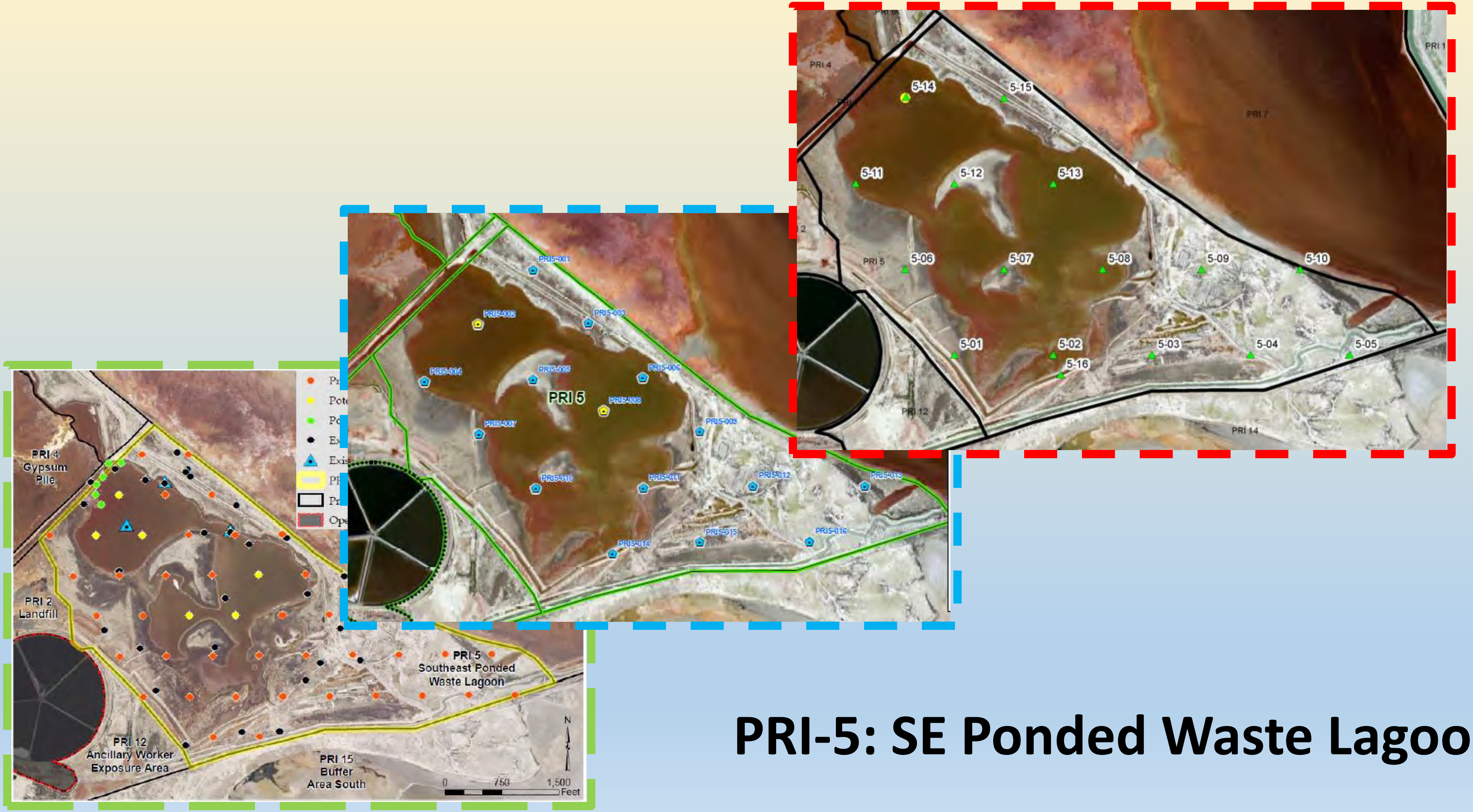
ERM 'New' Ph1B Proposal: Less COPC sampling and No N-&-E investig's
February 2015

PRI-1: Ditches



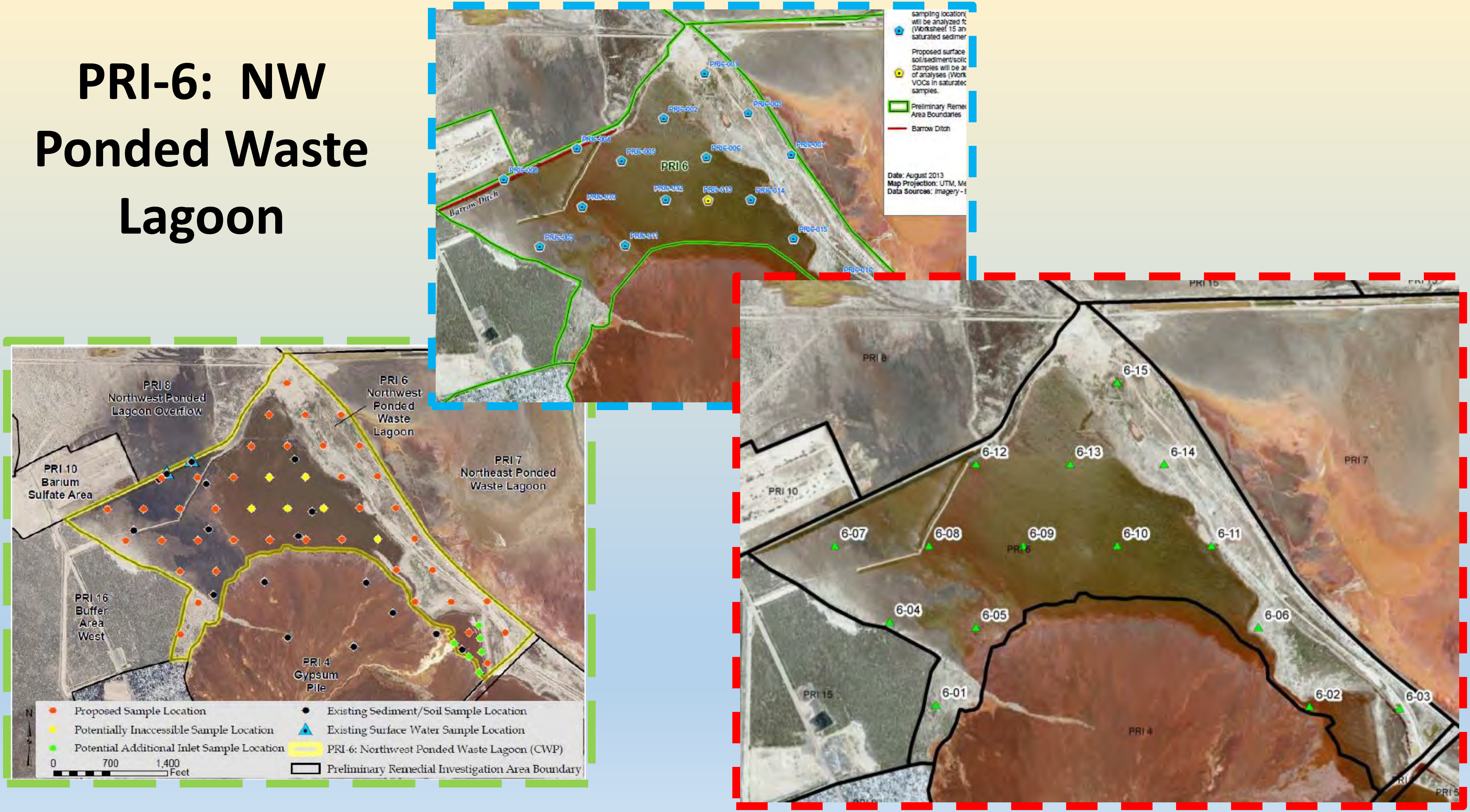


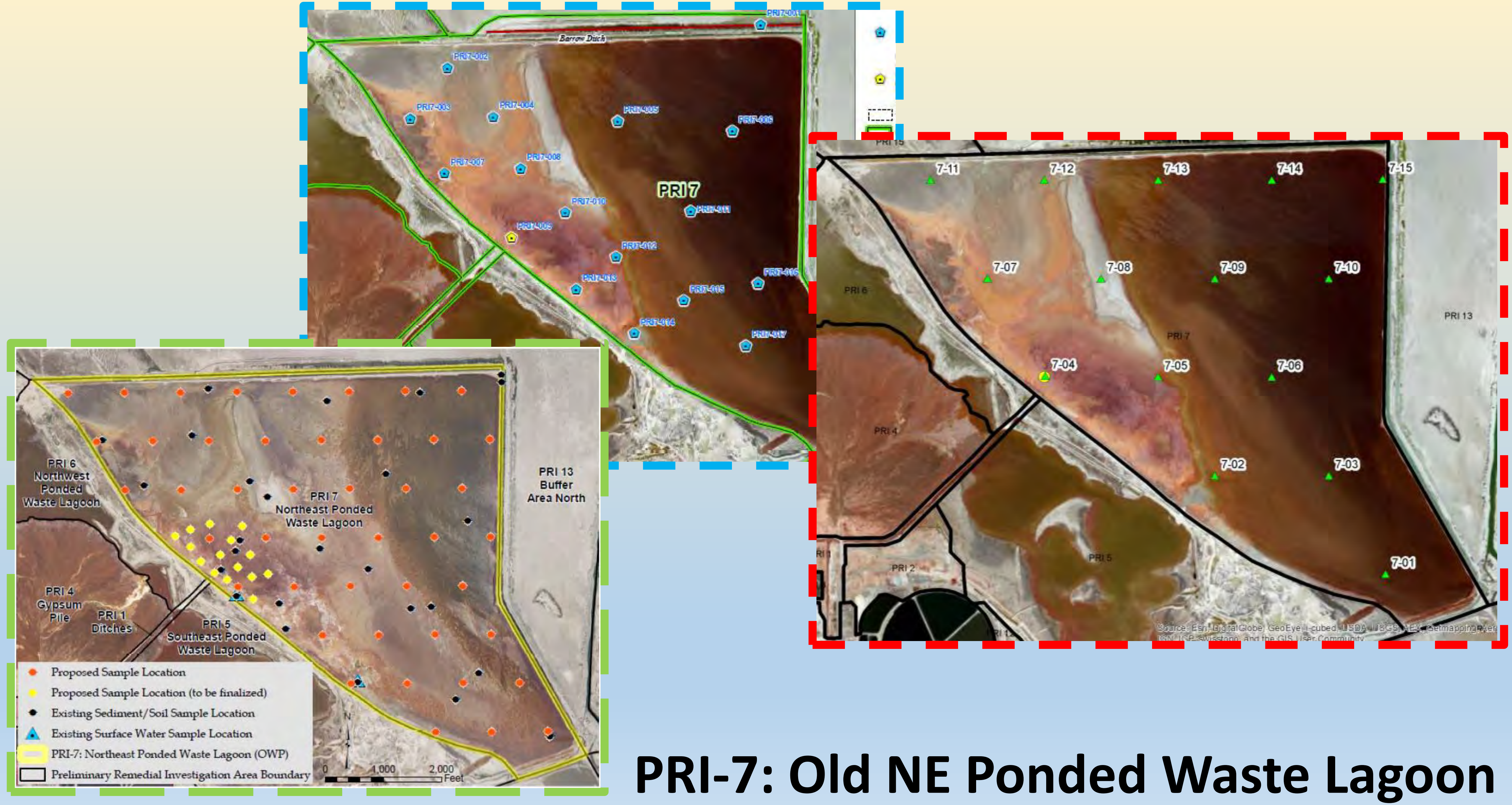
PRI-4: Gypsum Pile



PRI-5: SE Ponded Waste Lagoon

PRI-6: NW Ponded Waste Lagoon





Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aer
IGN, IGP, swisstopo, and the GIS User Community

PRI-7: Old NE Ponded Waste Lagoon

EPA - ATTACHMENT 2
COMPARISON OF SAMPLE SIZE ESTIMATES

Type	Distribution	Method	Goal	CV (= stdev / mean)						Notes
				1.0	**1.5**	**2.0**	**2.5**	**3.0**	**4.0**	
Grab	Normal	ERM	"Diminishing return"	9	11	13	15	16	19	a,b
		ERM Fig 11-2	MOE for N in yellow	62%	82%	99%	114%	132%	159%	
		ERM Fig 11-2	MOE = 50%	13	27	46	70	100	177	
		VSP	20% FP at RBC/2	8	16	27	40	57	101	a
	Skewed	VSP	20% FP at RBC/2	14	25	43	64	91	159	c
		+20% extra	20% FP at RBC/2	17	32	52	77	110	191	d
	Lognormal	MC sim	20% FP at RBC/2	20	38	54	72	87	116	e
		COPC calc	Cmax > mean	8	9	10	11	12	14	f
5 pt Comp.	Lognormal	MC sim	20% FP at RBC/2	7	10	13	17	20	26	g

Notes

a. Authentic data sets are almost never normal. Very likely to underestimate N.
b. Not based on goal of controlling FP error rate. Does not consider random sampling variation.
c. Based on UCL of median, not mean. Biased low.
d. Adding 20% helps account for use of median
e. Assuming lognormal will rarely underestimate N.
f. COPC N = ln(0.05) / ln(ptile of mean)
g. Use of compositing can reduce sample number a lot, depending on spatial patterns.

Basic Principles

a. Underestimating N results in increased uncertainty, increased chances of FP decisions, and likely increased cleanup cost
b. Calcs above do not consider relation of mean to RBC. Decreased sample size can be used if mean << RBC or >= RBC

Optimum Approach

a.. Use VSP assuming skewed data set with 20% margin
b. Use compositing (*optimum scheme TBD*)
c. Consider ratio of mean to RBC, at least for main risk drivers

EPA COMMENTS ON THE
DRAFT DEMONSTRATION OF METHOD APPLICABILITY
FOR LOW-RESOLUTION MASS SPECTROMETRY ANALYSES OF SOLIDS
TECHNICAL MEMORANDUM
(ERM Document date: 12 March 2014)
US MAGNESIUM NPL SITE, TOOELE COUNTY, UTAH

April 11, 2014

Introduction

After considering results of the October 2012, Demonstration of Methods Applicability (DMA) study of significantly contaminated media within Operable Unit (OU) 1 (inner-PRIs) of the US Magnesium site (Site), Rowley, Utah, Environmental Resources Management (ERM) proposed that modified analytical methods could be utilized within the highly-contaminated PRIs of the Site which would be: a) substantially less-costly; and b) provide data of sufficient precision and accuracy for site-characterization and risk assessment. Questions remained about whether the *modified* procedures for Method 680 [for polychlorinated biphenyls (PCBs)] and Method 8280 (for dioxins/furans) could attain the analytical precision and accuracy that may be needed for risk assessment to address low-threshold target quantitation limits (TQLs) and toxicity equivalence factors (TEFs). ERM developed, and the US Environmental Protection Agency (EPA) approved in July 2013, an amended DMA Work Plan to address these questions.

The following comments are provided by the EPA in response to the draft DMA for Low-Resolution Mass Spectrometry (LRMS) Analyses of Solids Technical Memorandum (TM) prepared by ERM, submitted to the EPA March 14, 2014. The LRMS TM discusses the results of an assessment of the use of a *Modified* Method 680 for analyzing PCBs and Method 8280 for dioxins/furans at the Site. ERM is proposing the potential use of low resolution methods in OU1 at the Site where PCBs and dioxins/furans occur at high concentrations.

General Comment

The LRMS DMA provides sufficient data on method performance to conclude that the uncertainties and potential biases in data generated by either LRMS method are usually too great to be useful for most risk assessment purposes. However, in certain circumstances, the data from the LRMS methods might be suitable for use, subject to the following conditions:

- Existing data are not sufficient to support reliable risk management decision-making and new data are needed.
- The levels of PCBs and/or dioxins/furans are expected to be well above (e.g., 100-fold or more) the applicable risk-based thresholds (either human and/or ecological). Such samples are expected to occur primarily within OU1, but may not include all samples from all areas of OU1.
- In the case of any sample that was expected to contain high contaminant concentration levels, but in fact is found to have levels that are at or below the useful detection range of the LRSM methods, the sample shall be reanalyzed by more sensitive and accurate methods (if needed for risk assessment and decision-making purposes).
- The useful detection range of the LRMS methods cannot be defined with certainty at present, because final risk-based concentrations (RBCs) cannot yet be specified for either human or ecological receptors. However, once these final RBCs are established, the useful detection range of the LRMS methods will likely comprise concentrations that are well above the RBC (e.g., a factor of 100-fold or more). In this event, the magnitude of the potential errors or biases in the data would likely not create

sufficient uncertainty to prohibit reliable risk management decision-making. Conversely, as concentrations approach or fall below final RBC values, the potential errors or biases in the data are likely to be too great to allow reliable risk assessment and risk management decision-making, and re-analysis of such samples by methods with greater accuracy and sensitivity are likely to be required.

Revisions to the Draft Technical memo

EPA recommends the following changes to the March 12, 2014, draft of the LRMS TM.

1. Nomenclature

The *Modified* Method 680 is referred to as Method 8270 or Method 608 throughout the validation summaries and Method 680 in the body of the text. The standard operating protocols for the laboratory references Methods 8081B, 8082A, 8270D, and 680. To refer to this hybrid *Modified* Method 680 simply as Method 680 is confusing. Please refer to the low resolution PCB method in a consistent fashion, such as "*Modified* Method 680".

2. Stratification of Results by Method

In several places (e.g., the data table at the bottom of page 6 and in Figure 1), metrics of performance from *Modified* Method 680 and Method 8280 are combined. It is more useful to present information on method performance stratified according to method.

3. Data Comparability

It would be helpful if the data summary included more discussion and summary statistics on the direction and magnitude of differences between paired high-resolution mass spectrometry (HRMS) and LRMS data. Based on an initial inspection, the EPA notes that PCBs and dioxins/furans using low resolution methods tended to be biased high, with some notable exceptions for less chlorinated congeners. This information will be valuable in making determinations as to when the LRMS data fall into the "unacceptable uncertainty" range.

Likewise, some expanded discussion and summary statics on precision (as judged by relative percent differences) would be helpful. Although this information can be derived from Figure 1, a tabular format would facilitate the evaluation and interpretation of these data.

4. Limitations of Use

The text of the LRMS TM (Section 5, bullet 5) should be modified to clearly state the circumstances in which data from LRMS methods may be considered acceptable for risk assessment and risk-management decision-making (as discussed above).

5. QC Data

Salient quality control (QC) results should be summarized in the LRMS TM and used to support any conclusions presented. For example matrix spike/matrix spike duplicate results, internal standard, recovery standards, surrogate recoveries, and performance evaluation sample results should be discussed.

6. Regression vs Correlation

On page 7, the LRMS TM discusses regression analysis as one way to evaluate the performance of two methods. However, what is presented is simply a correlation analysis. The EPA agrees with ERM's opinion stated in footnote 2 that regression analysis is not needed here, and that the results of the correlation analysis are adequate. However, the nomenclature should be corrected.

Environmental
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ERM

DRAFT 16 May 2014

Via Electronic Mail

Mr. Ken Wangerud
Remedial Project Manager
Superfund Remedial Program
USEPA Region 8 – EPR-SR
1595 Wynkoop Street
Denver, CO 80202-1129

Subject: Response to USEPA Comments on Draft Demonstration of Method Applicability for Low-Resolution Mass Spectrometry Analyses of Solids Technical Memorandum, March 2014

Dear Mr. Wangerud:

The Draft Demonstration of Method Applicability (DMA) for Low-Resolution Mass Spectrometry (LRMS) Analyses of Solids Technical Memorandum (Tech Memo) was submitted via email to the United States Environmental Protection Agency (USEPA) on 12 March 2014. USEPA comments on the Draft Inner PRI Data Report were received on 11 April 2014. This letter presents ERM-West, Inc.'s (ERM's) responses to USEPA's comments on the Draft LRMS DMA Tech Memo.

Response to USEPA's General Comment

ERM agrees with EPA that the LRMS analytical methods may produce definitive data, depending on the data quality objectives (DQOs) for the specific investigation. However, we feel that it is not appropriate to select criteria for analytical method performance prior to development of DQOs. The working ranges of the LRMS methods are known, these methods have been demonstrated to perform satisfactorily for solid-matrix samples from the Site, and the data quality indicators (DQIs) of precision and accuracy have been shown to meet measurement performance criteria that are consistent or identical to HRMS methods.

The usability of LRMS methods is therefore not limited by "uncertainties and potential biases" of the analytical data; these methods simply have higher detection limits and quantitation limits than the HRMS analogs. Consistent with the Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP) guidance, the DQI of Accuracy/Bias was evaluated in the LRMS DMA through LCS (both methods), surrogate spikes (both methods), matrix spikes (Method 8280), and PE samples (both methods). The LRMS DMA has demonstrated that the LRMS methods may performed on Site samples while meeting quality control criteria for accuracy/bias and precision; therefore, the LRMS methods have been shown to produce definitive data of know precision and accuracy.

Therefore ERM strongly disagrees with USEPA's determination that the data generated by either LRMS method are not useful for most risk assessment purposes. A determination of data usability can only be made relative to the DQO for which the data are collected.

It appears that the USEPA has misinterpreted the objective of the LRMS DMA and ERM's recommendations in the Tech Memo. ERM has not proposed the whole scale replacement of high-resolution mass spectrometry (HRMS) methods by LRMS methods, nor has a specific application of the LRMS methods to future investigation phases been proposed. The Recommendations section of the Tech Memo states:

> "Based on the above conclusions, ERM recommends that the subject LRMS analytical methods be considered suitable candidates during subsequent investigations at the Site, depending on the specific Data Quality Objectives of the investigation. ERM recognizes any method used for analyzing site samples collected under a Sampling and Analysis Plan would first require approval by the USEPA per Section IX of the AOC."

This recommendation is consistent with the primary purpose for the LRMS DMA. The 15 November 2013 ERM letter "Revised DMA Work Plan Addendum for Method 680 and 8280 and ERM/US Magnesium Response to USEPA/PWT3 Technical Comments on the DMA Work Plan Addendum for Method 680 and 8280 Received 29 October 2013"stated:

> "From its onset, the LRMS DMA was proposed as an initial screen whereby site samples would be analyzed by these

> standard laboratory methods as a step in determining whether these methods may be suitable for use during subsequent investigations at the Site."

Responses to USEPA Recommended Revisions to the Draft Technical Memo

Each of the USEPA recommended revisions is provided below in italic font, followed by ERM's response. As explained in the responses below, no revisions to the Tech Memo are warranted based on the comments received from USEPA. If there are supporting evaluations or data interpretation guidance documents that provided the basis for the recommended revisions but were not included or cited in the USEPA comment letter, ERM respectfully requests that USEPA provide these to ERM to help gain a better understanding of USEPA's concerns.

1. *Nomenclature - The Modified Method 680 is referred to as Method 8270 or Method 608 throughout the validation summaries and Method 680 in the body of the text. The standard operating protocols for the laboratory references Methods 8081B, 8082A, 8270D, and 680. To refer to this hybrid Modified Method 680 simply as Method 680 is confusing. Please refer to the low resolution PCB method in a consistent fashion, such as "Modified Method 680".*

   ERM Response: In the future, the LRMS PCB method will be referred to as "Modified Method 680."

2. *Stratification of Results by Method - In several places (e.g., the data table at the bottom of page 6 and in Figure 1), metrics of performance from Modified Method 680 and Method 8280 are combined. It is more useful to present information on method performance stratified according to method.*

   ERM Response: The points plotted in Figure 1 are stratified by method already. Dioxin/Furan points (Method 8280A) are shown by blue diamonds, while points corresponding to Total PCBs, PCB Homolog Totals, and PCB Congeners by Modified Method 680 are show using different symbols and colors. The stratification of metrics of performance for the inter-method comparison of LRMS and HRMS results is provided below; however, the comparability between LRMS and HRMS methods was similar for PCBs and D/F.

Scenario	**Inter-Method Comparison Measurement Performance Criteria (MPC)**	**Number of Paired LRMS/HRMS Results**		
		Scenario Total	**Meet MPC**	**Do Not Meet MPC**
1. Both Results > 5X QL	RPD < 50	89 Total 79 PCB 10 D/F	44 Total 39 PCB 5 D/F	45 Total 40 PCB 5 D/F
2. Both Results > QL, One or Both < 5X QL	± 2X Max QL	33 Total 18 PCB 15 D/F	27 Total 14 PCB 13 D/F	6 Total 4 PCB 2 D/F
3. Both Results ND	Both Results ND	30 Total 24 PCB 6 D/F	30 Total 24 PCB 6 D/F	0 Total 0 PCB 0 D/F
4. Both Results Det < QL	Both Results Det < QL	5 Total 0 PCB 5 D/F	5 Total 0 PCB 5 D/F	0 Total 0 PCB 0 D/F
5. All Other Combinations	None	163 Total 63 PCB 100 D/F	--	--

3. *Data Comparability - It would be helpful if the data summary included more discussion and summary statistics on the direction and magnitude of differences between paired high-resolution mass spectrometry (HRMS) and LRMS data. Based on an initial inspection, the EPA notes that PCBs and dioxins/furans using low resolution methods tended to be biased high, with some notable exceptions for less chlorinated congeners. This information will be valuable in making determinations as to when the LRMS data fall into the "unacceptable uncertainty" range.*

Likewise, some expanded discussion and summary statics on precision (as judged by relative percent differences) would be helpful. Although this information can be derived from Figure 1, a tabular format would facilitate the evaluation and interpretation of these data.

ERM Response: It is the opinion of ERM that USEPA is being over-reliant on the comparison of results between HRMS and LRMS methods. The HRMS methods struggled to accommodate the high concentrations and severe matrices of some Phase 1A

DMA samples, and as a result there were some quality control limitations associated with the HRMS data (for example, large dilutions were required for HRMS methods that resulted in the "diluting-out" of surrogates and/or internal standards). A more rigorous evaluation of differences between HRMS and LRMS results is not necessary to identify the "uncertainty" ranges for the LRMS methods. As with any other analytical method, the LRMS methods have method detection limits (DLs) and quantitation limits (QLs) that define the concentration levels at which analytes can be differentiated from noise (the DL) and at which a concentration can be reliably measured within specified limits of precision and accuracy (the QL).

The calculated RPDs for all paired sample results where both results were detected at concentrations greater than the QL are presented in Table 3 of the Tech Memo. As stated in the Tech Memo, the comparison between split samples analyzed by different methods provides little value, because if the results do not agree then it is not certain which value is more accurate, and the USEPA has identified that acceptance criteria are not available for differences between analytical methods. For these reasons, expanded discussion about RPDs between HRMS and LRMS methods would not contribute to the demonstration that LRMS methods produce definitive data of know accuracy and precision.

4. *Limitations of Use - The text of the LRMS TM (Section 5, bullet 5) should be modified to clearly state the circumstances in which data from LRMS methods may be considered acceptable for risk assessment and risk-management decision-making (as discussed above).*

   ERM Response: As stated above in ERM's response to USEPA's General Comment, it would be premature to identify when the LRMS methods would or would not be acceptable prior to developing the DQOs for the specific investigation phase.

5. *QC Data - Salient quality control (QC) results should be summarized in the LRMS TM and used to support any conclusions presented. For example matrix spike/matrix spike duplicate results, internal standard, recovery standards, surrogate recoveries, and performance evaluation sample results should be discussed.*

ERM Response: Salient quality control results are already summarized in the data validation reports (included as Attachment 2 of the Tech Memo) and the Performance Evaluation Sample Scoring Report (included as Attachment 3). Surrogate and/or internal standard recoveries are discussed in Section 4.2 of the Tech memo and PE sample results are discussed in Section 4.1. Please provide specific questions about the QC data included in the Tech memo, so ERM can prepare specific responses as appropriate.

6. *Regression vs Correlation - On page 7, the LRMS TM discusses regression analysis as one way to evaluate the performance of two methods. However, what is presented is simply a correlation analysis. The EPA agrees with ERM's opinion stated in footnote 2 that regression analysis is not needed here, and that the results of the correlation analysis are adequate. However, the nomenclature should be corrected.*

ERM Response: The r^2 values presented in the Tech Memo were calculated from least-squares linear regression analyses, not a correlation analyses. The coefficient of determination, or "r^2," is practically interpreted to be a measure of the goodness of fit for a statistical model (such as a linear regression) and may range from 0 to 1. The coefficient of determination presented in the Tech Memo is different than the Pearson product-moment correlation coefficient, also referred to as the "correlation coefficient" or "r," presumably referred to in the comment, which is computed from a correlation analysis to quantify the degree to which two variables are related, and may range from -1 to +1. The text of the Tech Memo is therefore correct as written.

If you have any questions, please contact me at (480) 998-2401, or Kevin Lundmark at (801) 595-8400.

Sincerely,

David J. Abranovic, P.E.
Project Coordinator (ERM)

DJA/jcb/0132320
Attachments

cc: David Gibby (US Mag)

OU-1 Phase 1B RI Scoping Meeting

11 – 12 March 2015

Salt Lake City, Utah

usmag®

The world's leading sustainability consultancy

ERM

Agenda

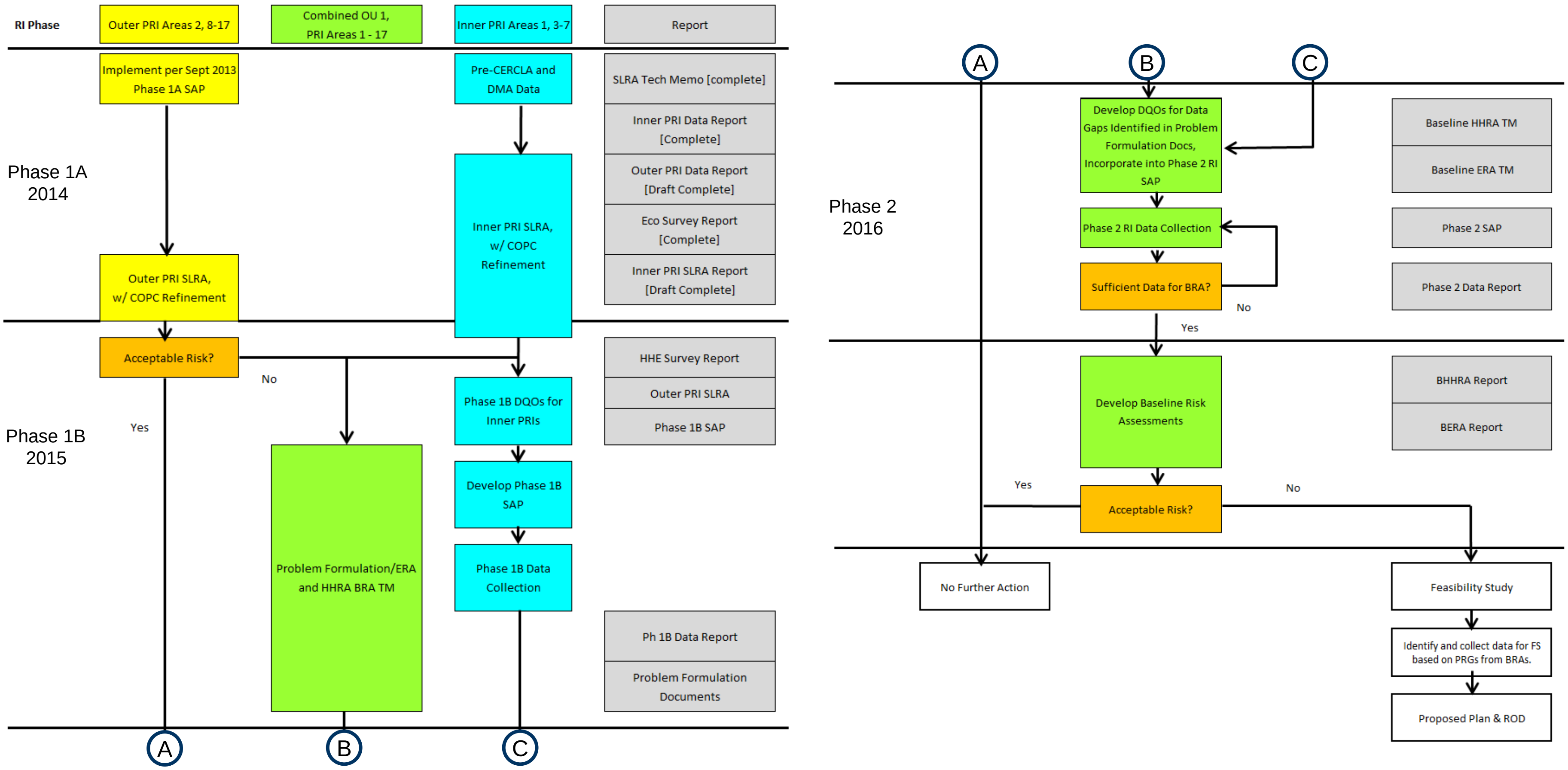
Day 1 – RI Process and Phase 1B DQOs

- RI Overview
- RCRA Settlement Update
- OU-1 Phase 1B RI DQOs
- Groundwater / Surface Water (PRI 17)

Day 2 – Technical Discussions

- 1 – Background
- 2 – Bulk vs. Fines Fractions Analysis
- 3 – Laboratory Analytical Methods
- 4 – Accessing Sampling Locations in Wastewater Ponds

RI Overview



RI Phase

Outer PRI Areas 2, 8-17

Combined OU 1, PRI Areas 1 - 17

Inner PRI Areas 1, 3-7

Report

Phase 1A
2014

Implement per Sept 2013 Phase 1A SAP

Outer PRI SLRA, w/ COPC Refinement

Pre-CERCLA and DMA Data

Inner PRI SLRA, w/ COPC Refinement

SLRA Tech Memo [complete]

Inner PRI Data Report [Complete]

Outer PRI Data Report [Draft Complete]

Eco Survey Report [Complete]

Inner PRI SLRA Report [Draft Complete]

Phase 1B
2015

Acceptable Risk?

No

Yes

Problem Formulation/ERA and HHRA BRA TM

Phase 1B DQOs for Inner PRIs

Develop Phase 1B SAP

Phase 1B Data Collection

HHE Survey Report

Outer PRI SLRA

Phase 1B SAP

Ph 1B Data Report

Problem Formulation Documents

A

B

C

Phase 2
2016

A

B

C

Develop DQOs for Data Gaps Identified in Problem Formulation Docs, Incorporate into Phase 2 RI SAP

Phase 2 RI Data Collection

Sufficient Data for BRA?

No

Yes

Baseline HHRA TM

Baseline ERA TM

Phase 2 SAP

Phase 2 Data Report

Develop Baseline Risk Assessments

Acceptable Risk?

Yes

No

BHHRA Report

BERA Report

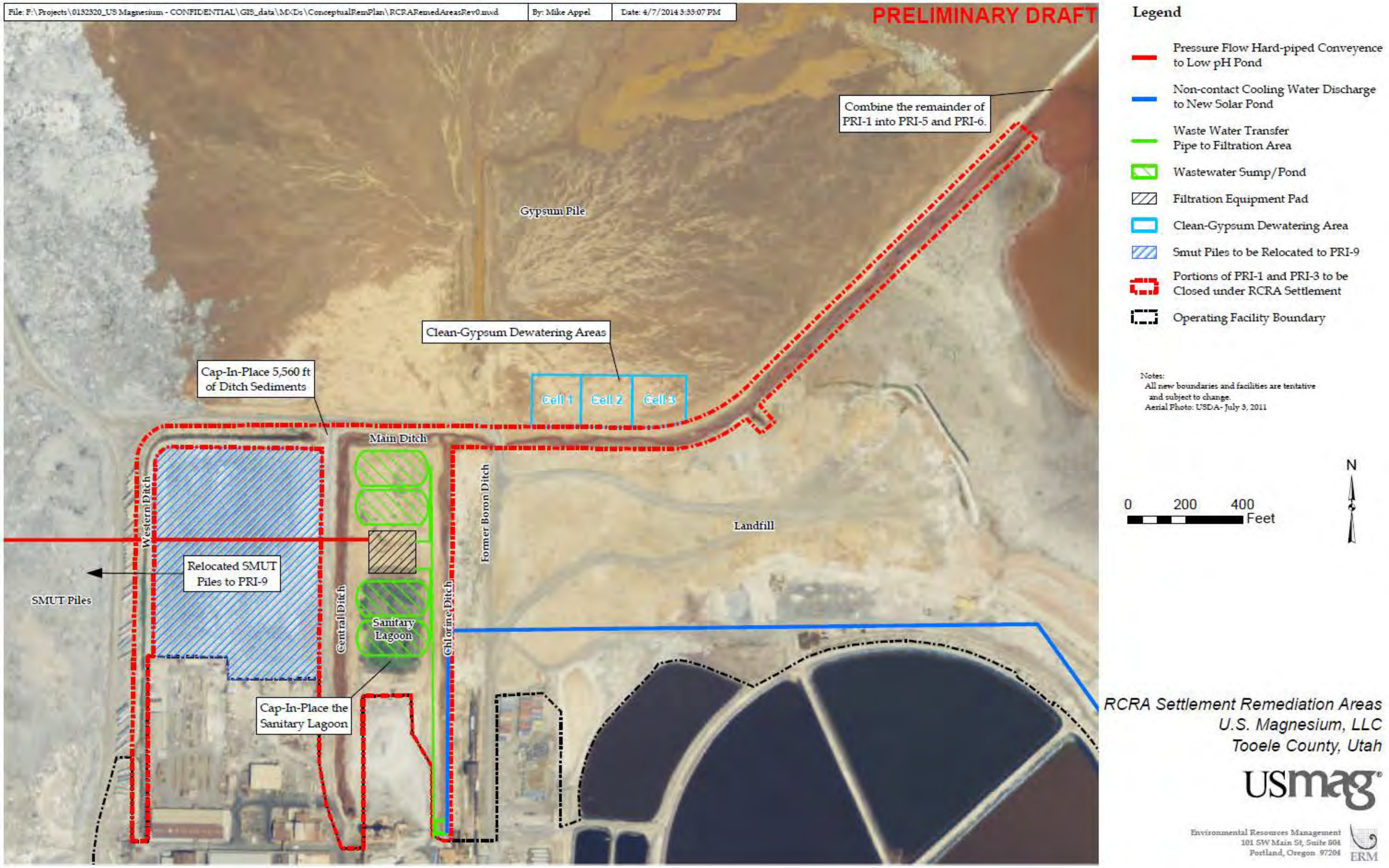
No Further Action

Feasibility Study

Identify and collect data for FS based on PRGs from BRAs.

Proposed Plan & ROD

RCRA Settlement Update



OU-1 Phase 1B DQOs

Comparison to Sept 2013 Phase 1A SAP

Element	2015 Phase 1B RI	Sept 2013 Phase 1A SAP
DQO	95UCL and Preliminary N&E	COPC Selection
Sample Locations (SB = subsurface)	PRI 1: 12 (5 SB) PRI 3: 9 PRI 4: 13 (1 SB) PRI 5: 16 (1 SB) PRI 6: 15 PRI 7: 15 (1 SB) Total: 80 (8 SB)	PRI 1: 17 (3 SB) PRI 3: 12 (1 SB) PRI 4: 14 (1 SB) PRI 5: 16 (2 SB) PRI 6: 17 (1 SB) PRI 7: 17 (1 SB) Total: 93 (9 SB)
Analyses	All samples analyzed for full list of COPCs	All samples analyzed for full list of COPCs

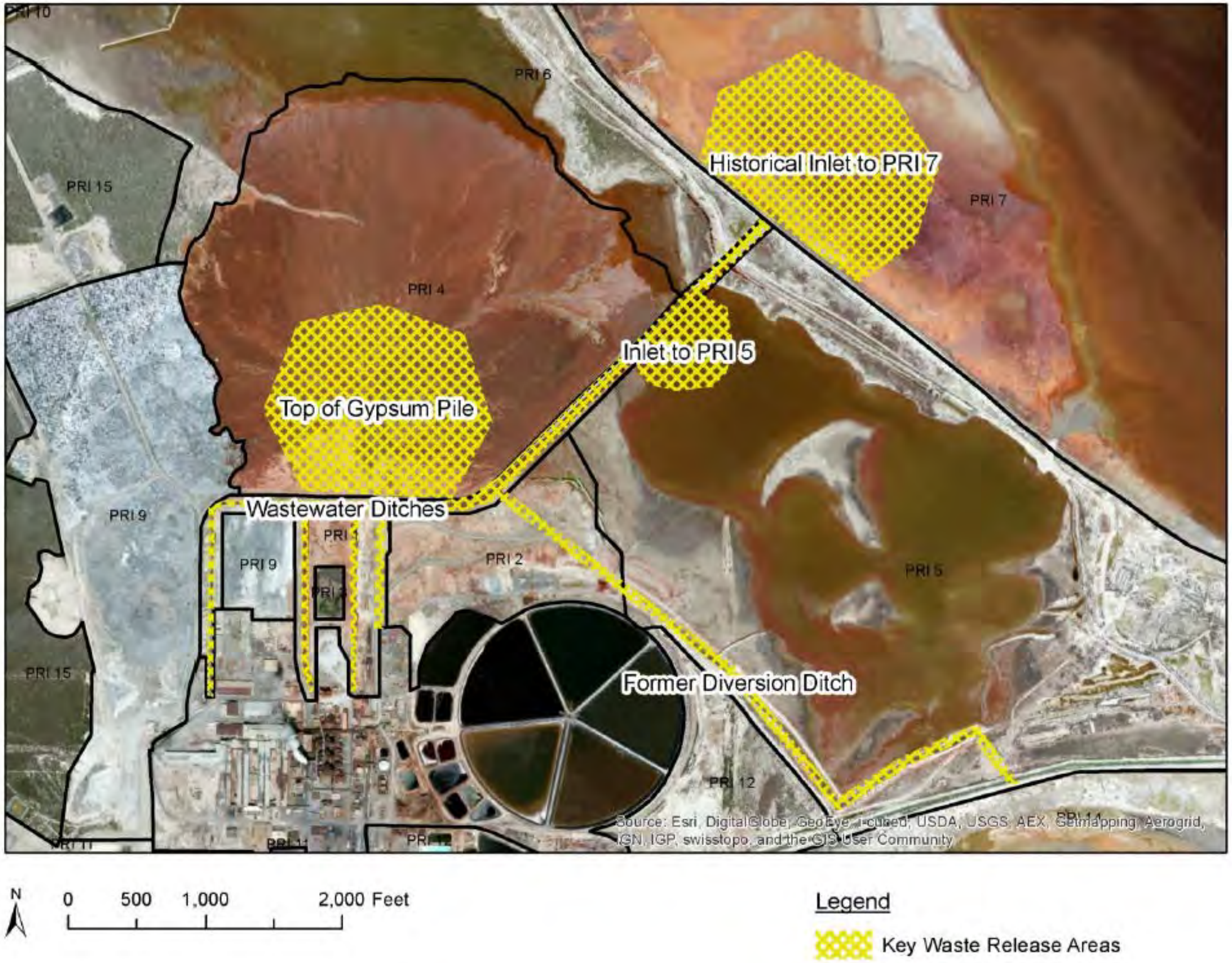
OU-1 Phase 1B DQOs

Sample Designs

95UCL	Preliminary N&E
Goal • Calculate reliable EPCs for COPCs in Inner PRIs	Goal • Preliminarily evaluate N&E of COPCs within Inner PRIs
Study Question • What is the 95UCL for COPCs in each of the Inner PRIs? (Principal Study Question)	Study Questions • How do COPC concentrations vary laterally? • How deep is waste present? • How do COPC concentrations vary with depth at key waste release locations?
Design • Precision curves to identify point of diminishing return for 95UCL estimate • Sample sizes at PRIs selected using CVs from Inner PRI data for D/F TEQs, total PCBs, HCB, and As.	Design • PRI-wide surface sampling for 95UCL • Subsurface sampling at key waste release locations • Waste thickness measurement at all locations

OU-1 Phase 1B DQOs

Key Waste Release Locations



Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

OU-1 Phase 1B DQOs

PRI 1 Ditches
Sample Locations

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

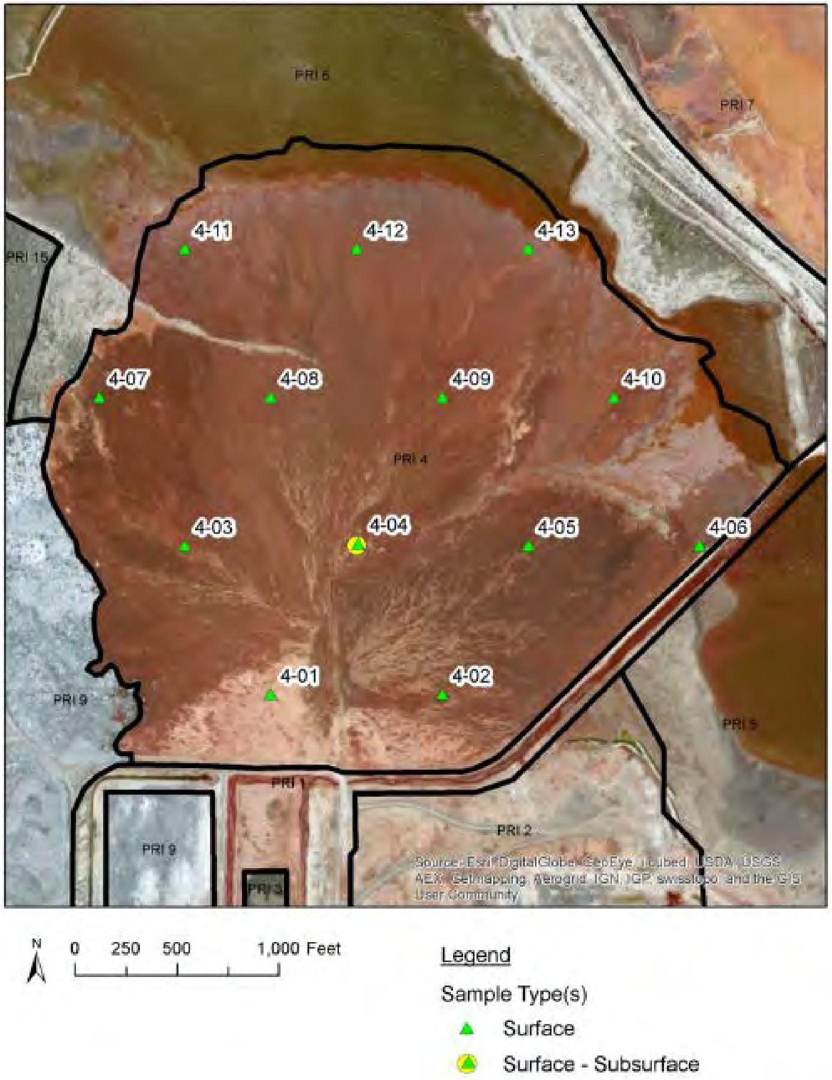
OU-1 Phase 1B DQOs

PRI 3 Sanitary Lagoon Sample Locations

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

OU-1 Phase 1B DQOs

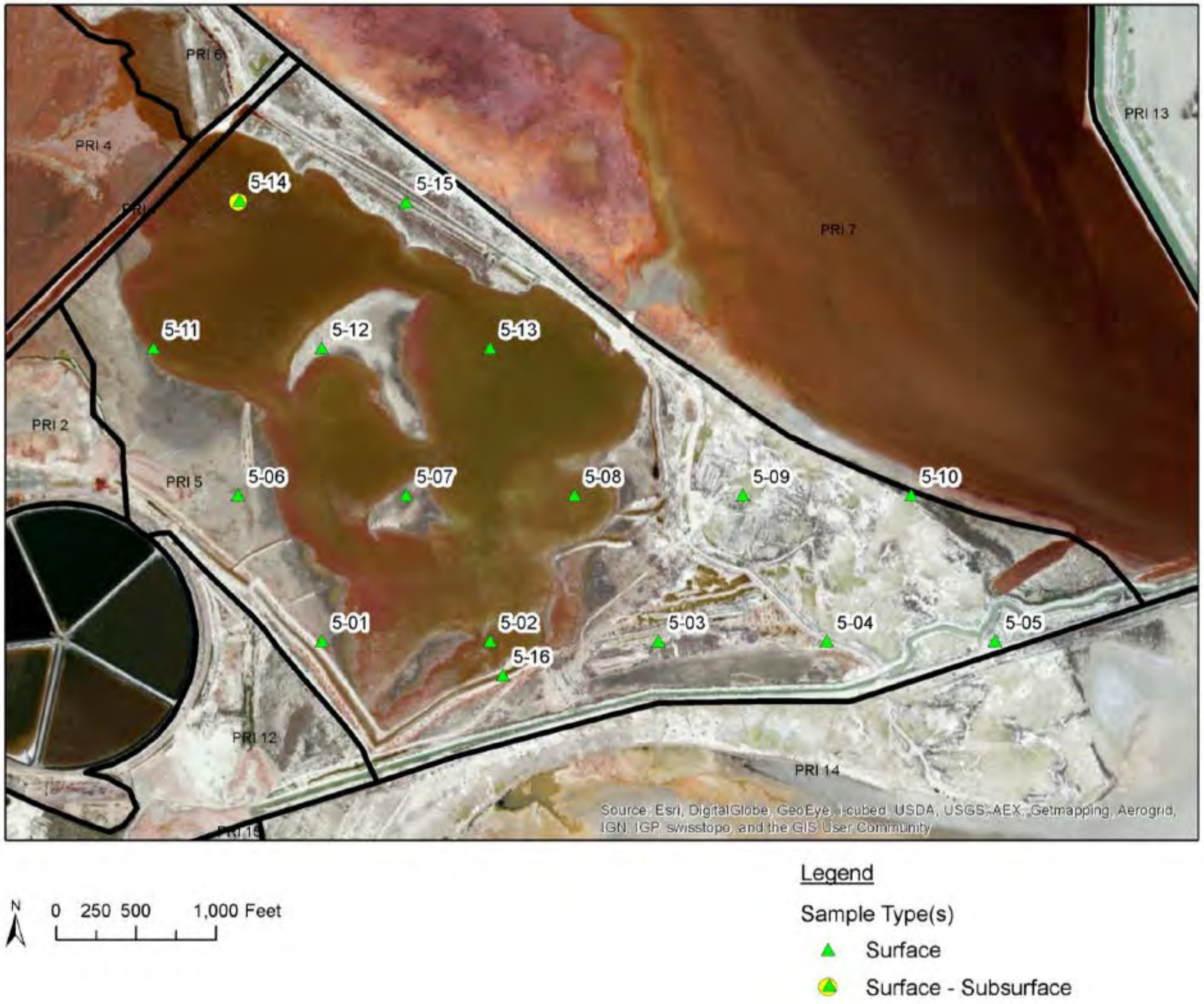
PRI 4 Gypsum Pile Sample Locations



Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

OU-1 Phase 1B DQOs

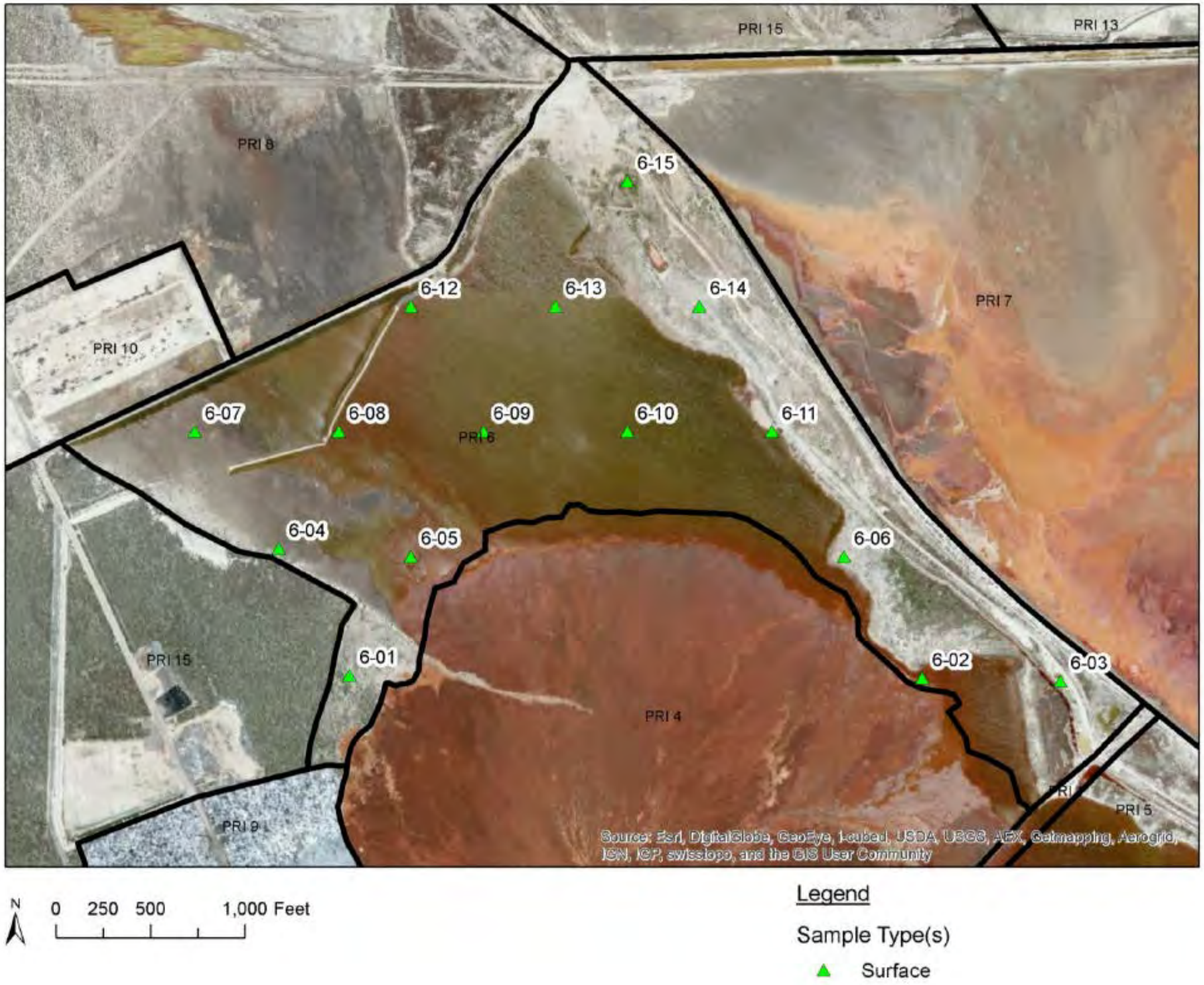
PRI 5 SE Waste Pond Sample Locations



Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

OU-1 Phase 1B DQOs

PRI 6 NW Waste Pond Sample Locations



Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

OU-1 Phase 1B DQOs

PRI 7 NE Waste Pond Sample Locations

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Groundwater/Surface Water PRI 17

Phase 1A SW/GW samples not collected:

- SW: 9 in PRI 1 Ditches, 2 in PRI 3 Sanitary Lagoon (if water present), 3 in PRI 5 SE Waste Pond, 5 in PRI 6 NW Waste Pond, 1 in PRI 7 OWP (if water present)
- GW: MW-16

Hydro CSM Summer 2015

- Component of the Salt Cap Treatability Study Work Plan
- Objective is to refine the understanding of groundwater-surface water interactions within and adjacent to the Current Waste Ponds (PRI Areas 5 and 6) and the Old Waste Pond (PRI Area 7)
- To include topographic (Lidar) survey, hydrogeologic cross sections, groundwater elevation contour maps and surface water elevations, groundwater and surface water geochemistry, and water budget

Technical Topic 1 - Background

Background Approach

Is there existing data to develop BG?

- EPA R8 (arsenic), UTTR-N (metals), FWS (wetlands; metals, PCB, D/F), CO Front Range (D/F), 2003 USM FERA
- Phase 1A data for Outer PRIs

Evaluate Phase 1A Data to support development of BG

- Determine if one population or to segregate RI/FS Study Area by soil and/or geology
- Assess whether BG can be extracted from Phase 1A data set
- Use Phase 1A data to support BG sampling design

Metals versus Organics

- Different data needs
- Some intersection of BG influences

Technical Topic 1 - Background

Phase 1A Data Evaluation

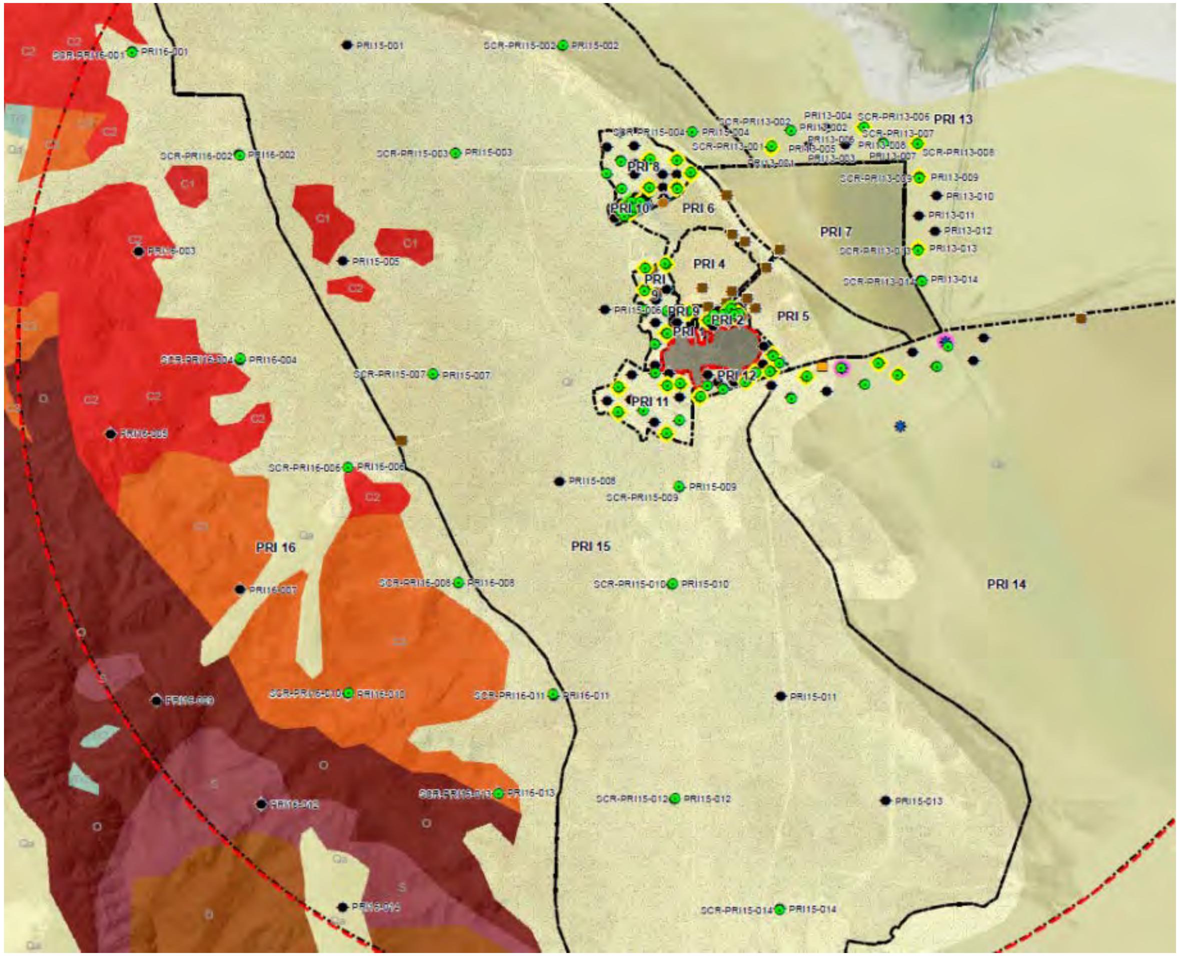
Part 1 – Determine if/how to segregate samples

1. Overall objective: lump when possible (maximize n, simplicity)
2. Segregate by geology, soil unit, or PRI?
3. Support lumping/segregation using multiple lines of evidence:
   - Multivariate analyses: NMDS plots (clustering/scaling), perMANOVA (significance testing), geochemical plots
   - Univariate analyses: Boxplots, ANOVA

Technical Topic 1 - Background

Geology

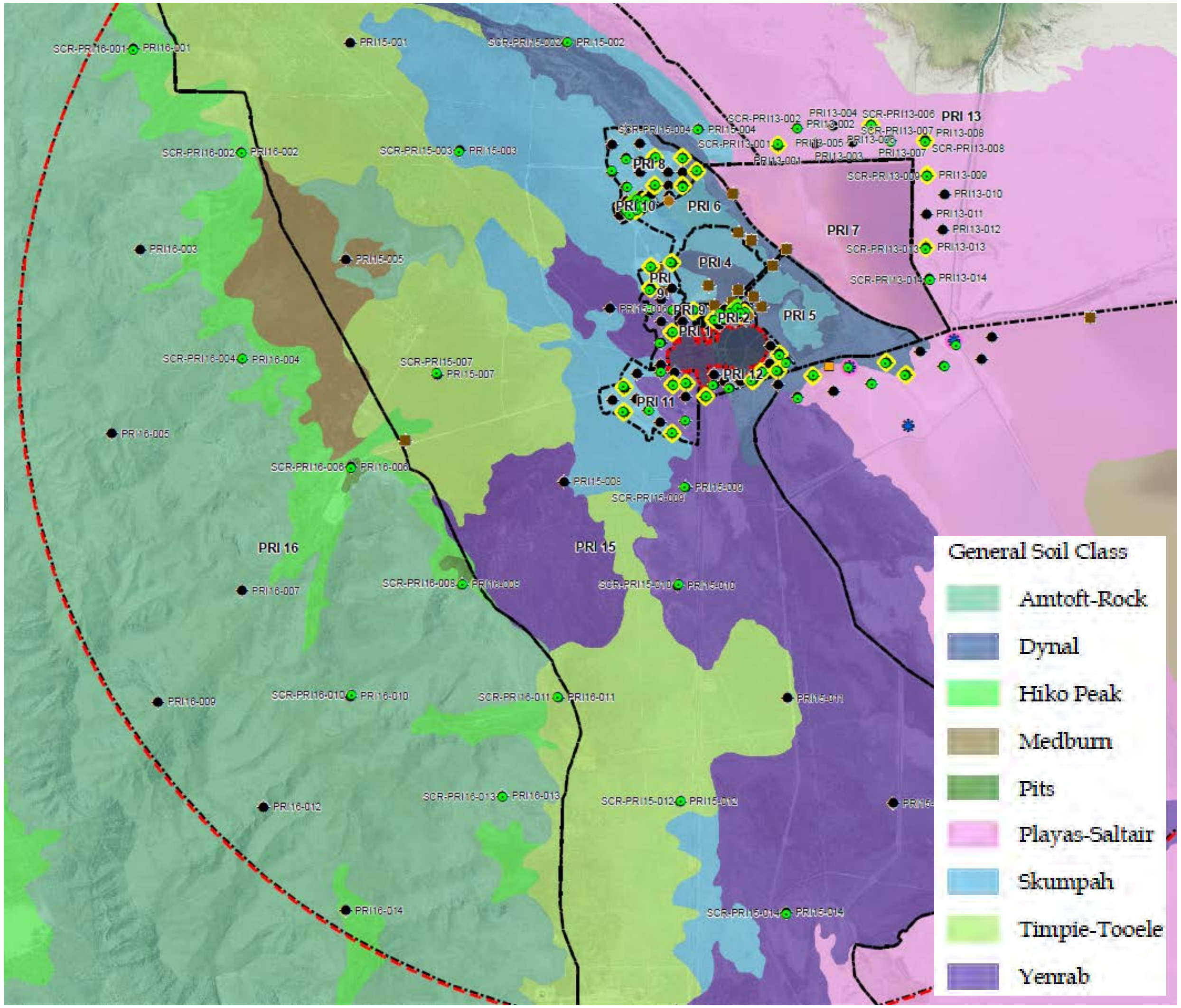
- Qs - Surficial mud and salt flat deposits
- Ql - Surficial Lake Bonneville deposits
- Other – Alluvium/ colluvium (Qa) and consolidated rock in Lakeside Mtns (C1, C2, C3, D, O, S)



Technical Topic 1 - Background

Soil

- 9 General soil classes
- Most samples are within 5 classes:
  - Playas-Saltair
  - Skumpah
  - Yenrab
  - Dynal
  - Amtoft Rock



Technical Topic 1 - Background

Samples by Soil and Geology

 # Samples with Overlapping Geology and Soils - All Units

		Geology		"Other"					
	Soil type	**Ql**	**Qs**	**C2**	**C3**	**O**	**Qa**	**S**	**Sum**
	Playas-Saltair	0	19	0	0	0	0	0	19
	Dynal	10	3	0	0	0	0	0	13
	Yenrab	13	0	0	0	0	0	0	13
	Skumpah	11	1	0	0	0	0	0	12
	Amtoft-Rock	2	0	2	3	1	0	1	9
"Other"	Timpie-Tooele	5	0	0	0	0	0	0	5
	Hiko Peak	2	0	0	0	0	1	0	3
	Checkett	0	2	0	0	0	0	0	2
	Medburn	1	0	0	0	0	0	0	1
	Pits	1	0	0	0	0	0	0	1
	Sum	45	25	2	3	1	1	1	78

 # Samples with Overlapping Geology and Soils - Major Units

Soil Type	**Ql**	**Qs**	**Other**
Playas-Saltair	0	19	0
Dynal	10	3	0
Yenrab	13	0	0
Skumpah	11	1	0
Amtoft-Rock	2	0	7
Other	9	2	1

 # Samples per Soil Type per PRI

		Playas-Saltair	**Dynal**	**Yenrab**	**Skumpah**	**Amtoft-Rock**	**Other**
Upland	PRI-11	0	0	5	9	0	0
	PRI-12	0	9	3	0	0	0
	PRI-15	0	1	5	3	0	6
	PRI-16	0	0	0	0	9	5
Lakebed	PRI-13	14	0	0	0	0	0
	PRI-14	5	3	0	0	0	1

 # Samples per Geologic Unit per PRI

		Ql	**Qs**	**Other**
Upland	PRI-11	14	0	0
	PRI-12	12	0	0
	PRI-15	12	3	0
	PRI-16	6	0	8
Lakebed	PRI-13	0	14	0
	PRI-14	1	8	0

Excludes PRI12-010 and -011 (salt) and PRI14-002 thru -008 (impacted)

Technical Topic 1 - Background

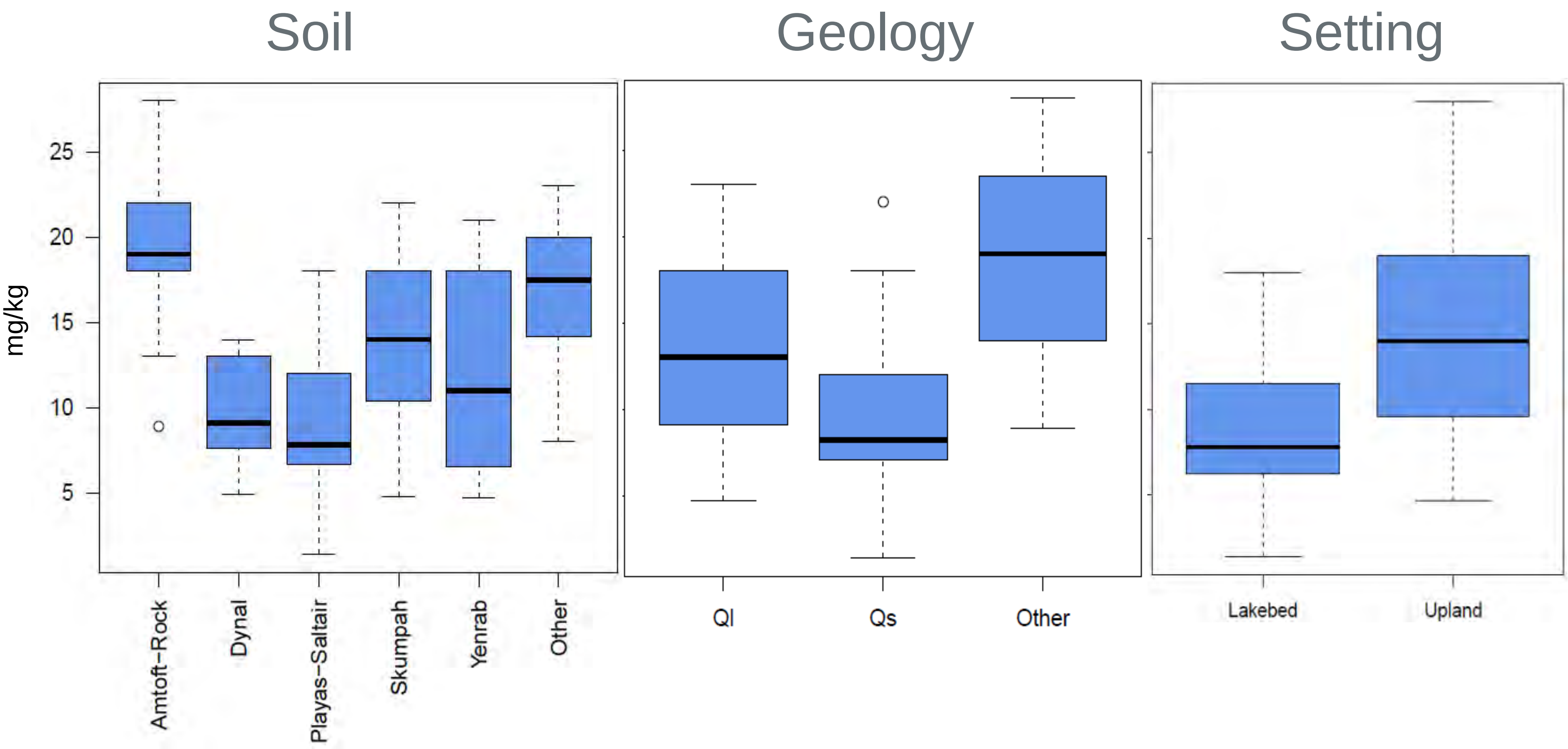
ANOVA Test Results

Grouping	Soil	Geology	Setting
Subgroups	1. Playas-Saltair 2. Dynal 3. Yenrab 4. Skumpah 5. Amtoft-Rock 6. Other	1. Qs 2. Ql 3. Other	1. Lakebed 2. Upland
ANOVA - Significant Difference	Aluminum Beryllium Iron Lead	Aluminum Beryllium Chromium Iron Lead	Beryllium Chromium Iron Lead
Post-hoc comparisons	Amtoft Rock different	Qs different	n/a (1 D.o.F.)

- ANOVA tests whether a single metal is different among any of the groups
- Post hoc tests follow ANOVA with pair-wise comparisons to determine which individual groups are significantly different from each other

Technical Topic 1 - Background

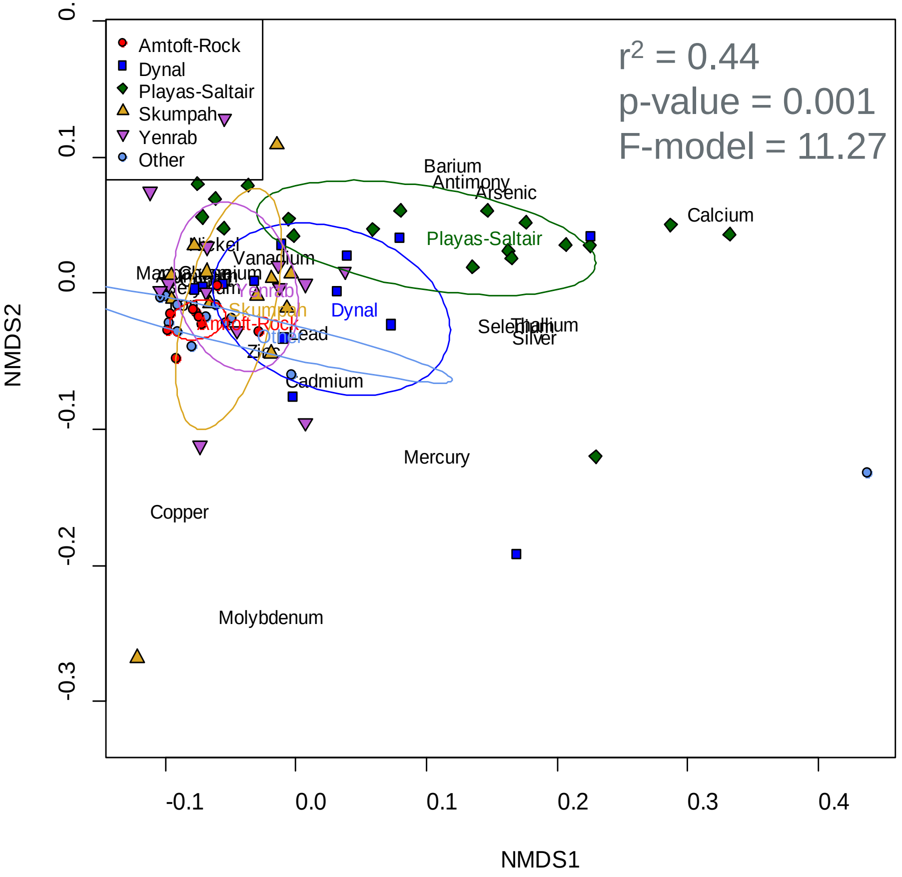
Boxplots - Lead



Technical Topic 1 - Background

NMDS Plots & perMANOVA Testing – Soil and Geology

Soil

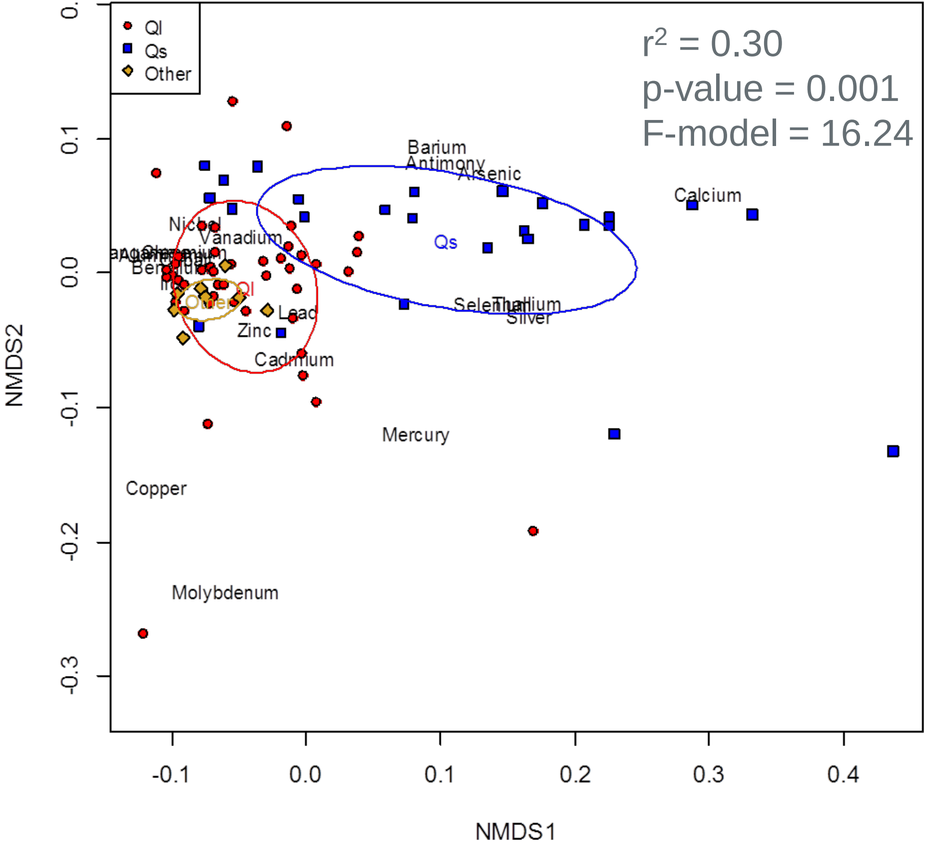


$r^2 = 0.44$

p-value = 0.001

F-model = 11.27

Geology



$r^2 = 0.30$

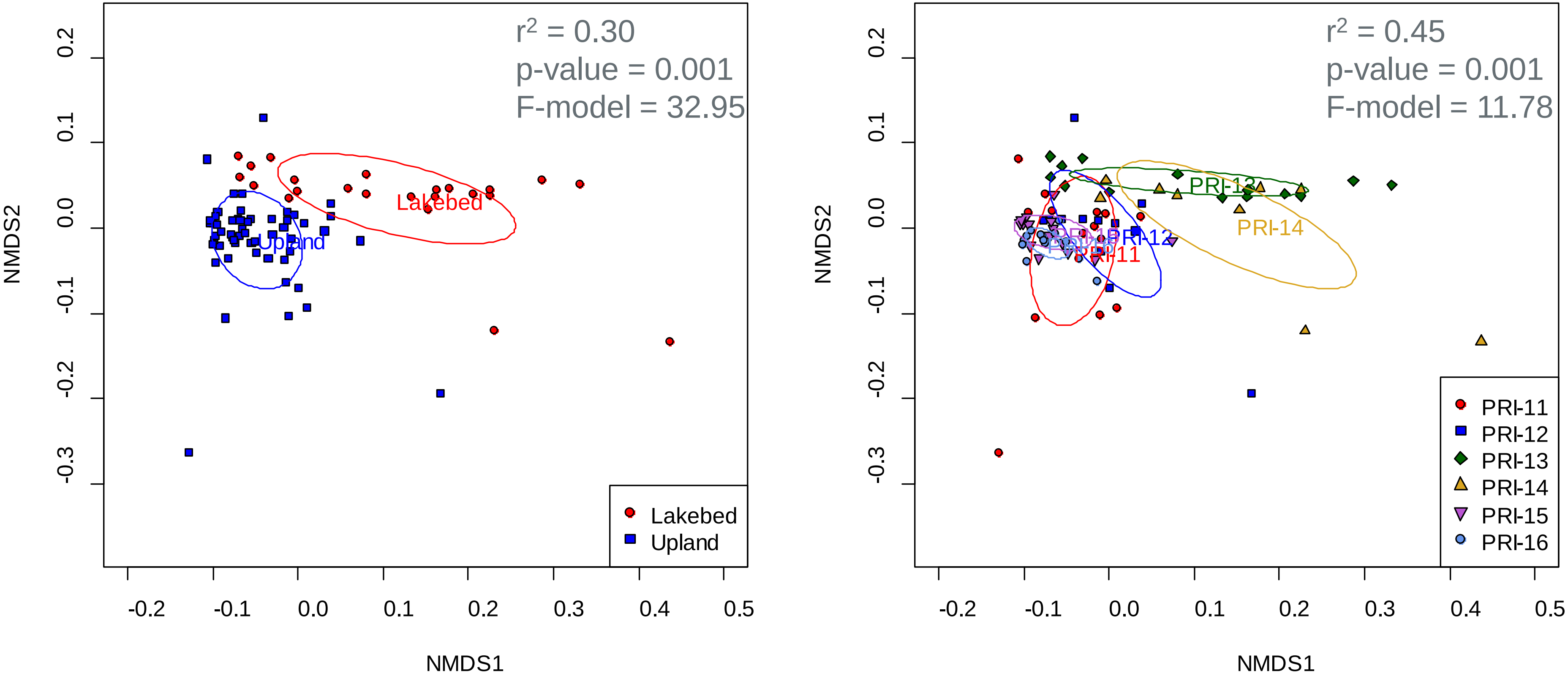
p-value = 0.001

F-model = 16.24

NMDS = Non-Metric Multi-Dimesional Scaling

Technical Topic 1 - Background

NMDS Plots & perMANOVA Testing – PRI Area and Setting



Setting

PRI Area

NMDS = Non-Metric Multi-Dimesional Scaling

Technical Topic 1 - Background

Results – Proposed Data Groups / Sampling by Setting

Group 1 = Lakebed

- Defined as PRIs 13 & 14
- Includes almost all Qs (geology) and Playas-Saltair (soil)
- Sample size n = 29

Group 2 = Upland

- Defined as PRIs 11, 12, 15, and 16
- Includes a variety of geology and soil types
- Sample size n = 56 (excludes 2 waste salt samples in PRI 12)
- Samples PRI12-011 and PRI12-012 excluded (waste salt, not soil)

Technical Topic 1 - Background

How to Develop BG Data Set?

Option 1 – Use existing regional data

- Existing data sets incomplete or limited sample size

Option 2 – Extract from Site data

- Following graphical iterative method in 2014 EPA Background Issue Paper: Prepare Q-Q plots, identify/eliminate outliers, identify break point (BP) as background concentration
- Requires ~subjective identification of BP in Q-Q plots

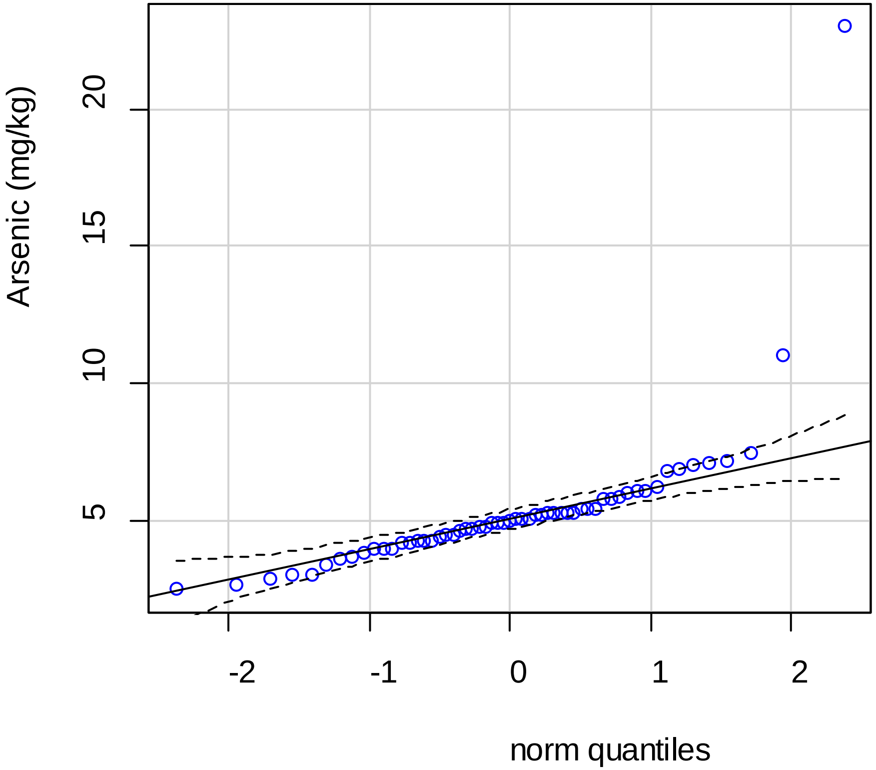
Option 3 – Collect BG samples at reference area

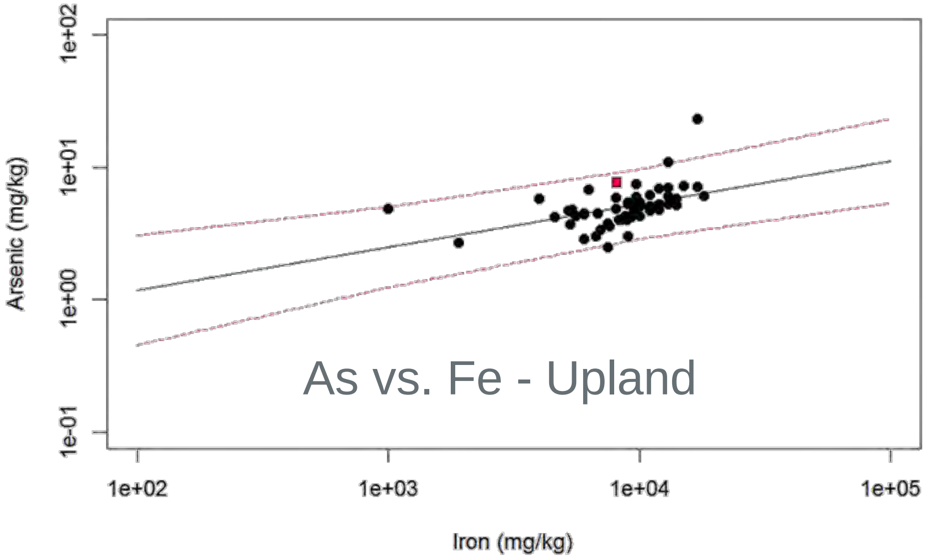
- Lakebed and Upland settings
- Statistically-derived sample size

Technical Topic 1 - Background

Arsenic

Upland




As vs. Fe - Upland

Technical Topic 1 - Background

Example BG Sample Size Estimate

Data treatment

- Lakebed dataset used (PRIs 13 &14) to calc mean and std. dev.
- Anomalies culled using Q-Q plots

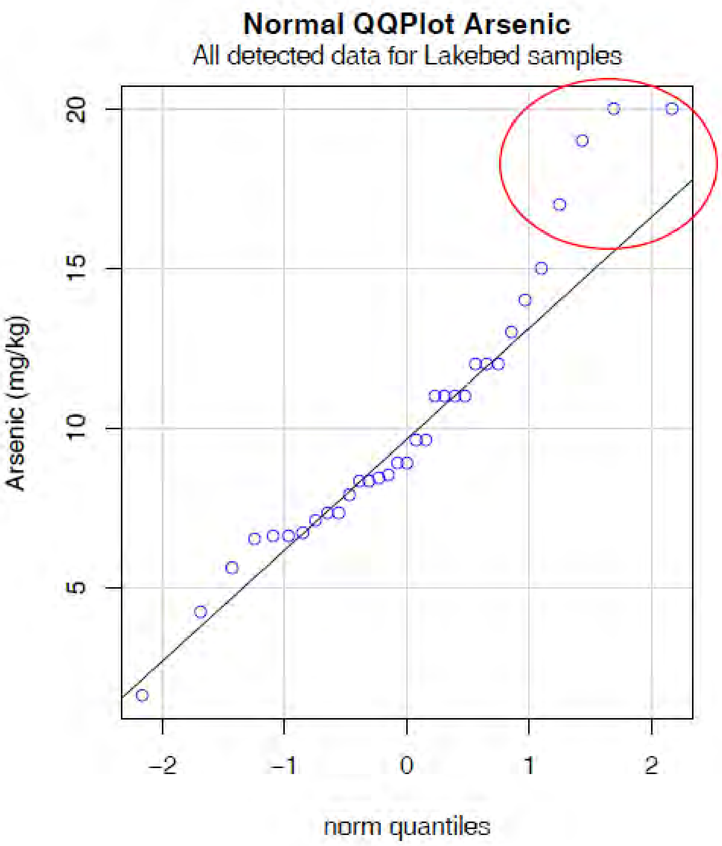
VSP Permutations for Mock Sample Size Calculations

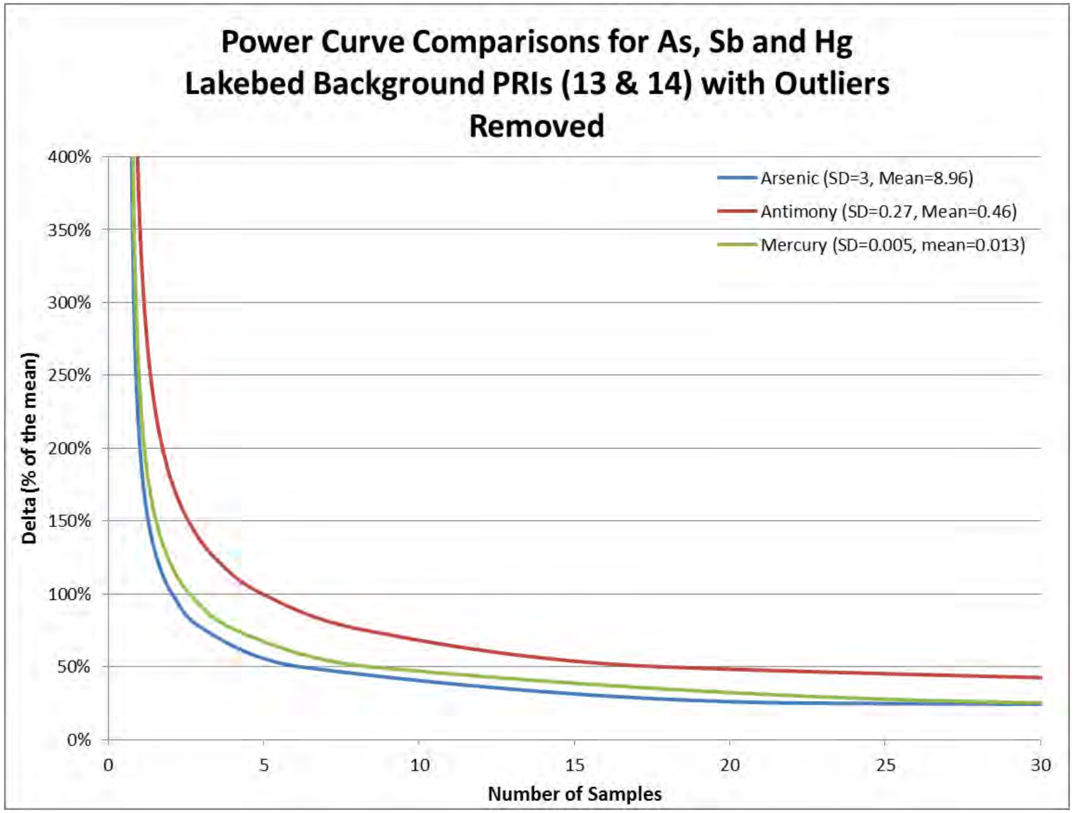
- Compare Average to Background Average module
- Normal distribution assumed, Alpha = 0.05, Beta = 0.2, H0 = site > background
- False positive (aka gray region or delta) was varied as percentage of the mean
- Power curves generated using equation from VSP to plot sample size as a function of delta (percent of mean)

Technical Topic 1 - Background

Example BG Sample Size Estimate

Power Curves (i.e., Return on Sample Investment)





Technical Topic 1 - Background

Example BG Sample Size Estimate Results

- Characterize two BG populations: Lakebed and Upland
- Sample size between 10 and 20 samples per population

Technical Topic 2 – Bulk vs. Fines Analysis

Relevance to Phase 1B DQO

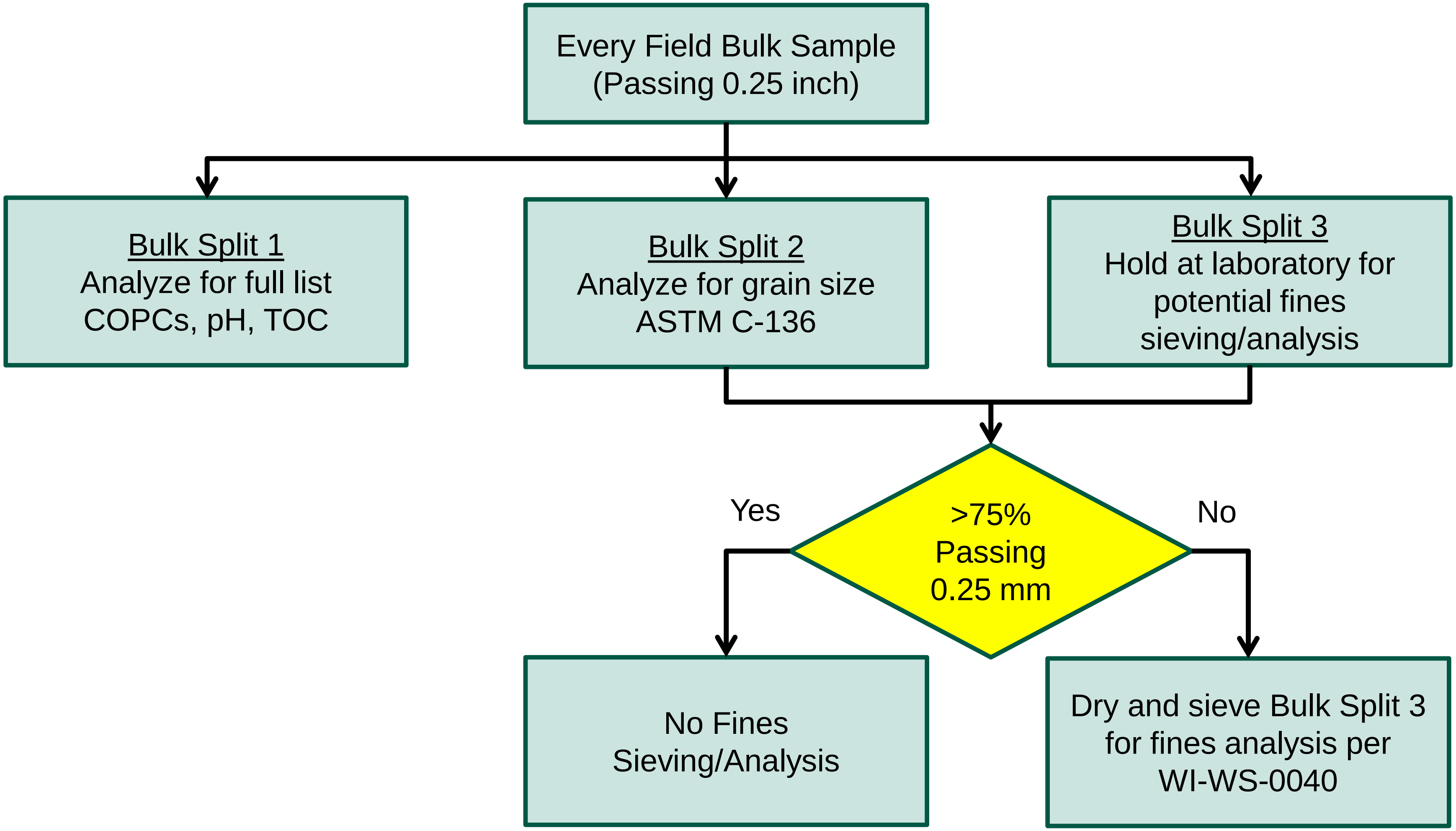
- Fines data may be needed for EPCs
- Role of fines in BRAs to be determined

Phase 1A Outer PRI Bulk vs. Fines Results

- PRIs 15 & 16:
  - Screening samples >75% fines → no fines analysis
- PRIs 2 & 8 – 14:
  - 33 analytes with ≥ 8 detect pairs
  - Tau^2 (r^2 equivalent) range 0.13 to 0.71, median 0.50
  - Slope range 0.51 to 1.86, median 1.04
  - Proxy adjustment factor of 2.0 selected for all detected SVOCs and PAHs.

Technical Topic 2 – Bulk vs. Fines Analysis

Phase 1B Proposal



Every Field Bulk Sample
(Passing 0.25 inch)

<u>Bulk Split 1</u>
Analyze for full list
COPCs, pH, TOC

<u>Bulk Split 2</u>
Analyze for grain size
ASTM C-136

<u>Bulk Split 3</u>
Hold at laboratory for
potential fines
sieving/analysis

>75%
Passing
0.25 mm

Yes

No Fines
Sieving/Analysis

No

Dry and sieve Bulk Split 3
for fines analysis per
WI-WS-0040

Technical Topic 3 – Laboratory Analytical

Outstanding laboratory analytical SOP issues from Sept 2013 Phase 1A SAP

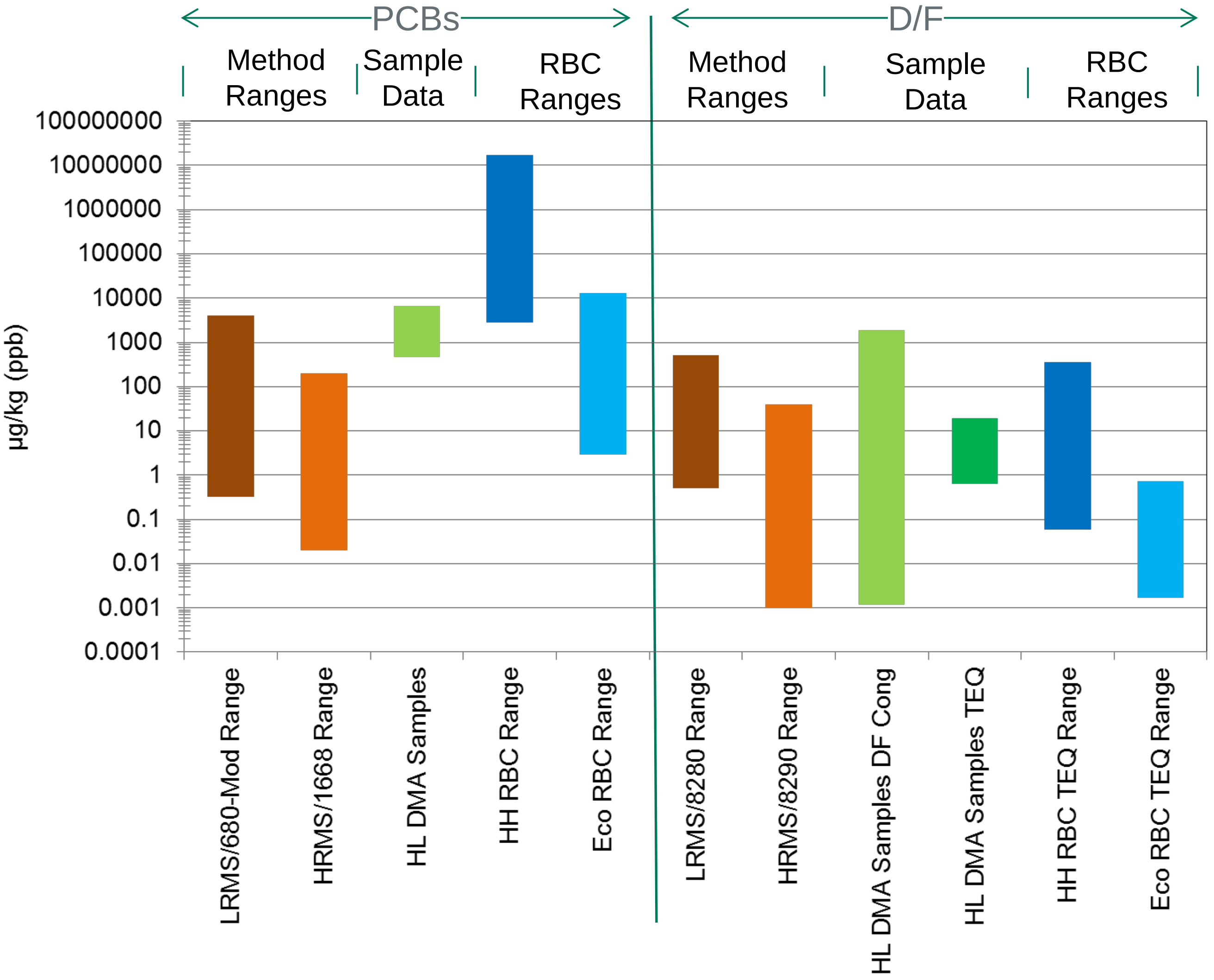
- 20 October 2013 comments from PWT3
- Comments specific to Inner PRI solids samples:
  - Methanol-preserved samples for VOC samples at ditches (field SOP)
  - Anti-foaming agents for aqueous VOC analysis
  - Other issues identified during Phase 1A sample analysis?

LRMS Analysis for PCB and D/F

- Method 680-Modified for PCB (Alpha Analytical)
- Method 8280 for DF (TestAmerica)

Technical Topic 3 – Laboratory Analytical

LRMS and HRMS Working Ranges



Technical Topic 3 – Laboratory Analytical

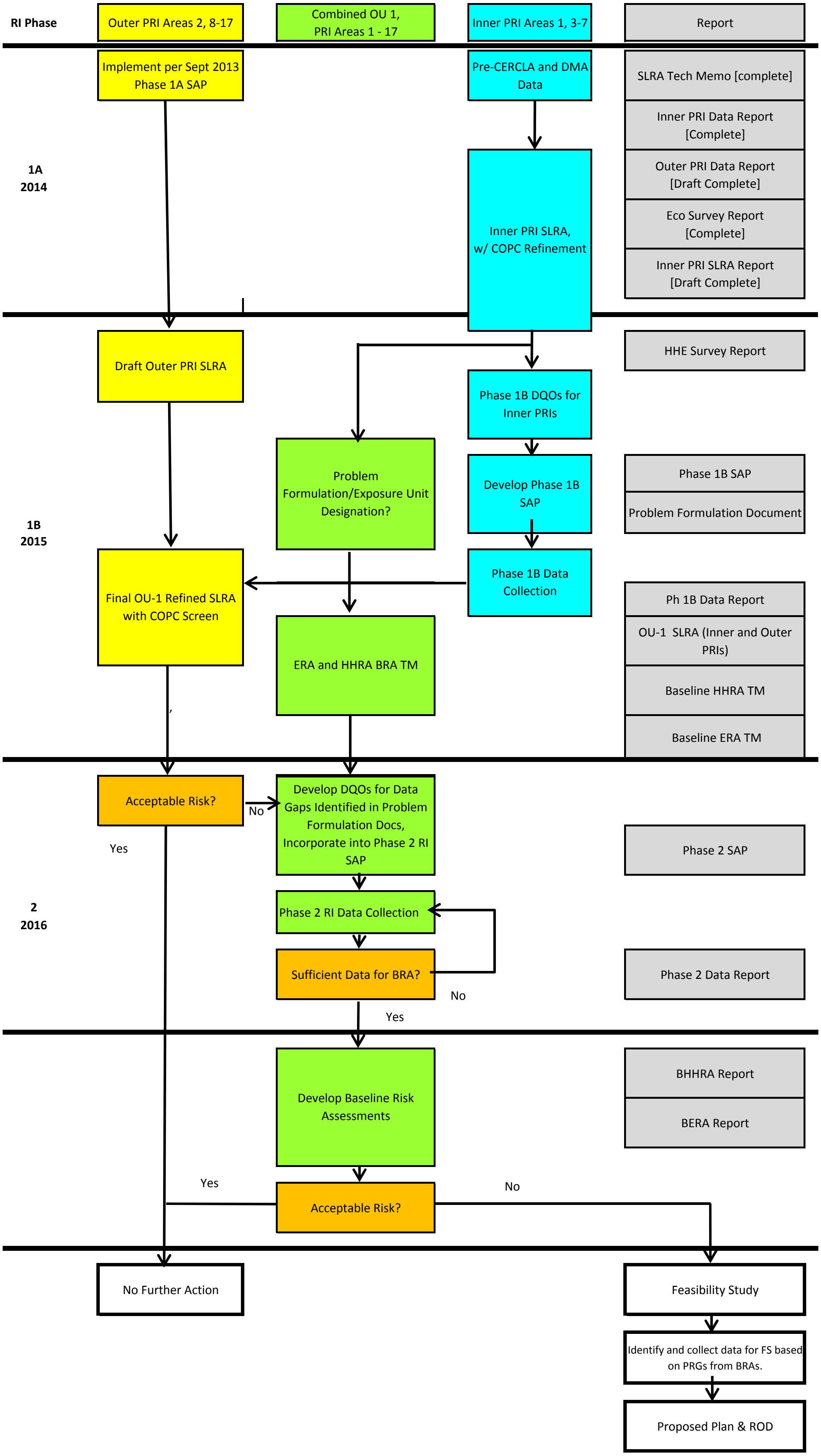
PCB and DF LRMS Analysis Phase 1B Proposal

- Procedures will be defined in SAP and Project-Specific Work Instructions
- Identify samples for LRMS analysis based on location and visible waste presence
- Re-analyze LRMS sample by HRMS methods:
  - If results from LRMS analysis are ND for all analytes; or
  - If the highest concentration constituent is within the HRMS calibration range and no potentially damaging matrix interferences are evident.
- Re-analyze HRMS sample by LRMS:
  - If HRMS results indicate very high concentrations (e.g, detector saturation at max dilution)

Technical Topic 4 – Waste Pond Access

Options for Open-water Sampling at PRIs 5 and 6

1. Drain current waste ponds to OWP and use OWP for evaporating process wastewater
2. Waste Pond Operations – Take one pond off-line, allow to dry, sample, then take other pond off-line and sample
3. Earthen ramps/berms
4. Relocate open-water samples to shore areas
5. Delay sampling at PRIs 5 and 6 until dry (after new wastewater system operating)
6. Air boat
7. Fiberglass boat with mud motor
8. Floating Dock
9. Man Lift
10. Pontoon work boat with mud motor
11. Skiff boat (Pelican boat) and Wading
12. Work platform with tether/winch lines
13. Marsh Buggy
14. Helicopter-deployed Dredge (Ponar, Eckman, etc.)
15. Helicopter – deployed Work Platform
16. Other Ideas?


RI Phase
Outer PRI Areas 2, 8-17
Combined OU 1, PRI Areas 1 - 17
Inner PRI Areas 1, 3-7
Report
Implement per Sept 2013 Phase 1A SAP
Pre-CERCLA and DMA Data
SLRA Tech Memo [complete]
Inner PRI Data Report [Complete]
1A 2014
Outer PRI Data Report [Draft Complete]
Inner PRI SLRA, w/ COPC Refinement
Eco Survey Report [Complete]
Inner PRI SLRA Report [Draft Complete]
Draft Outer PRI SLRA
HHE Survey Report
Phase 1B DQOs for Inner PRIs
Problem Formulation/Exposure Unit Designation?
Develop Phase 1B SAP
Phase 1B SAP
Problem Formulation Document
1B 2015
Final OU-1 Refined SLRA with COPC Screen
Phase 1B Data Collection
Ph 1B Data Report
OU-1 SLRA (Inner and Outer PRIs)
ERA and HHRA BRA TM
Baseline HHRA TM
Baseline ERA TM
Acceptable Risk?
No
Develop DQOs for Data Gaps Identified in Problem Formulation Docs, Incorporate into Phase 2 RI SAP
Yes
Phase 2 SAP
2 2016
Phase 2 RI Data Collection
Sufficient Data for BRA?
Phase 2 Data Report
No
Yes
Develop Baseline Risk Assessments
BHHRA Report
BERA Report
Yes
No
Acceptable Risk?
No Further Action
Feasibility Study
Identify and collect data for FS based on PRGs from BRAs.
Proposed Plan & ROD

Attachment 9I

7 April 2015 Draft Data Quality Objectives for OU-1 Phase 1A/1B RI SAP

Kevin Lundmark

From:	David Abranovic
Sent:	Tuesday, April 07, 2015 10:50 AM
To:	Ken Wangerud (Wangerud.Ken@epamail.epa.gov)
Cc:	Justin Burning; Catherine D. LeCours (clecours@PWT.COM); R. David Gibby (dgibby@usmagnesium.com); Mike Storck (mstorck@utah.gov); Kevin Lundmark; Mark Ransom; Jennifer Holder; Dan Wall (Wall.Dan@epamail.epa.gov)
Subject:	RE: Draft OU-1 Phase 1 A/B DQO
Attachments:	DQO OU-1 Ph 1AB RI - DRAFT.pdf

Ken

Please find attached the draft OU-1 Phase 1 A/B DQO for your review. This DQO was prepared based on the discussions and agreements reached during the 11/12 March 2015 scoping meeting. However please note that based on comments received via e-mail from Dan Wall on 2 April, requesting that HCB and PCBs be added to the background sample design among other things, we are unable to include the background study in this version of the DQO. We have therefore included a placeholder for the background portion of DQO, and will submit it to EPA under separate cover as soon as the risk assessors agree on how best to address Dan's comments. I do not believe that the additional work on the background sample design should delay EPA's submittal of the Phase 1A/B SAP template to ERM. Our team is immediately available to initiate work on the SAP, and as you know the Phase 1 A/B schedule is already very compressed, so we would like to avoid any unnecessary delays. Feel free to contact me anytime if you have any questions regarding this document.

david

David J. Abranovic P.E.
Partner

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Memorandum

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Resources
Management

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http://www.erm.com

To: Ken Wangerud, USEPA Region 8

From: David Abranovic (ERM), Kevin Lundmark (ERM)

Date: DRAFT 7 April 2015

Subject: Draft Data Quality Objectives for OU-1 Phase 1A/1B RI SAP

This memorandum presents the draft data quality objectives (DQOs) for the Phase 1A/1B Remedial Investigation (RI) for Operable Unit 1 (OU-1) at the US Magnesium site. As discussed and agreed on during the OU-1 Phase 1B RI DQOs Scoping Meeting conducted on 11 and 12 March 2015, ERM has develop this revised Phase 1A/1B DQO for review by the United States Environmental Protection Agency (USEPA) and the Utah Department of Environmental Quality. These DQOs will become Worksheet 11 in the OU-1 Phase 1A/1B Sampling and Analysis Plan (SAP), currently scheduled to be implemented during the 2015 field season. Accordingly, this document has been formatted consistently with Worksheet 11 as it would appear in the Phase 1A/1B SAP. The final Phase 1A/1B SAP will be approved and issued by the USEPA.

11.0 SAP WORKSHEET #11 – PROJECT QUALITY OBJECTIVES/ SYSTEMATIC PLANNING PROCESS STATEMENTS

Based on the conceptual site model provided in Worksheet #10 of the *Phase 1A Remedial Investigation Sampling and Analysis Plan to Identify Chemicals of Potential Concern in Soils, Sediment, Solid Waste, Water and Air, and Receptor Surveys, Revision 0 for PRI Areas 2 and 8 through 17* (hereafter referred to as "Phase 1A SAP") (USEPA 2013), this worksheet presents data quality objectives (DQOs) and associated sampling strategies and rationale for the Phase 1A/1B Remedial Investigation (RI) for Operable Unit 1 (OU-1) at the US Magnesium site (Site).

The DQOs presented herein follow the seven-step process described in the 2006 United States Environmental Protection Agency (USEPA) *Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G-4*.

11.1 OBJECTIVES OF THE PHASE 1A/1B RI FOR OU-1

The objective of Phase 1A/1B RI for OU-1 is to obtain sufficient data to support:

1. Identification of chemicals of potential concern (COPCs) for human and ecological receptors within Preliminary Remedial Investigation (PRI) Areas 1 and 3 through 7.
2. Preliminary evaluation of the nature and extent (N&E) of impacts within PRI Areas 1 and 3 through 7.
3. Estimation of background (ambient) concentrations for metals and dioxins/furans (D/F).
4. Confirm that suitable reference areas (i.e., non-impacted areas) are available for biota sampling that may be conducted during a future phase of the RI.

Broadly, these objectives are combined into two Principal DQOs of "COPC Selection and Preliminary N&E at Inner PRI Areas" and "Evaluation of Background." The remainder of this worksheet presents the seven-step DQO process for the two Principal DQOs.

11.2 DATA QUALITY OBJECTIVES FOR COPC SELECTION AND PRELIMINARY NATURE AND EXTENT AT INNER PRI AREAS

11.2.1 STEP 1: STATE THE PROBLEM

11.2.1.1 Description of the Problem

The RI/Feasibility Study (FS) Area Boundary has been preliminarily defined by the USEPA as a 5-mile radius around the US Magnesium facility. For purposes of project planning during the initial phases of the RI, the USEPA initially divided the site into 18 PRI Areas (or "PRIs"), with the "Inner PRIs" defined as PRIs 1 and 3 through 7, the "Outer PRIs" defined as PRIs 2 and 8 through 17, and PRI 18 being ambient air. The Site was subsequently divided into Operable Units by the USEPA, with OU-1 including PRIs 1 through 17 and OU-2 being defined as PRI 18.

Phase 1A of the OU-1 RI provided the information necessary to select human and ecological COPCs for the Outer PRIs. For the Inner PRIs, historical (i.e., pre-Comprehensive Environmental Response, Compensation and Liability Act [CERCLA]) and Phase 1A Demonstration of Method Applicability (DMA) data are available (ERM 2104a); however, the USEPA determined that historical and DMA data alone are not adequate for COPC selection[1]. The USEPA indicated that while historical (pre-CERCLA) data obtained at the Site in earlier investigations do provide insight into the chemicals likely to be of primary concern in soil/sediment and solid wastes (solid media or "solids") at the Site, these data may not accurately represent current Site conditions. In addition, the USEPA has identified that not all solids have been well-characterized previously, and the historical data are often restricted to a subset of analytes. Consequently, new data are needed to support selection of human and ecological COPCs for Inner PRI media.

Additionally, the N&E of impacts have not been characterized in the Inner PRIs. This is due in part to the fact that the historical data for the Inner PRIs in most cases did not include analyses for all COPCs and there were an insufficient number of samples collected. The USEPA has also identified that "vertical profile waste stratification and contaminant data are needed at key release locations and within areas where wastes have been discharged continually" (USEPA 2013). Based on Site operations, the Site history, a review of aerial photographs, and information from previous sampling events, the following key waste release locations are identified for the Inner PRIs:

- Wastewater Ditches (PRI 1);
- The south-central portion of the Gypsum Pile (PRI 4) where the pile is tallest;
- The Southeast Ponded Waste Lagoon (PRI 5) near the outlet of the Main Ditch;
- The historical inlet to the northeast ponded Waste Lagoon (PRI 7); and
- The former wastewater diversion ditch traversing the Southeast Ponded Waste lagoon (PRI 5).

---

[1] While the USEPA has determined that the historic data (alone) are not adequate for COPC selection, the USEPA has stated that, if historic data are found to be statistically similar to data collected in Phase 1A/1B, it may be appropriate to combine the data to increase sample size and decrease uncertainty. If so, then the historic data may be included in the dataset used for COPC selection and risk assessment.

These key waste release locations are shown in Figure 11-1.

11.2.1.2 Conceptual Model

Initial Site-wide conceptual site models (CSMs) for the current and future use at the Site are presented in Worksheet 10 of the Phase 1A SAP.

11.2.2 STEP 2: IDENTIFY GOALS OF THE STUDY

The goals of the study are:

1. To obtain sufficient data for solid media in the Inner PRIs to reliably select human and ecological COPCs that require further quantitative evaluation in the risk assessment process; and
2. To perform initial site characterization of the N&E of contaminants distributed within the Inner PRIs to support initial contaminant mapping and to guide subsequent site characterization sampling designs.

11.2.3 STEP 3: IDENTIFY INFORMATION INPUTS

11.2.3.1 Information Inputs

The information needed to support COPC selection is an adequate and reliable dataset to characterize the range of concentration values that occur in solid media within the Inner PRIs.

The information needed to support preliminary N&E characterization includes chemical concentration data from surface samples distributed throughout each Inner PRI and subsurface samples at key waste release locations, as well as waste thickness profiles. The sample design described in Steps 6 and 7 for COPC selection will also suffice for preliminary N&E characterization.

11.2.3.2 Sampling and Analytical Methods

Sampling and analytical methods are described in Step 7, Section 11.2.7.

11.2.4 STEP 4: DEFINE THE BOUNDARIES OF THE STUDY

11.2.4.1 Spatial Boundaries

For this study, the lateral spatial boundaries are prescribed by the boundaries of the Inner PRIs. The vertical boundaries for the study are defined based on the sampling method. Sampling will be performed to a depth of 6 inches below ground surface (bgs) at all surface sampling locations, consistent with the Phase 1A SAP. Subsurface sampling will be performed using 2-foot sample intervals from 6 inches bgs to 2 feet below the waste/native soil interface. Whenever possible, hand-auger borings to delineate waste thickness will extend to the waste/native soil interface or to a maximum depth of 5 feet bgs. The 5-foot maximum depth is due to practical constraints on hand-augering to greater depths under Site conditions.

11.2.4.2 Temporal Boundaries

Constituent concentrations within solid media at the Site are not expected to fluctuate substantially over the timescale of a year (provided that significant process changes have not been implemented at the facility during that time), so the time of year when sampling occurs is not likely to be important (USEPA 2013). The timing of sampling may affect access to sampling areas and health and safety of field personnel. Sampling should be avoided during spring due to high water conditions in wastewater ponds, or in peak summer months when excessive heat could adversely affect the health and safety of field personnel. Because sampling within inundated areas of PRIs 5 and 6 will be performed using a helicopter, weather conditions will also limit or affect the performance of sampling in these areas (e.g., no sampling during high winds and flight is more challenging due to poor lift during hot weather).

11.2.5 STEP 5: DEVELOP THE ANALYTIC APPROACH

The analytic approach for COPC selection was established by the USEPA in the Phase 1A SAP. Although several factors may be considered in selecting COPCs, the first step is to compare the maximum detected concentration in a dataset (Cmax) to an appropriate risk-based concentration (RBC). If the value of Cmax for an analyte in a medium at some specified area does not exceed the RBC, that analyte may be generally excluded as a COPC in that medium at that area. Otherwise, if the value of Cmax exceeds the RBC, the analyte is retained as a COPC in that medium at that area. The methods and RBCs to be used for selection of COPCs for OU-1 are described in the *Final Screening Level Risk*

Assessment Technical Memorandum (ERM 2014b). Because human and ecological exposure areas have not yet been established at the Site, COPC selection for solid media at the conclusion of Phase 1A/1B will occur on a PRI-by-PRI basis.

The Phase 1A/1B RI Data Report will include maps showing chemical constituent concentrations in each Inner PRI. If concentrations of a constituent in surface samples are similar across a PRI, then additional N&E data would not be required for that constituent. However, additional N&E information may be needed to delineate specific features or areas to support risk assessment or to delineate the extent of impacts requiring remediation after constituents of concern (COCs) are identified in the RI. If constituent concentrations are highly variable across a PRI, then additional site characterization data to delineate N&E may be collected during the Phase 2 RI.

If field screening identifies that waste is present at depths greater than 6 inches bgs, then additional sampling may be required to delineate the vertical extent of waste, to measure COPC concentrations in the subsurface to depths relevant to human or ecological exposure, or to support Feasibility Study evaluations. Subsurface sampling will be performed during Phase 1A/1B at key waste deposition locations. If subsurface concentrations are substantially higher than those in surficial samples, additional subsurface sampling may be necessary to adequately delineate the vertical extent of COCs.

11.2.6 STEP 6: SPECIFY PERFORMANCE OR ACCEPTANCE CRITERIA

The performance acceptance criteria for COPC selection was established by the USEPA in the Phase 1A SAP. To minimize the probability that a chemical in the soil, sediment, or solid waste of a PRI area will be excluded as a COPC when it should be retained for further evaluation, it is necessary to be confident that the observed Cmax will have a high probability of exceeding the RBC when the chemical is truly of potential concern. This, in turn, is related to the total number of samples collected, and to the methods that will be used to evaluate risk from chemicals that are retained. In accord with discussions at the March 2015 scoping meetings, the minimum sample size for each PRI shall be 14.

The statistical basis for a minimum sample size of 14 for COPC selection was developed by the USEPA in the Phase 1A SAP. The COPC selection process is founded on the concept that, given a dataset of adequate size, the maximum concentration value in that dataset will exceed the true mean concentration across the exposure area. If the observed maximum concentration does not exceed the RBC, there is confidence that the true mean will not exceed the RBC, and hence the chemical will not contribute significant risk and may be excluded as a COPC.

However, if the dataset is not large enough, the observed Cmax value may not exceed the true mean across the exposure area. This is demonstrated as follows:

> Let P equal the percentile of the distribution occupied by the mean. Then, if a single sample is drawn, the probability that the sample is lower than the mean is equal to P. If N samples are drawn, the probability that ALL the samples are below the mean is P^N. Thus, the probability that one or more samples exceed the mean is given by:
>
> $$\text{prob}(\text{Cmax} > \text{mean}) = 1 - P^N$$
>
> The number of samples (N) needed to ensure that the probability is at least 95 percent that one or more samples exceed the true mean is shown below for a range of distributions in which the true mean occurs at a percentile ranging from the 50th to 90th:

Percentile of the True Mean	N	Probability that Cmax > True Mean
50th	5	96.9%
60th	6	95.3%
70th	9	96.0%
80th	14	95.6%
90th	29	95.3%

For a dataset with a normal distribution, the mean occupies the 50th percentile (P = 0.5), and a dataset of five samples would likely be sufficient to support COPC selection. However, most environmental datasets for soil, sediment, or solid waste are right-skewed, and this results in the mean occupying a percentile higher than 0.5. Depending on the degree of skew, the mean usually falls between the 60th and 90th percentile (or even higher in extreme cases).

Consistent with the Phase 1A investigation, it is assumed for planning the Phase 1A/1B investigation of solid media in Inner PRIs that the mean will generally not be higher than the 80th percentile, so a dataset of 14 samples is likely to suffice for most analytes. However, if the data from the Phase 1A/1B investigation suggest that the distribution of some analytes is more strongly skewed than assumed (i.e., the sample mean is substantially higher than the 80th percentile of the dataset), it may be necessary to collect additional samples in subsequent phases of the site investigation to ensure analytes are not improperly excluded as COPCs.

11.2.7 STEP 7: DEVELOP THE PLAN FOR OBTAINING THE DATA

The data collection approach described below supports both COPC selection and preliminary N&E study goals.

11.2.7.1 *Surface Solids Sampling*

In accord with the performance criteria for COPC selection described in Step 6, the basic plan for surface solids sampling is to collect surface solids samples from at least 14 unbiased locations with the addition of biased/judgmental samples at selected locations. Surface solids samples will be collected from 0 to 6 inches bgs. Surface solids sampling outside of the inundated areas of PRIs 5 and 6 will be performed using a hand auger as detailed in Standard Operating Procedure (SOP) *USM-01: Surface Soil, Sediment, and Waste Sampling*. Within the inundated areas of PRIs 5 and 6, surface solids samples will be collected using a helicopter-deployed sampler as detailed in SOP *USM-12: Surface Solids Sampling within Current Wastewater Ponds*. When sampling within inundated areas of PRIs 5 and 6, all reasonable efforts will be made to ensure that samples are obtained from the target locations. Relocating a sample to a location that is accessible from the shoreline requires approval by the USEPA. SOP USM-12 includes criteria for evaluating when a sample is acceptable and procedures for adjusting sampling locations based on field conditions.

The presence/absence of visible waste will be noted at all sample locations. When waste is visible, the depth of waste will be measured. Waste may include gypsum, smut, salts, or sludge that have a different appearance than the native soils present within the Inner PRIs (e.g., oolitic sands, lacustrine clays, evaporite minerals). If waste is present at the bottom of a surface sample location (6 inches bgs) outside of the inundated areas of PRIs 5 and 6, then the hand-auger boring will be advanced to either the waste/native soil interface or a maximum depth of 5 feet bgs. The maximum depth of 5 feet bgs is based on the impracticality of advancing a hand auger to depths below 5 feet under Site conditions (e.g., standing water, shallow depth to groundwater, unconsolidated wastes, etc.) and health and safety considerations. Field screening for waste thickness at locations within the inundated areas of PRIs 5 and 6 will be limited to depth of penetration of the helicopter-deployed sampler.

11.2.7.1 Subsurface Solids Sampling

The role of subsurface solids sampling for COPC selection was described in the Phase 1A SAP. At most environmental sites, site-related contaminants tend to be highest in surficial soils or sediments, with decreasing concentrations as a function of depth. However, at this Site, it is considered plausible that, in at least some PRIs, concentrations of contaminants might be higher in subsurface materials than at the current surface. This condition might occur under several alternative scenarios, as follows:

- The types of chemicals released in the past might have been different than at present due to changes in plant operation conditions.
- The level (concentration, mass loading) of contaminants released to the environment may have been higher in the past than at present, especially if plant operations were changed with the goal of reducing levels of pollutant release.
- Historical wastes may have been moved or buried under less contaminated or clean materials.
- Chemical fate and transport processes might act on surficial materials differently than on deep materials, potentially resulting in higher concentrations in samples collected at depth.

Because it is not known whether any of the scenarios may actually have resulted in meaningful differences between surface and subsurface samples, it is necessary to obtain some limited data to recognize if this situation may exist. This is important for COPC selection because a Type I decision error (exclusion of an analyte as a COPC that should have been retained) could occur if surface levels of an analyte are below the RBC but concentrations at depth exceed the RBC. The Phase 1A/1B investigation therefore includes a limited number of borings to evaluate potential differences between surface and subsurface samples. These samples will also help inform the preliminary vertical N&E of chemical impacts.

In identifying COPCs for a PRI area where samples at depth have been collected, the value of Cmax will be the highest of any value in the dataset for the PRI area, including both surface and subsurface samples. If the data from depth samples are similar to or lower than in surficial samples, the COPCs identified for surficial samples will also be appropriate for any subsurface exposure scenarios that may require assessment. However, if subsurface concentrations are substantially higher than those in surficial samples, some analytes may be identified as COPCs in subsurface materials that may not be of concern in surficial samples. If this condition does arise, because only a small number of boring samples are to be collected, additional subsurface sampling may be necessary in subsequent field programs to adequately characterize the vertical extent of those COPCs.

Subsurface borings with sampling at 2-foot intervals for chemical analysis will be performed to evaluate chemical concentrations at depth and for characterizing vertical N&E within key waste release locations (Figure 11-1) and other locations identified by the USEPA. Surface samples (0 to 6 inches bgs) will also be collected at each subsurface sampling location; therefore, the subsurface sample intervals will be 6 inches to 2 feet bgs, 2 feet to 4 feet bgs, and so on with the final sample interval extending to 2 feet below the waste/native soil interface. Subsurface solid sampling will be performed as detailed in SOP *USM-09: Subsurface Soil, Sediment, and Waste Sampling*.

11.2.7.3 Sampling Locations

The number and approximate locations of surface and subsurface solids samples identified in this SAP were discussed and agreed to by ERM/US Magnesium and the USEPA during the March 2015 OU-1 Phase 1B RI DQOs Scoping Meeting (ERM 2015). Surface solids sampling locations were preferentially chosen using a systematic (grid) sampling design to ensure that the PRI is fully and uniformly represented by the set of samples collected. In addition, judgmental samples are placed at known features at PRIs 1, 5, and 7 to support COPC selection and preliminary characterizations of N&E. The systematic grids of sample locations at PRIs 3, 4, 5, and 7 include locations near areas of waste deposition or found to contain the highest concentrations of hexachlorobenzene (HCB), dioxin/furan toxic equivalency quotients (TEQs), and polychlorinated biphenyls (PCBs) based on historical Site data. Subsurface borings for COPC selection and vertical N&E are located within key waste deposition areas PRIs 1, 4, 5, and 7 (see Figure 11-1) and at locations in PRIs 3 and 6 as requested by the USEPA during the March 2015 Scoping Meeting.

Most sample locations include surface sampling only; however, field screening for waste thickness will be performed at all sample locations. If field screening for waste indicates that waste material is present at depths greater than 6 inches bgs within all or a portion of a PRI, then subsequent sampling to delineate vertical N&E would be considered during subsequent RI Phase 2. Waste thickness at subsurface sampling locations will be determined by extending the boring to below the waste/native soil interface.

Sample locations for each PRI are described in the subsections that follow. Sample locations for PRIs 3 through 7 were developed using VSP (vsp.pnnl.gov). To ensure the assumption of random sampling is met, a systematic sample grid layout was employed that utilized a randomized initial sample that serves as the origin on which the systematic grid is constructed.

PRI 1

Surface solids sampling will be performed at 14 locations in PRI 1 as shown in Figure 11-2. Twelve locations are within active wastewater ditches, one location (1-13) is within an inactive reach of the Main Ditch, and one location (1-14) is within the alignment of the former Boron Ditch. Because the wastewater ditches are linear features, sample locations were judgmentally selected instead of using a systematic grid. For the 13 sample locations not within the former Boron Ditch, locations were divided between the active wastewater ditches based on the relative approximate length of each ditch: three samples at the Western Ditch (2,000-foot length), two samples at the Central Ditch (1,300-foot length); two samples at the Chlorine Ditch (1,350-foot length), and six samples at the Main Ditch (4,200-foot length, including historical ditch alignment to the outlet at PRI 7). The distribution of samples between ditches results in one sample per approximately 700 feet. Samples were distributed along the wastewater ditches taking into account accessibility by placing samples at each of three bridges crossing the active wastewater ditches. The rationale for each Phase 1B sample at PRI 1 is provided below.

ID	Rationale
1-01	Near head of Western Ditch (surface)
1-02	Approximate midpoint of north-south segment of Western Ditch (surface)
1-03	West of bridge at confluence of Western and Main ditches (surface and subsurface)
1-04	Near head of Central Ditch (surface)
1-05	Central Ditch downstream of Sanitary Lagoon (surface)
1-06	Near head of Chlorine Ditch (surface)
1-07	Chlorine Ditch downstream of Boron Plant discharge and south of bridge (surface and subsurface)
1-08	Main Ditch after confluence with Chlorine Ditch and east of bridge (surface and subsurface)
1-09	Main Ditch adjacent to Landfill (surface)
1-10	Main Ditch below Landfill (surface)
1-11	Main Ditch near current outlet to PRI 5 waste pond (surface)
1-12	Main Ditch alignment adjacent to PRI 5 waste pond (surface)
1-13	Former Main Ditch near historical outlet to PRI 7 waste pond (surface and subsurface)
1-14	Former Boron Ditch (surface and subsurface)

Surface solids sampling will be performed at all locations (1-01 through 1-14). Subsurface sampling will be performed at five locations, including the three bridges over wastewater ditches (1-03, 1-07, and 1-08), the former Main Ditch near the historical outlet to the Northeast Ponded Waste Lagoon (1-13), and within the alignment of the former Boron Ditch (1-14).

PRI 3

Surface solids sampling will be performed at 14 locations in PRI 3, which include 13 evenly distributed grid sample locations and one biased/judgmental sample location. PRI 3 sample locations are shown in Figure 11-3. Locations 3-01 through 3-13 were generated as a systematic grid. Location 3-14 is a biased/judgmental location for surface and subsurface sampling to characterize conditions at the presumed inlet to lagoon.

PRI 4

Surface solids sampling will be performed at 14 evenly distributed grid sample locations in PRI 4 as shown in Figure 11-4. Subsurface sampling will be performed at a sample location within the top-center of the Gypsum Pile, where historical gypsum waste is expected to be present at depth (location 4-05 in Figure 11-4). This sample location is within a key waste release area (see Figure 11-1).

PRI 5

Surface solids sampling will be performed at 16 locations in PRI 5, which include 15 evenly-distributed grid sample locations and one biased/judgmental sample location. The base number of gridded sample locations at PRI 5 was increased from 14 to 15 based on (1) the elevated variability in D/F, PCB, and/or HCB concentrations exhibited in historical PRI 5 solids data, and (2) agreements between ERM/US Magnesium and the USEPA during the March 2015 OU-1 Phase 1B RI DQOs Scoping Meeting. PRI 5 sample locations are shown in Figure 11-5. Locations 5-01 through 5-15 for PRI 5 were generated as a systematic grid and include locations in both upland (terrestrial) and mudflat/waste pond areas. Subsurface sampling will be performed at the location nearest the inlet to the waste lagoon from the Main Ditch (location 5-14 in Figure 11-5). This location was selected for subsurface sampling because it is within a key waste release area (see Figure 11-1) and the inlet is the location where the greatest amount of waste deposition occurs, as apparent in aerial photographs. Drill rig access to location 5-14 will be attained by the construction of an earthen ramp into the wastewater pond. One biased/judgmental surface solids sample will be collected from within the former wastewater diversion ditch that traverses PRI 5 (location 5-16 in Figure 11-5).

PRI 6

Surface solids sampling will be performed at 16 locations in PRI 6, which include 15 evenly distributed grid sample locations and one biased/judgmental sample location. As described above for PRI 5, the base number of gridded sample locations at PRI 6 was increased to 15 based on the variability exhibited in historical PRI 6 solids data and agreements reached during the March 2015 OU-1 Phase 1B RI DQOs Scoping Meeting. PRI 6 sample locations are shown in Figure 11-6. Locations 6-01 through 6-15 were generated as a systematic grid and include locations in both upland (terrestrial) and mudflat/waste pond areas. Subsurface sampling to characterize historically deposited wastes/sediments in the PRI 6 waste lagoon will be performed at a biased/judgmental location within the current PRI 4 area (location 6-16 in Figure 11-6). Location 6-16 corresponds to the historical inlet and deepest portion of the PRI 6 waste lagoon based on aerial photographs. Over time this area has filled with gypsum waste, therefore drilling though gypsum waste at location 6-16 will allow access and sampling of historically deposited wastes/sediments in the PRI 6 waste lagoon. Subsurface sampling location 6-16 is co-located with surface solids sampling location 4-11 in PRI 4 (see Figure 11-4). Subsurface samples from location 6-16 comprised of gypsum waste may be appropriate to include with the PRI 4 dataset for COPC selection.

PRI 7

Surface solids sampling will be performed at 17 locations in PRI 7, which include 15 evenly distributed grid sample locations and two biased/judgmental sample locations. As described above, the base number of gridded sample locations at PRI 7 was increased to 15 based on the variability exhibited in historical PRI 7 solids data and agreements reached during the March 2015 OU-1 Phase 1B RI DQOs Scoping Meeting. PRI 7 sample locations are shown in Figure 11-7. Locations 7-01 through 7-15 for PRI 7 were generated as a systematic grid and are evenly distributed throughout the floor of the Old Waste Pond. Subsurface sampling will be performed at the location nearest the historical inlet to the Old Waste Pond (location 7-04 in Figure 11-7). This location was selected for subsurface sampling because it is within a key waste release area (see Figure 11-1) that received wastewater discharges during the early operations of the Magnesium Plant and the inlet is the location where the highest concentrations of HCB, D/F TEQs, and PCBs were detected during historical investigations. Two biased/judgmental surface solids sample will be collected from within the barrow ditch north of the

Old Waste Pond (locations 7-16 and 7-17 in Figure 11-7) due to the potential for ecological receptor exposures within the barrow ditch.

11.2.7.4 Laboratory Analysis

Laboratory analytical data used for risk assessment will meet applicable criteria for definitive data as defined under USEPA guidance (EPA 2005) and the measurement performance criteria for sampling and analysis defined in the OU-1 Phase 1A/1B SAP.

Laboratory analyses will be performed following the analytical SOPs and project-specific Work Instructions included in the OU-1 Phase 1A/1B SAP. Solids samples will be analyzed for the candidate COPCs listed in Worksheet 15, including:

- PCBs;
- D/F;
- Semi-volatile organic compounds (SVOCs) including HCB;
- Polycyclic aromatic hydrocarbons (PAHs);
- Volatile organic compounds[2] (VOCs);
- Metals;
- Cyanide; and
- Perchlorate.

In addition to analysis for candidate COPCs, all solids samples will be analyzed for total organic carbon (TOC), pH, and grain size. TOC, pH, and grain size data will not be used to select COPCs; however, these data will be collected to provide context for subsequent risk assessment characterizations.

Due to the very high levels of PCBs and D/F expected to be present within some areas in the Inner PRIs, analysis of Phase 1A/1B solids samples from the Inner PRIs for PCBs and D/F will be performed using a combination of high-resolution mass spectroscopy (HRMS) and low-resolution mass spectroscopy (LRMS) methods. The identification of samples for LRMS analysis and the criteria that will be used to decide if a

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[2] VOC analysis will be performed for saturated surface solids samples and all subsurface solids samples.

sample must be reanalyzed using HRMS method will be included in the project-specific laboratory Work Instructions described in SAP Worksheet 23 and included in SAP Appendix 19B.

11.2.7.5 Bulk versus Fines Fractions Analyses

Consistent with the Phase 1A RI for Outer PRIs, the OU-1 Phase 1A/1B RI will include an investigation to determine (1) if contaminant concentrations significantly differ between bulk and fine fractions, and (2) whether a large-enough proportion of coarse material is present in bulk samples to result in a substantial difference between the contaminant concentrations measured in the bulk and the fine fractions. For the purpose of this study, "bulk fraction" is defined as all material passing a 0.25-inch mesh sieve and "fine fraction" is defined as material passing a 0.25-millimeter (mm) (60 US Mesh) sieve. Evaluating bulk versus fines fractions is important for COPC selection because a Type I decision error (excluding a COPC that should be retained) could occur if concentrations of an analyte in bulk (unsieved) samples are below a level of concern but concentrations in fine-grained material are above a level of concern (USEPA 2013).

The sieving and analysis strategy for Phase 1A/1B RI samples is illustrated in the flow diagram shown in Figure 11-8. To facilitate the bulk versus fines evaluation, three splits will be collected for each Phase 1A/1B surface solids sample. Each split will be composed of the bulk sample (passing 0.25-inch mesh) after homogenization.

1. Split sample 1 will be analyzed as a bulk fraction sample.
2. Split sample 2 will be analyzed for grain size by ASTM Method C-136. The result from the grain size analysis of split sample 2 will be used to determine whether to analyze split sample 3 as a fines fraction sample:
3. If the percent passing 0.25 mm in split sample 2 is greater than 75, then no analysis for fines is required.
4. If the percent passing 0.25 mm in split sample 2 is less than 75, then split sample 3 will be dried, sieved through a 0.25 mm mesh, and the fines-fraction material (passing 0.25 mm) will be analyzed for PCBs, D/F, SVOCs, PAHs, metals, and TOC.

Specification of 75 percent as a cutoff is because in samples with mass of the fine fraction at greater than or equal to 75 percent of the bulk, the maximum possible ratio of the concentration in the fine fraction to the bulk fraction is 1.33 (when the concentration in the coarse fraction is zero). Because the analytical variability of most methods is usually about 30 percent, the ratio of concentration values in the fine fraction to those values in the bulk fraction is expected to fall inside the normal range of analytical variability for all samples with more than 75 percent fine material.

The relationship between the paired results of the bulk and corresponding fine fractions will be evaluated using regression analysis. This approach allows development of a quantitative relationship between the coarse fraction and the fine fraction, so that if a meaningful difference is evident, the concentration in the fine-grained fraction may be calculated from the coarse fraction.

11.3 DATA QUALITY OBJECTIVES FOR BACKGROUND EVALUATIONS

This section will be submitted to USEPA for review as a separate file.

11.8 REFERENCES

ERM-West Inc. (ERM). 2014a. *Final Inner PRI Data Report.* June.

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United States Environmental Protection Agency (USEPA). 1989. *Risk Assessment Guidance for Superfund, Volume I - Human Health Evaluation Manual (Part A)*. Interim Final. EPA/540/1-89/002. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C.

USEPA. 1992. *A Supplemental Guidance to RAGS: Calculating the Concentration Term.* Publication 9285.7-081. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C.

USEPA. 2005. *Uniform Federal Policy for Implementing Environmental Quality Systems. Evaluating, Assessing, and Documenting Environmental Data Collection/Use and Technology Programs.* Final. Version 1. Intergovernmental Data Quality Task Force. EPA-505-B-04-900A. March.

USEPA. 2005. *Uniform Federal Policy for Quality Assurance Project Plans Part 2B, Quality Assurance/Quality Control Compendium: Minimum QA/QC Activities*. Final. Version 1. EPA-505-B-04-900B. March 2005

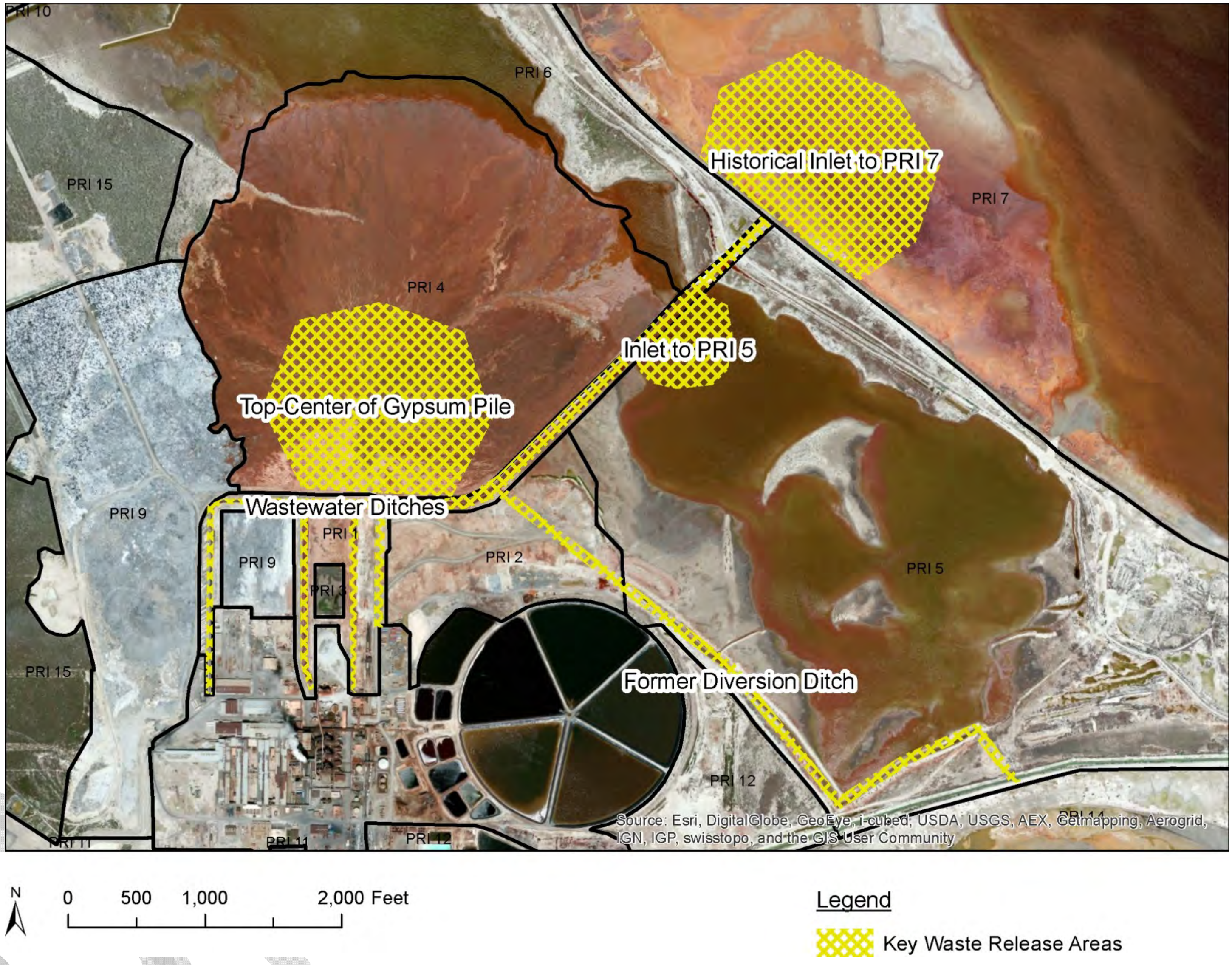
USEPA. 2006. *Guidance on Systematic Planning Using the Data Quality Objectives Process*. EPA QA/G-4. February.

USEPA. 2013a. *ProUCL Version 5.0.00 User Guide. Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations*. SCMTSC. EPA/600/R-07/041. September 2013

USEPA. 2013. *Phase 1A Remedial Investigation Sampling and Analysis Plan to Identify Chemicals of Potential Concern in Soils, Sediment, Solid Waste, Water and Air, and Receptor Surveys*. US Magnesium NPL Site, Tooele County, Utah. Revision 0 for PRI Areas 2 and 8 through 17. September.

Figures

Figure 11-1 Key Waste Release Areas

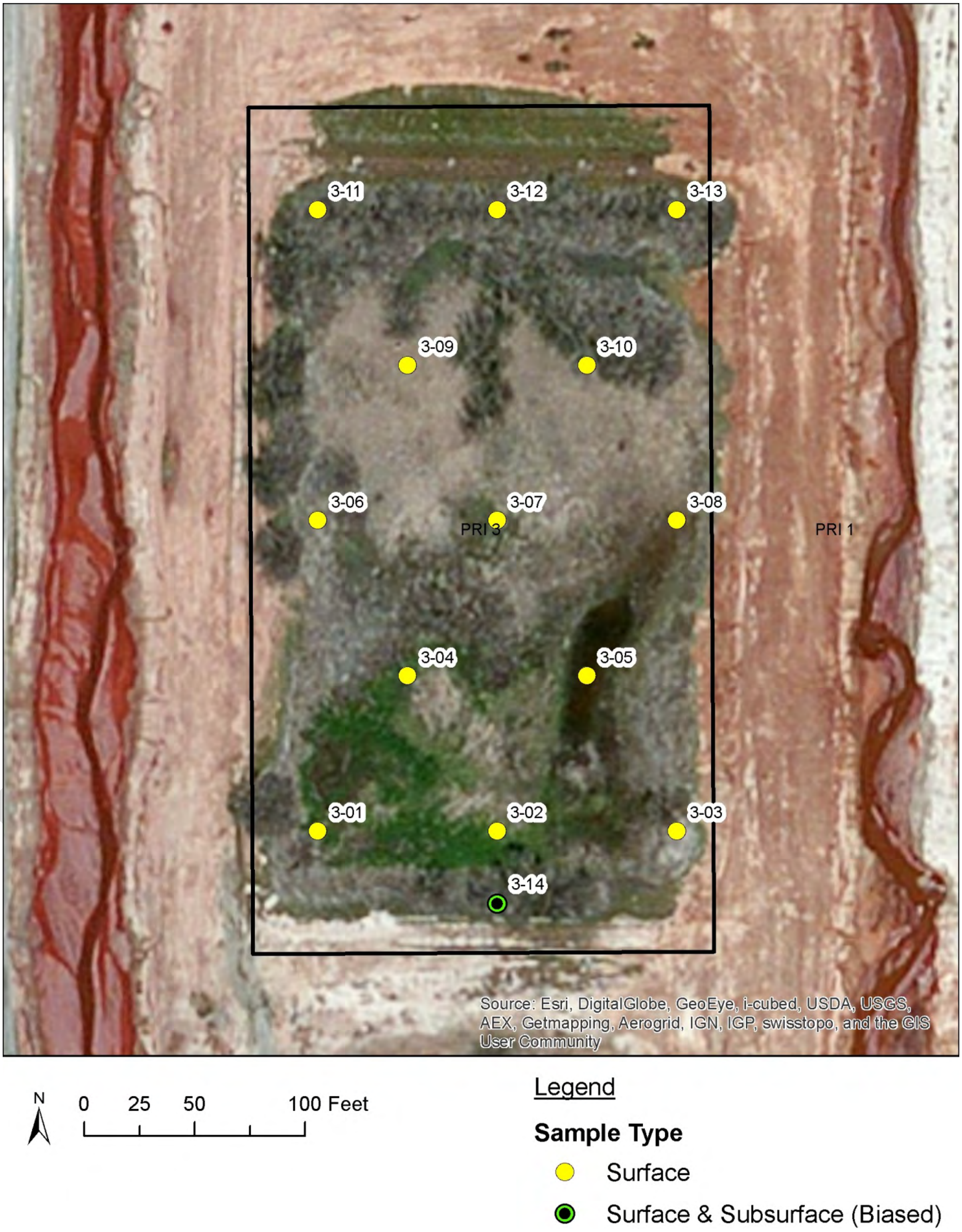


Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 11-2 Phase 1A/B Sample Locations for PRI Area 1 – Ditches

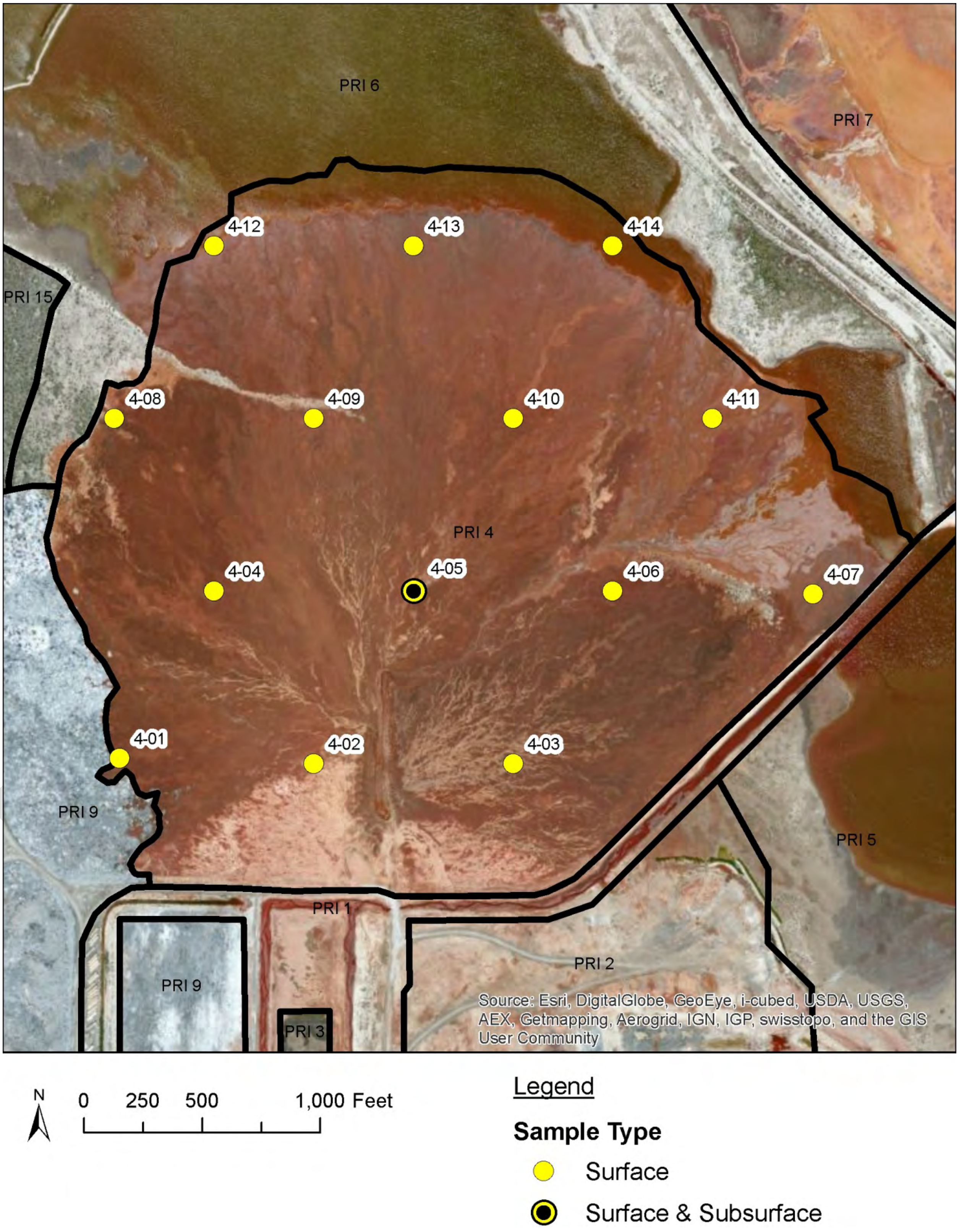
Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 11-3 Phase 1A/B Sample Locations for PRI Area 3 – Sanitary Lagoon



Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 11-4 Phase 1A/B Sample Locations for PRI Area 4 – Gypsum Pile



Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 11-5 Phase 1A/B Sample Locations for PRI Area 5 – Southeast Ponded Waste Lagoon

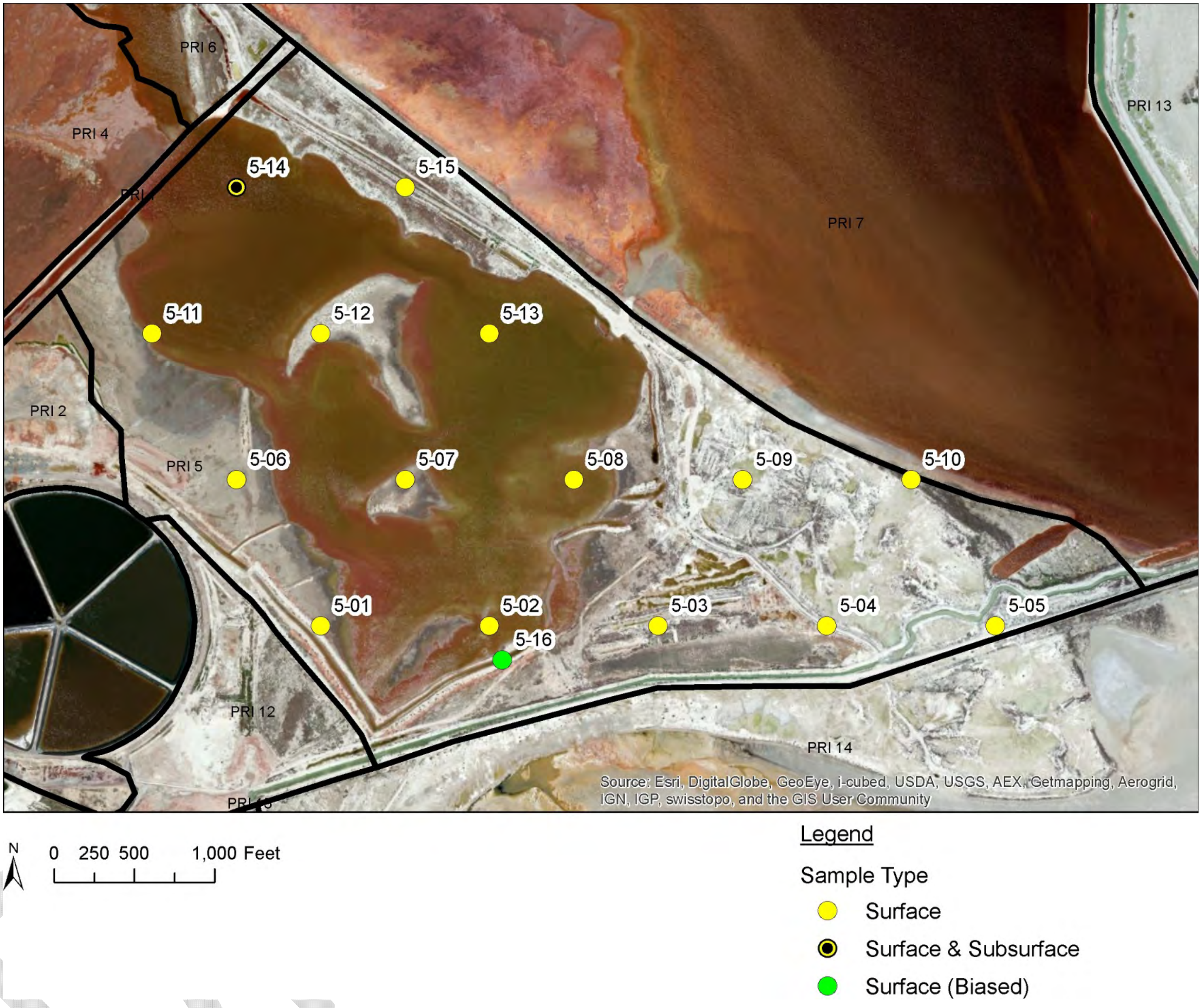
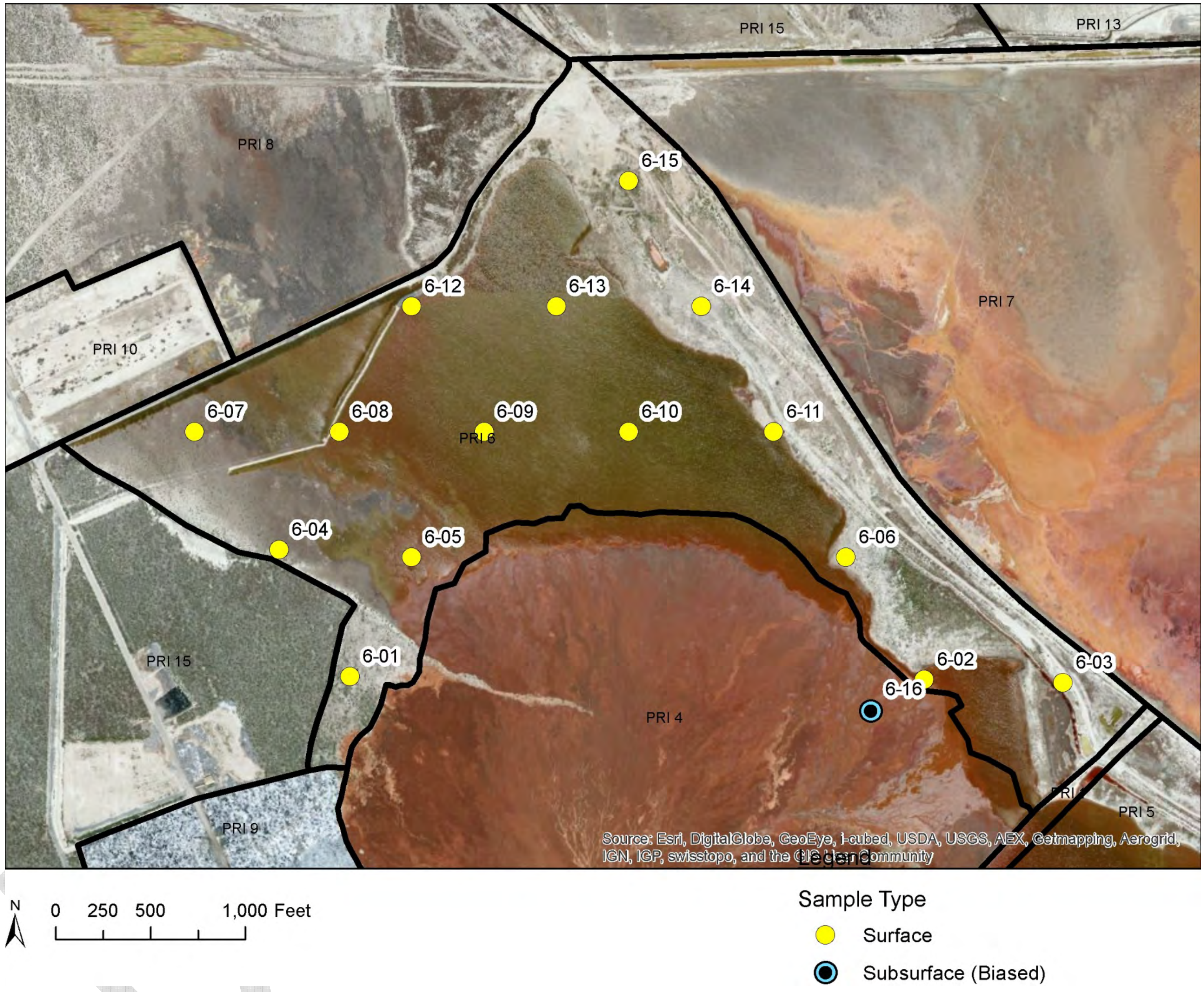
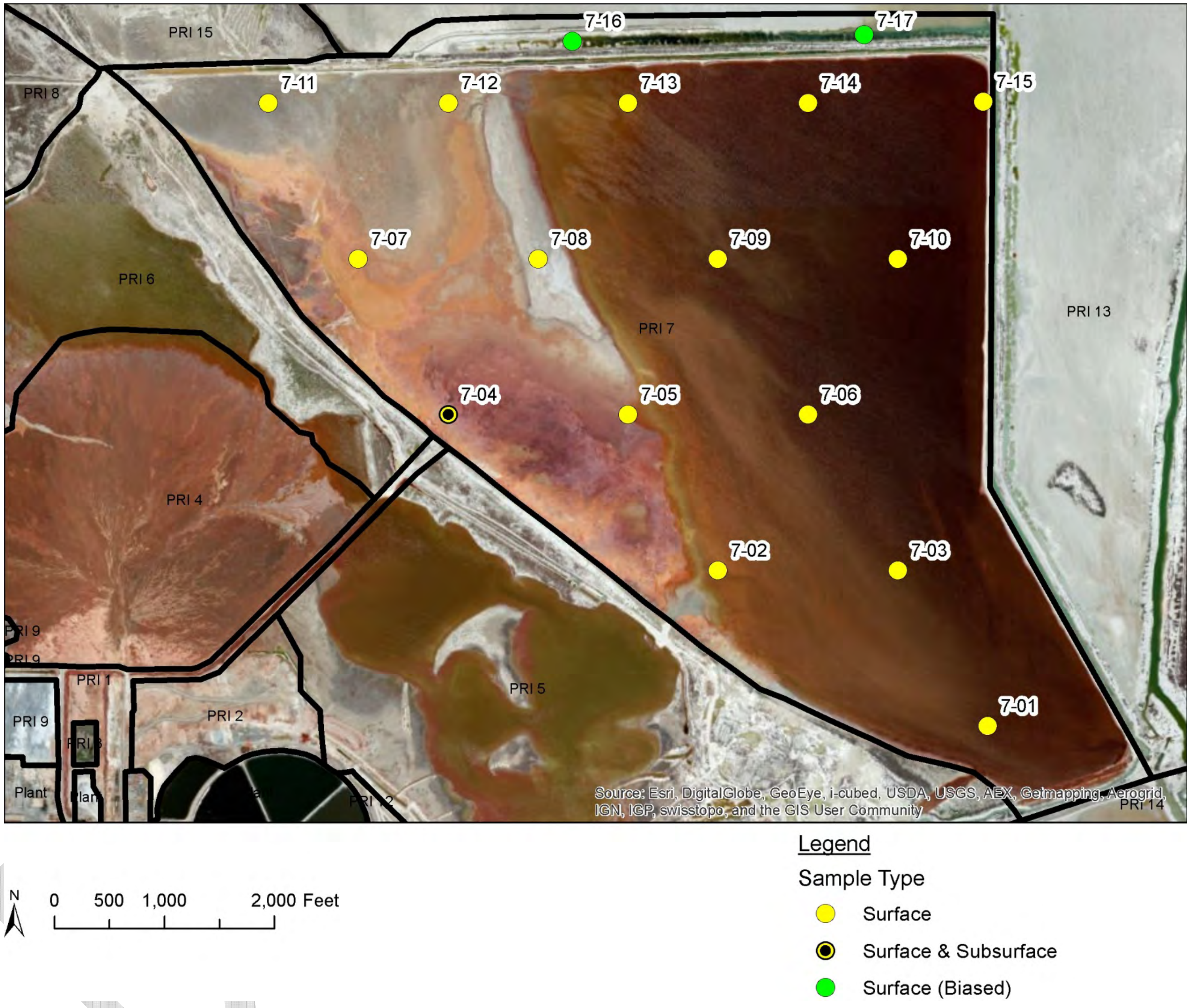

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 11-6 Phase 1A/B Sample Locations for PRI Area 6 – Northwest Ponded Waste Lagoon



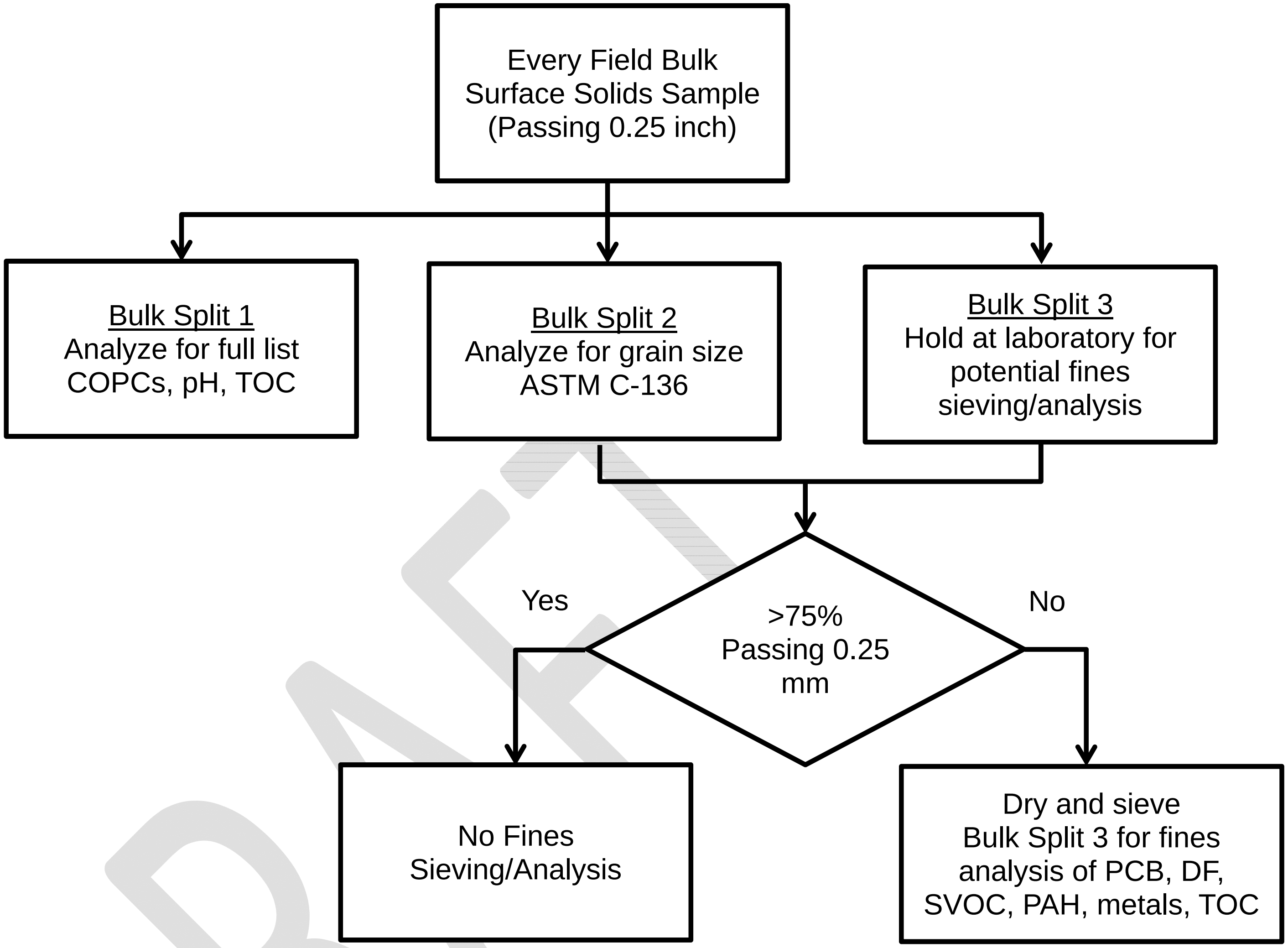
Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 11-7   Phase 1A/B Sample Locations for PRI Area 7 – Northeast Ponded Waste Lagoon



Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 11-8 Fines Fraction Sieving and Analysis Strategy



Attachment 9J

8 April 2015 Agenda and Pre-Read for 9 April 2015
Risk Assessor Call (re-scheduled to 16 April 2015)

From: Jennifer Holder
To: Wall, Dan; OBrien, Wendy; brattin@srcinc.com; severett@utah.gov; mstorck@utah.gov; Chris Cline (Chris_Cline@fws.gov); dcox@blm.gov; Sherry Skipper (sherry_skipper@fws.gov); Mark Jones; Mark Shibata; Judy Nedoff; Kevin Lundmark; George Weber; Karen Cejas
Cc: Justin Burning; David Abranovic
Subject: RE: US Mag Risk Assessor"s Biweekly Call
Date: Wednesday, April 08, 2015 7:00:26 PM
Attachments: image001.png

Hi,

The proposed agenda for tomorrow's US Mag risk call is:

1) Eco Acute Inhalation RBCs
2) BG DQO
3) Other?

In preparation for the call tomorrow, we have the following questions/proposals to discuss.

Eco Air RBCs

Dan has requested that we present inhalation RBCs for Cl and HCl in the Revised Phase 1B Air DQO. We are currently reviewing the information we had previously shared with the EPA back in 2012 along with the information collated in the EPA's Phase 1B Air DQO. To aid in our review, we have a few questions regarding the Eco RBCs presented in the EPA's Draft that we would like to discuss on our call. These include:

1) What studies were used to develop the lethality TRVs? Can we get the references?
2) For clarity, how are 'mild LOEC' and 'severe LOEC' defined (Table A3-1, A3-2)?
3) Was recovery considered when classifying (mild / severe) LOECs and/or selecting TRVs?
4) Were 'mild' LOECs used to bound 'severe' LOEC-based TRVs?
5) Eco TRV studies were grouped based on nasal/respiratory tract injury and lethality from a 10-30 min infrequent exposure, 6-8 hours infrequent exposure, and 6-8 hours repeated exposure, while HH TRVs are based on short-term, long-term (e.g., subchronic), and chronic exposures.
    a. How are the following exposure frequencies defined (Table A3-3)?
        i. Infrequent
        ii. Repeated
    b. How do the Eco and HH categories relate to each other?
    c. How will these be used with the exposure frequency goals? For example, is an exceedance of the 6-8 hr repeated exposure RBC determined as an average concentration that occurs more than once during an 8 hour time period for two consecutive days?
6) For clarity, what degree of 'nasal/respiratory tract injury' is relevant to the preliminary assessment endpoints identified in the SLERA TM (e.g., protection of population abundance / persistence, protection of community structure / function)?

BG DQO

Based on the email that Dan Wall sent on 4/2/2015, there are a couple of issues that remain to be resolved regarding the BG DQO. The issues and our proposed resolution follows:

1) Analytical suite for BG samples: In response to our proposal regarding the organic analytes (D/Fs, PCBs and HCB), Dan requested that we characterize all three as potentially being present due to ubiquitous anthropogenic activities. That would mean that we would need to adequately characterize the ambient concentrations of all these organic compounds and we would need to make sure that we have an adequate sample size so that we could make statistical comparisons of site against background concentrations. As we do not believe that concentrations of these organics are impacted by geology or soil type, we propose to develop only one background dataset for these compounds (in contrast to the separate upland and lakebed BG populations we will characterize for metals).

    To develop a sample size for the organics the following evaluation was conducted. The variability in background HCB, D/F TEQs and Total PCBs, Phase 1A and DMA results from PRIs 11-16 were examined, as these PRIs are assumed to be potentially impacted by aerial deposition. This is the same foundational dataset used to evaluate variability in metals, prior to segregating into Upland and Lakebed. The following data treatments were used:

    a. Consistent with the metals approach, samples assumed to be impacted in PRI 14 were excluded (PRI14-002 through 008) as were salt pile samples from PRI 12 (PRI12-010 and 011).
    b. Any sample result that exceeded a refined RBSL/RBESL from the SLRA were excluded (performed for each COPC independently).
    c. Remaining PRI data were pooled into a single dataset (Upland and Lakebed segregation is not applicable to organics).
    d. HCB had a high proportion of non-detected values (59%), which was disproportionately influencing variability. Non detected values were removed from the dataset to better represent natural variability. D/F TEQs and Total PCBs were both 100% detected.
    e. Summary stats and distribution testing were performed using ProUCL and tabulated (Table 1).

Using the information generated above, background sample sizes for each COPC were then calculated using VSP. The following assumptions and procedures were used:

- The "Comparison of average to reference average" module was used.
- Each COPC's dataset distribution guided which hypothesis test approach was used to calculate samples size. A normal distribution used the t-test. All others used the WRS.
- Null hypothesis was set to be Site > background.
- a = 0.05
- b = 0.2
- D (maximum detectable difference [MDD]) = 50% of the mean of the COPCs dataset.
- Results were tabulated (Table 1)

Consistent with the metals approach, the median value was selected as the sample size for the DQO. The median (34) was rounded up to 36. This was done to allow the sample size to be evenly appropriated across the six sample areas being proposed for the metals background data collection. This means 18 total samples will be collected from 3 locations in the Upland area (3 x 6 samples) and 18 total samples will be collected from Lakebed area (3 x 6 samples).

To further support the sample size evaluation, power curves were also generated (Figure 1) to evaluate the decrease in MDD (measured as a % of the mean) achieved by collecting additional samples above 36. As shown in Figure 1, increasing the sample size above 36 only creates a nominal reduction in MDD for all 3 COPCs. For example, increasing the sample size from 36 to the highest project value from VSP (51, Table 1), only results in approximately a 10% decrease in MDD. This indicates 36 samples occurs where the curve is approaching asymptotic, and that collecting additional samples will not significantly improve the test's performance.

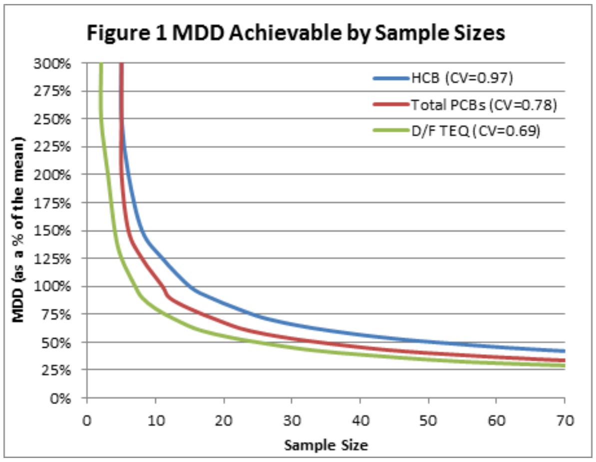
Table 1 - SAMPLE SIZE SUMMARIES FOR ORGANICS

COPC	% ND	mean	SD	CV	units	Distribution	a	b	MDD	n
hexachlorobenzene (PRI 11-16, detects only)	0%	21.7	20.98	0.97	µg/kg	Gamma	0.05	0.2	10.8	**51**
Total PCBs (PRI 11-16)	0%	862	668.3	0.78	µg/kg	Lognormal	0.05	0.2	431	**34**
TEQs (PRI 11-16)	0%	6.3E-04	4.36E-04	0.00	µg/kg	Normal	0.05	0.2	3.2E-04	**24**

Notes

Any sample that exceeded an RBSL was excluded from pooled datasets (on a compound-by-compound basis).

MDD (maximum detectable difference) = 50% of the mean



2) Location of Upland and Lakebed BG samples: Dan is concerned about having BG locations too close the facility. We have two ideas to mitigate this concern.
    a. On the field trip to select the actual BG locations, we propose to start at the farthest end of each area identified in Figure 1 of the BG pre-read sent out in support of the 3/26 call. As soon as a location is identified that fits the criteria outlined in the pre-read, it will be selected as one of the 6 locations. In this way, we hope to be able to select 3 upland and 3 lakebed BG locations that are substantially farther than 5 miles from the US Mag stack.
    b. We are uncomfortable with having the BG locations be too far from the facility such that lithology and soil types are substantially different resulting in BG metals concentrations that are not relevant for comparisons to the site. This is an issue when locations on the eastern side of the Great Salt Lake are proposed as possible BG locations. However, we recognize that we may need to separate the characterization of BG soil concentrations and identification of relevant reference locations for biotic sampling and characterizing organics from inorganics if the stack impacts (D/Fs, PCBs and HCB) soils beyond the 5 mile radius. Therefore, as insurance we propose to collect 5 soil samples from the Bear River Refuge and to analyze these samples for the same BG suite (inorganics, D/Fs, PCBs and HCB). The concentrations detected at Bear River will be compared to the other BG datasets, and regional datasets to confirm that it is unimpacted. This will allow the Bear River Refuge to be used as a possible location for reference biota sampling if none of the other BG locations are usable.

In summary, to resolve the outstanding issues raised by Dan, we propose that 36 samples of the 60 currently proposed for metals also be analyzed for D/Fs, PCBs and HCB. We propose to distribute these samples equally among the 3 upland and 3 lakebed BG locations. Additionally we propose to collect and analyze 5 samples for metals, D/Fs, PCBs and HCB at the Bear River Refuge to ensure that we have at least one location far enough away from the Site where biotic tissue can be collected.

We look forward to discussing this in more detail tomorrow.
-Jen

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From: Wall, Dan [mailto:wall.dan@epa.gov]
Sent: Thursday, April 02, 2015 10:05 AM
To: Jennifer Holder; OBrien, Wendy; brattin@srcinc.com; severett@utah.gov; mstorck@utah.gov; Chris Cline (Chris_Cline@fws.gov); dcox@blm.gov; Sherry Skipper (sherry_skipper@fws.gov); Mark Jones; Mark Shibata; Judy Nedoff; Kevin Lundmark
Subject: RE: US Mag Risk Assessor's Biweekly Call

Hi Jennifer
You are incorrect in your assumptions for point number one below. As with dioxins and furans, PCBs and HCB are ubiquitous in background soils as a result of anthropogenic activities. A quick google search suggests that this is not a controversial position. Like dioxins and furans, PCBs and HCB are site related, they are contributors to the dioxin-like toxicity and they are likely risk drivers.

These contaminants need to be analyzed at the same frequency as other background contaminants.

I regards to point number 2, I would really like to avoid a situation where we have biological data from reference areas coming back with octaPCBs and we have to argue about whether our ref area is truly outside the influence of the Site.

As you know, Cavitt monitored Plover nests at the site and reference areas. He chose 3 reference areas about ~30-40 miles from the site (from Saltair to Bear River Refuge). Stubblefield chose reference locations about 9-10 miles from the Site. FWS and EPA chose reference locations for egg collection that was ~ 40 miles away.

ERM is proposing as close as 5.19 miles. This seems like an unnecessary risk when other suitable sites are available.

Dan

From: Jennifer Holder [mailto:Jennifer.Holder@erm.com]
Sent: Wednesday, April 01, 2015 6:45 PM
To: Wall, Dan; OBrien, Wendy; brattin@srcinc.com; severett@utah.gov; mstorck@utah.gov; Chris Cline (Chris_Cline@fws.gov); dcox@blm.gov; Sherry Skipper (sherry_skipper@fws.gov); Mark.Jones@erm.com; Mark Shibata; Judy Nedoff; Kevin Lundmark
Subject: US Mag Risk Assessor's Biweekly Call

Hi all,
On our call on Thursday 3/26, we discussed initial comments on the background DQO pre-read. Bill brought up a couple of concerns that Dan raised. I wanted to respond to Dan's concerns via email first and then see if an additional discussion is required. Here is our understanding of Dan's concerns, and our thoughts on addressing them.

1) ERM proposed that metals and D/Fs be analyzed in all the soil/sediment background samples. Bill communicated that Dan would like to see PCBs and HCB added to the analytic suite. We assume that Dan's request to add PCBs and HCB is to confirm that the selected background locations are not impacted by the US Mag risk drivers (e.g. D/Fs, PCBs and HCB) and not that Dan believes that the presence of PCBs and HCB may be due to anthropogenic, non-point source ambient. If this assumption is correct, PCBs and HCB would not be required for every sample as it would not be part of the background evaluation. Instead a subset of samples from each background location would be analyzed for PCBs and HCB as a confirmation that the location was not impacted by US Mag activities. ERM proposes that 3 random samples from the 10 soil/sediment samples that will be sampled at each candidate location (3 candidate locations in Upland and 3 candidate locations in Lakebed) will have PCBs and HCB added to the analyte list that will include metals and D/Fs at all sample locations. This will result in a total of 9 samples with PCBs and HCB analyses in the Upland, and 9 samples in the Lakebed.
2) ERM proposed some general locations north, south and east of the 5 mile radius as areas where background samples could be collected. Bill communicated that Dan was concerned that the actual locations might be sampled too close to the 5 mile radius so that wildlife (specifically birds) might forage within the 5 mile radius and be exposed to US Mag contaminants even though their nests were outside the 5 mile radius. Thus biotic samples from these locations would be erroneously considered as relevant reference samples representative of ambient exposures. We reviewed the historical biological survey work and spoke with John Cavitt and believe that the bird species we are likely to find at US Mag will define the species we will collect in the reference locations. Based on what has been observed in the past, we believe that the horned lark in upland habitat, and the American avocet or snowy plover in wetland habitat will be likely bird targets. Bird species are likely to move around the most, as other species that may be targeted are sedentary or have very small home ranges (e.g., small mammals, invertebrates and plants). Therefore, we focused on the bird species and looked into the literature regarding foraging ranges during the nesting season. The territory size for the horned lark has been reported as 1.3-2.7 ha (radius of a 2.7 ha circle is 93 m or 305.1 ft); territories for this species are used for courtship, nesting, and feeding (Wiens et al. 1986). The American avocet has been observed foraging 130 m (426.5 ft) from the nest (Gibson 1971), while the snowy plover forages an average of 272 m (892.4 ft) from the nest (Paton 1995). While a few individual snowy plovers have been reported to travel up to 3770 m from the nest, the average distance reported in Paton (1995) is similar to site-specific observations from Cavit at US Magnesium (2010) and are relevant to most individuals studied. Based on these foraging ranges and rounding up for conservatism, we propose that background sampling locations be no closer than 500 ft from the 5 mile radius for Upland background locations, and no closer than 1000 ft from the 5 mile radius for Lakebed background locations. As described in our pre-read, we recommend a field trip to confirm the actual locations that will be sampled in upland and

wetland habitats to ensure that the species of interest are present and that these locations would be good candidate reference locations where relevant biota could be samples in Phase 2.

Dan, do these proposals address your concerns? As the revised Background DQO will be submitted to EPA on April 6th, we have included the above in the revision. Additional comments or questions can be discussed on our next risk call on 4/9 or as comments on the revised DQO.

Thanks,
Jen

References:
Gibson, F. 1971. The breeding biology of the American Avocet (*Recurvirostra americana*) in central Oregon. Condor 73:444-454.
Paton, P.W.C. 1995. Breeding biology of snowy plovers at Great Salt Lake, Utah. The Wilson Bulletin 107(2):275-288.
Wiens, J. A., J. T. Rotenberry, and B. Van Horne. 1986. A lesson in the limitations of field experiments: shrub steppe birds and habitat alteration. Ecology 67:365-376.

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Attachment 9K

27 April 2015 Agency Technical Comments on ERM's Draft Data Quality Objectives for OU-1 Phase 1A/1B RI SAP

Agency Technical Comments on ERM's
DRAFT DATA QUALITY OBJECTIVES FOR OU-1 PHASE 1A/1B RI SAP
(Document Date: 7 April 2015)
U.S. MAGNESIUM NPL SITE, TOOELE COUNTY, UTAH
27 April 2015

INTRODUCTION

The U.S. Environmental Protection Agency (EPA) and the Utah Department of Environmental Quality are providing the following comments on the *Draft Data Quality Objectives for OU-1 Phase 1A/1B RI SAP for the US Magnesium NPL Site, Tooele County, Utah.* This document was prepared by Environmental Resource Management (ERM) and submitted to the EPA 7 April 2015.

GENERAL COMMENTS

1. To be consistent with the name of the Phase 1A-B RI SAP; revise "Phase 1A/1B" to read "Phase 1A-B" throughout. (Revised text throughout this document does not include this modification.)
2. The USEPA believes detailed, waste-specific descriptions and potential strata-specific analysis of subsurface cores from the key waste areas are necessary. At the subsurface boring locations, continuous core will need to be collected using a sonic-type rig or other coring device to allow for the collection of an intact core and strata-specific samples as appropriate. Ensure the Phase 1A-B SAP and associated SOPs include such requirements and the potential for additional sample collection.

SPECIFIC COMMENTS

3. **Page 1, opening paragraph**: Revise text as follows:

> …US Magnesium site. As discussed and agreed on during the OU-1 Phase 1B RI DQOs Scoping Meeting conducted on 11 and 12 March 2015, ERM has developed this revised Phase 1A/1B DQO for review by the United States Environmental Protection Agency (USEPA) and the Utah Department of Environmental Quality. These DQOs will become Worksheet 11 in the OU-1 Phase 1A/1B Sampling and Analysis Plan (SAP), currently scheduled for implementation on or before August 15, 2015, subject to timely development of an ERM Phase 1A-B SAP in lieu of a start date for Phase 1A SAP issued by the USEPA in September 2013. ~~during the 2015 field season~~. Accordingly…

11.1 OBJECTIVES OF THE PHASE 1A/1B RI FOR OU-1

4. **Page 2, itemized list**: Revise text as follows:

    1. Identification of chemicals of potential concern (COPCs) for human and ecological receptors within Preliminary Remedial Investigation (PRI) Areas 1 and 3 through 7, along with initial human and ecological risk calculations.
    2. Preliminary evaluation of the nature and extent (N&E) of impacts ~~within PRI Areas 1 and 3~~ for the Inner-PRIs of the Phase 1A-B SAP to support Phase 2 RI planning site-wide.
    3. Estimation of background (ambient) concentrations for metals, PCBs, HCB, and dioxins/furans (D/F).
    4. ~~Confirm that~~ Identification of suitable reference areas (i.e., non-impacted areas) ~~are available~~ for abiotic sampling during 2015, and scoping of timely biota sampling expected to be necessary during 2016 Phase 2 RI activities. ~~a future phase of the RI.~~

11.2 DATA QUALITY OBJECTIVES FOR COPC SELECTION AND PRELIMINARY NATURE AND EXTENT AT INNER PRI AREAS

11.2.1 STEP 1: STATE THE PROBLEM

11.2.1.1 Description of the Problem

5. **Pages 2 and 3**: Revise text as follows:

The RI/Feasibility Study (FS) Area Boundary has been preliminarily defined by the USEPA as a 5-mile radius around the US Magnesium facility. For purposes of project planning during the initial phases of the RI, the USEPA initially divided the site into 18 Preliminary Remedial Investigation Areas (or "PRIs"), with the "Inner PRIs" defined as PRIs 1 and 3 through 7, the "Outer PRIs" defined as PRIs 2 and 8 through 17, and PRI 18 being ambient air. The Site was subsequently divided into Operable Units by the USEPA, with OU-1 including PRIs 1 through 17 and OU-2 being defined as PRI 18.

Phase 1A of the OU-1 RI provided the information necessary to select human and ecological COPCs for the Outer PRIs. For the Inner PRIs, historical ~~(i.e., pre-Comprehensive Environmental Response, Compensation and Liability Act [CERCLA]) and~~ [prior to the Phase 1A Demonstration of Method Applicability (DMA)] data are available (ERM 2104a); however, the USEPA determined that historical and DMA data alone are not adequate for COPC selection[1]. The USEPA indicated that while historical ~~(pre-CERCLA)~~ data obtained at the Site in earlier investigations do provide insight into the chemicals likely to be of primary concern in soil/sediment and solid wastes (solid media or "solids") at the Site, these data may not accurately ~~represent current~~ reflect current near surface Site conditions. In addition, the USEPA has identified that not all solids have been well-characterized previously, and the historical data are often restricted to a subset of analytes when compared to the list of target analytes identified by the USEPA for the Site. Consequently, new data are needed to support selection of human and ecological COPCs for Inner PRI media.

Additionally, the N&E of impacts have not been characterized in the Inner PRIs. This is ~~due in part to the fact that~~ because the historical data for the Inner PRIs in most cases did not include analyses for all ~~COPCs~~current target analytes and ~~there were an insufficient number of samples collected~~ historical sample locations were not based on an unbiased approach and only targeted selected portions of the Site. The USEPA has also identified that "vertical profile waste stratification and contaminant data are needed at key release locations and within areas where wastes have been discharged continually" (USEPA 2013). Based on Site operations, the Site history, a review of aerial photographs, and information from previous sampling events, the following key waste release locations are identified for the Inner PRIs:

- Wastewater Ditches (PRI 1);
- The south-central portion of the Gypsum Pile (PRI 4) where the pile is tallest;
- The Southeast Ponded Waste Lagoon (PRI 5) near the outlet of the Main Ditch;
- The historical inlet to the northeast ponded Waste Lagoon (PRI 7); and
- The former wastewater diversion ditch traversing the Southeast Ponded Waste lagoon (PRI 5).

These key waste release locations are shown on Figure 11-1. Key waste release areas were identified as areas where it is suspected that the waste profile is potentially the thickest or could contain higher concentrations of target analytes in the associated wastes.

11.2.2 STEP 2: IDENTIFY GOALS OF THE STUDY

6. **Page 4, item list**: Add item 3 as follows:

   3. To perform initial risk calculations for human and ecological receptors for each COPC in each PRI to determine what additional data may be needed to support reliable risk management decision-making.

11.2.3 STEP 3: IDENTIFY INFORMATION INPUTS

11.2.3.1 Information Inputs

7. **Page 4, second paragraph, last sentence**: Revise text as follows:

   The sample design described in Steps 6 and 7 for COPC selection will ~~also suffice for preliminary N&E~~ provide some limited preliminary data concerning contamination in media at the Site that can be used for initial risk calculations as well as planning for Phase 2 investigations that may be needed~~characterization~~.

11.2.4 STEP 4: DEFINE THE BOUNDARIES OF THE STUDY

11.2.4.1 Spatial Boundaries

8. **Page 5, only paragraph of subsection**: Revise the text as follows:

   For this study, the lateral spatial boundaries are prescribed by the boundaries of the Inner PRIs. The vertical boundaries for the study are defined based on the sampling method. Sampling will be performed to a depth of 6 inches below ground surface (bgs) at all surface sampling locations, consistent with the Phase 1A SAP.

   At all surface sample locations, hand-auger borings to delineate waste thickness will extend to the waste/native soil interface or to a maximum depth of 5 feet bgs. The 5-foot maximum depth is due to potential constraints for hand-augering to greater depths under Site conditions.

   Subsurface sampling will be generally performed using 2-foot sample intervals from 6 inches bgs to 2 feet below the waste/native soil interface. ~~Whenever possible, hand-auger borings to delineate waste thickness will extend to the waste/native soil interface or to a maximum depth of 5 feet bgs. The 5-foot maximum depth is due to practical constraints on hand-augering to greater depths under Site conditions.~~

11.2.4.2 Temporal Boundaries

9. **Page 5, only paragraph of subsection**: Revise the text as follows:

   Constituent concentrations within solid media at the Site are not expected to fluctuate substantially over the timescale of a year (provided that significant process changes have not been implemented at the facility during that time), so the time of year when sampling occurs is not likely to be important (USEPA 2013) to the temporal representation of the data. ~~The timing of sampling may affect access to sampling areas and health and safety of field personnel. Sampling should be avoided during spring due to high water conditions in wastewater ponds, or in peak summer months when excessive heat could adversely affect the health and safety of field personnel. Because sampling within inundated areas of PRIs and 6 will be performed using a helicopter, weather conditions will also limit or affect the performance of sampling in these areas (e.g., no sampling during high winds and flight is more challenging due to poor lift during hot weather).~~

   Comment Note: Such considerations are more appropriate in the site-specific health and safety plan.

10. **General comment for Steps 5 and 6**: Given the addition of a third study goal, revise the document to include subsections for each of these steps corresponding to each study goal. For example:

    Sections 11.2.5.1 and 11.2.6.1 COPC Selection

    Sections 11.2.5.2 and 11.2.6.2 Preliminary Nature and Extent Characterization

    Sections 11.2.5.3 and 11.2.6.3 Initial Risk Characterization

    The following comments incorporate the above approach.

11.2.5 STEP 5: DEVELOP THE ANALYTIC APPROACH

11. **Beginning on page 5, Step 5**: Revise the text as follows:

11.2.5.1 COPC Selection

~~The analytic approach for COPC selection was established by the USEPA in the Phase 1A SAP. Although s~~Several factors may be considered in selecting COPCs, the first step is to compare the maximum detected concentration in a dataset (Cmax) to an appropriate risk-based concentration (RBC). If the value of Cmax for an analyte in a medium at some ~~specified area~~ PRI does not exceed the RBC, that analyte may be generally excluded as a COPC in that medium ~~at that area~~ in that PRI. Otherwise, if the value of Cmax exceeds the RBC, the analyte is retained as a COPC in that medium ~~at that area~~ in that PRI. The methods and RBCs to be used for selection of COPCs for OU-1 are described in the Final Screening Level Risk Assessment Technical Memorandum (ERM 2014b). Because human and ecological exposure areas have not yet been established at the Site, COPC selection for solid media at the conclusion of Phase 1A/1B will occur on a PRI-by-PRI basis.

11.2.5.2 Preliminary Nature and Extent Characterization

The Phase 1A/1B RI Data Report will include maps showing chemical constituent concentrations in each Inner PRI. If concentrations of a constituent in surface samples are similar across a PRI, then additional N&E data would generally not be required for that constituent. However, additional N&E information may be subsequently needed to delineate specific ~~features or~~ areas to support risk assessment or to more clearly delineate contaminants for FS scoping~~the extent of impacts requiring remediation after constituents of concern (COCs) are identified in the RI~~. If constituent concentrations are highly variable across a PRI, then additional ~~site characterization~~ data to characterize and delineate N&E may be collected during the Phase 2 RI.

If field screening identifies that waste is present at depths greater than 6 inches bgs, then additional sampling may be required to delineate the vertical extent of waste, to measure COPC concentrations in the subsurface to depths relevant to human or ecological exposure, or to support Feasibility Study evaluations. Subsurface sampling will be performed during Phase 1A/1B at key waste deposition locations. If subsurface concentrations are substantially higher than those in surficial samples, additional subsurface sampling ~~may~~will be necessary to adequately delineate the vertical extent of COCs.

The Phase 1A-B portion of the RI will obtain a preliminary data set to support Phase 2 planning. USEPA DQO guidance (EPA 2006) states that data sets need to be evaluated to determine if the data are representative of Site conditions. Data may also need to be blocked into more logical groups for evaluating nature and extent if the data is shown to be tied to a particular waste type or release and fate and transport mechanisms.

Limited subsurface sampling in key waste disposal areas is identified for collection during the Phase 1A-B investigation. The purpose of these key waste disposal borings is to profile the stratigraphic column of wastes above and two feet into native materials. Sampling intervals may be altered to segregate native sampling intervals from waste intervals. No subsurface sampling interval will exceed two feet in thickness.

Additional samples may be appropriate to identify the characteristics of small, discrete layers within the stratigraphic column of the wastes. Smaller sampling intervals may be identified and sampled where significant physical changes are visually evident. For example, during the DMA, chemical hard pans of a foot or less in thickness were identified in the near subsurface that could represent chemical sinks for preferential contaminant accumulations. The focused sampling intervals may be less than two foot in thickness but not lesser than 6 inches in thickness, will be identified at the discretion of the USEPA (or their field representatives), documented in a field modification form, and may require a second boring at the same location.

Exposure and decision units have yet to be defined for the Site. The need for additional data to define nature and extent at the Site (to be collected during Phase 2) will be determined by comparing results of Phase 1A-B to risk based thresholds and blocking data into logical waste types or areas for further evaluation (decision units). Data assessment and related mapping efforts may include all useable and relevant data (including historical, DMA, Phase 1A, and Phase 1A-B) applicable to both solid and aqueous media. To the degree possible, data assessment and mapping will be performed across all impacted portions of the Site, considering PRI boundaries, ecological and human health exposure areas, and potential feasibility study needs.

11.2.5.3 Initial Risk Characterization

Initial risk calculations for humans and ecological receptors will be performed in basic accord with standard methods developed by EPA for use at Superfund sites, using all reliable data derived from the Phase 1A-B study. Details regarding the choice of human and ecological populations, exposure areas, exposure factors, and toxicity factors will be developed and documented in risk assessment technical memoranda, as specified in the AOC.

11.2.6 STEP 6: SPECIFY PERFORMANCE OR ACCEPTANCE CRITERIA

12. **<u>Pages 6 and 7, Step 6, second paragraph of existing text</u>**: Revise the text as follows:

11.2.6.1 COPC Selection

The statistical basis for a minimum sample size of 14 for COPC selection was developed by the USEPA in the Phase 1A SAP. The COPC selection process is founded on the concept that, given a dataset of adequate size, the maximum concentration value in that dataset will have a high probability (≥ 95%) of exceeding the true mean concentration across the exposure area. If the observed…not improperly excluded at COPCs.

13. **<u>Page 8, Step 6, last paragraph of existing text</u>**: Revise the text as follows:

Consistent with the Phase 1A investigation, it is assumed for planning the Phase 1A/1B investigation of solid media in Inner PRIs that the mean will generally not be higher than the 80th percentile. This assumption is supported by available data from historic studies and the more recent DMA studies, which indicate that, for the expected risk drivers (TEQ, HCB, PCBs), the sample mean usually occurs in the range of the 60th to 80th percentile, as shown below:

Comment Note: Populate the table with appropriate results.

PRI	Percentile of the Mean			
	TEQ (avian)	TEQ (mammalian)	Total PCB	HCB
1				

4				
5				
6				
7				

~~, so a~~ Based on this, it is considered likely that a dataset of 14 samples is likely to suffice for most analytes. However, if the data from the Phase 1A/1B investigation suggest that the distribution of some analytes is more strongly skewed than assumed (i.e., the sample mean is substantially higher than the 80th percentile of the dataset), it may be necessary to collect additional samples ~~in subsequent phases of the site investigation~~ to ensure analytes are not improperly excluded as COPCs.

11.2.6.2 Preliminary Nature and Extent Characterization

After the validated and verified Phase 1A-B data are available, the adequacy of the preliminary data to define the nature and extent of contaminants will be determined. The relevant data can then be combined and blocked appropriately in accordance with project needs and in accordance with the USEPA's data quality assessment (DQA) process. The DQA process involves the use of statistical and graphical tools (i.e., Q-Q plots and maps) to determine if the data will achieve their intended use (i.e., preliminary delineation of nature and extent) adequate to support decision-making. If the data does not support decision-making, Phase 2 will incorporate the collection of additional data to support decision-making.

11.2.6.3 Initial Risk Characterization

In accord with standard USEPA guidance, all risk calculations for humans and mobile ecological receptors (birds, mammals) will be based on the 95% upper confidence limit (95UCL) of the mean concentration in the exposure area of concern. The 95UCL will be derived using the most recent version of USEPA's ProUCL software application. Use of the 95UCL minimizes the probability of a false negative decision error (deciding risk is acceptable when it actually is unacceptable). However, use of the 95UCL tends to increase the probability of False Positive decision errors (declaring that risk is unacceptable when it actually is within acceptable limits). If initial risk estimates based on the 95UCL are below a level of concern, or if risks are above a level of concern based on the sample mean, then it is likely that additional data will not be needed for risk management decision making. In cases where risk is below a level of concern based on the sample mean but above a level of concern based on the 95UCL, then additional data may be useful to support decision-making. In this event, additional sampling needs will be planned and executed during Phase 2.

Initial risk characterization for sessile or small home range ecological receptors will be based on an assessment of the magnitude and frequency of Hazard Quotient values that exceed 1.0, with calculations performed on a sample-by-sample basis. In cases where the distribution of HQ values provides a clear prediction of population-level hazard, additional abiotic data to support the HQ approach are unlikely to be necessary. However, in cases where the data are not sufficient to allow a clear assessment of HQ-based population-level hazard, additional abiotic data may be needed. In this event, the necessary abiotic sampling will be planned and performed in Phase 2, along with any biotic-based studies that may be needed.

11.2.7 STEP 7: DEVELOP THE PLAN FOR OBTAINING THE DATA

14. **Page 8, first paragraph**: Revise text as follows:

> The data collection approach described below supports both COPC selection and preliminary N&E and initial risk characterization study goals.

11.2.7.1 Surface Solids Sampling

15. **Pages 8 and 9**: Revise the text as follows:

> *11.2.7.1 Surface Solids/Sediment Sampling*
>
> In accord with the performance criteria for COPC selection described in Step 6, the basic plan for surface solids/sediment sampling is to collect ~~surface solids~~ samples from at least 14 unbiased locations with the addition of biased/judgmental samples at selected locations. Surface solids/sediment samples will be collected from 0 to 6 inches bgs. Surface solids sampling outside of the inundated areas of PRIs 5, 6 and 7 ~~and 6~~ will be performed using a hand auger as detailed in Standard Operating Procedure (SOP) *USM-01: Surface Soil, Sediment, and Waste Sampling*. Within the inundated areas of PRIs 5, 6 and 7 ~~and 6~~, ~~surface solids~~ sediment samples will be collected using a helicopter-deployed sampler as detailed in SOP USM-12: *Surface Solids Sampling within Current Wastewater Ponds*. When sampling within inundated areas of PRIs 5, 6 and 7 ~~and 6~~ all reasonable efforts will be made to ensure that samples are obtained from the target locations. ~~Relocating a sample to a location that is accessible from the shoreline requires approval by the USEPA.~~ SOP USM-12 includes criteria for evaluating when a sample is acceptable, ~~and~~ procedures for adjusting sampling locations based on field conditions, and when to seek USEPA approval.
>
> The presence/absence of visible waste will be noted at all sample locations. When waste is visible, the depth of waste will be measured. Waste may include gypsum, smut, salts, or sludge that have a different appearance than the native soils present within the Inner PRIs (e.g., oolitic sands, lacustrine clays, evaporite minerals). Description of the materials, including type of waste, depths, and other general observations will be noted in the field logbook pursuant to SOP ##. If waste is present at the bottom of a surface sample location (6 inches bgs) outside of the inundated areas of PRIs 5, 6 and 7 ~~and 6~~, then the hand-auger boring will be advanced to either the waste/native soil interface or a maximum depth of 5 feet bgs. The maximum depth of 5 feet bgs is based on the impracticality of advancing a hand auger to depths below 5 feet under Site conditions (e.g., standing water, shallow depth to groundwater, unconsolidated wastes, etc.) ~~and health and safety considerations~~. Field screening for waste thickness at locations within the inundated areas of PRIs 5, 6 and 7 ~~and 6~~ will be the ~~limited to~~ depth of penetration of the helicopter-deployed sampler.

11.2.7.~~1~~2 Subsurface Solids Sampling [misnumbered in original doc - should be 11.2.7.2]

16. **Page 10, third paragraph**: Revise text as follows:

> Subsurface borings with sampling at 2-foot intervals for chemical analysis will be performed to evaluate chemical concentrations at depth and for characterizing vertical N&E within key waste release locations (Figure 11-1) and other locations identified by the USEPA. Surface samples (0 to 6 inches bgs) will ~~also~~ be collected at each subsurface sampling location; ~~therefore~~ then, the subsurface sample intervals will be 6 inches to 2 feet bgs, 2 feet to 4 feet bgs, etc., ~~and on~~ with the final sample interval extending to 2 feet below the waste/native soil interface. Waste materials and native soil will be segregated into separate samples. Segregating waste materials and native soil in the final sampling interval will allow for the evaluation of potential impacts from wastes on the native soil.

> As described in Section 11.2.5.2, additional sampling of subsurface intervals may be appropriate based on the visual inspection of the continuous cores. These samples of opportunity will be collected within 2-foot sampling intervals if the stratigraphy or other anomaly suggests changes in chemical concentration. Isolating such intervals will assure that sample homogenization and subsequent dilution of higher concentration layers will not occur during the sample processing step for subsurface samples. Subsurface solid sampling will be performed as detailed in SOP USM-09: Subsurface Soil, Sediment, and Waste Sampling.

Comment Note: Ensure the revised SOP USM-09 includes appropriate text for the collection of sub-sampling intervals as described throughout the comments herein.

11.2.7.3 Sampling Locations

17. **Page 11, first paragraph, third sentence**: The text states judgmental samples are in PRIs 1, 5 and 7. However only figures for PRIs 5 and 7 indicate "biased" samples. Review both text and figures and revise as appropriate.

    Comment Note: Ensure WS#14 of the SAP includes rationale for each judgmental sample for each PRI area.

PRI 1

18. **Page 12, first partial paragraph**: Revise the text as follows:

    > …active wastewater ditches. ~~The rationale for each Phase 1B sample at PRI1 is provided below.~~
    >
    > ~~List of rationale~~

    Comment Note: The sample rationale is required and more appropriate for WS#14.

PRI 5

19. **General Comment on Sample Locations**: Following the scoping meeting, EPA-UDEQ and ERM jointly reviewed the waste ditches present within PRI-5 during a site-visit on April 16, 2015. Attachment 1 provides an overview of the site-findings during that reconnaissance. Had this information about PRI-5 ditches been presented by ERM during the scoping meeting a more complete discussion could have occurred about sampling. In lieu of such discussions, EPA-UDEQ believe the sampling scheme presented in Attachment 1 is an appropriate amendment for the PRI-5 surface/sediment sampling to ascertain whether COPCs unique to each release/matrix are present within PRI-5 ditches and releases. A "marked up" Figure 11-5 is also attached.

PRI 6

20. **Page 14, first paragraph, sixth sentence**: Revise text as follows:

    > …current PRI 4 area (location 6-16 in Figure 11-6). Location 6-16 corresponds to the historical inlet ~~and deepest portion~~ of the PRI 6 waste lagoon based on aerial photographs and site reconnaissance. Over time this area…

11.2.7.4 Laboratory Analysis

21. **Page 15, first paragraph**: Revise text as follows:

    > Laboratory analytical data used for COPC selection, preliminary nature and extent characterizations, and initial risk characterization ~~assessment~~ will meet applicable criteria for definitive data as defined under USEPA guidance (EPA 2005) and the measurement performance criteria for sampling and analysis defined in the OU-1 Phase 1A/1B SAP.

22. **Page 15, fifth bullet and footnote 2**: The criteria shall include VOC analysis for all samples within the capillary fringe instead of only in saturated materials.

Comment note: The appropriate SOP shall include discussion of the use of a soil moisture meter to determine the presence of the capillary fringe.

23. **Pages 15 and 16, HRMS and LRMS discussion**: Note: The USEPA has provided ERM with initial comments identifying concerns regarding the criteria for HRMS determination. Resolution of this issue is necessary prior to submittal of a draft Phase 1A-B SAP which includes WS#23 and Appendix 19B.

11.2.7.5 Bulk versus fines Fractions Analyses

24. **Page 17, second paragraph**: Revise text as follows:

> The relationship between the paired results of the bulk and corresponding fine fractions will be evaluated using regression analysis. This approach allows development of a quantitative relationship between the ~~coarse~~ bulk fraction and the fine fraction, so that if a meaningful difference is evident, the concentration in the fine-grained fraction may be calculated from the ~~coarse~~ bulk fraction.

11.~~8~~4 REFERENCES *[misnumbered in original doc - should be 11.4]*

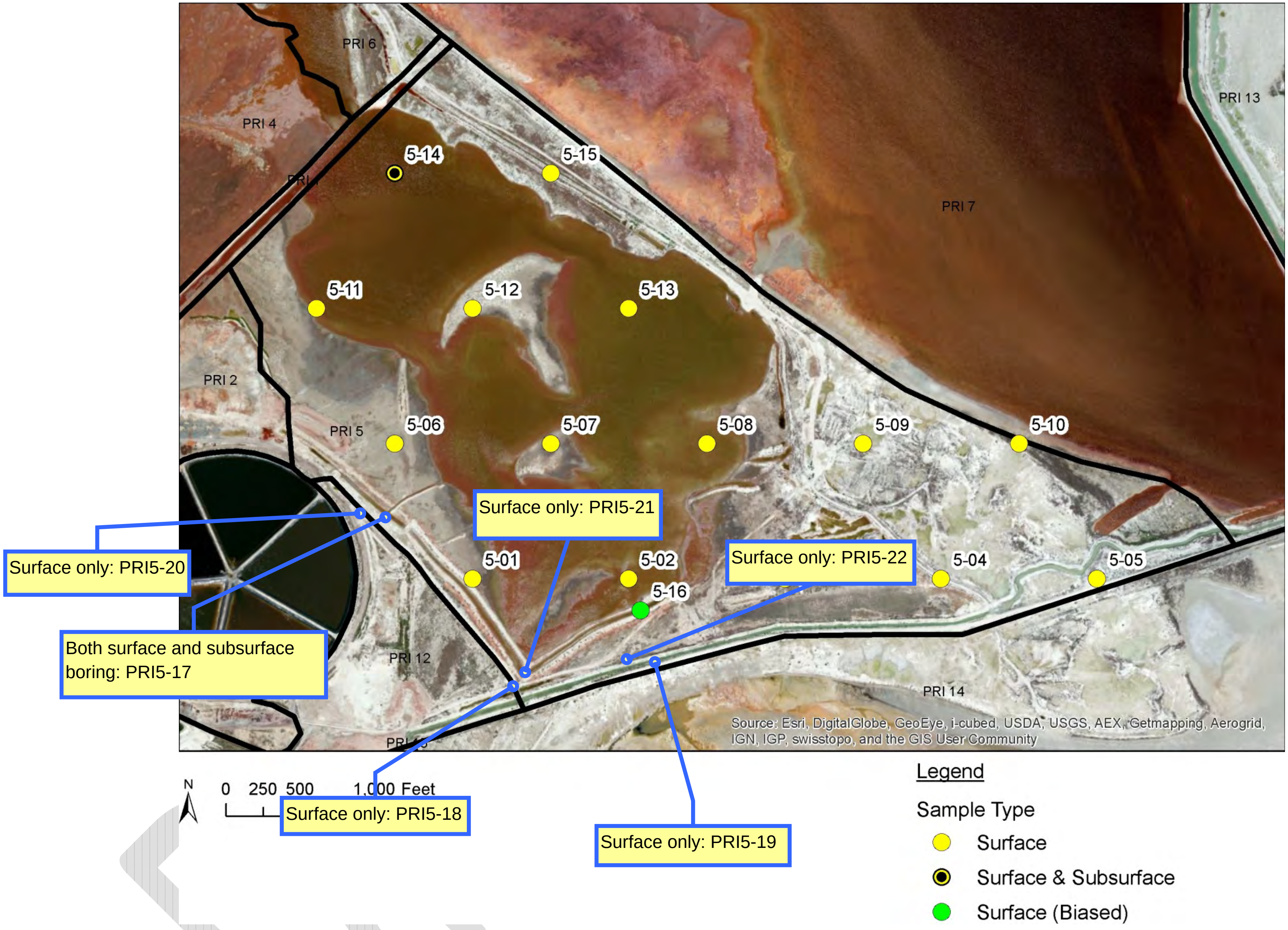
25. **Page 17, References**: Add the following references:

> USEPA. 2006. *Guidance on Systematic Planning Using the Data Quality Objectives Process*. (EPA QA/G-4). February.
>
> USEPA. 2006a. *Data Quality Assessment: A Reviewer's Guide* (EPA QA/G9R). February.

FIGURES

26. **Figure 11-5**: Revise per the attached marked up version.

Figure 11-5 Phase 1A/B Sample Locations for PRI Area 5 – Southeast Ponded Waste Lagoon



Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Attachment 9L

28 April 2015 Agency Comments on ERM Proposal for HRMS Reanalysis

AGENCY COMMENTS ON ERM PROPOSAL FOR HRMS REANALYSIS
28 April 2015

ERM has proposed that all samples of solid media (soil, sediment) collected from the inner PRIs in the Phase 1A/B investigation be analyzed for dioxins/furans/PCBs by Low Resolution Mass Spectroscopy (LRMS), and that, depending on the results of the LRMS analysis, a subset would be re-analyzed by High Resolution Mass Spectroscopy (HRMS). In accord with EPA suggestions, ERM has proposed a trigger for HRMS reanalysis that is intended to ensure that samples with HQ values for TEQ nearing a decision threshold would be identified for reanalysis.

The specific rule proposed is that samples with OCDF concentrations lower than 40 ug/kg be reanalyzed by HRMS. Given typical concentration ratios of TEQ risk drivers to OCDF, ERM indicated that samples with 40 ug/kg or higher of OCDF would have detectable levels of most TEQ risk drivers, and HQ values for TEQ would be well above the level of concern. If so, results of the LRMS analysis would likely be adequate for risk assessment and risk management decision making.

This approach is conceptually sound, but there is a potential problem. ERM evaluated the range of expected HQ values based on the lowest RBC available (0.00012 ug/kg). This might seem to be appropriate, but it is actually anti-conservative to focus on the lowest RBC. This is because the higher the RBC, the lower the HQ values, and the more samples that approach the "grey zone" (HQ values close to the decision threshold) for decision-making. In this regard, the RBCs for exposure of mammalian ecological receptors (fox, shrew) to TEQ derived during the refinement step are in the range of 0.02 to 0.3 ug/kg, substantially higher than the value of 0.00012 ug/kg used in ERM's assessment. The RBC values for humans exposed to TEQ are likely to be even somewhat higher, depending on site-specific and PRI-specific exposure assumptions. The current default recommended by EPA headquarters[1] for an outdoor worker is 0.8 ug/kg.

The basic problem is illustrated in Figure 1. Panel A plots HQ values based on mammalian[2] TEQ for the historic data using the proposed RBC of 0.00012 ug/kg, and Panel B plots the values using an RBC of 0.8 ug/kg. As seen, if the RBC were 0.00012, then HQ values at an OCDF trigger of 40 ug/kg would be well above the grey zone. However, if the RBC is 0.8 ug/kg, then most HQ values at the trigger are in the grey zone. Based on this, EPA believes the selection of a trigger for HRMS needs to be based on a consideration of the expected results using the highest, not the lowest, RBC value that is likely to be applicable.

---

[1] http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search

[2] For avian receptors, TEQ is dominated by HCB. All TEQ values used in this discussion are based on mammalian TEFs.

Granted that the RBC value is based on the highest reasonably expected, the next critical step is deciding how to recognize a sample when a reanalysis is needed. EPA proposes that the basic rule is: ***reanalysis is needed when the difference between LRMS and HRMS becomes significant for decision-making*** (i.e., LRMS yields a different decision than HRMS). Based on this, EPA feels the most informative data that are presently available are the set of 8 samples that were analyzed by both LRMS and HRMS as part of the DMA. The basic approach is to plot the HQ value for workers (RBC = 0.8 ug/kg TEQ) based on both LRMS and HRMS as a function of OCDF, and see where the difference between the two becomes large enough that the LRMS would not be considered optimal and HRMS would be needed.

This, in turn, raises a question as to how ND congeners in the LRMS analysis will be treated in the calculation of TEQ. For simplicity, substitution of ND=1/2DL has been used to date[3].

The results are shown in Figure 2. Although a data set of only 8 samples is too small to be highly confident, the main conclusions seem to be:

1. At high values of OCDF (e.g., above 5,000 ug/kg), there is not much difference between LRMS and HRMS, and LRMS results will likely be adequate.
2. As OCDF levels decrease, a difference begins to emerge, with the LRMS samples tending to yield higher TEQ and HQ values than the HRMS.
3. The concentration at which the difference begins to become important is difficult to judge with such a limited data set, but it seems likely it is in the range of 500 to 5,000 ug/kg OCDF. Above this range, risk conclusions are likely to be the same by both methods, while below this range, risk conclusions based on LRMS TEQ would likely be biased high.

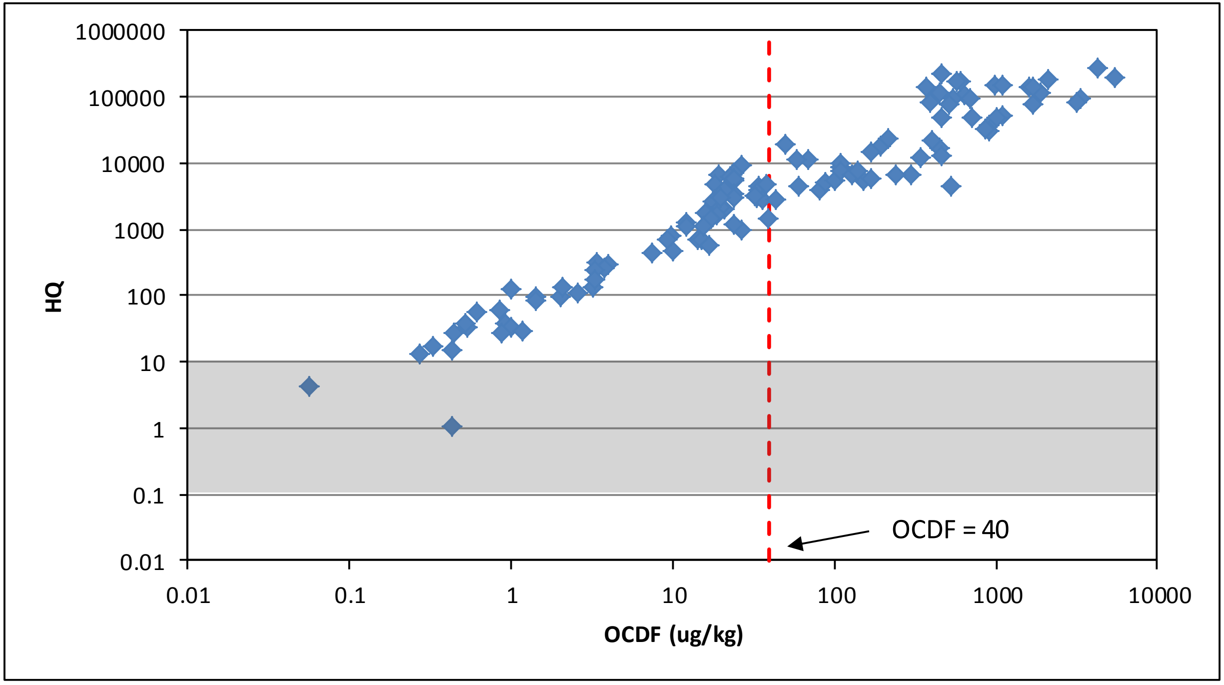
Based on this, EPA has concluded that an OCDF trigger of about 500-1000 ug/kg is needed to prevent substantial overestimation of hazard from samples in the low end of the risk range.

---

[3] EPA Region 8 has also briefly investigated the use of EPA's KM TEQ calculator spreadsheet tool, but it appears the results are generally similar to the ND=1/2DL approach.

FIGURE 1
HQ vs OCDF FOR LOW AND HIGH RBC VALUES
BASED ON HISTORIC DATA

Panel A: RBC = 0.00012 ug/kg



Panel B: RBC = 0.8 ug/kg

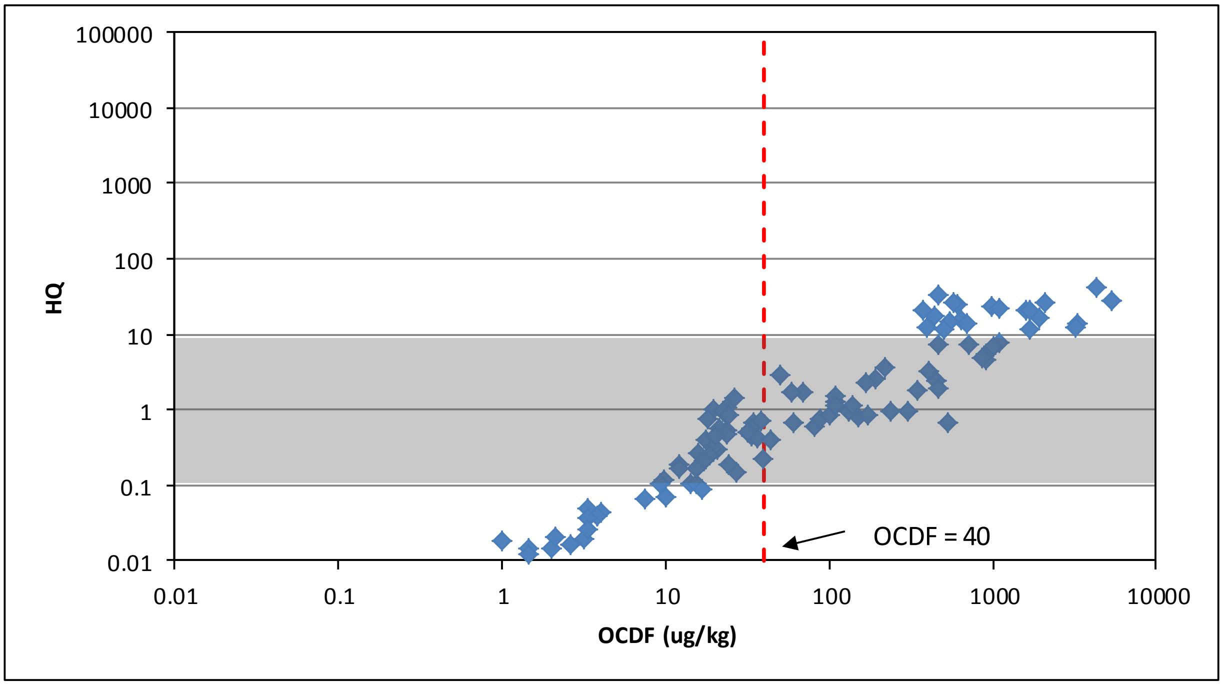
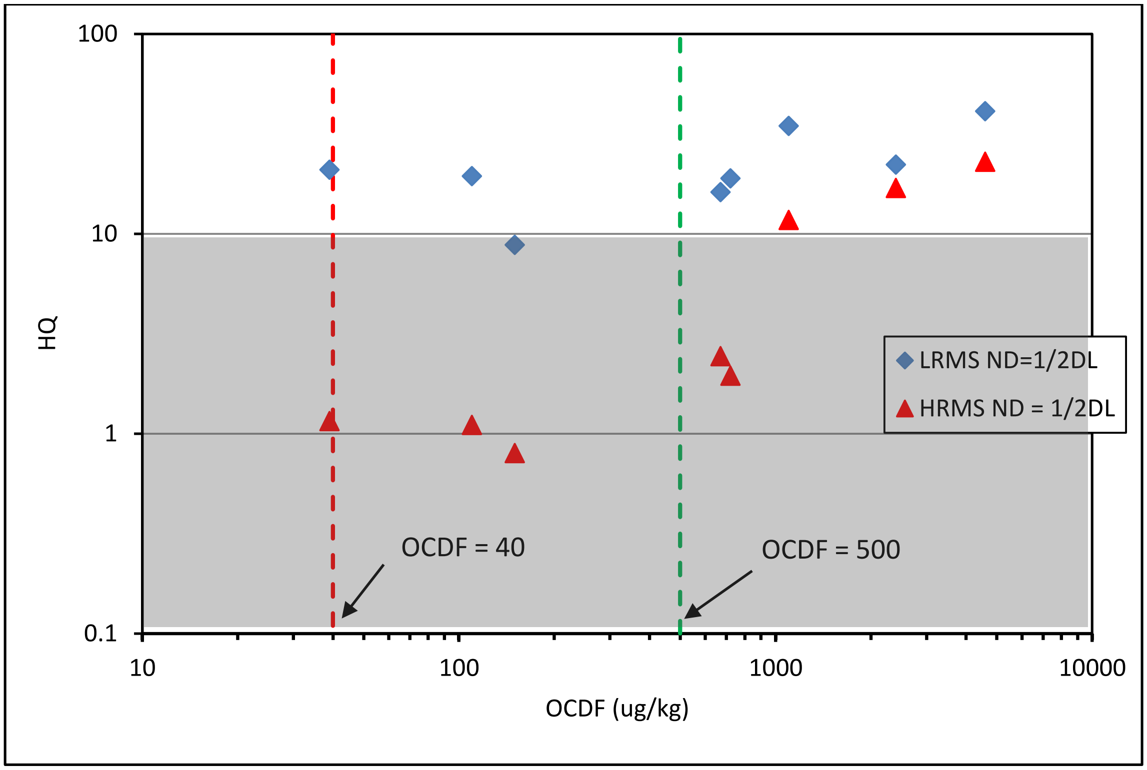


FIGURE 2
COMPARISON BETWEEN LRMS AND HRMS ESTIMATES OF HQ BASED ON PAIRED SAMPLES FROM THE DMA



Attachment 9M

29 April 2015 EPA Technical Comments on ERM's Phase 1B Project Scoping Session Outcomes Summary

From:	Wangerud, Ken <wangerud.ken@epa.gov>
Sent:	Wednesday, April 29, 2015 10:45 AM
To:	David Abranovic
Cc:	R. David Gibby (dgibby@usmagnesium.com); Mark Ransom; Jennifer Holder; Justin Burning; Kevin Lundmark; Catherine D. LeCours (clecours@PWT.COM); Mike Storck (mstorck@utah.gov)
Subject:	Agency final comments RE: ERM OU-1 Phase 1B Scoping Outcome Notes
Attachments:	AgencyComments to ERM OU1 INNER Phase 1B Scop-Mtg Outcome Notes.pdf

David etal:

My sincere apologies. These were finalized as I prepared to head over to SLC for a post scoping-meeting site visit April 15-16 and I neglected to get these forwarded.

My attention ended up getting more focused issues of ERM's Draft-DQO.

Again—my apologies as we wrap up the scoping-meeting episode.

Ken Wangerud, Remedial Project Manager
Superfund Remedial Program
Office of Ecosystems Protection and Remediation
USEPA Region 8 - EPR/SR
1595 Wynkoop, Denver CO 80202-1129
- -
ofc. tel. 303-312-6703
fax 303-312-7151
wangerud.ken@epa.gov

From: David Abranovic [mailto:David.Abranovic@erm.com]
Sent: Thursday, March 26, 2015 11:29 AM
To: Wangerud, Ken
Cc: R. David Gibby (dgibby@usmagnesium.com); Mark Ransom; Jennifer Holder; Justin Burning; Kevin Lundmark; Catherine D. LeCours (clecours@PWT.COM); Mike Storck (mstorck@utah.gov)
Subject: RE: OU-1 Phase 1B Scoping Outcome Notes

Ken,

Per the requirements of Section 5.1.1 of the SOW, please find attached the outcome notes from the 11 and 12 May scoping meeting for the OU-1 Phase 1B RI. We look forward to working through the breakout issues that were identified during the meeting so we can quickly develop a final SAP for this phase of the RI.

david

David J. Abranovic P.E.
Partner

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EPA Technical Comments on ERM's
PROJECT SCOPING SESSION OUTCOMES SUMMARY
US Magnesium OU-1 Phase 1B Remedial Investigation Data Quality Objective Scoping Meeting

(Document Date: 26 March 2015)

U.S. MAGNESIUM NPL SITE, TOOELE COUNTY, UTAH

April 13, 2015

INTRODUCTION

The U.S. Environmental Protection Agency (EPA) is providing the following comments on the *Project Scoping Session Outcome Summary for the US Magnesium OU-1 Phase 1B Remedial Investigation Data Quality Objective Scoping Meeting*. This document was prepared by Environmental Resource Management (ERM) and submitted to the EPA 26 March 2015.

GENERAL COMMENTS

1. Revise the text to consistently refer to the DQO and SAP as "Phase 1A-B" as agreed to during the scoping meeting.
2. The Outcome notes should include cover sheets separating and identifying the Attachments.

SPECIFIC COMMENTS

Attendees

3. Revise the text as follows: Bill Brattin (SRC~~/PWT~~)

Comments/Decisions; RI Process Overview

4. **Pages 1 and 2, item 1)**: Revise the text as follows:

> ERM presented an RI process overview that illustrated each phase of the RI and the associated reporting tasks. ~~The USEPA suggested that Phase 1A/1B Inner Preliminary Remedial Investigation (PRI) area data be included in an OU-1 screening-level risk assessment (SLRA) including Inner and Outer PRI areas.~~ The USEPA attendees noted the purpose of this scoping meeting was to principally focus on the Phase 1A-B DQO for the Inner PRI areas and details associated with the Outer PRI areas were not appropriate for discussion. However, the USEPA noted if Inner PRI area investigations and findings were completed in sufficient time, it may be possible that OU-1 SLRA could address both Inner and Outer PRI areas. ERM agreed to the modification of the flow chart and further suggested that the OU-1 SLRA could include additional refinements used to focus the baseline risk assessment (BRA) on those PRI areas requiring additional evaluation. The ~~USEPA was~~ meeting attendees were not prepared to evaluate the details associated with a refined SLRA for the Outer PRI areas, but ~~was~~ were in general agreement that this approach may be used to focus the RI prior to implementing Phase 2 of the RI. ERM and EPA discussed needed clarification to the RI Overview flow chart to clarify the relationships and time-sequencing of RI-phases and risk assessment (TMs, screening, etc). ERM agreed to prepare a revised RI process flow chart, which is included herein as Attachment 3. EPA recognizes improvements in the re-submitted RI Overview (Attachment 3); however, EPA will discuss additional clarification during project planning and SAP discussions. RI process and scheduling details will be addressed as part of the final development of Section 2 of the Phase 1A-B SAP.

5. **Page 2, item 2)**: Revise the text as follows:

> The USEPA stated that the Phase 1A-B ~~Phase 1A/1B~~ RI Sampling and Analysis Plan (SAP) must be finalized, including the USEPA's approval, no later than 1 July 2015, as stipulated in the 18 February 2015 letter from Steve Wharton (Re: Remedial Investigation Progress: Inner PRI Areas, US Magnesium Superfund Site). ERM stated that the conditions in July and August are not

optimum for conducting fieldwork due to excessive heat and large accumulations of water in the evaporation ponds. The USEPA recognized the range of conditions presenting sampling challenges throughout the year; thus the importance of initiating the Phase 1A-B ~~The USEPA stated that the Phase 1A/1B RI must be initiated~~ by this date in order to receive the data in time to plan and implement the Phase 2 RI in 2016. ERM agreed to develop a Phase 1A-B ~~Phase 1A/1B~~ SAP preparation schedule with a completion date of no later than 1 July 2015 so that fieldwork could commence at that time. The meeting attendees noted the rigorous schedule demands for completing all documents and pre-RI planning prior to the start of fieldwork. ~~This agreement was based on all parties abiding by the rigorous schedule that would allow completion of all documents and pre-RI planning prior to the start of fieldwork.~~

***Comments/Decisions;* RCRA Settlement Update**

6. **Page 2, item 1)**: Revise the text as follows:

ERM presented a conceptual diagram of the proposed location of a wastewater filtration system that ~~would~~ may be constructed as part of a ~~forthcoming~~ pending Resource Conservation and Recovery Act (RCRA) agreement. Construction of this system would require that all or portions of PRIs 1 and 3 be removed from the OU-1 Phase 1A-B ~~Phase1A/1B~~ RI. The USEPA instructed ERM if no RCRA settlement is signed by 1 July 2015, all samples for PRI areas 1 and 3 will be collected pursuant the Phase 1A-B RI SAP. The meeting attendees discussed the boundaries of the “RCRA carve-out” that ~~would~~ may be included in the agreement and USEPA suggested that ~~some portion of~~ the main ditch, east of the chlorine ditch, should remain in the Phase 1A-B ~~Phase 1A/1B~~ RI. ERM suggested that this eastern portion of the main ditch be combined with PRI 5 to avoid having to include a statistically representative sample design for this portion of the ditch in the Phase 1A-B ~~Phase1A/1B~~ RI. However, t~~T~~he USEPA suggested that, given the small area, collecting six samples from the main ditch east of the chlorine ditch would be sufficient; ERM agreed.

7. **Page 2, item 3)**: Revise the text as follows:

The USEPA stated that there may need to be additional sampling in the northern areas of PRI-14 if a new evaporation pond is sited in the former solar pond east of the plant.

***Comments/Decisions;* Phase 1A/ 1B DQOs**

8. **Page 2, item 1)**: Revise the text as follows:

The meeting attendees ~~debated the pros and cons~~ discussed the differences and similarities between the DQO presented in the USEPA 2013 Phase 1A SAP and the revised Phase 1B DQO presented by ERM on 20 February 2015. The meeting attendees decided that both approaches ~~have merit~~ achieve the same objective and that an acceptable path forward would be to develop a hybrid Phase 1A-B ~~Phase 1A/1B~~ DQO that incorporates elements of the USEPA 2013 Phase 1A DQO and ERM’s Phase 1B DQO into a combined Phase 1A-B ~~Phase 1A/1B~~ DQO that will be implemented in 2015. The USEPA pointed out that the Inner PRI SLRA with COPC refinement (Draft Inner PRI Screening-level Risk Assessment Report [ERM October 2014]) had no further applicability to the upcoming Phase 1A-B SAP and risk assessment. A consensus was reached to include the following three study questions in the Phase 1A-B ~~Phase 1A/1B~~ DQO:

- What are the COPCs?
- What is the preliminary nature and extent of COPCs?
- What are background concentrations of metals, dioxin/furans (D/Fs), PCBs, HCB, and polycyclic aromatic hydrocarbons in soils and sediments?

9. **Page 2, item 2), first sentence**: Revise the text as follows:

   The meeting attendees reviewed the revised Phase 1B sample designs presented in ERM's 20 February 2015 DQO submittal, and USEPA stated that they had concerns with the methodology used to derive the sample sizes because they were derived using a power analysis (with an assumption that the data were log-normally distributed) and a diminishing return argument.

10. **Page 3, item 3)**: Revise the text as follows:

    The meeting attendees reviewed sample designs for each Inner PRI area included in ERM's Phase 1A-B ~~Phase 1B~~ RI, and agreed that the following modifications to sampling locations would be adequate for the Phase 1A-B ~~Phase 1A/1B~~ RI:

    - PRI-1 – ~~No change to ERM Phase 1B design. (however two samples will be added in Main Ditch east of the Chlorine Ditch if "RCRA carve out" eliminates a portion of PRI-1 from the Phase 1A/1B SAP).~~ Increase the number of sampling locations in ERM Phase 1A-B design to 14 surface samples and retain the 4 subsurface borings as proposed if a RCRA settlement is not signed by 1 July 2015. If a RCRA settlement is signed by 1 July 2015, the USEPA directed ERM to place 6 surface sample locations in the ditch with two co-located subsurface borings for the CERCLA investigation.
    - PRI-3 – Increase the number of sampling locations in ERM Phase 1A-B ~~1B~~ design to 12 surface samples and 1 subsurface boring at a south central location.
    - PRI-4 – ~~No change to ERM Phase 1B design.~~ Increase the number of sampling locations in ERM Phase 1A-B design to 14 surface samples and locate the 1 subsurface boring at the estimated thickest part of the gypsum pile.
    - PRI-5 – No change to ERM Phase 1A-B ~~1B~~ design. (The USEPA noted and appreciated that ERM pointed out the presence of a former waste diversion ditch in PRI 5.)
    - PRI-6 – No change to ERM Phase 1A-B ~~1B~~ design, but add 1 subsurface boring at the northeast corner of the Gypsum Pile (PRI4) to penetrate the gypsum pile for characterization of original surface materials associated with PRI-6.
    - PRI-7 – No change to ERM Phase 1A-B ~~1B~~ design, but add 2 surface samples in the north barrow ditch.

11. **Page 3, item 5)**: Revise the text as follows:

    Based on the RCRA discussion (Item 1 under RCRA Settlement), eight of the 14 planned sediment samples in PRI 1 and all of the PRI 3 samples would be eliminated if the RCRA settlement AOC is finalized before 1 July 2015. These remaining six samples would be located along the main ditch (east of the chlorine ditch).

***Comments/Decisions;* Groundwater/Surface Water (PRI 17)**

12. **Page 4, item 2)**: Revise the text as follows:

    ERM stated that the 12 months of groundwater/surface water gauging stipulated in the Phase 1A SAP have been completed, and the USEPA gave approval to discontinue the PRI 17 monitoring program. EPA requested ERM provide the gauging data in electronic format.

13. **Page 4, item 6)**: Revise the text as follows:

    The USEPA ~~suggested that~~ stated it was necessary for ERM to utilize data that have been collected to promptly develop a hydrologic conceptual site model (CSM) ~~be completed~~ for the RI study area. ERM noted that the current salt cap treatability test work plan includes a hydrologic CSM, and that the objective is to refine the understanding of groundwater-surface water interactions within and adjacent to the Current Waste Ponds and the Old Waste Pond. The USEPA requested that this CSM address the hydrologic surface/groundwater system for the entire Site, and be a standalone document supporting the Study Area RI, so it could be utilized and expanded to include fate and transport of contaminants and ultimately integrated into the RI report. ERM agreed with this approach and agreed that, upon review of the Phase 1A surface water and groundwater data, development of the CSM should be undertaken in 2015.

Comments/Decisions; Technical Topic 1 – Background

14. **Page 4, item 1), last sentence**: Revise the text as follows:

> …The USEPA stated that although they instructed ERM previously that it may be appropriate to utilize the methodology provided in this guidance for the US Mag RI, the USEPA has clarified that this approach is to be attempted only if all traditional means to characterize background have been exhausted. ~~this is no longer an option due to a USEPA policy decision regarding this document.~~

15. **Page 4, item 2)**: Revise the text as follows:

> ERM presented an evaluation of the Outer PRI Phase 1A data that suggests background should be established based on setting rather than site soil types and/or geology (see Technical Topic 1 slides, Attachment 2). Further discussion and review of regional geological maps illustrated the differing soil types and geology coincide with the settings. The USEPA agreed that ~~the analysis supports that~~ there are two distinct settings within the RI study area that are likely to exhibit unique background characteristics (i.e., Lakebed and Upland), and that these settings are consistent with the two major habitat types in the RI/FS study area that are relevant to the ecological risk assessment (ERA).

16. **Page 5, item 3)**:

> The USEPA agreed that ERM should develop a DQO for a background study of Upland and Lakebed settings, and the sample design should be partially based on a statistical analysis of the Phase 1A data. ~~Preliminary results presented by ERM suggested a sample design consisting of 10 to 20 samples collected from two or three reference areas per setting would be appropriate~~ ERM presented a calculation system for "n" predicting something in the range of 20 samples per setting. USEPA indicated that the preliminary sample design seemed reasonable, but several other factors, such as habitat types and quality in candidate reference areas, must also be considered. Consensus was reached that a seven-step DQO be developed for incorporation into the Phase 1A-B ~~Phase 1A/1B~~ SAP; however, the details of the sampling design (DQO Step 7) would be discussed during future breakout sessions and may not be presented in the draft Phase 1A-B ~~Phase 1A/1B~~ background DQO submittal to the USEPA prior to SAP development

Comments/Decisions; Technical Topic 2 – Bulk vs. Fines Fractions Analysis

17. **Page 5, item 2)**: Revise the text as follows:

> The USEPA agreed that the revised approach—based on collecting split samples for full analysis, grain size analysis, and fines analysis—would be more efficient than the reconnaissance approach used during the Phase 1A RI for the Outer PRI areas.

Comments/Decisions; Technical Topic 3 — Laboratory Analytical Methods

18. **Page 5, item 1)**: Revise the text as follows:

> The ~~USEPA~~ meeting attendees noted ~~agreed~~ that ~~many~~ some of the unresolved comments on TestAmerica analytical standard operating procedures (SOPs) (provided in a comment letter from PWT dated 20 October 2013) ~~did~~ would not need to be addressed in the Phase 1A-B ~~Phase 1A/1B~~ SAP because they related to the aqueous samples addressed under the Phase 1A RI SAP

for PRI17. The USEPA acknowledged that "foaming" water samples for volatile organic compound (VOC) analysis resulted in relatively minor dilutions; however, ERM agreed to continue discussions with TestAmerica to identify potential anti-foaming agents to help minimize water VOC sample dilutions. The USEPA requested that ERM/TestAmerica evaluate adding pentachlorobenzene and 1,4-dioxane to the Method 8270 semivolatile organic compound analyte list, and that the procedures used to determine when a sample extract needs to be re-analyzed at dilution should be refined to reduce the probability that holding times would be exceeded. The USEPA also noted, based on the laboratory audit, ERM/TestAmerica should be able to eliminate the holding-time exceedances that occurred at the TestAmerica lab through better communication and possibly samples being diverted to a back-up lab to obtain timely analysis. ERM agreed with these requests and would coordinate with PWT on the appropriate modifications to the laboratory work instructions for the Phase 1A-B ~~Phase 1A/1B~~ SAP.

<u>Comments/Decisions;</u> **<u>Technical Topic 4 — Accessing Sampling Locations in Wastewater Ponds</u>**

19. **<u>Page 6, item 1)</u>**: Revise the text as follows:

> The meeting attendees discussed 15 potential alternatives presented by ERM for collecting surface sediment samples from submerged locations in the active acid ponds (specifically PRI Areas 5 and 6). The discussion was focused on eliminating alternatives that were considered to ~~be unsafe and/or not technically feasible~~ present worker health and safety challenges and technically impracticable. The meeting attendees agreed that it would not be safe to send a sampling crew into inundated areas of the acid ponds without a means of rapid egress should some health and safety response need arise ~~access to immediate egress~~. The meeting attendees also agreed that the very low pH pond environment would likely cause rapid mechanical failures to motorized equipment. This discussion resulted in the elimination of Options 1, 2, 5, 6, 7, 9, 10, 11, 12, 13, and 15 (see Technical Topic 4 slide, Attachment 2).

20. **<u>Page 6, item 2)</u>**: Revise the text as follows:

> A consensus was reached that the preferable ~~surface~~ sediment sample collection methodology for the sample locations in submerged areas of current ponds (except for PRI4-13 and PRI5-14) would be a helicopter-deployed ~~dredge~~ grab sampler device, and the following protocol was formulated as a potential methodology to be included in the Phase 1A-B ~~Phase 1A/1B~~ SAP:
>
> - First, attempt to collect a sample at the planned location with a grab sampler deployed from a helicopter (two to three attempts per location).
> - Second, attempt to collect a sample by helicopter at a nearby location (e.g., approximately 100 feet from the original; two to three attempts per location).
> - Third, relocate the sampling location to the vicinity of a submerged sample that was successfully collected (two to three attempts per location).
> - Finally, if and only all attempts above fail, ~~obtain~~ seek USEPA approval to relocate sampling location to the nearest shoreline.

21. **<u>Page 6, item 3)</u>:** Revise the text as follows:

> The meeting attendees discussed the feasibility of conducting a demonstration of method applicability (DMA) to ~~refine~~ evaluate the helicopter-deployed sediment grab sampling methodology to aid in selection of the sampling equipment and development of SOPs.US Mag stated that it may be possible to deploy a man-lift/long-reach hydraulic boom/crane to an accessible pond shore area and test different size and configuration samplers to inform the development of the Phase 1A-B ~~Phase 1A/1B~~ SOPs.

Action Items

22. **Action Items**: Revise the text as follows:

    2. ERM to prepare a technical memorandum, including schedule, summarizing ~~dredge~~ test methods to be evaluated for ~~surface~~ sediment collection from inundated areas of the evaporation ponds.

    4. ERM to evaluate high-resolution / low-resolution approach with laboratory and provide proposal for EPA to consider.

Attachment 2

EPA DISCLAIMER: While Attachment 2 of this Project Scoping Session Outcomes Summary reflects the presentation during the meeting from which discussions were based (in particular the slides), the contents do not necessarily reflect the views of the EPA nor does the EPA agree with nor endorse the contents. The slides were used to guide technical discussions reflected herein.

Attachment 3

EPA NOTE: Discussions held during the Scoping Meeting regarding the RI Overview Attachment 3 are discussed under Comment 4 of the Outcomes Summary. EPA does not endorse Attachment 3 beyond its value as a conceptual project framework for RI and risk assessment.

Attachment 9N

4 May 2015 ERM Response to EPA comments on the revised soil/sediment Phase 1 A-B DQO

From: David Abranovic
Sent: Monday, May 04, 2015 12:47 PM
To: Ken Wangerud (Wangerud.Ken@epamail.epa.gov)
Cc: Catherine D. LeCours (clecours@PWT.COM); Kevin Lundmark; Mike Storck (mstorck@utah.gov); Justin Burning; Jennifer Holder; Mark Ransom
Subject: Response to EPA comments on the revised soil/sediment Phase 1 A-B DQO

Ken,

We have reviewed the suggested edits to the revised soil/sediment portion of the OU-1 Phase 1 A-B DQO and will incorporate the appropriate edits in a final DQO that includes both the soil/sediment sampling and the background study components of the Phase 1 A-B DQO. Because the majority of the EPA comments were provided to us as text edits rather than concise technical comments, it was somewhat challenging for us to understand the intent of some of the requested changes. At any rate, given that it is essential for us to maintain forward momentum with the DQO development, I would prefer not to prepare a detailed response to all of these edits. Instead, I have prepared the following summary of how we propose to address these comments in the final DQO:

- Inclusion of initial human and ecological risk calculations (Comments 4, 6, 11 and 13) – As we discussed during our 29 April 2015 Quarterly RPM meeting, although ERM does not necessarily disagree with conducting the requested risk calculations with the Phase 1 A-B data, we have not had sufficient time to fully understand EPA's proposal and do not believe that it is necessary to include it in the DQO, as it does not appear to affect the sample design. We believe that the potential merits of the EPA's proposal need to be fully discussed by the risk assessors and incorporated into the Eco problem formulation document or the HH and Eco BRA TMs as appropriate.

- Sample locations (Comment 19) - As we discussed during our 29 April 2015 Quarterly RPM meeting, ERM will include new biased samples PRI5-17 PRI5-18, PRI5-19, PRI5-20, and PRI5-21 as shown on Attachment 1, and samples PRI5-12 and 5-16 will be omitted from the DQO. In accordance with Comment 17, and as we agreed at the Quarterly RPM meeting, please provide ERM with the rationale for each of these bias samples for inclusion in the DQO and SAP.

- All applicable references to project completion dates will be included in WS-16 of the Phase 1 A-B SAP and will be omitted from the DQO.

- References to exposure units and decision units and the blocking of data relative to waste types (Comment 11) – These elements were not discussed at the March 11/12 scoping meeting and are not appropriate to include in the Phase 1 A-B DQO. These elements will be discussed by the risk assessors and incorporated into the HH and Eco BRA TMs, problem formulation documents and/or Phase 2 RI DQO, as appropriate.

- Sampling of discrete layers of waste if identified in borings (Comments 11 and 16) – The final DQO will include clear and concise criteria for identifying and sampling discrete layers of waste material (i.e. layers less than 2 feet in thickness) if encountered in subsurface soil borings and to isolate native material from waste materials in the final sampling interval. SOP USM-09 will be revised accordingly.

- Data adequacy evaluation for preliminary nature and extent (Comment 13) – ERM is unaware of a statistical test to determine data adequacy for a qualitative goal of preliminary nature and extent and we do not believe that it is necessary to include it in the DQO worksheet. The reference provided by EPA for this assessment (USEPA 2006a) makes no mention of data adequacy methods for nature and extent data sets. Consistent with the UFP-QAPP format, the procedures for evaluating data usability for project objectives will be included in Worksheet 37 of the SAP.

- Include VOC analysis within the capillary fringe (Comment 22) – ERM does not believe that it is practical to objectively identify capillary fringe soils in the field, therefore we will include VOC analysis of all Phase 1 A-B samples from Inner PRIs. SOP USM-01 will be revised accordingly.

Please let me know as soon as possible if EPA is in agreement with these responses, so the ERM technical team can complete work on the final phase 1 A-B DQO and initiate SAP preparation. We can discuss further on our call this afternoon,

david

David J. Abranovic P.E.
Partner

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Attachment 9O

7 May 2015 Agenda, Pre-Read, and Call Notes from
7 May 2015 Risk Assessor Call

From: Jennifer Holder
To: Karen Cejas
Subject: FW: US Mag Risk Assessor"s Biweekly Call - Proposed Agenda
Date: Tuesday, June 16, 2015 8:11:24 AM

From: Jennifer Holder
Sent: Tuesday, May 05, 2015 11:15 AM
To: Dan Wall (wall.dan@epa.gov); Wendy O'Brien (obrien.wendy@epa.gov); brattin@srcinc.com; Scott Everett (SEVERETT@utah.gov); mstorck@utah.gov; Chris Cline (Chris_Cline@fws.gov); dcox@blm.gov; Sherry Skipper (sherry_skipper@fws.gov); Mark Jones; Mark Shibata; Kevin Lundmark
Subject: US Mag Risk Assessor's Biweekly Call - Proposed Agenda

Proposed Agenda for Thursday

1) LRMS – Resolve outstanding issues – Kevin Lundmark
2) Fine vs Bulk – Resolve outstanding issues – Mark Shibata
3) EPA comments on OU1 Phase 1a/b DQO dated 27 April. ERM would like clarification on Section 11.2.6.3 (risk calculations) – EPA
4) Preliminary EPA comments of HHE – EPA (tentative on Wendy's availability)
5) Schedule for Risk Assessment Deliverables in 2015 – ERM Update
6) Other??

From: Kevin Lundmark
To: Jennifer Holder; Dan Wall (wall.dan@epa.gov); Wendy O"Brien (obrien.wendy@epa.gov); brattin@srcinc.com; Scott Everett; mstorck@utah.gov; Chris Cline (Chris_Cline@fws.gov); dcox@blm.gov; Sherry Skipper; Mark Jones; Mark Shibata; Karen Cejas
Subject: RE: US Mag Risk Assessor"s Biweekly Call - Proposed Agenda
Date: Thursday, May 07, 2015 11:19:15 AM

Proposals for HRMS/LRMS analysis for D/F and PCBs for discussion during today's RA call.

For D/F:

- Analyze all samples using HRMS following the high-level/low-level protocol developed from DMA results (same as Phase 1A SAP). If HRMS analysis indicates any congener present at concentration greater than max calibration level (40 µg/kg for high-level samples) at max dilution (10X), i.e., if congener concentration in sample is greater than 400 µg/kg, then extract / analyze by LRMS method. All results (HRMS and LRMS) will be reported.

Considering the risk assessment data needs for the Phase 1A-B and the use of Phase 1A-B data to support baseline risk assessments, we feel that HRMS D/F analysis is appropriate for all samples. We feel that LRMS analysis may still be appropriate for future investigation phases, depending on the specific data needs.

For PCBs:

- Default analysis will be by HRMS. If HRMS analysis indicates any congener present at concentration greater than upper calibration range (2 µg/kg) at max dilution (25X), i.e., if congener concentration in sample is greater than 50 µg/kg, then re-extract at dilution for HRMS analysis. Re-extraction will be at 10X dilution unless otherwise indicated by severe sample matrix or results from initial analysis.
- Designate selected samples for LRMS analysis based on sample location and visible waste presence. For LRMS samples, submit a sample to Alpha Analytical for analysis by Method 680-Mod. Submit a split to TestAmerica for hold (frozen) for potential analysis by HRMS. If LRMS sample has no congener detected above 50 µg/kg, then ERM will request TestAmerica to analyze sample by HRMS.

The proposal for PCBs is unchanged from what was presented at the March 2015 Scoping Meeting, and there has been no discussion about LRMS/HRMS PCB methods since that meeting. Looking at Total PCBs concentration levels from a risk perspective, this proposal will meet the data needs for Phase 1A-B and addresses the spirit of the concern raised in the 28 April 2015 Agency Comments for HRMS Reanalysis. Basing PCB reanalysis decisions on RBCs for total PCBs seems reasonable considering the very low contribution of co-planar PCBs to D/F TEQs (average of 1.5% of TEQ).

Regards,
Kevin

. . . .

Kevin Lundmark
ERM

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From: Jennifer Holder
Sent: Tuesday, May 05, 2015 4:32 PM
To: Dan Wall (wall.dan@epa.gov); Wendy O'Brien (obrien.wendy@epa.gov); brattin@srcinc.com; Scott Everett; mstorck@utah.gov; Chris Cline (Chris_Cline@fws.gov); dcox@blm.gov; Sherry Skipper; Mark Jones; Mark Shibata; Kevin Lundmark; Karen Cejas
Subject: RE: US Mag Risk Assessor's Biweekly Call - Proposed Agenda

I forgot to add one more agenda item. See below in red.

From: Jennifer Holder
Sent: Tuesday, May 05, 2015 11:15 AM
To: Dan Wall (wall.dan@epa.gov); Wendy O'Brien (obrien.wendy@epa.gov); brattin@srcinc.com; Scott Everett (SEVERETT@utah.gov); mstorck@utah.gov; Chris Cline (Chris_Cline@fws.gov); dcox@blm.gov; Sherry Skipper (sherry_skipper@fws.gov); Mark Jones; Mark Shibata; Kevin Lundmark
Subject: US Mag Risk Assessor's Biweekly Call - Proposed Agenda

Proposed Agenda for Thursday

1) LRMS – Resolve outstanding issues – Kevin Lundmark
2) Fine vs Bulk – Resolve outstanding issues – Mark Shibata
3) EPA comments on OU1 Phase 1a/b DQO dated 27 April. ERM would like clarification on Section 11.2.6.3 (risk calculations) – EPA
4) Field trip to identify background locations – Karen Cejas
    a. Week of 6/1 - 6/5.
    b. 4 days total
        i. 2-3 days to cover area around 5 mile radius,
        ii. 1 day to go to Bear River Migratory Bird Refuge
5) Preliminary EPA comments of HHE – EPA (tentative on Wendy’s availability)
6) Schedule for Risk Assessment Deliverables in 2015 – ERM Update
7) Other??

From: Jennifer Holder
To: Dan Wall (wall.dan@epa.gov); Wendy O"Brien (obrien.wendy@epa.gov); brattin@srcinc.com; Scott Everett; mstorck@utah.gov; Chris Cline (Chris_Cline@fws.gov); dcox@blm.gov; Sherry Skipper; Mark Jones; Mark Shibata; Kevin Lundmark
Cc: Karen Cejas; David Abranovic; Justin Burning
Subject: US Mag Risk Assessor"s Biweekly Call - 5/7/15 DRAFT Call Notes
Date: Tuesday, May 12, 2015 5:21:21 PM

Hi all,

As per our last call, we will start to send out summaries after each call. Hopefully, these will provide a record of our discussions and help to track progress on technical issues. I am hopeful that we can keep this summary at a high level and to not have a significant amount of back and forth to finalize. However, if we have really messed something up in our summary, please send specific revisions to Karen Cejas and we will send out a final version if need be.

On a related topic, we are currently finalizing the joint soil and BG Phase 1A/B DQO and expect that will be submitted to the agencies for review in a few days.

Thanks,

-Jen

US Magnesium Superfund Site

Date: 05/07/2015

Hosted by: Jennifer Holder, ERM

Attendees:

Bill Brattin, SRC

Wendy O'Brien, EPA

Doug Cox, BLM

Scott Everett, UDEQ

Michael Storck, UDEQ

Dan Wall, EPA

Sherry Skipper, USFWS

Kevin Lundmark, ERM

Mark Jones, ERM

Mark Shibata, ERM

Karen Cejas, ERM

Summary notes (Action items in RED; Responses to Action Items in Green):

1) LRMS – Resolve outstanding issues – Kevin Lundmark

- Email was sent out prior to call describing proposal for HRMS/LRMS analysis for D/F and PCBs

- For D/F - All samples will be analyzed with HRMS following high-level, low-level protocol included in Phase 1A SAP. Use LRMS only if the D/F concentrations are greater than max calibration level (40 ug/kg) at max dilution (10X).

- For PCBs – Samples anticipated to have high concentrations due to location will be designated for LRMS, but if no congener detected above 50 ug/kg then sample will be analyzed using HRMS. All other samples will be analyzed with HRMS. If PCB concentration is greater than upper calibration range (2 ug/kg) at max dilution (25X), then re-extract at 10X dilution for HRMS analysis.

- Agencies –Look over the details and provide opinion in a week.

2) Fine vs Bulk – Resolve outstanding issues – Mark Shibata

- B. Brattin, M. Shibata, and N. Hausmann (ERM) had a call yesterday to discuss issues with language on fines vs bulk.

- All agreed there are no impacts to methodology or results if sentences are removed.

- ERM - M. Shibata will revise Appendix J so these sentences are removed. The final document will include the revised Appendix.

3) EPA comments on OU1 Phase 1a/b DQO dated 27 April. ERM would like clarification on Section 11.2.6.3 (risk calculations) – EPA

- B. Brattin clarified – For humans and mobile eco-receptors, a goal should be included for performing initial risk calculations using mean and 95UCL concentrations to evaluate if data collected is sufficient to make risk decisions. Initial risk calculations will identify COPCs and datasets that lead to uncertainty based on mean and 95UCL calculations. This should only be applied to COPCs that get through the screen, not the full list. This goal does not change the number of samples to collect; it is a downstream intended application only.

- ERM – ERM Team will discuss internally and get back to EPA with a recommendation.

- ERM Team agrees with adding the following goal to Step 2 of the DQO: "Evaluate whether sufficient data have been collected to support reliable risk management decision-making." We also agree with the types of evaluations that were proposed for this goal in Step 5. However, we temper this by recognizing that the performance acceptance criteria for the evaluation of whether sufficient abiotic data have been collected will be dependent on the risk assessment methodologies developed in the technical memoranda specified in the AOC. It is recognized that the evaluations described in the DQO may be modified once the risk assessment methodologies are finalized. We have added this modifying language to Step 5 in the DQO.

4) Field trip to identify background locations – Karen Cejas

- Field trip to evaluate potential background locations is proposed for the week of 6/1 - 6/5. It is expected to take 2-3 days to cover area around 5 mile radius and 1 day to go to Bear River Migratory Bird Refuge.

- K. Cejas is putting together scope and field forms for John Cavitt and others participating in field trip

- S. Everett and either C. Cline or S. Skipper will participate in the field trip also.

- K. Cejas will put together a call with mini group (S. Everett and S. Skipper) to discuss specifics on documentation needed from field trip

- K. Cejas will put develop a strawman on scope of field trip and will send out to larger group

5) Preliminary EPA comments of HHE – EPA

- W. O'Brien had concerns with data quality when surveys were administered by themselves such as the hunter recreational scenario by ATI. Not sure how we will evaluate data quality for these.

- There were also concerns over footnote that says groundwater will not be evaluated. M. Jones clarifies that this is specific to survey only though, not the case overall.

Suggestion is to change language to describe where drinking water is coming from and the reason that groundwater is not being evaluated in this survey.

- Risk should be quantified for anyone consuming contaminated beef from grazing cows despite the fact that ranchers said they do not eat their own beef. We will need to look at other receptors and may need to call ranchers to find out where the beef goes (e.g. butcher, auction). The survey report should say that we didn't collect this data.

- EPA - Comments to ERM in a couple of weeks.

6) Schedule for Risk Assessment Deliverables in 2015 – ERM Update

- J. Holder said she will send out a schedule for the rest of the year and a list of most important items to discuss on these calls for our next call on 5/21.

- Call frequency will be biweekly (it can be adjusted more frequent or less frequently dependent on topics and schedule).

- K. Cejas will start providing summary notes of the calls so we can track progress.

Jennifer Holder, Ph.D.
Partner

ERM

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Attachment 9P

12 May 2015 EPA Responses to ERM’s 4 May 2015 Responses to EPA Comments on the Phase 1A-B DQO

From: Wangerud, Ken <wangerud.ken@epa.gov>
Sent: Tuesday, May 12, 2015 9:37 AM
To: David Abranovic
Cc: Kevin Lundmark; mstorck@utah.gov; Catherine D. LeCours
Subject: EPA response to ERM 4May2015 review of EPA 28Apr revised-Draft OU-1 Phase 1 A/B DQO

David:

As promised during our call yesterday afternoon, EPA's response to the seven bullet items of your 4May email are inserted below. There have clearly been productive technical discussions between Agency and ERM staff.

You also noted during our call that ERM has prepared Sec. 11.3 DATA QUALITY OBJECTIVES FOR BACKGROUND EVALUATIONS for inclusion in the Draft-DQO. Please advise when ERM will deliver the re-submitted Draft-DQO document for EPA review.

I understand that ERM expects to have field-review of background study sites underway the first week of June, and that dredge-sampler testing may also be underway at that time. These efforts are both essential for draft-SAP completion.

I understand that ERM has begun work on the draft Ph1A-B SAP, but progress is now time-critical for draft-SAP completion and EPA review in order to have Ph1A-B work completed by early-October 2015.

Contact me if you have further questions about finalizing the Draft-DQO document, and please stay in contact with PWT's Catherine LeCours as draft-SAP development proceeds.

Ken

Ken Wangerud, Remedial Project Manager
Superfund Remedial Program
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wangerud.ken@epa.gov

From: David Abranovic [mailto:David.Abranovic@erm.com]
Sent: Thursday, April 30, 2015 6:58 PM
To: Wangerud, Ken
Subject: RE: Draft OU-1 Phase 1 A/B DQO

Ken,

We have reviewed the suggested edits to the OU-1 Phase 1 A-B revised soil/sediment DQO and will incorporate the appropriate edits in a final DQO that includes both the soil/sediment sampling and the background study components of the Phase 1 A-B DQO. Because the majority of the EPA comments were provided as text edits rather than concise technical comments, it was somewhat challenging for us to understand the true intent of many of the requested changes. At any rate, given that it is essential for us to maintain forward momentum with the DQO development, I would rather not prepare a detailed response to all of these edits. Instead, I have prepared the following summary of how we intend to address the significant comments in the final DQO:

- Inclusion of initial human and ecological risk calculations (Comments 4, 6, 11 and 13) – As we discussed during our 29 April 2015 Quarterly RPM meeting, although ERM does not necessarily disagree with conducting risk calculations with the Phase 1 A-B data, we have not has sufficient opportunity to understand the EPAs proposal and do not believe that it is necessary to included it in the DQO. We believe that the potential merits of the EPAs proposal should be discussed by the risk assessors and incorporated into a SLRA TM addendum, or the HH and Eco BRA TMs.

EPA Response: The EPA notes the inclusion of the risk assessment calculations as a DQO does not impact the sample design. Discussion of how data will be evaluated is an integral part of the DQO process. Details of the approach that will be used will depend on the nature of the results obtained; based on risk assessment team future discussions. At this stage in the RI process, the EPA expects ERM to provide more than just a presentation of raw data in the RI results reports. Reports must provide some interpretation of the results to advance the team's understanding of risks, the problem formulation, and the CSM. Revise the text as provided in the EPA comment as to not delay the Phase 1A-B SAP.

- Sample locations (Comment 19) - As we discussed during our 29 April 2015 Quarterly RPM meeting, ERM will include samples PRI5-17 PRI5-18, PRI5-19, PRI5-20, and PRI5-21 shown on Attachment 1 in the DQO. Samples PRI5-12 and 5-16 will be omitted from the DQO.

During the 29 April meeting, ERM was able to report on source-release waters of the 'Star Ditch'—being an emergency overflow to release the layer of waters that would accumulate atop Star Pond brines during large precipitation events. Accordingly, EPA-UDEQ agreed that the PRI-20 sample point could be deleted, and that PRI5-18 would suffice as the first Star-Ditch sample location, with PRI5-22 being a second downstream location farther towards the east. EPA-UDEQ also agreed that for the Former Diversion Ditch, PRI5-17 and PRI5-18 would suffice as sample locations, and PRI5-16 could be deleted. ERM's statement above that PRI5-12 will be omitted appears to be an error (perhaps meant to be the PRI5-20 location). PRI5-12 is a grid-based sample location (per ERM's proposed sample plan), is far removed from the ditches, and was not a part of the 29 April discussion.

Accordingly, the ditch-sampling rationale is briefly as follows…
Star-Ditch:

PRI5-18: evaluate potentially-impacted sediments sourced and potentially impacted by Star-Pond releases.

PRI-5-22: evaluate potentially-impacted sediments farther downstream (east) which appear to have comingled with Former Diversion Ditch and SE waste-lagoon waters.

Former Diversion Ditch:

PRI5-17: evaluate potentially-impacted sediments sourced from Red River Ditch diverted waters, with potential leachates from the PRI2-Landfill, near/at the upstream inlet into the SE waste-lagoon.

PRI5-21: evaluate potentially-impacted sediments from the lower-reach of the Former Diversion Ditch (representing the eastward leg draining into the SE waste-lagoon.

Skull Valley Diversion:

PRI5-19: evaluate potentially-impacted sediments of influent seep-zone from waste-ditches and lagoon waters immediately to the north.

- All applicable references to project completion dates will be included in WS-16 of the Phase 1 A-B SAP and will be omitted from the DQO.

The DQO reference WS-16 (to ensure the project schedule will achieve ERM's stated intent to complete RI investigations during 2015-2016 and is on the same timeline) will suffice.

- References to exposure units and decision units and the blocking of data relative to waste types (Comment 11) – These elements were not discussed at the March 11/12 scoping meeting and are not appropriate to include in the Phase 1 A-B DQO. These elements will be discussed by the risk assessors and incorporated into the HH and Eco BRA TM,s as appropriate.

EPA recognizes that exposure- and decision-units and 'data-blocking' were not discussed during the scoping meeting. However, EPA's DQO-edits were meant to expand on ERM's draft-text which only addressed in general language the need to delineate contaminant occurrence. Accordingly, and based on discussions subsequent to ERM's 4May email, EPA has revised it's editing of Sec. 11.2.5.2 text as follows:

11.2.5.2 Preliminary Nature and Extent Characterization

The Phase 1A/1B RI Data Report will include maps showing chemical constituent concentrations in each Inner PRI. If concentrations of a constituent in surface samples are similar across a PRI, then additional N&E data would not be required for that constituent. However, additional N&E information may be subsequently needed to delineate specific ~~features or~~ areas to support risk assessment or to more clearly delineate the spatial distribution of contaminants for site characterization and FS scoping~~the extent of impacts requiring remediation after constituents of concern (COCs) are identified in the RI~~. If constituent concentrations are highly variable across a PRI, then additional ~~site characterization~~ data to characterize and delineate N&E ~~may~~will be collected during the Phase 2 RI.

If field screening identifies that waste is present at depths greater than 6 inches bgs, then additional sampling may be required to delineate the vertical extent of waste, to measure COPC concentrations in the subsurface to depths relevant to human or ecological exposure, or to support Feasibility Study evaluations. Subsurface sampling will be performed during Phase 1A/1B at key waste deposition locations. If subsurface concentrations are substantially higher than those in surficial samples, additional subsurface sampling ~~may~~will be necessary to adequately delineate the vertical extent of COCs.

~~The Phase 1A-B portion of the RI will obtain a preliminary data set to support Phase 2 planning. USEPA DQO guidance (EPA 2006) states that data sets need to be evaluated to determine if the data are representative of Site conditions. Data may also need to be blocked into more logical groups for evaluating nature and extent if the data is shown to be tied to a particular waste type of release and fate and transport mechanisms.~~

~~Limited subsurface sampling in key waste disposal areas is identified for collection during the Phase 1A-B investigation. The purpose of these key waste disposal borings is to profile the stratigraphic column of wastes above and two feet into native materials. Sampling intervals may be altered to segregate native sampling intervals from waste intervals. No subsurface sampling interval will exceed two feet in thickness.~~

~~Additional samples may be appropriate to identify the characteristics of small, discrete layers within the stratigraphic column of the wastes. Smaller sampling intervals may be identified and sampled where significant physical changes are visually evident. For example, during the DMA, chemical hard pans of a foot or less in thickness were identified in the near subsurface that could represent chemical sinks for preferential contaminant accumulations. The focused sampling intervals may be less than two foot in thickness but no less than 6 inches in thickness, will be identified at the discretion of the USEPA (or their field representatives), documented in a field modification form, and may require a second boring at the same location.~~ *[Note: the above two paragraphs being deleted in response to ERM's revision of text per bullet #5 below.]*

~~Exposure and decision units have yet to be defined for the Site.~~ The need for additional data to define nature and extent at the Site (to be collected during Phase 2) will be determined by comparing results of Phase 1A-B to ~~risk based thresholds and blocking data into logical~~ waste types or areas for further site-characterization evaluation and remedy-scoping considerations (decision units). Data assessment and related mapping efforts may include all useable and relevant data (including historical, DMA, Phase 1A, and Phase 1A-B) ~~applicable to both solid and aqueous media. To the degree possible, data assessment~~ and mapping will be performed across all impacted portions of the Site, considering PRI boundaries~~, ecological and human health exposure areas,~~ and potential feasibility study needs.

- Sampling of discrete layers of waste if identified in borings (Comment 11 and 16) – The final DQO will include clear and concise criteria for sampling discrete layers of waste material (i.e. greater than 6 inches and less than 2 feet in thickness), if encountered in subsurface soil borings.

The EPA awaits the SOP submittal with the Phase 1A-B SAP for review and approval.

- Data adequacy evaluation for preliminary nature and extent (Comment 13) – ERM is unaware of a statistical test for to determine data adequacy for a qualitative goal for preliminary nature and extent. The reference provided by EPA for this assessment (USEPA 2006a) makes no mention of data adequacy methods for nature and extent data sets.

EPA-ERM discussions subsequent to 4May have indicated that EPA-ERM share similar views regarding the intended purposes of mapping endeavors. However, EPA has stressed the need to establish a framework for statistical assessment and evaluation of data in order to understand what is known (or remains unknown) about contaminant distribution for site-characterization. Accordingly, EPA has revised its editing of the Sec. 11.2.6.2 text as follows:

11.2.6.2 Preliminary Nature and Extent for Site-Characterization

After the validated and verified Phase 1A-B data are available, the adequacy of the preliminary data to ~~define~~ascertain the nature and extent of contaminants will be determined. ~~The relevant data can then combined and blocked appropriately in accordance with project needs and in accordance with the USEPA's data quality assessment (DQA) process.~~ The ~~DQA~~ data assessment process for site characterization ~~involves the use of~~ will utilize statistical and graphical tools (i.e., Q-Q plots, variograms, Kriging methods, and maps) to ~~determine if the data will achieve their intended use (i.e., preliminary delineation of nature and extent) adequate to support decision-making~~ undertake spatial-distribution and uncertainty analysis to support site-characterization and scoping of contaminant extent and distribution for Ph2 scoping. ~~If the data does not~~ This analysis will support ~~decision-making,~~ scoping of Phase 2 investigations for ~~will incorporate~~ the collection of additional data to complete site-characterization and support decision-making.

EPA understands that ERM has also reconsidered and possibly rewritten ERM's DQO-text regarding nature and extent evaluation.

- Include VOC analysis within the capillary fringe (Comment 22) – ERM does not believe that…from Inner PRIs. SOP USM-01 will be revised accordingly.

ERM's response is acceptable.

David J. Abranovic P.E.
Partner

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From: Wangerud, Ken [mailto:wangerud.ken@epa.gov]
Sent: Tuesday, April 28, 2015 8:57 AM
To: David Abranovic
Cc: Justin Burning; Catherine D. LeCours (clecours@PWT.COM); R. David Gibby (dgibby@usmagnesium.com); Mike Storck (mstorck@utah.gov); Kevin Lundmark; Mark Ransom; Jennifer Holder; Wall, Dan
Subject: RE: Draft OU-1 Phase 1 A/B DQO

David:

Attached are Agency comments to the subject DQO.

EPA looks forward to receiving ERM's submittal for Section 11.3 regarding background investigations.

Issues regarding LRMS-HRMS analyses and background-study design will be at the forefront of upcoming risk-assessor technical discussions.

Having received the SAP-template from EPA, ERM's now has draft-SAP preparations underway for the Ph1A-B investigation of Inner-PRIs. Please feel free to contact me and coordinate with PWT's Catherine LeCours at any time if you have questions.

Cheers, Ken

Ken Wangerud, Remedial Project Manager
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wangerud.ken@epa.gov

From: David Abranovic [mailto:David.Abranovic@erm.com]
Sent: Tuesday, April 07, 2015 10:50 AM
To: Wangerud, Ken
Cc: Justin Burning; Catherine D. LeCours (clecours@PWT.COM); R. David Gibby (dgibby@usmagnesium.com); Mike Storck (mstorck@utah.gov); Kevin Lundmark; Mark Ransom; Jennifer Holder; Wall, Dan
Subject: RE: Draft OU-1 Phase 1 A/B DQO

Ken

Please find attached the draft OU-1 Phase 1 A/B DQO for your review. This DQO was prepared based on the discussions and agreements reached during the 11/12 March 2015 scoping meeting. However please note that based on comments received via e-mail from Dan Wall on 2 April, requesting that HCB and PCBs be added to the background sample design among other things, we are unable to include the background study in this version of the DQO. We have therefore included a placeholder for the background portion of DQO, and will submit it to EPA under separate cover as soon as the risk assessors agree on how best to address Dan's comments. I do not believe that the additional work on the background sample design should delay EPA's submittal of the Phase 1A/B SAP template to ERM. Our team is immediately available to initiate work on the SAP, and as you know the Phase 1 A/B schedule is already very compressed, so we would like to avoid any unnecessary delays. Feel free to contact me anytime if you have any questions regarding this document.

david

David J. Abranovic P.E.
Partner

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Attachment 9Q

18 May 20115 EPA Acceptance of ERM's 7 May 2015 LRMS Analysis

Kevin Lundmark

From:	OBrien, Wendy <OBrien.Wendy@epa.gov>
Sent:	Monday, May 18, 2015 11:21 AM
To:	Jennifer Holder; Wall, Dan; brattin@srcinc.com; severett@utah.gov; mstorck@utah.gov; Chris Cline (Chris_Cline@fws.gov); dcox@blm.gov; Sherry Skipper; Mark Jones; Mark Shibata; Kevin Lundmark
Cc:	Karen Cejas; David Abranovic; Justin Burning; Wangerud, Ken
Subject:	RE: US Mag Risk Assessor's Biweekly Call - 5/7/15 DRAFT Call Notes

Hi Jennifer,

Thank you for sending out these meeting notes; I agree it is helpful to have a record of what we talked about along with action items.

As for the Agencies' first action item below regarding the revised proposal for HRMS/LRMS analysis for D/R and PCBs (provided via email by Kevin L on 5/7/15): based on the discussion during our risk assessors call and subsequent review and internal discussion, we accept the revised approach as proposed.

Regarding our comments on the HH Exposure Survey Report, we will send comments to you within the next week. We look forward to receiving the draft soil and background Phase 1A/B DQO from you soon.

One administrative request: You will note that I have cc'd Ken Wangerud on this email. Please include him on emails containing our meeting summaries (and in general on any email to our risk assessors group on which David Abranovic is cc'd). This is just to make sure the appropriate and equivalent levels of project management are not inadvertently left out of the loop (I'm happy to forward these emails on to Ken, but it's more timely and efficient to just include him on the original email).

Thank you,

Wendy

Wendy O'Brien, DVM, PhD, DABT
Toxicologist, Ecosystems Protection and Remediation
USEPA Region 8
1595 Wynkoop Street
Denver, CO 80202

Phone: 303.312.6712
FAX: 303.312.7151

From: Jennifer Holder [mailto:Jennifer.Holder@erm.com]
Sent: Tuesday, May 12, 2015 6:21 PM
To: Wall, Dan; OBrien, Wendy; brattin@srcinc.com; severett@utah.gov; mstorck@utah.gov; Chris Cline (Chris_Cline@fws.gov); dcox@blm.gov; Sherry Skipper; Mark.Jones@erm.com; Mark Shibata; Kevin Lundmark
Cc: Karen Cejas; David Abranovic; Justin Burning
Subject: US Mag Risk Assessor's Biweekly Call - 5/7/15 DRAFT Call Notes

Hi all,

As per our last call, we will start to send out summaries after each call. Hopefully, these will provide a record of our discussions and help to track progress on technical issues. I am hopeful that we can keep this summary at a high level and to not have a significant amount of back and forth to finalize. However, if we have really messed something up in our summary, please send specific revisions to Karen Cejas and we will send out a final version if need be.

On a related topic, we are currently finalizing the joint soil and BG Phase 1A/B DQO and expect that will be submitted to the agencies for review in a few days.
Thanks,
-Jen

--
US Magnesium Superfund Site
Date: 05/07/2015
Hosted by: Jennifer Holder, ERM

Attendees:
Bill Brattin, SRC
Wendy O'Brien, EPA
Doug Cox, BLM
Scott Everett, UDEQ
Michael Storck, UDEQ
Dan Wall, EPA
Sherry Skipper, USFWS
Kevin Lundmark, ERM
Mark Jones, ERM
Mark Shibata, ERM
Karen Cejas, ERM

Summary notes (Action items in RED; Responses to Action Items in Green):

1. LRMS – Resolve outstanding issues – Kevin Lundmark

- Email was sent out prior to call describing proposal for HRMS/LRMS analysis for D/F and PCBs

- For D/F - All samples will be analyzed with HRMS following high-level, low-level protocol included in Phase 1A SAP. Use LRMS only if the D/F concentrations are greater than max calibration level (40 ug/kg) at max dilution (10X).

- For PCBs – Samples anticipated to have high concentrations due to location will be designated for LRMS, but if no congener detected above 50 ug/kg then sample will be analyzed using HRMS. All other samples will be analyzed with HRMS. If PCB concentration is greater than upper calibration range (2 ug/kg) at max dilution (25X), then re-extract at 10X dilution for HRMS analysis.

- Agencies –Look over the details and provide opinion in a week.

2. Fine vs Bulk – Resolve outstanding issues – Mark Shibata

- B. Brattin, M. Shibata, and N. Hausmann (ERM) had a call yesterday to discuss issues with language on fines vs bulk.

- All agreed there are no impacts to methodology or results if sentences are removed.

- ERM - M. Shibata will revise Appendix J so these sentences are removed. The final document will include the revised Appendix.

3. EPA comments on OU1 Phase 1a/b DQO dated 27 April. ERM would like clarification on Section 11.2.6.3 (risk calculations) – EPA

- B. Brattin clarified – For humans and mobile eco-receptors, a goal should be included for performing initial risk calculations using mean and 95UCL concentrations to evaluate if data collected is sufficient to make risk decisions. Initial risk calculations will identify COPCs and datasets that lead to uncertainty based on mean and 95UCL calculations. This should only be applied to COPCs that get through the screen, not the full list. This goal does not change the number of samples to collect; it is a downstream intended application only.

- ERM – ERM Team will discuss internally and get back to EPA with a recommendation.

- ERM Team agrees with adding the following goal to Step 2 of the DQO: "Evaluate whether sufficient data have been collected to support reliable risk management decision-making." We also agree with the types of evaluations that were proposed for this goal in Step 5. However, we temper this by recognizing that the performance acceptance criteria for the evaluation of whether sufficient abiotic data have been collected will be dependent on the risk assessment methodologies developed in the technical memoranda specified in the AOC. It is recognized that the evaluations described in the DQO may be modified once the risk assessment methodologies are finalized. We have added this modifying language to Step 5 in the DQO.

4. Field trip to identify background locations – Karen Cejas

- Field trip to evaluate potential background locations is proposed for the week of 6/1 - 6/5. It is expected to take 2-3 days to cover area around 5 mile radius and 1 day to go to Bear River Migratory Bird Refuge.

- K. Cejas is putting together scope and field forms for John Cavitt and others participating in field trip

- S. Everett and either C. Cline or S. Skipper will participate in the field trip also.

- K. Cejas will put together a call with mini group (S. Everett and S. Skipper) to discuss specifics on documentation needed from field trip

- K. Cejas will put develop a strawman on scope of field trip and will send out to larger group

5. Preliminary EPA comments of HHE – EPA

- W. O'Brien had concerns with data quality when surveys were administered by themselves such as the hunter recreational scenario by ATI. Not sure how we will evaluate data quality for these.

- There were also concerns over footnote that says groundwater will not be evaluated. M. Jones clarifies that this is specific to survey only though, not the case overall. Suggestion is to change language to describe where drinking water is coming from and the reason that groundwater is not being evaluated in this survey.

- Risk should be quantified for anyone consuming contaminated beef from grazing cows despite the fact that ranchers said they do not eat their own beef. We will need to look at other receptors and may need to call ranchers to find out where the beef goes (e.g. butcher, auction). The survey report should say that we didn't collect this data.

- EPA - Comments to ERM in a couple of weeks.

6. Schedule for Risk Assessment Deliverables in 2015 – ERM Update

- J. Holder said she will send out a schedule for the rest of the year and a list of most important items to discuss on these calls for our next call on 5/21.

- Call frequency will be biweekly (it can be adjusted more frequent or less frequently dependent on topics and schedule).

- K. Cejas will start providing summary notes of the calls so we can track progress.

Jennifer Holder, Ph.D.
Partner
ERM

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Attachment 9R

19 May 2015 Draft Final Data Quality Objectives for OU-1 Phase 1A-B RI SAP

From: David Abranovic
Sent: Tuesday, May 19, 2015 3:34 PM
To: Ken Wangerud (Wangerud.Ken@epamail.epa.gov)
Cc: Justin Burning; Catherine D. LeCours (clecours@PWT.COM); R. David Gibby (dgibby@usmagnesium.com); Mike Storck (mstorck@utah.gov); Kevin Lundmark; Mark Ransom; Jennifer Holder
Subject: RE: Draft Final OU-1 Phase 1 A/B DQO
Attachments: DQO OU-1 Ph 1AB RI - Rev 5-18-2015.pdf

Ken

Please find attached the draft final OU-1 Phase 1 A-B DQO for your review. This version of the DQO includes the background sample design as well as redline strikeout changes to the soil/sediment portion of the document that EPA has already reviewed. This version should incorporate the changes requested in the agency comments received on 28 April 2015, in accordance with the modifications Kevin Lundmark and I discussed with you on 7 May 2015, as well as your response to my 30 April 2015 received on 12 May 2015. I believe that this DQO is the result of a lot of hard work done by our technical teams to formulate a workable approach for the Phase 1 A-B RI. We will proceed with the incorporating this version of the DQO into the Phase 1 A-B SAP as soon as we receive EPA approval to proceed.

Feel free to contact me anytime if you have any questions regarding this document.

david

David J. Abranovic P.E.
Partner

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Memorandum

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ERM

To:	Ken Wangerud, USEPA Region 8
From:	David Abranovic (ERM), Kevin Lundmark (ERM)
Date:	DRAFT 18 May 2015
Subject:	Draft Final Data Quality Objectives for OU-1 Phase 1A-B RI SAP

This memorandum presents the draft final data quality objectives (DQOs) for the Phase 1A-B Remedial Investigation (RI) for Operable Unit 1 (OU-1) at the US Magnesium site. As discussed and agreed on during the OU-1 Phase 1B RI DQOs Scoping Meeting conducted on 11 and 12 March 2015, ERM-West, Inc. (ERM) has developed this revised Phase 1A-B DQO for review by the United States Environmental Protection Agency (USEPA) and the Utah Department of Environmental Quality. These DQOs will become Worksheet 11 in the OU-1 Phase 1A-B Sampling and Analysis Plan (SAP), currently scheduled to be implemented during the 2015 field season. Accordingly, this document has been formatted consistently with Worksheet 11 as it would appear in the Phase 1A-B SAP. The final Phase 1A-B SAP will be approved and issued by the USEPA.

11.0 SAP WORKSHEET #11 – PROJECT QUALITY OBJECTIVES/ SYSTEMATIC PLANNING PROCESS STATEMENTS

Based on the conceptual site model provided in Worksheet #10 of the *Phase 1A Remedial Investigation Sampling and Analysis Plan to Identify Chemicals of Potential Concern in Soils, Sediment, Solid Waste, Water and Air, and Receptor Surveys, Revision 0 for Preliminary Remedial Investigation* (*PRI*) *Areas 2 and 8 through 17* (hereafter referred to as "Phase 1A SAP") (USEPA 2013), this worksheet presents DQOs and associated sampling strategies and rationale for the Phase 1A-B RI for OU-1 at the Site.

The DQOs presented herein follow the seven-step process described in the 2006 USEPA *Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G-4*.

11.1 OBJECTIVES OF THE PHASE 1A-B RI FOR OU-1

The objective of Phase 1A-B RI for OU-1 is to obtain sufficient data to support:

1. Reliable ~~I~~identification of chemicals of potential concern (COPCs) for human and ecological receptors within PRI Areas 1 and 3 through 7.

~~1.~~2. Evaluate whether sufficient data have been collected within PRI Areas 1 and 3 through 7 to support reliable risk management decision-making.

~~2.~~3. Preliminary evaluation of the nature and extent (N&E) of ~~impacts~~ site-related contamination within PRI Areas 1 and 3 through 7.

~~3.~~4. Estimation of background (ambient) concentrations for metals, ~~and~~ dioxins/furans (D/F).

~~4.~~5. Confirm that suitable reference areas (i.e., non-impacted areas) are available for biota sampling that may be conducted during a future phase of the RI.

Broadly, these objectives are combined into two principal DQOs of "COPC Selection and Preliminary N&E at Inner PRI Areas," and "Evaluation of Background." The remainder of this worksheet presents the seven-step DQO process for the two principal DQOs.

11.2 DATA QUALITY OBJECTIVES FOR COPC SELECTION AND PRELIMINARY NATURE AND EXTENT AT INNER PRI AREAS

11.2.1 Step 1: State the Problem

11.2.1.1 Description of the Problem

The RI/Feasibility Study (FS) Area Boundary has been preliminarily defined by the USEPA as a 5-mile radius around the US Magnesium facility. For purposes of project planning during the initial phases of the RI, the USEPA initially divided the site into 18 Preliminary Remedial Investigation Areas (or "PRIs"), with the "Inner PRIs" defined as PRIs 1 and 3 through 7, the "Outer PRIs" defined as PRIs 2 and 8 through 17, and PRI 18 being ambient air. The Site was subsequently divided into Operable Units by the USEPA, with OU-1 including PRIs 1 through 17 and OU-2 being defined as PRI 18.

Phase 1A of the OU-1 RI provided the information necessary to select human and ecological COPCs for the Outer PRIs. For the Inner PRIs, historical (i.e., ~~pre-Comprehensive Environmental Response, Compensation~~

~~and Liability Act [CERCLA]) and~~ collected prior to the Phase 1A Demonstration of Method Applicability ~~(~~[DMA]) and Phase 1A DMA data are available (ERM 2104a); however, the USEPA determined that historical and DMA data alone are not adequate for COPC selection[1]. The USEPA indicated that while historical ~~(pre-CERCLA)~~ data obtained at the Site in earlier investigations do provide insight into the chemicals likely to be of primary concern in soil/sediment and solid wastes (solid media or "solids") at the Site, these data may not accurately represent current Site conditions. In addition, the USEPA has identified that not all solids have been well-characterized previously, and the historical data are often restricted to a subset of analytes when compared to the list of target analytes identified by USEPA for the Site. Consequently, new data are needed to support selection of human and ecological COPCs for Inner PRI media.

Additionally, the N&E of impacts have not been characterized in the Inner PRIs. This is due in part to the fact that the historical data for the Inner PRIs in most cases did not include analyses for all ~~COPCs~~ current target analytes and there were either an insufficient number of samples collected or the sampling locations were not based on a suitable sample design (e.g., locations were not based on an unbiased approach and only targeted selected portions of the Site). The USEPA has also identified that "vertical profile waste stratification and contaminant data are needed at key release locations and within areas where wastes have been discharged continually" (USEPA 2013). Based on Site operations, the Site history, a review of aerial photographs, and information from previous sampling events, the following key waste release locations are identified for the Inner PRIs:

- Wastewater Ditches (PRI 1);
- The south-central portion of the Gypsum Pile (PRI 4) where the pile is tallest;
- The Southeast Ponded Waste Lagoon (PRI 5) near the outlet of the Main Ditch;

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[1] While the USEPA has determined that the historic data (alone) are not adequate for COPC selection, the USEPA has stated that, if historic data are found to be statistically similar to data collected in Phase 1A~~/1~~-B, it may be appropriate to combine the data to increase sample size and decrease uncertainty. If so, then the historic data may be included in the dataset used for COPC selection and risk assessment.

- The historical inlet to the northeast ponded Waste Lagoon (PRI 7); and
- The former wastewater diversion ditch traversing the Southeast Ponded Waste lagoon (PRI 5).

These key waste release locations are shown in Figure 11-1.

Finally it is recognized that Phase 1A-B data will also be used to support the baseline human health and ecological risk assessments. It will be important to evaluate whether the data collected at the end of Phase 1A-B are sufficient to support reliable risk management decision-making or if additional abiotic data collection is necessary in Phase 2.

11.2.1.2 Conceptual Model

Initial Site-wide conceptual site models for the current and future use at the Site are presented in Worksheet 10 of the Phase 1A SAP.

11.2.2 Step 2: Identify Goals of the Study

The goals of the study are:

1. To obtain sufficient data for solid media in the Inner PRIs to reliably select human and ecological COPCs that require further quantitative evaluation in the risk assessment process;
~~1.~~2. To evaluate whether sufficient data have been collected at the Inner PRIs to support reliable risk management decision-making, and
~~2.~~3. To perform initial site characterization of the N&E of contaminants distributed within the Inner PRIs to support initial contaminant mapping and to guide subsequent site characterization sampling designs.

11.2.3 Step 3: Identify Information Inputs

11.2.3.1 Information Inputs

The information needed to support COPC selection is an adequate and reliable dataset to characterize the range of concentration values that occur in solid media within the Inner PRIs. Additionally, the sample design described in Steps 6 and 7 for COPC selection will provide ~~preliminary~~ data concerning contamination in media at the Site. This can be used to assess whether data are sufficient for the baseline risk assessments as well as planning for Phase 2 investigations, as needed.

The information needed to support preliminary N&E characterization includes chemical concentration data from surface samples distributed throughout each Inner PRI and subsurface samples at key waste release locations, as well as waste thickness profiles. The sample design described in Steps 6 and 7 for COPC selection will ~~also suffice~~provide a sufficient data set for preliminary N&E characterization. The preliminary N&E characterization will be used for planning additional site characterization data collection for Phase 2, as needed.

11.2.3.2 Sampling and Analytical Methods

Sampling and analytical methods are described in Step 7, Section 11.2.7.

11.2.4 Step 4: Define the Boundaries of the Study

11.2.4.1 Spatial Boundaries

For this study, the lateral spatial boundaries are prescribed by the boundaries of the Inner PRIs. The vertical boundaries for the study are defined based on the sampling method. Sampling will be performed to a depth of 6 inches below ground surface (bgs) at all surface sampling locations, consistent with the Phase 1A SAP. Subsurface sampling will be performed using 2-foot maximum sample intervals from 6 inches bgs to 2 feet below the waste/native soil interface.

At sampling locations outside of the inundated areas of PRIs 5 and 6 where subsurface sampling is not performed, ~~Whenever possible,~~ hand-auger borings to delineate waste thickness will extend to the waste/native soil interface or to a maximum depth of 5 feet bgs. The 5-foot maximum depth is due to practical constraints on hand-augering to greater depths under Site conditions.

11.2.4.2 Temporal Boundaries

Constituent concentrations within solid media at the Site are not expected to fluctuate substantially over the timescale of a year (provided that significant process changes have not been implemented at the facility during that time), so the time of year when sampling occurs is not likely to be important (USEPA 2013). The timing of sampling may affect access to sampling areas and health and safety of field personnel. Sampling should be avoided during spring due to high water conditions in wastewater ponds, or in peak summer months when excessive heat could adversely affect the health and safety of field personnel. Because sampling within inundated areas of PRIs 5 and 6 will be performed using a helicopter, weather conditions will also limit or affect the performance of sampling in these areas (e.g., no sampling during high winds and flight is more challenging due to poor lift during hot weather).

11.2.5 Step 5: Develop the Analytic Approach

11.2.5.1 COPC Selection

~~The analytic approach for COPC selection was established by the USEPA in the Phase 1A SAP. Although s~~Several factors may be considered in selecting COPCs, the first step is to compare the maximum detected concentration in a dataset (Cmax) to an appropriate risk-based concentration (RBC). If the value of Cmax for an analyte in a medium at ~~some specified area~~ a PRI does not exceed the RBC, that analyte may be generally excluded as a COPC in that medium at that ~~area~~PRI. Otherwise, if the value of Cmax exceeds the RBC, the analyte is retained as a COPC in that medium ~~at~~ in that ~~area~~PRI. The methods and RBCs to be used for selection of COPCs for OU-1 are described in the *Final Screening Level Risk Assessment Technical Memorandum* (ERM 2014b). Because human and ecological exposure areas have not yet been established at the Site, COPC selection for solid media at the conclusion of Phase 1A-B will occur on a PRI-by-PRI basis.

11.2.5.2 Reliable Risk Management Decision Making

To evaluate whether sufficient data have been collected to support reliable risk-management decisions, initial risk calculations will be performed using ~~the reliable~~ all usable Phase 1A-B data ~~as~~following the methods described in risk assessment memoranda as specified in the AOC. Initial risk calculations will be limited to the COPCs identified in the OU-1 *Screening Level Risk Assessment Report* (SLRA). The initial risk calculations will be included in the OU-1 SLRA.

11.2.5.3 Preliminary Nature and Extent

The Phase 1A-B RI Data Report will include maps showing chemical constituent concentrations for the expected risk drivers (D/F TEQs, HCB, total PCBs) in each Inner PRI~~.~~[2]. Chemical mapping will include data from

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[2] Additional chemical constituent maps for Phase 2 RI scoping will be prepared for Outer PRIs and for other Inner PRI risk drivers based on the results of the OU-1 SLRA.

the Phase 1A-B RI and the historical/DMA data described in the Final Inner PRI Data Report (ERM 2014a). If concentrations of a constituent in surface samples are similar across a PRI, then additional N&E data would not be required for that constituent. However, additional N&E information may be subsequently needed to delineate specific ~~features or~~ areas to support risk assessment or remedy decision to more clearly delineate the spatial distribution of contaminants for site characterization or ~~extent of impacts requiring remediation after constituents of concern are identified in the RI~~for FS evaluations. If constituent concentrations are highly variable across a PRI, and/or additional delineation is necessary to support remedy selection, then additional ~~site characterization data~~ sampling to characterize and delineate N&E ~~may~~ may be ~~collected~~ performed during the Phase 2 RI.

To supplement the sample point chemical concentration maps, geostatistical modeling (e.g., kriging) will also be conducted for HCB, total PCBs, and mammal TEQs for each Inner PRI, where the data permit. Geostatistics will provide a spatial depiction of the data that can be used to predict concentrations of HCB, total PCBs, and mammal TEQs in soil throughout a particular PRI. More importantly, geostatistics can provide a spatial description of the level of uncertainty associated with unsampled locations, which will aid in understanding the spatial variability in HCB, total PCBs, and mammal TEQs. This will provide a fuller view of the extent of impacts and help determine areas requiring additional sampling for site-characterization evaluation and remedy-scoping considerations. A description of the geostatistical method(s) used, results, and interpretation of the results will be included in the Phase 1A-B Data Report. The Data Report will also provide results and interpretation of statistical evaluations (e.g., scatter plots, outlier tests, Q-Q plots) to analyze N&E of expected risk drivers.

The need for additional sampling to delineate N&E at the Site will be determined for OU-1 during the Phase 2 RI scoping process. Site-characterization DQOs for the Phase 2 RI may be identified based on waste types, PRI Area or other boundaries, and/or remedy-scoping considerations (e.g, decision units). Chemical concentration maps, geostatistical modeling output, and statistical evaluations provided in the Phase 1A-B Data Report will be used to support the Phase 2 RI scoping process and associated DQO development.

If field screening identifies that waste is present at depths greater than 6 inches bgs, then additional sampling ~~may~~ will be required to delineate the vertical extent of waste, to measure COPC concentrations in the subsurface to depths relevant to human or ecological exposure, or to support FS evaluations. Subsurface sampling will be performed during Phase 1A-B at key waste deposition locations. If subsurface concentrations are substantially higher than those in surficial samples, additional subsurface sampling may be necessary to adequately delineate the vertical extent of constituents of concern. The maximum subsurface sampling interval will be 2 feet. Subsurface sampling intervals will be adjusted in the field for the following reasons:

- Native material will be segregated from waste material for the final sample interval to allow for the evaluation of potential impacts from wastes in native soil.
- If anomalous or discrete layers of waste or sediments are observed in a boring, the sample interval will be adjusted (reduced) to target the anomalous/discrete layers; however, due to sample volume requirements, no sample interval will be less than 6 inches. Anomalous layers will be identified based on color, texture, field screening, and comparison with other wastes/sediments within a boring.-

11.2.6 *Step 6: Specify Performance or Acceptance Criteria*

11.2.6.1 COPC Selection

The performance acceptance criteria for COPC selection were established by the USEPA in the Phase 1A SAP. To minimize the probability that a chemical in the soil, sediment, or solid waste of a PRI area will be excluded as a COPC when it should be retained for further evaluation, it is necessary to be confident that the observed Cmax will have a high probability of exceeding the RBC when the chemical is truly of potential concern. This, in turn, is related to the total number of samples collected, and to the methods that will be used to evaluate risk from chemicals that are retained. In accord with discussions at the March 2015 scoping meetings, the minimum sample size for each PRI shall be 14.

The statistical basis for a minimum sample size of 14 for COPC selection was developed by the USEPA in the Phase 1A SAP. The COPC selection process is founded on the concept that, given a dataset of adequate size, the maximum concentration value in that dataset will have a high probability (greater than or equal to 95 percent) of exceeding the true mean concentration across the exposure area. If the observed maximum concentration does not exceed the RBC, there is confidence that the true mean will not exceed the RBC, and hence the chemical will not contribute significant risk and may be not improperly excluded as a COPC.

However, if the dataset is not large enough, the observed Cmax value may not exceed the true mean across the exposure area. This is demonstrated as follows:

Let P equal the percentile of the distribution occupied by the mean. Then, if a single sample is drawn, the probability that the sample is lower than the mean is equal to P. If N samples are drawn, the probability that ALL the samples are below the mean is P^N. Thus, the probability that one or more samples exceed the mean is given by:

$$\text{prob}(\text{Cmax} > \text{mean}) = 1 - P^N$$

The number of samples (N) needed to ensure that the probability is at least 95% that one or more samples exceed the true mean is shown below for a range of distributions in which the true mean occurs at a percentile ranging from the 50th to 90th:

Percentile of the True Mean	N	Probability that Cmax > True Mean
50th	5	96.9%
60th	6	95.3%
70th	9	96.0%
80th	14	95.6%
90th	29	95.3%

For a dataset with a normal distribution, the mean occupies the 50th percentile (P = 0.5), and a dataset of five samples would likely be sufficient to support COPC selection. However, most environmental datasets for soil, sediment, or solid waste are right-skewed, and this results in the mean occupying a percentile higher than 0.5. Depending on the degree of skew, the mean usually falls between the 60th and 90th percentile (or even higher in extreme cases).

Consistent with the Phase 1A investigation, it is assumed for planning the Phase 1A-B investigation of solid media in Inner PRIs that the mean will generally not be higher than the 80th percentile. This assumption is supported by historic and DMA data available for the Inner PRIs, which indicate that, for the expected risk drivers (D/F TEQs, HCB, total PCBs), the sample mean usually occurs in the range of the 60th to 80th percentile, as shown below:

PRI Area	Percentile of the Mean			
	D/F TEQ (avian)	D/F TEQ (mammalian)	HCB	Total PCBs
PRI-1	59%	47%	64%	65%
PRI-4	68%	82%	68%	79%
PRI-5	72%	76%	76%	74%
PRI-6	77%	69%	77%	60%
PRI-7	79%	83%	79%	75%

Based on this, it is considered likely that a dataset of 14 samples is likely to suffice for most analytes. However, if the data from the Phase 1A-B investigation suggest that the distribution of some analytes is more strongly skewed than assumed (i.e., the sample mean is substantially higher than the 80th percentile of the dataset), it may be necessary to collect additional samples in subsequent phases of the site investigation to ensure analytes are not improperly excluded as COPCs.

11.2.6.2 Reliable Risk Management Decision Making

The performance acceptance criteria for the evaluation of whether sufficient abiotic data have been collected will be dependent on the risk assessment methodologies developed in the technical memoranda specified in the AOC. It is recognized~~,~~ that the evaluations described below may be modified once the risk assessment methodologies are finalized.

All risk calculations for humans and mobile ecological receptors (birds, mammals) will be in accord with standard USEPA guidance, and will be based on the 95% upper confidence limit (95UCL) of the mean concentration in the exposure area of concern. The 95UCL will be derived on a PRI-basis for COPCs identified in the OU-1 SLRA using the most recent version of USEPA's ProUCL software application. Use of the 95UCL minimizes the probability of a false negative decision error (deciding risk is acceptable when it actually is unacceptable). However, use of the 95UCL tends to increase the probability of false positive decision errors (declaring that risk is unacceptable when it actually is within acceptable limits). If initial risk estimates based on the 95UCL are below a level of concern, or if risks are above a level of concern based on the sample mean, then it is likely that additional data will not be needed for risk management decision making. In cases where risk is below a level of concern based on the sample mean but above a level of concern based on the 95UCL, then additional data may be useful to support decision-making. In this event, additional sampling needs will be planned and executed during Phase 2.

For sessile or small home range ecological receptors, an assessment of the magnitude and frequency of Hazard Quotient values that exceed 1.0, with calculations performed on a sample-by-sample basis may be performed. In cases where the distribution of HQ values provides a clear prediction of population-level hazard, additional abiotic data to support the HQ approach are unlikely to be necessary. However, in cases where the data are not sufficient to allow a clear assessment of HQ-based population-level hazard, additional abiotic data may be needed. In this event, the necessary abiotic sampling will be planned and performed in Phase 2, along with any biotic-based studies that may be needed.

11.2.6.3 Preliminary Nature and Extent

The need for additional sampling to delineate N&E at the Site will be determined for OU-1 during the Phase 2 RI scoping process. Site-characterization DQOs for the Phase 2 RI may be identified based on waste types, PRI boundaries or other areal extents, and/or remedy-scoping considerations (e.g., decision units). Chemical concentration maps, geostatistical modeling output, and statistical evaluations provided in the Phase 1A-B Data Report will be used to support the Phase 2 RI scoping process and associated DQO development.

The validated and verified Phase 1A-B data will be combined with historical/DMA data and used to prepare chemical concentration maps and perform geostatistical modeling and statistical evaluations as described in Section 11.2.5.3. The degree to which the combined datasets delineate the N&E of site-related contamination within the Inner PRIs will be described by the variability of concentrations, the spatial distribution of chemical concentrations, and level of uncertainty for unsampled locations as predicted by geostatistical modeling. The mapping, geostatistical modeling, and statistical evaluations provided for D/F TEQs, HCB, total PCBs in the Phase 1A-B Data Report will support scoping of Phase 2 investigations for the collection of additional data to complete site-characterization and support remedy-scoping and FS evaluations.

11.2.7 Step 7: Develop the Plan for Obtaining the Data

The data collection approach described below supports both COPC selection and preliminary N&E study goals. The data obtained during Phase 1A-B to support COPC selection and preliminary N&E will also be used to perform initial risk calculations to evaluate whether sufficient data have been collected to support reliable risk-management decisions.

11.2.7.1 Surface Solids Sampling

In accord with the performance criteria for COPC selection described in Step 6, the basic plan for surface solids sampling is to collect surface solids samples from at least 14 unbiased locations with the addition of biased/judgmental samples at selected locations. Surface solids samples will be collected from 0 to 6 inches bgs. Surface solids sampling outside of the inundated areas of PRIs 5 and 6 will be performed using a hand auger as detailed in Standard Operating Procedure (SOP) *USM-01: Surface Soil, Sediment, and Waste Sampling*. Within the inundated areas of PRIs 5 and 6, surface solids samples will be collected using a helicopter-deployed sampler as detailed in SOP *USM-12: Surface Solids Sampling within Current Wastewater Ponds*. When sampling within inundated areas of PRIs 5 and 6, all reasonable efforts will be made to ensure that samples are obtained from the target locations. ~~Relocating a sample to a location that is accessible from the shoreline requires approval by the USEPA.~~ SOP USM-12 includes criteria for evaluating when a sample is acceptable and procedures for adjusting sampling locations based on field conditions.

The presence/absence of visible waste will be noted on sampling forms at all sample locations, as described in SOP USM-01. When waste is visible, the depth of waste will be measured. Waste may include gypsum, smut, salts, or sludge that have a different appearance than the native soils present within the Inner PRIs (e.g., oolitic sands, lacustrine clays, evaporate minerals). If waste is present at the bottom of a surface sample location (6 inches bgs) outside of the inundated areas of PRIs 5 and 6, then the hand-auger boring will be advanced to either the waste/native soil interface or a maximum depth of 5 feet bgs. The maximum depth of 5 feet bgs is based on the impracticality of advancing a hand auger to depths below 5 feet under Site conditions (e.g., standing water, shallow depth to groundwater, unconsolidated wastes, etc.) and health and safety considerations. Field screening for waste thickness at locations within the inundated areas of PRIs 5 and 6 will be ~~limited~~ to depth of penetration of the helicopter-deployed sampler.

11.2.7.~~1~~2 Subsurface Solids Sampling

The role of subsurface solids sampling for COPC selection was described in the Phase 1A SAP. At most environmental sites, site-related contaminants tend to be highest in surficial soils or sediments, with decreasing concentrations as a function of depth. However, at this Site, it is considered plausible that, in at least some PRIs, concentrations of contaminants might be higher in subsurface materials than at the current surface. This condition might occur under several alternative scenarios, as follows:

- The types of chemicals released in the past might have been different than at present due to changes in plant operation conditions.
- The level (concentration, mass loading) of contaminants released to the environment may have been higher in the past than at present, especially if plant operations were changed with the goal of reducing levels of pollutant release.
- Historical wastes may have been moved or buried under less contaminated or clean materials.
- Chemical fate and transport processes might act on surficial materials differently than on deep materials, potentially resulting in higher concentrations in samples collected at depth.

Because it is not known whether any of the scenarios may actually have resulted in meaningful differences between surface and subsurface samples, it is necessary to obtain some limited data to recognize if this situation may exist. This is important for COPC selection because a Type I decision error (exclusion of an analyte as a COPC that should have been retained) could occur if surface levels of an analyte are below the RBC but concentrations at depth exceed the RBC. The Phase 1A-B investigation therefore includes a limited number of borings to evaluate potential differences between surface and subsurface samples. These samples will also help inform the preliminary vertical N&E of chemical impacts.

In identifying COPCs for a PRI area where samples at depth have been collected, the value of Cmax will be the highest of any value in the dataset for the PRI area, including both surface and subsurface samples. If the data from depth samples are similar to or lower than in surficial samples, the COPCs identified for surficial samples will also be appropriate for any subsurface exposure scenarios that may require assessment. However, if subsurface concentrations are substantially higher than those in surficial samples, some analytes may be identified as COPCs in subsurface materials that may not be of concern in surficial samples. If this condition does arise, because only a small number of boring samples are to be collected, additional subsurface sampling may be necessary in subsequent field programs to adequately characterize the vertical extent of those COPCs.

Subsurface solid sampling will be performed as detailed in SOP *USM-09: Subsurface Soil, Sediment, and Waste Sampling*. Subsurface borings with sampling ~~at~~ using 2-foot maximum intervals for chemical analysis will be performed to evaluate chemical concentrations at depth and for characterizing vertical N&E within key waste release locations (Figure 11-1) and other locations identified by the USEPA. Surface samples (0 to 6 inches bgs) will also be collected at each subsurface sampling location; therefore, the typical/default subsurface sample intervals will be 6 inches to 2 feet bgs, 2 feet to 4 feet bgs, and so on with the final sample interval extending to 2 feet below the waste/native soil interface. Native material will be segregated from waste material for the final sample interval to allow for the evaluation of potential impacts from wastes in native soil. If anomalous layers of waste or sediments are observed in a boring, the sample interval will be adjusted (reduced) to target the anomalous layers; however, due to sample volume requirements, no sample interval will be less than 6 inches. Anomalous waste/sediment layers will be identified by ERM and USEPA/USEPA contractor oversight personnel based on color, texture, field screening, and comparison with other wastes/sediments within a boring. ~~Subsurface solid sampling will be performed as detailed in SOP *USM-09: Subsurface Soil, Sediment, and Waste Sampling*.~~

11.2.7.3 Sampling Locations

The number and approximate locations of surface and subsurface solids samples identified in this SAP were discussed and agreed to by ERM/US Magnesium and the USEPA during the March 2015 OU-1 Phase 1B RI DQOs Scoping Meeting (ERM 2015a). Surface solids sampling locations were preferentially chosen using a systematic (grid) sampling design to ensure that the PRI is fully and uniformly represented by the set of samples collected. In addition, judgmental samples are placed at known features at PRIs 1, 5, and 7 to support COPC selection and preliminary characterizations of N&E. The systematic grids of sample locations at PRIs 3, 4, 5, and 7 include locations near areas of waste deposition or found to contain the highest concentrations of hexachlorobenzene (HCB), dioxin/furan toxic equivalency quotients (TEQs), and polychlorinated biphenyls (PCBs) based on historical Site data. Subsurface borings for COPC selection and vertical N&E are located within key waste deposition areas PRIs 1, 4, 5, and 7 (see Figure 11-1) and at locations in PRIs 3 and 6 as requested by the USEPA during the March 2015 Scoping Meeting.

Most sample locations include surface sampling only; however, field screening for waste thickness will be performed at all sample locations. If field screening for waste indicates that waste material is present at depths greater than 6 inches bgs within all or a portion of a PRI, then subsequent sampling to delineate vertical N&E would be considered during subsequent RI Phase 2. Waste thickness at subsurface sampling locations will be determined by extending the boring to below the waste/native soil interface.

Sample locations for each PRI are described in the subsections that follow. Sample locations for PRIs 3 through 7 were developed using VSP (vsp.pnnl.gov). To ensure the assumption of random sampling is met, a systematic sample grid layout was employed that utilized a randomized initial sample that serves as the origin on which the systematic grid is constructed.

US magnesium is planning construction of a wastewater filtration system that will require that PRIs 1 and 3 be removed from the OU-1 Phase 1A-B RI. The USEPA has instructed US magnesium that if a RCRA settlement is reached prior to implementation of this phase of the RI, the Phase 1A-B samples that are located in areas to be included in the RCRA settlement will be deleted from the Phase 1A-B RI SAP.-

PRI 1

Surface solids sampling will be performed at 14 locations in PRI 1 as shown in Figure 11-2. Twelve locations are within active wastewater ditches, one location (1-13) is within an inactive reach of the Main Ditch, and one location (1-14) is within the alignment of the former Boron Ditch. Because the wastewater ditches are linear features, all sample locations in PRI 1 were judgmentally selected instead of using a systematic grid. For the 13 sample locations not within the former Boron Ditch, locations were divided between the active wastewater ditches based on the relative approximate length of each ditch: three samples at the Western Ditch (2,000-foot length), two samples at the Central Ditch (1,300-foot length); two samples at the Chlorine Ditch (1,350-foot length), and six samples at the Main Ditch (4,200-foot length, including historical ditch alignment to the outlet at PRI 7). The distribution of samples between ditches results in one sample per approximately 700 feet. Samples were distributed along the wastewater ditches taking into account accessibility by placing samples at each of three bridges crossing the active wastewater ditches. The rationale for each Phase 1B sample at PRI 1 is provided below.

ID	Rationale
1-01	Near head of Western Ditch (surface)
1-02	Approximate midpoint of north-south segment of Western Ditch (surface)
1-03	West of bridge at confluence of Western and Main ditches

ID	Rationale
	(surface and subsurface)
1-04	Near head of Central Ditch (surface)
1-05	Central Ditch downstream of Sanitary Lagoon (surface)
1-06	Near head of Chlorine Ditch (surface)
1-07	Chlorine Ditch downstream of Boron Plant discharge and south of bridge (surface and subsurface)
1-08	Main Ditch after confluence with Chlorine Ditch and east of bridge (surface and subsurface)
1-09	Main Ditch adjacent to Landfill (surface)
1-10	Main Ditch below Landfill (surface)
1-11	Main Ditch near current outlet to PRI 5 waste pond (surface)
1-12	Main Ditch alignment adjacent to PRI 5 waste pond (surface)
1-13	Former Main Ditch near historical outlet to PRI 7 waste pond (surface and subsurface)
1-14	Former Boron Ditch (surface and subsurface)

Surface solids sampling will be performed at all locations (1-01 through 1-14). Subsurface sampling will be performed at five locations, including the three bridges over wastewater ditches (1-03, 1-07, and 1-08), the former Main Ditch near the historical outlet to the Northeast Ponded Waste Lagoon (1-13), and within the alignment of the former Boron Ditch (1-14).

PRI 3

Surface solids sampling will be performed at 14 locations in PRI 3, which include 13 evenly distributed grid sample locations and one biased/judgmental sample location. PRI 3 sample locations are shown in Figure 11-3. Locations 3-01 through 3-13 were generated as a systematic grid. Location 3-14 is a biased/judgmental location for surface and subsurface sampling to characterize conditions at the presumed inlet to lagoon.

PRI 4

Surface solids sampling will be performed at 14 evenly distributed grid sample locations in PRI 4 as shown in Figure 11-4. Subsurface sampling will be performed at a sample location within the top-center of the Gypsum Pile, where historical gypsum waste is expected to be present at depth (location 4-05 in Figure 11-4). This sample location is within a key waste release area (see Figure 11-1).

PRI 5

Surface solids sampling will be performed at ~~16~~ 20 locations in PRI 5, which include 15 evenly-distributed grid sample locations and ~~one~~ five biased/judgmental sample locations. The base number of gridded sample locations at PRI 5 was increased from 14 to 15 based on (1) the elevated variability in D/F, PCB, and/or HCB concentrations exhibited in historical PRI 5 solids data, and (2) agreements between ERM/US Magnesium and the USEPA during the March 2015 OU-1 Phase 1B RI DQOs Scoping Meeting. PRI 5 sample locations are shown in Figure 11-5. Locations 5-01 through 5-15 for PRI 5 were generated as a systematic grid and include locations in both upland (terrestrial) and mudflat/waste pond areas.

Subsurface sampling will be performed at the location nearest the inlet to the waste lagoon from the Main Ditch (location 5-14 in Figure 11-5) and at a location within a former wastewater diversion ditch (location 5-16 in Figure 11-5). ~~This~~ These locations ~~was~~ were selected for subsurface sampling because ~~it is~~they are within ~~a~~ key waste release areas (see Figure 11-1). ~~and the~~The lagoon inlet (location 5-14) is the location where the greatest amount of waste deposition occurs, as apparent in aerial photographs. The former diversion ditch location was selected by USEPA to investigate accumulated sediment/wastes within the ditch and potential subsurface impacts from leachate from the landfill. Drill rig access to location 5-14 will be attained by the construction of an earthen ramp into the wastewater pond.

The rationale for each of the five ~~One~~ biased/judgmental ~~surface solids~~ sample locations in PRI 5 is provided below.

ID	Sample Type	Rationale
5-16	Surface and Subsurface	Former Wastewater Diversion Ditch - Evaluate potentially impacted sediments from historical wastewater diversions and potential leachates from the Landfill, located near/at an inlet of the ditch into the PRI 5 waste lagoon.
5-17	Surface	Former Wastewater Diversion Ditch - Evaluate potentially impacted sediments from the lower reach of the Former Wastewater Diversion Ditch (representing the eastward leg draining into the PRI 5 waste lagoon).
5-18	Surface	Star Pond Ditch - Evaluate potentially impacted sediments downgradient of the discharge point from the Star Pond.

5-19	Surface	Skull Valley Diversion - Evaluate potentially-impacted sediments in an area of influent seepage.
5-20	Surface	Star Pond Ditch - Evaluate potentially-impacted sediments within a downstream (east) reach where Star Pond discharges appear to have comingled with Former Diversion Ditch and PRI 5 waste lagoon waters.

~~will be collected from within the former wastewater diversion ditch that traverses PRI 5 (location 5-16 in Figure 11-5).~~

PRI 6

Surface solids sampling will be performed at 16 locations in PRI 6, which include 15 evenly distributed grid sample locations and one biased/judgmental sample location. As described above for PRI 5, the base number of gridded sample locations at PRI 6 was increased to 15 based on the variability exhibited in historical PRI 6 solids data and agreements reached during the March 2015 OU-1 Phase 1B RI DQOs Scoping Meeting. PRI 6 sample locations are shown in Figure 11-6. Locations 6-01 through 6-15 were generated as a systematic grid and include locations in both upland (terrestrial) and mudflat/waste pond areas. Subsurface sampling to characterize historically deposited wastes/sediments in the PRI 6 waste lagoon will be performed at a biased/judgmental location within the current PRI 4 area (location 6-16 in Figure 11-6). Location 6-16 ~~corresponds to~~ is within the historical inlet and deepest portion of the PRI 6 waste lagoon based on aerial photographs which show the PRI 6 lagoon area prior to inundation by gypsum waste. Over time this area has filled with gypsum waste, therefore drilling though gypsum waste at location 6-16 will allow access and sampling of historically deposited wastes/sediments in the PRI 6 waste lagoon. Subsurface sampling location 6-16 is co-located with surface solids sampling location 4-11 in PRI 4 (see Figure 11-4). Subsurface samples from location 6-16 comprised of gypsum waste may be appropriate to include with the PRI 4 dataset for COPC selection.

PRI 7

Surface solids sampling will be performed at 17 locations in PRI 7, which include 15 evenly distributed grid sample locations and two biased/judgmental sample locations. As described above, the base number of gridded sample locations at PRI 7 was increased to 15 based on the variability exhibited in historical PRI 7 solids data and agreements reached during the March 2015 OU-1 Phase 1B RI DQOs Scoping Meeting. PRI 7 sample locations are shown in Figure 11-7. Locations 7-01 through 7-15 for PRI 7 were generated as a systematic grid and are evenly distributed throughout the floor of the Old Waste Pond. Subsurface sampling will be performed at the location nearest the historical inlet to the Old Waste Pond (location 7-04 in Figure 11-7). This location was selected for subsurface sampling because it is within a key waste release area (see Figure 11-1) that received wastewater discharges during the early operations of the Magnesium Plant and the inlet is the location where the highest concentrations of HCB, D/F TEQs, and PCBs were detected during historical investigations. Two biased/judgmental surface solids samples will be collected from within the barrow ditch north of the Old Waste Pond (locations 7-16 and 7-17 in Figure 11-7) due to the potential for ecological receptor exposures within the barrow ditch.

11.2.7.4 Laboratory Analysis

Laboratory analytical data used for ~~risk assessment~~COPC selection, initial risk calculations, and preliminary N&E characterization will meet applicable criteria for definitive data as defined under USEPA guidance (USEPA 2005) and the measurement performance criteria for sampling and analysis defined in the OU-1 Phase 1A-B SAP.

Laboratory analyses will be performed following the analytical SOPs and project-specific Work Instructions included in the OU-1 Phase 1A-B SAP. All Phase 1A-B surface and subsurface s~~S~~olids samples will be analyzed for the complete roster of candidate COPCs listed in Worksheet 15, which includes:

- PCBs;
- D/F;
- Semi-volatile organic compounds including HCB;
- Polycyclic aromatic hydrocarbons (PAHs);
- Volatile organic compounds[3];
- Metals;
- Cyanide; and

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[3] VOC analysis will be performed for ~~saturated~~ all surface solids samples and all subsurface solids samples.

- Perchlorate.

In addition to analysis for candidate COPCs, all solids samples will be analyzed for total organic carbon (TOC), pH, and grain size. TOC, pH, and grain size data will not be used to select COPCs; however, these data will be collected to provide context for subsequent risk assessment characterizations.

Due to the very high levels of PCBs and D/F expected to be present within some areas in the Inner PRIs, analysis of Phase 1A-B solids samples from the Inner PRIs for PCBs and D/F will be performed using a combination of high-resolution mass spectroscopy and low-resolution mass spectroscopy methods. The identification of samples for low-resolution mass spectroscopy analysis and the criteria that will be used to decide if a sample must be reanalyzed using high-resolution mass spectroscopy method will be included in the project-specific laboratory Work Instructions described in SAP Worksheet 23 and included in SAP Appendix 19B.

11.2.7.5 Bulk versus Fines Fractions Analyses

Consistent with the Phase 1A RI for Outer PRIs, the OU-1 Phase 1A-B RI will include an investigation to determine (1) if contaminant concentrations significantly differ between bulk and fine fractions, and (2) whether a large-enough proportion of coarse material is present in bulk samples to result in a substantial difference between the contaminant concentrations measured in the bulk and the fine fractions. For the purpose of this study, “bulk fraction” is defined as all material passing a 0.25-inch mesh sieve and “fine fraction” is defined as material passing a 0.25-millimeter (mm) (60 US Mesh) sieve. Evaluating bulk versus fines fractions is important for COPC selection because a Type I decision error (excluding a COPC that should be retained) could occur if concentrations of an analyte in bulk (unsieved) samples are below a level of concern but concentrations in fine-grained material are above a level of concern (USEPA 2013).

The sieving and analysis strategy for Phase 1A-B RI samples is illustrated in the flow diagram shown in Figure 11-8. To facilitate the bulk versus fines evaluation, three splits will be collected for each Phase 1A-B surface solids sample. Each split will be composed of the bulk sample (passing 0.25-inch mesh) after homogenization.

1. Split sample 1 will be analyzed as a bulk fraction sample.

2. Split sample 2 will be analyzed for grain size by ASTM Method C-136. The result from the grain size analysis of split sample 2 will be used to determine whether to analyze split sample 3 as a fines fraction sample:
3. If the percent passing 0.25 mm in split sample 2 is greater than 75, then no analysis for fines is required.
4. If the percent passing 0.25 mm in split sample 2 is less than 75, then split sample 3 will be dried, sieved through a 0.25 mm mesh, and the fines-fraction material (passing 0.25 mm) will be analyzed for PCBs, D/F, semi-volatile organic compounds, PAHs, metals, and TOC.

Specification of 75% as a cutoff is because in samples with mass of the fine fraction at greater than or equal to 75% of the bulk, the maximum possible ratio of the concentration in the fine fraction to the bulk fraction is 1.33 (when the concentration in the coarse fraction is zero). Because the analytical variability of most methods is usually about 30%, the ratio of concentration values in the fine fraction to those values in the bulk fraction is expected to fall inside the normal range of analytical variability for all samples with more than 75% fine material.

The relationship between the paired results of the bulk and corresponding fine fractions will be evaluated using regression analysis. This approach allows development of a quantitative relationship between the ~~coarse~~ bulk fraction and the fine fraction, so that if a meaningful difference is evident, the concentration in the fine-grained fraction may be calculated from the ~~coarse~~ bulk fraction.

11.3 DATA QUALITY OBJECTIVES FOR BACKGROUND EVALUATIONS

11.3.1 Step 1: State the Problem

A necessary component of the RI/FS is to define the naturally occurring or “background” concentrations of chemicals in solid media. The purpose of characterizing background is so that site-to-background comparisons can be conducted and site-related contaminants can be identified. These chemicals include metals, which are natural components of the earth’s crust, and organic compounds that are either anthropogenically produced or combustion byproducts (wildfires), which are ubiquitous in the environment due to wind dispersal and aerial deposition. For the purposes of this evaluation, both naturally occurring and anthropogenic ambient will be defined as “background.” Two classifications of compounds are relevant to characterizing background for the US Magnesium RI/FS: metals and organics. Organics include polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (D/Fs), total PCBs, and hexachlorobenzene (HCB). PAHs are also a constituent with a ubiquitous background signature in the environment. Based on the Phase 1A RI data, PAHs do not appear to be a significant risk driver. Concentrations detected at the PRIs sampled during the Phase 1A were low and exceeded an RBC in only one PRI. Based on the Phase 1A data, characterizing PAHs in background is unnecessary.

Background concentrations of naturally occurring metals in soils and sediments are influenced by the underlying soil types and lithologies. Figures 11-9 and 11-10 summarize the different lithologies and soil types present in the general area of US Magnesium, respectively. Understanding the influence of soil and lithology on metals concentrations is a critical aspect of the background characterization sample design.

There are historical datasets in the general area of US Magnesium that provide some information regarding background concentrations of metals and organics. These include:

1. Parametrix 2004: A limited background dataset for a subset of metals (arsenic, barium, cadmium, chromium, lead and selenium), D/Fs, coplanar PCBs, and HCB was collected to support a focused ecological risk assessment at US Magnesium. This dataset is small (n=6) and does not include all the metals of interest.
2. Phase 1A RI soil data: A full suite of metals, D/Fs, HCB, and total PCBs were collected as part of Phase 1A data collected in 2014 (ERM 2014a). PRIs that represent areas where aerial deposition from the stack is the potential contaminant source (PRIs 11-16) provide a relevant, comparative dataset.
3. Other regional datasets: A number of regional datasets exist that can be used to further inform regional background concentrations for metals, D/Fs, and/or PCBs. Examples of these datasets include but are not limited to:
    a. Utah Test and Training Range – North: Soil data collected for evaluating background metals levels in an area north and west of the US Magnesium site (URS 2004);
    b. Former Defense Depot Ogden: Background concentrations of metals developed for the Defense Depot Ogden National Priorities List Site as presented in an Agency for Toxic Substances and Disease Registry (ATSDR) Public Health Assessment report (ATSDR 1992).

c. Wetland Sites around the Great Salt Lake: Characterization of sediment, water and biota data from 30 wetland sites around the Great Salt Lake (United States Fish and Wildlife Service 2009)

While there are historical data available, none of these datasets provide sufficient information to develop relevant background for the purposes of the RI/FS. However, these datasets can be used to inform the design of a background dataset for the RI/FS. Additionally, they may provide context for comparisons for data that are collected as part of this background evaluation.

While not the specific objective of this background soil characterization study design, the baseline ecological risk assessment will likely require characterization of COPCs in biotic tissue samples from non-impacted reference sites. The soil data collected in background areas will support the selection of reference areas for biotic sampling by confirming that the locations are not impacted by either the US Magnesium site or other point sources.

In summary, background metal and organics concentrations have not been adequately characterized. These data are critical for conducting RI/FS activities, including the characterization of N&E, identification of site-related constituents of concern, and identifying candidate reference locations for the collection of biotic tissue samples.

11.3.2 Step 2: Identify Goals of the Study

The goal of the study is:

1. To obtain sufficient data to reliably define and use background concentrations to identify elevated (site-related) metals and organics (D/Fs, total PCBs and HCB); and
2. To identify non-impacted background soil/sediment reference locations keeping in mind that the same locations may be re-visited in Phase 2 to characterize tissue burdens at reference locations.

11.3.3 Step 3: Identify Information Inputs

The information needed to support background evaluation is an adequate and reliable data set to characterize the range of metals and organics concentrations that occur in solid media within non-impacted soils/sediments (solid media) that are representative of soils/sediments found at the US Magnesium site. Additionally, habitat and species information from the Site and the background locations are needed so that the background locations sampled are likely to provide the biotic reference samples during Phase 2 sampling.

11.3.4 Step 4: Define the Boundaries of the Study

11.3.4.1 Spatial Boundaries

The initial study boundary for the background characterization includes areas located:

1. Outside of the 5-mile radius RI/FS Study Area;
2. Away from any other known point-source areas of contamination;
3. In areas where species of interest would not be expected to forage in RI/FS Study Area;
4. In similar lithologies and soil types as those found at the Site; and
5. In habitats where species expected to be at the Site are also found.

11.3.4.2 Temporal Boundaries

Within media such as soils and sediments, metal and organics concentrations are not expected to fluctuate seasonally, so the time of year when sampling of these media occurs is not an important variable.

11.3.5 Step 5: Develop the Analytic Approach

The primary objective of the background characterization is to obtain sufficient data to reliably define and use background concentrations to identify elevated (site-related) metals and organics. Once background concentrations are characterized, these data will be used to compare to site data to evaluate whether concentrations of metals and organics detected on Site are within the range of background or are elevated. The study data will be used to confirm that the background sampling locations are: 1) not impacted by either the US Magnesium site or another potential point-source area; and 2) suitable for future collection of biological samples. Based on these objectives, the decision rules for the background evaluation are as follows:

1. If detected concentrations of metals, D/Fs, total PCBs, and HCB do not show site influence, then conclude that the data are appropriate for background evaluations (see 11.3.5.1); and

2. If detected concentrations of metals and D/Fs, total PCBs, or HCB detected at the site are within the range of background, then conclude that the presence of these compounds are not related to releases or other activities at the Site (see 11.3.5.2).

To address the above decision rules, a multi-line of evidence approach is proposed and discussed in detail below.

11.3.5.1 Characterization of Background Dataset

The first step of the analysis will focus on confirming that an appropriate background dataset was collected. For each background population characterized, a number of evaluations will be conducted to confirm that only non-contaminated samples are included in the background dataset. The following tools will be used to determine whether there is any evidence a sample is affected by the site:

1. Statistical outlier tests;
2. Graphical evaluations including geochemical bivariate plots and Q-Q plots (see below for more details on these methodologies);
3. Comparison of D/F congener fingerprints between background samples, other regional background datasets (where available) and US Magnesium site data; and
4. Comparison of D/F, PCB and HCB data to risk-based screening levels.

Results of these tests will be used to determine if additional evaluation is needed.

Based on the outcomes of these evaluations, samples that are concluded to contain concentrations of a specific metal or organic that are elevated, indicating potential contamination, will be identified. For these samples, a decision will be made as to whether the specific compound concentration is removed from the dataset, or whether the entire sample should be removed from the dataset. The decision as to whether individual compound(s) or the entire sample is removed from the background dataset will depend on: (1) the number of individual compounds that are elevated in the sample, (2) the spatial distribution of samples with elevated concentrations, and 3) observations made in the field regarding specific samples.

Once the background dataset(s) is finalized, the dataset will be used to: (1) compare site data against background data, and (2) to identify those locations that are non-impacted and are potential candidate locations for reference biota sampling. The background comparison methodologies that will be conducted are presented below.

11.3.5.2 Background Comparison Analyses

A holistic approach will be used that considers multiple lines of evidence to determine whether a compound is elevated above background. Comparisons to background will be conducted on a PRI basis. These lines of evidence will include a comparative statistical analysis, a geochemical analysis, and a graphical evaluation using quantile-quantile (Q-Q) plots. The analytical approach for each of these lines is described below.

Statistical Comparisons

The statistical comparison method employs a series of tests to compare site sampling data against data sampled from a comparable population known to be non-impacted (background). Statistical hypothesis tests are used to determine whether concentrations at the site are statistically similar to background concentrations or elevated. Two statistical tests will be conducted during the background evaluation. One compares the central tendency of data distributions, and the second compares the upper tails of distributions. Depending on the distribution of the datasets, parametric or nonparametric methods will be used. The central tendency and tails tests are described further below.

Central Tendency Testing

Central tendency testing will be employed in both metal and organics[4] background evaluations. The central tendency tests consist of two steps. First, the distribution of each dataset will be tested by application of the Shapiro-Wilks test. Then depending on the distribution of the dataset, the central tendency of the sites and background datasets will be compared using either parametric or nonparametric analyses as follows:

1. t-test – will be used when the site and background datasets have parametric probability distributions.

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[4] For the statistical comparisons, D/Fs will be evaluated as tetrachlorodibenzo-p-dioxin TEQs.

2. Wilcoxon Rank Sum Test – will be used when the site and background probability distributions do match or both were non-parametrically distributed.

The null hypothesis (H_0) for the above tests will assume that site concentrations are greater than background (Background Test Form 2 per USEPA 2002). The alternative hypothesis (H_A) for this test form is that site concentrations are not greater than background. Central tendency testing requires establishing values for α, β and Δ to generate sample sizes and establishing acceptable probability thresholds for potential decision errors. These values are discussed further as performance criteria in Section 11.3.6.1.

Quantile Testing

The quantile test is a nonparametric test that is designed to compare the upper tails of the distributions (USEPA 2002) and will be employed in both metal and organics background evaluations. The quantile test will be used to compare the upper tails of the site and background datasets. This test detects whether a site's upper tail (highest concentrations) is shifted higher than the upper tail of background concentrations, i.e., tests if a PRI's highest concentrations are higher than the highest concentrations in the background dataset. Statistical test values calculated during the quantile test are r, k and α. These values are discussed further as performance criteria in Section 11.3.6.2.

Geochemical Evaluation

Metals will be evaluated by examining geochemical relationships between trace metals and reference metals. Geochemical correlations of trace versus major elements are predicated on the natural elemental associations in soil. Linear trends with positive slopes are expected for scatter plots of specific trace versus major elements in uncontaminated samples. Individual samples that may contain contamination are identified by their positions off the trend formed by uncontaminated samples. In addition to pinpointing which samples may be contaminated, this technique provides mechanistic explanations for naturally elevated element concentrations (Myers and Thornbjornsen 2004).

Trace metal distributions in soil tend to span a wide range of concentrations and are highly right-skewed, approximating lognormal distributions, and background data sets are frequently too small to capture this range. The distribution of reference metals in soils depends primarily on the source rock, weathering processes, geochemical environment, and sorption and precipitation processes. These are broad terms that refer to the physical and geochemical processes that result in metal immobilization through: 1) adsorption processes where a metal is bound or "sticks" to soil materials; and 2) precipitation processes where metals form new minerals. Furthermore, these processes can work concomitantly.

One of the factors controlling metals distribution is speciation, which dictates their charge and affinity for different types of soil minerals. Table 11-1 provides: 1) a summary of metals/inorganics and their likely speciation in natural systems; 2) the key constituents that are broadly responsible for their immobilization and distribution; and 3) a description of predominant immobilization processes.

As an example of a geochemical correlation, arsenic in most uncontaminated oxic soils is commonly associated with iron oxide minerals (Myers and Thornbjornsen 2004). This association of arsenic with iron oxides is a result of the adsorptive behavior of this particular trace metal in an oxic soil environment. Arsenic is present in oxic soil pore fluid as negatively charged oxyanions. These oxyanions have strong affinities to adsorb on the surfaces of iron oxides, which maintain a strong positive surface charge for this reason, if a soil sample has a high percentage of iron oxides, then it is expected to have a proportionally higher concentration of arsenic (Myers and Thornbjornsen 2004).

The absolute concentrations of arsenic and iron can vary by several orders of magnitude at a site, but the arsenic/iron ratios in each sample are usually quite constant at a given site as long as no contamination is present (Myers and Thornbjornsen 2004). If a sample has some naturally occurring arsenic plus additional arsenic from an anthropogenic source, then it will have an anomalously high ratio relative to the other uncontaminated samples. These ratios thus serve as a powerful technique for identifying contaminated samples.

In order to utilize the geochemical method approach outlined above, potential geochemical associations as defined by those in Table 11-1 will be evaluated against one another for their relative strength. Geochemical plots will be used to assess how strongly individual sample concentrations from a PRI hold to the linear relationship created by the reference metal-to-trace metal concentration ratio defined by the background dataset. Bivariate scatter plots will be constructed with the "reference" metal concentration on the x-axis, and the "trace" metal of interest concentrations on the y-axis.

A least squares regression line will be drawn from the scatter plot to illustrate the linear trend exhibited between reference and trace metal for the background dataset. A 95% predictive interval on the regression will be drawn to provide a confidence interval on the background population. The 95% predictive interval provides the range within which the trace metal concentration value (y-axis value) is expected to fall based on the corresponding reference metal concentration (x-axis value) 95% of the time. Samples that fall above this line are suspected to be elevated above background concentrations. An example geochemical plot is provided in Figure 11-11 using fictitious data, along with an explanation of plot interpretation.

In summary, the geochemical evaluation provides a line of evidence that is not constrained by statistical and computational requirements. This provides a check against potential decision errors stemming from statistical methods.

Q-Q Plot Evaluation

As another line of evidence, Q-Q plots of metals and organics will be generated and reviewed. In a Q-Q plot, the x-axis is arranged such that a dataset's theoretical quantiles will plot (ideally) as a straight line with relatively flat tails. A curve with an apparent inflection point (a point on the curve where a change in direction occurs) is commonly produced when the plotted data set contains multiple populations (either multiple background populations from different geological units, or background plus anomalous populations due to site releases). Q-Q plots will be developed for each PRI and the background dataset. Inflection points in the Q-Q plot can represent the transition between different geologic units or it can represent the background "threshold" concentration (i.e., the value that marks the transition between background concentrations and concentrations resulting from site operations).

Like the geochemical evaluation, the Q-Q plot evaluation provides a line of evidence that is not constrained by statistical and computational requirements, and provides a check against potential decision errors stemming from statistical methods.

Dioxin/Furans Evaluation

In addition to the statistical evaluation, Site D/Fs will be compared to background D/Fs by using congener fingerprinting techniques. This will include, but is not limited to, calculating the relative proportions of congener in each sample, and comparing the patterns in proportions exhibited by the site and background datasets (USEPA 2004), and/or more quantitative techniques—e.g., regression analysis, principal component analysis, and/or non-metric multi-dimensional scaling.

11.3.6 Step 6: Specify Performance or Acceptance Criteria

The primary objective of specifying performance criteria is to minimize the probability that a metal or organic constituent in soil or sediment at a PRI will be identified as being within the range of background when it should be identified as being above the range of background and is likely site-related. Therefore, it is necessary to be confident that the observed PRI dataset has a high probability of exceeding the background dataset when the concentration of the chemical at the PRI is truly elevated above the range of background. In addition, care should also be taken to minimize the probability of concluding that a metal or organic in soil or sediment at a PRI will be identified as being elevated above background when it should be identified as being within the range of background.

To minimize the probability of committing either decision error, multiple lines of evidence will be used. These multiple lines of evidence include both quantitative statistical evaluations, as well as geochemical and graphical methods.

Specific performance and acceptance criteria for each line of evidence are presented below.

11.3.6.1 Central Tendency Testing

The central tendency testing requires establishing performance criteria for hypothesis testing. These include

> *Significance Level (α)* – The probability of rejecting a true null hypothesis (H_0) is referred to as a Type I or false positive error (α) and is commonly called the significance level of the test. Because H_0 is that site concentrations are greater than background, a Type I error would be erroneously concluding the site is not greater than background, when in reality it is. For this evaluation the confidence level is set at 95%, or $\alpha=0.05$. This performance criterion means there is a 5% chance of a Type I error.

> *Power ($1-\beta$)* – The probability of accepting a false null hypothesis is referred to as a Type II or false negative error (β). For this evaluation, a Type II error would erroneously conclude the site concentrations

are greater than background concentrations, when in reality they are not. The statistical power (1- β) of a test is a measure of a test's ability to discern an effect – i.e., reject a false null hypothesis. Consistent with convention, the power is set at 80% (β=0.2). For this evaluation, this performance criteria means there is a 20% chance of a Type II error.

Minimum Detectable Difference (MDD or Δ) – For the specified errors, the minimum detectable difference (MDD) is the smallest difference that the test can detect. For this evaluation the MDD is set at 50% of the mean concentration of Phase 1A and DMA data from PRIs assumed to not be impacted by the facility (See section 11.3.7.1).

The central tendency testing parameters α, β, and Δ are used as performance criteria to select appropriate background sample sizes to minimize the risk of decision errors. Sample size estimation is described in Step 7, Section 11.3.7.2.

11.3.6.2 Quantile Testing

The Quantile Test is a test that determines whether the values in the right-tail of site dataset are generally larger than the values in the right-tail of the site dataset. This test consists of considering the largest *r* measurements in the pooled datasets and counting the number of those measurements that are from the dataset of interest (e.g., site dataset). If *k* or more of the *r* measurements are site measurements, the site dataset is considered to be elevated relative to background. The values for *r* and *k* are typically obtained from a look up table for a specified significance level (α) and power (1-β). Consistent with convention, the significance level is 0.05 (α=0.05) and the power is 80%(β=0.2).

11.3.6.3 Geochemical Evaluation

Examining geochemical relationships will be used to qualitatively compare site and background datasets. Plots will be examined for similar trace metal-reference metal correlations between site and background datasets. In order to quantify the predictive relationship between references and trace metal, geochemical bivariate plots require there be a clearly defined correlation between the two. To determine which reference metal possesses the strongest correlation with a given trace metal, Pearson correlation tests will be performed on all common trace-to-reference metal combinations in background data, as defined in Table 11-1. The strongest correlation between possible parings for a given metal will then be used in developing the plot.

A minimum Pearson correlation coefficient (r) of 3 will be required for a geochemical relationship to be considered strong enough for use in the evaluation. If the highest available r is less than 3, that trace metal will be excluded from the geochemical evaluation.

11.3.6.4 Q-Q plot Evaluation

Formal quantitative acceptance criteria for comparing site and background datasets are not defined for Q-Q plots. Q-Q plots will be used to qualitatively compare site and background datasets. Interpretation of Q-Q plots will be based on professional judgment, with the objective of identifying significant breaks or inflection points in the curve. Significant breaks and inflections points are potentially indicative of multiple populations in a dataset.

11.3.6.5 Dioxin Fingerprinting

Formal quantitative acceptance criteria are not defined for dioxin fingerprinting. Interpretation of fingerprinting plots will be based on professional judgment, with the objective of identifying similarities and differences in congener profiles between site samples, background samples and off-site regional background samples. Following an initial review, if statistical methods (e.g., regression analysis, non-metric multi-dimensional scaling [NMDS]) are judged to be useful in distinguishing patterns, then performance criteria (e.g., significance levels) will be proposed.

11.3.6.6 General Data Adequacy

Besides quantitative criteria and using multiple lines of evidence to mitigate against decision errors, data of adequate quality will also be required. Laboratory analytical data used for the characterization of background will meet applicable criteria for definitive data as defined under USEPA guidance (USEPA 2005) and the measurement performance criteria for sampling and analysis defined in the Phase 1A-B RI SAP (WS#12 and WS#15).

11.3.7 Step 7: Develop the Plan for Obtaining the Data

To develop a sample design that addresses the DQOs defined in Steps 1 through 6, the following design aspects are required: (1) definition of background populations(s) that need to be characterized, (2) the number of samples required to characterize each population(s); (3) the locations that will be sampled, and (4) the methodologies for sampling and analysis. The design aspects are described in more detail below.

11.3.7.1 Definition of Background Population(s)

In Step 1 it was recognized that soil types and lithology may influence background metal concentrations. Establishing site-specific background concentrations for each combination of soil and lithology could result in an overly complex process, where background populations are so specific that the corresponding site sample sizes would decrease and result in low statistical power for background comparisons. It is therefore critical to appropriately define the background population(s) to allow meaningful comparison to site data.

The degree to which soil types and lithology influence metals concentrations was evaluated using recent Site data from the Phase 1A DMA and the Phase 1A RI (collectively referred to as “Phase 1A samples”). Data were only used from PRIs that could be assumed to not be directly impacted by waste releases from the Site, i.e., PRIs 11 through 16. The first step in the evaluation is to identify the soil and lithologic factors so that meaningful physical characteristics can be used to delineate site-specific background sampling groups. As identified in Figure 11-9, the lithology of the Site falls into three main categories:

- Ql – Surficial Quaternary Lake Bonneville deposits
- Qs – Surficial Quaternary mud and salt flat deposits, associated with the lake bed of the Great Salt Lake
- Other[5] - Quaternary alluvium and colluvium (Qa) and consolidated rock in the Lakeside Mountains (C1, C2, C3, D, O and S)

The main soil types at the Site are identified on Figure 11-10 and include:

- Playas-Saltair – associated with the lake bed of the Great Salt Lake;
- Amtoft-Rock
- Dynal – Oolitic sand deposits
- Skumpah

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[5] Insufficient samples were collected in each of these geologic types for them to be considered individually.

- Yenrab
- Other[6]

Understanding how soil and lithology are co-located is meaningful so that background sampling areas can be established. To this end, the number of Phase 1A samples that were collected in each lithology and soil type were tallied across PRIs 11 through 16. As samples were randomly located with respect to any underlying pattern in soil type/lithology, the number of samples serves as a proxy for the prevalence of each soil type (Table 11-2) and lithology (Table 11-3) type in areas of interest for risk assessment. The intersection of soil and geologic types is provided in Table 11-4.

These tallies show that the Qs geologic type is largely comprised of the Playas-Saltair soil type and falls primarily into PRIs 13 and 14. These PRIs are within the “Lakebed” setting of the bed of the Great Salt Lake. The Dynal, Skumpah and Yenrab soil types fall primarily or entirely within the Ql geologic type which largely corresponds to PRIs 11, 12, and 15. These PRIs are considered to be in an “Upland” setting, as they are located outside of the bed of the Great Salt Lake. The “Other” soil and geologic types tend to be associated with the Lakeside Mountains in PRI 16, and are therefore also considered to be in an “Upland” setting. Based on these tallies, the distinct lithologic/soil groupings at the site can be generally divided into two settings, Lakebed and Upland, with Lakebed corresponding to PRIs 13 and 14 and Upland corresponding to PRIs 11, 12, 15, and 16.

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[6] The “other” soil types include the Checkett, Hiko Peak, Medburn, Puts, and Timpie-Tooele. Insufficient samples were collected in each of these soil types for them to be considered individually.

Statistical Support for Site-Specific Background Areas

Ordination and multivariate statistical techniques can be used to determine whether the metals composition differs significantly based on grouping variables (e.g., soil type, lithology, or PRIs). These techniques describe the relative similarity of metals composition for samples from similar versus different groups. To mitigate other confounding factors associated with the use of the Phase 1A data from PRIs 11-16, samples with known anomalies and/or site-related impacts were removed from these analyses. Excluded locations were as follows:

- Phase 1A RI samples PRI12-010 and -011 were collected on salt waste piles, not in soil
- Phase 1A RI samples PRI14-002 through -008 had suspected site-related impacts, as evidenced by elevated concentrations of D/Fs, Total PCBs, and/or HCB.

NMDS is a non-parametric ordination technique that plots sample locations relatively closer together if they have similar metals composition or farther apart if they are more dissimilar. The groupings on an NMDS plot can then be further defined by plotting 95% confidence ellipses around the centroid of each group of interest (McCune & Grace 2002). Overlapping confidence ellipses suggest metals composition between groups is indistinguishable, whereas non-overlapping confidence ellipses suggest that groups are distinct.

An NMDS plot was generated on a PRI basis since these groups seem to best capture both soil and geology (Figure 11-11). The Lakebed background population (PRI 13 and PRI 14) clusters together. Similarly, the Upland background population (PRI 11, 12, 15, and 16) clusters together. The Upland and Lakebed background populations are supported by visual assessment with an NMDS plot (Figure 11-12) as well as with multivariate hypothesis testing[7] (perMANOVA F-statistic = 33.0, R^2 = 0.30, p-value = 0.001).

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[7] perMANOVA (<u>per</u>mutation <u>m</u>ultivariate <u>an</u>alysis <u>o</u>f <u>va</u>riance) is a non-parametric version of a MANOVA that complements the descriptive NMDS plots. While samples from certain groups may visually segregate on an NMDS plot, the perMANOVA helps determine whether these groups are

Characterization of Upland and Lakebed

While the NMDS and perMANOVA demonstrate that the Lakebed and Upland settings have distinct metals composition, they do not describe how background populations are different on a metal-by-metal basis. A t-test (used for normally distributed data) or Wilcoxon Rank Sum test (used for all other distribution types) was used to compare the metals concentrations in the Lakebed and Upland samples (USEPA 2010). Comparison results are presented in Table 11-5. A Bonferroni correction (Zar 1999) was made to control for the family-wise Type I error rate[8] since multiple comparisons were made on the same set of samples. The accompanying boxplots (Attachment 1) show that the Upland area has significantly higher beryllium, chromium, iron and lead compared to the Lakebed. The two groups do not significantly differ for any other metals concentrations.

Conclusions

Multiple lines of evidence including ordinations, multivariate tests, and pair-wise test, support characterizing background using Lakebed and Upland settings to capture variability due to soil and lithology type: A summary of each setting's dominant characteristics are presented in Table 11-6. Based on these results, two background populations will be characterized: Upland setting and Lakebed setting. Each background population will then be compared to the appropriate PRI. For example, the Upland background dataset will be compared to PRIs 1 through 6, 8-12, and 15 and 16, while the Lakebed background dataset will be compared to PRIs 7, 13 and most of 14.

Characterizing Upland and Lakebed background populations will also be relevant to the biotic sampling. As both upland and wetland species will likely be targeted for biotic sampling in Phase 2, characterizing both

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statistically distinct and how much variance they explain. Thus, the perMANOVA can more rigorously test for differences among groups by offering a p-value, F-statistic, and R^2.

[8] The desired significance level for the whole family of tests was $\alpha = 0.05$, so the Bonferroni correction tests each individual hypothesis at a significance level of α/n. In this case, 21 metals are compared, with a desired $\alpha = 0.05$, so the Bonferroni correction tests each individual hypothesis at $\alpha = 0.05/21 = 0.0024$.

Lakebed (relevant to wetland) and Upland background populations will support the identification of relevant candidate reference locations for the upland and wetland biotic sampling effort.

11.3.7.2 Background Sample Size Estimation

Background dataset sample sizes need to be large enough to ensure sufficient power in the comparative statistical testing. Sample sizes were calculated using Visual Sample Plan v7.2 (http://vsp.pnnl.gov/). Details on this procedure are presented below.

Data Treatment

The Phase 1A data were used as proxies to characterize anticipated variability and statistical distribution expected in background data. For metals, the standard deviation, mean, and the distribution of the Phase 1A data were calculated for each metal in the Lakebed and Upland datasets (as described in Section 11.3.7.1). For organics, the standard deviation, mean and the distribution of the TEQ, Total PCBs and HCB datasets from PRIs 11 through 16 were used to represent conditions in the background population. The following additional data treatments were used for organic data from PRIs 11 through 16:

- Consistent with the metals approach, samples assumed to be impacted in PRI 14 were excluded (PRI14-002 through 008) as were salt pile samples from PRI 12 (PRI12-010 and 011).
- In addition to the above, any sample result that exceeded refined risk-based ecological screening levels from the *Revised Draft Inner PRI SLRA Report* (ERM 2015b) were excluded, to eliminate other samples that were potentially impacted by organics (performed for each organic compound independently).
- HCB had a high proportion of non-detected values (59%), which was disproportionately influencing variability. Non detected values were removed from the dataset to better represent natural variability. D/F TEQs and Total PCBs were both 100% detected.
- The remaining PRI data were pooled into a single dataset (Upland and Lakebed segregation is not applicable to organics).
- D/F TEQs were calculated excluding dioxin-like co-planar PCB congeners and HCB, as PCBs and HCB were evaluated independently.

Standard deviations were calculated using ProUCL to represent the natural variability in background metals and organics. Each dataset's distribution was also tested using ProUCL and identified as being normal, lognormal, gamma, or nonparametric. These parameters are presented in Tables 11-7, 11-8 and 11-9 and were used to calculate sample sizes in VSP.

Sample Size Calculations

VSP was used to calculate samples sizes using the "Comparison Average to Reference Average" module. For each metal sample, sizes were calculated for Lakebed and Upland datasets independently, and for organics using the PRI 11 through 16 pooled dataset. Sample sizes were calculated based on the performance criteria for the central tendency test (Section 11.3.6.1) to ensure that future statistical evaluations using the background datasets have acceptable power. If a metal had a normal distribution, its sample size was calculated based on the t-test application. A metal with any other distribution used the Wilcoxon Rank Sum application.

It was recognized that the datasets contain a broad range of variability, and that this variability drives a broad range of potential sample sizes. Some of the variability in metals data appeared to be driven by the presence of outliers. Statistical outlier testing using ProUCL was conducted to determine if individual metals contained suspect samples that may not be representative of background concentrations. In the Upland dataset, metals that had the highest variability also tended to have more statistical outliers (Table 11-8). This pattern was not observed in Lakebed samples (Table 11-7). High levels of non-detects also appear to drive variability in the Upland dataset (Table 11-8), but not the lakebed dataset (Table 11-7). While the presence of outliers and high frequency of non-detects impact variability, to be conservative, no outliers were removed from the datasets used to calculate standard deviations.

Potential metal sample sizes for Lakebed and Upland media were tabulated and ranked from lowest to highest (Tables 11–7 and 11-8). The range of metal sample sizes were also plotted as bar charts for visual inspection (Figure 11-14). The sample size calculations for organics were tabulated separately from metals (Table 11-9), as background D/F, PCBs and HCB are not expected to be influenced by soil type or lithology. To address the broad range of variability in compounds and its effect on potential sample sizes, the selection of a sample size that falls to the right of the median of the distribution of potential metal sample sizes calculated by VSP was agreed to by US Magnesium/ERM and USEPA during the March 2015 Phase 1B RI Scoping Meetings as a reasonable approach to selecting an appropriate background sample size. Because there were only three sample sizes for organics, the median sample size was selected.

As noted in Table 11-7, the Lakebed dataset had potential sample sizes ranging from 8 to 92, with a median of 25 to 26 samples. The sample size above the median is 29 samples. The Upland dataset had potential sample sizes ranging from 5 to 599, with a median between 14 and 17 samples (Table 11-8). Thus, 17 samples was chosen as a reasonable sample size for the Upland setting.

To add an additional level of conservatism and make sample collection consistent across the Lakebed and Upland datasets, the higher of the two datasets (29) was rounded to 30 and selected as the number of samples that will be collected from each setting (i.e. 30 Lakebed and 30 Upland samples). These 30 samples will be spread among the locations identified in the next section.

As noted in Table 11-9, the organics dataset had potential sample sizes ranging from 24 to 51, with a median of 34 samples. This median value was rounded up to 36, so that it could be divided equally between three Lakebed and three Upland sampling areas (6 samples per area; Section 11.3.7.4.

11.3.7.3 Background Sampling Locations

Reference locations for background sampling will be selected based on their appropriateness for characterizing naturally occurring concentrations of metals and ambient concentrations of organic chemicals in abiotic and biotic media. Background soil and sediment samples will be collected during the Phase 1A-B sampling effort in three locations of Upland and Lakebed habitats, respectively. The reference locations will also support the Phase 2 biotic sampling effort.

It is envisioned that biota collections will likely focus on bird eggs, plants, invertebrates, and small mammals that are found both within the Site boundaries and in reference locations. Based on historic survey data and conversations with biologists familiar with the Site, bird egg collections will likely focus on the horned lark for the Upland habitat and snowy plover and/or American avocet for Lakebed habitat (John Cavitt, Ph.D pers. comm.). Using literature-based foraging ranges, reference locations will be located far enough from the Site to ensure nesting birds in the reference locations are not foraging within the 5 mile radius of the Plant that defines the RI/FS study area. For Upland habitats, the territory size for the horned lark was reported as 1.3-2.7 ha[9]; territories for this species are used for courtship, nesting, and feeding (Wiens et al. 1986). For Lakebed habitats, American avocet was observed foraging 130 m from the nest (Gibson 1971), while the snowy plover forages an average of 272 m[10] from the nest[11] (Paton 1995).

Selection Criteria

Candidate reference locations for Upland habitat will be evaluated using the following criteria: (1) located beyond the 5-mile radius of the Site (at least 500 feet from the edge of the 5 mile radius to ensure the horned lark is not foraging within the RI/FS site boundary), (2) contains minimally disturbed intermountain basin (IMB) greasewood flat or annual invasive grassland land cover, (3) collection of bird eggs (e.g. horned lark), small mammals, plants, and invertebrates is very likely; and (4) accessible for sampling.

Candidate reference locations for Lakebed habitat will be evaluated using the following criteria: (1) located beyond the 5-mile radius of the Site (located at least 1000 feet from the edge of the 5 mile radius to ensure the snowy plover and American avocet are not foraging within the RI/FS site boundary), (2) contains minimally disturbed IMB playa land cover, (3) collection of bird eggs (e.g. snowy plover and/or American avocet), plants, and invertebrates is very likely; and (4) accessible for sampling.

Preliminary Selection of Candidate Locations

Preliminary candidate areas have been selected based on an understanding of site conditions and conversations with local biologists (John Cavitt, Ph.D, pers. comm.). These areas are located on the west side of Great Salt Lake to the north, south, and east of the Site as shown on Figure 11-15. The two Upland areas (Upland North and Upland South) contain IMB greasewood flat/annual invasive grassland and are located 500 feet from the Site boundary which provides a conservative distance for horned lark to forage

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[9] Radius of a 2.7 ha circle is 93 m or 305.1 feet. Rounded to 500 for additional conservatism.

[10] Rounded to 1000 feet for additional conservatism.

[11] The average distance reported in Paton (1995) is similar to site-specific observations from Cavit (2010).

outside the Site. The three Lakebed areas (Lakebed North, Lakebed South, and Lakebed Southeast) contain IMB playa and are located 1000 feet from the Site boundary, which provides a conservative distance for snowy plover and American avocet to forage outside the Site. The area to the north of the site contains both Upland and Lakebed habitat that are bordered by the Utah Test and Training Range site boundary. Upland and Lakebed habitats to the south are located between the Site and Interstate 80. The candidate area to the east of the Site contains IMB playa on Badger Island, Stansbury Island, and along the southern portion of Stansbury Bay near the Timpie Springs Waterfowl Management Area. Three locations for Upland and Lakebed background samples will be selected within these candidate areas.

A field trip will be conducted during the 2015 bird nesting season (May – June) to evaluate the accessibility and likelihood of collecting biota samples within the Upland and Lakebed candidate areas shown in Figure 11-15. Whenever feasible, sample locations will be identified in candidate locations along the borders furthest from the site. This will be done to maximize the distance between site and reference tissue organisms, and in particular birds.

The results from the field trip will be documented in a Background/Reference Area Identification Technical Memorandum which will be included as Attachment 11 to the Phase 1A-B SAP. The Technical Memorandum will be submitted for USEPA review and approval as a SAP Modification and will include the following information:

- A narrative summary of the field trip and the findings;
- Final background locations for sediment and soil samples. Selected background locations will be shown in maps and coordinates will be provided;
- Copies of field notes; and
- A photograph log.

11.3.7.4 Contingency Reference Location Samples

In the event that biological data cannot be collected from the six candidate reference locations described above (either from the absence of sufficient biological tissue or impacts traceable to the Site) a contingency reference tissue area may be utilized. The Bear River Migratory Bird Refuge (BRMBR) was identified as the contingency reference location (Figure 11-16). To confirm contingency reference location is not impacted by site-related contaminants, five samples will be collected from the BRMBR. These data will be assessed to confirm that they do not contain elevated concentrations of metals or organics. The contingency reference location will only be utilized during Phase 2 if insufficient reference tissue data can be collected from the candidate Great Salt Lake reference locations.

The field trip to identify background locations will include a visit to the BRMBR. The five sample locations at BRMBR will be identified during the field trip and these locations will be included in the Background/Reference Area Identification Technical Memorandum to be included as Attachment 11 to the Phase 1A-B SAP.

11.3.7.5 Sample Collection and Laboratory Analysis Methodology

As described above, background will be characterized for 2 populations: Lakebed and Upland. A sample size of 30 for metal and 18 for organics will be sampled for each population. The 30 and 18 samples will be distributed across three different locations in each population characterized (Upland and Lakebed). The three locations that will be selected will be representative of potential candidate reference areas where biotic sampling will be conducted in spring of 2016. Therefore, there will be 10 metal and 6 organics sample locations in each of the candidate areas.

Sampling will be performed following site-specific Standard Operating Procedures (SOPs) for surface solids sampling (SOP USM-01: Surface Soil, Sediment, and Waste Sampling). Laboratory analyses will be performed following the SOPs and Project-Specific Work Instructions included in the Phase 1A-B SAP.

Specifically for the background characterization study, bulk surficial soils from 0-2 inches bgs will be targeted. As there is no reason to believe that metals concentrations vary significantly with soil depth, and the shallowest soil horizon is relevant to measure aerially deposited anthropogenic compounds such as D/Fs, PCBs, and HCB, shallow soils will be sampled. This sample depth is consistent with the Phase 1A SAP, which specified that surface samples be collected from the top 2 inches of material in PRIs where the only pathway for contaminant deposition is air deposition.

Characterization of background soils will focus on the bulk fraction. The bulk fraction is considered relevant for the following reasons:

- Concerns regarding contaminant concentrations in the fine fraction focus on the selection of human health COPCs, and are not relevant to background characterization;

- Bulk soil samples are available for all the locations sampled at US Magnesium and fines samples are only available for a subset;
- Phase 1A data focusing on the difference between bulk and fine concentrations for metals and D/Fs in soils found only small differences; and
- D/F data collected to support the characterization of regional background for the Front Range of Colorado (US EPA 2002) found that the slope of the best fit regression line was slightly less than 1.0, indicating that there was no significant enrichment of TEQ in the fine soil compared to the bulk soil, and that TEQ values based on bulk field soil samples are similar to those based on the fine sieved soil.

All background soil samples will be analyzed for:

- Metals (USEPA Methods 6010/6020/7471);
- D/Fs (USEPA Method 8290);
- Total PCBs (USEPA Method 1668);
- HCB (USEPA Method 8270 with SIM confirmation); and
- TOC (USEPA Method 9060).

This will result in a total of 65 samples that will have metals results (30 in Lakebed, 30 in Upland, and 5 at BRMBR) and 41 background samples (18 in Lakebed, 18 in Upland, and 5 at BRMBR) that will also include D/Fs, PCBs and HCB results. As previously noted, the sample results will also provide confirmation that the candidate reference locations are not impacted by US Magnesium site related contaminants.

11.8 REFERENCES

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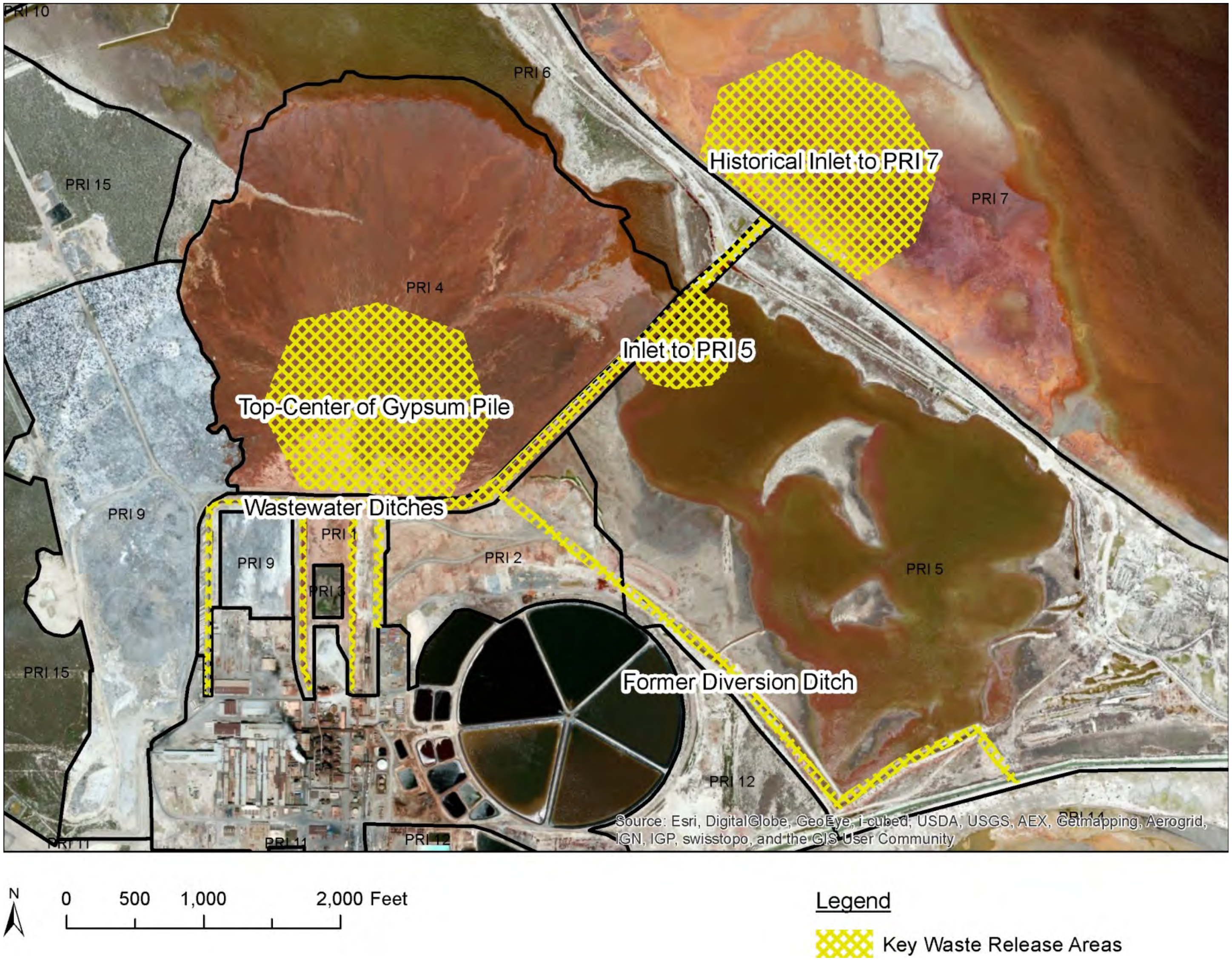
Figures

Figure 11-1 Key Waste Release Areas



Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 11-2 Phase 1A-B Sample Locations for PRI Area 1 – Ditches

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 11-3 Phase 1A-B Sample Locations for PRI Area 3 – Sanitary Lagoon

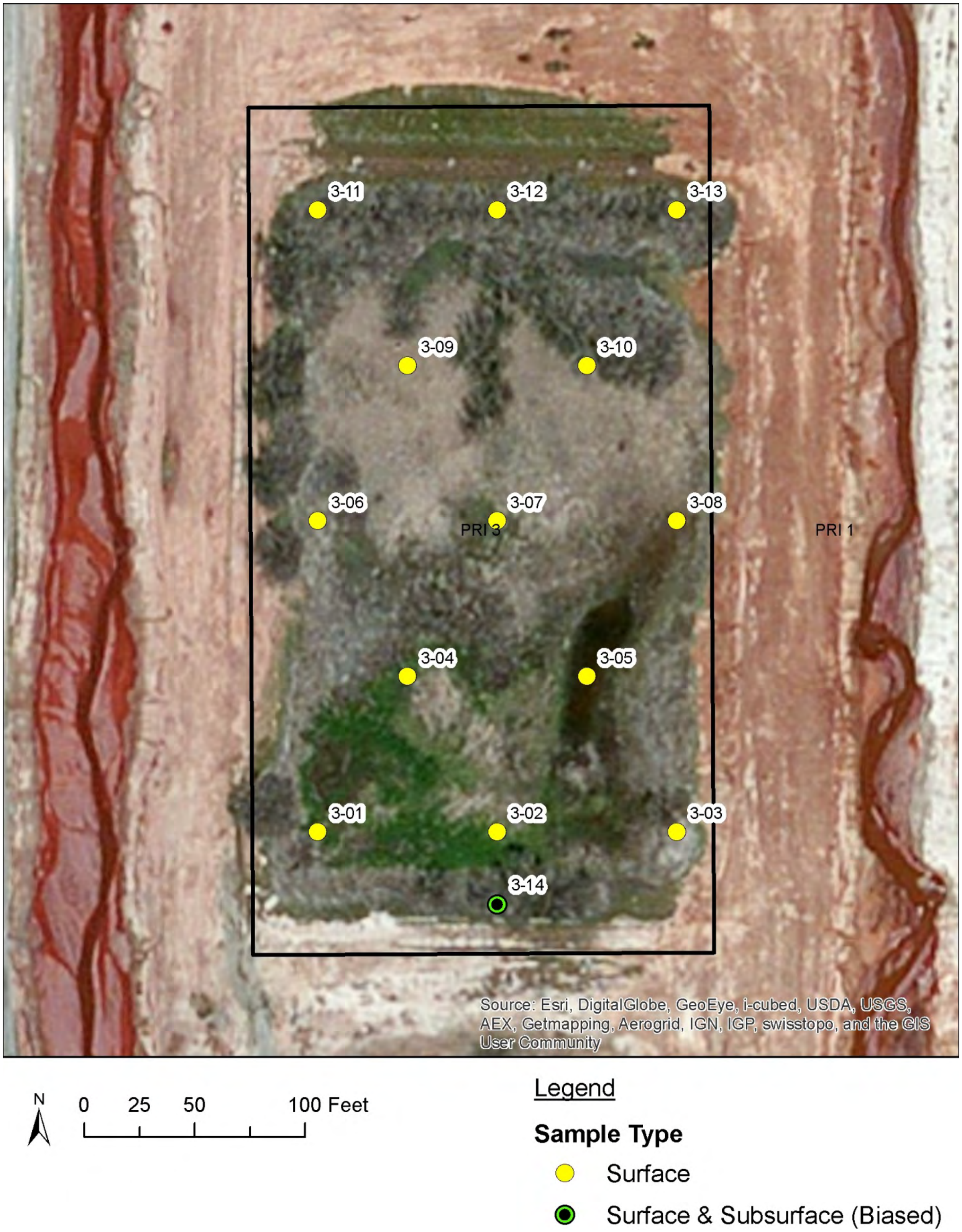
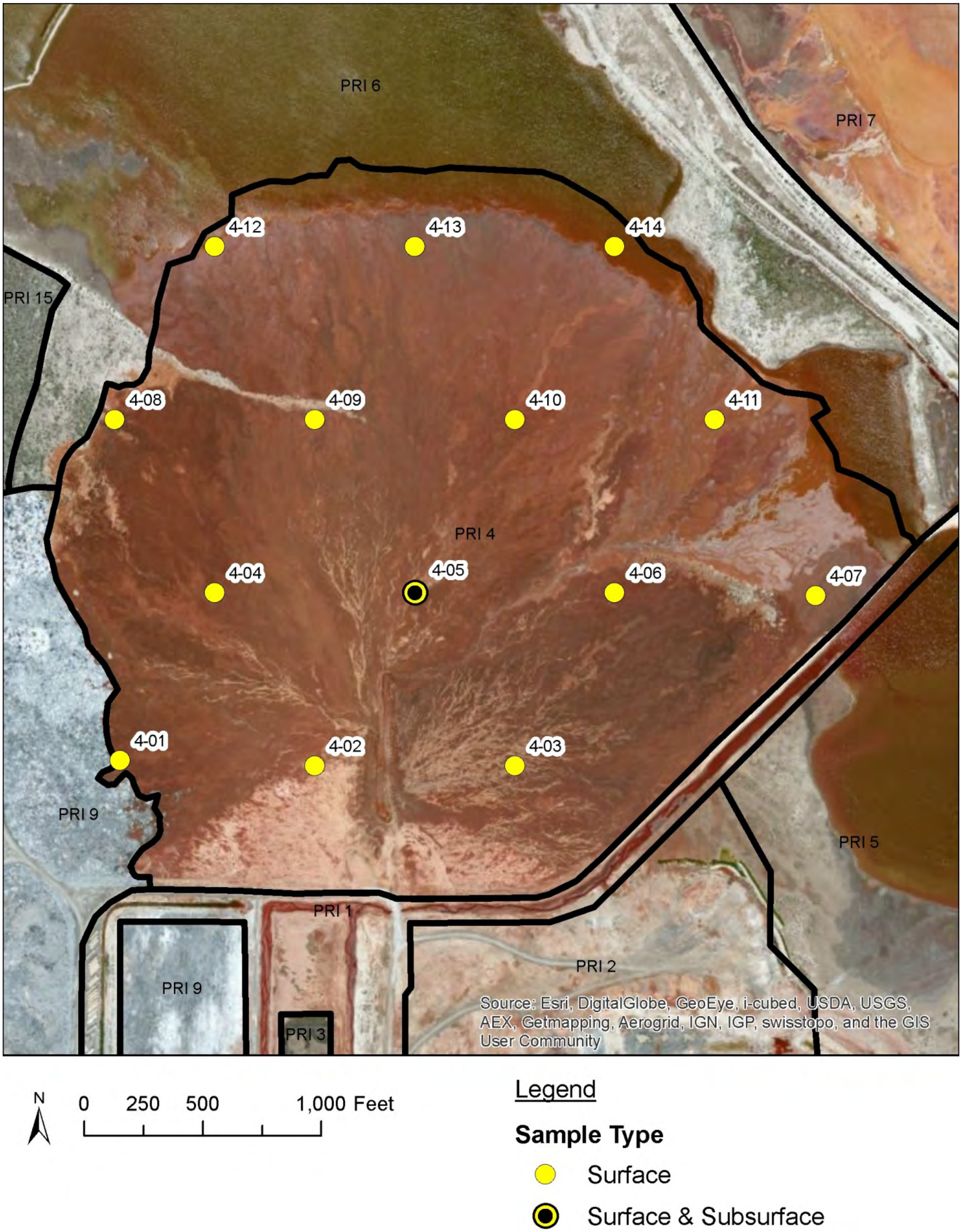
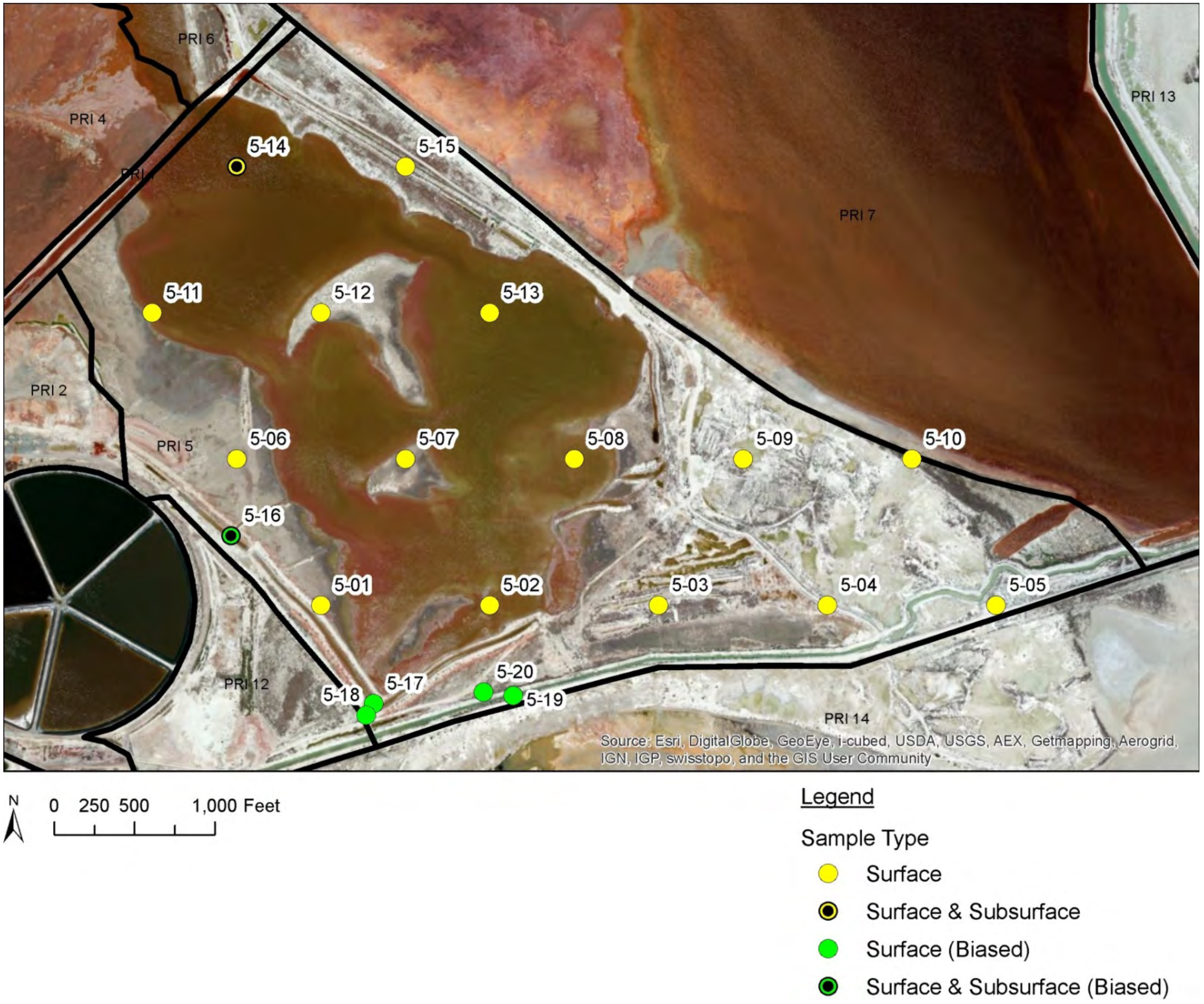


Figure 11-4 Phase 1A-B Sample Locations for PRI Area 4 – Gypsum Pile



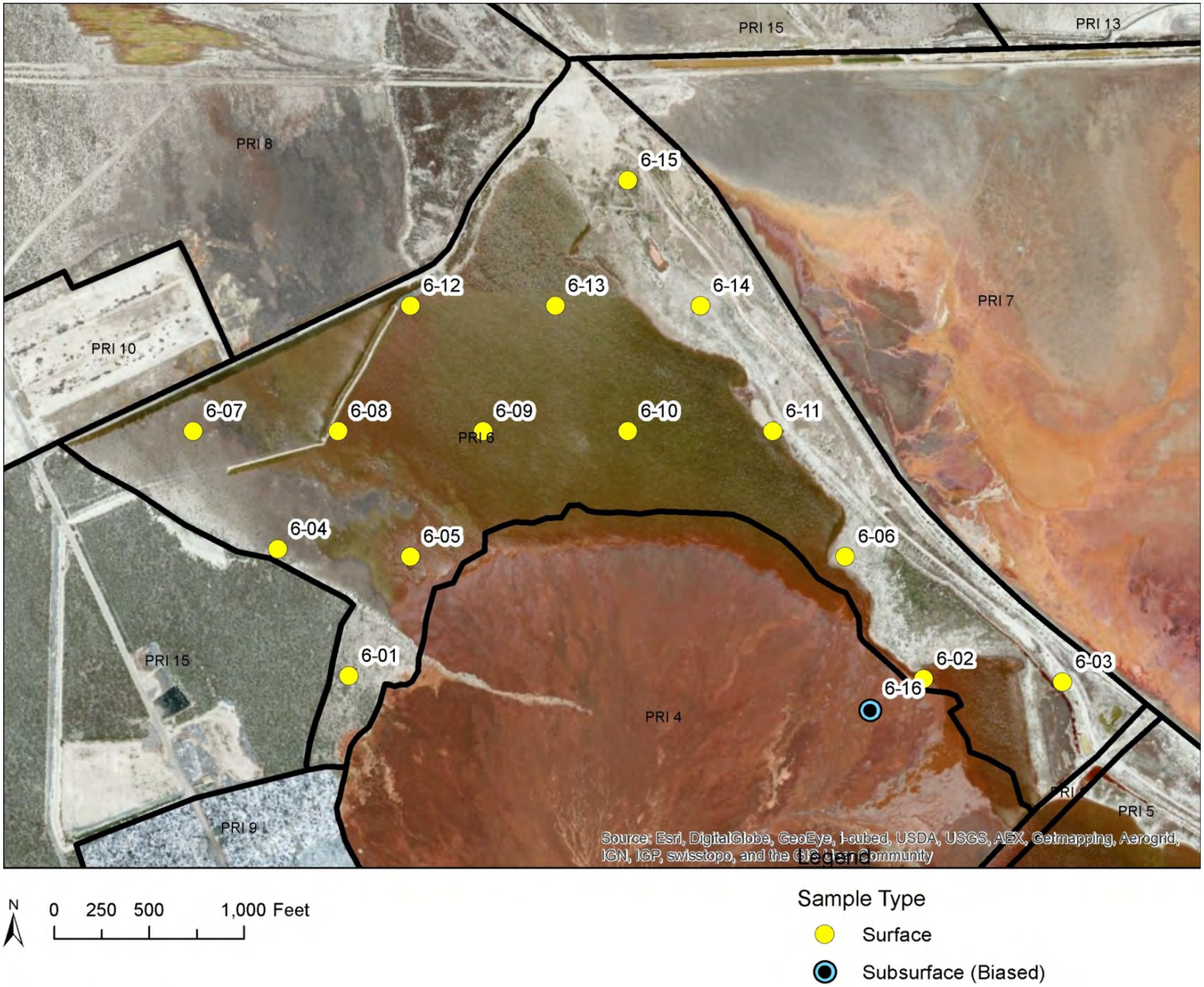
Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 11-5 Phase 1A/B Sample Locations for PRI Area 5 – Southeast Ponded Waste Lagoon



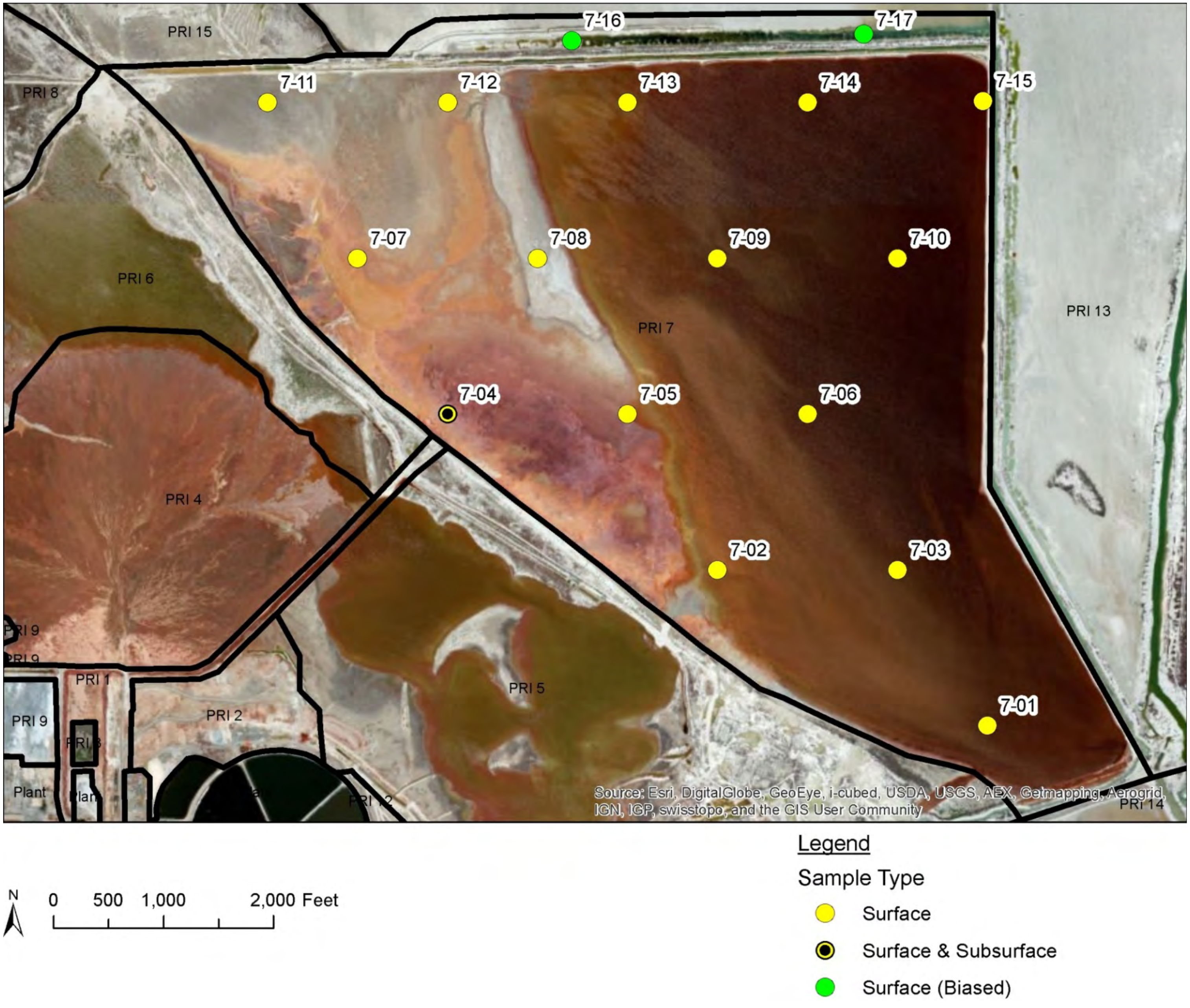
Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 11-6 Phase 1A/B Sample Locations for PRI Area 6 – Northwest Ponded Waste Lagoon



Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 11-7 Phase 1A/B Sample Locations for PRI Area 7 – Northeast Ponded Waste Lagoon



Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 11-8 Fines Fraction Sieving and Analysis Strategy

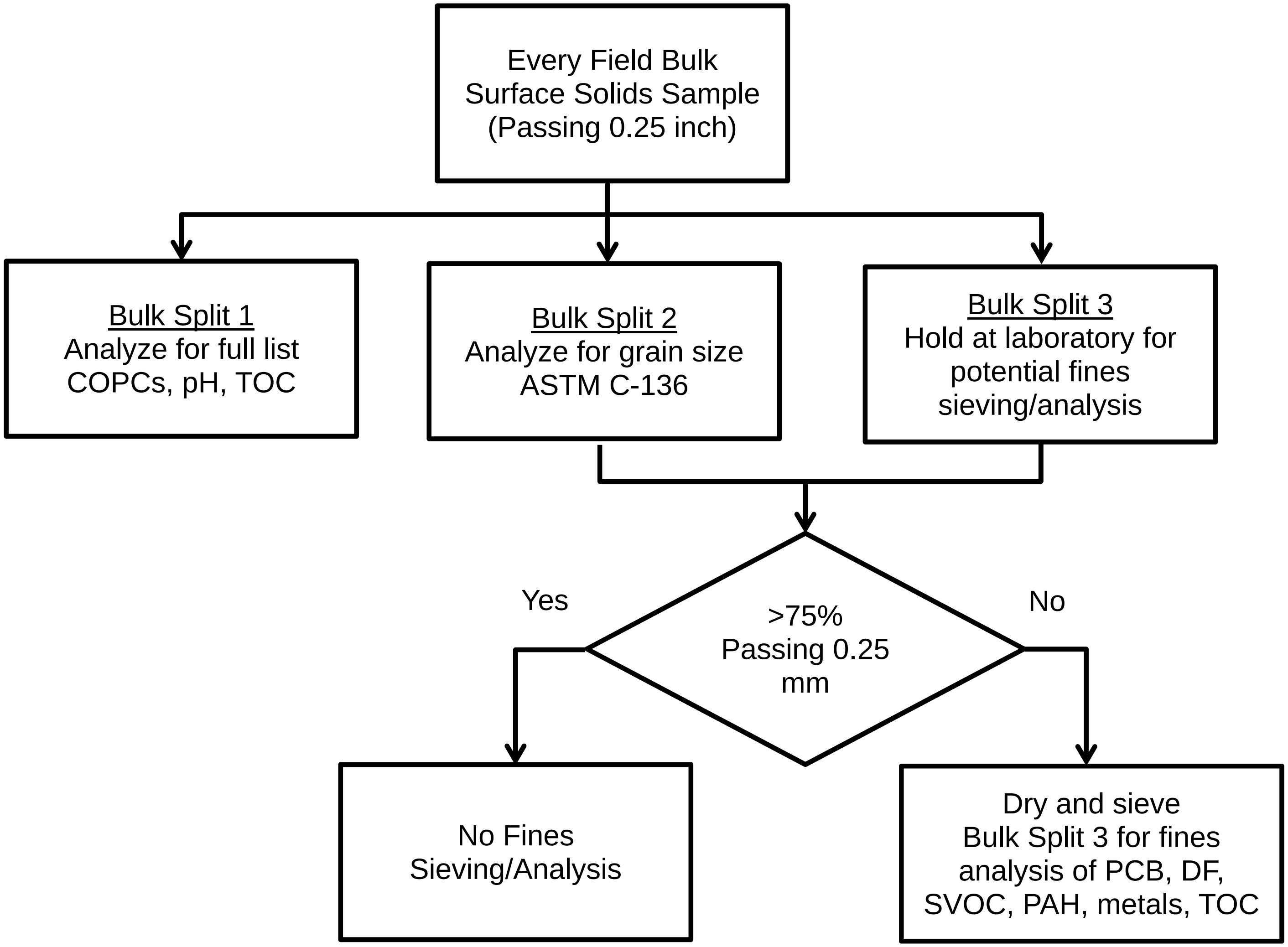
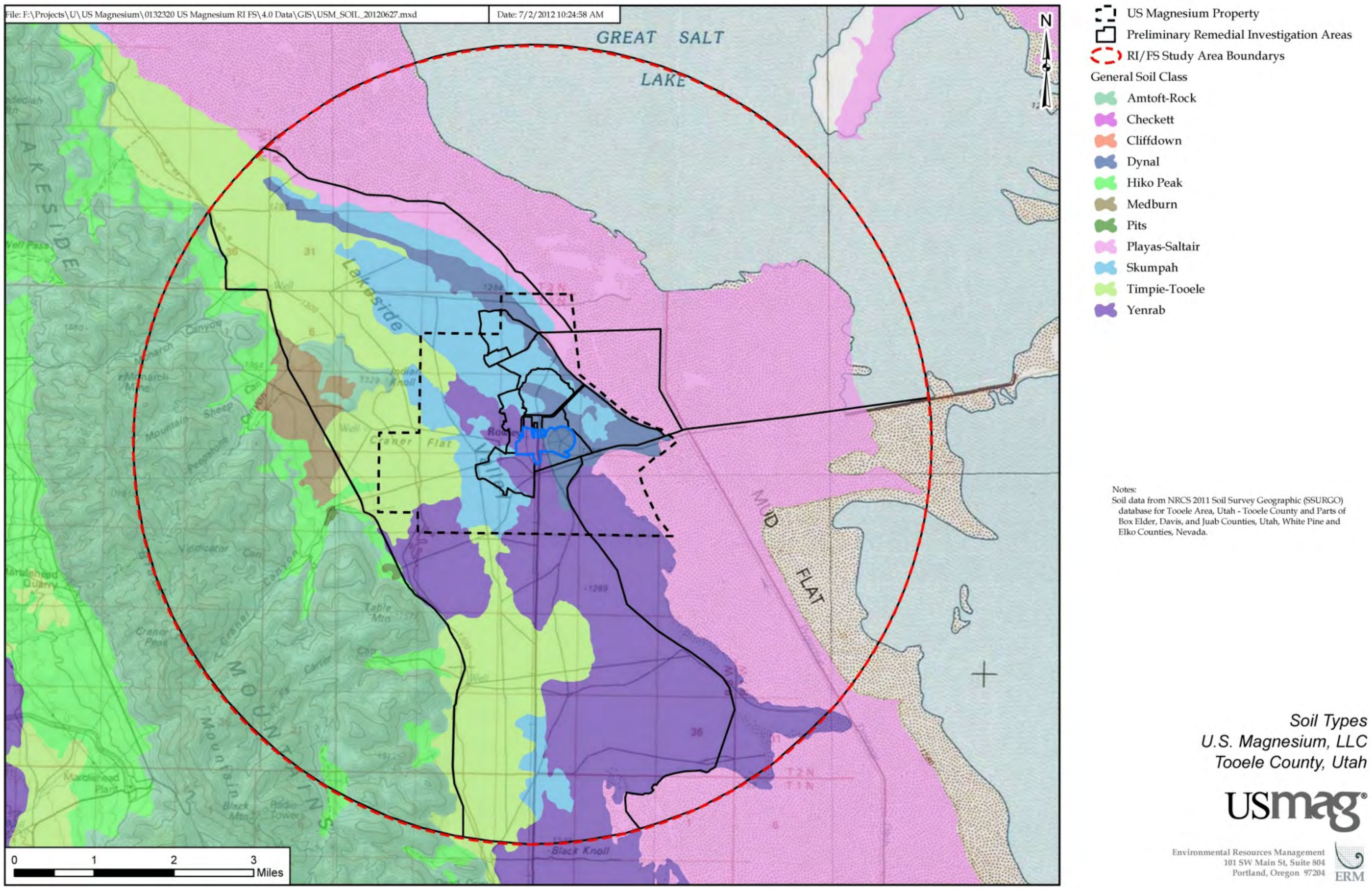


Figure 11-9 Soils Map



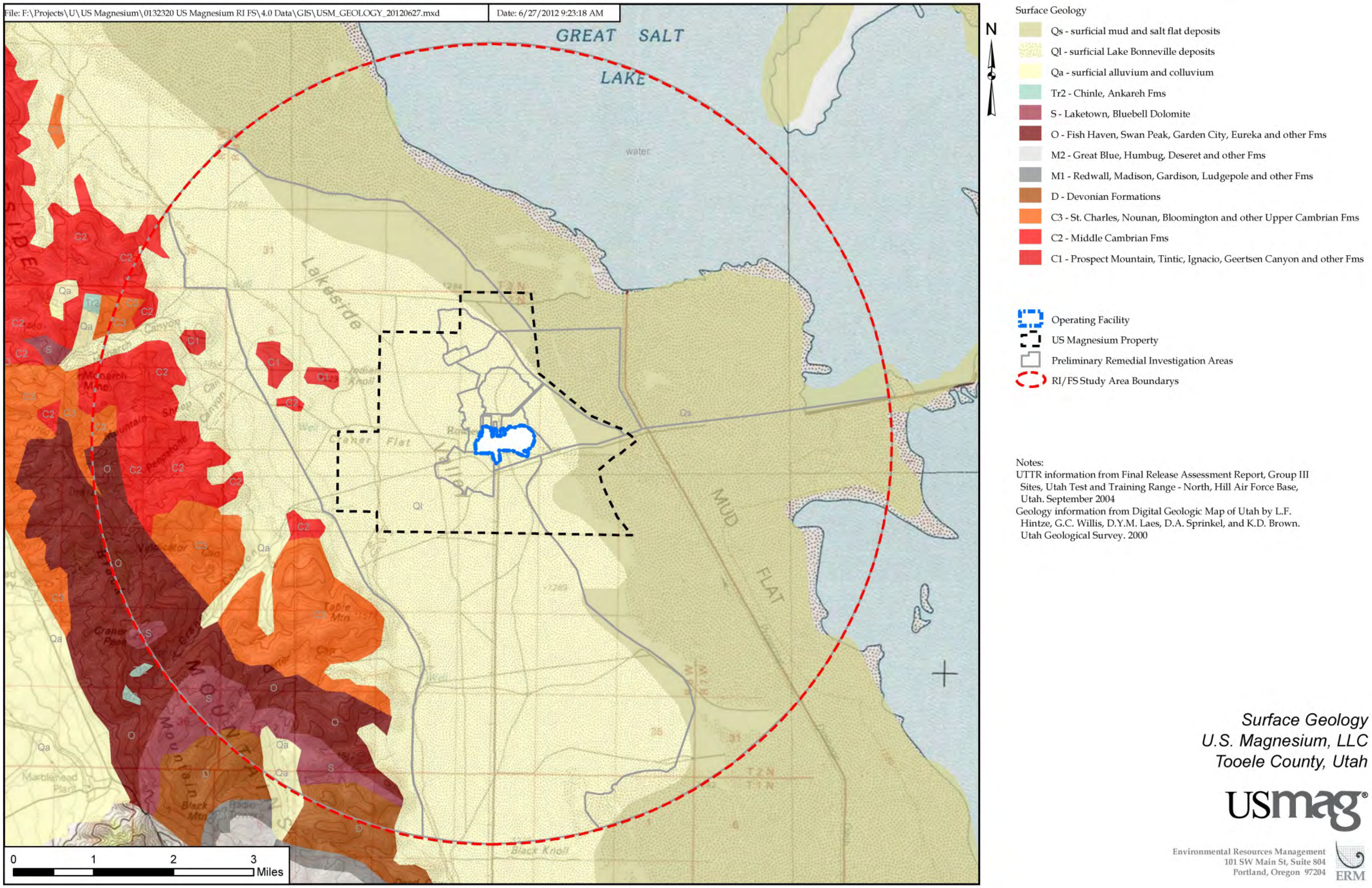
Notes:
Soil data from NRCS 2011 Soil Survey Geographic (SSURGO) database for Tooele Area, Utah - Tooele County and Parts of Box Elder, Davis, and Juab Counties, Utah, White Pine and Elko Counties, Nevada.

Soil Types
U.S. Magnesium, LLC
Tooele County, Utah

usmag®

Environmental Resources Management
101 SW Main St, Suite 804
Portland, Oregon 97204
ERM

Figure 11-10 Surface Geology Map

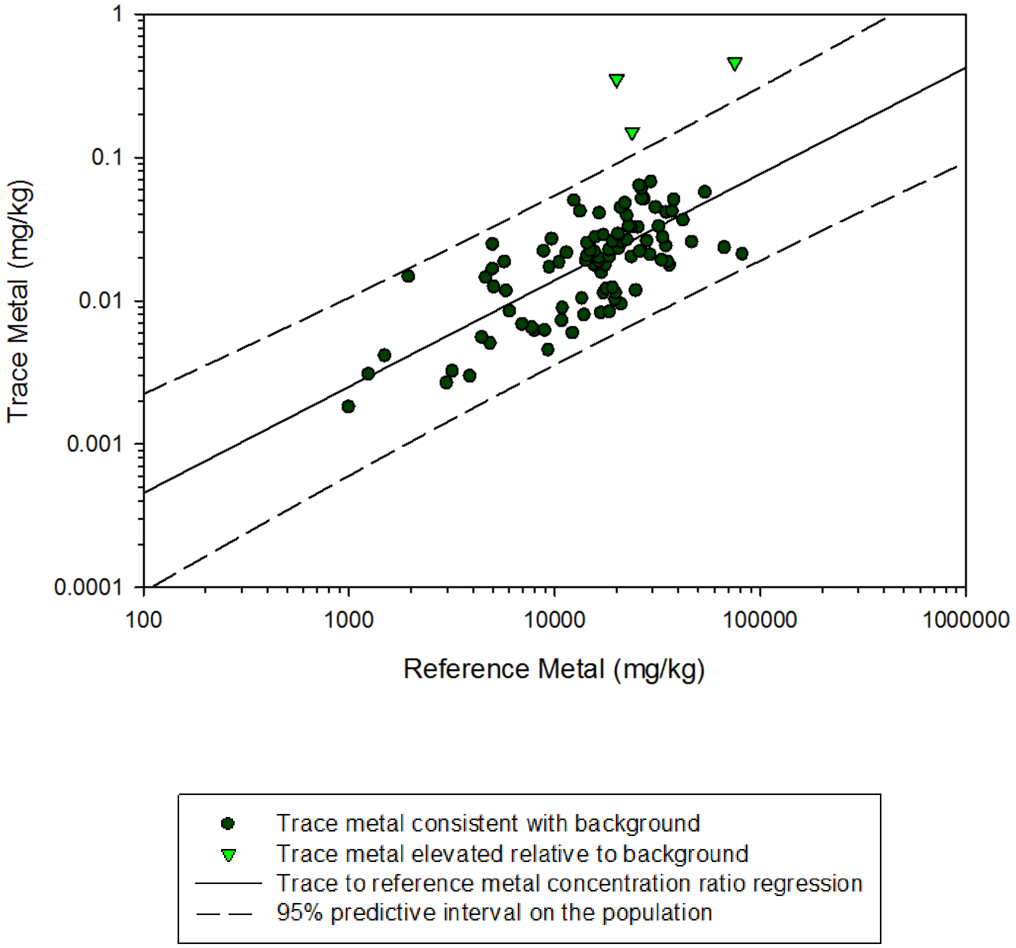


Notes:
UTTR information from Final Release Assessment Report, Group III Sites, Utah Test and Training Range - North, Hill Air Force Base, Utah. September 2004
Geology information from Digital Geologic Map of Utah by L.F. Hintze, G.C. Willis, D.Y.M. Laes, D.A. Sprinkel, and K.D. Brown. Utah Geological Survey. 2000

Surface Geology
U.S. Magnesium, LLC
Tooele County, Utah

Environmental Resources Management
101 SW Main St, Suite 804
Portland, Oregon 97204
ERM

Figure 11-11. Hypothetical Geochemical Relationship Plot Example



Plot Explanation

The reference metal concentration composes the x-axis in log scale. The y-axis is composed of the log-scale concentration of the trace metal. The bivariate plot is a simple scatter plot of these two metal concentrations reported from the each sample location. The regression line is used to predict the approximate concentration of a trace metal that is expected to correspond to a given reference metal concentration based on the relationships found in the background dataset. In this example, a reference metal concentration of 10,000 mg/kg should correspond to a trace metal concentration of 0.02 mg/kg. Because other naturally occurring conditions will undoubtedly influence the concentration ratio, the 95 percent predictive interval is used to provide a reasonable boundary on the population that adheres to the geochemical relationship shown by the regression line. Bivariate points that fall outside the upper predictive interval line have trace metal with concentration ratios that are artificially enriched, thus considered elevated. In this example, three points fall outside the 95 percent predictive interval. This represents three sample locations that appear elevated relative to background.

Figure 11-12. NMDS Comparing Metals of PRIs 11, 12, 13, 14, 15 and 16

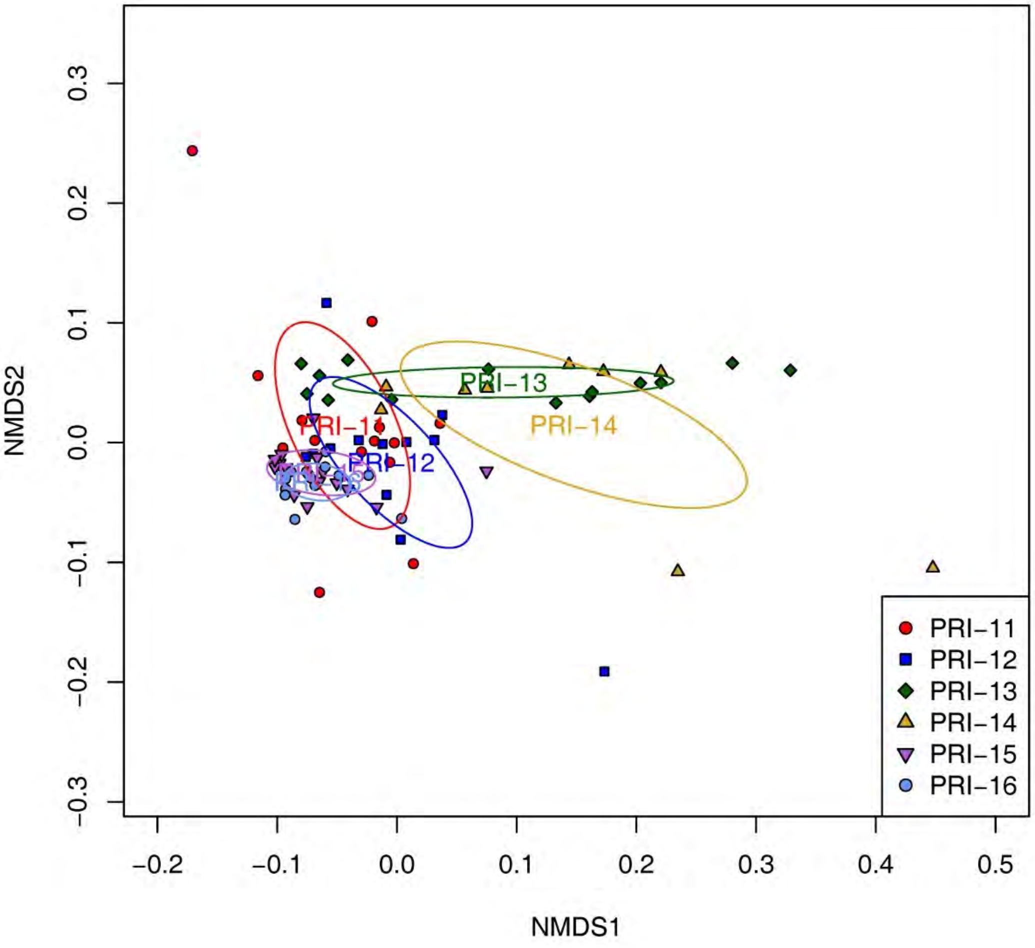


Figure 11-13. NMDS Comparing Metals for Lakebed and Upland Solid Media Designations

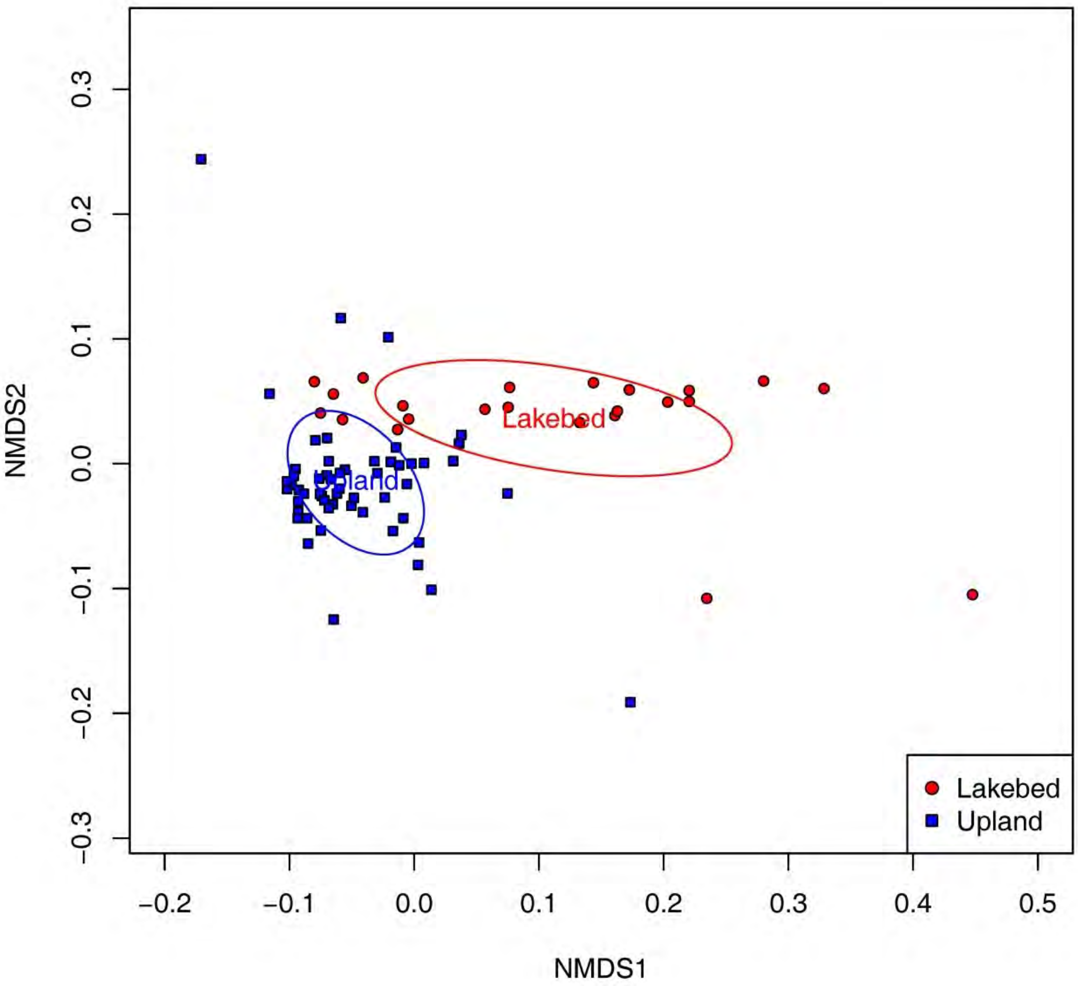
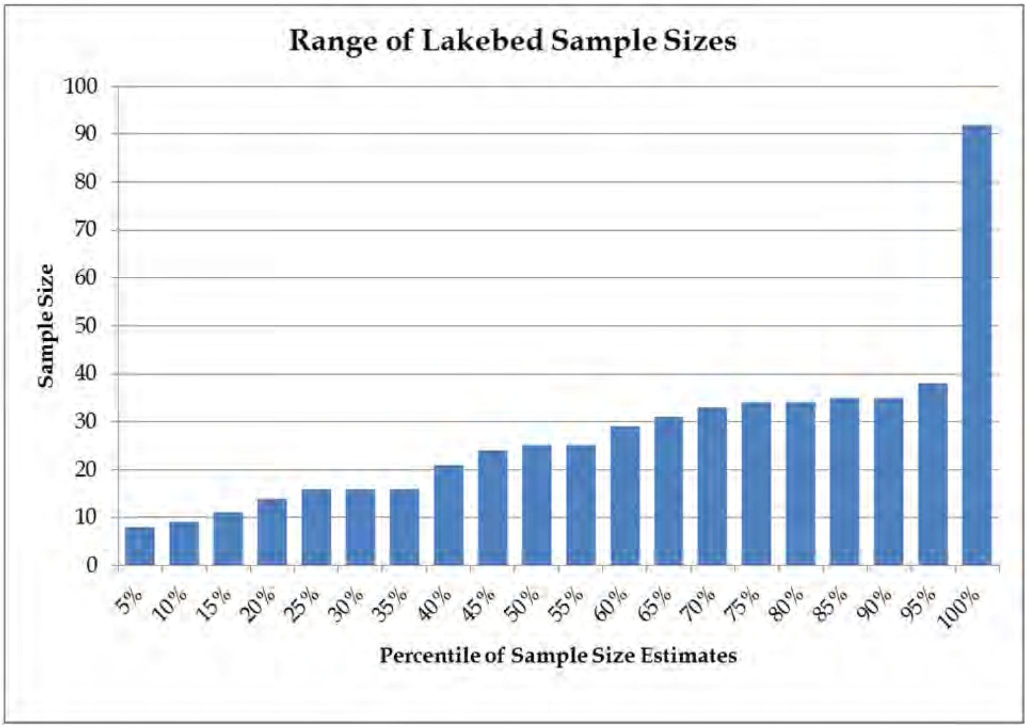


Figure 11-14 Distribution of Calculated Datasets for Lakebed and Upland Solid Media



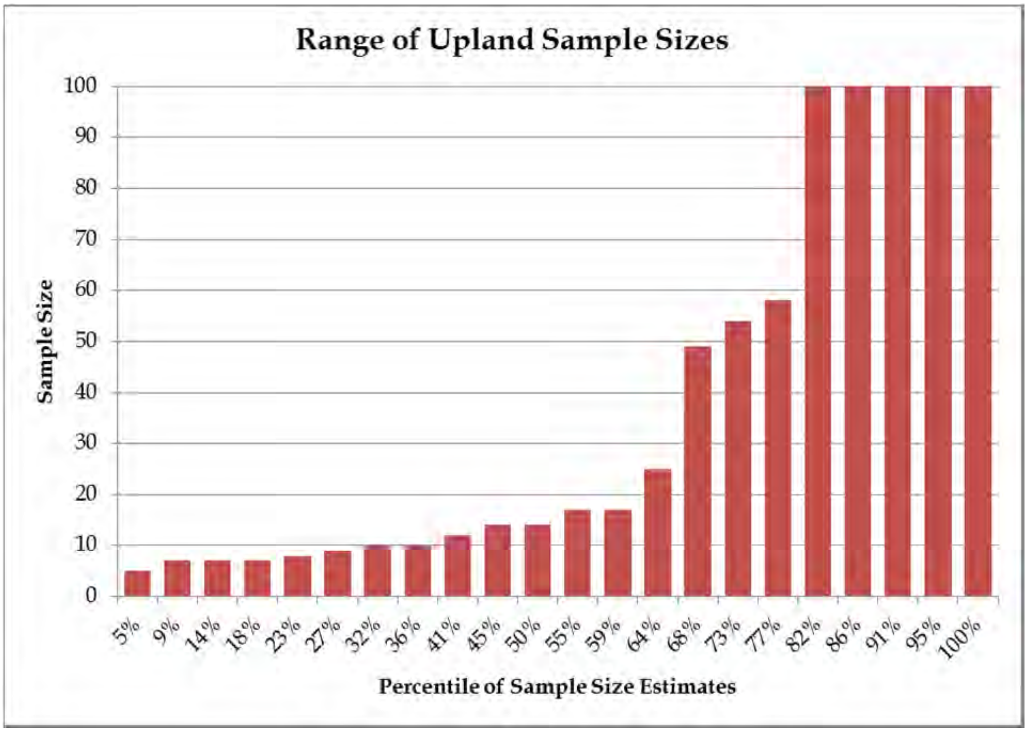
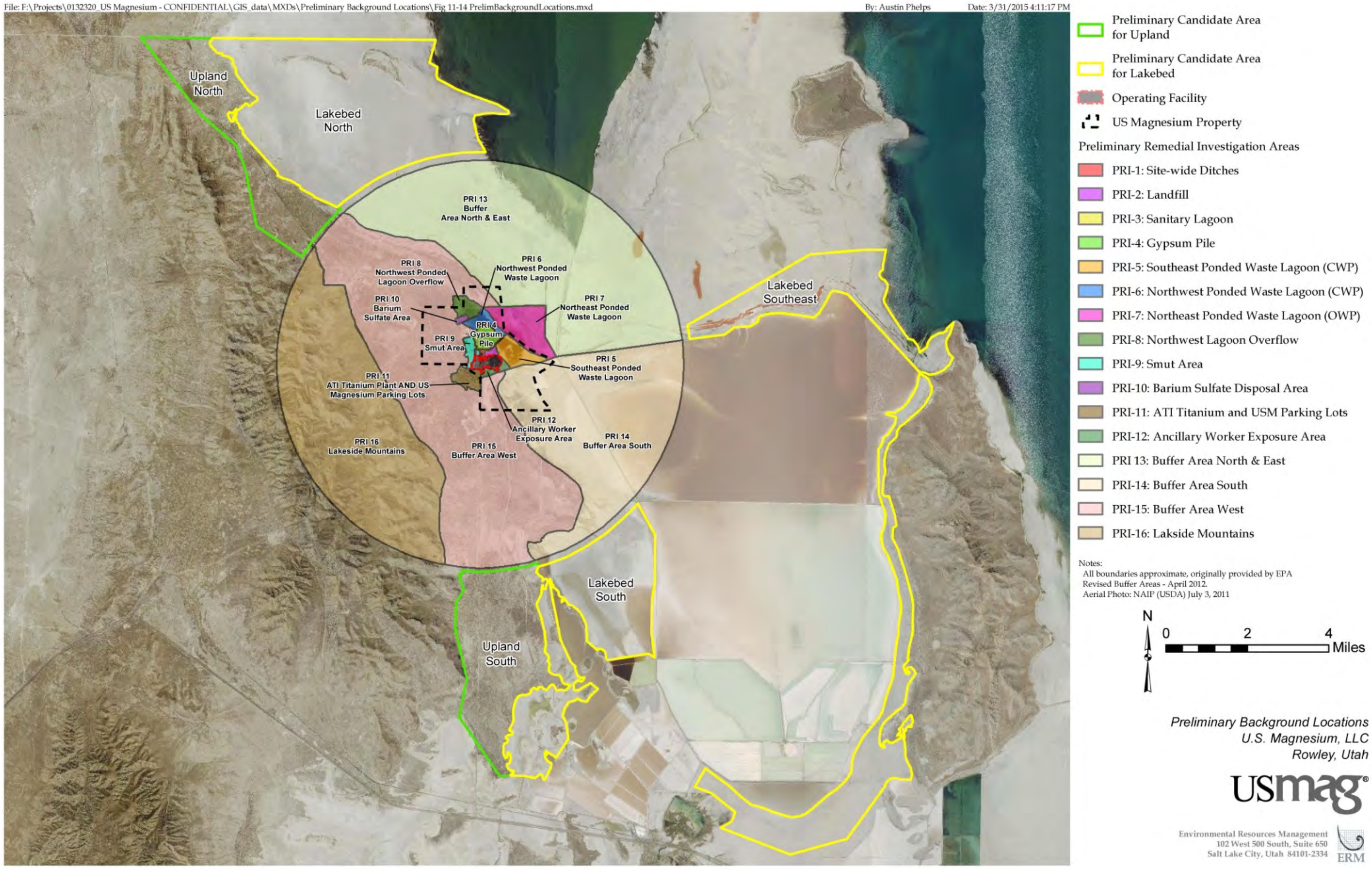


Figure 11-15 Proposed Background Sampling Locations



File: F:\Projects\0132320_US Magnesium - CONFIDENTIAL\GIS_data\MXDs\Preliminary Background Locations\Fig 11-14 PrelimBackgroundLocations.mxd By: Austin Phelps Date: 3/31/2015 4:11:17 PM

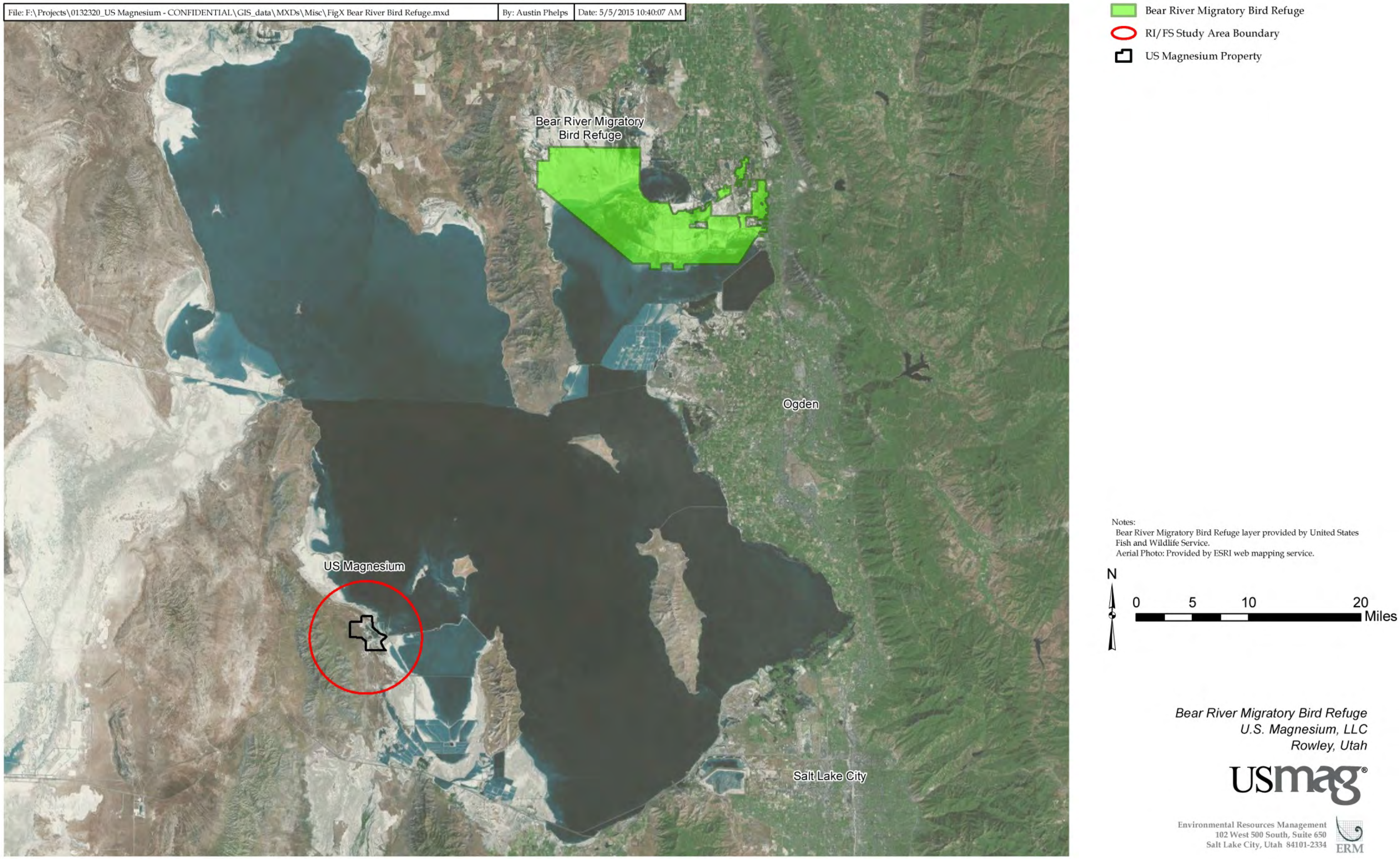
Notes:
All boundaries approximate, originally provided by EPA
Revised Buffer Areas - April 2012.
Aerial Photo: NAIP (USDA) July 3, 2011

Preliminary Background Locations
U.S. Magnesium, LLC
Rowley, Utah

usmag®

Environmental Resources Management
102 West 500 South, Suite 650
Salt Lake City, Utah 84101-2334
ERM

Figure 11-16 Location of Bear River Migratory Bird Refug



Notes:
Bear River Migratory Bird Refuge layer provided by United States Fish and Wildlife Service.
Aerial Photo: Provided by ESRI web mapping service.

Tables

Table 11-1. Geochemical Correlations

Metal/ Inorganic	Potential Aqueous/Soluble Forms in the Environment[a]	Primary Sorptive Association[b]	Other Common Associations[c]	Association Description
Predominantly Anionic Inorganics				
Antimony	Reduced Form - $Sb(OH)_3$ Oxidized Form - $Sb(OH)_6^-$	Fe	Mn, Al, S^{2-}	Sorption to iron, manganese and aluminum oxides and hydroxides, noncrystalline aluminosilicates. Precipitation of sulfide mineral under reducing conditions.
Vanadium	$VO_3(OH)^{2-}$, $VO_2(OH)_2^-$, $VO(OH)_3$, VO^{2+},	Fe	Mn, Al	Complexation with iron and manganese minerals, and formation of oxide minerals. Sorption to soil minerals
Arsenic	Reduced Form - $H_3AsO_3^o$, Oxidized Form - H_2AsO_4, $HAsO_4^{2-}$	Fe	Mn, Al, Ca, and S^{2-}	Sorption to iron and aluminum hydroxides, noncrystalline aluminosilicates, Fe and Ca precipitates. Precipitation of arsenic sulfides (AsS, As_2S_3 , As_4S_4) under reducing conditions.
Selenium	HSe^-, $HSeO_3^-$	Fe	Mn, Al, Ca, and S^{2-}	Sorption to iron and aluminum hydroxides, noncrystalline aluminosilicates, Fe and Ca precipitates. Precipitation of selenium sulfide mineral under reducing conditions.
Predominantly Cationic Inorganics				

Table 11-1. Geochemical Correlations

Barium	Ba^{2+}	Al, SO_4^{2-}	Fe, Ca, Mn, SO_4^{2-}, CO_3^{2-}	Cationic sorption to soil minerals (clays), Precipitation of sparingly soluble sulfate ($BaSO_4$), and carbonate minerals ($BaCO_3$).
Cadmium	Cd^{2+}	Al	Fe, Ca, Mn, CO_3^{2-}, S^{2-}, PO_4^{3-}	Sorption to Fe/Mn/Al hydroxides and carbonate minerals; precipitation of sparingly soluble carbonates ($CdCO_3$), phosphate, and sulfide minerals.
Lead	Pb^{2+}, $PbCO_3$	Al	Fe, Mn, Ca, S^{2-}, SO_4^{2-}, PO_4^{3-}	Sorption to iron hydroxides, organic matter, noncrystalline aluminosilicates, carbonate minerals; formation of sparingly soluble carbonates ($PbCO_3$), phosphates, sulfides (PbS), sulfate ($PbSO_4$) minerals.
Zinc	Zn^{2+}	Al	Fe, Mn, Ca, CO_3^{2-}, S^{2-}	Sorption to Fe/Mn/Al hydroxides, noncrystalline aluminosilicates and carbonate minerals ($ZnCO_3$); formation of sulfide (ZnS) minerals under reducing conditions.
Copper	Cu^{2+}, Cu^{+}, $Cu(OH)^{+}$	Al	Fe, Mn, OM, Ca, CO_3^{2-}, S^{2-}	Sorption to Al/Fe/Mn oxides, noncrystalline aluminosilicates, organic matter and silicate clays; sparingly soluble carbonate, hydroxide, and sulfides (CuS, Cu_2S).
Iron	Fe^{+2}	OH and O	Ca, CO_3^{2-}, S^{2-}	Precipitation as oxidized ferrihydrite minerals ($FeOOH$), iron carbonates, precipitation as reduced iron sulfide (FeS)
Manganese	Mn^{2+}	OH and O	Ca, CO_3^{2-}	Formation of sparingly soluble oxide, hydroxide, and carbonate complexes

Table 11-1. Geochemical Correlations

Mercury	Hg	Al	S^{2-}, Cl, OM	Formation of sparingly soluble sulfides (HgS); sorption to soil minerals and organic matter.
Beryllium	Be^{2+}, $BeOH^{+}$	Al	Fe, Mn	Sorption to negatively charged sites of clays and other soil minerals
Silver	Ag^{+}	Al	Fe, Mn, S^{2-},SO_4^{2-}, CO_3^{2-}, PO_4^{3-}	Forms strong complexes with sulfides (AgS), halides, cyanides, and thiosulfates. Weaker complexes with arsenates, phosphates, sulfates, carbonates, and organic ligands
Thallium	Tl^{3+}, Tl^{+}	Al	Fe, Mn	Thallium oxide formation (Tl_2O_3) and sorption to soil minerals.
Inorganics that May Be Both Predominantly Cationic and Anionic				
Cobalt	Co^{2+} $HCoO^{2-}$	Al, Fe	Mn, CO_3^{2-}, Ca, Ni, OM	Sorption to Al/Mn/Fe hydroxides, organic matter, carbonate minerals ($CoCO_3$).
Nickel	Ni^{2+}, $Ni(OH)_3^{-}$, $Ni(OH)_2$	Fe, Al,	Mn, Co, Mn, S^{2-}	Sorption to Fe/Mn/Al hydroxides and noncrystalline aluminosilicates; precipitation of nickel sulfide. Nickel also has similar properties to cobalt and may be associated with cobalt in areas of weathered basalt or similar rocks.

Table 11-1. Geochemical Correlations

Chromium	Oxidized Forms - CrO_4^{2-}, $HCrO_4^-$ Reduced forms - $CrOH^{2+}$ Cr^{3+}	Fe, Al	Mn	Sorption to Fe/Al/Mn hydroxides, organic matter, noncrystalline aluminosilicates; formation of sparingly soluble hydroxides

Table 11-2. Number of Samples from PRIs 11 - 16 in each Soil Class

PRI	Amtoft-Rock	Dynal	Playas-Saltair	Skumpah	Yenrab	Other
PRI-11	0	0	0	9	5	0
PRI-12	0	9	0	0	3	0
PRI-13	0	0	14	0	0	0
PRI-14	0	3	5	0	0	1
PRI-15	0	1	0	3	5	6
PRI-16	9	0	0	0	0	5

Table 11-3. Number of Samples from PRIs 11 - 16 in each Geologic Type

PRI	Ql	Qs	Other
PRI-11	14	0	0
PRI-12	12	0	0
PRI-13	0	14	0
PRI-14	1	8	0
PRI-15	12	3	0
PRI-16	6	0	8

Table 11-4. Number of Samples that Appear in each Soil-geologic Type Combination

Soil Type	Ql	Qs	Other
Amtoft-Rock	2	0	7
Dynal	10	3	0
Playas-Saltair	0	19	0
Skumpah	11	1	0
Yenrab	13	0	0
Other	9	2	1

Table 11-5. Pair-wise Tests Comparing Individual Metals Concentrations between Upland and Lakebed Areas

Analyte	N	Distribution	Test Method	p-value	Significant[a]
Aluminum	78	Lognormal	WRS	0.171	
Antimony	78	Lognormal	WRS	0.055	
Arsenic	78	NDD	WRS	0.029	
Barium	78	Normal	t-test	0.055	
Beryllium	78	Normal	t-test	0.000	Significant
Calcium	78	Lognormal	WRS	0.059	
Cadmium	78	NDD	WRS	0.113	
Chromium	78	Normal	t-test	0.000	Significant
Cobalt	78	Lognormal	WRS	0.033	
Copper	78	Normal	t-test	0.079	
Iron	78	Normal	t-test	0.000	Significant
Lead	78	Normal	t-test	0.000	Significant
Manganese	78	Lognormal	WRS	0.135	
Mercury	78	NDD	WRS	0.227	
Molybdenum	78	Lognormal	WRS	0.113	
Nickel	78	Lognormal	WRS	0.174	
Selenium	78	NDD	WRS	0.153	
Silver	78	NDD	WRS	0.094	
Thallium	78	NDD	WRS	0.016	
Vanadium	78	Normal	t-test	0.004	
Zinc	78	Normal	t-test	0.093	

Notes

[a] Significance is based on a Bonferroni-corrected p-value of 0.0024

Table 11-6. Summary of Characteristics of each Background Area

Characteristic	Lakebed	Upland
PRIs	13 & 14	11, 12, 15 & 16
Dominant Geology	Qs	Ql & 'Other'
Dominant Soil type	Playa-Saltair	Dynal, Skumpah, Yenrab, & 'Other'
Beryllium, chromium, iron & lead	Lower concentrations	Higher concentrations

Table 11-7. Summary of Calculated Datasets for Lakebed Soil

Metal	Percent not detected	Mean (mg/kg)	Standard Deviation (mg/kg)	CV	Number of outliers	Δ[a] (mg/kg)	Distribution	Sample Size[b] (n)	Rank
Barium	0%	227	84.9	0.37	1	114	Normal	8	1
Cadmium	65%	0	0.0	0.37	0	0.0	Normal	9	2
Lead	0%	9	3.9	0.45	0	4.4	Normal	11	3
Arsenic	0%	9	4.2	0.47	1	4.5	Gamma	14	4
Antimony	17%	0	0.2	0.56	1	0.2	Gamma	16	5
Mercury	65%	0	0.0	0.47	0	0.0	Lognormal	16	6
Selenium	70%	0	0.1	0.51	0	0.1	Normal	16	7
Zinc	0%	31	18.4	0.60	0	15.5	Normal	21	8
Vanadium	0%	13	8.4	0.65	0	6.5	Lognormal	24	9
Copper	0%	6	3.6	0.62	0	2.9	Normal	25	10
Manganese	0%	138	97.9	0.71	0	69.2	Lognormal	29	12
Chromium	0%	7	4.9	0.76	0	3.3	Lognormal	31	13
Beryllium	0%	0	0.2	0.82	0	1.3E-01	Lognormal	33	14
Calcium	0%	209000	161606.0	0.77	1	104500	NP	34	15
Cobalt	0%	2	1.7	0.74	0	1.1	Lognormal	34	16
Aluminum	0%	5415	4299.0	0.79	0	2708	Lognormal	35	17
Iron	0%	5445	4276.0	0.79	0	2723	Lognormal	35	18
Nickel	0%	6	4.6	0.81	0	2.8	Lognormal	38	19
Molybdenum	43%	0	0.5	1.23	1	0.2	Lognormal	92	20
Silver	100%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Thallium	100%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Notes

[a] Grey area (equivalent to the maximum detectable difference) is defined as 50% of the mean

[b] Calculated in VSP using the "Compare Average to Reference Average"

The median potential sample sizes is highlighted in blue

The calculated sample size directly to the right of the median is highlighted in purple

N/A = Not applicable because metal was not detected

Table 11-8. Summary of Calculated Datasets for Upland Solid Media

Metal	Percent not detected	Mean (mg/kg)	Standard Deviation (mg/kg)	CV	Number of outliers	Δ[a] (mg/kg)	Distribution	Sample Size[b] (n)	Rank
Vanadium	0%	17.6	5.1	0.29	1	8.8	Lognormal	5	1
Beryllium	0%	0.44	0.15	0.35	0	0.2	Normal	7	2
Chromium	0%	10.8	3.78	0.35	0	5.4	Normal	7	3
Iron	0%	9605	3270	0.34	0	4803	Normal	7	4
Lead	0%	14.5	5.6	0.39	0	7.3	Normal	8	5
Nickel	0%	8.35	3.37	0.40	1	4.2	Normal	9	6
Aluminum	0%	9397	3454	0.37	0	4699	NP	10	7
Cobalt	0%	3.4	1.4	0.42	1	1.7	Normal	10	8
Barium	0%	186	86.7	0.47	0	92.8	Normal	12	9
Cadmium	4%	0.31	0.14	0.45	0	0.2	NP	14	10
Manganese	0%	297	137	0.46	0	148.6	Lognormal	14	11
Arsenic	0%	5.36	2.81	0.52	2	2.7	NP	17	12
Calcium	0%	91809	48632	0.53	1	45905	Lognormal	17	13
Zinc	0%	49.1	49.4	1.01	1	24.5	NP	49	15
Mercury	22%	0.02	0.02	1.02	4	0.0	NP	54	16
Selenium	49%	0.15	0.15	1.01	0	0.1	Gamma	58	17
Copper	0%	16.5	28.5	1.73	2	8.2	NP	154	18
Silver	78%	0.02	0.04	2.13	1	0.0	NP	199	19
Thallium	80%	0.03	0.06	2.08	0	0.0	NP	446	20
Antimony	45%	0.34	1.15	3.39	4	0.2	NP	599	21
Molybdenum	13%	1.12	3.83	3.40	2	0.6	NP	599	22

Notes

[a] Grey area (equivalent to the maximum detectable difference) is defined as 50% of the mean

[b] Calculated in VSP using the "Compare Average to Reference Average"

The median potential sample sizes is highlighted in blue

The calculated sample size directly to the right of the median is highlighted in purple

Table 11-9. Summary of Calculated Datasets for Organics in Solid Media

Metal	**Percent not detected**	**Mean (mg/kg)**	**Standard Deviation (mg/kg)**	**CV**	**Δ^a (mg/kg)**	**Distribution**	**Sample Size[b] (n)**	**Rank**
D/F TEQs [c]	0%	6.3E-04	4.4E-04	6.9E-01	3.2E-04	Normal	24	1
Total PCBs	0%	862	668.3	0.78	431	Lognormal	34	2
Hexachlorobenzene	0%	21.7	20.98	0.97	10.8	Gamma	51	3

Notes

[a] Grey area (equivalent to the maximum detectable difference) is defined as 50% of the mean

[b] Calculated in VSP using the "Compare Average to Reference Average"

[c] Avian TEQ used as it had higher variability than the mammalian TEQ

D/F TEQ = Dioxin/Furan Toxic Equivalency

The median potential sample size is highlighted in blue

Attachment 9S

21 May 2015 Agenda and Call Notes from 21 May 2015 Risk Assessors Call

From: Jennifer Holder
To: Dan Wall (wall.dan@epa.gov); Wendy O"Brien (obrien.wendy@epa.gov); brattin@srcinc.com; Scott Everett (SEVERETT@utah.gov); mstorck@utah.gov; Chris Cline (Chris_Cline@fws.gov); dcox@blm.gov; Sherry Skipper (sherry_skipper@fws.gov); Mark Jones; Mark Shibata; Karen Cejas
Subject: RE: US Mag Risk Assessor"s Biweekly Call
Date: Tuesday, May 19, 2015 5:19:19 PM

Hi all,

For our risk call on 5/21, I propose the following agenda:

1) BG Field trip logistics and field forms

2) Risk Assessment Schedule for next 12 months – conceptual discussion

3) Other items?

I will be sending out draft BG Field Forms for your review tomorrow (Wednesday) in preparation of the call on Thursday.

-Jen

-----Original Appointment-----
From: Jennifer Holder
Sent: Monday, March 16, 2015 5:48 PM
To: Jennifer Holder; Dan Wall (wall.dan@epa.gov); Wendy O'Brien (obrien.wendy@epa.gov); brattin@srcinc.com; Scott Everett (SEVERETT@utah.gov); mstorck@utah.gov; Chris Cline (Chris_Cline@fws.gov); dcox@blm.gov; Sherry Skipper (sherry_skipper@fws.gov); Mark Jones; Mark Shibata
Subject: US Mag Risk Assessor's Biweekly Call
When: Thursday, May 21, 2015 12:00 PM-1:00 PM (UTC-08:00) Pacific Time (US & Canada).
Where: (866) 668-0721 code: 6124771193

Agenda TBD

Reference Sampling Area Data Sheet		Photo numbers: ______________________________
Ref. Locale & Sampling Area:______________________		Surveyor's name: ____________________________
Area Surveyed (ha) (estimated):____________________		Land owner: _________________________________
Date & Time: ________________	PN:_____________	Project: US Mag Reference Area
Latitude: ______________ Longitude: ______________		Distance from 5 mile radius______________________

Accessibility (describe steps taken to get to sampling area):

Topography (note general and notable features**):**

Hydrology (note the presence of potential drinking water sources such as standing water, likeliness to accumulate standing water, *etc*.):

Habitat (type, notable features, *etc*.)**:** **Photo numbers:**_________________

Level of Disturbance (circle one): undisturbed, minimally disturbed, substantially disturbed

☐ Habitat suitable for nesting snowy plover ☐ Habitat suitable for nesting American avocet

☐ Habitat suitable for nesting horned lark ☐ Habitat suitable for providing food and cover to wildlife

Vegetation (dominant species [overstory, understory, ground cover], *etc*.):**:** **Photo numbers:**_________________

Percent cover (estimated): 100-76% ☐, 75-51% ☐, 50-26% ☐, 25-1% ☐, no cover ☐

Reference Sampling Area Data Sheet (cont.)	Surveyor's name: ____
Ref. Locale & Sampling Area:__________________________________	Date & Time: ____

Invertebrates (direct observations of species, signs of invertebrates [ant hills, molts, burrows], *etc.*):

Photo numbers:_______________________

Birds (direct observations of species, abundance [general], singing/other behaviors, signs, presence of nests, *etc.* Where present, include information specific to American avocet, snowy plover, or horned lark):

Photo numbers:_______________________

Mammals (direct observations of species, abundance [general], signs [scat, burrows], *etc.*):

Photo numbers:_______________________

Reference Sampling Area Data Sheet (cont.)	Surveyor's name: ____
Ref. Locale & Sampling Area: ________________________________	Date & Time: ____

Additional notes (if needed):

PHOTOGRAPHIC LOCATION INFORMATION

Ref. Locale & Sampling Area: ________________________________

Surveyor's name: ____

Date and Time: ____

Photo Number Series: _____________________________________

Photo Location

Latitude: ____

Longitude: ____

Four Cardinal Positions (photos taken rotating clockwise, in sequence (N, S, E, W), from the same orientation, zoom level, and distance from the ground)

Photo Number (North) : _____________________________

Photo Number (South): _____________________________

Photo Number (East): _______________________________

Photo Number (West): ______________________________

Describe and photo document important features, disturbance, species, or evidence of animal activity.

Photo #	Description

Ref. Locale & Sampling Area: ____

From: Jennifer Holder
To: Dan Wall (wall.dan@epa.gov); Wendy O"Brien (obrien.wendy@epa.gov); brattin@srcinc.com; Scott Everett (SEVERETT@utah.gov); mstorck@utah.gov; Chris Cline (Chris_Cline@fws.gov); dcox@blm.gov; Sherry Skipper (sherry_skipper@fws.gov); Mark Jones; Mark Shibata
Cc: Karen Cejas; David Abranovic; Ken Wangerud (wangerud.ken@epa.gov); Justin Burning
Subject: US Mag Risk Assessor"s Biweekly Call 05/21/15 Meeting notes
Date: Monday, June 01, 2015 6:21:45 PM

Hi all,
Below please find the call minutes from 05/21/15 risk assessors call. Sorry for the lateness of the summary, but I was traveling for most of last week and am still trying to catch up. I have also included a proposed agenda for this week's call. Due to travel schedules (ERM/USFWS/UDEQ staff on BG field trip, Jen Holder on travel etc), I thought it was best to focus our discussion this week on clarifying questions on the HHE Survey comments. Mark Jones will lead the discussion.

6/4/15 Draft Agenda

1) HHE Survey Comments – Mark Jones Lead
2) Eco Air Questions (see below in green)? – Karen Cejas Lead (may decide another venue is better for this topic)
3) Other?

==

Call Summary
US Magnesium Superfund Site
Date: 05/21/2015
Hosted by: Jennifer Holder, ERM

Attendees:
Bill Brattin, SRC
Wendy O'Brien, EPA
Doug Cox, BLM
Scott Everett, UDEQ
Michael Storck, UDEQ
Mark Jones, ERM
Mark Shibata, ERM
Karen Cejas, ERM

Summary notes (Action items in RED; Responses to Action Items in Green):

1) BG Field trip logistics and field forms – K. Cejas
    - BG field trip scheduled for June 1-4.
    - The team will spend one day at each of the following: South (Upland S and Lakebed S), North (Upland N and Lakebed N), Southeast (Lakebed SE), and Bear River Refuge.
    - Two sampling areas will be identified within each Upland locale and the Lakebed N locale. Three sampling areas will be identified within the Lakebed S and Lakebed SE locale. One sampling area will be identified in the Bear River Refuge. Sampling areas within a locale will be at least 0.5 mile apart. Field forms will be filled out for each sampling area. Using the observations on the field forms and the photolog, the

number of sampling areas will be narrowed down to 3 for Upland and 3 for Lakebed.

- Group – send comments on field forms to K. Cejas by COB Wednesday. Action Complete
- K. Cejas – send field forms to Dan for comments and set up call during the week of 5/56 – 5/29 to discuss logistics of field trip. Action Complete

2) Risk Assessment Schedule for next 12 months – conceptual discussion- J. Holder

- J. Holder wants to start a discussion about innovative ways to reach the goal of biological sampling in Spring 2016. Per the AOC, the planning documents will be written after the SLERA is complete. However, we need to have the Problem Formulation and ERA tech memos worked through prior to developing a DQO and SAP for biological sampling.
- J. Holder has submitted a memo to US Magnesium that outlines these challenges and proposes options for meeting the Spring 2016 biological sampling milestone for their review and approval.
- J. Holder - will send the memo out to the group after US Magnesium has finished their review and agrees with the proposal. After that the group can discuss the memo on the next call (6/4). Still awaiting US Mag review, will not be able to talk about this on our next call on 6/4.

3) Other items?

- J. Holder asked B. Brattin if ERM can set up a separate call to get clarification on specific Eco-Air RBCs questions.
- B. Brattin would like the questions to be submitted via email and would like D. Wall to be copied on the email. If they are comfortable with the questions, B. Brattin will set up the call.
- K. Cejas – send questions to the group by end of next week. See questions below. When can we schedule a call to discuss? Who wants to be present on the call?

Questions for Eco Air RBC clarification:

- What was the basis for choosing the exposure durations in Tables A 3-3 and B 3-3 in the Appendices of the EPA Air DQO sent to ERM in 2014? Is there a reason the eco exposure durations are different than the human exposure durations presented in Tables A 2-3 and B 2-3?

- In Tables A 3-3 and B 3-3, TRVs are presented for a 6-8 hour repeated exposure. We recognize that this is based on the study exposures from repeated dose toxicity studies in which animals are exposed for a certain amount of time every day (usually 6 hours) for a certain number of days per week (usually 5 days). Where we need clarification is how the study data should be used to represent exposures at the site and how these TRVs will be applied to data from the site.

    - In Appendix B, the systemic effect TRV from the repeated dose study has a Haber's Rule Adjustment of 6/24. This implies that the repeated 6 hour exposure is being adjusted to reflect a 24 hour (i.e. continuous) exposure. Are the results from the repeated dose studies intended to be adjusted to reflect a continuous exposure over multiple days or are they intended to only represent the exposure conditions in the study (i.e. only 6 hours a day)? If the latter, how will the data collected from the monitors at the facility be evaluated against a TRV for 6-8 hours/day over multiple days? Please be as specific as possible, as this has generated much confusion.

- In Appendix A, why wasn’t the TRV from the repeated dose study adjusted for a 24 h exposure?

Attachment 9T

3 June 2015 Re: Draft DQO #3 for Proposed Phase 1A-B SAP Inner PRIs and Background Stud

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8
1595 Wynkoop Street
Denver, Colorado 80202-1129
Phone 800-227-8917
www.epa.gov/region8

Via electronic mail

June 3, 2015

Ref: 8EPR-SR

Mr. David Abranovic, P.E.
Environmental Resources Management
7272 E. Indian School Rd., Suite 100
Scottsdale, AZ 85251

Re: Draft DQO #3 for proposed Ph1A-B SAP for inner-PRIs and background study

Dear Mr. Abranovic:

In December 2014, on behalf of U.S. Magnesium, ERM reviewed with the U.S. Environmental Protection Agency and Utah Department of Environmental Quality a preliminary data quality objectives (DQO) proposal for a Ph1B investigation of inner-PRIs. ERM proposed to undertake the investigation during 2015 in lieu of the EPA-issued (September 2013) SAP.

On February 20, 2015, ERM submitted a preliminary draft DQO for the Phase 1A-B Sampling and Analysis Plan (SAP) to the EPA. A scoping meeting was held with the EPA on March 11 and 12, 2015, to discuss these DQOs. Following this meeting, ERM submitted a second draft DQO for the EPA to review on April 7, 2015. The EPA provided comments to ERM on the second DQO draft on April 28, 2015, which pointed out deficiencies in the document and described changes needed for the DQO to meet the EPA's requirements. ERM replied to the EPA's comments on May 4, 2015, to which EPA responded on May 12, 2015. ERM submitted a third draft DQO on May 19, 2015 – which now contains the preliminary draft DQO (Section 11.3) for background evaluations.

Consequently, the enclosed DQO addresses only Sections 11.1 and 11.2 of ERM's third draft DQO document for inner-PRIs, and establishes the final DQO that is to be incorporated and used for that portion of the Phase 1A-B draft SAP.

As we discussed on Monday June 1, ERM and the EPA will have technical discussions about the preliminary draft Section 11.3 following completion of the field reconnaissance of background investigation sites. ERM may then submit necessary and appropriate amendments to the draft DQO Section 11.3, and the EPA will complete a review and finalize that portion of the DQO for inclusion in the Phase 1A-B SAP.

Pursuant to numbered paragraph 39 of the August 4, 2011 Administrative Order on Consent, between the EPA and U.S. Magnesium, Docket No. CERCLA 08-2011-0013 (AOC), the EPA is acting on ERM's May 18, 2015, Draft Final Data Quality Objectives for OU-1 Phase 1A-B Inner-PRIs RI (Sec. 11.1 and 11.2) for the U.S. Magnesium site by modifying (as shown in the Enclosure) the submission to cure the deficiencies (per subpart 39(c)).

With the DQOs for the Phase 1A-B inner-PRIs SAP now established, ERM can submit a draft Phase 1A-B Inner-PRIs SAP for the EPA's consideration. The Background Study portion of the SAP can follow soon thereafter. Final SAP preparation also requires that ERM completes dredge-sampler testing to finalize a field-SOP for obtaining samples of inundated lagoon sediments.

Time is waning for completion and the EPA's approval of an ERM Phase 1A-B SAP in order to have 2015 investigations underway. In a February 18, 2015 letter from Steven Wharton, Unit Chief, Superfund Remedial Response Program, the EPA wrote:

> *"...the EPA is open to discussing with ERM a range of investigations that ERM may propose for achieving the objectives of the Ph1A SAP, as well as additional objectives including characterization of the preliminary nature and extent of contaminants (i.e., the original RI Phase 1 objective). However, given USM's commitment to initiate investigation of the Inner PRIs in 2015, the EPA will at a minimum expect remedial investigations pursuant to EPA's September 26, 2013, Phase 1A Sampling and Analysis Plan to commence in July 2015. Any SAP preparations that are supplemental to the Ph1A SAP must obtain EPA approval in time for sampling to be completed in 2015."*

The EPA looks forward to receipt of ERM's draft Phase 1A-B SAP so that mobilization for investigations can begin in July of 2015.

Sincerely,

Ken Wangerud
Remedial Project Manager
Superfund Remedial Program

Enclosure:
Final Data Quality Objectives for OU1
Phase 1A-B Inner-PRIs RI (Sections 11.1 and 11.2)

cc: David Gibby, US Magnesium
Michael Storck, UDEQ-DERR

Memorandum

Environmental
Resources
Management

7272 E. Indian School Rd.
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Scottsdale, AZ 85250
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http://www.erm.com

ERM

To: Ken Wangerud, USEPA Region 8

From: David Abranovic (ERM), Kevin Lundmark (ERM)

Date: DRAFT 18 May 2015

Subject: Draft Final Data Quality Objectives for OU-1 Phase 1A-B RI SAP

EPA FINAL EDITS dated June 2, 2015 to Draft DQO Sections. 11.1 and 11.2 for inclusion in Draft Ph1A-B SAP for Inner PRIs

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This memorandum presents the draft final data quality objectives (DQOs) for the Phase 1A-B Remedial Investigation (RI) for Operable Unit 1 (OU-1) at the US Magnesium site. As discussed and agreed on during the OU-1 Phase 1B RI DQOs Scoping Meeting conducted on 11 and 12 March 2015, ERM-West, Inc. (ERM) has developed this revised Phase 1A-B DQO for review by the United States Environmental Protection Agency (USEPA) and the Utah Department of Environmental Quality. These DQOs will become Worksheet 11 in the OU-1 Phase 1A-B Sampling and Analysis Plan (SAP), currently scheduled to be implemented during the 2015 field season. Accordingly, this document has been formatted consistently with Worksheet 11 as it would appear in the Phase 1A-B SAP. The final Phase 1A-B SAP will be approved and issued by the USEPA.

11.0 SAP WORKSHEET #11 – PROJECT QUALITY OBJECTIVES/ SYSTEMATIC PLANNING PROCESS STATEMENTS

Based on the conceptual site model provided in Worksheet #10 of the *Phase 1A Remedial Investigation Sampling and Analysis Plan to Identify Chemicals of Potential Concern in Soils, Sediment, Solid Waste, Water and Air, and Receptor Surveys, Revision 0 for Preliminary Remedial Investigation (PRI) Areas 2 and 8 through 17* (hereafter referred to as "Phase 1A SAP") (USEPA 2013), this worksheet presents DQOs and associated sampling strategies and rationale for the Phase 1A-B RI for OU-1 at the Site.

The DQOs presented herein follow the seven-step process described in the 2006 USEPA *Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G-4*.

11.1 OBJECTIVES OF THE PHASE 1A-B RI FOR OU-1

The objective of Phase 1A-B RI for OU-1 is to obtain sufficient data to support:

1. Reliable identification of chemicals of potential concern (COPCs) for human and ecological receptors within PRI Areas 1 and 3 through 7.
2. Initial risk calculations to ~~E~~evaluate whether sufficient data have been collected within PRI Areas 1 and 3 through 7 to support ~~reliable risk management decision-making~~confident risk characterization.
3. Preliminary evaluation of the nature and extent (N&E) of site-related contamination within PRI Areas 1 and 3 through 7.
4. Estimation of background (ambient) concentrations for metals and organics including, dioxins/furans (D/F), total PCBs and WHO congeners, and HCB~~, dioxins/furans (D/F)~~.
5. ~~Confirm that~~Identification of suitable reference areas (i.e., non-impacted areas) ~~are available~~ for biota sampling that may be conducted during ~~a future phase of the RI~~2016 Phase 2 RI activities.

Broadly, these objectives are combined into two principal DQOs of "COPC Selection and Preliminary N&E at Inner PRI Areas," and "Evaluation of Background." The remainder of this worksheet presents the seven-step DQO process for the two principal DQOs.

11.2 DATA QUALITY OBJECTIVES FOR COPC SELECTION AND PRELIMINARY NATURE AND EXTENT AT INNER PRI AREAS

11.2.1 Step 1: State the Problem

11.2.1.1 Description of the Problem

The RI/Feasibility Study (FS) Area Boundary has been preliminarily defined by the USEPA as a 5-mile radius around the US Magnesium facility. For purposes of project planning during the initial phases of the RI, the USEPA initially divided the site into 18 Preliminary Remedial Investigation Areas (or "PRIs"), with the "Inner PRIs" defined as PRIs 1 and 3 through 7, the "Outer PRIs" defined as PRIs 2 and 8 through 17, and PRI 18 being ambient air. The Site was subsequently divided into Operable Units by the USEPA, with OU-1 including PRIs 1 through 17 and OU-2 being defined as PRI 18.

Phase 1A of the OU-1 RI provided the information necessary to select human and ecological COPCs for the Outer PRIs. For the Inner PRIs, historical (i.e., collected prior to the Phase 1A Demonstration of Method Applicability [DMA]) and Phase 1A DMA data are available (ERM 2104a); however, the USEPA determined that historical and DMA data alone are not adequate for COPC selection[1]. The USEPA indicated that while historical data obtained at the Site in earlier investigations do provide insight into the chemicals likely to be of primary concern in soil/sediment and solid wastes (solid media or "solids") at the Site, these data may not accurately ~~represent~~ reflect current, near-surface Site conditions. In addition, the USEPA has identified that not all solids have been well-characterized previously, and the historical data are often restricted to a subset of analytes when compared to the list of target analytes identified by USEPA for the Site. Consequently, new data are needed to support selection of human and ecological COPCs for Inner PRI media.

Additionally, the N&E of impacts have not been characterized in the Inner PRIs. This is due in part to the fact that the historical data for the Inner PRIs in most cases did not include analyses for all current target analytes and there were either an insufficient number of samples collected or the sampling locations were not based on a suitable sample design (e.g., locations were not based on an unbiased approach and only targeted selected portions of the Site). The USEPA has also identified that "vertical profile waste stratification and contaminant data are needed at key release locations and within areas where wastes have been discharged continually" (USEPA 2013). Based on Site operations, the Site history, a review of aerial photographs, and information from previous sampling events, the following key waste release locations are identified for the Inner PRIs:

- Wastewater Ditches (PRI 1);
- The south-central portion of the Gypsum Pile (PRI 4) where the pile is tallest;

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[1] While the USEPA has determined that the historic data (alone) are not adequate for COPC selection, the USEPA has stated that, if historic data are found to be statistically similar to data collected in Phase 1A-B, it may be appropriate to combine the data to increase sample size and decrease uncertainty. If so, then the historic data may be included in the dataset used for COPC selection and risk assessment.

- The Southeast Ponded Waste Lagoon (PRI 5) near the outlet of the Main Ditch;
- The historical inlet to the northeast ponded Waste Lagoon (PRI 7); and
- The former wastewater diversion ditch traversing the Southeast Ponded Waste lagoon (PRI 5).

These key waste release locations are shown in Figure 11-1.

Finally it is recognized that Phase 1A-B data will also be used to support the baseline human health and ecological risk assessments. It will be important to evaluate whether the data collected at the end of Phase 1A-B are sufficient to support ~~reliable risk management decision-making~~confident risk characterization or if additional ~~abiotic~~ data collection is necessary in Phase 2.

11.2.1.2 Conceptual Model

Initial Site-wide conceptual site models for the current and future use at the Site are presented in Worksheet 10 of the Phase 1A SAP.

11.2.2 Step 2: Identify Goals of the Study

The goals of the study are:

1. To obtain sufficient data for solid media in the Inner PRIs to reliably select human and ecological COPCs that require further quantitative evaluation in the risk assessment process;
2. To evaluate whether sufficient data have been collected at the Inner PRIs to support ~~reliable risk management decision-making~~confident risk characterization;~~,~~ and
3. To perform initial site characterization of the N&E of contaminants distributed within the Inner PRIs to support initial contaminant mapping and to guide subsequent site characterization sampling designs.

11.2.3 Step 3: Identify Information Inputs

11.2.3.1 Information Inputs

The information needed to support COPC selection is an adequate and reliable dataset to characterize the range of concentration values that occur in solid media within the Inner PRIs. Additionally, the sample design described in Steps 6 and 7 for COPC selection will provide data concerning contamination in media at the Site. This can be used to assess whether data are sufficient for the baseline risk assessments as well as planning for Phase 2 investigations, as needed.

The information needed to support preliminary N&E characterization includes chemical concentration data from surface samples distributed throughout each Inner PRI and subsurface samples at key waste release locations, as well as waste thickness profiles. The sample design described in Steps 6 and 7 for COPC selection will provide ~~a sufficient~~ data ~~set~~ for preliminary N&E characterization. The preliminary N&E characterization will be used for planning additional site characterization data collection for Phase 2, as needed.

11.2.3.2 Sampling and Analytical Methods

Sampling and analytical methods are described in Step 7, Section 11.2.7.

11.2.4 Step 4: Define the Boundaries of the Study

11.2.4.1 Spatial Boundaries

For this study, the lateral spatial boundaries are prescribed by the boundaries of the Inner PRIs. The vertical boundaries for the study are defined based on the sampling method. Sampling will be performed to a depth of 6 inches below ground surface (bgs) at all surface sampling locations, consistent with the Phase 1A SAP. Subsurface sampling will be performed using 2-foot maximum sample intervals from 6 inches bgs to 2 feet below the waste/native soil interface.

At sampling locations outside of the inundated areas (e.g., ~~of~~ PRIs 5, ~~and~~ 6, and 7 as appropriate) where subsurface sampling is not performed, hand-auger borings to delineate waste thickness will extend to the waste/native soil interface or to a maximum depth of 5 feet bgs. The 5-foot maximum depth is due to practical constraints on hand-augering to greater depths under Site conditions.

11.2.4.2 Temporal Boundaries

Constituent concentrations within solid media at the Site are not expected to fluctuate substantially over the timescale of a year (provided that significant process changes have not been implemented at the facility during that time), so the time of year when sampling occurs is not likely to be important (USEPA 2013) to the temporal representation of the data.

It is recognized that site-specific conditions and practical constraints may occur that affect t~~T~~he timing of sampling, ~~may affect~~ access to sampling areas, and health and safety of field personnel. Sampling should be avoided during spring due to high water conditions in wastewater ponds, or in peak summer months when excessive heat could adversely affect the health and safety of field personnel. Because sampling within inundated areas ~~of PRIs 5 and 6~~ will be performed using a helicopter, weather conditions may~~will~~ also limit or affect the performance of sampling in these areas (e.g., no sampling during high winds and helicopter flight is more challenging due to poor lift during hot weather). Because such conditions may hinder sample collection, the field sampling SOPs will describe the suitable times and conditions during which such sampling will need to be conducted to ensure that a complete sample set is obtained.

11.2.5 Step 5: Develop the Analytic Approach

11.2.5.1 COPC Selection

Several factors may be considered in selecting COPCs, the first step is to compare the maximum detected concentration in a dataset (Cmax) to an appropriate risk-based concentration (RBC). If the value of Cmax for an analyte in a medium at a PRI does not exceed the RBC, that analyte may be generally excluded as a COPC in that medium at that PRI. Otherwise, if the value of Cmax exceeds the RBC, the analyte is retained as a COPC in that medium in that PRI. The methods and RBCs to be used for selection of COPCs for OU-1 are described in the *Final Screening Level Risk Assessment Technical Memorandum* (ERM 2014b). Because human and ecological exposure areas have not yet been established at the Site, COPC selection for solid media at the conclusion of Phase 1A-B will occur on a PRI-by-PRI basis.

11.2.5.2 ~~Reliable Risk Management Decision Making~~Confident Risk Characterization

To evaluate whether sufficient data have been collected to support ~~reliable risk management decisions~~confident risk characterization, initial risk calculations will be performed using all usable Phase 1A-B data following the methods described in risk assessment memoranda as specified in the AOC. Initial risk calculations will be limited to the COPCs identified in the OU-1 *Screening Level Risk Assessment Report* (SLRA). The initial risk calculations will be included in the OU-1 SLRA.

11.2.5.3 Preliminary Nature and Extent

The Phase 1A-B RI Data Report will include maps showing chemical constituent concentrations for the ~~expected~~ primary risk drivers ~~(D/F TEQs, HCB, total PCBs)~~ in each Inner PRI[2]. Chemical mapping will include data from the Phase 1A-B RI and the historical/DMA data described in the Final Inner PRI Data Report (ERM 2014a). If concentrations of a constituent in surface samples are similar across a PRI and below applicable risk thresholds, then additional N&E data ~~would~~ may not be required for that constituent. However, additional N&E information may be subsequently needed to delineate specific areas to support risk assessment or remedy decision to more clearly delineate the spatial distribution of contaminants for site characterization or for FS evaluations. If constituent concentrations are highly variable across a PRI, and/or additional delineation is necessary to support remedy selection, then additional sampling to characterize and delineate N&E may be performed during the Phase 2 RI.

To supplement the sample point chemical concentration maps, geostatistical modeling (e.g., kriging) will also be conducted for HCB, total PCBs, and mammal TEQs for each Inner PRI, where the data permit. Geostatistics will provide a spatial depiction of the data that can be used to predict concentrations of HCB, total PCBs, and mammal TEQs in soil throughout a particular PRI. More importantly, geostatistics can provide a spatial description of the level of uncertainty associated with unsampled locations, which will aid in understanding the spatial variability in HCB, total PCBs, and mammal TEQs. This will provide a fuller view of the extent of impacts and help determine areas requiring additional sampling for site-characterization evaluation and remedy-scoping considerations. A description of the geostatistical method(s) used, results, and interpretation of the results will be included in the Phase 1A-B Data Report. The Data Report will also provide results and interpretation of statistical evaluations (e.g., scatter plots, outlier tests, Q-Q plots) to analyze N&E of expected risk drivers.

The need for additional sampling to delineate N&E at the Site will be determined for OU-1 during the Phase 2 RI scoping process. Site-characterization DQOs for the Phase 2 RI may be identified based on waste types, PRI Area or other boundaries, and/or remedy-scoping considerations (e.g, decision units). Chemical concentration maps, geostatistical modeling output, and statistical evaluations provided in the Phase 1A-B Data Report

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[2] Additional chemical constituent maps for Phase 2 RI scoping will be prepared for Outer PRIs and for other Inner PRI risk drivers based on the results of the OU-1 SLRA.

will be used to support the Phase 2 RI scoping process and associated DQO development.

If field screening identifies that waste is present at depths greater than 6 inches bgs, then additional sampling will be required to delineate the vertical extent of waste, to measure COPC concentrations in the subsurface to depths relevant to human or ecological exposure, or to support FS evaluations. Subsurface sampling will be performed during Phase 1A-B at key waste deposition locations. If subsurface concentrations are substantially higher than those in surficial samples, additional subsurface sampling may be necessary to adequately delineate the vertical extent of constituents of concern. The maximum subsurface sampling interval will be 2 feet. Subsurface sampling intervals will be adjusted in the field for the following reasons:

- Native material will be segregated from waste material for the final sample interval to allow for the evaluation of potential impacts from wastes in native soil.
- If anomalous or discrete layers of waste or sediments are observed in a boring, the sample interval will be adjusted (reduced) to target the anomalous/discrete layers; however, due to sample volume requirements, no sample interval will be less than 6 inches. Anomalous layers will be identified by the USEPA, USEPA contractor, or USMag/ERM field personnel based on color, texture, field screening, and comparison with other wastes/sediments within a boring.

11.2.6 Step 6: Specify Performance or Acceptance Criteria

11.2.6.1 COPC Selection

The performance acceptance criteria for COPC selection were established by the USEPA in the Phase 1A SAP. To minimize the probability that a chemical in the soil, sediment, or solid waste of a PRI area will be excluded as a COPC when it should be retained for further evaluation, it is necessary to be confident that the observed Cmax will have a high probability of exceeding the RBC when the chemical is truly of potential concern. This, in turn, is related to the total number of samples collected, and to the methods that will be used to evaluate risk from chemicals that are retained. In accord with discussions at the March 2015 scoping meetings, the minimum sample size for each PRI shall be 14.

The statistical basis for a minimum sample size of 14 for COPC selection was developed by the USEPA in the Phase 1A SAP. The COPC selection process is founded on the concept that, given a dataset of adequate size, the maximum concentration value in that dataset will have a high probability (greater than or equal to 95 percent) of exceeding the true mean concentration across the exposure area. If the observed maximum concentration does not exceed the RBC, there is confidence that the true mean will not exceed the RBC, and hence the chemical will not contribute significant risk and may be not improperly excluded as a COPC.

However, if the dataset is not large enough, the observed Cmax value may not exceed the true mean across the exposure area. This is demonstrated as follows:

Let P equal the percentile of the distribution occupied by the mean. Then, if a single sample is drawn, the probability that the sample is lower than the mean is equal to P. If N samples are drawn, the probability that ALL the samples are below the mean is P^N. Thus, the probability that one or more samples exceed the mean is given by:

$$\text{prob}(\text{Cmax} > \text{mean}) = 1 - P^N$$

The number of samples (N) needed to ensure that the probability is at least 95% that one or more samples exceed the true mean is shown below for a range of distributions in which the true mean occurs at a percentile ranging from the 50th to 90th:

Percentile of the True Mean	N	Probability that Cmax > True Mean
50th	5	96.9%
60th	6	95.3%
70th	9	96.0%
80th	14	95.6%
90th	29	95.3%

For a dataset with a normal distribution, the mean occupies the 50th percentile (P = 0.5), and a dataset of five samples would likely be sufficient to support COPC selection. However, most environmental datasets for soil, sediment, or solid waste are right-skewed, and this results in the mean occupying a percentile higher than 0.5. Depending on the degree of skew, the mean usually falls between the 60th and 90th percentile (or even higher in extreme cases).

Consistent with the Phase 1A investigation, it is assumed for planning the Phase 1A-B investigation of solid media in Inner PRIs that the mean will generally not be higher than the 80th percentile. This assumption is supported by historic and DMA data available for the Inner PRIs, which indicate that, for the expected risk drivers (D/F TEQs, HCB, total PCBs), the sample mean usually occurs in the range of the 60th to 80th percentile, as shown below:

PRI Area	Percentile of the Mean			
	D/F TEQ (avian)	D/F TEQ (mammalian)	HCB	Total PCBs
PRI-1	59%	47%	64%	65%
PRI-4	68%	82%	68%	79%
PRI-5	72%	76%	76%	74%
PRI-6	77%	69%	77%	60%
PRI-7	79%	83%	79%	75%

Based on this, it is considered likely that a dataset of 14 samples is likely to suffice for most analytes. However, if the data from the Phase 1A-B investigation suggest that the distribution of some analytes is more strongly skewed than assumed (i.e., the sample mean is substantially higher than the 80th percentile of the dataset), it may be necessary to collect additional samples ~~in subsequent phases of the site investigation~~ to ensure analytes are not improperly excluded as COPCs.

11.2.6.2 ~~Reliable Risk Management Decision Making~~Confident Risk Characterization

The performance acceptance criteria for the evaluation of whether sufficient abiotic data have been collected will be dependent on the risk assessment methodologies developed in the technical memoranda specified in the AOC. It is recognized that the evaluations described below may be modified once the risk assessment methodologies are finalized.

All risk calculations for humans and mobile ecological receptors (birds, mammals) will be in accord with standard USEPA guidance, and will be based on the 95% upper confidence limit (95UCL) of the mean concentration in the exposure area of concern. The 95UCL will be derived on a PRI-basis for COPCs identified in the OU-1 SLRA using the most recent version of USEPA's ProUCL software application. Use of the 95UCL minimizes the probability of a false negative decision error (deciding risk is ~~acceptable~~ below a level of concern when it actually is ~~unacceptable~~above a level of concern). However, use of the 95UCL tends to increase the probability of false positive decision errors (declaring that risk is above a level of concern ~~unacceptable~~ when it actually is below a level of concern~~within acceptable limits~~). If initial risk estimates based on the 95UCL are below a level of concern, or if risks are above a level of concern based on the sample mean, then it is likely that additional data will not be needed for risk management decision making. In cases where risk is below a level of concern based on the sample mean but above a level of concern based on the 95UCL, then additional data may be useful to support ~~decision-making~~confident risk characterization. In this event, additional sampling needs will be planned and executed during Phase 2.

For sessile or small home range ecological receptors, an assessment of the magnitude and frequency of Hazard Quotient values that exceed 1.0, with calculations performed on a sample-by-sample basis may be performed. In cases where the distribution of HQ values provides a clear prediction of population-level hazard, additional abiotic data to support the HQ approach are unlikely to be necessary. However, in cases where the data are not sufficient to allow a clear assessment of HQ-based population-level hazard, additional abiotic data may be needed. In this event, the necessary abiotic sampling will be planned and performed in Phase 2, along with any biotic-based studies that may be needed.

11.2.6.3 Preliminary Nature and Extent

The need for additional sampling to delineate N&E at the Site will be determined for OU-1 during the Phase 2 RI scoping process. Site-characterization DQOs for the Phase 2 RI may be identified based on waste types and expected thickness, PRI boundaries or other ~~areal extents~~important spatial boundaries (e.g., geologic, hydrologic, waste, etc.) and/or remedy-scoping considerations (e.g., decision units). Chemical concentration maps, geostatistical modeling output, and statistical evaluations provided in the Phase 1A-B Data Report will be used to support the Phase 2 RI scoping process and associated DQO development.

The validated and verified Phase 1A-B data will be combined with historical/DMA data and used to prepare chemical concentration maps and perform geostatistical modeling and statistical evaluations as described in Section 11.2.5.3. The degree to which the combined datasets delineate the N&E of site-related contamination within the Inner PRIs will be described by the variability of concentrations, relationship of results to risk thresholds, the spatial distribution of chemical concentrations, and level of uncertainty for unsampled locations as predicted by geostatistical modeling. The mapping, geostatistical modeling, and statistical evaluations provided for D/F TEQs, HCB, and total PCBs in the Phase 1A-B Data Report will support scoping of Phase 2 investigations for the collection of additional data to complete site-characterization and support remedy-scoping and FS evaluations.

11.2.7 Step 7: Develop the Plan for Obtaining the Data

The data collection approach described below supports both COPC selection and preliminary N&E study goals. The data obtained during Phase 1A-B to support COPC selection and preliminary N&E will also be used to perform initial risk calculations to evaluate whether sufficient data have been collected to support confident risk characterization and adequate characterization of the N&E of areas that exceed a level of concern~~reliable risk management decisions~~.

11.2.7.1 Surface Solids Sampling

In accord with the performance criteria for COPC selection described in Step 6, the basic plan for surface solids sampling is to collect surface solids samples from at least 14 unbiased locations with the addition of biased/judgmental samples at selected locations. Surface solids samples will be collected from 0 to 6 inches bgs. Surface solids sampling outside of the inundated areas (e.g., PRIs 5, 6, and 7 as appropriate)~~of PRIs 5 and 6~~ will be performed using a hand auger as detailed in Standard Operating Procedure (SOP) *USM-01: Surface Soil, Sediment, and Waste Sampling*. Within the inundated areas (e.g., PRIs 5, 6, and 7 as appropriate)~~of PRIs 5 and 6~~, surface solids samples will be collected using a helicopter-deployed sampler as detailed in SOP *USM-12: Surface Solids Sampling within Current Wastewater Ponds*. When sampling within inundated areas (e.g., PRIs 5, 6, and 7 as appropriate)~~of PRIs 5 and 6~~, all reasonable efforts will be made to ensure that samples are obtained from the target locations. SOP USM-12 includes criteria for evaluating when a sample is acceptable and procedures for adjusting sampling locations based on field conditions.

The presence/absence of visible waste will be noted on sampling forms at all sample locations, as described in SOP USM-01. When waste is visible, the depth of waste will be measured. Waste may include gypsum, smut, salts, or sludge that have a different appearance than the native soils present within the Inner PRIs (e.g., oolitic sands, lacustrine clays, evaporate minerals). If waste is present at the bottom of a surface sample location (6 inches bgs) outside of the inundated areas (e.g., PRIs 5, 6, and 7 as appropriate)~~of PRIs 5 and 6~~, then the hand-auger boring will be advanced to either the waste/native soil interface or a maximum depth of 5 feet bgs. The maximum depth of 5 feet bgs is based on the impracticality of advancing a hand auger to depths below 5 feet under Site conditions (e.g., standing water, shallow depth to groundwater, unconsolidated wastes, etc.) and health and safety considerations. Field screening for waste thickness at locations within the inundated areas (e.g., PRIs 5, 6, and 7 as appropriate) ~~of PRIs 5 and 6~~ will be to depth of penetration of the helicopter-deployed sampler.

11.2.7.2 Subsurface Solids Sampling

The role of subsurface solids sampling for COPC selection was described in the Phase 1A SAP. At most environmental sites, site-related contaminants tend to be highest in surficial soils or sediments, with decreasing concentrations as a function of depth. However, at this Site, it is considered plausible that, in at least some PRIs, concentrations of contaminants might be higher in subsurface materials than at the current surface. This condition might occur under several alternative scenarios, as follows:

- The types of chemicals released in the past might have been different than at present due to changes in plant operation conditions.
- The level (concentration, mass loading) of contaminants released to the environment may have been higher in the past than at present, especially if plant operations were changed with the goal of reducing levels of pollutant release.
- Historical wastes may have been moved or buried under less contaminated or clean materials.
- Chemical fate and transport processes might act on surficial materials differently than on deep materials, potentially resulting in higher concentrations in samples collected at depth.

Because it is not known whether any of the scenarios may actually have resulted in meaningful differences between surface and subsurface samples, it is necessary to obtain some limited data to recognize if this situation may exist. This is important for COPC selection because a Type I decision error (exclusion of an analyte as a COPC that should have been retained) could occur if surface levels of an analyte are below the RBC but concentrations at depth exceed the RBC. The Phase 1A-B investigation therefore includes a limited number of borings to evaluate potential differences between surface and subsurface samples. These samples will also help inform the preliminary vertical N&E of chemical impacts.

In identifying COPCs for a PRI area where samples at depth have been collected, the value of Cmax will be the highest of any value in the dataset for the PRI area, including both surface and subsurface samples. If ~~the data from depth samples are similar to or lower than in surficial samples, the COPCs identified for surficial samples will also be appropriate for any subsurface exposure scenarios that may require assessment. However, if~~ subsurface concentrations are substantially higher than those in surficial samples, some analytes may be identified as COPCs in subsurface materials that may not be of concern in surficial samples. ~~If this condition does arise, b~~Because only a small number of boring samples are to be collected, additional subsurface sampling ~~may~~ will be necessary in subsequent field programs to adequately characterize the vertical extent of ~~those~~ COPCs.

Subsurface solid sampling will be performed as detailed in SOP *USM-09: Subsurface Soil, Sediment, and Waste Sampling*. Subsurface borings with sampling using 2-foot maximum intervals for chemical analysis will be performed to evaluate chemical concentrations at depth and for characterizing vertical N&E within key waste release locations (Figure 11-1) and other locations identified by the USEPA. Surface samples (0 to 6 inches bgs) will also be collected at each subsurface sampling location; therefore, the typical/default subsurface sample intervals will be 6 inches to 2 feet bgs, 2 feet to 4 feet bgs, and so on with the final sample interval extending to 2 feet below the waste/native soil interface. Native material will be segregated from waste material for the final sample interval to allow for the evaluation of potential impacts from wastes in native soil. If anomalous layers of waste or sediments are observed in a boring, the sample interval will be adjusted (reduced) to target the anomalous layers; however, due to sample volume requirements, no sample interval will be less than 6 inches. Anomalous waste/sediment layers will be identified by the USEPA, USEPA contractor, or USMag/ERM field personnel ~~ERM and USEPA/USEPA contractor oversight personnel~~ based on color, texture, field screening, and comparison with other wastes/sediments within a boring.

11.2.7.3 Sampling Locations

The number and approximate locations of surface and subsurface solids samples identified in this SAP were discussed and agreed to by ERM/US Magnesium and the USEPA during the March 2015 OU-1 Phase 1B RI DQOs Scoping Meeting (ERM 2015a). Surface solids sampling locations were preferentially chosen using a systematic (grid) sampling design to ensure that the PRI is fully and uniformly represented by the set of samples collected. In addition, judgmental samples are placed at known features at PRIs 1, 5, and 7 to support COPC selection and preliminary characterizations of N&E. The systematic grids of sample locations at PRIs 3, 4, 5, and 7 include locations near areas of waste deposition or found to contain the highest concentrations of hexachlorobenzene (HCB), dioxin/furan toxic equivalency quotients (TEQs), and polychlorinated biphenyls (PCBs) based on historical Site data. Subsurface borings for COPC selection and vertical N&E are located within key waste deposition areas PRIs 1, 4, 5, and 7 (see Figure 11-1) and at locations in PRIs 3 and 6 as requested by the USEPA during the March 2015 Scoping Meeting.

Most sample locations include surface sampling only; however, field screening for waste thickness will be performed at all sample locations. If field screening for waste indicates that waste material is present at depths greater than 6 inches bgs within all or a portion of a PRI, then subsequent sampling to delineate vertical N&E would be considered during subsequent RI Phase 2. Waste thickness at subsurface sampling locations will be determined by extending the boring to below the waste/native soil interface.

Sample locations for each PRI are described in the subsections that follow. Sample locations for PRIs 3 through 7 were developed using VSP (vsp.pnnl.gov). To ensure the assumption of random sampling is met, a systematic sample grid layout was employed that utilized a randomized initial sample that serves as the origin on which the systematic grid is constructed.

US ~~m~~Magnesium ~~is planning construction~~may construct ~~of~~ a wastewater filtration system located upon ~~that will require that~~ PRIs 1 and 3 areas. ~~be removed from the OU-1 Phase 1A-B RI.~~ The USEPA has instructed US ~~m~~Magnesium that if a RCRA settlement is reached prior to implementation of this phase of the RI, the Phase 1A-B samples that are located in areas ~~to be~~ included ~~in the~~within a RCRA settlement area will be ~~deleted~~ revised in an appropriate Record of Modification to ~~from~~ the Phase 1A-B RI SAP.

PRI 1

Surface solids sampling will be performed at 14 locations in PRI 1 as shown in Figure 11-2. Twelve locations are within active wastewater ditches, one location (1-13) is within an inactive reach of the Main Ditch, and one location (1-14) is within the alignment of the former Boron Ditch. Because the wastewater ditches are linear features, all sample locations in PRI 1 were judgmentally selected instead of using a systematic grid. For the 13 sample locations not within the former Boron Ditch, locations were divided between the active wastewater ditches based on the relative approximate length of each ditch: three samples at the Western Ditch (2,000-foot length), two samples at the Central Ditch (1,300-foot length); two samples at the Chlorine Ditch (1,350-foot length), and six samples at the Main Ditch (4,200-foot length, including historical ditch alignment to the outlet at PRI 7). The distribution of samples between ditches results in one sample per approximately 700 feet. Samples were distributed along the wastewater ditches taking into account accessibility by placing samples at each of three bridges crossing the active wastewater ditches. The rationale for each Phase 1B sample at PRI 1 is provided below.

ID	Rationale
1-01	Near head of Western Ditch (surface)
1-02	Approximate midpoint of north-south segment of Western Ditch (surface)
1-03	West of bridge at confluence of Western and Main ditches (surface and subsurface)
1-04	Near head of Central Ditch (surface)
1-05	Central Ditch downstream of Sanitary Lagoon (surface)
1-06	Near head of Chlorine Ditch (surface)
1-07	Chlorine Ditch downstream of Boron Plant discharge and south of bridge (surface and subsurface)
1-08	Main Ditch after confluence with Chlorine Ditch and east of bridge (surface and subsurface)
1-09	Main Ditch adjacent to Landfill (surface)
1-10	Main Ditch below Landfill (surface)
1-11	Main Ditch near current outlet to PRI 5 waste pond (surface)
1-12	Main Ditch alignment adjacent to PRI 5 waste pond (surface)
1-13	Former Main Ditch near historical outlet to PRI 7 waste pond (surface and subsurface)
1-14	Former Boron Ditch (surface and subsurface)

Surface solids sampling will be performed at all locations (1-01 through 1-14). Subsurface sampling will be performed at five locations, including the three bridges over wastewater ditches (1-03, 1-07, and 1-08), the former Main Ditch near the historical outlet to the Northeast Ponded Waste Lagoon (1-13), and within the alignment of the former Boron Ditch (1-14).

PRI 3

Surface solids sampling will be performed at 14 locations in PRI 3, which include 13 evenly distributed grid sample locations and one biased/judgmental sample location. PRI 3 sample locations are shown in Figure 11-3. Locations 3-01 through 3-13 were generated as a systematic grid.

Location 3-14 is a biased/judgmental location for surface and subsurface sampling to characterize conditions at the presumed inlet to lagoon.

PRI 4

Surface solids sampling will be performed at 14 evenly distributed grid sample locations in PRI 4 as shown in Figure 11-4. Subsurface sampling will be performed at a sample location within the top-center of the Gypsum Pile, where historical gypsum waste is expected to be present at depth (location 4-05 in Figure 11-4). This sample location is within a key waste release area (see Figure 11-1).

PRI 5

Surface solids sampling will be performed at 20 locations in PRI 5, which include 15 evenly-distributed grid sample locations and five biased/judgmental sample locations. The base number of gridded sample locations at PRI 5 was increased from 14 to 15 based on (1) the elevated variability in D/F, PCB, and/or HCB concentrations exhibited in historical PRI 5 solids data, and (2) agreements between ERM/US Magnesium and the USEPA during the March 2015 OU-1 Phase 1B RI DQOs Scoping Meeting. PRI 5 sample locations are shown in Figure 11-5. Locations 5-01 through 5-15 for PRI 5 were generated as a systematic grid and include locations in both upland (terrestrial) and mudflat/waste pond areas.

Subsurface sampling will be performed at the location nearest the inlet to the waste lagoon from the Main Ditch (location 5-14 in Figure 11-5) and at a location within a former wastewater diversion ditch (location 5-16 in Figure 11-5). These locations were selected for subsurface sampling because they are within key waste release areas (see Figure 11-1). The lagoon inlet (location 5-14) is the location where the greatest amount of waste deposition occurs, as apparent in aerial photographs. The former diversion ditch location was selected by USEPA to investigate accumulated sediment/wastes within the ditch and potential subsurface impacts from leachate from the landfill. Drill rig access to location 5-14 will be attained by the construction of an earthen ramp into the wastewater pond.

The rationale for each of the five biased/judgmental sample locations in PRI 5 is provided below.

ID	Sample Type	Rationale

5-16	Surface and Subsurface	Former Wastewater Diversion Ditch - Evaluate potentially impacted sediments from historical wastewater diversions and potential leachates from the Landfill, located near/at an inlet of the ditch into the PRI 5 waste lagoon.
5-17	Surface	Former Wastewater Diversion Ditch - Evaluate potentially impacted sediments from the lower reach of the Former Wastewater Diversion Ditch (representing the eastward leg draining into the PRI 5 waste lagoon).
5-18	Surface	Star Pond Ditch - Evaluate potentially impacted sediments downgradient of the discharge point from the Star Pond.
5-19	Surface	Skull Valley Diversion - Evaluate potentially-impacted sediments in an area of influent seepage.
5-20	Surface	Star Pond Ditch - Evaluate potentially-impacted sediments within a downstream (east) reach where Star Pond discharges appear to have comingled with Former Diversion Ditch and PRI 5 waste lagoon waters.

PRI 6

Surface solids sampling will be performed at 16 locations in PRI 6, which include 15 evenly distributed grid sample locations and one biased/judgmental sample location. As described above for PRI 5, the base number of gridded sample locations at PRI 6 was increased to 15 based on the variability exhibited in historical PRI 6 solids data and agreements reached during the March 2015 OU-1 Phase 1B RI DQOs Scoping Meeting. PRI 6 sample locations are shown in Figure 11-6. Locations 6-01 through 6-15 were generated as a systematic grid and include locations in both upland (terrestrial) and mudflat/waste pond areas. Subsurface sampling to characterize historically deposited wastes/sediments in the PRI 6 waste lagoon will be performed at a biased/judgmental location within the current PRI 4 area (location 6-16 in Figure 11-6). Location 6-16 is within the historical inlet and deepest portion of the PRI 6 waste lagoon based on aerial photographs which show the PRI 6 lagoon area prior to inundation by gypsum waste. Over time this area has filled with gypsum waste, therefore drilling though gypsum waste at location 6-16 will allow access and sampling of historically deposited wastes/sediments in the PRI 6 waste lagoon. Subsurface sampling location 6-16 is co-located with surface solids sampling location 4-11 in PRI 4 (see Figure 11-4). Subsurface samples from location 6-16 comprised of gypsum waste may be appropriate to include with the PRI 4 dataset for COPC selection.

PRI 7

Surface solids sampling will be performed at 17 locations in PRI 7, which include 15 evenly distributed grid sample locations and two biased/judgmental sample locations. As described above, the base number of gridded sample locations at PRI 7 was increased to 15 based on the variability exhibited in historical PRI 7 solids data and agreements reached during the March 2015 OU-1 Phase 1B RI DQOs Scoping Meeting. PRI 7 sample locations are shown in Figure 11-7. Locations 7-01 through 7-15 for PRI 7 were generated as a systematic grid and are evenly distributed throughout the floor of the Old Waste Pond. Subsurface sampling will be performed at the location nearest the historical inlet to the Old Waste Pond (location 7-04 in Figure 11-7). This location was selected for subsurface sampling because it is within a key waste release area (see Figure 11-1) that received wastewater discharges during the early operations of the Magnesium Plant and the inlet is the location where the highest concentrations of HCB, D/F TEQs, and PCBs were detected during historical investigations. Two biased/judgmental surface solids samples will be collected from within the barrow ditch north of the Old Waste Pond (locations 7-16 and 7-17 in Figure 11-7) due to the potential for ecological receptor exposures within the barrow ditch.

11.2.7.4 Laboratory Analysis

Laboratory analytical data used for COPC selection, initial risk calculations, and preliminary N&E characterization will meet applicable criteria for definitive data as defined under USEPA guidance (USEPA 2005) and the measurement performance criteria for sampling and analysis defined in the OU-1 Phase 1A-B SAP.

Laboratory analyses will be performed following the analytical SOPs and project-specific Work Instructions included in the OU-1 Phase 1A-B SAP. All Phase 1A-B surface and subsurface solids samples will be analyzed for the ~~complete roster of candidate COPCs~~target analytes listed in Worksheet 15, which includes:

- PCBs;
- D/F;
- Semi-volatile organic compounds including HCB;

- Polycyclic aromatic hydrocarbons (PAHs);
- Volatile organic compounds[3];
- Metals;
- Cyanide; and
- Perchlorate.

In addition to analysis for candidate COPCs, all solids samples will be analyzed for total organic carbon (TOC), pH, and grain size. TOC, pH, and grain size data will not be used to select COPCs; however, these data will be collected to provide context for subsequent risk assessment characterizations.

Due to the very high levels of PCBs and D/F expected to be present within some areas in the Inner PRIs, analysis of Phase 1A-B solids samples from the Inner PRIs for PCBs and D/F will be performed using a combination of high-resolution mass spectroscopy and low-resolution mass spectroscopy methods. The identification of samples for low-resolution mass spectroscopy analysis and the criteria that will be used to decide if a sample must be reanalyzed using high-resolution mass spectroscopy method will be included in the project-specific laboratory Work Instructions described in SAP Worksheet 23 and included in SAP Appendix 19B.

11.2.7.5 Bulk versus Fines Fractions Analyses

Consistent with the Phase 1A RI for Outer PRIs, the OU-1 Phase 1A-B RI will include an investigation to determine (1) if contaminant concentrations significantly differ between bulk and fine fractions, and (2) whether a large-enough proportion of coarse material is present in bulk samples to result in a substantial difference between the contaminant concentrations measured in the bulk and the fine fractions. For the purpose of this study, “bulk fraction” is defined as all material passing a 0.25-inch mesh sieve and “fine fraction” is defined as material passing a 0.25-millimeter (mm) (60 US Mesh) sieve. Evaluating bulk versus fines fractions is important for COPC selection because a Type I decision error (excluding a COPC that should be retained) could occur if concentrations of an analyte in bulk (unsieved) samples are

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[3] VOC analysis will be performed for all surface solids samples and all subsurface solids samples.

below a level of concern but concentrations in fine-grained material are above a level of concern (USEPA 2013).

The sieving and analysis strategy for Phase 1A-B RI samples is illustrated in the flow diagram shown in Figure 11-8. To facilitate the bulk versus fines evaluation, three splits will be collected for each Phase 1A-B surface solids sample. Each split will be composed of the bulk sample (passing 0.25-inch mesh) after homogenization.

1. Split sample 1 will be analyzed as a bulk fraction sample.
2. Split sample 2 will be analyzed for grain size by ASTM Method C-136. The result from the grain size analysis of split sample 2 will be used to determine whether to analyze split sample 3 as a fines fraction sample:
3. If the percent passing 0.25 mm in split sample 2 is greater than 75, then no analysis for fines is required.
4. If the percent passing 0.25 mm in split sample 2 is less than 75, then split sample 3 will be dried, sieved through a 0.25 mm mesh, and the fines-fraction material (passing 0.25 mm) will be analyzed for PCBs, D/F, semi-volatile organic compounds, PAHs, metals, and TOC.

Specification of 75% as a cutoff is because in samples with mass of the fine fraction at greater than or equal to 75% of the bulk, the maximum possible ratio of the concentration in the fine fraction to the bulk fraction is 1.33 (when the concentration in the coarse fraction is zero). Because the analytical variability of most methods is usually about 30%, the ratio of concentration values in the fine fraction to those values in the bulk fraction is expected to fall inside the normal range of analytical variability for all samples with more than 75% fine material.

The relationship between the paired results of the bulk and corresponding fine fractions will be evaluated using regression analysis. This approach allows development of a quantitative relationship between the bulk fraction and the fine fraction, so that if a meaningful difference is evident, the concentration in the fine-grained fraction may be calculated from the bulk fraction.

Attachment 9U

8 June 2015 Agency Final Comments to ERM Ph1A-B DQO Section 11.3 - Background Study

From:	Wangerud, Ken <wangerud.ken@epa.gov>
Sent:	Monday, June 08, 2015 12:01 PM
To:	David Abranovic
Cc:	Justin Burning; Catherine D. LeCours (clecours@PWT.COM); R. David Gibby (dgibby@usmagnesium.com); Mike Storck (mstorck@utah.gov); Kevin Lundmark; Mark Ransom; Jennifer Holder; Wall, Dan; OBrien, Wendy; severett@utah.gov; Chris Cline; dcox@blm.gov; Wangerud, Ken
Subject:	Agency Final Comments to ERM Ph1A-B DQO Section 11.3 - Background Study
Attachments:	Final Agency comments 8June2015 on ERM Draft Ph1A-B DQO Section 11.3-Background Study.pdf

David:

Please find attached EPA and UDEQ comments on Draft DQO Sec. 11.3.

Because this is the initial DQO submitted for this aspect of the Ph1A-B investigations, ERM should re-submit this document for EPA review and finalization for inclusion in the om the Draft Ph1A SAP under development.

I understand that our eco-risk teams had a very productive week last week doing the joint reconnaissance of the candidate study sites. We look forward to ERM incorporating that into the Draft-SAP plans for 2015 abiotic sample collection at those locations.

Thanks again for all the work ERM is devoting to this aspect of 2015 site investigations.

Ken

Ken Wangerud, Remedial Project Manager
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From: David Abranovic [mailto:David.Abranovic@erm.com]
Sent: Tuesday, May 19, 2015 3:34 PM
To: Wangerud, Ken
Cc: Justin Burning; Catherine D. LeCours (clecours@PWT.COM); R. David Gibby (dgibby@usmagnesium.com); Mike Storck (mstorck@utah.gov); Kevin Lundmark; Mark Ransom; Jennifer Holder
Subject: RE: Draft Final OU-1 Phase 1 A/B DQO

Ken

Please find attached the draft final OU-1 Phase 1 A-B DQO for your review. This version of the DQO includes the background sample design as well as redline strikeout changes to the soil/sediment portion of the document that EPA has already reviewed. This version should incorporate the changes requested in the agency comments received on 28 April 2015, in accordance with the modifications Kevin Lundmark and I discussed with you on 7 May 2015, as well as your response to my 30 April 2015 received on 12 May 2015. I believe that this DQO is the result of a lot of hard work done by our technical teams to formulate a workable approach for the Phase 1 A-B RI. We will proceed with the incorporating this version of the DQO into the Phase 1 A-B SAP as soon as we receive EPA approval to proceed.

Feel free to contact me anytime if you have any questions regarding this document.

david

David J. Abranovic P.E.
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Agency Technical Comments on ERM's
Draft Phase 1A-B DQOs Section 11.3 – Background Study
(Document Date: 18 May 2015)
U.S. MAGNESIUM NPL SITE, TOOELE COUNTY, UTAH
8 June 2015

INTRODUCTION

The U.S. Environmental Protection Agency (EPA) and the Utah Department of Environmental Quality are providing the following comments on the *Preliminary Draft Ph1A-B DQOs Section 11.3 – Background Study for the US Magnesium NPL Site, Tooele County, Utah.* This document was prepared by Environmental Resource Management (ERM) and submitted to the EPA 19 May 2015 pursuant to scoping meeting discussions held on 11-12 March 2015. Because this is the initial DQO submitted for this aspect of Ph1A-B investigations, ERM should re-submit this document for EPA review and for inclusion in the Draft Ph1A SAP under development.

1. Section 11.3.1

Edit the following text as marked in yellow:

> Based on the Phase 1A RI data, PAHs do not appear to be a significant risk driver. Concentrations detected at the PRIs sampled during the Phase 1A were low and exceeded an RBC in only one PRI (the landfill), and do not rank as human or ecological COPCs in any of the outer buffer areas.

2. Section 11.3.1

The text states:

> Phase 1A RI soil data: A full suite of metals, D/Fs, HCB, and total PCBs were collected as part of Phase 1A data collected in 2014 (ERM 2014a). PRIs that represent areas where aerial deposition from the stack is the potential contaminant source (PRIs 11-16) provide a relevant, comparative dataset.

It is not clear what is meant by "provide a relevant, comparative dataset". Comparative to what? If this data set is envisioned as a candidate data set for background, this is not correct. Concentrations of analytes in the outer PRIs (i.e., the Phase 1A set) should not be assumed to be background. While some samples may be similar to background, it is readily apparent that there are a number of samples, especially in PRI 12 and PRI 14, that are not similar to background. There is little to be learned from a comparison of the outers (Phase 1A) to the inners (Phase 1A-B). This paragraph should be deleted.

3. Section 11.3.5.1.

While the Agencies agree that it is desirable to ensure that a data set that is called "background" does not contain samples that have been impacted by site related releases, the text that describes the planned analyses should be left more flexible. Accordingly, insert this language at the top of this section:

> Once the background data sets are collected, it will be important to evaluate the data and ensure that samples or areas (if any) that appear to be impacted by site-related contamination are identified and excluded. The exact methods to identify such samples or areas cannot be selected with certainty before the data are obtained, but a number of potentially useful approaches are available, including the following:

Retain the text describing the outlier test, geochemical bivariate plots, Q-Q plots, and D/F congener fingerprint analysis. However, comparison of D/F, PCB and HCB data to risk-based screening levels has no conceptual basis in recognizing individual samples or areas that ought to be excluded. This test should be deleted.

4. Section 11.3.5.2.

EPA agrees that comparisons of site data to background data may be based on a "holistic" assessment using multiple tests. However, as above, this section should begin with text that allows for flexibility in choosing which tests are potentially useful and how the results will be interpreted in the event that multiple tests yield differing conclusions. Accordingly, insert this language at the top of this section:

> There are a number of alternative methods that may be used to compare the background data sets to site data sets in order to evaluate whether various areas of the site have been impacted and, if so, by how much. The exact methods that will be most useful and most reliable cannot be selected with certainty before the data are obtained, but a number of potentially useful approaches are available, including the following:

With regard to the first test (*Central Tendency Testing),* the Agencies recommend that the main emphasis be placed on the WRS test. The text states that a t-test "will be used when the site and background datasets have parametric probability distributions". A t-test is appropriate only when both distributions are normal, not simply "parametric". The WRS test is appropriate even if both data sets happen to pass a normality test, since the WRS test has nearly the same power as a t-test, and most data sets are not actually normal (even if they pass a normality test)[1]. In addition, this test is relatively insensitive to the occurrence of non-detects, at least if the detection limit is generally similar between site and background data sets.

---

[1] For example, in a set of 100 random data sets of size 14 drawn from a lognormal distribution with CV = 0.8, a total of 43 of the data sets passed the normality test in ProUCL, even though the true distribution is lognormal.

5. Section 11.3.5.2.

The text states that comparisons to background will be conducted on a PRI basis. The Agencies agree that this is the most likely first level of comparison, but the text should allow for comparisons based either on sub-areas of PRIs or on combinations of adjacent PRIs. Accordingly, modify the text as follows:

> In most cases, initial comparisons to background will be conducted on a PRI basis. In some cases (e.g., if a PRI is noted to have a localized area of contamination), it may be appropriate to subdivide a PRI into zones and compare the differing zones to background. Likewise, if adjacent PRIs or parts of adjacent PRIs appear to be quite similar to each other, it may be appropriate to combine some or all of the data from those similar areas.

6. Section 11.3.6

This text should simply describe the two basic types of decision errors, and give the tolerance limits for each. Because the definition of Type I and Type II errors is different for Form I and Form II null hypotheses, the discussion should only talk about false negative decisions (concluding the site is not greater than background when it actually is) and false positive decision errors (deciding the site is higher than background when it actually is not). This is not the place to be discussing MDD. See comments on Section 11.3.7.2, below.

7. Section 11.3.7.2.

The text states “background D/F, PCBs and HCB are not expected to be influenced by soil type or lithology”, so no distinction between upland and lakebed samples is made for organics. This decision is rather uncertain. Even if the amount of organics deposited in the two media were similar (this is not certain, since upland soils will be impacted only by air while lakebed sediments may also be impacted by runoff), differences in organic COPC concentration could occur due to differences in various fate and transport processes between the two media types. Consequently, the text should be modified to include the following language:

> Once the data are collected, this assumption will be evaluated by comparing the levels of organic COPCs in lakebed and upland background samples. If there are differences, and if the existing data sets are not sufficient to allow reliable comparison of site to the appropriate background data set, then additional sampling may be required in Phase II.

8. Section 11.3.7.2

The rationale leading to the estimation of required sample size is rather complex and cumbersome, and contains some weak points. Specifically, the assumption that MDD = 50% of the mean is presented without explanation or justification. Moreover, selection of a sample size based on the median size requirement across different analytes implies that the data sets collected might not be adequate for about half of the analytes.

The text states that "the selection of a sample size that falls to the right of the median of the distribution of potential metal sample sizes calculated by VSP was agreed to by US Magnesium/ERM and USEPA during the March 2015 Phase 1B RI Scoping Meetings as a reasonable approach to selecting an appropriate background sample size." This is not correct and this assertion must be deleted. EPA simply stated that, although EPA had not performed a review of the exact statistical calculations, based on general experience at other sites, it seemed likely that background data sets of 30-36 would be adequate.

The proposed approach uses Phase 1A and DMA data from outer PRIs to estimate what might be expected for mean and standard deviation values in data sets drawn from background areas. While this is a useful strategy, it is overly complex to use the data on an analyte-by-analyte basis in order to derive a different samples size for each analyte. Rather, the data should be used to draw general conclusions about the most likely type of distribution (non-normal) and the range of CVs (0.6 to 0.8) that are likely to occur. These general choices can then support the derivation of a general (non-analyte specific) sample size. In choosing the data to use for calculation of CVs using the Phase 1A data, two factors that should be considered include:

- Samples that are likely to be site-impacted should be excluded. ERM proposes that samples 10 and 11 in PRI 12 be excluded, and that samples 2-8 from PRI 14 be excluded. However, using TEQ as an indicator of site contamination, these choices may not be best. In PRI 12, samples that appear to be impacted by TEQ include 2-6 and 9. In PRI 14, samples that appear to be impacted by TEQ include 1, 3, 5, 6, 7, and 10. Inclusion of site-impacted samples in the data sets used to calculate statistics will tend to bias both the mean and the standard deviation high, and will make the CV less representative.
- Analytes that are limited by low detection frequency (e.g., < 80%) should simply be excluded from this analysis, rather than struggling to derive reliable estimates of the mean and standard deviation in the face of a large number of NDs.

To minimize these issues, the Agencies recommend a revised presentation of the approach used to select sample size, as presented in the attached alternative text (see below).

9. Section 11.3.7.5

The Agencies agree that the background study need only be concerned with bulk samples, not fines. However, the set of four reasons that are listed to support this decision are mainly irrelevant. The only reason that need be cited is that if, there is no important difference observed between site and background bulk data sets, there is no reason to suppose an important difference might occur at the level of the fine fractions.

AGENCY MODIFIED TEXT FOR SECTION 11.3.7.2

11.3.7.2 Background Sample Size Estimation

The sample size that is needed to support a reliable statistical comparison between site and background sample sets depends on a number of factors, including:

- The form of the null hypothesis (Form I or Form II). In accord with the recommendations of EPA (2002), the Form II null hypothesis is selected for use:
  H0: Site > (Background + S)
- The acceptable probability of a false negative decision error (declaring the site is not greater than background + S when it actually is). In accord with the recommendations of EPA (2002), the maximum false negative decision error rate for a Form II test is set to 0.10.
- The acceptable probability of a false positive decision error (declaring the site is greater than background + S when in reality it is not). In accord with the recommendations of EPA (2002), the maximum acceptable false positive decision error rate is set to 0.20.
- The form of the data distributions (normal vs not normal). Based on data collected from the outer PRIs during the Phase 1A investigation, a majority of data sets (60-70%) are best characterized as non-normal (see Tables 11-7 to 11-9). Based on this, all calculations of sample size assumed a non-normal distribution. Because statistical calculations that assume a non-normal distribution are based on the median rather than the mean, all samples sizes include an extra 20% to account for this bias.
- The variability between samples, as characterized by the coefficient of variation (CV = stdev / mean). Based on data collected from the outer PRIs during the Phase 1A investigation, a majority of data sets (> 60%) have CVs in the range of 0.6 to 0.8, with only a few having values greater than 1 (see Tables 11-7 to 11-9). Based on this, all calculations of sample size assumed CVs of 0.6 to 0.8.
- The value of S. This is the true difference between the mean of the site and the mean of the background data sets that is considered to be of "substantial risk" (i.e., large enough to be of potential importance in risk characterization). In general, the smaller the value of S the more sensitive the statistical test but the higher the number of samples that are needed. Because of this, all calculations of sample size evaluated values of S ranging from 30% up to 50% of the mean of the background data set.

Background dataset sample sizes were calculated in accord with the inputs described above using Visual Sample Plan v7.2 (http://vsp.pnnl.gov/). The results are shown below:

S	Sample Size	
	CV = 0.6	CV = 0.8
30%	48	83
40%	28	48
50%	20	32

As seen, estimated samples sizes range from about 20 to 80, depending on the assumed values of S and CV. In accord with EPA (2002), the final choice of sample size depends on the expected consequences of any decision errors that might occur, as well as the cost of sample collection and analysis. Based on the estimates above, it is considered likely that data sets of size 30-36 will be adequate to identify differences between site and background that are in the range of 40-50%, and it is expected that decision errors will be within reasonable limits in almost all cases. In special cases where the statistical comparison based on the samples collected in Phase 1A-B is substantially uncertain and this uncertainty is of importance in risk characterization, it may be necessary to collect additional background samples for the problematic analytes in Phase II.

Attachment 9V

10 June 2015 Response to EPA Letter Dated 3 June 2015; Re: Draft DQO #3 for Proposed Phase 1A-B SAP Inner PRIs and Background Study

Environmental
Resources
Management

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(480) 998-2401
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10 June 2015
ERM Project No. 0132320

Mr. Ken Wangerud
Remedial Project Manager
Superfund Remedial Program
USEPA Region 8 – EPR-SR
1595 Wynkoop Street
Denver, CO 80202-1129

Subject: Response to EPA Letter Dated 3 June 2015; Re: Draft DQO #3 for Proposed Phase 1A-B SAP Inner PRIs and Background Study

Dear Mr. Wangerud:

The milestone summary provided in the above referenced letter contains numerous inaccuracies and omissions that are critical to establishing a clear path forward to complete the OU1 Phase 1A-B Sampling and Analysis Plan (SAP). ERM and EPA/UDEQ have been working diligently on various documents and schedules, and it is important to accurately document the milestones and agreements that have been reached along the way so that we can continue to move forward and implement the fieldwork in a timely manner in 2015.

The timeline and key milestones provided in the EPA 3 June 2015 letter for development of the Phase 1A-B data quality objectives (DQOs) contains several omissions and inaccuracies; a more complete and accurate summary is provided below:

- EPA's statement that the preliminary Phase 1B DQO was developed as an alternate to the EPA-issued SAP (EPA 2013) is not accurate. ERM submitted a *Preliminary Data Quality Objective Framework OU-1 Phase 1B RI for Nature and Extent* to EPA on 25 November 2014 to address nature and extent (N&E) data gaps for all of OU1. It was based on the *OU 1 Multiple Phase RI Risk Assessment Process Diagram* that was jointly developed with EPA at the 20 August quarterly RPM meeting (submitted to EPA via e-mail on 28 August 2014). The fundamental agreement supporting the development of the preliminary OU1 Phase 1B DQO was that the Phase 1A DQO (selection of constituents of potential concern [COPCs] in the EPA-issued SAP) was not necessary, as described in the draft Inner Preliminary Remedial Investigation (PRI) Screening-Level Risk Assessment (SLRA) (ERM January 2015).

- EPA provided verbal comments on ERM's preliminary Phase 1B DQO at the quarterly RPM meeting held on 2 December 2014, and suggested that the preliminary Phase 1B DQO was too broad in scope (i.e., should not refer to collecting data to support the feasibility study evaluation). EPA also suggested that a site-specific background dataset could be extracted from the Phase 1A RI dataset for the outer PRIs and that including a background study in the Phase 1B DQO may not be necessary.
- Based on these verbal comments from EPA, ERM submitted a second draft of the OU1 Phase 1B DQO on 20 February 2015 to support scoping discussions held on 11 and 12 March 2015. This version of the OU1 Phase 1B DQO included data collection to support preliminary N&E and exposure point concentrations for the inner PRIs. This DQO was not the first draft of the Phase 1A-B DQO as indicated in EPA's 3 June 2015 letter.
- EPA stated at the 11-12 March 2015 scoping meeting that ERM must prepare an OU1 DQO that provides data needed to achieve the Phase 1A objective of COPC selection. Recognizing that the amount of data required for COPC selection was similar to that needed for preliminary N&E and development of exposure point concentrations (the two key elements of ERM's draft Phase 1B DQO), ERM and EPA agreed to prepare a new, more comprehensive OU1 DQO that included all three of these elements, subsequently referred to as the OU1 Phase 1A-B DQO.
- EPA also informed ERM during the 11-12 March 2015 scoping meeting that the EPA guidance regarding background determination they suggested we evaluate at the 2 December 2015 quarterly meeting had been recalled, and would no longer be accepted by EPA. Based on this new information, ERM and EPA jointly agreed to include a background study in the OU1 Phase 1A-B DQO.
- Following the 11-12 March 2015 scoping meeting, ERM initiated preparation of the first draft of the combined OU1 Phase 1A-B DQO, not the second draft as indicated in EPA's 3 June 2015 letter.

- In accordance with the agreement between ERM and EPA/UDEQ at the 11-12 March 2015 scoping meeting, ERM developed a detailed Gantt project schedule for the development of the first draft OU1 Phase 1A-B SAP that included key EPA and ERM milestones (documented in the Scoping Outcome notes submitted to EPA on 23 March 2015). This Gantt project schedule, dated 7 April 2015, was provided to EPA and UDEQ at a meeting held on 15 April 2015 at the UDEQ Salt Lake City office. The EPA and UDEQ agreed verbally with ERM to the milestones and interdependencies presented in this schedule as well as to update the schedule frequently based on actual completion dates of the key milestones. There was agreement in this meeting that the EPA must complete Gantt schedule Task 9, *EPA Approval of the OU1 Phase 1A-B DQO* (including background & soil/sediment) in order for ERM to initiate preparation of the draft OU1 Phase 1A-B SAP. ERM provided an updated version of this Gantt schedule that incorporated the agreements from the meeting to EPA and UDEQ via e-mail on 17 April.
- EPA requested that ERM provide them with the soil sediment portion of the OU1 Phase 1A-B DQO in order to facilitate expedited review while the background portion of the DQO was being discussed by the ERM/EPA risk assessment teams. ERM submitted the soil sediment portion of the OU1 Phase 1A-B DQO, prepared according to the agreements reached at the 11-12 March 2015 scoping meetings, to EPA on 7 April 2015. This was the first draft of the OU1 Phase 1A-B DQO, not the second draft as indicated in EPA's 3 June 2015 letter.
- EPA conducted a site visit with ERM on 16 April 2015 to observe the former wastewater ditch that ERM identified as a potential waste release location in the preliminary Phase 1B DQO submitted on 25 November 2014 as well as in the draft OU 1 Phase 1 A-B DQO submitted on 20 February 2015. During this site visit, EPA observed a ditch emanating from the Star Pond that was identified by US Magnesium as a storm water management feature. EPA indicated during this site visit that collection of additional samples from these features may be needed during the OU1 Phase 1A-B Remedial Investigation (RI). This is an example of EPA unilaterally adding and modifying scopes of work after Phase 1A-B sample design was agreed to and the scoping process and the draft DQO had been completed.

- EPA comments on the soil sediment portion of the draft OU1 Phase 1A-B DQO received by ERM on 28 April 2015 (7 days after the review period deadline in the 17 April 2015 Gantt schedule) were incorrectly presented as deficiencies per Section 39c of the Administrative Order on Consent (AOC). The 28 April 2015 correspondence from EPA requested significant edits and additions, all of which had not been discussed or agreed to at the 11-12 March 2015 scoping meeting. It is not appropriate for EPA to refer to these edits and additions as a "cure of deficiencies" because ERM had not been previously notified of any deficiencies as is required by Section 39c of the AOC. In fact this was EPA's first review of the draft OU1 Phase 1A-B DQO and the comments were the first time the EPA provided ERM with feedback, and included the additional samples noted in the previous bullet that were never previously requested or discussed by the EPA. These modifications therefore cannot be characterized as deficiencies.

- ERM responded via e-mail to EPA's 28 April 2015 correspondence on 4 May 2015 with a detailed proposal of how best to address the most significant EPA additions and edits to the soil sediment portion of the draft OU1 Phase 1A-B DQO. A teleconference was conducted between EPA and ERM on 7 May 2015 to review the EPA's proposed additions and edits. During this call, the EPA acknowledged that, based on consultation with the EPA risk assessors and ERM's written response, many of the proposed additions and edits to the draft OU1 Phase 1A-B DQO were indeed confusing and inappropriate. EPA and ERM agreed jointly during this call to appropriate edits and changes, and EPA provided confirmation of these verbal agreements to ERM on 12 May 2015.

- ERM submitted the first complete draft of the OU1 Phase 1A-B DQO (including the background portion that was developed based on detailed discussions with EPA risk assessors) to EPA on 19 May 2015. This submittal represents the Task 8 milestone in the 17 April 2015 Gantt project schedule and initiated EPA's review task (Task 9 - *EPA Approval of the OU1 Phase 1A-B DQO*).

- EPA provided ERM comments and edits via a redline-strikeout version of the soil sediment portion of the 19 May 2015 draft OU1 Phase 1A-B DQO as an attachment to their 3 June 2015 letter. In this communication, EPA inappropriately referred to the comments and edits and proposed modifications as deficiencies per Section 39c of the AOC. ERM was not previously notified of any "deficiencies" and was not provided the opportunity to cure within 20 days, as is required by Section 39 of the AOC.

- EPA also noted in their 3 June 2015 letter that they were unable to provide comments on the background portion until completion of field reconnaissance of the candidate sampling sites, which occurred on 4 June 2015. ERM attempted to schedule a technical call for 9 June 2015 to discuss EPA comments on the background portion of the DQO, but EPA was not available. On the 4 June 2015 risk assessor call, the EPA notified ERM that they were not prepared to discuss their comments on the background portion of ERM's DQO submitted to EPA on 19 May 2015. The deadline in the most recent schedule (dated 1 June 2015) for EPA to approve or provide comments on the 19 May 2015 draft OU1 Phase 1A-B DQO was 5 June 2015. ERM received comments on 8 June 2015 and therefore will include the necessary comment review and response time to the Phase 1 A-B RI schedule.

The sixth paragraph of EPA's 3 June 2015 letter states that ERM "can submit a draft Phase 1 A-B Inner PRI SAP" and that "the Background Study portion of the SAP can follow soon thereafter." This statement is not accurate, and is not consistent with the OU1 Phase 1A-B RI schedule jointly agreed to at the 15 April 2015 meeting, as updated and discussed during our weekly call on 1 June 2015 (attached to this letter). The 1 June 2015 version of the Phase 1A-B RI Gantt schedule clearly shows that ERM will prepare a comprehensive OU1 Phase 1A-B SAP and submit it to EPA for review 30 days after EPA approval of the OU1 Phase 1A-B DQO including soil/sediment and background portions of the DQO (i.e., Gantt schedule Task 9). EPA's reference to a "Phase 1 A-B Inner PRI SAP" is incorrect; the Phase 1A-B SAP is for all of OU1 and includes a background study. Because ERM has not received EPA approval of the background portion of the OU1 Phase 1A-B DQO, we cannot initiate preparation of the draft OU1 Phase 1A-B SAP (Gantt schedule Task 17). ERM stands ready to proceed with the development of the comprehensive OU1 Phase1A-B SAP, but is still awaiting final approval of the background portion from EPA. We are reluctant to issue a partial or incomplete draft of the SAP, because we believe that this will result in additional schedule delays and unnecessary cost for US Mag.

ERM clearly understands that in order to achieve the EPA's goal of completing the OU1 Phase 1A-B fieldwork in 2015, it is critical that a draft

OU1 Phase 1A-B SAP be completed as soon as possible. Therefore ERM proposes to adhere to the 1 June 2015 version of the OU1 Phase 1A-B RI Gantt schedule and submit the draft SAP to EPA for review on 3 July 2015. This schedule can be met only if EPA agrees that the draft SAP will include a version of the complete OU1 Phase 1A-B DQO that incorporates EPA's final edits to the soil sediment portion provided in the 3 June 2015 letter with ERM's 19 May 2015 version of the background study. This approach will allow ERM to complete work on a comprehensive Phase 1A-B SAP while ERM reviews and prepares responses to the comments received on 8 June 2015 on the background study portion of the DQO. This will give ERM sufficient time to review EPA's comments on the background study while EPA reviews the draft SAP. All appropriate comments can then be incorporated into a final OU1 Phase 1A-B SAP that, according to the 1 June 2015 version of the OU1 Phase 1 A-B RI Gantt schedule, will be issued by EPA on 7 September 2015.

We believe that this approach is workable and consistent with the instruction provided in the 18 February 2015 letter from Steve Wharton to "obtain EPA approval in time for sampling to be completed in 2015." However the final sentence of EPA's 3 June 2015 letter anticipating mobilization for OU1 Phase 1A-B fieldwork in July 2015 is clearly not realistic nor is it consistent with the agreed-upon 1 June 2015 version of the Phase 1 A-B RI Gantt schedule. In order to meet the schedule requirements and proceed with fieldwork in a timely manner, EPA must meet review deadlines as outlined in the 1 June 2015 schedule. We believe that if the EPA can maintain focus on achieving critical project milestones, and recognize that their role is one of oversight not execution, the OU1 Phase 1A-B fieldwork can be completed in 2015 as shown on the attached 1 June 2015 version of the Phase 1A-B RI Gantt schedule. ERM is working diligently on the development of all documents outlined in the 1 June 2015 schedule so that fieldwork can be completed in 2015.

ERM looks forward to continuing to work closely with the EPA on completion of the OU1 Phase 1A-B RI. Please feel free to contact me at (480) 455-6770 if you have any questions or would like any clarification on the content of this letter.

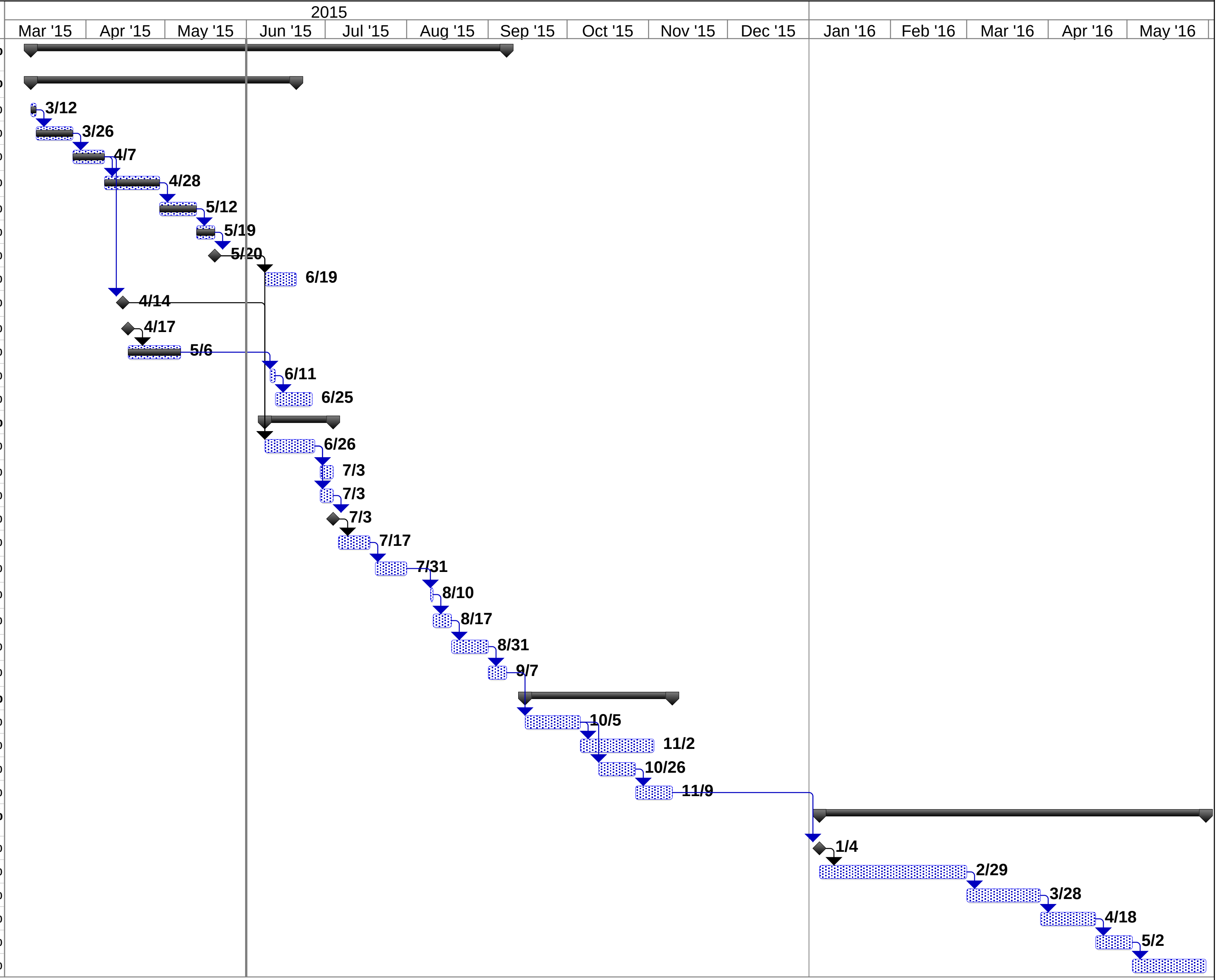
Sincerely,

David J. Abranovic, P.E.
Project Coordinator (ERM)

cc: Michael Stork UDEQ-DERR
Tom Tripp, US Magnesium
David Gibby, US Magnesium
Mark Ransom, ERM

US Magnesium OU-1 Phase 1 A/B RI Schedule

ID	Task Name	Duration	Start	Finish	% Complete
1	**Phase 1A/B SAP**	**129 days**	**Wed 3/11/15**	**Mon 9/7/15**	**45%**
2	**Phase 1B Scoping Process**	**73 days**	**Wed 3/11/15**	**Fri 6/19/15**	**83%**
3	Scoping Meeting	2 days	Wed 3/11/15	Thu 3/12/15	100%
4	Draft Outcome Notes	10 days	Fri 3/13/15	Thu 3/26/15	100%
5	Draft Phase 1A/B DQO (soil/sed)	8 days	Fri 3/27/15	Tue 4/7/15	100%
6	EPA Review & Comment	15 days	Wed 4/8/15	Tue 4/28/15	100%
7	ERM/EPA Consultation (if necessary)*	10 days	Wed 4/29/15	Tue 5/12/15	100%
8	Draft Final Phase 1A/B DQO (background & soil/sed)*	5 days	Wed 5/13/15	Tue 5/19/15	100%
9	EPA Review & Approval	13 days	Wed 5/20/15	Fri 6/5/15	80%
10	Final Outcome Notes	10 days	Mon 6/8/15	Fri 6/19/15	0%
11	EPA provides ERM Phase 1A SAP Template	0 days	Tue 4/14/15	Tue 4/14/15	100%
12	Draft Submerged Sediment Samper Test Protocol TM	0 days	Fri 4/17/15	Fri 4/17/15	100%
13	EPA Review & Approval	14 days	Fri 4/17/15	Wed 5/6/15	100%
14	Sediment Samper Test	2 days	Wed 6/10/15	Thu 6/11/15	0%
15	Submerged Sedement Sampling SOP Development	10 days	Fri 6/12/15	Thu 6/25/15	0%
16	**Draft Phase 1A/B SAP**	**20 days**	**Mon 6/8/15**	**Fri 7/3/15**	**0%**
17	Preparation of Draft Phase 1A/B SAP	15 days	Mon 6/8/15	Fri 6/26/15	0%
18	Internal Review/QAQC	5 days	Mon 6/29/15	Fri 7/3/15	0%
19	US Mag Review	5 days	Mon 6/29/15	Fri 7/3/15	0%
20	Issue Draft SAP to EPA	0 days	Fri 7/3/15	Fri 7/3/15	0%
21	EPA Review & Comment	10 days	Mon 7/6/15	Fri 7/17/15	0%
22	ERM Review and Preparation of RTC Letter*	10 days	Mon 7/20/15	Fri 7/31/15	0%
23	ERM/EPA Consultation (if necessary)*	1 day	Mon 8/10/15	Mon 8/10/15	0%
24	RTC Issues - Agency Decision	5 days	Tue 8/11/15	Mon 8/17/15	0%
25	ERM Prepares Final Draft Phase 1A/B SAP	10 days	Tue 8/18/15	Mon 8/31/15	0%
26	EPA Issues Final Phase 1A/B SAP	5 days	Tue 9/1/15	Mon 9/7/15	0%
27	**Phase 1A/B Fieldwork**	**40 days**	**Tue 9/15/15**	**Mon 11/9/15**	**0%**
28	Background Sampling	15 days	Tue 9/15/15	Mon 10/5/15	0%
29	Non Saturated Surface Sample Collection	20 days	Tue 10/6/15	Mon 11/2/15	0%
30	Subsurface Sample Collection (Drilling)	10 days	Tue 10/13/15	Mon 10/26/15	0%
31	Saturated Surface Sample Collection (Helicopter)	10 days	Tue 10/27/15	Mon 11/9/15	0%
32	**Phase 1A/B Data Report**	**105 days**	**Mon 1/4/16**	**Mon 5/30/16**	**0%**
33	Validated Phase 1 A/B Data	0 days	Mon 1/4/16	Mon 1/4/16	0%
34	Draft Phase 1A/B Data and Preliminary N&E Report	40 days	Tue 1/5/16	Mon 2/29/16	0%
35	EPA Review	20 days	Tue 3/1/16	Mon 3/28/16	0%
36	ERM Preparation of RTC Letter*	15 days	Tue 3/29/16	Mon 4/18/16	0%
37	EPA Review & Approval of RTC	10 days	Tue 4/19/16	Mon 5/2/16	0%
38	Final Phase 1A/B Data Report	20 days	Tue 5/3/16	Mon 5/30/16	0%



Project: USM RI/FS
Date: Mon 6/1/15

Task	▨	Project Summary	▬	Inactive Task	▭	Duration-only	▬	Finish-only	]
Split	┈	External Tasks	▨	Inactive Milestone	◇	Manual Summary Rollup	▬	Progress	▬
Milestone	◆	External Milestone	◆	Inactive Summary	▭	Manual Summary	▬	Deadline	⇩
Summary	▬	Inactive Task	▾	Manual Task	▬	Start-only	[		

* Task with considerable uncertainty, therefore if additional time is necessary to resolve technical topics, the overall schedule will be ajusted acordingly.

Attachment 9W

16 June 2015 Clarification of Terms in Final Inner PRIs DQO

Kevin Lundmark

From: Wangerud, Ken <wangerud.ken@epa.gov>
Sent: Tuesday, June 16, 2015 4:27 PM
To: Kevin Lundmark; Catherine D. LeCours (clecours@PWT.COM)
Cc: David Abranovic; Justin Burning; Mike Storck (mstorck@utah.gov); OBrien, Wendy; Wall, Dan; severett@utah.gov; Bill Brattin
Subject: RE: EPA final-comments for Inner-PRIs RE: Draft Final OU-1 Phase 1 A/B DQO - CLARIFICATION NEEDED

Kevin etal:

EPA is providing response to the four questions you posed as follows:

Please provide clarification for terminology inserted by EPA into the DQO, as follows:

- Section 11.2.4.2, bottom of Page 5: The text states: "Constituent concentrations within solid media at the Site are not expected to fluctuate substantially over the timescale of a year (provided that significant process changes have not been implemented at the facility during that time), so the time of year when sampling occurs is not likely to be important (USEPA 2013) to the temporal representation of the data." Please define or explain the term "temporal representation of the data"

RESPONSE: EPA recommends that the language above be replaced with the following:

> "Constituent concentrations within solid media at the Site are not expected to fluctuate substantially over the timescale of a year, provided that significant process changes have not been implemented at the facility during that time and that the solid medium has not been substantially disturbed (e.g., by earthmoving activities, flood event, etc.). Consequently, the time of year when sampling occurs is not likely to be important (USEPA 2013)."

- Section 11.2.5.3, top of page 7: The text states: "The Phase 1A-B RI Data Report will include maps showing chemical constituent concentrations for the primary risk drivers in each Inner PRI." Please define the term "primary risk drivers" and explain what constituents are/will be considered "primary risk drivers." Please explain how "primary risk drivers" differ from "expected risk drivers" as defined in Section 11.2.6.1 at the top of page 10.

RESPONSE: Primary risk drivers are COPCs that are determined to be of primary concern based on the initial human and ecological risk calculations performed using the data collected from the Phase 1A-B sampling and analysis effort. Expected risk drivers are COPCs that have been identified as being of primary concern based on the historic or DMA data. It is expected that the primary risk drivers will include TEQ, HCB and PCBs, and may also include a few additional COPCs (depending of the outcome of the Phase 1A-B data). To simplify the issues, replace the text above with the following:

> "The Phase 1A-B RI Data Report will include maps showing chemical constituent concentrations for TEQ, HCB, and PCBs, and may also include maps for other COPCs that are determined to be of significant interest based on the Phase 1A-B data."

- Section 11.2.5.3, top of page 7: The text states: "If concentrations of a constituent in surface samples are similar across a PRI and below applicable risk thresholds, then additional N&E data may not be required for that constituent ." Please define "applicable risk thresholds"

RESPONSE: EPA recommends deleting the text highlighted in yellow, above.

- Section 11.3.6.3, bottom of page 11: The text states "The degree to which the combined datasets delineate the N&E of site-related contamination within the Inner PRIs will be described by the variability of concentrations, relationship of results to risk thresholds, the spatial distribution of chemical concentrations, and level of uncertainty for un-sampled locations as predicted by geo-statistical modeling." Please define "risk thresholds".

RESPONSE: In this context, "risk thresholds" is intended to refer to risk-based concentrations for either human and/or ecological receptors. The implication is that additional data to characterize N&E will likely not be needed for COPCs that are either well below or well above a level of concern across an exposure area, but may be required in an exposure area where a transition between acceptable and unacceptable risk is occurring and the existing data do not define the boundary with adequate confidence.

Hopefully this answers your concerns and questions.
Cheers, and carry on… thanks.
Ken

Ken Wangerud, Remedial Project Manager
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From: Kevin Lundmark [mailto:Kevin.Lundmark@erm.com]
Sent: Thursday, June 11, 2015 4:02 PM
To: Catherine D. LeCours (clecours@PWT.COM)
Cc: Wangerud, Ken; David Abranovic; Justin Burning; Mike Storck (mstorck@utah.gov)
Subject: RE: EPA final-comments for Inner-PRIs RE: Draft Final OU-1 Phase 1 A/B DQO - CLARIFICATION NEEDED

Hello Catherine –

Having reviewed the EPA Final Edits to the Draft DQO for Phase 1A-B RI at Inner PRI Areas, our team needs some clarification for terminology inserted by EPA into the DQO. This clarification is needed to help ensure other SAP Worksheets (e.g., WS #37) are consistent with EPA's DQO requirements.

- Section 11.2.4.2, bottom of Page 5: Please define or explain the term "temporal representation of the data"
- Section 11.2.5.2, top of page 7: Please define the term "primary risk drivers" and explain what constituents are/will be considered "primary risk drivers." Please explain how "primary risk drivers" differ from "expected risk drivers" as defined in Section 11.2.6.1 at the top of page 10.
- Section 11.2.5.1, top of page 7: Please define "applicable risk thresholds"
- Section 11.3.6.3, bottom of page 11: Please define "risk thresholds"

Thank you in advance for helping us understand the meaning of these terms in the context of the DQO and SAP.

Kevin

. . . .

Kevin Lundmark
ERM

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From: Wangerud, Ken [mailto:wangerud.ken@epa.gov]
Sent: Wednesday, June 03, 2015 8:15 AM
To: David Abranovic
Cc: Justin Burning; Catherine D. LeCours (clecours@PWT.COM); R. David Gibby (dgibby@usmagnesium.com); Mike Storck (mstorck@utah.gov); Kevin Lundmark; Mark Ransom; Jennifer Holder
Subject: EPA final-comments for Inner-PRIs RE: Draft Final OU-1 Phase 1 A/B DQO

David etal:

Per EPA's review, please find attached the Final DQO for Inner PRIs and preparation of a Draft Ph1A-B SAP.

Please call if you have further questions.

EPA looks forward to ERM's rapid progress on Draft Ph1A-B SAP development and submittal. Per ERM's request at the scoping meeting, the UFPQAPP-framework was provided by PWT in Word.doc format. As you develop the Draft SAP please feel free to contact Catherine LeCours at PWT for any assistance and coordination.

Ken

Ken Wangerud, Remedial Project Manager
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From: David Abranovic [mailto:David.Abranovic@erm.com]
Sent: Tuesday, May 19, 2015 3:34 PM
To: Wangerud, Ken
Cc: Justin Burning; Catherine D. LeCours (clecours@PWT.COM); R. David Gibby (dgibby@usmagnesium.com); Mike Storck (mstorck@utah.gov); Kevin Lundmark; Mark Ransom; Jennifer Holder
Subject: RE: Draft Final OU-1 Phase 1 A/B DQO

Ken

Please find attached the draft final OU-1 Phase 1 A-B DQO for your review. This version of the DQO includes the background sample design as well as redline strikeout changes to the soil/sediment portion of the document that EPA has already reviewed. This version should incorporate the changes requested in the agency comments received on 28 April 2015, in accordance with the modifications Kevin Lundmark and I discussed with you on 7 May 2015, as well as your response to my 30 April 2015 received on 12 May 2015. I believe that this DQO is the result of a lot of hard work done by our technical teams to formulate a workable approach for the Phase 1 A-B RI. We will proceed with the incorporating this version of the DQO into the Phase 1 A-B SAP as soon as we receive EPA approval to proceed.

Feel free to contact me anytime if you have any questions regarding this document.

david

David J. Abranovic P.E.
Partner

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Please visit ERM's web site: http://www.erm.com

Attachment 9X

2 July 2015 Response to Agency Technical Comments on ERM's Draft Phase 1A-B DQOs Section 11.3 – Background Study (document date 8 June 2015)

Environmental
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Management

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ERM

1 July 2015

Via Electronic Mail

Mr. Ken Wangerud
Remedial Project Manager
Superfund Remedial Program
USEPA Region 8 – EPR-SR
1595 Wynkoop Street
Denver, CO 80202-1129

Subject: Response to Agency Technical Comments on ERM's Draft Phase 1A-B DQOs Section 11.3 – Background Study (document date 8 June 2015)

Dear Mr. Wangerud:

The *Draft Final Data Quality Objectives for OU-1 Phase 1A-B RI SAP* was submitted via email to the United States Environmental Protection Agency (USEPA) on 18 May 2015. The USEPA provided comments on this submittal on behalf of the USEPA and Utah Department of Environmental Quality (collectively "the Agencies") via e-mail on 8 June 2015, and this letter presents ERM-West, Inc.'s (ERM's) responses to the Agencies' comments.

Each of the Agencies' comments is provided below in italic font, followed by ERM's response in green font.

1. *Section 11.3.1: Edit the following text as marked in yellow:*

> *Based on the Phase 1A RI data, PAHs do not appear to be a significant risk driver. Concentrations detected at the PRIs sampled during the Phase 1A were low and exceeded an RBC in only one PRI (the landfill), and do not rank as human or ecological COPCs in any of the outer buffer areas.*

Response: The text will be revised as requested.

2. *Section 11.3.1: The text states:*

> *Phase 1A RI soil data: A full suite of metals, D/Fs, HCB, and total PCBs were collected as part of Phase 1A data collected in 2014 (ERM 2014a). PRIs that represent areas where aerial deposition from the stack is the potential contaminant source (PRIs 11-16) provide a relevant, comparative dataset.*

It is not clear what is meant by "provide a relevant, comparative dataset". Comparative to what? If this data set is envisioned as a candidate data set for background, this is not correct. Concentrations of analytes in the outer PRIs (i.e., the Phase 1A set) should not be assumed to be background. While some samples may be similar to background, it is readily apparent that there are a number of samples, especially in PRI 12 and PRI 14, that are not similar to background. There is little to be learned from a comparison of the outers (Phase 1A) to the inners (Phase 1A-B). This paragraph should be deleted.

Response: Data from PRIs 11-16 are not being considered as a candidate dataset for background, and US Magnesium/ERM agree there is little utility in comparing outer and inner PRI data. Variance is a critical parameter for calculating sample sizes using the "Compare Average to Reference Average" module in Visual Sample Plan (VSP) (see Section 11.3.7.2 of DQO). Data from PRIs 11-16 are included in the DQO to provide estimates of natural variability in background concentrations, and as noted in Section 11.3.7.2, effort was made to exclude samples from PRIs 11-16 that may be impacted. Removal of the paragraph Section 11.3.1, as requested in the comment, would eliminate the contextual basis for using data from PRIs 11-16 to support sample size calculations described in Section 11.3.7.2.

Rather than removing the text, the following edit is proposed:

> Phase 1A RI soil data: A full suite of metals, D/Fs, HCB, and total PCBs were collected as part of Phase 1A data collected in 2014 (ERM 2014a). PRIs that represent areas where aerial deposition from the stack is the potential contaminant source (PRIs 11-16) provides a ~~relevant, comparative~~ dataset from which an estimate of the variability in concentrations representative of background may be made.

3. <u>Section 11.3.5.1:</u> *While the Agencies agree that it is desirable to ensure that a data set that is called "background" does not contain samples that have been impacted by site related releases, the text that describes the planned analyses should be left more flexible. Accordingly, insert this language at the top of this section:*

   > *Once the background data sets are collected, it will be important to evaluate the data and ensure that samples or areas (if any) that appear to be impacted by site-related contamination are identified and excluded. The exact methods to identify such samples or areas cannot be selected with certainty before the data are obtained, but a number of potentially useful approaches are available, including the following:*

   Retain the text describing the outlier test, geochemical bivariate plots, Q-Q plots, and D/F congener fingerprint analysis. However, comparison of D/F, PCB and HCB data to risk-based screening levels has no conceptual basis in recognizing individual samples or areas that ought to be excluded. This test should be deleted.

   Response: The risk-based screening level comparison text will be deleted as requested. US Magnesium/ERM believe that while flexibility is important, it is equally important, for clarity/transparency, to establish a coherent process (in preference of an *indeterminate* methodology) for evaluating whether background samples are impacted and should be excluded from the background dataset to avoid ambiguity in interpreting results. As such, the following text is proposed as an alternative to the revisions proposed by EPA:

   > Once the background data sets are collected, it will be important to evaluate the data and ensure that samples or areas (if any) that appear to be impacted by site-related contamination are identified and excluded. The ~~exact~~ methodology to identify such samples or areas ~~cannot be selected with certainty before the data are obtained, but a number of potentially useful approaches are available, including the following~~: is described in the Data Quality Assessment (Worksheet 37), and will include the following evaluations:

1. Statistical outlier tests;
2. Graphical evaluations including geochemical bivariate plots and Q-Q plots (see below for more details on these methodologies); and
3. Comparison of D/F congener fingerprints between background samples, other regional background datasets (where available) and US Magnesium site data.

4. *Section 11.3.5.2: EPA agrees that comparisons of site data to background data may be based on a "holistic" assessment using multiple tests. However, as above, this section should begin with text that allows for flexibility in choosing which tests are potentially useful and how the results will be interpreted in the event that multiple tests yield differing conclusions. Accordingly, insert this language at the top of this section:*

> *There are a number of alternative methods that may be used to compare the background data sets to site data sets in order to evaluate whether various areas of the site have been impacted and, if so, by how much. The exact methods that will be most useful and most reliable cannot be selected with certainty before the data are obtained, but a number of potentially useful approaches are available, including the following:*

With regard to the first test (Central Tendency Testing), the Agencies recommend that the main emphasis be placed on the WRS test. The text states that a t-test "will be used when the site and background datasets have parametric probability distributions". A t-test is appropriate only when both distributions are normal, not simply "parametric". The WRS test is appropriate even if both data sets happen to pass a normality test, since the WRS test has nearly the same power as a t-test, and most data sets are not actually normal (even if they pass a normality test)[1]. In addition, this test is relatively insensitive to the occurrence of non-detects, at least if the detection limit is generally similar between site and background data sets.

Footnote [1]: For example, in a set of 100 random data sets of size 14 drawn from a lognormal distribution with CV = 0.8, a total of 43 of the data sets passed the normality test in ProUCL, even though the true distribution is lognormal.

Response: The central tendency test approach described in the DQO will be revised to only use the WRS (or Gehan test*). Similar to the previous comment, flexibility is important, but US Magnesium/ERM also believe that, for clarity/transparency, a coherent process (in preference of an *indeterminate* methodology) should be established to guide the application of background-to-site comparisons to minimize ambiguity in interpretation and decision-making.

The description of the methodology will be revised to include a testing progression (e.g. outlier tests, followed by hypothesis testing, followed by geochemical testing, etc.) with each step potentially yielding a conclusion on whether site is elevated relative to background. The proposed progression is presented below:

Metals:

Outlier test → hypothesis tests (WRS/Gehan and quantile tests) → Q-Q plots → geochemical analysis

Organics:

Outlier test → hypothesis tests (WRS/Gehan and quantile tests) → Q-Q plots → D/F/co-planar fingerprinting.

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* The Gehan test is a nonparametric test that can be used to examine whether differences exist between two populations when the data sets have multiple censoring points / detection limits. The Gehan test is selected because it [i] is easy to explain and [ii] reduces to the WRS test for a single censoring point / detection limit (USEPA 2013).

5. <u>*Section 11.3.5.2:*</u> *The text states that comparisons to background will be conducted on a PRI basis. The Agencies agree that this is the most likely first level of comparison, but the text should allow for comparisons based either on sub-areas of PRIs or on combinations of adjacent PRIs. Accordingly, modify the text as follows:*

    In most cases, initial comparisons to background will be conducted on a PRI basis. In some cases (e.g., if a PRI is noted to have a localized area of contamination), it may be appropriate to subdivide a

> *PRI into zones and compare the differing zones to background. Likewise, if adjacent PRIs or parts of adjacent PRIs appear to be quite similar to each other, it may be appropriate to combine some or all of the data from those similar areas.*

Response: US Magnesium/ERM agree that defining alternative exposure units may have utility. However, US Magnesium/ERM disagree that it is appropriate to sub-divide and/or combine PRIs into alternative units for comparison to background during the Phase 1A-B investigation. The sample designs proposed in the DQOs to investigate the Site during Phase 1A (for Outer PRIs) and Phase 1A-B (for Inner PRIs) are designed specifically to characterize each PRI independently. Comparison to background is integral to that characterization. Investigating units other than the PRIs is outside the scope of Phase 1A-B, but likely will be appropriate in a future step in the project (e.g. future human health and ecological risk assessments). As such, US Magnesium/ERM propose that no revision to Section 11.3.5.2 is required.

6. *<u>Section 11.3.6:</u> This text should simply describe the two basic types of decision errors, and give the tolerance limits for each. Because the definition of Type I and Type II errors is different for Form I and Form II null hypotheses, the discussion should only talk about false negative decisions (concluding the site is not greater than background when it actually is) and false positive decision errors (deciding the site is higher than background when it actually is not). This is not the place to be discussing MDD. See comments on Section 11.3.7.2, below.*

   Response: The discussion on the MDD will be moved to Section 11.3.7.2. Please see response to Comment 8 for the proposed revision.

7. *<u>Section 11.3.7.2:</u> The text states "background D/F, PCBs and HCB are not expected to be influenced by soil type or lithology", so no distinction between upland and lakebed samples is made for organics. This decision is rather uncertain. Even if the amount of organics deposited in the two media were similar (this is not certain, since upland soils will be impacted only by air while lakebed sediments may also be impacted by runoff), differences in organic COPC concentration could occur due to differences*

in various fate and transport processes between the two media types. Consequently, the text should be modified to include the following language:

> *Once the data are collected, this assumption will be evaluated by comparing the levels of organic COPCs in lakebed and upland background samples. If there are differences, and if the existing data sets are not sufficient to allow reliable comparison of site to the appropriate background data set, then additional sampling may be required in Phase II.*

Response: US Magnesium/ERM disagree that runoff is a realistic transport pathway impacting the proposed background locations. It is not a realistic assumption that runoff (transport) from sources at the Facility (e.g. waste piles, waste ponds, etc.) would reach proposed background locations that are greater than 5 miles away, and in some cases up-gradient, from the site. As such, US Magnesium/ERM propose that no revision is warranted to Section 11.3.7.2 regarding background D/F, PCBs and HCB influence by soil type or lithology.

8. *<u>Section 11.3.7.2:</u>*

Note: To address USEPA Comment 8, the comment has been divided into Parts A and B below, with responses provided to each part.

<u>Comment 8 Part A</u>

The text states that "the selection of a sample size that falls to the right of the median of the distribution of potential metal sample sizes calculated by VSP was agreed to by US Magnesium/ERM and USEPA during the March 2015 Phase 1B RI Scoping Meetings as a reasonable approach to selecting an appropriate background sample size." This is not correct and this assertion must be deleted. EPA simply stated that, although EPA had not performed a review of the exact statistical calculations, based on general experience at other sites, it seemed likely that background data sets of 30-36 would be adequate.

Response: The proposed approach was initially suggested by USEPA and discussed at the Scoping meeting on 11 and 12 March 2015. US Magnesium/ERM presented this approach to USEPA in written form on two separate occasions: first, on March 24, and then on April 8, 2015. Both of these communications outlined the approach for discussion on upcoming risk assessment calls. On neither occasion did USEPA provide comments suggesting they disagreed with the approach. Note that the number samples estimated using the proposed approach is validated by USEPA's more recent approach (Comment 8, Part B) and their general experience at other sites.

The following revision is proposed to address the comment:

> The selection of a sample size that falls to the right of the median of the distribution of potential metal sample sizes calculated by VSP was ~~agreed to by US Magnesium/ERM and~~ initially ~~proposed~~ suggested by USEPA during the March 2015 Phase 1B RI Scoping Meetings as a reasonable approach to selecting an appropriate background sample size. US Magnesium/ERM agreed to develop a sample plan following this approach.

Comment 8 Part B

The rationale leading to the estimation of required sample size is rather complex and cumbersome, and contains some weak points. Specifically, the assumption that MDD = 50% of the mean is presented without explanation or justification. Moreover, selection of a sample size based on the median size requirement across different analytes implies that the data sets collected might not be adequate for about half of the analytes…

[Paragraph omitted, addressed above as Part A]

The proposed approach uses Phase 1A and DMA data from outer PRIs to estimate what might be expected for mean and standard deviation values in data sets drawn from background areas. While this is a useful strategy, it is overly complex to use the data on an analyte-by-analyte basis in order to derive a different samples size for each analyte. Rather, the data should be used to draw general conclusions about the most likely *type of distribution (non-normal) and the range of CVs (0.6 to 0.8) that are likely to occur. These general choices can then support the derivation of a general (non-analyte specific) sample size. In choosing the data to use for calculation of CVs using the Phase 1A data, two factors that should be considered include:*

- *Samples that are likely to be site-impacted should be excluded. ERM proposes that samples 10 and 11 in PRI 12 be excluded, and that samples 2-8 from PRI 14 be excluded. However, using TEQ as an indicator of site contamination, these choices may not be best. In PRI 12, samples that appear to be impacted by TEQ include 2-6 and 9. In PRI 14, samples that appear to be impacted by TEQ include 1, 3, 5, 6, 7, and 10. Inclusion of site-impacted samples in the data sets used to calculate statistics will tend to bias both the mean and the standard deviation high, and will make the CV less representative.*
- *Analytes that are limited by low detection frequency (e.g., < 80%) should simply be excluded from this analysis, rather than struggling to derive reliable estimates of the mean and standard deviation in the face of a large number of NDs.*

To minimize these issues, the Agencies recommend a revised presentation of the approach used to select sample size, as presented in the attached alternative text (see below).

Response: US Magnesium/ERM agree that the proposed approach for establishing sample sizes is complex. However, US Magnesium/ERM also believe this approach is technically sound, and is based on the approach discussed at the March 2015 Phase 1A-B RI Scoping Meetings. US Magnesium/ERM appreciate that USEPA provided an alternative approach for consideration (Comment 8, Part B). This alternative approach also has utility in that it validates the conclusions from the original approach by independently arriving at the same background sample sizes. Because both approached yield the same sample sizes, US Magnesium/ERM propose to retain the approach currently presented in Section 11.3.7.5. However, specific comments provided by USEPA for this section do point out opportunities for improving the technical discussion, which US Magnesium/ERM appreciate. As such, these comments will be addressed by making revisions to the text currently presented in 11.3.7.5. These are discussed further below.

1) Regarding the selection of 50% of the mean as the MDD to represent S:

> 50% of the mean is consistent with guidance (USEPA, 2002), which prescribes as a valid approach option, defining S as a proportion of the mean background concentration. An exact value of the proportion is not prescribed however. An S of 50% was selected as a reasonable proportion that balances conservatism with not generating large sample sizes that are infeasible to collect. The discussion of MDD in Section 11.3.6 will be moved to section 11.3.7.5 (per USEPA comment 6), and will be revised to provide better justification. Text revisions are presented at the end of this response.

2) Regarding the comments on CVs, range of standard deviations, inclusion and exclusion of "impacted samples," and the statistics on analytes with a large number of non-detects:

> In concept, US Magnesium/ERM concur with the statements provided in the Comment 8 Part B, above. However, as previously noted, the approach implemented by US Magnesium/ERM generated the same number of samples as the alternative approach presented in Agency comments. US Magnesium/ERM also believe that while more complex than the alternative approach, the original approach is more transparent. The values of 30 (metals) and 36 (organics) are more easily traced through the DQO development steps and presentation tables than the alternative approach. Particularly, with respect to how the Agencies selected 30-36 from a range of 20 to 83 (as shown in the table on the last page of comments). However, US Magnesium/ERM appreciate the Agencies clarifying some background-to-site comparison approach assumptions based on guidance, and will revise the DQO accordingly.

The following revisions will be made to address the comments above:

11.3.5.2 Background Comparison Analyses

Central Tendency Testing

Central tendency testing will be employed in both metal and organics background evaluations. ~~The central tendency tests consist of two steps. First, the distribution of each dataset will be tested by application of the Shapiro-Wilks test. Then depending on the distribution of the dataset~~, The central tendency of the sites and background datasets will be compared using Wilcoxon Rank Sum Test (WRS) (or Gehan Test, where datasets have multiple detection limits) ~~the either parametric or nonparametric analyses as follows:~~

~~1) t-test – will be used when the site and background datasets have parametric probability distributions.~~

~~2) Wilcoxon Rank Sum Test – will be used when the site and background probability distributions do match or both were non-parametrically distributed.~~

The null hypothesis (H_0) for the ~~above~~ WRS/Gehan tests will assume that site concentrations are greater than background (Background Test Form 2 as described in USEPA 2002). The alternative hypothesis (H_A) for this test form is that site concentrations are not greater than background. Central tendency testing requires establishing values for α and β ~~and Δ to generate sample sizes and establishing~~ as acceptable probability thresholds for potential decision errors. These values are discussed further as performance criteria in Section 11.3.6.1.

11.3.6.1 Central Tendency Testing

The central tendency testing requires establishing performance criteria for hypothesis testing. These include:

Type I Error ~~Significance Level (α)~~ – The probability of rejecting a true null hypothesis (H_0) is referred to as a Type I or false positive error and is commonly called the significance level (α) of the test. Because H_0 is that site concentration is greater than the background concentration, a Type I error would be erroneously concluding the site is not greater than background, when in reality it is true. For this evaluation the significance level is set at ~~95~~10percent, or α=0.10~~5~~. This performance criterion means there is a ~~5~~10% chance of a Type I error.

Type II Error ~~Power (1- β)-~~ The probability of accepting a false null hypothesis is referred to as a Type II or false negative error (β). For this evaluation, a Type II error would erroneously conclude the site concentration~~s are~~ is greater than the background concentration, when in reality ~~they are~~ it is not. ~~The statistical power (1- β) of a test is a measure of a test's ability to discern an effect – i.e., reject a false null hypothesis. Consistent with convention, the power is set at 80% (β =0.2). For this evaluation, this performance criteria means there is a 20% chance of a Type II error.~~ For this evaluation and consistent with USEPA guidance (2002), the Type II error is set at 20 percent (β=0.20). This performance criteria means there is a 20 percent chance of a Type II error.

~~Minimum Detectable Difference (MDD or Δ – For the specified errors, the minimum detectable difference (MDD) is the smallest difference that the test can detect. For this evaluation the MDD is set at 50% of the mean concentration of Phase 1A and DMA data from PRIs assumed to not be impacted by the facility (See section 11.3.7.1).~~

~~The central tendency testing parameters α, β, and Δ are used as performance criteria to select appropriate background sample sizes to minimize the risk of decision errors.~~ Performance criteria for the central tendency testing (α=0.1, and β=0.2) are used to establish appropriate background sample sizes. Sample size estimation is described in Step 7, Section 11.3.7.2.

11.3.7.2 Background Sample Size Estimation

Sample Size Calculations

VSP was used to calculate samples sizes using the "Comparison Average to Reference Average" module. For each metal sample, sizes were calculated for Lakebed and Upland datasets independently, and for organics using the PRI 11 through 16 pooled dataset. Sample sizes were calculated based on the following performance criteria~~ for the central tendency test (Section 11.3.6.1)~~ to ensure that future statistical evaluations using the background datasets will have a high probability of meeting acceptable performance criteria~~.~~ ~~If a metal had a normal distribution, its sample size was calculated based on the t-test application. A metal with any other distribution used the Wilcoxon Rank Sum application.~~

α = 0.05 – The probability of committing a Type I error was set to one-half of the performance criteria described in Section 11.3.6.1. This was selected to add an additional level of conservatism to the sample size calculation.

β = 0.2 – The probability of committing a Type II error was set equal to the performance criteria described in Section 11.3.6.1.

S (Minimum Detectable Difference [MDD] or *Δ)* –The MDD is the smallest difference of interest that the test is intended to detect. For this evaluation the MDD is set at 50% of the mean concentration of Phase 1A and DMA data from PRIs assumed to not be impacted by the facility (See Section 11.3.7.1). A MDD of 50 percent of the mean was selected to balance conservatism with preventing the generation of large sample size that are infeasible to collect and is consistent with USEPA (2002) guidance.

9. *Section 11.3.7.5: The Agencies agree that the background study need only be concerned with bulk samples, not fines. However, the set of four reasons*

> *that are listed to support this decision are mainly irrelevant. The only reason that need be cited is that if, there is no important difference observed between site and background bulk data sets, there is no reason to suppose an important difference might occur at the level of the fine fractions.*

Response: Section 11.3.7.5 will be revised as recommended.

References:

United States Environmental Protection Agency (USEPA). 2002. *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites.* USEPA Office of Emergency and Remedial Response. 540-R-01-003, OSWER 9285.7-41. September 2002.

If you have any questions, please contact me at (480) 998-2401.

Sincerely,

David J. Abranovic, P.E.
Project Coordinator (ERM)

DJA/jcb/0132320
Attachments

cc: David Gibby (US Mag)
Mark Ransom (ERM)

Attachment 9Y

9 July 2015 Agency Evaluation of ERM's RTC on Phase 1A-B Background Study DQOs

AGENCY EVALUATION OF
ERM's RTC ON
PHASE 1A-B BACKGROUND STUDY DQOs

1. *Section 11.3.1:* *Edit the following text as marked in yellow:*

   Based on the Phase 1A RI data, PAHs do not appear to be a significant risk driver. Concentrations detected at the PRIs sampled during the Phase 1A were low and exceeded an RBC in only one PRI (the landfill), and do not rank as human or ecological COPCs in any of the outer buffer areas.

   ERM Response: The text will be revised as requested.

   Agency Evaluation: The response is accepted.

2. *Section 11.3.1:* *The text states:*

   > *Phase 1A RI soil data: A full suite of metals, D/Fs, HCB, and total PCBs were collected as part of Phase 1A data collected in 2014 (ERM 2014a). PRIs that represent areas where aerial deposition from the stack is the potential contaminant source (PRIs 11-16) provide a relevant, comparative dataset.*

   It is not clear what is meant by "provide a relevant, comparative dataset". Comparative to what? If this data set is envisioned as a candidate data set for background, this is not correct. Concentrations of analytes in the outer PRIs (i.e., the Phase 1A set) should not be assumed to be background. While some samples may be similar to background, it is readily apparent that there are a number of samples, especially in PRI 12 and PRI 14, that are not similar to background. There is little to be learned from a comparison of the outers (Phase 1A) to the inners (Phase 1A-B). This paragraph should be deleted.

   ERM Response: Data from PRIs 11-16 are not being considered as a candidate dataset for background, and US Magnesium/ERM agree there is little utility in comparing outer and inner PRI data. Variance is a critical parameter for calculating sample sizes using the "Compare Average to Reference Average" module in Visual Sample Plan (VSP) (see Section 11.3.7.2 of DQO). Data from PRIs

11-16 are included in the DQO to provide estimates of natural variability in background concentrations, and as noted in Section 11.3.7.2, effort was made to exclude samples from PRIs 11-16 that may be impacted. Removal of the paragraph Section 11.3.1, as requested in the comment, would eliminate the contextual basis for using data from PRIs 11-16 to support sample size calculations described in Section 11.3.7.2.

Rather than removing the text, the following edit is proposed:

> Phase 1A RI soil data: A full suite of metals, D/Fs, HCB, and total PCBs were collected as part of Phase 1A data collected in 2014 (ERM 2014a). PRIs that represent areas where aerial deposition from the stack is the potential contaminant source (PRIs 11-16) provides a ~~relevant, comparative~~ dataset from which an estimate of the variability in concentrations representative of background may be made.

Agency Evaluation: The response is accepted.

3. <u>*Section 11.3.5.1:*</u> *While the Agencies agree that it is desirable to ensure that a data set that is called "background" does not contain samples that have been impacted by site related releases, the text that describes the planned analyses should be left more flexible. Accordingly, insert this language at the top of this section:*

> *Once the background data sets are collected, it will be important to evaluate the data and ensure that samples or areas (if any) that appear to be impacted by site-related contamination are identified and excluded. The exact methods to identify such samples or areas cannot be selected with certainty before the data are obtained, but a number of potentially useful approaches are available, including the following:*

Retain the text describing the outlier test, geochemical bivariate plots, Q-Q plots, and D/F congener fingerprint analysis. However, comparison of D/F, PCB and HCB data to risk-based screening levels has no conceptual basis in recognizing individual samples or areas that ought to be excluded. This test should be deleted.

ERM Response: The risk-based screening level comparison text will be deleted as requested. US Magnesium/ERM believe that while flexibility is important, it is equally important, for clarity/transparency, to establish a coherent process (in preference of an *indeterminate* methodology) for evaluating whether background samples are impacted and should be excluded from the background dataset to avoid ambiguity in interpreting results. As such, the following text is proposed as an alternative to the revisions proposed by EPA:

> Once the background data sets are collected, it will be important to evaluate the data and ensure that samples or areas (if any) that appear to be impacted by site-related contamination are identified and excluded. The ~~exact~~ methodology to identify such samples or areas ~~cannot be selected with certainty before the data are obtained, but a number of potentially useful approaches are available, including the following:~~ is described in the Data Quality Assessment (Worksheet 37), and will include the following evaluations:
>
> 1. Statistical outlier tests;
>
> 2. Graphical evaluations including geochemical bivariate plots and Q-Q plots (see below for more details on these methodologies); and
>
> 3. Comparison of D/F congener fingerprints between background samples, other regional background datasets (where available) and US Magnesium site data.

Agency Evaluation: The response is accepted.

4. <u>*Section 11.3.5.2:*</u> *EPA agrees that comparisons of site data to background data may be based on a "holistic" assessment using multiple tests. However, as above, this section should begin with text that allows for flexibility in choosing which tests are potentially useful and how the results will be interpreted in the event that multiple tests yield differing conclusions.*

Accordingly, insert this language at the top of this section:

> *There are a number of alternative methods that may be used to compare the background data sets to site data sets in order to evaluate whether various areas of the site have been impacted and, if so, by how much. The exact methods that will be most useful and most reliable cannot be selected with certainty before the data are obtained, but a number of potentially useful approaches are available, including the following:*

With regard to the first test (Central Tendency Testing), the Agencies recommend that the main emphasis be placed on the WRS test. The text states that a t-test "will be used when the site and background datasets have parametric probability distributions". A t-test is appropriate only when both distributions are normal, not simply "parametric". The WRS test is appropriate even if both data sets happen to pass a normality test, since the WRS test has nearly the same power as a t-test, and most data sets are not actually normal (even if they pass a normality test)[1]*. In addition, this test is relatively insensitive to the occurrence of non-detects, at least if the detection limit is generally similar between site and background data sets.*

Footnote [1]*: For example, in a set of 100 random data sets of size 14 drawn from a lognormal distribution with CV = 0.8, a total of 43 of the data sets passed the normality test in ProUCL, even though the true distribution is lognormal.*

ERM Response: The central tendency test approach described in the DQO will be revised to only use the WRS (or Gehan test*). Similar to the previous comment, flexibility is important, but US Magnesium/ERM also believe that, for clarity/transparency, a coherent process (in preference of an *indeterminate* methodology) should be established to guide the application of background-to-site comparisons to minimize ambiguity in interpretation and decision-making.

The description of the methodology will be revised to include a testing progression (e.g. outlier tests, followed by hypothesis testing, followed by geochemical testing, etc.) with each step potentially yielding a conclusion on whether site is elevated relative to background. The proposed progression is presented below:

Metals:
Outlier test → hypothesis tests (WRS/Gehan and quantile tests) → Q-Q plots → geochemical analysis

Organics:
Outlier test → hypothesis tests (WRS/Gehan and quantile tests) → Q-Q plots → D/F/co-planar fingerprinting.

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* The Gehan test is a nonparametric test that can be used to examine whether differences exist between two populations when the data sets have multiple censoring points / detection limits. The Gehan test is selected because it [i] is easy to explain and [ii] reduces to the WRS test for a single censoring point / detection limit (USEPA 2013).

Agency Evaluation: The response is generally accepted, except that an outlier test was not included in the original proposal and should not be identified as an appropriate component of a protocol for comparison of site and background data sets. An outlier test is a technique for identifying unexpected data values with a data set, and is not useful for a between-data-set comparison. While an outlier test is appropriate for ensuring that the background data set does not include any samples that may have been impacted by site releases, an outlier test should not be applied to the site data, because site releases could result in a few individual samples being higher than most others, and exclusion of such samples would tend to decrease the ability to recognize site impacts.

5. *<u>Section 11.3.5.2:</u> The text states that comparisons to background will be conducted on a PRI basis. The Agencies agree that this is the most likely first level of comparison, but the text should allow for comparisons based either on sub-areas of PRIs or on combinations of adjacent PRIs. Accordingly, modify the text as follows:*

> *In most cases, initial comparisons to background will be conducted on a PRI basis. In some cases (e.g., if a PRI is noted to have a localized area of contamination), it may be appropriate to subdivide a PRI into zones and compare the differing zones to background.*

Likewise, if adjacent PRIs or parts of adjacent PRIs appear to be quite similar to each other, it may be appropriate to combine some or all of the data from those similar areas.

ERM Response: US Magnesium/ERM agree that defining alternative exposure units may have utility. However, US Magnesium/ERM disagree that it is appropriate to sub-divide and/or combine PRIs into alternative units for comparison to background during the Phase 1A-B investigation. The sample designs proposed in the DQOs to investigate the Site during Phase 1A (for Outer PRIs) and Phase 1A-B (for Inner PRIs) are designed specifically to characterize each PRI independently. Comparison to background is integral to that characterization. Investigating units other than the PRIs is outside the scope of Phase 1A-B, but likely will be appropriate in a future step in the project (e.g. future human health and ecological risk assessments). As such, US Magnesium/ERM propose that no revision to Section 11.3.5.2 is required.

Agency Evaluation: Although the Agencies see little reason for deferring a spatial analysis that considers within- and between-PRI spatial patterns, if this is performed "in a future step in the project", the response is accepted.

6. *Section 11.3.6: This text should simply describe the two basic types of decision errors, and give the tolerance limits for each. Because the definition of Type I and Type II errors is different for Form I and Form II null hypotheses, the discussion should only talk about false negative decisions (concluding the site is not greater than background when it actually is) and false positive decision errors (deciding the site is higher than background when it actually is not). This is not the place to be discussing MDD. See comments on Section 11.3.7.2, below.*

   ERM Response: The discussion on the MDD will be moved to Section 11.3.7.2. Please see response to Comment 8 for the proposed revision.

   Agency Evaluation: The response is accepted.

7. *Section 11.3.7.2: The text states "background D/F, PCBs and HCB are*

not expected to be influenced by soil type or lithology", so no distinction between upland and lakebed samples is made for organics. This decision is rather uncertain. Even if the amount of organics deposited in the two media were similar (this is not certain, since upland soils will be impacted only by air while lakebed sediments may also be impacted by runoff), differences in organic COPC concentration could occur due to differences in various fate and transport processes between the two media types. Consequently, the text should be modified to include the following language:

> *Once the data are collected, this assumption will be evaluated by comparing the levels of organic COPCs in lakebed and upland background samples. If there are differences, and if the existing data sets are not sufficient to allow reliable comparison of site to the appropriate background data set, then additional sampling may be required in Phase II.*

ERM Response: US Magnesium/ERM disagree that runoff is a realistic transport pathway impacting the proposed background locations. It is not a realistic assumption that runoff (transport) from sources at the Facility (e.g. waste piles, waste ponds, etc.) would reach proposed background locations that are greater than 5 miles away, and in some cases up-gradient, from the site. As such, US Magnesium/ERM propose that no revision is warranted to Section 11.3.7.2 regarding background D/F, PCBs and HCB influence by soil type or lithology.

Agency Evaluation: The response is not adequate. The Agencies did not intend to suggest that runoff from site sources was a likely mechanism that could impact any of the potential background sampling locations. Rather, this comment simply suggested that runoff from upland background areas could result in transport of persistent organic chemicals into lakebed background areas. However, regardless of Agency or ERM expectations as to whether this and/or other fate and transport processes might or might not result in differences between upland and lakebed background concentrations of organics, it will be necessary to compare the concentrations of organic analytes in upland and lakebed background samples once the data are collected. The paragraph provided above in the Agency comment must be inserted.

8. *Section 11.3.7.2:*

Note: To address USEPA Comment 8, the comment has been divided into Parts A and B below, with responses provided to each part.

Comment 8 Part A

The text states that "the selection of a sample size that falls to the right of the median of the distribution of potential metal sample sizes calculated by VSP was agreed to by US Magnesium/ERM and USEPA during the March 2015 Phase 1B RI Scoping Meetings as a reasonable approach to selecting an appropriate background sample size." This is not correct and this assertion must be deleted. EPA simply stated that, although EPA had not performed a review of the exact statistical calculations, based on general experience at other sites, it seemed likely that background data sets of 30-36 would be adequate.

Response: The proposed approach was initially suggested by USEPA and discussed at the Scoping meeting on 11 and 12 March 2015. US Magnesium/ERM presented this approach to USEPA in written form on two separate occasions: first, on March 24, and then on April 8, 2015. Both of these communications outlined the approach for discussion on upcoming risk assessment calls. On neither occasion did USEPA provide comments suggesting they disagreed with the approach. Note that the number samples estimated using the proposed approach is validated by USEPA's more recent approach (Comment 8, Part B) and their general experience at other sites.

The following revision is proposed to address the comment:

> The selection of a sample size that falls to the right of the median of the distribution of potential metal sample sizes calculated by VSP was ~~agreed to by US Magnesium/ERM and~~ initially ~~proposed~~ suggested by USEPA during the March 2015 Phase 1B RI Scoping Meetings as a reasonable approach to selecting an appropriate background sample size. US Magnesium/ERM agreed to develop a sample plan following

this approach.

Agency Evaluation: The response is not acceptable. EPA did not propose or suggest the specific statistical approach, but rather tentatively agreed in general terms with the number of samples proposed. The approach should simply be presented without any attempt to state or imply that this approach was suggested and/or approved by the Agencies.

This comment and response raises a general issue that requires careful consideration. Scoping meeting discussions and technical phone calls between the Agencies and ERM must not be over-interpreted. Spontaneous ideas and thoughts offered in scoping meetings and during teleconferences by individual members of the Agency team do not constitute "Agency approval". To do so would completely defeat the purpose of technical discussions between the parties, since no individual would feel free to offer ideas or suggestions for consideration by the group. Likewise, absence of comment on a proposed approach during risk assessor calls does not constitute approval. Unless specifically stated to represent Agency position, all ideas and thoughts offered during technical discussions should be considered as EPA's 'deliberative process.'

Comment 8 Part B

The rationale leading to the estimation of required sample size is rather complex and cumbersome, and contains some weak points. Specifically, the assumption that MDD = 50% of the mean is presented without explanation or justification. Moreover, selection of a sample size based on the median size requirement across different analytes implies that the data sets collected might not be adequate for about half of the analytes…
[Paragraph omitted, addressed above as Part A]
The proposed approach uses Phase 1A and DMA data from outer PRIs to estimate what might be expected for mean and standard deviation values in data sets drawn from background areas. While this is a useful strategy, it is overly complex to use the data on an analyte-by-analyte basis in order to derive a different samples size for each analyte. Rather, the data should be used to draw general conclusions about the most likely type of distribution (non-normal) and the range of CVs (0.6 to 0.8) that are likely to occur. These general choices can then support the derivation of a general (non-analyte specific) sample size. In choosing the data to use

for calculation of CVs using the Phase 1A data, two factors that should be considered include:

- *Samples that are likely to be site-impacted should be excluded. ERM proposes that samples 10 and 11 in PRI 12 be excluded, and that samples 2-8 from PRI 14 be excluded. However, using TEQ as an indicator of site contamination, these choices may not be best. In PRI 12, samples that appear to be impacted by TEQ include 2-6 and 9. In PRI 14, samples that appear to be impacted by TEQ include 1, 3, 5, 6, 7, and 10. Inclusion of site-impacted samples in the data sets used to calculate statistics will tend to bias both the mean and the standard deviation high, and will make the CV less representative.*
- *Analytes that are limited by low detection frequency (e.g., < 80%) should simply be excluded from this analysis, rather than struggling to derive reliable estimates of the mean and standard deviation in the face of a large number of NDs.*

To minimize these issues, the Agencies recommend a revised presentation of the approach used to select sample size, as presented in the attached alternative text (see below).

ERM Response: US Magnesium/ERM agree that the proposed approach for establishing sample sizes is complex. However, US Magnesium/ERM also believe this approach is technically sound, and is based on the approach discussed at the March 2015 Phase 1A-B RI Scoping Meetings. US Magnesium/ERM appreciate that USEPA provided an alternative approach for consideration (Comment 8, Part B). This alternative approach also has utility in that it validates the conclusions from the original approach by independently arriving at the same background sample sizes. Because both approached yield the same sample sizes, US Magnesium/ERM propose to retain the approach currently presented in Section 11.3.7.5. However, specific comments provided by USEPA for this section do point out opportunities for improving the technical discussion, which US Magnesium/ERM appreciate. As such, these comments will be addressed by making revisions to the text currently presented in 11.3.7.5. These are discussed further below.

1) Regarding the selection of 50% of the mean as the MDD to represent S:

> 50% of the mean is consistent with guidance (USEPA, 2002), which prescribes as a valid approach option, defining S as a proportion of the mean background concentration. An exact value of the proportion is not prescribed however. An S of 50% was selected as a reasonable proportion that balances conservatism with not generating large sample sizes that are infeasible to collect. The discussion of MDD in Section 11.3.6 will be moved to section 11.3.7.5 (per USEPA comment 6), and will be revised to provide better justification. Text revisions are presented at the end of this response.

2) Regarding the comments on CVs, range of standard deviations, inclusion and exclusion of "impacted samples," and the statistics on analytes with a large number of non-detects:

> In concept, US Magnesium/ERM concur with the statements provided in the Comment 8 Part B, above. However, as previously noted, the approach implemented by US Magnesium/ERM generated the same number of samples as the alternative approach presented in Agency comments. US Magnesium/ERM also believe that while more complex than the alternative approach, the original approach is more transparent. The values of 30 (metals) and 36 (organics) are more easily traced through the DQO development steps and presentation tables than the alternative approach. Particularly, with respect to how the Agencies selected 30-36 from a range of 20 to 83 (as shown in the table on the last page of comments). However, US Magnesium/ERM appreciate the Agencies clarifying some background-to-site comparison approach assumptions based on guidance, and will revise the DQO accordingly.

The following revisions will be made to address the comments above:

11.3.5.2 Background Comparison Analyses

Central Tendency Testing

Central tendency testing will be employed in both metal and organics background evaluations. ~~The central tendency tests consist of two steps. First, the distribution of each dataset will be tested by application of the Shapiro-Wilks test. Then depending on the distribution of the dataset,~~ The central tendency of the sites and background datasets will be compared using Wilcoxon Rank Sum Test (WRS) (or Gehan Test, where datasets have multiple detection limits) ~~the either parametric or nonparametric analyses as follows:~~

~~1) t-test – will be used when the site and background datasets have parametric probability distributions.~~

~~2) Wilcoxon Rank Sum Test – will be used when the site and background probability distributions do match or both were non-parametrically distributed.~~

The null hypothesis (H_0) for the ~~above~~ WRS/Gehan tests will assume that site concentrations are greater than background (Background Test Form 2 as described in USEPA 2002). The alternative hypothesis (H_A) for this test form is that site concentrations are not greater than background. Central tendency testing requires establishing values for □and □~~and Δ to generate sample sizes and establishing~~ as acceptable probability thresholds for potential decision errors. These values are discussed further as performance criteria in Section 11.3.6.1.

11.3.6.1 Central Tendency Testing

The central tendency testing requires establishing performance criteria for hypothesis testing. These include:

> Type I Error ~~Significance Level (α)~~ – The probability of rejecting a true null hypothesis (H_0) is referred to as a

Type I or false positive error and is commonly called the significance level (α) of the test. Because H0 is that site concentration is greater than the background concentration, a Type I error would be erroneously concluding the site is not greater than background, when in reality it is true. For this evaluation the significance level is set at ~~95~~10percent, or α=0.10~~5.~~ This performance criterion means there is a ~~5~~10% chance of a Type I error.

Type II Error ~~Power (1- β)~~ The probability of accepting a false null hypothesis is referred to as a Type II or false negative error (β). For this evaluation, a Type II error would erroneously conclude the site concentration~~s are~~ is greater than the background concentration, when in reality ~~they are~~ it is not. ~~The statistical power (1- β) of a test is a measure of a test's ability to discern an effect – i.e., reject a false null hypothesis. Consistent with convention, the power is set at 80% (β =0.2). For this evaluation, this performance criteria means there is a 20% chance of a Type II error.~~ For this evaluation and consistent with USEPA guidance (2002), the Type II error is set at 20 percent (β=0.20). This performance criteria means there is a 20 percent chance of a Type II error.

~~Minimum Detectable Difference (MDD or Δ – For the specified errors, the minimum detectable difference (MDD) is the smallest difference that the test can detect. For this evaluation the MDD is set at 50% of the mean concentration of Phase 1A and DMA data from PRIs assumed to not be impacted by the facility (See section 11.3.7.1).~~

~~The central tendency testing parameters ☐, ☐ and Δ are used as performance criteria to select appropriate background sample sizes to minimize the risk of decision errors.~~ Performance criteria for the central tendency testing (☐=0.1, and ☐=0.2) are used to establish appropriate background sample sizes. Sample size estimation is described in Step 7, Section 11.3.7.2.

11.3.7.2 Background Sample Size Estimation

Sample Size Calculations

VSP was used to calculate samples sizes using the "Comparison Average to Reference Average" module. For each metal sample, sizes were calculated for Lakebed and Upland datasets independently, and for organics using the PRI 11 through 16 pooled dataset. Sample sizes were calculated based on the following performance criteria ~~for the central tendency test (Section 11.3.6.1)~~ to ensure that future statistical evaluations using the background datasets will have a high probability of meeting acceptable performance criteria: ~~If a metal had a normal distribution, its sample size was calculated based on the t-test application. A metal with any other distribution used the Wilcoxon Rank Sum application.~~

> α = 0.05 – The probability of committing a Type I error was set to one-half of the performance criteria described in Section 11.3.6.1. This was selected to add an additional level of conservatism to the sample size calculation.
>
> β = 0.2 – The probability of committing a Type II error was set equal to the performance criteria described in Section 11.3.6.1.
>
> S (Minimum Detectable Difference [MDD] or Δ) –The MDD is the smallest difference of interest that the test is intended to detect. For this evaluation the MDD is set at 50% of the mean concentration of Phase 1A and DMA data from PRIs assumed to not be impacted by the facility (See Section 11.3.7.1). A MDD of 50 percent of the mean was selected to balance conservatism with preventing the generation of large sample size that are infeasible to collect and is consistent with USEPA (2002)

guidance.

Agency Evaluation: The response is generally acceptable, except that the text of Section 11.3.6.1 should be revised to clarify that the choices of α and β are needed to estimate sample size, but that this does not guarantee that the risk of Type I and Type II decision errors will be within tolerance limit goals. This can only be determined by a data adequacy assessment after the data are collected.

9. *Section 11.3.7.5: The Agencies agree that the background study need only be concerned with bulk samples, not fines. However, the set of four reasons that are listed to support this decision are mainly irrelevant. The only reason that need be cited is that if, there is no important difference observed between site and background bulk data sets, there is no reason to suppose an important difference might occur at the level of the fine fractions.*

Response: Section 11.3.7.5 will be revised as recommended.

Agency Evaluation: The response is acceptable.

References:

United States Environmental Protection Agency (USEPA). 2002. *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites.* USEPA Office of Emergency and Remedial Response. 540-R-01-003, OSWER 9285.7-41. September 2002.

Attachment 9Z

17 July 2015 Re: US Magnesium NPL Site: Comments and Modifications to Draft Phase 1A-B SAP

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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Via electronic-mail

July 17, 2015

Ref: EPR-SR

David Abranovic, P.E.
ERM West, Inc.
7272 E. Indian School Road, Suite 100
Scottsdale, AZ 85251

Re: US Magnesium NPL Site: Comments and Modifications to Draft Phase 1A-B SAP

Dear Mr. Abranovic:

The Environmental Protection Agency (EPA) and Utah Department of Environmental Quality (UDEQ) (the Agencies) have reviewed ERM's July 2, 2015 submittal of a Draft Phase 1A-B Sampling and Analysis Plan (SAP) and hereby provide comments and modifications on the date we had set as a goal.

Thank you for the numerous discussions PWT has had with your staff since July 6th to address specific items and get correction-replacement worksheets into the Draft for review.

As you reported on Tuesday this week, ERM has reviewed EPA's final July 9, 2015 comments for the Background Study DQO Sec. 11.3, and ERM will incorporate that modified document into the Draft Final SAP to be prepared for EPA approval.

EPA has prepared the 'Preface' for the Ph1A-B SAP, and has also included text for Sec. 2.0 'Overall Objectives and Structure of the Remedial Investigation Activities for the RIFS.' The Preface recounts the history and transition that occurred from the Ph1A SAP of September 2013 to this document. Sec. 2.0 presents the overall context of the ongoing RIFS process, into which this specific Ph1A-B SAP fits.

Pursuant to the March 11-12, 2015 scoping meeting and ERM's use of the Ph1A SAP document format provided by PWT, the Agencies found this draft document to be well-prepared and easy to review. Hopefully ERM will find the modifications sufficient for preparation and submittal of a Draft Final SAP for EPA review and final approval. SAP issuance as soon as possible could enable ERM to initiate field work as early as possible in the remaining field season.

In accordance with AOC Sec. 39(c), EPA has modified the submission to cure deficiencies. Accordingly, this comment and notice affords ERM the opportunity to cure the Draft SAP within twenty (20) days. As planned in the anticipated SAP schedule you provided (6/1/15), this 20 days accommodates ERM's review of comments and informal consultation with EPA (if necessary), and for ERM to decide (in accordance with AOC Sections 40 and 58-60) if it chooses to invoke Dispute Resolution on any particular matter.

Lastly, as we discussed last week regarding EPA comments and modifications to the Draft Worksheet #16, the finalization of Worksheet #16 Project Schedule is something we can discuss as the last element of EPA's Final SAP approval. I look forward to completing that as we move towards SAP approval in the coming days.

Thank you very much for moving the Ph1A-B SAP phase of RI work towards 2015 completion.

Sincerely,

Ken Wangerud

Ken Wangerud, RPM
Superfund Remedial Response Program

Enclosure 1 – Agency Comment Summary for Draft Phase 1A-B RI SAP (ERM, 2 July 2015)
Enclosure 1, Attachment 1 – Region 8 GIS Deliverable Guidance
Enclosure 1, Attachment 2 – RIFS Project Plan (EPA, July 2015)
Enclosure 2a – Agency RLSO Draft Ph1A-B SAP (17 July 2015) in .pdf
Enclosure 2b – Agency RLSO Draft Ph1A-B SAP (17July 2015) in .docx

cc: David Gibby, US Magnesium
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Agency Technical Comments on ERM's
DRAFT OPERABLE UNIT 1 PHASE 1A-B RI SAP
(Document Transmission Date: 2 July 2015)
U.S. MAGNESIUM NPL SITE, TOOELE COUNTY, UTAH
17 July 2015

Attachments

Attachment 1: U.S. EPA Region 8 GIS Deliverable Guidance, Version 1.0, January 6, 2014
Attachment 2: RIFS Project Plan, U.S. EPA, July 2015

INTRODUCTION

The U.S. Environmental Protection Agency (EPA) and the Utah Department of Environmental Quality are providing the following comments on the *Draft Operable Unit 1 Phase 1A-B RI SAP, Revision 0, for the US Magnesium NPL Site, Tooele County, Utah* (Phase 1A-B SAP). The Phase 1A-B SAP was prepared by Environmental Resource Management (ERM) and submitted to the EPA 2 July 2015.

The EPA is appreciative of the numerous consultations between technical staff during the 10-day review period allotted to the agencies. These consultations reduced the need for exchanges of written comments and potentially complicated communications. Examples include:

- Worksheet #12 with regards to the inclusion or elimination of matrix spike duplicates. The inconsistency identified within Worksheet #12 could have had potential impact throughout the remainder of the Phase 1A-B SAP. A single email clarified the need for correction and saved unnecessary changes throughout the redline/strikeout submittal.
- Attachment 15 with regards to an error in calculating the PCB and Dioxin/Furan Target Quantitation Limits. ERM provided a revised Attachment 15, correcting the error; therefore, no comments are included herein. However, the EPA anticipates the inclusion of the revised Attachment 15 in the draft final Phase 1A-B SAP.
- Worksheet #37 with regards to data usability assessment for background samples. A phone call between the EPA risk assessment team and ERM provided insight as to the intent of ERM's text throughout Section 37.4. The redline/strikeout submittal includes text changes resulting from that consultation. Again, the telephone consultation eliminated the need for wrongful interpretation by the agencies of unclear text provided in the Phase 1A-B SAP.

The comments below supplement a Word version of the main text of the document in which the Agencies have inserted redline/strikeout changes to the text.

SPECIFIC COMMENTS

1. **Page i, Preparer's Name and Organizational Affiliation**: The EPA invites ERM to include their company logo on this page.
2. **Page XI, List of Attachments, Attachment 29B**: This guidance has been updated. A copy of the January 2014 guidance has been provided as Attachment 1 to these comments. Update the Phase 1A-B SAP as necessary.
3. **Section 2.0**: Attachment 2 as noted in the new text has been provided as Attachment 2 to these comments for inclusion in the Phase 1A-B SAP.
4. **Section 9.0**: Prior to submittal of the draft final Phase 1A-B SAP, update Worksheet #9 to include documentation of scoping discussions (emails, comments, response to comments, etc.) related to the Background DQO Section 11.3 culminating in the final text being included in the draft final Phase 1A-B SAP.

5. **Section 10.1, PRI Area 7 – Northeast Ponded Waste Lagoon, first paragraph**: The sentence was stricken as the presence or absence of a NPDES permit is unnecessary and irrelevant to CERCLA investigations.
6. **Section 11.3**: The EPA notes that ERM has accepted the Final DQO language as provided by the EPA to ERM on 2 June 2015, and ERM will incorporate the approved text accordingly into the final SAP for EPA approval. Therefore, this comment deliverable does not include comments or directions for Section 11.3.
7. **Section 16.0**: UFP QAPP Manual Section 2.8.2 addresses the need for project-specific schedule requirements. Section 2.1.1 of the AOC-SOW requires a SAP to include a schedule. Pursuant to the above, draft Worksheet #16 only needs to include certain key project milestones, deliverable due dates, and completion dates for this project-specific SAP, in order to maintain progress consistent with overall RI/FS project objectives. In order to conform Worksheet #16 to the Progress Report requirements of the AOC-SOW and the UFP QAPP Manual, the EPA has modified Worksheet #16 proposed by ERM to, among other things, add several (interim deliverable) milestones and due dates that will document the progress of SAP activities.
8. **Worksheet 16, Table**: The activities included in the rows stricken by the EPA were not elements included on the April 15 or June 1, 2015 project schedule prepared by ERM. In addition, these activities are not key project milestones for the RI/FS.
9. **Worksheet 16, Table**: Provide rationale as to why the surface solids sampling of background reference areas and surface solids sampling at Inner PRI areas cannot be done concurrently. Concurrent sampling would provide a margin of safety with regards to inclement weather delays to the field activities.
10. **Section 37.4.2**: Because a comparison between Site and background will be performed, and because the PCB fingerprint for Site samples is likely to be dominated by PCB-209 (which is not coplanar), restrictions to coplanars have been deleted throughout this section.
11. **Section 37.4.2.4, second to last sentence of paragraph**: If the fingerprint of a background sample is similar to both Site and regional background, then fingerprint analysis is very unlikely to be useful. Either delete this sentence or edit to clarify the point being made.

SOP USM-12 Surface Solids Sampling within Current Wastewater Ponds Standard Operating Procedure

12. **Page 1, Footer**: "SOP USM-21, Surface Soil, Sediment, and Waste Sampling" does not match the SOP title. Revise the footnote accordingly.
13. **Page 8, Section 6.3 Grab Sampler Procedures, Step 17**: Step 17 details the protocol for performing additional attempts to collect an acceptable sample. Revise Step 17 to clearly define how many attempts and what constitutes a *successful* attempt:
    a. A minimum of three successful attempts with EACH sampling device must be completed at each SAP location.
    b. Successful attempts are defined as the sample collection equipment functions properly with adequate weight to deploy and penetrate. For example:
        i. Malfunction of the spring-release mechanism is not to be considered a successful attempt.
        ii. Inadequate penetration which can be rectified by additional weights is not to be considered a successful attempt.
14. **Page 9, Section 6.3 Grab Sampler Procedures, Step 17d, second sentence**: Revise text as follows:

    Using an excavator at the near-shore sample location, collect the sample following steps 1 through ~~15~~17a.

15. **Attachment 1, Equipment List**: Change table to make box corer a required piece of equipment.

U.S. EPA Region 8
GIS Deliverable Guidance

Region 8 Ecosystems Protection and Remediation

Program Support

Data Systems Team

GIS

Version1.0

January 6, 2014

Document Revision History

Date	Author	Version	Description
1/6/14	John Wieber	1.0	Final

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Contents

Purpose

The purpose of this document is to provide guidance to contractors, grantees, or others who provide GIS deliverables to EPA Region 8 programs, projects, or staff.

Scope

This document covers the types of GIS deliverables anticipated in Region 8 and how the Region would like to receive these deliverables. Additionally, data standards, formats, and best management practices are identified.

Responsibilities

The Region 8 GIS team is responsible for maintaining this document and providing it to those parties wishing to provide Region 8 with spatial data or products. It is the responsibility of those providing deliverables to the Region to adhere to the guidance provided in this document to the best of their abilities. The Region 8 GIS team relies on other EPA staff such as grant/contracting officers, RPMs, and inspectors to ensure data are getting submitted for long-term use at EPA.

Introduction

This document is intended to specify GIS file delivery formats for all geospatial materials developed in support of GIS related work within EPA Region 8. It is the intent of EPA Region 8 to acquire, catalog and manage all GIS files comprehensively across all projects to:

1) ensure future use and access to EPA,
2) provide an archive of work accomplished,
3) maintain and serve data that spatially represent features pertinent to on-going EPA efforts, and
4) provide a basis for future activities such as CERCLA Five Year Review.

GIS Formatted Data Files

All final version spatially enabled files acquired or developed to support mapping and/or spatial analysis by a contractor or grantee are considered property of the EPA and are required to be submitted to EPA. Delivery schedules are negotiable, but should be annual at a minimum. This includes but is not limited to all GIS, CAD, and image formatted files used to develop maps for any scoping or decision document developed for EPA, as well as any spatial file used to inform a decision on site management or development. Only final versions of each layer are required for delivery to EPA, and must be in an approved format as specified in this document. In addition, all electronic geospatial data, whether vector or raster, must be projection defined (have a projection defined and embedded in or associated with the data file), and in the case of CAD data must NOT be in page space or a custom site-specific projection. All CAD data must be in known real world coordinate space, ideally conforming to the projection specifications outlined below. Should tabular data be appropriate to connect location information with attribute information, then documentation specifying the primary and foreign keys is required. Should coordinate information be provided in tabular format it should contain at minimum the following fields:

ID – a unique identifier given to each feature
Latitude – the Y coordinate in decimal degrees, 6 significant digits
Longitude – the X coordinate in decimal degrees, 6 significant digits
Horizontal Datum – the datum of the coordinates.

Additionally all static maps that appear in an EPA document should be in an electronic Adobe PDF format with fonts embedded and at a resolution of 300 dots per inch (dpi) or greater. Finally, any dynamic maps used in final map production, such as ESRI ArcMap documents (.mxd), may also required for delivery to EPA with accompanying data in a stand-alone directory structure. Such documents are recommended to be provided as ESRI map packages (.mpk).

Projection Requirements

All GIS files submitted to EPA must have spatial reference information that describes the projection, datum, and where applicable the collection methods. The EPA requests that all vector data be submitted in geographic coordinate system, decimal degree units, and NAD83 datum, as is required under the EPA National Geospatial Data Policy, 2008. Raster data, such as aerial photographs may be submitted in their native projection, and maps should be in the appropriate projection/coordinate system for the area depicted. EPA Region 8 GIS staff will be happy to consult and advise on projection, coordinate, and datum details for submission to EPA.

Metadata Requirements

All GIS files developed for EPA are required by Executive Order 12906 to have associated metadata. EPA requires FGDC compliant metadata on all GIS files developed for site support. Region 8 also requires that all dynamic maps (ArcMap documents) have metadata completed. The Content Standard for Digital Geospatial Metadata can be found at www.fgdc.gov. Metadata, including information about the data's projection, can be developed using one of several built-in or add on tools within a GIS, and typically is associated with the geometry file as an XML file. EPA Region 8 GIS staff will be happy to consult and advise on development of required metadata.

Organizational Requirements

If the project is complex, a directory structure and readme text file in the upper level directory that describes the structure is required. Because EPA will be managing data across many projects, it is important to make your submittals as understandable as possible. A recommended directory structure is as follows:

<**Project_Name**>
|_ **Docs** (reports, SOPs, correspondence, and other such documents)
|_ **Images** (aerial photos, satellite imagery, logos, DEMs, and other raster type data)
|_ **Maps** (MXDs and PDFs. Map names should use the project name as a prefix)
|_ **Shapes** (geodatabases, shape files, and other approved vector data formats)
|_ **Source** (original unmodified data that may have been acquired from external/internal sources)
|_ **Tables** (MS-Access databases, spreadsheets, delimited text files, or other such tabular data not stored in a geodatabase)

File naming conventions should be logical, consistent, and contain no spaces or special characters. An underscore may be used in lieu of a space.

Delivery Requirements

EPA will accept data delivered on CD-Rom, DVD, or external hard drive, as well as direct electronic submission via email or FTP site. Other delivery methods may be allowed if those requirements present a significant burden or as technology changes.

EPA Acceptable Data Formats

The following file formats are considered acceptable and all maps and data must include an associated metadata document:

DATA
Vector - **projected to geographic, decimal degrees, NAD83**
File Geodatabase (.gdb) *Preferred Shape File (.shp, .shx, .dbf, .prj, .sbx, .sbn) Personal Geodatabase (.mdb) ESRI Map Package (.mpk)
Raster – **native projection acceptable**
TIFF image with world reference file or as a GeoTIFF (.tif, .tfw) JPEG image with world reference file (.jpg, .jpw) ERDAS Imagine image with pyramid file (.img, .rrd) MrSid image (.sid) ESRI Grid DEM
TINs – **appropriate projection/coordinate system for the area depicted**
ESRI TIN
CAD - **projected to geographic, decimal degrees, NAD83**
DXF layer separates (.dxf)
Tabular – **primary keys should be clearly identified/documented**
MS-Access database (.mdb) MS-Excel spreadsheet (.xls) Delimited text file (.txt, .csv)
MAPS
Static
Adobe PDF at 300 dpi or better with embedded fonts (.pdf)
Dynamic
ESRI Map Package (.mpk)

FGDC Compliant METADATA
XML (.xml)

ATTACHMENT 2 US Magnesium NPL Site: Site Management & Project Plan (EPA, July 2015)

		REMEDIAL INVESTIGATION(s) & FEASIBILITY STUDY(s)									
TIMELINE		OU1 - Outer & Inner PRIs (incl. surface- and ground-water)								OU2 - Sitewide Air Contamination	
Year	Months	REMEDIAL INVESTIGATIONS - FEASIBILITY STUDIES									
		Outer PRIs 8 -16 (+ Hydro PRI17)		Inner PRIs 1-7		Sitewide Hydrology (SW & GW)		Screening-FS & Treatability Study(s)		Air-Pathway Chronic-COPCs	
2012		Field-&-Lab DMA for Soil, Sediments, Waste, & Water								DMAs for Air Samplers & Lab	
2013	Jan-Mar	Ph1A Scoping, DQOs, & SAP development									
	Apr-Jun									AERMOD-analysis of seasonal air-distribution	
	Jul-Sep	EPA issued Sitewide Ph1A SAP for COPCs: w/offer of SLRA-AltFS for InnerPRIs				Wells-Piezometers Installed					
	Oct-Dec	Ph1A sampling of Outer PRIs		*Historic data & SLRA development for AltFS-fastrack*							
2014	Jan-Mar					GW-chemistry samples				SAP for Chronic-COPCs	
	Apr-Jun	Data validation				Water-levels (wells & staff-guages)					
	Jul-Sep	ERM Draft OuterPRIs Data-Report								Ph1A - Sampling for Chronic-COPCs	
	Oct-Dec			*SLRA draft*	*AltFS offer declined*			Salt-Cap TS scoping		EPA Draft DQO for Cl_2-HCl	
2015	Jan-Mar	EPA review Draft Data-Report		Ph1A-B scoping & DQO-SAP for Detailed-BRA & Site-Characterization						ERM-EPA consults re Cl2-HCl scoping/sampling	AERMOD & DQO for Cl2-HCl stations
	Apr-Jun					Surface-water samples/chemistry		Accumul. Test Plan	SCAT-cell		
	Jul-Sep	Ph1A OuterPRI Report		Ph1A-B sampling for COPCs & Backgrnd		SW-data Addend	Hydro-CSM	SCTS Workplan	Leach-test design	Gastronics Cl_2-HCl DMA	Cl_2-HCl Ph2 SAP for N&E
	Oct-Dec	Problem Formulation		& Prel N&E	Valid. & Prel. data-report	Scope add'l SW-GW investig.		ScreeningFS: ARARs & Remedy Goals		Ph1A Chronic-COPCs Report	Collect sitewide Cl2-HCl data
2016	Jan-Mar	Ph2 Biotic-sampling DQOs & SAP	Ph2 N&E DQOs	Ph2 scoping & DQOs for N&E		Ph2 Hydro-DQOs for N&E		Implement Salt-Cap Treatability Study	ScreeningFS Plan	ID Air-Chronic COPC(s)	
	Apr-Jun	Ph2 Biotic-SAP sampling	Ph2 N&E Dft SAP	Ph2 N&E Fnl SAP		Ph2 Hydro-SAP			Dft ScreenFS TM		
	Jul-Sep	Sitewide Ph2 N&E Sampling							Fnl ScreenFS Rpt		
	Oct-Dec									Validate Cl_2-HCl data	
2017	Jan-Mar	ERM data-validation & site-characterization mapping								Draft Air-RI Report	
	Apr-Jun	ERM prepare Draft data-report(s)							Pre-FS Scoping	AIR Risk Evaluation	
	Jul-Sep	Agency rev & ERM finalize data/mapping						SCTS Report			
	Oct-Dec	Remedial Investigation & Site Characterization Final Report and BASELINE RISK ASSESSMENT REPORT								Air-Findings into RI & BRA Reports	
2018	Jan-Mar	ARARs & Risk-Based RAOs for FS-development								(as appropriate) CAA & CERCLA deliberations re risk-reduction	
	Apr-Jun	Select response-alternatives for Draft FS Workplan									
	Jul-Sep	Agency rev/approve Detailed-FS workplan									
	Oct-Dec	Develop Detailed-FS									
2019	Jan-Mar										
	Apr-Jun	Draft-FS for Agency review									
	Jul-Sep	Detailed-FS Final Report									
	Oct-Dec	Remedial Investigation & Feasibility Study draft report									
2020	Jan-Mar	Agency review of Draft RIFS report									
	Apr-Jun	Final RIFS Report for Agency approval									
	Jul-Sep	EPA-Reg8 & UDEQ develop draft Proposed Plan & Fact-Sheets									
	Oct-Dec										
2021	Jan-Mar	EPA-HQ briefing & consultations re draft Proposed Plan									
	Apr-Jun	EPA-Reg8 prepare Final Proposed Plan for public release									
	Jul-Sep	Issue Proposed Plan for public & stakeholder comment									
	Oct-Dec	EPA-UDEQ review/reconcile comments to Proposed Plan									
2022	Jan-Mar	EPA-UDEQ prepare draft Record-of-Decision									
	Apr-Jun	Internal-agency ROD review									
	Jul-Sep	EPA/UDEQ Issue CERCLA Record-of-Decision for OU1 Site-Cleanup									
	Oct-Dec										
2023	Jan-Mar	Public briefings re ROD									
	Apr-Jun	Negotiate RD/RA (Remedial-Design & Remedial-Action) Consent Decree									
	Jul-Sep	Remedial design development - Phased Implementation									
	Oct-Dec										
2024	Jan-Mar	Implement Remedy-Construction									
	Apr-Jun										
	Jul-Sep										
	Oct-Dec										
2025	Jan-Mar										
	Apr-Jun										
	Jul-Sep										
	Oct-Dec										

~~OPERABLE UNIT 1~~ PHASE 1A-B
REMEDIAL INVESTIGATION
SAMPLING AND ANALYSIS PLAN
for
Soil, Sediment, and Solid Wastes PRI Areas 1 and 3 through 7,
Preliminary Site Characterization Mapping,
and
Background Chemical and Biota Study

Revision 0

US MAGNESIUM NPL SITE

EPA Site Identification No. UTN000802704

TOOELE COUNTY, UTAH

DATE 2015

U.S. EPA Region VIII
Denver, Colorado

TITLE AND APPROVAL PAGE (SAP WORKSHEET #1)

Document Title	~~Operable Unit 1~~ Phase 1A-B Remedial Investigation Sampling and Analysis Plan -for Soil, Sediment, and Solid Wastes for PRI Areas 1 and 3 through 7, Preliminary Site Characterization Mapping, and Background Chemical and Biota Study US Magnesium NPL Site, Tooele County, Utah.
Lead Organization	U.S. EPA Region 8
Supported by	UDEQ, PWT3 and SRC
Preparer's Name and Organizational Affiliation	Kevin Lundmark, ERM, on behalf of US Magnesium LLC
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Signature Date

For Implementation by: **ERM**

David Abranovic, PE
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for US Magnesium

Signature Date

Kevin Lundmark
ERM RI Lead

Signature Date

Judy Nedoff
ERM QA Manager

Signature Date

PREFACE

Phase 1A-B RI SAP

The U.S. Environmental Protection Agency (EPA) placed the US Magnesium Site (Site) on the National Priorities List (NPL) for remedial response pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) in November 2009. The U.S. Court of Appeals for the Washington D.C. Circuit upheld EPA's action for the listing in August 2010.

The US Magnesium plant electro-chemically processes magnesium chloride (derived from Great Salt Lake brine waters) in melt-reactors (adding petroleum-coke and hydrochloric-acid), with recent increases to production of primary magnesium-metal (~72,000 metric-tons/year in 2015) and chlorine (approximately 36 million-gallons in 2015). By-product wastes being released have increased since the start of the remedial investigation and feasibility study (RI/FS) and include: (1) highly acidic liquid- and slurry-streams containing large concentrations of hexachlorobenzene (HCB), polychlorinated biphenyl (PCBs), dioxins/furans; and (2) liquid and gaseous releases of chlorine (Cl_2) and hydrogen-chloride (HCl), as well as particulates/aerosols containing chlorinated-organic compounds. While the entire Site is included on the NPL which requires that the Site undergo a RI/FS and potential remedial action pursuant to CERCLA, the plant proper remains in continuous operation and subject to various hazardous pollutant control and risk-management requirements under the Clean Air Act and the Resource Conservation and Recovery Act.

Administrative Settlement Order on Consent for Remedial Investigation/Feasibility Study. In August 2011, EPA and US Magnesium entered into an Administrative Order on Consent (AOC) for RI/FS, under which US Magnesium (supported by Environmental Resources Management [ERM]) is to carry out the work required for RIs, data-management, risk assessment (RA), and FS for consideration of remedial action. The AOC and Appendix A: Statement-of-Work (SOW) for RI/FS calls for scoping meetings during which US Magnesium/ERM engages in planning and technical discussions with the EPA for EPA's consideration in developing particular phases and stages of Sampling and Analysis Plans (SAPs). Numerous planning and scoping meetings to develop a site-wide Phase 1A SAP (described below) were held from October 2011 through March 2013. Subsequent discussions addressing the Inner PRI areas (the most contaminated portions of the Site) and refinement of RI activities for the Inner PRI areas occurred between August 2014 and March 2015; final development of this Phase 1A-B RI SAP (see below) is summarized in this document. Upon EPA approval and issuance of this Phase 1A-B RI SAP, US Magnesium/ERM is required to implement the Inner PRI areas and Background Study investigations as specified in this SAP.

Phase 1A RI SAP. In accordance with the AOC-SOW, the EPA issued the *Phase 1A Remedial Investigation Sampling and Analysis Plan to Identify Chemical of Potential Concern in Soils, Sediment, Solid Waste, Water and Air, and Receptor Surveys (Revision 0) for PRI Areas 2 and 8 through 17* (EPA 2013) (Phase 1A RI SAP) (with Quality Assurance Project Plan [QAPP]) in September 2013, laying out the technical specifications to implement Phase 1A investigations (identification of chemicals of potential concern [COPCs]) across the Site. In order to initiate sampling and data collection activities in 2013 to begin remedial investigations of PRI Areas 2 and 8 through 17 (Outer PRI areas), and to reduce the need for multiple sampling plan documents, the EPA issued the Phase 1A RI SAP as Revision 0, depending on the outcome of deliberations regarding PRI Areas 1 and 3 through 7 (Inner PRI areas).

Upon completion of the Air DMA, the EPA approved the *Phase 1A Remedial Investigation Sampling and Analysis Plan for Operable Unit 2 – Ambient Air* (ERM 2014) which finalized the basis for standard operating procedures and worksheets pertinent to commencing the PRI Area 18 air investigations.

Development of the Phase 1A-B RI SAP. While the EPA was finalizing the Phase1A RI SAP, ERM and US Magnesium (having reviewed data from DMA investigations of Inner PRI areas indicating high concentrations of numerous constituent contaminant chemicals, and presuming little chance of eliminating any chemicals as COPCs) asserted that Phase 1A investigations (for COPC identification) of the Inner PRI areas were not necessary, and instead proposed proceeding with Phase 1B (preliminary nature and extent) investigations. Accordingly, the EPA sent a September 2013 cover letter and accompanying Attachment 5 for issuance of the Final Phase 1A RI SAP, to accommodate the request by US Magnesium and ERM to postpone implementation of Phase 1A sampling for the most contaminated areas of the Site until 2014, allowing US Magnesium to consider an alternative offer by EPA for a more streamlined risk assessment and for accomplishing FS objectives for the Inner PRI areas.

When the Phase 1A SAP was issued, EPA offered US Magnesium an alternative, streamlined RIFS framework using appropriate data collected during previous RCRA investigations (and limited samples collected during initial Superfund [DMA] investigations), along with 'conservative' screening risk assessments, in order to forego detailed remedial investigations and risk assessment and proceed to cleanup feasibility studies for Inner PRI areas (the most contaminated areas of the Site). EPA agreed to defer the Inner PRI area sampling scheduled under the Phase 1A SAP while ERM carried out assessment of historic data and addressed technical issues for completing a screening level risk assessment (SLRA) for the Inner PRI areas. Under the Phase 1A SAP, US Magnesium and ERM were to decide by June 2014 whether to proceed with the streamlined RIFS or go back to the process set out in the Phase 1A Sampling Plan.

On October 30, 2013, ERM (for US Magnesium) accepted the EPA-proposed streamlined RI/RA approach for the Inner PRI areas, with a screening level risk assessment technical memorandum and inner PRI data report to be provided by the end of December 2013. EPA replied on November 8, 2013, indicating ERM should have sufficient time to discuss preliminary remediation goals (PRGs: i.e., preliminary action levels) and reach a decision on EPA's offer in June 2014; enabling RIFS activity for Inner PRI areas to commence in 2014.

On March 20, 2014, the EPA replied to another ERM request to delay sampling of the Inner PRI areas until after waste lagoons dried out (following a RCRA settlement, after which waters would presumably no longer be discharged into Inner PRI area ponds). With a final Inner PRI areas SLRA report (to include PRGs) to be delivered in May 2014, EPA reminded US Magnesium that unless it a decided in June 2014 to implement the streamlined FS process, considerable Inner PRI area work pursuant to the Phase 1A SAP needed to proceed in 2014.

During June-July 2014, US Magnesium indicated it wished to discontinue pursuing the SLRA and streamlined FS approach and return to the original Phase 1A investigations. In a letter dated August 1, 2014, EPA noted that reverting to original Phase 1A and 1B plans could be more costly and the time required for RIFS completion and remedy selection would be extended considerably. EPA further noted that given ERM's completion of the SLRA tech-memo, final historic data report, and preliminary risk-estimate summaries, there was little additional effort required to complete a SLRA report as a basis for establishing preliminary remediation goals (PRGs) for the Inner PRI areas.

In a meeting on August 20, 2014, ERM outlined a process for completing COPC refinement and PRG development for an Inner PRI areas SLRA report to be submitted by the end of December 2014, for a decision regarding the streamlined FS approach by US Magnesium in January 2015. At this meeting, responding to EPA concerns about continuing delay of Inner PRI areas investigations, ERM also proposed to immediately initiate DQO development to complete a Phase 1B (nature and extent) investigation of the Inner PRI areas in 2015, and complete a Phase 2 (detailed site-characterization) investigation for baseline risk assessment in 2016. In a November 3, 2014, letter EPA emphasized that completing PRG development in 2014 was paramount and that ERM was to submit by December 2014, a draft agenda for a February 2015, Inner PRI areas Phase 1B scoping meeting.

In a December 2, 2014, meeting EPA reviewed ERM's draft *Preliminary Data Quality Objective Framework, OU1 Phase 1B for Nature and Extent* and highlighted a number of inconsistencies in the document and its lack of a clear DQO rationale. ERM agreed to update the document after US Magnesium's late January decision deadline, and prepare for review at the February 2015 scoping meeting. In late 2014, the EPA acceded that US Magnesium/ERM could develop a draft Phase 1A-B RI SAP for EPA review and approval.

In late January 2015, US Magnesium declined EPA's streamlined FS offer. Absent ERM's submittal of a draft agenda and scheduling of a February scoping meeting, EPA pressed ERM for the submittal and scheduled the meeting for March 11-12, 2015; ERM submitted the agenda and revised DQO document on February 20, 2015. At the scoping meeting, ERM requested that EPA provide in MSWord format the pertinent sections of the Phase 1A SAP worksheets which ERM could essentially duplicate for the Ph1A-B SAP.

This Phase 1A-B SAP for the Inner PRI areas largely mimics the sampling approach and plans laid out in the original Phase 1A SAP of 2013. This SAP does add a major section dealing with the startup of Background Study investigations and also lays out the approach to data-evaluation for initial mapping of nature and extent of contamination.

State and Federal Consultation. The EPA has a State Superfund Memorandum of Agreement with the Utah Department of Environmental Quality (UDEQ) Division of Environmental Response and Remediation (DERR) (per National Oil and Hazardous Substances Pollution Contingency Plan [NCP] Part 300.505). The State and the EPA have agreed that EPA Region 8 would be the lead-agency for site management and remedial response actions at the Site and the EPA maintains a close working partnership with UDEQ-DERR throughout the RIFS planning process. The EPA has also engaged in consultations with federal and state trustees for natural resources in accordance with NCP Parts 300.600 and .615.

The format of this document is generally consistent with specifications of the following: (1) Intergovernmental Data Quality Task Force; (2) Uniform Federal Policy (UFP) for QAPPs; (3) Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs, Part 1: UFP-QAPP Manual (EPA 2005b). The manual is available at the following website: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

~~EPA WILL INSERT UPON ISSUANCE OF THE SAP.~~

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LIST OF ATTACHMENTS

Attachments are labeled according to the Worksheet in which their content is most extensively discussed. Some placeholders are listed below for documents that will be generated and amended to this Phase 1A-B RI SAP as the project progresses.

ACRONYMS AND ABBREVIATIONS

°C	Degrees Celsius
°F	Degrees Fahrenheit
µg/kg	Micrograms per kilogram
%D	Percent difference
%R	Percent recovery
95UCL	95% Upper Confidence Limit
AET	Apparent effect threshold
amu	Atomic mass unit
AOC	Administrative Order on Consent
ASTM	ASTM International
ATSDR	Agency for Toxic Substances and Disease Registry
BFB	Bromofluorobenzene
BG	Background
bgs	Below ground surface
BLM	Bureau of Land Management
BRMBR	Bear River Migratory Bird Refuge
CA	Corrective action
$CaSO_4$	Gypsum solids
CCB	Continuing calibration blank
CCC	Calibration check compound
CCME	Canadian Council of Ministers of the Environment
CCV	Continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
CLP	Contract Laboratory Program
Cmax	Maximum detected concentration in a data set
COC	Chain of custody
COD	Chemical oxygen demand
COPC	Chemical of potential concern
COPEC	Chemical of potential environmental concern
CPSM	Column Performance Check Solution
CVAA	Cold vapor atomic absorption
CWP	Current Waste Pond
D/Fs	Dioxins/furans
DERR	Division of Environmental Response and Remediation
DL	Detection limit
DMA	Demonstration of methods applicability
DMP	Data management plan
DQA	Data quality assessment
DQI	Data quality indicator

DQO	Data quality objective
EcoSSL	Ecological Soil Screening Level
EDD	Electronic data deliverable
EMPC	Estimated Maximum Potential Concentration
EPA	U.S. Environmental Protection Agency
ERM	ERM-West, Inc.
ESL	Ecological screening level
FS	Feasibility Study
GC	Gas chromatography
GC/MS	Gas chromatography/mass spectrometry
GIS	Geographic Information System
GPS	Global Positioning System
GSL	Great Salt Lake
H&S	Health and safety
HASP	Health and Safety Plan
HCB	Hexachlorobenzene
HQ	Hazard quotient
HRGC	High resolution gas chromatograph
HRMS	High resolution mass spectrometer
IC	Ion chromatography
ICAL	Initial calibration
ICB	Initial calibration blank
ICP	Inductively coupled plasma
ICS	Interference check standard
ICSA	Interference check standard A
ICV	Initial calibration verification
ID	Identification
IDL	Instrument detection limit
IDW	Investigation-derived waste
IMB	Intermountain basin
ISTD	Internal standard
LC	Liquid chromatography
LC/MS/MS	Liquid chromatography/tandem mass spectrometry
LCS	Laboratory control sample
LCSD	Laboratory control sample duplicate
LELs/SELs	Lowest/severe effect levels
LLC	Limited Liability Corporation
LOC	Limit of chlorination
LOD	Limit of detection

LODv	Limit of detection verification
LOQ	Limit of quantitation
LPC	Laboratory performance check
LRMS	Low resolution mass spectrometer
MB	Method blank
MDD	Minimum Detectable Difference
MDL	Method detection limit
mL	Milliliter
mm	Millimeter
MQO	Measurement quality objective
MS	Mass spectrometry
MSD	Matrix spike duplicate
MTCA	Model Toxics Control Act
MXS	Matrix spike
m/z	Mass to charge ratio
N&E	Nature and extent
NA	Not applicable
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NDMA	N-nitrosodimethylamine
NELAP	National Environmental Laboratory Accreditation Conference
NMDS	Non-metric multi-dimensional scaling
NOAA	National Oceanic and Atmospheric Administration
NPL	National Priority List
OCDD	Octachlorinated dibenzo-p-dioxin
ORNL	Oak Ridge National Laboratory
OSC	On-site Coordinator
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Environmental Response
OU	Operable Unit
OWP	Old Waste Pond
PAH	Polycyclic aromatic hydrocarbon
PARCCS	Precision, accuracy, representativeness, completeness, comparability, and sensitivity
PCB	Polychlorinated biphenyl
PCDD	Polychlorinated dibenzo-p-dioxin
PCDF	Polychlorinated dibenzofuran
PCDPE	Polychlorinated diphenyl ethers
perMANOVA	Permutation multivariate analysis of variance
PFK	Perfluorokerosene
PFTBA	Perfluorotributylamine
PID	Photoionization detector
ppb	Parts per billion

ppm	Parts per million
PQL	Practical quantitation limit
PRI	Preliminary remedial investigation
PRG	Preliminary remediation goal
PWT3	Pacific Western Technologies/Tetra Tech, Inc.
Q-Q	Quantile-quantile
QA	Quality assurance
QAM	Quality Assurance Manual
QAPP	Quality Assurance Project Plan
QC	Quality control
QL	Quantitation limit
QSM	Quality Systems Management
RBC	Risk-based concentration
RBESL	Risk-based ecological screening level
RBSL	Risk-based screening level
RCRA	Resource Conservation and Recovery Act
RA	Risk assessment
RF	Response factor
RI	Remedial Investigation
RL	Reporting limit
RPD	Relative percent difference
RPM	Remedial Project Manager
RRF	Relative Response Factor
RSD	Relative standard deviation
RSL	Regional screening level
SAP	Sampling and Analysis Plan
Site	US Magnesium Site
SIM	Selective ion monitoring
SITLA	School and Institutional Trust Land Administration
SLERA	Screening level ecological risk assessment
SLRA	Screening level risk assessment
S/N	Signal to noise ratio
SOP	Standard operating procedure
SOW	Statement of work
SQuiRTs	Screening Quick Reference Tables
SRC	Syracuse Research
Study Area	A 5-mile radius around the plant stack
SVOC	Semivolatile organic compound
TAT	Turnaround time
TBD	To be determined
TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin

TECs/PECs	Threshold/probable effect concentrations
TEF	Toxicity Equivalence Factor
TELs/PELs	Threshold/probable effect levels
TEQ	Toxic equivalency quotient
TOC	Total organic carbon
TQL	Target quantitation limit
UCI	Upper confidence interval
UDEQ	Utah Department of Environmental Quality
UFP	Uniform Federal Policy
UPL	Upper prediction limit
U.S.C.	*United States Code*
USFWS	U.S. Fish and Wildlife Service
UTTR	Utah Test and Training Range
VDTSR	Verified date and time of sample receipt
VOC	Volatile organic compound
VSP	Visual Sample Plan software
WDOE	Washington Department of Ecology
WHO	World Health Organization
WS	Worksheet

SECTION A: PROJECT ORGANIZATION

SAP WORKSHEETS #2-9

2.0 SAP IDENTIFYING INFORMATION (SAP WORKSHEET #2)

[Note: This section has been modified (updated and edited) by EPA to reflect changes to the Remedial Investigation (RI) and Feasibility Study (FS) project framework since EPA's issuance of the Phase 1A RI Sampling and Analysis Plan (SAP) in September 2013.]

The Remedial Investigation (RI), Risk Assessment (RA) and Feasibility Study (FS) include a 5-mile radius area around the plant stack. The EPA (as set forth in the 2011 AOC and Statement of Work) anticipated US Magnesium and its contractor Environmental Resources Management (ERM) to implement RI, RA, and FS activities for the study area in phases under plans issued and/or approved by the EPA. Risk assessment work being conducted by ERM and EPA is proceeding concurrently with each phase and element of the RI/FS.

During planning and scoping meetings with ERM in 2011 and early 2012, initial plans were for a Phase 1 investigation to identify chemicals of potential concern (COPCs) and evaluate preliminary nature and extent for site characterization covering preliminary remedial investigation areas (PRIs) across the Site. ERM collected limited samples in 2012 to carry out a demonstration of methods applicability (DMA) to evaluate the suitability of sampling and analytical methods. Scoping considerations by ERM during 2012 were the basis to initiate site investigations in two phases: a Phase 1A Sampling and Analysis Plan (SAP) to ascertain COPCs, to be followed by a Phase 1B SAP to characterize the nature and extent of COPCs.

The initial Phase 1A RI objectives for the entire Site included the following:

Phase 1A: COPC and Receptor-Exposure Investigations

- Develop preliminary Conceptual Site Model (CSM) and RI/Risk Scoping.
- Develop SAP specifications for the RI to identify COPCs in media-types and pathways across all PRI areas of the Site.
- Conduct surveys to assess ecological habitats, types of human and ecological receptors, and potential exposures threatening human health and the environment, as noted in the preliminary CSM.
- Develop a Screening-Level Ecological Risk Assessment (SLERA) and refine the Preliminary CSM for potential human and ecological risk.

In accordance with the AOC-SOW and beginning in May 2013, EPA prepared a Phase 1A SAP (with Quality Assurance Project Plan [QAPP]) issued in September 2013, which laid out the technical specifications necessary to commence Phase 1A investigations in 2013 (to identify COPCs) across the Site.

In comments on the draft SAP and as EPA was finalizing the site-wide Phase 1A SAP in August 2013, ERM and US Magnesium (having reviewed data from the DMA investigations of Inner-PRIs indicating high concentrations of numerous constituent contaminant chemicals, and presuming little chance of eliminating any chemicals as COPCs) asserted that Phase 1A investigations (for COPC identification) of the Inner PRI areas were not necessary and proposed instead to proceed to Phase 1B (preliminary nature & extent) investigations. The EPA (as noted in the September 2013 Final Phase 1A SAP cover letter) accommodated US Magnesium and ERM's request to postpone implementation of Phase 1A sampling for the most contaminated areas of the Site (the Inner PRI areas) until 2014. ERM was to submit sampling method specifications and proceed with Inner PRI RI work in mid-2014.

When the Phase 1A SAP was originally issued in September 2013, EPA offered US Magnesium an alternative, streamlined RIFS framework using appropriate data collected during previous RCRA investigations (and limited samples collected during initial Superfund [DMA] investigations), along with 'conservative' screening risk assessments, in order to forego detailed RI/RA and proceed directly to cleanup feasibility studies for Inner PRI Areas 1 through 7 (the most contaminated areas of the Site). EPA agreed to further defer the Inner PRI areas sampling scheduled under the Phase 1A SAP while ERM carried out assessment of historic data and addressed technical issues for completing a screening level risk assessment (SLRA) for the Inner PRIs. US Magnesium and ERM were to decide in 2014 whether to proceed with the streamlined RIFS or go back to the process set out in the Phase 1A SAP.

In August 2014, as US Magnesium further considered EPA's streamlined FS offer, ERM, responding to EPA's concerns about continuing delay of Inner PRI investigations, committed to carry out in 2015 an investigation that would entail the components of both Phase 1A and Phase 1B sampling investigations for the Inner PRIs. In January 2015, US Magnesium declined EPA's streamlined FS offer.

At a scoping meeting in March 2015, EPA reviewed ERM's draft DQO document and proposed sampling plans for the Inner PRIs that mimic the approach of the 2013 Phase 1A SAP. ERM then began to develop DQOs for a Draft SAP for Phase 1A (COPCs) and Phase 1B (preliminary nature and extent) investigations of the Inner PRIs: the subject of this document. US Magnesium and ERM have further agreed to carry out detailed site-characterization investigations in 2016 and baseline risk assessment in 2017 in order to commence FS in 2018 for completion of an RIFS report in 2020.

During 2014, as part of the implementation of the Phase 1A SAP, ERM completed an Ecological Habitat Survey and was near completion of a Human Exposure Survey. ERM had completed the Phase 1A solid medai sampling for the Outer PRI Areas 2 and 8 through 16, groundwater sampling for PRI Area 17, and sampling for chronic (chlorine and hydrochloric acid) COPCs in air. Given ongoing Inner PRI considerations by US Magnesium and ERM during 2014, the EPA again agreed to defer Phase 1A sampling of surface waters until 2015.

By late 2013, US Magnesium and ERM recognized the importance of evaluating the risks from airborne chlorine (Cl_2) and hydrochloric acid (HCl) as COPCs. An aspect of site-investigations which ERM completed in 2014 pursuant to the Phase 1A SAP was air pathway sampling to obtain data to identify other potential COPCs in air. These data are under review by ERM and EPA. Accordingly, EPA has designated air pathway investigations as a separate Operable Unit (OU2), and air investigations and risk assessment of airborne Cl_2/HCl releases are proceeding on a separate and independent track from site investigations and risk assessment addressing contamination in the soils, sediments, wastes, and waters of OU1 (PRI Areas 1 through 17).

In parallel with the CERCLA site investigations, US Magnesium, EPA Region 8 RCRA Program, and the US Department of Justice (DOJ) are in settlement negotiations to address those aspects of Site operations to be subject to RCRA Corrective Action. While EPA's Superfund Program anticipates that certain aspects or portions of the site will be addressed in Corrective Action Management Units under jurisdiction of RCRA, this Phase 1A-B SAP proceeds with site investigations pursuant to the CERCLA AOC-SOW until a RCRA settlement can be reached and the parties know which portions of the Site will be addressed by RCRA. In any case, the information collected will be used to help identify chemicals of concern and understanding the nature and extent of contamination at the Site that will be addressed under RCRA and CERCLA respectively.

The following RIFS activities will enable completion of Phase 1 activities as originally planned, including:

Phase 1A-B: Identify Inner PRI Areas COPCs and Preliminary Nature and Extent Investigation (during 2015)

- For contaminants identified as COPCs in Phase 1A-B investigations, conduct preliminary mapping to characterize the potential scope and scale of contaminant distribution within the Inner PRI areas.
- Refine CSM and risk-assessment (human and ecological) for scoping of detailed Phase 2 contaminant investigations (including biotic exposure assessment).
- Preliminarily identify Remedial Action Objectives (RAOs) and Applicable or Relevant and Appropriate Requirements (ARAR).

While reviewing data for the Phase 1A Outer PRI areas and during Phase 1A-B scoping discussions, ERM and EPA recognized the need for a Background Study of contaminant concentrations that may be unrelated to Site releases. This study (as part of this Phase 1A-B SAP) will initially evaluate abiotic chemical constituents at select 'off-site' locations, and is preparatory to subsequent detailed biological chemical constituent investigations during Phase 2.

Phase 1A-B: Background Study of Chemical Constituents (2015)

- Identify locations (beyond the RI study area) as reference areas.
- Collect data to compare naturally occurring chemicals of concern to constituents within the RI study areas.

While addressed under a separate workplan from this Phase 1A-B SAP, an additional aspect of RIFS work began in 2014 in response to US Magnesium's desire to conduct a treatability study to evaluate a 'Salt Cap' as a potential remedial alternative or portion of a remedial alternative. ERM agreed with EPA to also begin a screening-level FS to identify other remedial alternatives that should be evaluated in a detailed FS along with a 'Salt-Cap' alternative. In November 2014, EPA, UDEQ and ERM held a scoping meeting to discuss ERM's preparation of a Salt Cap Treatability Study (including a salt cap accumulation test which began in June 2015). ERM committed to developing a screening-level FS during 2015-2016.

Subsequent phases of the RIFS will include:

Phase 2: Detailed RI, Screening FS, and Baseline Risk Assessment (late-2015, 2016 and 2017)

- Develop DQOs and SAP specifications for detailed Site characterization and risk assessment.
- Perform detailed Site characterization and biotic studies.
- Complete screening-level FS, identifying RAOs and ARARs.
- Complete a Baseline Risk Assessment.
- Select screened alternatives to carry forward into detailed FS.

Phase 3: Detailed Feasibility Study (2018-2020)

- Establish preliminary risk-reduction goals (EPA and UDEQ).
- Develop specifications for the FS.
- Conduct FS for a range of remedial alternatives.

Phase 4: Remedial Response Decision (2021-2022)

- Prepare a Proposed Plan and Record of Decision (ROD).

Attachment 2 is a chart that summarizes RIFS activity to date and shows the schedule for completing RI/FS activities and a Baseline Risk Assessment, followed by development of detailed Feasibility Study(s) and a Record of Decision selecting a cleanup remedy.

This Phase 1A-B SAP is project specific and pertains only to the Phase 1A-B activities and implementation. Briefing and planning sessions that have been held are identified in Worksheet (WS) #9.

Phase 1A-B activities will include acquisition of data allowing development of a refined list of chemicals in order to select COPCs; these acquired data also will be necessary to prepare a plan for more complete investigations of the Site. Preparation of a Phase 2 SAP will occur after completion of investigation activities, completion of a SLERA by ERM/US Magnesium, and determination by EPA of any need for additional data to complete the baseline human health and ecological RAs.

Phase 1A-B activities will include sampling Site media to evaluate the nature and extent of contaminants within the soils, sediments and wastes of the Inner PRI areas, and to obtain preliminary data to support initial risk calculations. Phase 2 will include additional sampling of Site media to fill data gaps and to reduce uncertainties in the Phase 1A-B data sets. In addition, Phase 2 is expected to include biota sampling, as well as further lateral and vertical sampling of soil, sediment, water and waste across areas subjected to the preliminary remedial investigation.

The preliminary objective of the Phase 2 RI is to further characterize the nature and extent of contaminated media and obtain data sufficient for ERM to conduct baseline human health and ecological RAs subject to EPA review and approval. Phase 2 will include screening possible remedial options for the FS.

Phase 3 RIFS activities will focus on filling any final data gaps to further refine the CSM to sufficiently support detailed evaluation of remedial alternatives in the FS for reliable risk and remedial action decision making. These data may include, but would not be limited to, analytical data, engineering data, and any treatability study data. If necessary, information necessary to address specific RA needs will be acquired. During this phase, full development of the FS and evaluation of remediation alternatives to achieve ARARs and protect human health and the environment will occur.

~~US Magnesium LLC (US Magnesium) is a commercial producer of magnesium and magnesium alloys and operates a facility in Rowley, Tooele County, Utah (Figure 2-1).The Site includes an active primary magnesium production facility, which has been in operation since 1972. Magnesium is refined from brine obtained from the Great Salt Lake (GSL). The facility includes employee offices and process buildings and other ancillary structures and facilities. Surrounding the process buildings is a series of waste disposal evaporation ponds, a concentrator pond, a landfill, and smut and calcium sulfate (gypsum) disposal areas. A series of earthen, open-air ditches conveys liquid waste from the process facility to earthen wastewater evaporation ponds. An engineered disposal site for cast house residues containing barium sulfate and an inactive wastewater evaporation pond are located northwest and northeast of the facility, respectively.~~

~~On 4 August 2011, an Administrative Settlement Agreement and Order on Consent (AOC) for a Remedial Investigation and Feasibility Study (RI/FS) was entered into by US Magnesium and U.S. Environmental Protection Agency (EPA) Region 8. The AOC defines the roles, responsibilities, schedule, and administration of the RI/FS to be performed. For planning purposes, the EPA divided the Site into 18 Preliminary Remedial Investigation (PRI) Areas (Figure 2-2). The Site was subsequently divided in Operable Units (OUs) by the EPA, with Operable Unit 1 (OU-1) being defined as all soils, sediments, solid wastes, surface water and groundwater within PRI Areas 1 through 17, and OU-2 being defined as PRI Area 18 or ambient air.~~

1. Identify guidance used to prepare SAP:

This Sampling and Analysis Plan (SAP) has been prepared in general accordance with the *Uniform Federal Policy for Quality Assurance Project Plans* (UFP-QAPP), EPA-505-B-04-900A (EPA 2005a) and *the EPA Requirements for Quality Assurance Project Plans*, EPA QA/R-5 (EPA 2001).

2. Identify regulatory program:

In August 2011, EPA Region 8 and US Magnesium entered into an AOC for RI/FS under Sections 104, 107, and 122 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, 42 *United States Code* (U.S.C.) §§ 9604, 9607, and 9633. Under the AOC, ERM-West, Inc. (ERM) is responsible for administrations of all actions by US Magnesium (Respondent) required by the AOC.

3. Identify approval entity:

The approval entity is EPA Region 8. The EPA has a State Superfund Memorandum of Agreement with the Utah Department of Environmental Quality (UDEQ) Division of Environmental Response and Remediation (DERR) (per National Oil and Hazardous Substances Pollution Contingency Plan [NCP] Part 300.505). The State and the EPA agreed that EPA Region 8 would be the lead agency for Site management and remedial response actions at the Site.

4. Indicate whether the QAPP is a generic or a project-specific QAPP:

This is a project-specific and phase-specific SAP.

5. List dates of scoping sessions that were held:

A Phase 1A-B RI scoping session was held 11–12 March 2015 in Salt Lake City, Utah. Outcomes from the Phase 1A-B scoping session and follow-on correspondence are summarized in this SAP in Worksheet 9 - Project Scoping Session Participants Sheet.

6. List dates and titles of QAPP documents written for previous Site work, if applicable:

Title	Approval Date
Phase 1A Remedial Investigation Sampling and Analysis Plan to Identify Chemicals of Potential Concern in Soils, Sediments, Solid Waste, Water and Air, and Receptor Surveys, Revision 0 for PRI Areas 2 and 8 through 17	September 2013

7. List organizational partners (stakeholders) and connection with lead organization:

EPA maintains a close working partnership with UDEQ-DERR throughout the RI/FS planning process. The EPA has also engaged in consultations with federal and state trustees for natural resources in accordance with NCP Parts 300.600 and .615.

8. List data users:

This SAP involves sampling of soil, sediment, and solid wastes (collectively referred to as "solids") to support the objective of obtaining sufficient data to support:

1. Reliable identification of chemicals of potential concern (COPCs) for human and ecological receptors within PRI Areas 1 and 3 through 7.

2. Initial risk calculations to evaluate whether sufficient data have been collected within PRI Areas 1 and 3 through 7 to support confident risk characterization.

3. Preliminary evaluation of the nature and extent (N&E) of Site-related impacts within PRI Areas 1 and 3 through 7.

4. Estimation of background (ambient) concentrations for metals and organics including, dioxins/furans (D/Fs), total polychlorinated biphenyls (PCBs) and World Health Organization (WHO) congeners, and hexachlorobenzene (HCB).

5. Identification of suitable reference areas (i.e., non-impacted areas) for biota sampling that may be conducted during 2016 Phase 2 RI activities.

Broadly, these objectives are combined into two principal data quality objectives (DQOs) of "COPC Selection and Preliminary N&E at Inner PRI Areas," and "Evaluation of Background." Data generated under this SAP will be for remedial decision-making by risk assessors and managers. Data generated under this SAP will be managed in accordance with requirements of the AOC and the Data Management Plan (ERM 2013b) and will become part of the Administrative Record for the project.

3.0 DISTRIBUTION LIST (SAP WORKSHEET #3)

The Distribution List below identifies those entities to whom copies of the approved SAP and any subsequent revisions will be sent.

Name of SAP Recipients	Title/Role	Organization	Telephone Number	E-mail Address or Mailing Address
EPA TEAM				
Ken Wangerud	Remedial Project Manager	EPA	Office: (303) 312-6703 Mobile: (720) 951-0955	Wangerud.ken@epa.gov
Wendy O'Brien	Human-health ~~(and eco-)~~ Risk Assessment	EPA	Office: (303) 312-6712	Obrien.wendy@epa.gov
Dan Wall	Ecological Risk Assessment	EPA	Office: (303) 312-6560	Wall.dan@epa.gov
Charlie Partridge	Health and Safety Toxicologist	EPA	Office: (303) 312-6094	Partridge.charles@epa.gov
Andrew Schmidt	Hydrogeology	EPA	Office: (303) 312-6283	Schmidt.andrew@epa.gov
Shun-Ping Chau	On-Site Coordinator (OSC), Health and Safety	EPA	Office: (303) 312-6848	Chau.shun-ping@epa.gov
Jeff Mosal	Data-Manager/Coordinator	EPA	Office: (303) 312-6802	Mosal.jeffrey@Epa.gov
Bill Brattin	Toxicologist & Risk Assessment	Syracuse Research (SRC)	Office: (303) 357-3121	brattin@srcinc.com
Michael Storck	Project Manager	UDEQ	Office: (801) 536-4179	mstorck@utah.gov
Scott Everett	Risk Assessment	UDEQ	Office: (801) 536-4117	severett@utah.gov
Christine Cline	US Fish and Wildlife Service Representative	U.S. Fish and Wildlife Service (USFWS)	Office: (801) 975-3330, x145	Chris_cline@fws.gov
Kevin Oliver	Bureau of Land Management Representative	Bureau of Land Management (BLM)	Office: (801) 977-4338 Mobile: (801) 450-3134	koliver@blm.gov
Catherine LeCours	Contractor Project Manager	Pacific Western Technologies/Tetra Tech, Inc (PWT3)	Office: (406) 457-5495 Mobile: (406) 422-6915	clecours@pwt.com
Dorthea Hoyt	Contractor Quality Assurance Manager	PWT3	Office: (303) 274-5400, x54 Mobile: (303) 482-6973	dhoyt@pwt.com
Aaron Baird	Contractor Field Team Leader / Health and Safety Coordinator	PWT3	Mobile: ~~(720) 202-2664~~(435) 731-7519	abaird@pwt.com
Robert Howe	Contractor Geochemist	PWT3	Office: (303) 441-7911 Mobile: (303) 518-1083	Robert.howe@tetratech.com

Name of SAP Recipients	Title/Role	Organization	Telephone Number	E-mail Address or Mailing Address
ERM/US Magnesium Team				
David Gibby	US Magnesium Representative	US Magnesium	Office: (801) 532-1522, x1355	dgibby@usmagnesium.com
David Abranovic	Project Coordinator, US Magnesium RI/FS	ERM	Office: (480) 424-1821 Mobile: (602) 284-4917	david.abranovic@erm.com
Judy Nedoff	ERM Quality Assurance (QA) Manager and Analytical Coordinator	ERM	Office: (925) 482-8210 Mobile: (925) 209-6899	judy.nedoff@erm.com
Jennifer Holder	Lead Risk Assessor	ERM	Office: (805) 684-2801 Mobile: (805) 680-8484	jennifer.holder@erm.com
Kevin Lundmark	RI Task Lead/Field Lead	ERM	Office: (801) 595-8400 Mobile: (801) 440-8296	kevin.lundmark@erm.com
Mike Appel	Database Manager	ERM	Office: (503) 488-5282	mike.appel@erm.com
David Alltucker	Laboratory Project Manager	TestAmerica	Office: (916) 374-4383	David.Alltucker@testamericainc.com
Liz Porta	Laboratory Project Manager	Alpha Analytical	Office: (508) 844-4124	eporta@alphalab.com

4.0 PERSONNEL SIGN-OFF SHEET (SAP WORKSHEET #4)

The project Personnel Sign-Off Sheet below documents that all key project personnel performing work have read the applicable sections of this SAP and will perform the tasks as described.

Name	Organization/Title/Role	Signature/E-Mail Receipt	SAP Section(s) Reviewed	Date SAP Read
Ken Wangerud	EPA Project Manager			
Catherine LeCours	Contractor Project Manager			
David Abranovic	ERM Project Manager			
Judy Nedoff	ERM QA Manager			
Kevin Lundmark	ERM RI Task Lead/Field Lead			
Judy Nedoff	ERM Analytical Coordinator			
David Alltucker	TestAmerica - Primary Lab			
Liz Porta	Alpha Analytical – LRMS PCB Lab			

5.0 PROJECT ORGANIZATIONAL CHART (SAP WORKSHEET #5)

The Project Organizational Chart provided as Figure 5-1 identifies the reporting relationships for the Phase 1A-B RI.

6.0 COMMUNICATION PATHWAYS TABLE (SAP WORKSHEET #6)

Communication Drivers	Responsible Affiliation	Name	Phone Number or E-Mail	Procedure
EPA Team				
Project Management	EPA Remedial Project Manager (RPM)	Ken Wangerud	See Worksheet (WS) #3	The EPA RPM will manage all EPA and EPA Contractor personnel and communicate directly with the ERM Project Manager.
Phase 1A-B RI SAP Amendments	EPA RPM	Ken Wangerud	See WS#3	Any changes to approved field procedures or the Phase 1A-B RI SAP will require documentation that must be approved by the EPA RPM before the change is implemented. See Attachments 14A and 14B for modification forms. As the SAP issuer, the EPA RPM will be responsible for maintaining the official, approved SAP.
Quality Control (QC) management	QA Manager	Ken Wangerud supported by EPA Contractor	See WS#3	The EPA Contractor QA Manager will be the point of contact with the EPA RPM for quality-related matters.
Technical Issues	EPA Project Team and ERM Project Team	Various (see WS#3)	See WS#3	When explicitly directed by the EPA RPM and accepted by the ERM Project Coordinator, EPA and/or EPA Contractor team members may communicate directly with their ERM technical counterparts to resolve technical issues. Recommendations for resolution shall be brought to the EPA and ERM Project Coordinator for approval.
Field-Investigation Oversight	EPA and/or EPA Contractor Field Team Leader	Aaron Baird	See WS#3	EPA and/or EPA Contractor Field Team Leader may communicate directly with ERM's Field Team Leader during preparation and execution of the investigation and EPA Contractor personnel may make suggestions consistent with the Phase 1A-B RI SAP to the ERM Field Team Leader, but shall not direct the work or instruct ERM.

Communication Drivers	Responsible Affiliation	Name	Phone Number or E-Mail	Procedure
ERM Team				
Project Management	ERM Project Coordinator	David Abranovic	See WS#3	The ERM Project Coordinator will serve as liaison to the EPA, and manage field personnel, project personnel, and all subcontractors. ERM Project Coordinator will report data and documents to the EPA RPM. As necessary, the ERM Project Coordinator will bring the need/request for Phase 1A-B RI SAP amendments to the attention of the EPA RPM.
Quality Assurance (QA) Management	ERM QA Manager	Judy Nedoff	See WS#3	The ERM QA Manager will ensure implementation of the Phase 1A-B RI SAP by performing on-Site field QA audits, as appropriate. The ERM QA Manager will be the point of contact with the ERM Project Coordinator for quality-related matters.
Coordination and Communication of Fieldwork Activities Related to Sampling	RI Field Team Leader[1]	Kevin Lundmark	See WS#3	The ERM RI Field Team Leader will: • Routinely (daily) communicate with the field crew during investigation, and will address field implementation issues in adherence with the Phase 1A-B RI SAP; • Communicate relevant field information to the ERM Analytical Coordinator; Ensure subcontractor activities are conducted in accordance with requirements of the Phase 1A-B RI SAP; and • In conjunction with the QA Manager, report data and field documentation to the ERM Project Coordinator.
Submittal of Samples to the Laboratory	RI Field Team Leader[1]	Kevin Lundmark	See WS#3	RI Field Team Leader will arrange for sampling personnel to package and ship samples in accordance with this Phase 1A-B RI SAP.
Daily Chain-of-Custody Records and Shipping Documentation				RI Field Team Leader will arrange for chain-of-custody records and shipping documentation to be submitted via fax or e-mail to the analytical coordinator at the end of each day that samples are transmitted to the laboratory.

Communication Drivers	Responsible Affiliation	Name	Phone Number or E-Mail	Procedure
Field Data				The RI Field Team Leader will routinely communicate with the Analytical Coordinator and Database Manager regarding field activities. RI Field Team Leader will coordinate with the Air Task Leader and Water Task Leader, as appropriate, to manage field data as required by the Data Management Plan.
Deviations From Phase 1A-B RI SAP Procedures Identified during Field Activities				Prepare and submit to EPA a SAP Modification or Field Modification request, as appropriate.[2] Forms are provided in Attachment 14.
Reporting Laboratory Data, Quality Issues, and Issue Resolution	Laboratory Project Manager	David Alltucker (TA) Liz Porta (Alpha Analytical)	See WS#3	Report documents and data to the RI Field Team Leader and Analytical Coordinator in an electronic format as required by the Data Management Plan and report QA and QC issues.
Coordination of Laboratory Supplies for Field Activities	Analytical Coordinator	Judy Nedoff	See WS#3	The Analytical Coordinator or RI Field Team Leader will contact the laboratory to provide all necessary sample containers and appropriate shipping materials (such as coolers and bubble wrap) to be delivered on Site before field sampling begins and throughout the project.
Liaison between ERM and Analytical Laboratories				The ERM Analytical Coordinator will routinely communicate with the laboratory point of contact, and will address any analytical issues to the extent possible while adhering to the Phase 1A-B RI SAP.
Field QC and Analytical Corrective Actions				The ERM Analytical Coordinator will immediately notify the QA Manager, RI Field Team Leader, and Project Coordinator in writing of any field QC or analytical procedures - beyond any deviations identified by the RI Field Team Leader - that were not performed in accordance with this Phase 1A-B RI SAP. The Analytical Coordinator, in coordination with the Project Coordinator, will complete documentation of the non-conformance and corrective actions to be taken. The Analytical Coordinator will verify that the corrective actions have been implemented.

Notes:

This WS identifies lines of communication that will be used during the Phase 1A-B RI. See WS#7 for personnel responsibilities.

1. The ERM Field Team Leader will coordinate with EPA and EPA's Contractor Field Team Leader regarding oversight activities.
2. Protocol for Approval of Changes Requested During Field Sampling (from WS14):

   During field sampling, it is sometimes necessary to make changes in sampling location and/or sampling methods compared to the specifications of the Phase 1A-B RI SAP. Either the EPA or ERM may propose such changes.

   In cases where the change is "minor" (e.g., relocating a sampling station a short distance away from the target location), and both ERM and EPA agree in "real time" that the change is appropriate, the change may be implemented and subsequently documented (i.e., later that day) by completion of a Field Modification Form. Note that agreement must be reached before implementing any such change. This may be accomplished by a consultation between the field team leader and an EPA oversight representative present at the Site, or by calling an appropriate EPA staff member by phone, as identified below:

Name	Office Phone	Cell Phone
Ken Wangerud	303-312-6703	720-951-0955
Dan Wall	303-312-6560	720-347-5520
Wendy O'Brien	303-312-6712	720-951-0970

In the event that an EPA representative cannot be reached, or if the EPA representative cannot issue a decision in "real time," then no change shall be implemented until authorization is granted.

In the event of a proposed "major" change in the Phase 1A-B RI SAP (e.g., a substantial revision to a sampling or processing method), the proposing party (either ERM or the EPA) shall complete a Field Modification Form for review and consideration by both parties. After a decision is reached and authorization for the change is approved, then the revision may be implemented.

In the event that a change is proposed and agreement between the parties cannot be reached, then the procedure for dispute resolution defined in the AOC shall be followed.

7.0 PERSONNEL RESPONSIBILITIES AND QUALIFICATIONS TABLE (SAP WORKSHEET #7)

Name	Title/Role	Organization Affiliation	Phone No. or email	Responsibilities
EPA Team				
Ken Wangerud	EPA RPM	EPA	See WS#3	Responsible for providing management and technical direction to ERM's Project Management and to the EPA Team during data collection efforts. Actively participates in Project DQO process. Review and sign-off on SAPs and SAP Amendments. Responsible for coordination with other Agencies (UDEQ, BLM, USFWS). As the SAP issuer, the EPA RPM will be responsible for maintaining the official, approved SAP.
Ken Wangerud	Program QA Manager (with EPA-team consultation & advisement)	EPA	See WS#3	Responsible for overall QA and QC of EPA's work; develops and maintains a comprehensive QA program and is responsible for audits, reviews of work performed, and recommendations to project personnel regarding quality while independent of data generation. Provides QA and QC of technical work carried out at the Site; works closely with and reviews work carried out by the project team; and reviews deliverables to verify conformance with QA and QC procedures. QA Manager has authority to suspend affected project or Site activities if approved quality requirements are not adequately met.
Various (see WS#3)	EPA Project Team	EPA	See WS#3	Responsible for technical content of SAPs and SAP Amendments. Responsible for resolving technical issues that arise during implementation, and for recommending actions to the EPA Project Manager for approval.
Catherine LeCours	EPA Contractor Project Manager	PWT3	See WS#3	Responsible for managing contractor personnel, staying briefed on field activities, briefing the EPA RPM on field activities, ensuring contractor technical personnel are available to assist in resolution of technical issues, and participating in resolution of those technical issues. Responsible for distributing approved SAP Modification Forms to individuals listed in WS#3 (Distribution List).
Aaron Baird	EPA and/or EPA Contractor Field Team Leader	PWT3	See WS#3	EPA and/or EPA Contractor Field Team Leader will collaborate with ERM's Field Team Leader during preparation and execution of the investigation. EPA Contractor personnel may make suggestions consistent with the Phase 1A-B RI SAP to the ERM Field Team Leader, but shall not direct the work or instruct ERM. EPA Contractor field personnel will provide daily briefings to the EPA Contractor Project Manager.

Name	Title/Role	Organization Affiliation	Phone No. or email	Responsibilities
ERM Team				
David Abranovic	ERM Project Coordinator	ERM	See WS#3	The ERM Project Coordinator will serve as liaison to the EPA. Responsible for ensuring compliance with Phase 1A-B RI SAP requirements. As necessary, the ERM Project Coordinator will bring the need for Phase 1A-B RI SAP amendments to the attention of the EPA RPM. The ERM Project Coordinator will manage project personnel, field personnel, and all subcontractors. Oversees administrative and technical performance, and maintains compliance with schedules and budgets. The ERM Project Coordinator will report data and documents to the EPA RPM.
Judy Nedoff	QA Manager	ERM	See WS#3	The ERM QA Manager will ensure implementation of the Phase 1A-B RI SAP, including performance of on-Site field QC audits, as appropriate. QA Manager will be the point of contact with the ERM Project Coordinator for quality-related matters.
Multiple (task-specific)	Field Safety Officer	ERM		Responsible for implementing the health and safety plan; authority to correct and change Site control measures and the required level of health and safety protection; and primary on-Site enforcement authority for the policies and provisions of the health and safety program and Health and Safety Plan (HASP). Conducts safety briefings for Site and subcontractor personnel and Site visitors, and can suspend operations that threaten health and safety of workers and visitors.

Name	Title/Role	Organization Affiliation	Phone No. or email	Responsibilities
Kevin Lundmark	RI Field Team Leader[1]	ERM	See WS#3	Directs the day-to-day field activities and oversees all subcontractors; verifies that field measurement and sampling procedures are conducted in accordance with the Phase 1A-B RI SAP; and is responsible for ensuring subcontractor activities are conducted in accordance with requirements of the Phase 1A-B RI SAP. Responsible for preparing field change requests (Field Modification Approval Form – Attachment 14). These requests will be submitted to the EPA RPM, EPA oversight personnel, or EPA contractor Field Team Leader for approval before the change is initiated. Responsible for communicating relevant field information to the ERM Project Coordinator and ERM Analytical Coordinator. Reports directly to the ERM Project Coordinator on implementation issues, planning, cost and schedule control, and data management information needs. Responsible for generating and reporting data and documents as required by the Data Management Plan along with QC reports to the ERM QA Manager. Responsible for ensuring sampling personnel package and ship samples in accordance with this Phase 1A-B RI SAP.
Judy Nedoff	Analytical Coordinator	ERM	See WS#3	Coordinates analytical tests with the information required from the field activity; coordinates with laboratories to conduct required analyses; coordinates pickup and delivery schedules with laboratories; verifies that the laboratories implement the requirements of the sampling and analysis plan; and ensures that laboratory data are validated in accordance with the Data Management Plan and the Phase 1A-B RI SAP. Responsible for immediately notifying the QA Manager, RI Field Team Leader, and Project Coordinator in writing of any field QC or laboratory analytical procedures - beyond any deviations identified by the RI Field Team Leader - that were not performed in accordance with this Phase 1A-B RI SAP. The Analytical Coordinator, in coordination with the QA Manager and ERM Project Coordinator will complete documentation of the non-conformance and corrective actions to be taken. The Analytical Coordinator will verify that the corrective actions have been implemented.

Name	Title/Role	Organization Affiliation	Phone No. or email	Responsibilities
David Alltucker	Laboratory Project Manager	TA	See WS#3	Phase 1A-B RI SAP. Responsible for reporting QA and QC issues to the ERM Analytical Coordinator in a timely manner. Responsible for reporting documents and data to the RI Field Team Leader in an electronic format as required by the Data Management Plan.
Liz Porta	Laboratory Project Manager	Alpha Analytical	See WS#3	
Mike Appel	Database Manager	ERM	Office: (503) 488-5282	Responsible for developing, monitoring, and maintaining project database in accordance with the Data Management Plan, under guidance of ERM Project Coordinator, and works with Analytical Coordinator during implementation of the Phase 1A-B RI SAP to resolve sample identification issues.

Notes:

1. The ERM Field Team Leader will coordinate with EPA and EPA’s Contractor Team Leader per oversight activities.

8.0 SPECIAL PERSONNEL TRAINING REQUIREMENTS TABLE (SAP WORKSHEET #8)

Specialized Training – Title or Description of Course	Training Provider	Training Date	Personnel/ Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates
Medical Clearance for Respirator Use (Pulmonary Function Tests)	WorkCare	Within last year (Annual)	All ERM staff performing field work at US Magnesium Site	Various	ERM Files, Project H&S File, US Magnesium
Employer Respiratory Protection Training	ERM	Within last year (Annual)	All ERM staff performing field work at US Magnesium Site	Various	ERM Files
Respirator Fit Test	ERM	Within last year (Annual)	All ERM staff performing field work at US Magnesium Site	Various	ERM Files, Project H&S File, US Magnesium
OSHA 40-Hour Training per 29 CFR 1920.120(e)	ERM / Third Party	One time	All ERM staff performing sampling at US Magnesium Site	Various	ERM Files
8 Hours of Refresher Training	ERM / Third Party	Within last year (Annual)	All ERM staff performing sampling at US Magnesium Site	Various	ERM Files
8-Hour OSHA Supervisor Training	Third Party	One time	Field Lead	Kevin Lundmark / ERM	ERM Files
First Aid / CPR	Third Party	CPR within last 2 years, First Aid within last 3 years	At least one member of each field team	Various	ERM Files
US Magnesium Contractor Training	US Magnesium	Within last year (Annual), prior to field work	All ERM staff performing field work at US Magnesium Site	Various	US Magnesium

9.0 JOINT PROJECT PLANNING SESSION(S) PARTICIPANTS SHEET (SAP WORKSHEET #9)

Joint planning meetings, teleconferences, and document exchanges that resulted from the RI scoping process performed between November 2011 and July 2013 are documented in Worksheet 9 and Attachment 9A of the September 2013 Phase 1A Sampling and Analysis Plan (EPA 2013). This summary of the scoping process has not been repeated in this Phase 1A-B SAP.

Scoping discussions and documentation pertinent to the ~~OU-1~~ Phase 1A-B RI- for PRI Areas 1 and 3 through 7 held since the publication by EPA of the September 2013 Phase 1A SAP are summarized below. Relevant documentation from these scoping discussions is provided in Attachment 9 to this SAP.

Date / Title / Description	Attachment
25 November 2014 / Preliminary Data Quality Objective Framework OU-1 Phase 1B RI for Nature and Extent / Prepared by ERM to address nature and extent (N&E) data gaps for all of OU-1	9A
17 December 2014 / Quarterly Project Management Meeting Summary and RIFS Status Update / EPA letter providing initial comments on ERM's 25 November 2014 Preliminary DQO Framework for the OU-1 Phase 1B RI	9B
20 February 2015 / Data Quality Objectives Framework OU-1 Phase 1B RI / Prepared by ERM to support scoping discussions held on 11 and 12 March 2015, this DQO included data collection to support preliminary N&E and exposure point concentrations for the Inner PRIs.	9C
20 February 2015 / OU-1 Phase 1B Scoping Meeting Agenda / Prepared by ERM to support scoping discussions held on 11 and 12 March 2015	9D
3 March 2015 / EPA's Proposed Final Agenda for OU-1 Phase 1B Scoping Meeting / Revised Phase 1-B Scoping Meeting Agenda with three attachments	9E
17 March 2015 / Scoping Meeting for DQOs Addressing 2015 Inner-PRI Investigations / EPA letter providing Agencies' comments for ERM's consideration during revisions to the DQO	9F
24 March 2015 / Agenda and Pre-Read for 24 March 2015 Risk Assessor Call / Provides ERM proposals for LRMS analysis and Background Evaluation DQO revised per Agency comments during the March 2015 Scoping Meeting	9G

Date / Title / Description	Attachment
26 March 2015 / Project Scoping Session Outcomes Summary for OU-1 Phase 1B Remedial Investigation Data Quality Objective Scoping Meeting, 11 and 12 March 2015 / Outcomes summary from the 11–12 March 2015 scoping meeting, including as attachments the Final OU-1 Phase 1B Scoping Meeting Agenda and ERM Slides Used to Guide Technical Discussions	9H
7 April 2015 / Draft Data Quality Objectives for OU-1 Phase 1A/1B RI SAP / Draft DQOs revised per the March 2015 Scoping meeting, includes a placeholder for the background(BG) DQO due to ongoing BG-related scoping discussions with EPA	9I
8 April 2015 / Agenda and Pre-Read for 9 April 2015 Risk Assessor Call (re-scheduled to 16 April 2015) / Includes responses to comments from EPA on BG DQO, a revised BG DQO proposal, and related correspondence between ERM and EPA regarding the BG DQO proposal (email from Dan Wall [EPA] 2 April 2015, email from Jen Holder [ERM] 1 April 2015)	9J
27 April 2015 / Agency Technical Comments on ERM's Draft Data Quality Objectives for OU-1 Phase 1A/1B RI SAP / Agency comments on ERM's DQO dated 7 April 2015	9K
28 April 2015 / Agency Comments on ERM Proposal for HRMS Reanalysis / EPA issue-paper regarding the LRMS-HRMS reanalysis 'trigger' for the Ph1A-B draft SAP	9L
29 April 2015 / EPA Technical Comments on ERM's Phase 1B Project Scoping Session Outcomes Summary / Comments on ERM's 26 March 2015 Outcomes Summary, dated 13 April 2015 but sent 29 April 2015	9M
4 May 2015 / ERM Response to EPA comments on the revised soil/sediment Phase 1 A-B DQO / Email from David Abranovic (ERM) providing responses to EPA's 27 April 2015 comments on the Phase 1A-B DQO and proposal for addressing the comments	9N
7 May 2015 / Agenda, Pre-Read, and Call Notes from 7 May 2015 Risk Assessor Call / 7 May 2015 Risk Assessor Call included items relating to ERM's response to EPA's 28 April 2015 comments on LRMS analysis, discussion of EPA's 27 April 2015 comments on the Phase 1A-B DQO, and scoping of the Background Areas reconnaissance field trip	9O
12 May 2015 / EPA Responses to ERM's 4 May 2015 Responses to EPA Comments on the Phase 1A-B DQO / Email from Ken Wangerud (EPA) responding to 4 May 2015 email from David Abranovic (ERM) and reflecting outcomes from a teleconference on 7 May 2015 between Ken Wangerud, David Abranovic, and Kevin Lundmark (ERM)	9P

Date / Title / Description	Attachment
18 May 20115 / EPA Acceptance of ERM's 7 May 2015 LRMS Analysis Proposal / Email from Wendy O'Brien (EPA) responding to call notes from 7 May 2015 Risk Assessor Call, including acceptance of ERM's 7 May 2015 proposal for LRMS analysis	9Q
19 May 2015 / Draft Final Data Quality Objectives for OU-1 Phase 1A-B RI SAP / ERM revised Phase 1A-B DQO including Background Evaluations and incorporating 27 April 2015 EPA comments on Draft DQO, 30 April 2015 ERM responses to EPA comments, 7 May 2015 discussions between ERM and EPA, and 12 May 2015 EPA responses to ERM comments	9R
21 May 2015 / Agenda and Call Notes from 21 May 2015 Risk Assessors Call / Scoping discussions for the Background Areas reconnaissance field trip	9S
3 June 2015 / Re: Draft DQO #3 for Proposed Phase 1A-B SAP Inner PRIs and Background Study / Final EPA comments on 3 June 2015 Draft Final DQO for Inner PRI investigations (Sections 11.1 and 11.2 only)	9T
8 June 2015 / Agency Final Comments to ERM Ph1A-B DQO Section 11.3 - Background Study / EPA comments on the ~~3 June~~18 May 2105 initial submittal of the DQO for Background Evaluation	9U
10 June 2015 / Response to EPA Letter Dated 3 June 2015; Re: Draft DQO #3 for Proposed Phase 1A-B SAP Inner PRIs and Background Study / ERM response to EPA's 3 June 2015 letter	9V
16 June 2015 / Clarification of Terms in Final Inner PRIs DQO / Email from Ken Wangerud (EPA) clarifying terminology in EPA's 3 June 2015 final edits to the Phase 1A-B DQO for Inner PRIs investigations in response to 11 June 2015 request from Kevin Lundmark (ERM)	9W

SECTION B: PRELIMINARY CONCEPTUAL SITE MODEL AND PROBLEM DEFINITION

SAP WORKSHEET #10

10.0 PRELIMINARY CONCEPTUAL SITE MODEL AND PROBLEM DEFINITION (SAP WORKSHEET #10)

10.1 PRELIMINARY CONCEPTUAL SITE MODEL

The EPA's preliminary conceptual site model for the N&E of impacts is provided in Section 10.3 of the September 2013 Phase 1A SAP. Comments from ERM/US Magnesium on the EPA's preliminary conceptual site model and responses to these comments from EPA were included as Attachment 4 to the Cover Letter of the September 2013 Phase 1A SAP.

In the subsections that follow, a summary is provided for each Inner Preliminary Remedial Investigation (PRI) Area that includes a general description of the PRI Area and the known sources of wastes discharged to the PRI Area, and also to reflect changed site conditions since 2013. As described in the Phase 1A SAP, PRI Areas were established by EPA based on similarities ~~of wastes in terms of COPCs~~to historic waste 'management' units and their previously identified ~~concentrations~~contaminants, ~~and on~~as well as locations and sizes of the areas to be studied.

Based on historical data and Site processes, the primary constituents of interest in solid media have historically been considered to be PCBs, Polychlorinated dibenzo-p-dioxins/polychlorinated dibenzofurans (PCDDs/PCDFs), and HCB, and these contaminants represent the expected primary risk drivers for the Inner PRI Areas (PRI Areas 1, 3, 4, 5, 6, and 7). Concentrations of these constituents appear to be highest in the wastewater ditches (PRI Area 1), the northeast ponded waste lagoon, also known as the 'Old Waste Pond" (OWP) (PRI Area 7), ~~and~~ the active wastewater ponds (PRI Areas 5 and 6), and the Gypsum pile (PRI 4). Other constituents detected historically at the Inner PRI Areas include trace metals, volatile organic compounds (VOCs), and semivolatile organic compounds (SVOCs) such as phthalates, polycyclic aromatic hydrocarbons (PAHs), chlorinated benzenes, phenols, and N-nitrosodimethylamine (NDMA).

PRI Area 1 – Ditches

PRI Area 1 includes the following wastewater ditches and associated features (dimensions are approximate):

- Western Ditch: 2,000 feet long, comprising a north-south leg 1,300 feet in length, 6 to 8 feet deep, 6 feet wide at bottom, and 20 feet in top width, and an east-west leg 700 feet in length. The Western Ditch receives non-contact cooling water from the magnesium plant. Wastewater in the Western Ditch is not acidic and abundant vegetation, primarily cat tails and phragmites, are present within the ditch.
- Central Ditch: 1,300 feet long, 10 feet deep, bottom width of 33 feet, and top width of 45 feet. The Central Ditch receives wastewater from the magnesium chloride pre-heater, melt reactor building, off-gas wet scrubbers, and anode dust wash operations.
- Chlorine Ditch: 1,350 feet long, 6 feet deep, and bottom width of 12 feet. The Chlorine Ditch receives wastewater from boron stripping cells, ferric chloride, and chlorine reduction burner operations.
- Main Ditch: Currently 3,000 feet long, 9 feet deep, bottom width of 33 feet, and top width of 45 feet. The Main Ditch conveys wastewaters from the Westen, Central, and Chlorine ditches and currently discharges to the Current Waste Pond (CWP, PRI 5); however, discharge was formerly routed to the OWP (PRI 7). Approximately 800 feet of the Main Ditch are now filled and help form the isthmus between the northwest and southeast areas of the CWP (PRI Area 6 and PRI

Area 5, respectively). ~~Wastewaters from the Western, Central, and Chlorine ditches are the source of the Main Ditch.~~

- Former Boron Ditch: The Boron Ditch was filled between approximately 1985 and 1990. The ditch was about 1,450 feet long. The Former Boron Ditch bottom is approximately 8 feet below ground surface (bgs).
- Dredge Spoil Areas: Areas between the ditches where material from within the ditches may have been placed.

Historical data suggest that Site concentrations of PCB, PCDD/PCDF, and HCB are elevated in the wastewater ditches, and that concentrations are higher in the Central and Main ditches than in the Chlorine and Western ditches.

PRI Area 3 – Sanitary Lagoon

PRI Area 3 is the Sanitary Lagoon, with an area of approximately 2 acres. It has steep sidewalls and a flat bottom. The lagoon, which functions as a leach field, was constructed during initial Site development (early 1970s) and has operated continuously. Abundant vegetation is present within the lagoon. The lagoon receives sanitary wastewater from plant operations following treatment by a bacteriological process. Dredged spoils from ditch maintenance may have washed into the sanitary lagoon.

Historical data suggest that concentrations of PCB, PCDD/PCDF, and HCB are lower in the sanitary lagoon than in the wastewater ditches and wastewater ponds.

PRI Area 4 – Gypsum Pile

PRI Area 4, the gypsum pile, consists of (i) calcium sulfate (gypsum) removed from the concentrated brine and derived from the desulfation process, where sulfate is removed as gypsum solids ($CaSO_4$) from the concentrated brine via addition of calcium chloride solution; (ii) the unreacted calcium carbonate and other solids from calcium chloride production; and (iii) raw plant water. In the desulfation process, calcium chloride solution is mixed with concentrated brine to remove sulfur from the brine, producing calcium sulfate (gypsum). After thickening, gypsum filter cake is removed using a drum filter. The calcium chloride used for desulfation is produced on Site in the calcium chloride reactor/thickener via reaction of limestone with hydrochloric acid from the reactor process. The hydrochloric acid feed to the calcium chloride reactor/thickener production process tank comes from several process areas that produce COPCs as byproducts. Unreacted calcium carbonate and other solids from the calcium chloride reactor/thickener are mixed with gypsum filter cake (from the drum filter) and raw plant water (well water from the western foot of the Stansbury Mountain range) and discharged as a slurry to the gypsum pile.

The pile expands by approximately 6 to 10 acres per year. The current footprint of the gypsum pile has expanded to within the footprint of the Northwest Ponded Waste Lagoon (PRI Area 6). The boundary between PRI Areas 4 and 6 varies over time due to fluctuating water levels in the pond and the increasing size of the gypsum pile.

Historical data suggest that concentrations of PCB, PCDD/PCDF, and HCB are lower in the gypsum pile than in the wastewater ditches and wastewater ponds, and concentrations within the gypsum pile show less variability than in the wastewater ditches and wastewater ponds.

PRI Area 5 – Southeast Ponded Waste Lagoon

PRI Area 5 is an active wastewater impoundment that covers approximately 330 acres. This lagoon was constructed in June 1986 in response to the GSL flooding the OWP and was operational in July 1986. PRI

Area 5 receives acidic process wastewater potentially impacted by sediment containing COPCs via the Main Ditch and has a surface connection to PRI Area 6. Waste magnesium oxide received from Hill Brothers was historically placed in the northwest edge of PRI Area 5 near the inlet. A vertically buried plastic liner was installed between the active wastewater pond (PRI Areas 5 and 6) and the OWP in an attempt to ~~help~~ prevent migration of wastewater through the berm separating the active and pond and the OWP.

A former wastewater diversion ditch traversing PRI Area 5 is evident in aerial photographs. This former wastewater diversion ditch originated at the Main Ditch and ran along the northeastern edge of the landfill to a discharge point in a former evaporation pond (northern PRI 14). Aerial photographs from 1985, 1987, and 1998 showing the former wastewater diversion ditch are included as Attachment 10. A ditch conveying storm water discharges from the brine evaporation holding pond (the "Star Pond") also skirts the southwest boundary of PRI Area 5.

Based on a review of historical aerial photographs and recent observations of Site conditions, the continuously ponded area within PRI 5 (and PRI 6) and wastewater depths within PRI 5 (and PRI 6) have ~~been~~ increased~~ing~~ in recent years, seemingly~~. This may be~~ due to increased wastewater discharges resulting from increased magnesium production, a reduction in overall wastewater pond capacity due to gypsum in-filling of the PRI Area 6 lagoon; this has been accompanied by acid~~, and/or~~ dissolution ~~by acid~~ of the oolitic sand substrate within the waste lagoons~~ footprint~~. Wastewater from the PRI Area 5 lagoon has intermittently discharged to the OWP (PRI Area 7) through the formation of sinkholes and preferential flow paths through the berm separating PRI Areas 5 and 7.

Historical data from PRI Area 5 suggest that constituent concentrations in sediment are highest at the lagoon inlet, and that concentrations in the central portion of the lagoon are higher than in the southeastern portion of the lagoon.

PRI Area 6 – Northwest Ponded Waste Lagoon

PRI Area 6 is approximately 174 acres in size. Along with PRI Area 5, the PRI Area 6 lagoon was constructed in June 1986 in response to the GSL flooding the OWP and was operational in July 1986. PRI Area 6 receives acidic process wastewater and sediments potentially impacted by COPCs from PRI 5 and runoff from the gypsum pile (PRI Area 4). As described above, the gypsum pile is encroaching into the PRI Area 6 lagoon footprint, and the boundary between PRI Areas 4 and 6 varies over time due to fluctuating water levels in the pond and the increasing size of the gypsum pile. Based on a review of aerial photographs that show the PRI Area 6 lagoon area prior to inundation by gypsum waste, the historical inlet and deepest portion of the PRI Area 6 waste lagoon has apparently been filled with gypsum waste.

A vertically buried plastic liner was installed between the active wastewater pond (PRI Areas 5 and 6) and the OWP in an attempt to ~~help~~ prevent migration of wastewater through the berm separating the active and pond and the OWP. A clay barrier wall was installed at the north-northeast edge of the active waste pond in PRI Area 6 as an additional ~~measure~~ attempt to reduce wastewater migration.

As described above for PRI Area 5, the continuously ponded area and wastewater depths within PRI Area 6 have also been apparently increasing in recent years. Wastewater from the PRI Area 6 lagoon has intermittently discharged to Northwest Lagoon Overflow Area (PRI Area 8) through the formation of sinkholes and preferential flow paths through the berm separating PRI Areas 6 and 8.

Historical data from PRI Area 6 suggest that chemical concentrations in the central portion of the lagoon are higher than in the northern portion of the lagoon.

PRI Area 7 – Northeast Ponded Waste Lagoon

PRI Area 7 (Northeast Ponded Waste Lagoon) is the former wastewater disposal pond, also referred to as the OWP. It is approximately 800 acres in size and was constructed concurrently with the initial construction of the plant in the early 1970s. ~~The OWP was permitted by the EPA under National Pollutant Discharge Elimination System permit UT-0000779.~~ In 1984, it was flooded by the GSL and closed to discharges. Currently, the waste lagoon intermittently ~~the pond is dry most of the year, though~~ has standing water during springtime (runoff and possible related to groundwater infiltration), ~~ponds during large~~ rain events, and increased site-water inflows. Groundwater seepage into the pond occurs at multiple locations along the southeastern edge of the pond. The OWP has intermittently been flooded by wastewater from PRI 5 due to undermining of the dyke separating PRI Areas 5 and 7.

Historical data from PRI Area 7 suggest that chemical concentrations in OWP sediment are highest near the historic inlet and appear to generally decline with distance from the inlet.

10.2 PROBLEM DEFINITION

Under the RI/FS framework prescribed by the AOC, a Baseline Risk Assessment will be performed to evaluate risks to human health and ecological receptors. Prior to performing the Baseline Risk Assessment, a Screening-Level Ecological Risk Assessment (SLERA) will be performed to select the chemical of potential ecological concern (COPECs) to be carried through the risk assessment.

Site Data

For the Inner PRI Areas, historical and some recent data are available (ERM 2014a); however, the available Inner PRI Area data alone are not adequate for COPC selection. While historical data obtained at the Site in earlier investigations do provide insight into the chemicals likely to be of primary concern in soil/sediment and solid wastes (solid media or "solids") ~~at the Site~~, these data may not accurately reflect current, near-surface Site conditions. In addition, the EPA has identified that not all solids have been well-characterized previously, and the historical data are often restricted to a subset of analytes when compared to the list of target analytes identified by EPA for the Site. Consequently, new data are needed to support selection of human and ecological COPCs for Inner PRI media.

Additionally, the N&E of impacts have not been characterized in the Inner PRI Areas. This is due in part to the fact that the historical data for the Inner PRI Areas in most cases did not include analyses for all current target analytes and there was either an insufficient number of samples collected or the sampling locations were not based on a suitable sample design (e.g., locations were not based on an unbiased approach and only targeted selected portions of the Site). The EPA has also identified that "vertical profile waste stratification and contaminant data are needed at key release locations and within areas where wastes have been discharged continually" (EPA 2013).

Background Data

A necessary component of the RI/FS is to define the naturally occurring or "background" concentrations of chemicals in solid media. The purpose of characterizing background is so that Site-to-background comparisons can be conducted and Site-related chemicals can be identified. The~~se~~ chemicals of chief interest in background samples include metals, which are natural components of the Earth's crust, and organic compounds that are either anthropogenically produced or combustion byproducts (wildfires), which are ubiquitous in the environment due to wind dispersal and aerial deposition. For the purposes of this evaluation, both naturally occurring and ubiquitous anthropogenic ~~ambient~~ chemicals will be ~~defined~~

~~as "background."~~ evaluated in background samples. Two classifications of compounds are relevant to characterizing background for the US Magnesium RI/FS: metals and organics. Organics include PCDD/PCDF, PCBs, and HCB.

There are historical datasets in the general area of the US Magnesium Site that provide some information regarding background concentrations of metals and organics; however, none of these datasets provide sufficient information to develop relevant background for the purposes of the RI/FS. Collection of data for evaluation of background metal and organics concentrations is therefore critical for conducting RI/FS activities, including the characterization of N&E, and identification of Site-related constituents of concern. The soil data collected in background areas will support the selection of reference areas for biotic sampling by confirming that the locations are not impacted by releases from the US Magnesium Site.

SECTION C: DATA QUALITY OBJECTIVES

SAP WORKSHEET #11

11.0 PROJECT QUALITY OBJECTIVES/SYSTEMATIC PLANNING PROCESS STATEMENTS (SAP WORKSHEET #11)

Based on the conceptual site model provided in Worksheet #10 of the *Phase 1A Remedial Investigation Sampling and Analysis Plan to Identify Chemicals of Potential Concern in Soils, Sediment, Solid Waste, Water and Air, and Receptor Surveys,* Revision 0 for PRI Areas 2 and 8 through 17 (hereafter referred to as "Phase 1A SAP") (EPA 2013), this worksheet presents DQOs and associated sampling strategies and rationale for the Phase 1A-B RI ~~for OU-1~~ for PRI Areas 1 and 3 through 7 at the Site.

The DQOs presented herein follow the seven-step process described in the EPA *Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G-4* (EPA 2006a).

11.1 OBJECTIVES OF THE PHASE 1A-B RI ~~FOR OU-1~~

The objective of Phase 1A-B RI ~~for OU-1~~ is to obtain sufficient data to support:

1. Reliable identification of COPCs for human and ecological receptors within PRI Areas 1 and 3 through 7.
2. Initial risk calculations to evaluate whether sufficient data have been collected within PRI Areas 1 and 3 through 7 to support confident risk characterization.
3. Preliminary evaluation of the N&E of Site-related impacts within PRI Areas 1 and 3 through 7.
4. Estimation of background (ambient) concentrations for metals and organics including, D/Fs, total PCBs and WHO congeners, and HCB.
5. Identification of suitable reference areas (i.e., non-impacted areas) for biota sampling that may be conducted during 2016 Phase 2 RI activities.

Broadly, these objectives are combined into two principal DQOs of "COPC Selection and Preliminary N&E at Inner PRI Areas," and "Evaluation of Background." The remainder of this worksheet presents the seven-step DQO process for the two principal DQOs.

11.2 DATA QUALITY OBJECTIVES FOR COPC SELECTION AND PRELIMINARY NATURE AND EXTENT AT INNER PRI AREAS

11.2.1 Step 1: State the Problem

11.2.1.1 Description of the Problem

The RI/ FS Area Boundary has been preliminarily defined by the EPA as a 5-mile radius around the US Magnesium facility. For purposes of project planning during the initial phases of the RI, the EPA initially divided the Site into 18 Preliminary Remedial Investigation Areas (or "PRI Areas"), with the "Inner PRI Areas" defined as PRI Areas 1 and 3 through 7, the "Outer PRI Areas" defined as PRI Areas 2 and 8 through 17, and PRI Area 18 being ambient air. The Site was subsequently divided into OUs by the EPA, with OU-1 including PRI Areas 1 through 17 and OU-2 being defined as PRI Area 18.

Phase 1A ~~of the OU-1 RI~~ provided the information necessary to select human and ecological COPCs for the Outer PRI Areas. For the Inner PRI Areas, historical (i.e., collected prior to the Phase 1A Demonstration of Method Applicability [DMA]) and Phase 1A DMA data are available (ERM 2014a); however, the EPA determined that historical and DMA data alone are not adequate for COPC selection.[1] The EPA indicated that, while historical data obtained at the Site in earlier investigations do provide insight into the chemicals likely to be of primary concern in soil/sediment and solid wastes (solid media or "solids") at the Site, these data may not accurately reflect current, near-surface Site conditions. In addition, the EPA has identified that not all solids have been well characterized previously, and the historical data are often restricted to a subset of analytes when compared to the list of target analytes identified by EPA for the Site. Consequently, new data are needed to support selection of human and ecological COPCs for Inner PRI media.

Additionally, the N&E of impacts have not been characterized in the Inner PRI Areas. This is due in part to the fact that the historical data for the Inner PRI Areas in most cases did not include analyses for all current target analytes and there were either an insufficient number of samples collected or the sampling locations were not based on a suitable sample design (e.g., locations were not based on an unbiased approach and only targeted selected portions of the Site). The EPA has also identified that "vertical profile waste stratification and contaminant data are needed at key release locations and within areas where wastes have been discharged continually" (EPA 2013). Based on Site operations, the Site history, a review of aerial photographs, and information from previous sampling events, the following key waste release locations are identified for the Inner PRI Areas:

- Wastewater Ditches (PRI Area 1);
- The south-central portion of the Gypsum Pile (PRI Area 4) where the pile is tallest;
- The Southeast Ponded Waste Lagoon (PRI Area 5) near the outlet of the Main Ditch;
- The historical inlet to the northeast ponded Waste Lagoon (PRI Area 7); and
- The former wastewater diversion ditch traversing the Southeast Ponded Waste lagoon (PRI Area 5).

These key waste release locations are shown in Figure 11-1.

Finally, it is recognized that Phase 1A-B data will also be used to support the baseline human health and ecological risk assessments. It will be important to evaluate whether the data collected at the end of Phase 1A-B are sufficient to support confident risk characterization or if additional data collection is necessary in Phase 2.

11.2.1.2 Conceptual Model

Initial Site-wide conceptual site models for the current and future use at the Site are presented in Worksheet 10 of the Phase 1A SAP.

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[1] While the EPA has determined that the historical data (alone) are not adequate for COPC selection, the EPA has stated that, if historical data are found to be statistically similar to data collected in Phase 1A-B, it may be appropriate to combine the data to increase sample size and decrease uncertainty. If so, then the historical data may be included in the dataset used for COPC selection and risk assessment.

11.2.2 Step 2: Identify Goals of the Study

The goals of the study are:

1. To obtain sufficient data for solid media in the Inner PRI Areas to reliably select human and ecological COPCs that require further quantitative evaluation in the risk assessment process;

2. To evaluate whether sufficient data have been collected at the Inner PRI Areas to support confident risk characterization; and

3. To perform initial Site characterization of the N&E of impacts distributed within the Inner PRI Areas to support initial chemical mapping and to guide subsequent Site characterization sampling designs.

11.2.3 Step 3: Identify Information Inputs

11.2.3.1 Information Inputs

The information needed to support COPC selection is an adequate and reliable dataset to characterize the range of concentration values that occur in solid media within the Inner PRI Areas. Additionally, the sample design described in Steps 6 and 7 for COPC selection will provide data concerning contamination in media at the Site. This can be used to assess whether data are sufficient for the Baseline Risk Assessments as well as planning for Phase 2 investigations, as needed.

The information needed to support preliminary N&E characterization includes chemical concentration data from surface samples distributed throughout each Inner PRI Area and subsurface samples at key waste release locations, as well as waste thickness profiles. The sample design described in Steps 6 and 7 for COPC selection will provide data for preliminary N&E characterization. The preliminary N&E characterization will be used for planning additional Site characterization data collection for Phase 2, as needed.

11.2.3.2 Sampling and Analytical Methods

Sampling and analytical methods are described in Step 7, Section 11.2.7.

11.2.4 Step 4: Define the Boundaries of the Study

11.2.4.1 Spatial Boundaries

For this study, the lateral spatial boundaries are prescribed by the boundaries of the Inner PRI Areas. The vertical boundaries for the study are defined based on the sampling method. Sampling will be performed to a depth of 6 inches bgs at all surface sampling locations, consistent with the Phase 1A SAP. Subsurface sampling will be performed using 2-foot maximum sample intervals from 6 inches bgs to 2 feet below the waste/native soil interface.

At sampling locations outside of the inundated areas (e.g., PRI Areas 5, 6, and 7 as appropriate) where subsurface sampling is not performed, hand-auger borings to delineate waste thickness will extend to the waste/native soil interface or to a maximum depth of 5 feet bgs. The 5-foot maximum depth is due to practical constraints of hand-augering to greater depths under Site conditions.

11.2.4.2 Temporal Boundaries

Constituent concentrations within solid media at the Site are not expected to fluctuate substantially over the timescale of a year, provided that significant process changes have not been implemented at the facility during that time and that the solid medium has not been substantially disturbed (e.g., by earthmoving activities, flood event, etc.). Consequently, the time of year when sampling occurs is not likely to be important (EPA 2013).

It is recognized that Site-specific conditions and practical constraints may occur that affect the timing of sampling, access to sampling areas, and health and safety of field personnel. Sampling should be avoided during spring due to high water conditions in wastewater ponds, or in peak summer months when excessive heat could adversely affect the health and safety of field personnel. Because sampling within inundated areas will be performed using a helicopter, weather conditions may also limit or affect the performance of sampling in these areas (e.g., no sampling during high winds and helicopter flight is more challenging due to poor lift during hot weather). Because such conditions may hinder sample collection, the field sampling standard operating procedures (SOPs) will describe the suitable times and conditions during which such sampling will need to be conducted to ensure that a complete sample set is obtained.

11.2.5 Step 5: Develop the Analytical Approach

11.2.5.1 COPC Selection

Several factors may be considered in selecting COPCs, the first step is to compare the maximum detected concentration in a dataset (Cmax) to an appropriate risk-based concentration (RBC). If the value of Cmax for an analyte in a medium at a PRI Area does not exceed the RBC, that analyte may be generally excluded as a COPC in that medium at that PRI Area. Otherwise, if the value of Cmax exceeds the RBC, the analyte is retained as a COPC in that medium in that PRI Area. The methods and RBCs to be used for selection of COPCs for OU-1 are described in the *Final Screening Level Risk Assessment Technical Memorandum* (ERM 2014b). Because human and ecological exposure areas have not yet been established at the Site, COPC selection for solid media at the conclusion of Phase 1A-B will occur on a PRI-Area-by-PRI-Area basis.

11.2.5.2 Confident Risk Characterization

To evaluate whether sufficient data have been collected to support confident risk characterization, initial risk calculations will be performed using all usable Phase 1A-B data following the methods described in risk assessment memoranda as specified in the AOC. Initial risk calculations will be limited to the COPCs identified in the OU-1 SLRA Report. The initial risk calculations will be included in the OU-1 SLRA.

11.2.5.3 Preliminary Nature and Extent

The Phase 1A-B RI Data Report will include maps showing chemical constituent concentrations for toxic equivalency quotients (TEQs), HCB, and PCBs, and may also include maps for other COPCs that are determined to be of significant interest based on the Phase 1A-B data.[2] Chemical mapping will include data from the Phase 1A-B RI and the historical/DMA data described in the Final Inner PRI Data Report (ERM 2014a). If concentrations of a constituent in surface samples are similar across a PRI Area, then additional N&E data may not be required for that constituent. However, additional N&E information may be subsequently needed to delineate specific areas to support risk assessment or remedy decision to more clearly delineate the spatial distribution of chemicals for Site characterization or for FS evaluations. If constituent concentrations are highly variable across a PRI Area, and/or additional delineation is necessary to support remedy selection, then additional sampling to characterize and delineate N&E may be performed during the Phase 2 RI.

To supplement the sample point chemical concentration maps, geostatistical modeling (e.g., kriging) will also be conducted for HCB, total PCBs, and mammal TEQs for each Inner PRI Area, where the data permit. Geostatistics will provide a spatial depiction of the data that can be used to predict concentrations of HCB, total PCBs, and mammal TEQs in soil throughout a particular PRI Area. More importantly, geostatistics can provide a spatial description of the level of uncertainty associated with unsampled locations, which will aid in understanding the spatial variability in HCB, total PCBs, and mammal TEQs. This will provide a fuller view of the extent of impacts and help determine areas requiring additional sampling for Site-characterization evaluation and remedy-scoping considerations. A description of the geostatistical method(s) used, results, and interpretation of the results will be included in the Phase 1A-B Data Report. The Data Report will also provide results and interpretation of statistical evaluations (e.g., scatter plots, outlier tests, quantile-quantile [Q-Q] plots) to analyze N&E of expected risk drivers.

The need for additional sampling to delineate N&E at the Site will be determined for OU-1 during the Phase 2 RI scoping process. Site-characterization DQOs for the Phase 2 RI may be identified based on waste types, PRI Area or other boundaries, and/or remedy-scoping considerations (e.g., decision units). Chemical concentration maps, geostatistical modeling output, and statistical evaluations provided in the Phase 1A-B Data Report will be used to support the Phase 2 RI scoping process and associated DQO development.

If field screening identifies that waste is present at depths greater than 6 inches bgs, then additional sampling will be required to delineate the vertical extent of waste, to measure COPC concentrations in the subsurface to depths relevant to human or ecological exposure, or to support FS evaluations. Subsurface sampling will be performed during Phase 1A-B at key waste deposition locations. If subsurface concentrations are substantially higher than those in surficial samples, additional subsurface sampling may be necessary to adequately delineate the vertical extent of constituents of concern. The maximum subsurface sampling interval will be 2 feet. Subsurface sampling intervals will be adjusted in the field for the following reasons:

- Native material will be segregated from waste material for the final sample interval to allow for the evaluation of potential impacts from wastes in native soil.
- If anomalous or discrete layers of waste or sediments are observed in a boring, the sample interval will be adjusted (reduced) to target the anomalous/discrete layers; however, due to sample volume requirements, no sample interval will be less than 6 inches. Anomalous layers will be identified by the EPA, EPA contractor, or US Magnesium/ERM field personnel based on color, texture, field screening, and comparison with other wastes/sediments within a boring.

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[2] Additional chemical constituent maps for Phase 2 RI scoping will be prepared for Outer PRI Areas and for other Inner PRI Area risk drivers based on the results of the OU-1 SLRA.

11.2.6 Step 6: Specify Performance or Acceptance Criteria

11.2.6.1 COPC Selection

The performance acceptance criteria for COPC selection were established by the EPA in the Phase 1A SAP. To minimize the probability that a chemical in the soil, sediment, or solid waste of a PRI Area will be excluded as a COPC when it should be retained for further evaluation, it is necessary to be confident that the observed Cmax will have a high probability of exceeding the RBC when the chemical is truly of potential concern. This, in turn, is related to the total number of samples collected, and to the methods that will be used to evaluate risk from chemicals that are retained. In accord with discussions at the March 2015 scoping meetings, the minimum sample size for each PRI Area shall be 14.

The statistical basis for a minimum sample size of 14 for COPC selection was developed by the EPA in the Phase 1A SAP. The COPC selection process is founded on the concept that, given a dataset of adequate size, the maximum concentration value in that dataset will have a high probability (greater than or equal to 95 percent) of exceeding the true mean concentration across the exposure area. If the observed maximum concentration does not exceed the RBC, there is confidence that the true mean will not exceed the RBC, and hence the chemical will not contribute significant risk and may be not improperly excluded as a COPC.

However, if the dataset is not large enough, the observed Cmax value may not exceed the true mean across the exposure area. This is demonstrated as follows:

Let P equal the percentile of the distribution occupied by the mean. Then, if a single sample is drawn, the probability that the sample is lower than the mean is equal to P. If N samples are drawn, the probability that ALL the samples are below the mean is P^N. Thus, the probability that one or more samples exceed the mean is given by:

$$\text{prob}(\text{Cmax} > \text{mean}) = 1 - P^N$$

The number of samples (N) needed to ensure that the probability is at least 95% that one or more samples exceed the true mean is shown below for a range of distributions in which the true mean occurs at a percentile ranging from the 50th to 90th:

Percentile of the True Mean	N	Probability that Cmax > True Mean
50th	5	96.9%
60th	6	95.3%
70th	9	96.0%
80th	14	95.6%
90th	29	95.3%

For a dataset with a normal distribution, the mean occupies the 50th percentile (P = 0.5), and a dataset of five samples would likely be sufficient to support COPC selection. However, most environmental datasets for soil, sediment, or solid waste are right-skewed, and this results in the mean occupying a percentile higher than 0.5. Depending on the degree of skew, the mean usually falls between the 60th and 90th percentile (or even higher in extreme cases).

Consistent with the Phase 1A investigation, it is assumed for planning the Phase 1A-B investigation of solid media in Inner PRI Areas that the mean will generally not be higher than the 80th percentile. This assumption is supported by historical and DMA data available for the Inner PRI Areas, which indicate that, for the expected risk drivers (D/F TEQs, HCB, total PCBs), the sample mean usually occurs in the range of the 60th to 80th percentile, as shown below:

PRI Area	Percentile of the Mean			
	D/F TEQ (avian)	D/F TEQ (mammalian)	HCB	Total PCBs
1	59%	47%	64%	65%
4	68%	82%	68%	79%
5	72%	76%	76%	74%
6	77%	69%	77%	60%
7	79%	83%	79%	75%

Based on this, it is considered likely that a dataset of 14 samples is likely to suffice for most analytes. However, if the data from the Phase 1A-B investigation suggest that the distribution of some analytes is more strongly skewed than assumed (i.e., the sample mean is substantially higher than the 80th percentile of the dataset), it may be necessary to collect additional samples to ensure analytes are not improperly excluded as COPCs.

11.2.6.2 Confident Risk Characterization

The performance acceptance criteria for the evaluation of whether sufficient abiotic data have been collected will be dependent on the risk assessment methodologies developed in the technical memoranda specified in the AOC. It is recognized that the evaluations described below may be modified once the risk assessment methodologies are finalized.

All risk calculations for humans and mobile ecological receptors (birds, mammals) will be in accord with standard EPA guidance, and will be based on the 95% upper confidence limit (95UCL) of the mean concentration in the exposure area of concern. The 95UCL will be derived on a PRI Area-basis for COPCs identified in the OU-1 SLRA using the most recent version of EPA's ProUCL software application. Use of the 95UCL minimizes the probability of a false negative decision error (deciding risk is below a level of concern when it actually is above a level of concern). However, use of the 95UCL tends to increase the probability of false positive decision errors (declaring that risk is above a level of concern when it actually is below a level of concern). If initial risk estimates based on the 95UCL are below a level of concern, or if risks are above a level of concern based on the sample mean, then it is likely that additional data will not be needed for risk management decision making. In cases where risk is below a level of concern based on the sample mean but above a level of concern based on the 95UCL, then additional data may be useful to support confident risk characterization. In this event, additional sampling needs will be planned and executed during Phase 2.

For sessile or small home range ecological receptors, an assessment of the magnitude and frequency of Hazard Quotient (HQ) values that exceed 1.0, with calculations performed on a sample-by-sample basis, may be performed. In cases where the distribution of HQ values provides a clear prediction of population-level hazard, additional abiotic data to support the HQ approach are unlikely to be necessary. However, in cases where the data are not sufficient to allow a clear assessment of HQ-based population-level hazard, additional abiotic data may be needed. In this event, the necessary abiotic sampling will be planned and performed in Phase 2, along with any biotic-based studies that may be needed.

11.2.6.3 Preliminary Nature and Extent

The need for additional sampling to delineate N&E at the Site will be determined for OU-1 during the Phase 2 RI scoping process. Site-characterization DQOs for the Phase 2 RI may be identified based on waste types and expected thickness, PRI Area boundaries or other important spatial boundaries (e.g., geologic, hydrologic, waste, etc.) and/or remedy-scoping considerations (e.g., decision units). Chemical concentration maps, geostatistical modeling output, and statistical evaluations provided in the Phase 1A-B Data Report will be used to support the Phase 2 RI scoping process and associated DQO development.

The validated and verified Phase 1A-B data will be combined with historical/DMA data and used to prepare chemical concentration maps and perform geostatistical modeling and statistical evaluations as described in Section 11.2.5.3. The degree to which the combined datasets delineate the N&E of Site-related contamination within the Inner PRI Areas will be described by the variability of concentrations, relationship of results to risk thresholds, the spatial distribution of chemical concentrations, and level of uncertainty for unsampled locations as predicted by geostatistical modeling. The mapping, geostatistical modeling, and statistical evaluations provided for D/F TEQs, HCB, and total PCBs in the Phase 1A-B Data Report will support scoping of Phase 2 investigations for the collection of additional data to complete Site-characterization and support remedy-scoping and FS evaluations.

11.2.7 Step 7: Develop the Plan for Obtaining the Data

The data collection approach described below supports both COPC selection and preliminary N&E study goals. The data obtained during Phase 1A-B to support COPC selection and preliminary N&E will also be used to perform initial risk calculations to evaluate whether sufficient data have been collected to support confident risk characterization and adequate characterization of the N&E of areas that exceed a level of concern.

11.2.7.1 Surface Solids Sampling

In accord with the performance criteria for COPC selection described in Step 6, the basic plan for surface solids sampling is to collect surface solids samples from at least 14 unbiased locations with the addition of biased/judgmental samples at selected locations. Surface solids samples will be collected from 0 to 6 inches bgs. Surface solids sampling outside of the inundated areas (e.g., PRI Areas 5, 6, and 7 as appropriate) will be performed using a hand auger as detailed in the SOP *USM-01: Surface Soil, Sediment, and Waste Sampling*. Within the inundated areas (e.g., PRI Areas 5, 6, and 7 as appropriate), surface solids samples will be collected using a helicopter-deployed sampler as detailed in SOP *USM-12: Surface Solids Sampling within Current Wastewater Ponds*. When sampling within inundated areas (e.g., PRI Areas 5, 6, and 7 as appropriate), all reasonable efforts will be made to ensure that samples are obtained from the target locations. SOP USM-12 includes criteria for evaluating when a sample is acceptable and procedures for adjusting sampling locations based on field conditions.

The presence/absence of visible waste will be noted on sampling forms at all sampling locations, as described in SOP USM-01. When waste is visible, the depth of waste will be measured. Waste may include gypsum, smut, salts, or sludge that have a different appearance than the native soils present within the Inner PRI Areas (e.g., oolitic sands, lacustrine clays, evaporate minerals). If waste is present at the bottom of a surface sample location (6 inches bgs) outside of the inundated areas (e.g., PRI Areas 5, 6, and 7 as appropriate), then the hand-auger boring will be advanced to either the waste/native soil interface or a maximum depth of 5 feet bgs. The maximum depth of 5 feet bgs is based on the impracticality of advancing a hand auger to depths below 5 feet under Site conditions (e.g., standing water, shallow depth to groundwater, unconsolidated wastes) and health and safety considerations. Field screening for waste thickness at locations within the inundated areas (e.g., PRI Areas 5, 6, and 7 as appropriate) will be to depth of penetration of the helicopter-deployed sampler.

11.2.7.2 Subsurface Solids Sampling

The role of subsurface solids sampling for COPC selection was described in the Phase 1A SAP. At most environmental sites, site-related contaminants tend to be highest in surficial soils or sediments, with decreasing concentrations as a function of depth. However, at this Site, it is considered plausible that, in at least some PRI Areas, concentrations of chemicals might be higher in subsurface materials than at the current surface. This condition might occur under several alternative scenarios, as follows:

- The types of chemicals released in the past might have been different than at present due to changes in plant operation conditions.
- The level (concentration, mass loading) of contaminants released to the environment may have been higher in the past than at present, especially if plant operations were changed with the goal of reducing levels of chemical release.
- Historical wastes may have been moved or buried under less impacted or clean materials.
- Chemical fate and transport processes might act on surficial materials differently than on deep materials, potentially resulting in higher concentrations in samples collected at depth.

Because it is not known whether any of the scenarios may actually have resulted in meaningful differences between surface and subsurface samples, it is necessary to obtain some limited data to recognize if this situation may exist. This is important for COPC selection, because a Type I decision error (exclusion of an analyte as a COPC that should have been retained) could occur if surface levels of an analyte are below the RBC but concentrations at depth exceed the RBC. The Phase 1A-B investigation therefore includes a limited number of borings to evaluate potential differences between surface and subsurface samples. These samples will also help inform the preliminary vertical N&E of chemical impacts.

In identifying COPCs for a PRI Area where samples at depth have been collected, the value of Cmax will be the highest of any value in the dataset for the PRI Area, including both surface and subsurface samples. If subsurface concentrations are substantially higher than those in surficial samples, some analytes may be identified as COPCs in subsurface materials that may not be of concern in surficial samples. Because only a small number of boring samples are to be collected, additional subsurface sampling will be necessary in subsequent field programs to adequately characterize the vertical extent of COPCs.

Subsurface solid sampling will be performed as detailed in SOP *USM-09: Subsurface Soil, Sediment, and Waste Sampling*. Subsurface borings with sampling using 2-foot maximum intervals for chemical analysis will be performed to evaluate chemical concentrations at depth and for characterizing vertical N&E within key waste release locations (Figure 11-1) and other locations identified by the EPA. Surface samples (0 to 6 inches bgs) will also be collected at each subsurface sampling location; therefore, the typical/default subsurface sample intervals will be 6 inches to 2 feet bgs, 2 feet to 4 feet bgs, and so on with the final sample interval extending to 2 feet below the waste/native soil interface. Native material will be segregated from waste material for the final sample interval to allow for the evaluation of potential impacts from wastes in native soil. If anomalous layers of waste or sediments are observed in a boring, the sample interval will be adjusted (reduced) to target the anomalous layers; however, due to sample volume requirements, no sample interval will be less than 6 inches. Anomalous waste/sediment layers will be identified by the EPA, EPA contractor, or US Magnesium/ERM field personnel based on color, texture, field screening, and comparison with other wastes/sediments within a boring.

11.2.7.3 Sampling Locations

The number and approximate locations of surface and subsurface solids samples identified in this SAP were discussed and agreed to by ERM/US Magnesium and the EPA during the March 2015 OU-1 Phase 1B RI DQOs Scoping Meeting (ERM 2015a). Surface solids sampling locations were preferentially chosen using a systematic (grid) sampling design to ensure that the PRI Area is fully and uniformly represented by the set of samples collected. In addition, judgmental samples are placed at known features at PRI Areas 1, 5, and 7 to support COPC selection and preliminary characterizations of N&E. The systematic grids of sampling locations at PRI Areas 3, 4, 5, and 7 include locations near areas of waste deposition or found to contain the highest concentrations of HCB, D/F TEQs, and PCBs based on historical Site data. Subsurface borings for COPC selection and vertical N&E are located within key waste deposition areas (PRI Areas 1, 4, 5, and 7; see Figure 11-1) and at locations in PRI Areas 3 and 6 as requested by the EPA during the March 2015 Scoping Meeting.

Most sampling locations include surface sampling only; however, field screening for waste thickness will be performed at all sampling locations. If field screening for waste indicates that waste material is present at depths greater than 6 inches bgs within all or a portion of a PRI Area, then subsequent sampling to delineate vertical N&E would be considered during subsequent RI Phase 2. Waste thickness at subsurface sampling locations will be determined by extending the boring to below the waste/native soil interface.

Sampling locations for each PRI Area are described in the subsections that follow. Sampling locations for PRI Areas 3 through 7 were developed using Visual Sample Plan software (VSP; vsp.pnnl.gov). To ensure the assumption of random sampling is met, a systematic sample grid layout was employed that utilized a randomized initial sample that serves as the origin on which the systematic grid is constructed.

US Magnesium may construct a wastewater filtration system located on PRI Areas 1 and 3. The EPA has instructed US Magnesium that if a Resource Conservation and Recovery Act (RCRA) settlement is reached prior to implementation of this phase of the RI, the Phase 1A-B samples that are located in areas included within a RCRA settlement area will be revised in an appropriate Record of Modification to the Phase 1A-B RI SAP.

PRI Area 1

Surface solids sampling will be performed at 14 locations in PRI Area 1 as shown on Figure 11-2. Twelve locations are within active wastewater ditches, one location (1-13) is within an inactive reach of the Main Ditch, and one location (1-14) is within the alignment of the Former Boron Ditch. Because the wastewater ditches are linear features, all sampling locations in PRI Area 1 were judgmentally selected instead of using a systematic grid. For the 13 sampling locations not within the former Boron Ditch, locations were divided between the active wastewater ditches based on the relative approximate length of each ditch: three samples at the Western Ditch (2,000-foot length), two samples at the Central Ditch (1,300-foot length); two samples at the Chlorine Ditch (1,350-foot length), and six samples at the Main Ditch (4,200-foot length, including historical ditch alignment to the outlet at PRI Area 7). The distribution of samples between ditches results in one sample per approximately 700 feet. Samples were distributed along the wastewater ditches taking into account accessibility by placing samples at each of three bridges crossing the active wastewater ditches. The rationale for each Phase 1B sample at PRI Area 1 is provided below.

ID	Rationale
1-01	Near head of Western Ditch (surface)
1-02	Approximate midpoint of north-south segment of Western Ditch (surface)
1-03	West of bridge at confluence of Western and Main ditches (surface and subsurface)
1-04	Near head of Central Ditch (surface)
1-05	Central Ditch downstream of Sanitary Lagoon (surface)
1-06	Near head of Chlorine Ditch (surface)
1-07	Chlorine Ditch downstream of Boron Plant discharge and south of bridge (surface and subsurface)
1-08	Main Ditch after confluence with Chlorine Ditch and east of bridge (surface and subsurface)
1-09	Main Ditch adjacent to Landfill (surface)
1-10	Main Ditch below Landfill (surface)
1-11	Main Ditch near current outlet to PRI 5 waste pond (surface)
1-12	Main Ditch alignment adjacent to PRI 5 waste pond (surface)
1-13	Former Main Ditch near historical outlet to PRI 7 waste pond (surface and subsurface)
1-14	Former Boron Ditch (surface and subsurface)

Surface solids sampling will be performed at all locations (1-01 through 1-14). Subsurface sampling will be performed at five locations, including the three bridges over wastewater ditches (1-03, 1-07, and 1-08), the former Main Ditch near the historical outlet to the Northeast Ponded Waste Lagoon (1-13), and within the alignment of the former Boron Ditch (1-14).

PRI Area 3

Surface solids sampling will be performed at 14 locations in PRI Area 3, which include 13 evenly distributed grid sampling locations and one biased/judgmental sampling location. PRI 3 sampling locations are shown on Figure 11-3. Locations 3-01 through 3-13 were generated as a systematic grid. Location 3-14 is a biased/judgmental location for surface and subsurface sampling to characterize conditions at the presumed inlet to lagoon.

PRI Area 4

Surface solids sampling will be performed at 14 evenly distributed grid sampling locations in PRI Area 4 as shown in Figure 11-4. Subsurface sampling will be performed at a sampling location within the top-center of the Gypsum Pile, where historical gypsum waste is expected to be present at depth (location 4-05 on Figure 11-4). This sampling location is within a key waste release area (see Figure 11-1).

PRI Area 5

Surface solids sampling will be performed at 20 locations in PRI Area 5, which include 15 evenly distributed grid sampling locations and five biased/judgmental sampling locations. The base number of gridded sampling locations at PRI Area 5 was increased from 14 to 15 based on (1) the elevated variability in D/Fs, PCB, and/or HCB concentrations exhibited in historical PRI Area 5 solids data, and (2) agreements between ERM/US Magnesium and the EPA during the March 2015 OU-1 Phase 1B RI DQOs Scoping Meeting. PRI Area 5 sampling locations are shown on Figure 11-5. Locations 5-01 through 5-15 for PRI Area 5 were generated as a systematic grid and include locations in both upland (terrestrial) and mudflat/waste pond areas.

Subsurface sampling will be performed at the location nearest the inlet to the waste lagoon from the Main Ditch (location 5-14 on Figure 11-5) and at a location within a former wastewater diversion ditch (location 5-16 in Figure 11-5). These locations were selected for subsurface sampling because they are within key waste release areas (see Figure 11-1). The lagoon inlet (location 5-14) is the location where the greatest amount of waste deposition occurs, as apparent in aerial photographs. The former diversion ditch location was selected by EPA to investigate accumulated sediment/wastes within the ditch and potential subsurface impacts from leachate from the landfill. Drill rig access to location 5-14 will be attained by the construction of an earthen ramp into the wastewater pond.

The rationale for each of the five biased/judgmental sampling locations in PRI Area 5 is provided below.

ID	Sample Type	Rationale
5-16	Surface and Subsurface	Former Wastewater Diversion Ditch - Evaluate potentially impacted sediments from historical wastewater diversions and potential leachates from the landfill, located near/at an inlet of the ditch into the PRI Area 5 waste lagoon.

5-17	Surface	Former Wastewater Diversion Ditch - Evaluate potentially impacted sediments from the lower reach of the Former Wastewater Diversion Ditch (representing the eastward leg draining into the PRI Area 5 waste lagoon).
5-18	Surface	Star Pond Ditch - Evaluate potentially impacted sediments downgradient of the discharge point from the Star Pond.
5-19	Surface	Skull Valley Diversion - Evaluate potentially impacted sediments in an area of influent seepage.
5-20	Surface	Star Pond Ditch - Evaluate potentially-impacted sediments within a downstream (east) reach where Star Pond discharges appear to have comingled with Former Diversion Ditch and PRI Area 5 waste lagoon waters.

PRI Area 6

Surface solids sampling will be performed at 16 locations in PRI Area 6, which include 15 evenly distributed grid sampling locations and one biased/judgmental sampling location. As described above for PRI Area 5, the base number of gridded sampling locations at PRI Area 6 was increased to 15 based on the variability exhibited in historical PRI Area 6 solids data and agreements reached during the March 2015 OU-1 Phase 1B RI DQOs Scoping Meeting. PRI 6 sampling locations are shown on Figure 11-6. Locations 6-01 through 6-15 were generated as a systematic grid and include locations in both upland (terrestrial) and mudflat/waste pond areas. Subsurface sampling to characterize historically deposited wastes/sediments in the PRI Area 6 waste lagoon will be performed at a biased/judgmental location within the current PRI Area 4 (location 6-16 on Figure 11-6). Location 6-16 is within the historical inlet and deepest portion of the PRI Area 6 waste lagoon based on aerial photographs that show the PRI Area 6 lagoon area prior to inundation by gypsum waste. Over time, this area has filled with gypsum waste; therefore, drilling though gypsum waste at location 6-16 will allow access and sampling of historically deposited wastes/sediments in the PRI Area 6 waste lagoon. Subsurface sampling location 6-16 is co-located with surface solids sampling location 4-11 in PRI Area 4 (see Figure 11-4). Subsurface samples from location 6-16 composed of gypsum waste may be appropriate to include with the PRI Area 4 dataset for COPC selection.

PRI Area 7

Surface solids sampling will be performed at 17 locations in PRI Area 7, which include 15 evenly distributed grid sampling locations and two biased/judgmental sampling locations. As described above, the base number of gridded sampling locations at PRI Area 7 was increased to 15 based on the variability exhibited in historical PRI Area 7 solids data and agreements reached during the March 2015 OU-1 Phase 1B RI DQOs Scoping Meeting. PRI Area 7 sampling locations are shown on Figure 11-7. Locations 7-01 through 7-15 for PRI Area 7 were generated as a systematic grid and are evenly distributed throughout the floor of the OWP. Subsurface sampling will be performed at the location nearest the historical inlet to the OWP (location 7-04 in Figure 11-7). This location was selected for subsurface sampling because it is within a key waste release area (see Figure 11-1) that received wastewater discharges during the early operations of the Magnesium Plant and the inlet is the location where the highest concentrations of HCB, D/F TEQs, and PCBs were detected during historical investigations. Two biased/judgmental surface solids samples will be collected from within the barrow ditch north of the OWP (locations 7-16 and 7-17 on Figure 11-7) due to the potential for ecological receptor exposures within the barrow ditch.

11.2.7.4 Laboratory Analysis

Laboratory analytical data used for COPC selection, initial risk calculations, and preliminary N&E characterization will meet applicable criteria for definitive data as defined under EPA guidance (2005a) and the measurement performance criteria for sampling and analysis defined in the ~~OU-1~~ Phase 1A-B SAP.

Laboratory analyses will be performed following the analytical SOPs and project-specific Work Instructions included in the ~~OU-1~~ Phase 1A-B SAP. All Phase 1A-B surface and subsurface solid samples will be analyzed for the target analytes listed in Worksheet 15, which include the following:

- PCBs
- D/Fs
- SVOCs including HCB
- PAHs
- VOCs[3]
- Metals
- Cyanide
- Perchlorate

In addition to analysis for candidate COPCs, all solids samples will be analyzed for total organic carbon (TOC), pH, and grain size. TOC, pH, and grain size data will not be used to select COPCs; however, these data will be collected to provide context for subsequent risk assessment characterizations.

Due to the very high levels of PCBs and D/Fs expected to be present within some areas in the Inner PRI Areas, analysis of Phase 1A-B solids samples from the Inner PRI Areas for PCBs and D/Fs will be performed using a combination of high-resolution mass spectroscopy and low-resolution mass spectroscopy methods. The identification of samples for low-resolution mass spectroscopy analysis and the criteria that will be used to decide if a sample must be reanalyzed using high-resolution mass spectroscopy method will be included in the project-specific laboratory Work Instructions described in SAP Worksheet 23 and included in SAP Appendix 19B.

11.2.7.5 Bulk versus Fines Fractions Analyses

Consistent with the Phase 1A RI for Outer PRI Areas, the ~~OU-1~~ Phase 1A-B RI for the Inner PRI Areas will include an investigation to determine (1) if constituent concentrations significantly differ between bulk and fine fractions, and (2) whether a large-enough proportion of coarse material is present in bulk samples to result in a substantial difference between the constituent concentrations measured in the bulk and the fine fractions. For the purpose of this study, “bulk fraction” is defined as all material passing a 0.25-inch mesh sieve and “fine fraction” is defined as material passing a 0.25-millimeter (mm) (60 US Mesh) sieve. Evaluating bulk versus fines fractions is important for COPC selection because a Type I decision error (excluding a COPC that should be retained) could occur if concentrations of an analyte in bulk (unsieved) samples are below a level of concern but concentrations in fine-grained material are above a level of concern (EPA 2013).

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[3] VOC analysis will be performed for all surface solids samples and all subsurface solids samples.

The sieving and analysis strategy for Phase 1A-B RI samples is illustrated in the flow diagram shown on Figure 11-8. To facilitate the bulk versus fines evaluation, three splits will be collected for each Phase 1A-B surface solids sample. Each split will be composed of the bulk sample (passing 0.25-inch mesh) after homogenization.

1. Split sample 1 will be analyzed as a bulk fraction sample.

2. Split sample 2 will be analyzed for grain size by ASTM International (ASTM) Method C-136. The result from the grain size analysis of split sample 2 will be used to determine whether to analyze split sample 3 as a fines fraction sample.

3. If the percent passing 0.25 mm in split sample 2 is greater than 75, then no analysis for fines is required.

4. If the percent passing 0.25 mm in split sample 2 is less than 75, then split sample 3 will be dried, sieved through a 0.25 mm mesh, and the fines-fraction material (passing 0.25 mm) will be analyzed for PCBs, D/Fs, SVOCs, PAHs, metals, and TOC.

The cutoff specification is set at 75% because in samples with mass of the fine fraction at greater than or equal to 75% of the bulk, the maximum possible ratio of the concentration in the fine fraction to the bulk fraction is 1.33 (when the concentration in the coarse fraction is zero). Because the analytical variability of most methods is usually about 30%, the ratio of concentration values in the fine fraction to those values in the bulk fraction is expected to fall inside the normal range of analytical variability for all samples with more than 75% fine material.

The relationship between the paired results of the bulk and corresponding fine fractions will be evaluated using regression analysis. This approach allows development of a quantitative relationship between the bulk fraction and the fine fraction, so that if a meaningful difference is evident, the concentration in the fine-grained fraction may be calculated from the bulk fraction.

11.3 DATA QUALITY OBJECTIVES FOR BACKGROUND EVALUATIONS

The DQOs for background evaluations presented below are provisionary and are repeated from the Draft DQO document transmitted by ERM to EPA on 18 May 2015. EPA's comments on the 18 May 2015 draft background evaluations DQO were received by ERM on 8 June 2015 are included in Attachment 9 of this SAP.

11.3.1 Step 1: State the Problem

A necessary component of the RI/FS is to define the naturally occurring or "background" concentrations of chemicals in solid media. The purpose of characterizing background is so that Site-to-background comparisons can be conducted and Site-related constituents can be identified. These chemicals include metals, which are natural components of the Earth's crust, and organic compounds that are either anthropogenically produced or combustion byproducts (wildfires), which are ubiquitous in the environment due to wind dispersal and aerial deposition. For the purposes of this evaluation, both naturally occurring and anthropogenic ambient will be defined as "background." Two classifications of compounds are relevant to characterizing background for the US Magnesium RI/FS: metals and organics. Organics include PCDD/PCDF, total PCBs, and HCB. PAHs are also a constituent with a ubiquitous background signature in the environment. Based on the Phase 1A RI data, PAHs do not appear to be a significant risk driver. Concentrations detected at the PRIs sampled during the Phase 1A were low and exceeded an RBC in only one PRI Area. Based on the Phase 1A data, characterizing PAHs in background is unnecessary.

Background concentrations of naturally occurring metals in soils and sediments are influenced by the underlying soil types and lithologies. Figures 11-9 and 11-10 summarize the different lithologies and soil types present in the general area of US Magnesium, respectively. Understanding the influence of soil and lithology on metals concentrations is a critical aspect of the background characterization sample design.

There are historical datasets in the general area of US Magnesium that provide some information regarding background concentrations of metals and organics. These include:

1. Parametrix 2004: A limited background dataset for a subset of metals (arsenic, barium, cadmium, chromium, lead and selenium), D/Fs, coplanar PCBs, and HCB was collected to support a focused ecological risk assessment at US Magnesium. This dataset is small (n=6) and does not include all the metals of interest.

2. Phase 1A RI soil data: A full suite of metals, D/Fs, HCB, and total PCBs were collected as part of Phase 1A data collected in 2014 (ERM 2014a). PRI Areas that represent areas where aerial deposition from the stack is the potential source of impacts (PRI Areas 11-16) provide a relevant, comparative dataset.

3. Other regional datasets: A number of regional datasets exist that can be used to further inform regional background concentrations for metals, D/Fs, and/or PCBs. Examples of these datasets include but are not limited to:

    a. Utah Test and Training Range – North: Soil data collected for evaluating background metals levels in an area north and west of the US Magnesium Site (URS 2004);

    b. Former Defense Depot Ogden: Background concentrations of metals developed for the Defense Depot Ogden NPL Site as presented in an Agency for Toxic Substances and Disease Registry (ATSDR) Public Health Assessment Report (ATSDR 1992).

    c. Wetland Sites around the GSL: Characterization of sediment, water and biota data from 30 wetland sites around the GSL (USFWS 2009).

While there are historical data available, none of these datasets provide sufficient information to develop relevant background for the purposes of the RI/FS. However, these datasets can be used to inform the design of a background dataset for the RI/FS. Additionally, they may provide context for comparisons for data that are collected as part of this background evaluation.

While not the specific objective of this background soil characterization study design, the baseline ecological risk assessment will likely require characterization of COPCs in biotic tissue samples from non-impacted reference sites. The soil data collected in background areas will support the selection of reference areas for biotic sampling by confirming that the locations are not impacted by either the US Magnesium Site or other point sources.

In summary, background metal and organics concentrations have not been adequately characterized. These data are critical for conducting RI/FS activities, including the characterization of N&E,

identification of Site-related constituents of concern, and identifying candidate reference locations for the collection of biotic tissue samples.

11.3.2 Step 2: Identify Goals of the Study

The goal of the study is:

1. To obtain sufficient data to reliably define and use background concentrations to identify elevated (Site-related) metals and organics (D/Fs, total PCBs and HCB); and
2. To identify non-impacted background soil/sediment reference locations keeping in mind that the same locations may be revisited in Phase 2 to characterize tissue burdens at reference locations.

11.3.3 Step 3: Identify Information Inputs

The information needed to support background evaluation is an adequate and reliable dataset to characterize the range of metals and organics concentrations that occurs in solid media within non-impacted soils/sediments (solid media) that are representative of soils/sediments found at the US Magnesium Site. Additionally, habitat and species information from the Site and the background locations are needed so that the background locations sampled are likely to provide the biotic reference samples during Phase 2 sampling.

11.3.4 Step 4: Define the Boundaries of the Study

11.3.4.1 Spatial Boundaries

The initial study boundary for the background characterization includes areas located:

1. Outside of the 5-mile radius RI/FS Study Area;
2. Away from any other known point-source areas of impacts;
3. In areas where species of interest would not be expected to forage in RI/FS Study Area;
4. In similar lithologies and soil types as those found at the Site; and
5. In habitats where species expected to be at the Site are also found.

11.3.4.2 Temporal Boundaries

Within media such as soils and sediments, metal and organics concentrations are not expected to fluctuate seasonally, so the time of year when sampling of these media occurs is not an important variable.

11.3.5 Step 5: Develop the Analytical Approach

The primary objective of the background characterization is to obtain sufficient data to reliably define and use background concentrations to identify elevated (Site-related) metals and organics. Once background concentrations are characterized, these data will be used to compare to Site data to evaluate whether concentrations of metals and organics detected on Site are within the range of background or are elevated. The study data will be used to confirm that the background sampling locations are: (1) not impacted by either the US Magnesium Site or another potential point-source area; and (2) suitable for future collection of biological samples. Based on these objectives, the decision rules for the background evaluation are as follows:

1. If detected concentrations of metals, D/F, total PCBs, and HCB do not show Site influence, then conclude that the data are appropriate for background evaluations (see 11.3.5.1); and

2. If detected concentrations of metals and D/F, total PCBs, or HCB detected at the Site are within the range of background, then conclude that the presence of these compounds is not related to releases or other activities at the Site (see 11.3.5.2).

To address the above decision rules, a multi-line of evidence approach is proposed and discussed in detail below.

11.3.5.1 Characterization of Background Dataset

The first step of the analysis will focus on confirming that an appropriate background dataset was collected. For each background population characterized, a number of evaluations will be conducted to confirm that only non-detect samples are included in the background dataset. The following tools will be used to determine whether there is any evidence a sample is affected by the Site:

1. Statistical outlier tests;

2. Graphical evaluations including geochemical bivariate plots and Q-Q plots (see below for more details on these methodologies);

3. Comparison of D/F congener fingerprints between background samples, other regional background datasets (where available) and US Magnesium Site data; and

4. Comparison of D/F, PCB, and HCB data to risk-based screening levels.

Results of these tests will be used to determine if additional evaluation is needed.

Based on the outcomes of these evaluations, samples that are concluded to contain concentrations of a specific metal or organic that are elevated, indicating potential impacts, will be identified. For these samples, a decision will be made as to whether the specific compound concentration is removed from the dataset, or whether the entire sample should be removed from the dataset. The decision as to whether individual compound(s) or the entire sample is removed from the background dataset will depend on: (1) the number of individual compounds that are elevated in the sample, (2) the spatial distribution of samples with elevated concentrations, and (3) observations made in the field regarding specific samples.

Once the background dataset(s) is finalized, the dataset will be used to: (1) compare Site data against background data, and (2) identify those locations that are not impacted and are potential candidate locations for reference biota sampling. The background comparison methodologies that will be conducted are presented below.

11.3.5.2 Background Comparison Analyses

A holistic approach will be used that considers multiple lines of evidence to determine whether a compound is elevated above background. Comparisons to background will be conducted on a PRI basis. These lines of evidence will include a comparative statistical analysis, a geochemical analysis, and a graphical evaluation using Q-Q plots. The analytical approach for each of these lines is described below.

Statistical Comparisons

The statistical comparison method employs a series of tests to compare Site sampling data against data sampled from a comparable population known to be not impacted (background). Statistical hypothesis tests are used to determine whether concentrations at the Site are statistically similar to background concentrations or elevated. Two statistical tests will be conducted during the background evaluation. One compares the central tendency of data distributions, and the second compares the upper tails of distributions. Depending on the distribution of the datasets, parametric or nonparametric methods will be used. The central tendency and tails tests are described further below.

Central Tendency Testing

Central tendency testing will be employed in both metal and organics[4] background evaluations. The central tendency tests consist of two steps. First, the distribution of each dataset will be tested by application of the Shapiro-Wilks test. Then depending on the distribution of the dataset, the central tendency of the sites and background datasets will be compared using either parametric or nonparametric analyses as follows:

1. t-test – will be used when the Site and background datasets have parametric probability distributions.

2. Wilcoxon Rank Sum Test – will be used when the Site and background probability distributions do match or both were non-parametrically distributed.

The null hypothesis (H_0) for the above tests will assume that Site concentrations are greater than background (Background Test Form 2 per EPA 2002b). The alternative hypothesis (H_A) for this test form is that Site concentrations are not greater than background. Central tendency testing requires establishing values for α, β and Δ to generate sample sizes and establishing acceptable probability thresholds for potential decision errors. These values are discussed further as performance criteria in Section 11.3.6.1.

Quantile Testing

The quantile test is a nonparametric test that is designed to compare the upper tails of the distributions (EPA 2002b) and will be employed in both metal and organics background evaluations. The quantile test will be used to compare the upper tails of the Site and background datasets. This test detects whether a site's upper tail (highest concentrations) is shifted higher than the upper tail of background concentrations, i.e., tests if a PRI Area's highest concentrations are higher than the highest concentrations in the background dataset. Statistical test values calculated during the quantile test are r, k and α. These values are discussed further as performance criteria in Section 11.3.6.2.

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[4] For the statistical comparisons, D/Fs will be evaluated as tetrachlorodibenzo-p-dioxin TEQs.

Geochemical Evaluation

Metals will be evaluated by examining geochemical relationships between trace metals and reference metals. Geochemical correlations of trace versus major elements are predicated on the natural elemental associations in soil. Linear trends with positive slopes are expected for scatter plots of specific trace versus major elements in non-detect samples. Individual samples that may contain detections are identified by their positions off the trend formed by non-detect samples. In addition to pinpointing which samples may be contaminated, this technique provides mechanistic explanations for naturally elevated element concentrations (Myers and Thornbjornsen 2004).

Trace metal distributions in soil tend to span a wide range of concentrations and are highly right-skewed, approximating lognormal distributions, and background data sets are frequently too small to capture this range. The distribution of reference metals in soils depends primarily on the source rock, weathering processes, geochemical environment, and sorption and precipitation processes. These are broad terms that refer to the physical and geochemical processes that result in metal immobilization through: 1) adsorption processes where a metal is bound or “sticks” to soil materials; and 2) precipitation processes where metals form new minerals. Furthermore, these processes can work concomitantly.

One of the factors controlling metals distribution is speciation, which dictates their charge and affinity for different types of soil minerals. Table 11-1 provides: (1) a summary of metals/inorganics and their likely speciation in natural systems; (2) the key constituents that are broadly responsible for their immobilization and distribution; and 3) a description of predominant immobilization processes.

As an example of a geochemical correlation, arsenic in most uncontaminated oxic soils is commonly associated with iron oxide minerals (Myers and Thornbjornsen 2004). This association of arsenic with iron oxides is a result of the adsorptive behavior of this particular trace metal in an oxic soil environment. Arsenic is present in oxic soil pore fluid as negatively charged oxyanions. These oxyanions have strong affinities to adsorb on the surfaces of iron oxides, which maintain a strong positive surface charge for this reason, if a soil sample has a high percentage of iron oxides, then it is expected to have a proportionally higher concentration of arsenic (Myers and Thornbjornsen 2004).

The absolute concentrations of arsenic and iron can vary by several orders of magnitude at a site, but the arsenic/iron ratios in each sample are usually quite constant at a given site as long as no contamination is present (Myers and Thornbjornsen 2004). If a sample has some naturally occurring arsenic plus additional arsenic from an anthropogenic source, then it will have an anomalously high ratio relative to the other uncontaminated samples. These ratios thus serve as a powerful technique for identifying contaminated samples.

In order to utilize the geochemical method approach outlined above, potential geochemical associations as defined by those in Table 11-1 will be evaluated against one another for their relative strength. Geochemical plots will be used to assess how strongly individual sample concentrations from a PRI hold to the linear relationship created by the reference metal-to-trace metal concentration ratio defined by the background dataset. Bivariate scatter plots will be constructed with the “reference” metal concentration on the x-axis, and the “trace” metal of interest concentrations on the y-axis.

A least squares regression line will be drawn from the scatter plot to illustrate the linear trend exhibited between reference and trace metal for the background dataset. A 95% predictive interval on the regression will be drawn to provide a confidence interval on the background population. The 95% predictive interval provides the range within which the trace metal concentration value (y-axis value) is expected to fall based on the corresponding reference metal concentration (x-axis value) 95% of the time. Samples that fall above this line are suspected to be elevated above background concentrations. An example geochemical plot is provided on Figure 11-11 using fictitious data, along with an explanation of plot interpretation.

In summary, the geochemical evaluation provides a line of evidence that is not constrained by statistical and computational requirements. This provides a check against potential decision errors stemming from statistical methods.

Q-Q Plot Evaluation

As another line of evidence, Q-Q plots of metals and organics will be generated and reviewed. In a Q-Q plot, the x-axis is arranged such that a dataset's theoretical quantiles will plot (ideally) as a straight line with relatively flat tails. A curve with an apparent inflection point (a point on the curve where a change in direction occurs) is commonly produced when the plotted data set contains multiple populations (either multiple background populations from different geological units, or background plus anomalous populations due to Site releases). Q-Q plots will be developed for each PRI and the background dataset. Inflection points in the Q-Q plot can represent the transition between different geologic units or it can represent the background "threshold" concentration (i.e., the value that marks the transition between background concentrations and concentrations resulting from Site operations).

Like the geochemical evaluation, the Q-Q plot evaluation provides a line of evidence that is not constrained by statistical and computational requirements, and provides a check against potential decision errors stemming from statistical methods.

Dioxin/Furans Evaluation

In addition to the statistical evaluation, Site D/Fs will be compared to background D/Fs by using congener fingerprinting techniques. This will include, but is not limited to, calculating the relative proportions of congener in each sample, and comparing the patterns in proportions exhibited by the Site and background datasets (EPA 2004), and/or more quantitative techniques—e.g., regression analysis, principal component analysis, and/or non-metric multi-dimensional scaling (NMDS).

11.3.6 Step 6: Specify Performance or Acceptance Criteria

The primary objective of specifying performance criteria is to minimize the probability that a metal or organic constituent in soil or sediment at a PRI Area will be identified as being within the range of background when it should be identified as being above the range of background and is likely Site-related. Therefore, it is necessary to be confident that the observed PRI dataset has a high probability of exceeding the background dataset when the concentration of the chemical at the PRI is truly elevated above the range of background. In addition, care should also be taken to minimize the probability of concluding that a metal or organic in soil or sediment at a PRI will be identified as being elevated above background when it should be identified as being within the range of background.

To minimize the probability of committing either decision error, multiple lines of evidence will be used. These multiple lines of evidence include both quantitative statistical evaluations, as well as geochemical and graphical methods.

Specific performance and acceptance criteria for each line of evidence are presented below.

11.3.6.1 Central Tendency Testing

The central tendency testing requires establishing performance criteria for hypothesis testing. These include

Significance Level (α) – The probability of rejecting a true null hypothesis (H_0) is referred to as a Type I or false positive error (α) and is commonly called the significance level of the test. Because H_0 is that Site concentrations are greater than background, a Type I error would be erroneously concluding the Site is not greater than background, when in reality it is. For this evaluation the confidence level is set at 95%, or α=0.05. This performance criterion means there is a 5% chance of a Type I error.

Power (1-β) – The probability of accepting a false null hypothesis is referred to as a Type II or false negative error (β). For this evaluation, a Type II error would erroneously conclude the Site concentrations are greater than background concentrations, when in reality they are not. The statistical power (1- β) of a test is a measure of a test's ability to discern an effect – i.e., reject a false null hypothesis. Consistent with convention, the power is set at 80% (β=0.2). For this evaluation, this performance criteria means there is a 20% chance of a Type II error.

Minimum Detectable Difference (MDD or Δ)– For the specified errors, the MDD is the smallest difference that the test can detect. For this evaluation the MDD is set at 50% of the mean concentration of Phase 1A and DMA data from PRI Areas assumed to not be impacted by the facility (see Section 11.3.7.1).

The central tendency testing parameters α, β, and Δ are used as performance criteria to select appropriate background sample sizes to minimize the risk of decision errors. Sample size estimation is described in Step 7, Section 11.3.7.2.

11.3.6.2 Quantile Testing

The Quantile Test is a test that determines whether the values in the right-tail of the Site dataset are generally larger than the values in the right-tail of the Site dataset. This test consists of considering the largest *r* measurements in the pooled datasets and counting the number of those measurements that are from the dataset of interest (e.g., Site dataset). If *k* or more of the *r* measurements are Site measurements, the Site dataset is considered to be elevated relative to background. The values for *r* and *k* are typically obtained from a look up table for a specified significance level (α) and power (1-β). Consistent with convention, the significance level is 0.05 (α =0.05) and the power is 80% (β=0.2).

11.3.6.3 Geochemical Evaluation

Examining geochemical relationships will be used to qualitatively compare Site and background datasets. Plots will be examined for similar trace metal-reference metal correlations between Site and background datasets. In order to quantify the predictive relationship between references and trace metal, geochemical bivariate plots require there be a clearly defined correlation between the two. To determine which reference metal possesses the strongest correlation with a given trace metal, Pearson correlation tests will be performed on all common trace-to-reference metal combinations in background data, as defined in Table 11-1. The strongest correlation between possible parings for a given metal will then be used in developing the plot. A minimum Pearson correlation coefficient (r) of 3 will be required for a geochemical relationship to be considered strong enough for use in the evaluation. If the highest available r is less than 3, that trace metal will be excluded from the geochemical evaluation.

11.3.6.4 Q-Q Plot Evaluation

Formal quantitative acceptance criteria for comparing Site and background datasets are not defined for Q-Q plots. Q-Q plots will be used to qualitatively compare Site and background datasets. Interpretation of Q-Q plots will be based on professional judgment, with the objective of identifying significant breaks or inflection points in the curve. Significant breaks and inflections points are potentially indicative of multiple populations in a dataset.

11.3.6.5 Dioxin Fingerprinting

Formal quantitative acceptance criteria are not defined for dioxin fingerprinting. Interpretation of fingerprinting plots will be based on professional judgment, with the objective of identifying similarities and differences in congener profiles between Site samples, background samples and off-Site regional background samples. Following an initial review, if statistical methods (e.g., regression analysis, NMDS) are judged to be useful in distinguishing patterns, then performance criteria (e.g., significance levels) will be proposed.

11.3.6.6 General Data Adequacy

Besides quantitative criteria and using multiple lines of evidence to mitigate against decision errors, data of adequate quality will also be required. Laboratory analytical data used for the characterization of background will meet applicable criteria for definitive data as defined under EPA guidance (2005a) and the measurement performance criteria for sampling and analysis defined in the Phase 1A-B RI SAP (WS#12 and WS#15).

11.3.7 Step 7: Develop the Plan for Obtaining the Data

To develop a sample design that addresses the DQOs defined in Steps 1 through 6, the following design aspects are required: (1) definition of background populations(s) that need to be characterized, (2) the number of samples required to characterize each population(s); (3) the locations that will be sampled, and (4) the methodologies for sampling and analysis. The design aspects are described in more detail below.

11.3.7.1 Definition of Background Population(s)

In Step 1, it was recognized that soil types and lithology may influence background metal concentrations. Establishing Site-specific background concentrations for each combination of soil and lithology could result in an overly complex process, where background populations are so specific that the corresponding Site sample sizes would decrease and result in low statistical power for background comparisons. It is therefore critical to appropriately define the background population(s) to allow meaningful comparison to Site data.

The degree to which soil types and lithology influence metals concentrations was evaluated using recent Site data from the Phase 1A DMA and the Phase 1A RI (collectively referred to as “Phase 1A samples”). Data were only used from PRI Areas that could be assumed to not be directly impacted by waste releases from the Site, i.e., PRI Areas 11 through 16. The first step in the evaluation is to identify the soil and lithologic factors so that meaningful physical characteristics can be used to delineate Site-specific background sampling groups. As identified on Figure 11-9, the lithology of the Site falls into three main categories:

Ql – Surficial Quaternary Lake Bonneville deposits

Qs – Surficial Quaternary mud and salt flat deposits, associated with the lake bed of the GSL

Other[5] - Quaternary alluvium and colluvium (Qa) and consolidated rock in the Lakeside Mountains (C1, C2, C3, D, O, and S)

The main soil types at the Site are identified on Figure 11-10 and include:

Playas-Saltair – associated with the lakebed of the GSL

Amtoft-Rock

Dynal – Oolitic sand deposits

Skumpah

Yenrab

Other[6]

Understanding how soil and lithology are co-located is meaningful so that background sampling areas can be established. To this end, the number of Phase 1A samples that were collected in each lithology and soil type were tallied across PRI Areas 11 through 16. As samples were randomly located with respect to any underlying pattern in soil type/lithology, the number of samples serves as a proxy for the prevalence of each soil type (Table 11-2) and lithology (Table 11-3) type in areas of interest for risk assessment. The intersection of soil and geologic types is provided in Table 11-4.

These tallies show that the Qs geologic type is largely comprised of the Playas-Saltair soil type and falls primarily into PRI Areas 13 and 14. These PRI Areas are within the “Lakebed” setting of the bed of the GSL. The Dynal, Skumpah and Yenrab soil types fall primarily or entirely within the Ql geologic type which largely corresponds to PRI Areas 11, 12, and 15. These PRI Areas are considered to be in an “Upland” setting, as they are located outside of the bed of the GSL. The “Other” soil and geologic types tend to be associated with the Lakeside Mountains in PRI Area 16, and are therefore also considered to be in an “Upland” setting. Based on these tallies, the distinct lithologic/soil groupings at the Site can be generally divided into two settings, Lakebed and Upland, with Lakebed corresponding to PRI Areas 13 and 14 and Upland corresponding to PRI Areas 11, 12, 15, and 16.

Statistical Support for Site-Specific Background Areas

Ordination and multivariate statistical techniques can be used to determine whether the metals composition differs significantly based on grouping variables (e.g., soil type, lithology, or PRIs). These techniques describe the relative similarity of metals composition for samples from similar versus different groups. To mitigate other confounding factors associated with the use of the Phase 1A data from PRI Areas 11-16, samples with known anomalies and/or Site-related impacts were removed from these analyses. Excluded locations were as follows:

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[5] Insufficient samples were collected from each of these geologic types for them to be considered individually.

[6] The “other” soil types include the Checkett, Hiko Peak, Medburn, Puts, and Timpie-Tooele. Insufficient samples were collected from each of these soil types for them to be considered individually.

- Phase 1A RI samples PRI12-010 and -011 were collected on salt waste piles, not in soil; and
- Phase 1A RI samples PRI14-002 through -008 had suspected Site-related impacts, as evidenced by elevated concentrations of D/Fs, total PCBs, and/or HCB.

NMDS is a non-parametric ordination technique that plots sampling locations relatively closer together if they have similar metals composition or farther apart if they are more dissimilar. The groupings on an NMDS plot can then be further defined by plotting 95% confidence ellipses around the centroid of each group of interest (McCune and Grace 2002). Overlapping confidence ellipses suggest metals composition between groups is indistinguishable, whereas non-overlapping confidence ellipses suggest that groups are distinct.

An NMDS plot was generated on a PRI Area basis since these groups seem to best capture both soil and geology (Figure 11-11). The Lakebed background population (PRI Area 13 and PRI Area 14) clusters together. Similarly, the Upland background population (PRI Areas 11, 12, 15, and 16) clusters together. The Upland and Lakebed background populations are supported by visual assessment with an NMDS plot (Figure 11-12) as well as with multivariate hypothesis testing[7] (perMANOVA F-statistic = 33.0, R^2 = 0.30, p-value = 0.001).

Characterization of Upland and Lakebed

While the NMDS and perMANOVA demonstrate that the Lakebed and Upland settings have distinct metals composition, they do not describe how background populations are different on a metal-by-metal basis. A t-test (used for normally distributed data) or Wilcoxon Rank Sum test (used for all other distribution types) was used to compare the metals concentrations in the Lakebed and Upland samples (EPA 2010). Comparison results are presented in Table 11-5. A Bonferroni correction (Zar 1999) was made to control for the family-wise Type I error rate[8] since multiple comparisons were made on the same set of samples. The accompanying boxplots (Attachment 1) show that the Upland area has significantly higher beryllium, chromium, iron and lead compared to the Lakebed. The two groups do not significantly differ for any other metals concentrations.

Conclusions

Multiple lines of evidence including ordinations, multivariate tests, and pair-wise test, support characterizing background using Lakebed and Upland settings to capture variability due to soil and lithology type: A summary of each setting's dominant characteristics are presented in Table 11-6. Based on these results, two background populations will be characterized: Upland setting and Lakebed setting. Each background population will then be compared to the appropriate PRI. For example, the Upland background dataset will be compared to PRI Areas 1 through 6, 8 through 12, and 15 and 16, while the Lakebed background dataset will be compared to PRI Areas 7, 13, and most of 14.

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[7] perMANOVA (permutation multivariate analysis of variance) is a non-parametric version of a MANOVA that complements the descriptive NMDS plots. While samples from certain groups may visually segregate on an NMDS plot, the perMANOVA helps determine whether these groups are statistically distinct and how much variance they explain. Thus, the perMANOVA can more rigorously test for differences among groups by offering a p-value, F-statistic, and R^2.

[8] The desired significance level for the whole family of tests was $\alpha = 0.05$, so the Bonferroni correction tests each individual hypothesis at a significance level of α/n. In this case, 21 metals are compared, with a desired $\alpha = 0.05$, so the Bonferroni correction tests each individual hypothesis at $\alpha = 0.05/21 = 0.0024$.

Characterizing Upland and Lakebed background populations will also be relevant to the biotic sampling. As both Upland and wetland species will likely be targeted for biotic sampling in Phase 2, characterizing both Lakebed (relevant to wetland) and Upland background populations will support the identification of relevant candidate reference locations for the Upland and wetland biotic sampling effort.

11.3.7.2 Background Sample Size Estimation

Background dataset sample sizes need to be large enough to ensure sufficient power in the comparative statistical testing. Sample sizes were calculated using VSP -v7.2 (http://vsp.pnnl.gov/). Details on this procedure are presented below.

Data Treatment

The Phase 1A data were used as proxies to characterize anticipated variability and statistical distribution expected in background data. For metals, the standard deviation, mean, and the distribution of the Phase 1A data were calculated for each metal in the Lakebed and Upland datasets (as described in Section 11.3.7.1). For organics, the standard deviation, mean and the distribution of the TEQ, total PCBs and HCB datasets from PRI Areas 11 through 16 were used to represent conditions in the background population. The following additional data treatments were used for organic data from PRI Areas 11 through 16:

- Consistent with the metals approach, samples assumed to be impacted in PRI Area 14 were excluded (PRI Area 14-002 through 008) as were salt pile samples from PRI Area 12 (PRI Area 12-010 and 011).
- In addition to the above, any sample result that exceeded refined risk-based ecological screening levels from the Revised Draft Inner PRI SLRA Report (ERM 2015) were excluded, to eliminate other samples that were potentially impacted by organics (performed for each organic compound independently).
- HCB had a high proportion of non-detect values (59%), which was disproportionately influencing variability. Non-detect values were removed from the dataset to better represent natural variability. D/F TEQs and total PCBs were both 100% detected.
- The remaining PRI Area data were pooled into a single dataset (Upland and Lakebed segregation is not applicable to organics).
- D/F TEQs were calculated excluding dioxin-like co-planar PCB congeners and HCB, as PCBs and HCB were evaluated independently.

Standard deviations were calculated using ProUCL to represent the natural variability in background metals and organics. Each dataset's distribution was also tested using ProUCL and identified as being normal, lognormal, gamma, or nonparametric. These parameters are presented in Tables 11-7, 11-8 and 11-9 and were used to calculate sample sizes in VSP.

Sample Size Calculations

VSP was used to calculate samples sizes using the "Comparison Average to Reference Average" module. For each metal sample, sizes were calculated for Lakebed and Upland datasets independently, and for organics using the PRI Areas 11 through 16 pooled dataset. Sample sizes were calculated based on the performance criteria for the central tendency test (Section 11.3.6.1) to ensure that future statistical evaluations using the background datasets have acceptable power. If a metal had a normal distribution, its sample size was calculated based on the t-test application. A metal with any other distribution used the Wilcoxon Rank Sum application.

It was recognized that the datasets contain a broad range of variability, and that this variability drives a broad range of potential sample sizes. Some of the variability in metals data appeared to be driven by the presence of outliers. Statistical outlier testing using ProUCL was conducted to determine if individual metals contained suspect samples that may not be representative of background concentrations. In the Upland dataset, metals that had the highest variability also tended to have more statistical outliers (Table 11-8). This pattern was not observed in Lakebed samples (Table 11-7). High levels of non-detects also appear to drive variability in the Upland dataset (Table 11-8), but not the Lakebed dataset (Table 11-7). While the presence of outliers and high frequency of non-detects impact variability, to be conservative, no outliers were removed from the datasets used to calculate standard deviations.

Potential metal sample sizes for Lakebed and Upland media were tabulated and ranked from lowest to highest (Tables 11–7 and 11-8). The range of metal sample sizes were also plotted as bar charts for visual inspection (Figure 11-14). The sample size calculations for organics were tabulated separately from metals (Table 11-9), as background D/Fs, PCBs and HCB are not expected to be influenced by soil type or lithology. To address the broad range of variability in compounds and its effect on potential sample sizes, the selection of a sample size that falls to the right of the median of the distribution of potential metal sample sizes calculated by VSP was agreed to by US Magnesium/ERM and EPA during the March 2015 Phase 1B RI Scoping Meetings as a reasonable approach to selecting an appropriate background sample size. Because there were only three sample sizes for organics, the median sample size was selected.

As noted in Table 11-7, the Lakebed dataset had potential sample sizes ranging from 8 to 92, with a median of 25 to 26 samples. The sample size above the median is 29 samples. The Upland dataset had potential sample sizes ranging from 5 to 599, with a median between 14 and 17 samples (Table 11-8). Thus, 17 samples was chosen as a reasonable sample size for the Upland setting.

To add an additional level of conservatism and make sample collection consistent across the Lakebed and Upland datasets, the higher of the two datasets (29) was rounded to 30 and selected as the number of samples that will be collected from each setting (i.e., 30 Lakebed and 30 Upland samples). These 30 samples will be spread among the locations identified in the next section.

As noted in Table 11-9, the organics dataset had potential sample sizes ranging from 24 to 51, with a median of 34 samples. This median value was rounded up to 36, so that it could be divided equally between three Lakebed and three Upland sampling areas (six samples per area; Section 11.3.7.4.

11.3.7.3 Background Sampling Locations

Reference locations for background sampling will be selected based on their appropriateness for characterizing naturally occurring concentrations of metals and ambient concentrations of organic chemicals in abiotic and biotic media. Background soil and sediment samples will be collected during the Phase 1A-B sampling effort in three locations of Upland and Lakebed habitats, respectively. The reference locations will also support the Phase 2 biotic sampling effort.

It is envisioned that biota collections will likely focus on bird eggs, plants, invertebrates, and small mammals that are found both within the Site boundaries and in reference locations. Based on historical survey data and conversations with biologists familiar with the Site, bird egg collections will likely focus on the horned lark for the Upland habitat and snowy plover and/or American avocet for Lakebed habitat (John Cavitt, Ph.D., pers. comm.). Using literature-based foraging ranges, reference locations will be located far enough from the Site to ensure nesting birds in the reference locations are not foraging within the 5-mile radius of the plant that defines the RI/FS Study Area. For Upland habitats, the territory size for the horned lark was reported as 1.3 to 2.7 hectares[9]; territories for this species are used for courtship, nesting, and feeding (Wiens et al. 1986). For Lakebed habitats, American avocet was observed foraging 130 meters from the nest (Gibson 1971), while the snowy plover forages an average of 272 meters[10] from the nest[11] (Paton 1995).

Selection Criteria

Candidate reference locations for Upland habitat will be evaluated using the following criteria: (1) located beyond the 5-mile radius of the Site (at least 500 feet from the edge of the 5-mile radius to ensure the horned lark is not foraging within the RI/FS Site boundary), (2) contains minimally disturbed intermountain basin (IMB) greasewood flat or annual invasive grassland land cover, (3) collection of bird eggs (e.g., horned lark), small mammals, plants, and invertebrates is very likely; and (4) accessible for sampling.

Candidate reference locations for Lakebed habitat will be evaluated using the following criteria: (1) located beyond the 5-mile radius of the Site (located at least 1,000 feet from the edge of the 5-mile radius to ensure the snowy plover and American avocet are not foraging within the RI/FS Site boundary), (2) contains minimally disturbed IMB playa land cover, (3) collection of bird eggs (e.g., snowy plover and/or American avocet), plants, and invertebrates is very likely; and (4) accessible for sampling.

Preliminary Selection of Candidate Locations

Preliminary candidate areas have been selected based on an understanding of Site conditions and conversations with local biologists (John Cavitt, Ph.D., pers. comm.). These areas are located on the west side of GSL to the north, south, and east of the Site as shown on Figure 11-15. The two Upland areas (Upland North and Upland South) contain IMB greasewood flat/annual invasive grassland and are located 500 feet from the Site boundary, which provides a conservative distance for horned lark to forage outside the Site. The three Lakebed areas (Lakebed North, Lakebed South, and Lakebed Southeast) contain IMB playa and are located 1,000 feet from the Site boundary, which provides a conservative distance for snowy plover and American avocet to forage outside the Site. The area to the north of the Site contains both Upland and Lakebed habitat that are bordered by the Utah Test and Training Range site boundary. Upland and Lakebed habitats to the south are located between the Site and Interstate 80. The candidate area to the east of the Site contains IMB playa on Badger Island, Stansbury Island, and along the southern portion of Stansbury Bay near the Timpie Springs Waterfowl Management Area. Three locations for Upland and Lakebed background samples will be selected within these candidate areas.

A field trip will be conducted during the 2015 bird nesting season (May – June) to evaluate the accessibility and likelihood of collecting biota samples within the Upland and Lakebed candidate areas shown in Figure 11-15. Whenever feasible, sampling locations will be identified in candidate locations along the borders farthest from the Site. This will be done to maximize the distance between Site and reference tissue organisms, and in particular birds.

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[9] Radius of a 2.7-hectare circle is 93 meters or 305.1 feet. Rounded to 500 for additional conservatism.

[10] Rounded to 1,000 feet for additional conservatism.

[11] The average distance reported in Paton (1995) is similar to site-specific observations from Cavitt (2010).

The results from the field trip will be documented in a Background/Reference Area Identification Technical Memorandum which will be included as Attachment 11 to the Phase 1A-B SAP. The Technical Memorandum will be submitted for EPA review and approval as an SAP Modification and will include the following information:

- A narrative summary of the field trip and the findings.
- Final background locations for sediment and soil samples. Selected background locations will be shown in maps and coordinates will be provided.
- Copies of field notes.
- A photograph log.

11.3.7.4 Contingency Reference Location Samples

In the event that biological data cannot be collected from the six candidate reference locations described above (either from the absence of sufficient biological tissue or impacts traceable to the Site) a contingency reference tissue area may be utilized. The Bear River Migratory Bird Refuge (BRMBR) was identified as the contingency reference location (Figure 11-16). To confirm the contingency reference location is not impacted by Site-related contaminants, five samples will be collected from the BRMBR. These data will be assessed to confirm that they do not contain elevated concentrations of metals or organics. The contingency reference location will only be utilized during Phase 2 if insufficient reference tissue data can be collected from the candidate GSL reference locations.

The field trip to identify background locations will include a visit to the BRMBR. The five sampling locations at BRMBR will be identified during the field trip and these locations will be included in the Background/Reference Area Identification Technical Memorandum to be included as Attachment 11 to the Phase 1A-B SAP.

11.3.7.5 Sample Collection and Laboratory Analysis Methodology

As described above, background will be characterized for two populations: Lakebed and Upland. A sample size of 30 for metals and 18 for organics will be sampled for each population. The 30 and 18 samples will be distributed across three different locations in each population characterized (Upland and Lakebed). The three locations that will be selected will be representative of potential candidate reference areas where biotic sampling will be conducted in spring 2016. Therefore, there will be 10 metals and six organics sampling locations in each of the candidate areas.

Sampling will be performed following Site-specific SOPs for surface solids sampling (SOP *USM-01: Surface Soil, Sediment, and Waste Sampling*). Laboratory analyses will be performed following the SOPs and Project-Specific Work Instructions included in the Phase 1A-B SAP.

Specifically for the background characterization study, bulk surficial soils from 0 to 2 inches bgs will be targeted. As there is no reason to believe that metals concentrations vary significantly with soil depth, and the shallowest soil horizon is relevant to measure aerially deposited anthropogenic compounds such as D/Fs, PCBs, and HCB, shallow soils will be sampled. This sample depth is consistent with the Phase 1A SAP, which specified that surface samples be collected from the top 2 inches of material in PRI Areas where the only pathway for contaminant deposition is air deposition.

Characterization of background soils will focus on the bulk fraction. The bulk fraction is considered relevant for the following reasons:

- Concerns regarding constituent concentrations in the fine fraction focus on the selection of human health COPCs, and are not relevant to background characterization;
- Bulk soil samples are available for all the locations sampled at US Magnesium and fines samples are only available for a subset;
- Phase 1A data focusing on the difference between bulk and fine concentrations for metals and D/Fs in soils found only small differences; and
- D/F data collected to support the characterization of regional background for the Front Range of Colorado (EPA 2002a) found that the slope of the best fit regression line was slightly less than 1.0, indicating that there was no significant enrichment of TEQ in the fine soil compared to the bulk soil, and that TEQ values based on bulk field soil samples are similar to those based on the fine sieved soil.

For the Lakebed and Upland setting areas, all background soil samples will be analyzed for:

- Metals (EPA Methods 6010/6020/7471); and
- pH (EPA Method 9045D).

A subset of Lakebed and Upland setting areas background soil samples will also be analyzed for:

- D/Fs (EPA Method 8290);
- PCBs (EPA Method 1668);
- HCB (EPA Method 8270 with SIM confirmation); and
- TOC (EPA Method 9060).

All background soil samples from the BRMBR will be analyzed for metals, pH, D/Fs, PCBs, HCB, and TOC following the methods identified above. This will result in a total of 65 samples that will have metals and pH results (30 in Lakebed, 30 in Upland, and 5 at BRMBR) and 41 background samples (18 in Lakebed, 18 in Upland, and 5 at BRMBR) that will also include D/Fs, PCBs, HCB, and TOC results. As previously noted, the sample results will also provide confirmation that the candidate reference locations are not impacted by US Magnesium Site-related constituents.

Table 11-1. Geochemical Correlations

Metal/ Inorganic	**Potential Aqueous/Soluble Forms in the Environment**[a]	**Primary Sorptive Association**[b]	**Other Common Associations**[c]	**Association Description**
Predominantly Anionic Inorganics				
Antimony	Reduced Form - $Sb(OH)_3$ Oxidized Form - $Sb(OH)_6^-$	Fe	Mn, Al, S^{2-}	Sorption to iron, manganese and aluminum oxides and hydroxides, noncrystalline aluminosilicates. Precipitation of sulfide mineral under reducing conditions.
Vanadium	$VO_3(OH)^{2-}$, $VO_2(OH)_2^-$, $VO(OH)_3$, VO^{2+},	Fe	Mn, Al	Complexation with iron and manganese minerals, and formation of oxide minerals. Sorption to soil minerals
Arsenic	Reduced Form - $H_3AsO_3^o$, Oxidized Form - H_2AsO_4, $HAsO_4^{2-}$	Fe	Mn, Al, Ca, and S^{2-}	Sorption to iron and aluminum hydroxides, noncrystalline aluminosilicates, Fe and Ca precipitates. Precipitation of arsenic sulfides (AsS, As_2S_3 , As_4S_4) under reducing conditions.
Selenium	HSe^-, $HSeO_3^-$	Fe	Mn, Al, Ca, and S^{2-}	Sorption to iron and aluminum hydroxides, noncrystalline aluminosilicates, Fe and Ca precipitates. Precipitation of selenium sulfide mineral under reducing conditions.
Predominantly Cationic Inorganics				
Barium	Ba^{2+}	Al, SO_4^{2-}	Fe, Ca, Mn, SO_4^{2-}, CO_3^{2-}	Cationic sorption to soil minerals (clays), Precipitation of sparingly soluble sulfate ($BaSO_4$), and carbonate minerals ($BaCO_3$).
Cadmium	Cd^{2+}	Al	Fe, Ca, Mn, CO_3^{2-} , S^{2-}, PO_4^{3-}	Sorption to Fe/Mn/Al hydroxides and carbonate minerals; precipitation of sparingly soluble carbonates ($CdCO_3$), phosphate, and sulfide minerals.
Lead	Pb^{2+}, $PbCO_3$	Al	Fe, Mn, Ca, S^{2-}, SO_4^{2-}, PO_4^{3-}	Sorption to iron hydroxides, organic matter, noncrystalline aluminosilicates, carbonate minerals; formation of sparingly soluble carbonates ($PbCO_3$), phosphates, sulfides (PbS), sulfate ($PbSO_4$) minerals.
Zinc	Zn^{2+}	Al	Fe, Mn, Ca, CO_3^{2-}, S^{2-}	Sorption to Fe/Mn/Al hydroxides, noncrystalline aluminosilicates and carbonate minerals ($ZnCO_3$); formation of sulfide (ZnS) minerals under reducing conditions.
Copper	Cu^{2+} , Cu^+, $Cu(OH)^+$	Al	Fe, Mn, OM, Ca, CO_3^{2-}, S^{2-}	Sorption to Al/Fe/Mn oxides, noncrystalline aluminosilicates, organic matter and silicate clays; sparingly soluble carbonate, hydroxide, and sulfides (CuS, Cu_2S).

Iron	Fe^{+2}	OH and O	Ca, CO_3^{2-}, S^{2-}	Precipitation as oxidized ferrihydrite minerals (FeOOH), iron carbonates, precipitation as reduced iron sulfide (FeS)
Manganese	Mn^{2+}	OH and O	Ca, CO_3^{2-}	Formation of sparingly soluble oxide, hydroxide, and carbonate complexes
Mercury	Hg	Al	S^{2-}, Cl, OM	Formation of sparingly soluble sulfides (HgS); sorption to soil minerals and organic matter.
Beryllium	Be^{2+}, $BeOH^+$	Al	Fe, Mn	Sorption to negatively charged sites of clays and other soil minerals
Silver	Ag^+	Al	Fe, Mn, S^{2-}, SO_4^{2-}, CO_3^{2-}, PO_4^{3-}	Forms strong complexes with sulfides (AgS), halides, cyanides, and thiosulfates. Weaker complexes with arsenates, phosphates, sulfates, carbonates, and organic ligands
Thallium	Tl^{3+}, Tl^+	Al	Fe, Mn	Thallium oxide formation (Tl_2O_3) and sorption to soil minerals.
Inorganics that May Be Both Predominantly Cationic and Anionic				
Cobalt	Co^{2+} $HCoO^{2-}$	Al, Fe	Mn, CO_3^{2-}, Ca, Ni, OM	Sorption to Al/Mn/Fe hydroxides, organic matter, carbonate minerals ($CoCO_3$).
Nickel	Ni^{2+}, $Ni(OH)_3^-$, $Ni(OH)_2$	Fe, Al,	Mn, Co, Mn, S^{2-}	Sorption to Fe/Mn/Al hydroxides and noncrystalline aluminosilicates; precipitation of nickel sulfide. Nickel also has similar properties to cobalt and may be associated with cobalt in areas of weathered basalt or similar rocks.
Chromium	Oxidized Forms - CrO_4^{2-}, $HCrO_4^-$ Reduced forms - $CrOH^{2+}$ Cr^{3+}	Fe, Al	Mn	Sorption to Fe/Al/Mn hydroxides, organic matter, noncrystalline aluminosilicates; formation of sparingly soluble hydroxides

Table 11-2. Number of Samples from PRIs 11 - 16 in each Soil Class

PRI	Amtoft-Rock	Dynal	Playas-Saltair	Skumpah	Yenrab	Other
PRI-11	0	0	0	9	5	0
PRI-12	0	9	0	0	3	0
PRI-13	0	0	14	0	0	0
PRI-14	0	3	5	0	0	1
PRI-15	0	1	0	3	5	6
PRI-16	9	0	0	0	0	5

Table 11-3. Number of Samples from PRIs 11 - 16 in each Geologic Type

PRI	Ql	Qs	Other
PRI-11	14	0	0
PRI-12	12	0	0
PRI-13	0	14	0
PRI-14	1	8	0
PRI-15	12	3	0
PRI-16	6	0	8

Table 11-4. Number of Samples that Appear in each Soil-geologic Type Combination

Soil Type	Ql	Qs	Other
Amtoft-Rock	2	0	7
Dynal	10	3	0
Playas-Saltair	0	19	0
Skumpah	11	1	0
Yenrab	13	0	0
Other	9	2	1

Table 11-5. Pair-wise Tests Comparing Individual Metals Concentrations between Upland and Lakebed Areas

Analyte	N	Distribution	Test Method	p-value	Significant[a]
Aluminum	78	Lognormal	WRS	0.171	
Antimony	78	Lognormal	WRS	0.055	
Arsenic	78	NDD	WRS	0.029	
Barium	78	Normal	t-test	0.055	
Beryllium	78	Normal	t-test	0.000	Significant
Calcium	78	Lognormal	WRS	0.059	
Cadmium	78	NDD	WRS	0.113	
Chromium	78	Normal	t-test	0.000	Significant
Cobalt	78	Lognormal	WRS	0.033	
Copper	78	Normal	t-test	0.079	
Iron	78	Normal	t-test	0.000	Significant
Lead	78	Normal	t-test	0.000	Significant
Manganese	78	Lognormal	WRS	0.135	
Mercury	78	NDD	WRS	0.227	
Molybdenum	78	Lognormal	WRS	0.113	
Nickel	78	Lognormal	WRS	0.174	
Selenium	78	NDD	WRS	0.153	
Silver	78	NDD	WRS	0.094	
Thallium	78	NDD	WRS	0.016	
Vanadium	78	Normal	t-test	0.004	
Zinc	78	Normal	t-test	0.093	

Notes

[a] Significance is based on a Bonferroni-corrected p-value of 0.0024

Table 11-6. Summary of Characteristics of each Background Area

Characteristic	**Lakebed**	**Upland**
PRIs	13 & 14	11, 12, 15 & 16
9Dominant Geology	Qs	Ql & ‘Other’
Dominant Soil type	Playa-Saltair	Dynal, Skumpah, Yenrab, & ‘Other’
Beryllium, chromium, iron & lead	Lower concentrations	Higher concentrations

Table 11-7. Summary of Calculated Datasets for Lakebed Soil

Metal	**Percent not detected**	**Mean (mg/kg)**	**Standard Deviation (mg/kg)**	**CV**	**Number of outliers**	**□[a] (mg/kg)**	**Distribution**	**Sample Size[b] (n)**	**Rank**
Barium	0%	227	84.9	0.37	1	114	Normal	8	1
Cadmium	65%	0	0.0	0.37	0	0.0	Normal	9	2
Lead	0%	9	3.9	0.45	0	4.4	Normal	11	3
Arsenic	0%	9	4.2	0.47	1	4.5	Gamma	14	4
Antimony	17%	0	0.2	0.56	1	0.2	Gamma	16	5
Mercury	65%	0	0.0	0.47	0	0.0	Lognormal	16	6
Selenium	70%	0	0.1	0.51	0	0.1	Normal	16	7
Zinc	0%	31	18.4	0.60	0	15.5	Normal	21	8
Vanadium	0%	13	8.4	0.65	0	6.5	Lognormal	24	9
Copper	0%	6	3.6	0.62	0	2.9	Normal	25	10
Manganese	0%	138	97.9	0.71	0	69.2	Lognormal	29	12
Chromium	0%	7	4.9	0.76	0	3.3	Lognormal	31	13
Beryllium	0%	0	0.2	0.82	0	1.3E-01	Lognormal	33	14
Calcium	0%	209000	161606.0	0.77	1	104500	NP	34	15
Cobalt	0%	2	1.7	0.74	0	1.1	Lognormal	34	16
Aluminum	0%	5415	4299.0	0.79	0	2708	Lognormal	35	17
Iron	0%	5445	4276.0	0.79	0	2723	Lognormal	35	18
Nickel	0%	6	4.6	0.81	0	2.8	Lognormal	38	19
Molybdenum	43%	0	0.5	1.23	1	0.2	Lognormal	92	20
Silver	100%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Thallium	100%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Notes

[a] Grey area (equivalent to the maximum detectable difference) is defined as 50% of the mean

[b] Calculated in VSP using the “Compare Average to Reference Average”

The median potential sample sizes is highlighted in blue

The calculated sample size directly to the right of the median is highlighted in purple

N/A = Not applicable because metal was not detected

Table 11-8. Summary of Calculated Datasets for Upland Solid Media

Metal	Percent not detected	Mean (mg/kg)	Standard Deviation (mg/kg)	CV	Number of outliers	□[a] (mg/kg)	Distribution	Sample Size[b] (n)	Rank
Vanadium	0%	17.6	5.1	0.29	1	8.8	Lognormal	5	1
Beryllium	0%	0.44	0.15	0.35	0	0.2	Normal	7	2
Chromium	0%	10.8	3.78	0.35	0	5.4	Normal	7	3
Iron	0%	9605	3270	0.34	0	4803	Normal	7	4
Lead	0%	14.5	5.6	0.39	0	7.3	Normal	8	5
Nickel	0%	8.35	3.37	0.40	1	4.2	Normal	9	6
Aluminum	0%	9397	3454	0.37	0	4699	NP	10	7
Cobalt	0%	3.4	1.4	0.42	1	1.7	Normal	10	8
Barium	0%	186	86.7	0.47	0	92.8	Normal	12	9
Cadmium	4%	0.31	0.14	0.45	0	0.2	NP	14	10
Manganese	0%	297	137	0.46	0	148.6	Lognormal	14	11
Arsenic	0%	5.36	2.81	0.52	2	2.7	NP	17	12
Calcium	0%	91809	48632	0.53	1	45905	Lognormal	17	13
Zinc	0%	49.1	49.4	1.01	1	24.5	NP	49	15
Mercury	22%	0.02	0.02	1.02	4	0.0	NP	54	16
Selenium	49%	0.15	0.15	1.01	0	0.1	Gamma	58	17
Copper	0%	16.5	28.5	1.73	2	8.2	NP	154	18
Silver	78%	0.02	0.04	2.13	1	0.0	NP	199	19
Thallium	80%	0.03	0.06	2.08	0	0.0	NP	446	20
Antimony	45%	0.34	1.15	3.39	4	0.2	NP	599	21
Molybdenum	13%	1.12	3.83	3.40	2	0.6	NP	599	22

Notes

[a] Grey area (equivalent to the maximum detectable difference) is defined as 50% of the mean

[b] Calculated in VSP using the "Compare Average to Reference Average"

The median potential sample sizes is highlighted in blue

The calculated sample size directly to the right of the median is highlighted in purple

Table 11-9. Summary of Calculated Datasets for Organics in Solid Media

Metal	**Percent not detected**	**Mean (mg/kg)**	**Standard Deviation (mg/kg)**	**CV**	**□[a] (mg/kg)**	**Distribution**	**Sample Size[b] (n)**	**Rank**
D/F TEQs[c]	0%	6.3E-04	4.4E-04	6.9E-01	3.2E-04	Normal	24	1
Total PCBs	0%	862	668.3	0.78	431	Lognormal	34	2
Hexachlorobenzene	0%	21.7	20.98	0.97	10.8	Gamma	51	3

Notes

[a] Grey area (equivalent to the maximum detectable difference) is defined as 50% of the mean

[b] Calculated in VSP using the “Compare Average to Reference Average”

[c] Avian TEQ used as it had higher variability than the mammalian TEQ

D/F TEQ = Dioxin/Furan Toxic Equivalency

The median potential sample size is highlighted in blue

SECTION D: SAMPLING AND ANALYSIS

SAP WORKSHEETS #12-21

12.0 MEASUREMENT PERFORMANCE CRITERIA TABLE (SAP WORKSHEET #12)

QC Sample	Analytical Group	Minimum Frequency	Data Quality Indicators (DQI)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Field Duplicate	PCB, PCDD/PCDF, SVOC, PAH, TOC, VOC, Perchlorate, Metals, pH, Cyanide	10%	Precision-Overall	Metals, cyanide, TOC: RPD ≤ 35% if results > 5 x PQL ±2 x PQL if results < 5 x PQL Organics: RPD ≤ 50% if results > 5 x PQL ±2 x PQL if results < 5 x PQL	S&A
Matrix Spike (MXS) and Matrix Spike Duplicate (MSD) [a]	Cyanide, Perchlorate, Metals	5%	Precision and Accuracy	Percent recoveries (%R) and RPDs are identified in the laboratory SOPs. If no RPD is specified, a default RPD of ≤ 50 shall be used. If no %R is specified, a default %R of 70-130 shall be used~~Metals, cyanide, perchlorate: per Method~~ ~~RPDs are identified in the laboratory SOPs. If no RPD is specified, a default RPD of ≤ 50% shall be used~~	S&A
Lab Duplicate	PCB, PCDD/PCDF, SVOC, PAH, VOC, Perchlorate, Metals, TOC, pH, Cyanide	5%	Precision	Metals, cyanide, TOC: RPD ≤ 35% if results > 5 x PQL ±2 x PQL if results < 5 x PQL Organics: RPD ≤ 50% if results > 5 x PQL ±2 x PQL if results < 5 x PQL	A
Lab Control Sample (LCS)	PCB, PCDD/PCDF, SVOC, PAH, VOC, Perchlorate, Metals, Cyanide, TOC	5%	Accuracy	Metals, cyanide, perchlorate, SVOC, PAH, VOC, TOC: per Method PCB, PCDD/PCDF, HCB: Percent recovery 50%-150%	A

QC Sample	Analytical Group	Minimum Frequency	Data Quality Indicators (DQI)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Equipment Rinsate Blank[b,e]	PCB, PCDD/PCDF, SVOC, PAH, VOC, Perchlorate, Metals, Cyanide	1 per week per type of non-dedicated equipment used	Accuracy/ Contamination	No target compounds > PQL, except for methylene chloride, acetone, and 2-butanone, which must be less than 2 times (2x) their respective PQLs and bis(2-ethylhexyl)phthalate, which must be less than five times (5x) its PQL	S
Source Blank[c,e]	PCB, PCDD/PCDF, SVOC, PAH, VOC, Perchlorate, Metals, Cyanide	1 per source of water	Accuracy/ Contamination	No target compounds > PQL, except for methylene chloride, acetone, and 2-butanone, which must be less than 2 times (2x) their respective PQLs and bis(2-ethylhexyl)phthalate, which must be less than five times (5x) its PQL	S
Method Blank	PCB, PCDD/PCDF, SVOC, PAH, VOC, Perchlorate, Metals, Cyanide	1 per laboratory batch	Accuracy/ Contamination	No target compounds > PQL, except for methylene chloride, acetone, and 2-butanone, which must be less than 2 times (2x) their respective PQLs and bis(2-ethylhexyl)phthalate, which must be less than five times (5x) its PQL	A
Trip Blank[d,e]	VOC	1 per cooler	Accuracy/ Contamination	No target compounds > PQL, except for methylene chloride, acetone, and 2-butanone, which must be less than 2 times (2x) their respective PQLs and bis(2-ethylhexyl)phthalate, which must be less than five times (5x) its PQL	S

Notes:

a. Matrix spike (MXS) and matrix spike duplicate (MSD) ~~QC~~ samples will be analyzed for inorganics only. Per the UFP-QAPP QA/QC Compendium (EPA 2005b), MXS are for useful for inorganics but not for organics. Surrogate spikes identify matrix effects for organic analyses. ~~The UFP-QAPP QA/QC Compendium also identifies that matrix spike duplicates (MSD) "are not an effective measurement of precision in environmental media."~~

b. Equipment rinsate samples will be collected at a frequency of one per week per type of non-dedicated sample collection equipment used. Deionized water will be poured over or through the equipment into a sample container and sent to the laboratory for analysis. The equipment rinsate will allow for verification that the decontamination procedures were appropriately performed. Equipment rinsates are not needed for samples collected using dedicated equipment.

c. One source water blank will be collected for each source of deionized water used to decontaminate the soil and groundwater equipment and collect rinsate blank samples. The source-water blank sample will verify that the water used for decontamination was analyte free. If an analytical group is not detected in an equipment blank > PQL [or two times (2x) the PQL for methylene chloride, acetone, or 2-butanone or five times (5x) the PQL for bis(2-ethylhexyl)phthalate], then source blank analysis for that analytical group is not required.

d. A trip blank demonstrates that contamination is not originating from sample containers or from any factor during sample transport. A trip blank originates at the laboratory as a 40-milliliter vial typically used for analysis for VOCs. The vial is filled at the laboratory with reagent-grade, organic-free water. The trip blanks are then transported to the Site with the empty containers that will be used for sample collection. The trip blanks are stored at the Site until the proposed field samples have been collected. One trip blank will accompany back to the laboratory each sample transport container that holds samples for analysis for VOCs. The trip blank is not opened until it is returned to the laboratory.

e. See September 2013 Phase 1A SAP (EPA 2013) for measurement performance criteria for aqueous samples.

13.0 SECONDARY DATA CRITERIA AND LIMITATIONS (SAP WORKSHEET #13)

Secondary data consist of information generated historically at the Site by past investigators or data from other sources that are relevant to attainment of project objectives. Secondary data considered in the development of the Phase 1A-B Study design are summarized below, along with an assessment of the potential limitations to reliance on the data.

Type of Source (reports, databases, articles)	Data Source (report title, and date)	Data Generator(s) (originating organization, data types, data generator and collection dates)	How Data Where/Will Be Used	Limitations on Data Use
Historical environmental concentration data	Multiple - see September 2013 Phase 1A RI SAP WS10	Multiple - see September 2013 Phase 1A RI SAP WS10	Historical data were used to provide an initial list of the primary types of Site-related contaminants that may be released on Site, and the approximate spatial pattern of contamination.	Some historical data are not well documented. In addition, even if the data are well documented and of adequate analytical quality, they may not be representative of current Site conditions. Also, data are limited or absent for some chemicals of potential interest. Consequently, COPC selection will be based on Phase 1A-B data.
Current project environmental data	Phase 1A Laboratory DMA (ERM 2013a) and Draft Phase 1A Data Report for PRI Areas 2 and 8–17 (ERM 2014c)	US Magnesium: metals and organic chemistry	Used to estimate the variability and distribution of background metals and organics (D/Fs, PCBs and HCB)	Data were collected on Site. While the data were filtered to remove samples obviously impacted by the Site, these data may exhibit higher variability than actual background concentrations collected off Site.

Type of Source (reports, databases, articles)	Data Source (report title, and date)	Data Generator(s) (originating organization, data types, data generator and collection dates)	How Data Where/Will Be Used	Limitations on Data Use
Regional background datasets and studies	Hill Air Force Base Utah Test and Training Range (UTTR) background dataset (URS 2004); Historical Site background dataset (Paramatrix, 2004); and Front Range Ambient Dioxin study (EPA 2002a)	US Air Force; US Magnesium; and EPA	Data will be used provide context to, and evaluate the data collected for the Background DQO.	Data are not available for many metals. Front range study is dioxin fingerprint data, which can be subjective.
Report	Presence and Relative Abundance of Birds at the Old Waste Pond and Vicinity, Breeding Season. 2006.	BIO-Logic Environmental, observations of biota	Observations of horned lark, American avocet, and snowy plover nests at the US Magnesium facility were used to determine target bird species for background biota sampling.	Observations were made in 2006 and may not be representative of nesting birds currently at the Site.
Report	US Magnesium Avian Studies, 2008. US Magnesium Avian Studies, 2010.	Avian Ecology Lab, Weber State University (authored by J. Cavitt), observations of biota	Observations of horned lark, American avocet, and snowy plover nests at the US Magnesium facility were used to determine target bird species for background biota sampling.	Observations were made in 2008 and 2010 and may not be representative of nesting birds currently at the Site.
Article	A lesson in the limitations of field experiments: shrubsteppe birds and habitat alteration. 1986.	Ecological Society of America (authored by J. Wiens, J. Rotenberry, and B. Van Horne), foraging range observations	Foraging range of horned lark was used to determine minimum distance between reference area and RI/FS Study Area.	Observations of the horned lark foraging range were made in central Oregon and may not be representative of the foraging range around the western side of the GSL.
Article	The breeding biology of the American Avocet (*Recurvirostra americana*) in central Oregon. 1971.	The Condor (authored by F. Gibson), foraging range observations	Foraging range of American avocet was used to determine minimum distance between reference area and RI/FS Study Area.	Observations of the American avocet foraging range were made in central Oregon and may not be representative of the foraging range around the western side of the GSL.

Type of Source (reports, databases, articles)	Data Source (report title, and date)	Data Generator(s) (originating organization, data types, data generator and collection dates)	How Data Where/Will Be Used	Limitations on Data Use
Article	Breeding biology of snowy plovers at Great Salt Lake, Utah. 1995.	The Wilson Bulletin (authored by Paton), foraging range observations	Foraging range of snowy plover was used to determine minimum distance between reference area and RI/FS Study Area.	Observations of the snowy plover foraging range were made in areas along the eastern side of GSL and may not be representative of the conditions along the western side of the GSL.
Report	Final Inner PRI Data Report (ERM 2014a)	Compilation of available chemistry data for Inner PRI Areas	Historical Inner PRI Area data ~~will~~ may be included in chemical concentration maps and geostatistical evaluations for preliminary N&E evaluation in Phase 1A-B Data Report once comparability of the data sets has been determined.	Limitations of historical data are described in the report.

14.0 SUMMARY OF PROJECT TASKS (SAP WORKSHEET #14)

As stated in WS#11, the objective of the Phase 1A-B RI ~~for OU-1~~ is to obtain sufficient data to support:

1. Reliable identification of COPCs for human and ecological receptors within PRI Areas 1 and 3 through 7.

2. Initial risk calculations to evaluate whether sufficient data have been collected within PRI Areas 1 and 3 through 7 to support confident risk characterization.

3. Preliminary evaluation of the N&E of Site-related impacts within PRI Areas 1 and 3 through 7.

4. Estimation of background (ambient) concentrations for metals and organics including D/Fs, total PCBs and WHO congeners, and HCB.

5. Identification of suitable reference areas (i.e., non-impacted areas) for biota sampling that may be conducted during 2016 Phase 2 RI activities.

Specific project tasks required in order to achieve this objective are described below. Project tasks include:

- Sampling
- Analysis
- Quality control
- Secondary data
- Data management
- Documentation and records
- Assessments/audits
- Data review
- Reporting

The general sampling rationale and the required analytical testing are discussed in WS#11. Detailed rationale for the Phase 1A-B sampling locations is described in WS#11 and WS#17. Sampling locations are shown inWS#11 Figures 11-2 through 11-7.

The EPA will conduct independent split sampling as described in their oversight-planning document(s). The collection and analysis of split samples by EPA are not discussed in this SAP.

14.1 SAMPLING TASKS

Pre-sampling startup tasks include a background/reference Sampling Area reconnaissance, cultural resources survey, and subsurface utilities clearance. Tasks associated with sampling include surface solids sampling, subsurface solids sampling, sampling location surveying, management of investigation-derived waste (IDW), and equipment decontamination.

14.1.1 Background/Reference Sampling Area Reconnaissance

A field trip was conducted during the 2015 bird nesting season (1 to 4 June 2015) to evaluate the accessibility and likelihood of collecting biota samples within the Upland and Lakebed candidate areas shown in WS#11, Figure 11-15. Whenever feasible, sampling locations were identified in candidate locations along the borders furthest from the Site. This was done to maximize the distance between Site and reference tissue organisms, and in particular birds. The results from the field trip will be documented in a Background/Reference Area Identification Technical Memorandum which will be included as Attachment 11 to the Phase 1A-B SAP. The Technical Memorandum will be submitted for EPA review and approval as a SAP Modification and will include the final background locations for sediment and soil samples, including sampling locations at the BRMBR.

14.1.2 Cultural Resources Survey

Pursuant to Title 36, Section 800 of the Code of Federal Regulations and Utah Code Annotated 9-8-404, a cultural resources survey will be completed for any sampling locations located on United States Bureau of Land Management (BLM) or State of Utah School and Institutional Trust Land Administration (SITLA) lands. This requirement is potentially applicable for background/reference area sampling locations only; all sampling locations at Inner PRI Areas are located on property owned by US Magnesium. The cultural resources survey will be conducted by a BLM-certified professional archaeologist of Logan Simpson Design, Inc., under subcontract to ERM. The archaeologist will be accompanied by ERM during the cultural resources surveying field activities. A report documenting the cultural resources survey will be submitted to the BLM (lead agency) and the Utah State Historic Preservation Office for review. Approval to proceed from BLM is required before performing any ground disturbance on BLM or SITLA lands.

14.1.3 Underground Utilities

Subsurface utilities will be cleared at all ground disturbance locations before performing intrusive sampling activities. All clearances needed for borehole drilling will be obtained in accordance with ERM's Global Subsurface Clearance Policy, which is included in Attachment 21.

14.1.4 Sampling Location Surveying

Samples will be collected at the precise pre-determined locations for all systematic grid sampling locations outside of inundated areas of PRI Areas 5, ~~and~~ 6, and 7, as appropriate, including systematic grid sampling locations at background/reference areas. A Global Positioning System (GPS) unit will be used to navigate to the locations specified in SAP WS#18 (plus or minus 3 feet due to GPS accuracy) at the time of sample collection.

Judgmental/biased sampling locations will be determined in the field at the time of sampling based on the sampling rationale (provided in WS#11 and WS#17) and the approximate northing and easting provided in SAP WS#18. The actual sampling locations will be documented using GPS, to an accuracy of plus or minus 3 feet.

Sampling locations within inundated areas of PRI Areas 5, 6, and 7, as appropriate,~~and 6~~ will be located and recorded using on-board helicopter GPS as described in SOP USM-12.

Samples collected below ground surface should be measured and recorded within plus or minus 0.1 foot.

14.1.5 Surface Solids Sampling

Inner PRI Area surface solids sampling locations are shown on Figures 11-2 through 11-7 and are listed in WS#18. Sampling locations for background/reference areas are identified in SAP Attachment 11. Surface solids sampling will be performed as follows:

- Within PRI Areas 1, 3, and 4, and non-inundated areas of PRI Areas 5, 6, and 7 (as appropriate) surface solids sampling will be performed using a hand auger to a depth of 6 inches bgs as described in SOP USM-01.
- Within inundated areas of PRI Areas 5, 6 and 7 (as appropriate), surface solids sampling will be performed using a helicopter-deployed sediment sampler with a target sampling depth of 6 inches bgs as described in SOP USM-12.
- At all background/reference areas, surface sampling will be to a depth of 2 inches bgs using a flat-bottom scoop or shovel as described in SOP USM-01.

The presence/absence of visible waste will be noted on sampling forms at all sampling locations, as described in SOP USM-01. When waste is visible, the depth of waste will be measured. Waste may include gypsum, smut, salts, or sludge that have a different appearance than the native soils present within the Inner PRI Areas (e.g., oolitic sands, lacustrine clays, evaporate minerals). If waste is present at the bottom of a surface sampling location (6 inches bgs) outside of the inundated areas (i.e., PRI Areas 5, 6, and 7 as appropriate), then the hand-auger boring will be advanced to either the waste/native soil interface or a maximum depth of 5 feet bgs. Field screening for waste thickness at locations within the inundated areas (i.e., PRI Areas 5, 6, and 7 as appropriate) will be to depth of penetration of the helicopter-deployed sampler.

14.1.6 Subsurface Solids Sampling

Subsurface sampling will be performed at one or more locations in each Inner PRI Area as shown on Figures 11-2 through 11-7 and listed in WS#18. No subsurface solids sampling will be performed at background/reference areas. Subsurface sampling will be performed as detailed in SOP *USM-09: Subsurface Soil, Sediment, and Waste Sampling* and using 2-foot maximum sample intervals from 6 inches bgs to 2 feet below the waste/native soil interface. Subsurface sampling will be performed using a sonic drill rig or similar equipment equipped with a 6-inch (minimum) coring barrel to help ensure adequate material is available for collecting the required sample volume from targeted intervals as short as 6 inches.

Surface samples (0 to 6 inches bgs) will also be collected at each subsurface sampling location; therefore, the typical/default subsurface sample intervals will be 6 inches to 2 feet bgs, 2 feet to 4 feet bgs, and so on with the final sample interval extending to 2 feet below the waste/native soil interface, unless field conditions warrant adjustments to the sampling intervals. Native material will be segregated from waste material for the final sample interval to allow for the evaluation of potential impacts from wastes in native soil. Subsurface sampling intervals will be adjusted in the field for the following reasons:

- Native material will be segregated from waste material for the final sample interval to allow for the evaluation of potential impacts from wastes in native soil.

- If anomalous or discrete layers of waste or sediments are observed in a boring, the sample interval will be adjusted (reduced) to target the anomalous/discrete layers; however, due to sample volume requirements, no sample interval will be less than 6 inches. Anomalous layers will be identified by the EPA, EPA contractor, or ERM field personnel based on color, texture, field screening, and comparison with other wastes/sediments within a boring.

14.1.7 MANAGEMENT OF INVESTIGATION-DERIVED WASTE

IDW, both solid and liquid, will be generated during this investigation. IDW will be handled as follows:

- Used personal protective equipment or dedicated/disposable sampling equipment will be disposed of in dumpsters at the plant;
- Decontamination water will be disposed of either to the central Wastewater Ditch in the plant or to the current wastewater ponds (PRI Areas 5 and 6);
- Excess soil from surface soil sample collection will be left in place; and
- Excess soil from subsurface borings will be containerized in drums, pending characterization for disposal.

14.1.8 EQUIPMENT DECONTAMINATION

All equipment will be decontaminated according to SOP USM-03 (Attachment 21). In general, all sampling tools will be decontaminated before sampling begins and after sampling at each location. Sampling tools will be decontaminated by scrubbing in a solution of potable water and detergent (Alconox or Liquinox). The tools will then be double-rinsed with deionized water. Sampling tools not used immediately after decontamination will be allowed to air dry and stored wrapped in plastic or aluminum foil.

14.2 ANALYTICAL TASKS

Laboratory analyses will be performed following the analytical SOPs and project-specific Work Instructions listed in WS#23. All Phase 1A-B surface and subsurface solid samples from Inner PRI Areas will be analyzed for the target analytes listed in WS#15, which include:

- PCBs
- D/Fs
- SVOCs including HCB
- PAHs
- VOCs
- Metals
- Cyanide
- Perchlorate
- TOC
- pH
- Grain size

As described in WS#11 and shown on Figure 11-8, three splits will be collected for each Phase 1A-B Inner PRI Area surface solids sample to facilitate an evaluation of chemical concentrations in bulk and fines fractions. Each split will be composed of the bulk sample (passing 0.25-inch mesh) after homogenization as described in SOP USM-01.

1. Split sample 1 will be analyzed as a bulk fraction sample.

2. Split sample 2 will be analyzed for grain size. The result from the grain size analysis of split sample 2 will be used to determine whether to analyze split sample 3 as a fines fraction sample.

3. If the percent passing 0.25 mm in split sample 2 is greater than 75, then no analysis for fines is required.

4. If the percent passing 0.25 mm in split sample 2 is less than 75, then split sample 3 will be dried, sieved through a 0.25 mm mesh, and the fines-fraction material (passing 0.25 mm) will be analyzed for PCBs, D/Fs, SVOCs, PAHs, metals, and TOC.

All surface solids samples from background/reference areas will be analyzed for metals target analytes listed in WS#15. A subset of samples from background sampling locations will be also analyzed for the following subset of target analytes listed in WS#15:

- PCBs
- D/Fs
- HCB
- TOC

All solids samples collected during Phase 1A-B will be archived at the laboratory and may be reanalyzed up to a year after collection or extraction, depending on the analytical suite and preservation steps employed.

14.3 QUALITY CONTROL TASKS

US Magnesium/ERM and EPA will assess the quality of data through regular collection and analysis of field QC samples and the analysis of laboratory QC samples. WS#12 discusses the types and purposes of field QC samples that will be collected for this Project. Laboratory QC samples are discussed in WS#28. QC will also be evaluated through project assessments (WS#31), data validation (WS#36), and data usability assessment (WS#37).

14.4 SECONDARY DATA

Secondary data will be used for preliminary N&E evaluations and potentially for background data set evaluations:

- The Phase 1A-B RI Data Report will include maps showing chemical constituent concentrations for the primary risk drivers in each Inner PRI Area. Maps ~~will~~ may include historical/DMA data presented in the Final Inner PRI Data Report (ERM 2014a). Worksheet 12 identifies limitations on use of secondary data.
- Historical background datasets in the general area of the US Magnesium Site may provide some information regarding background concentrations of metals and organics: ATSDR 1992, Parametrix 2004, USFWS 2009, URS 2004. These datasets will not be used to develop relevant background for the purposes of the RI/FS; however, they may ~~be used to provide~~offer context for ~~comparisons for~~ data that are collected as part of this background ~~evaluation~~investigation.

14.5 DATA MANAGEMENT TASKS

All data generated during the Phase 1A-B RI will be managed in accordance with the Data Management Plan (ERM 2013b).

14.6 DOCUMENTATION AND RECORDS

Documentation and records will be managed as described in WS#29 and in the Data Management Plan (ERM 2013b). Deviations from this SAP or the attached SOPs will be documented by the following protocol for approval of changes requested during field sampling:

> During field sampling, it is sometimes necessary to make changes in sampling location and/or sampling methods compared to the specifications of the Phase 1A-B RI SAP. Either the EPA or ERM may propose such changes.
>
> In cases where the change is "minor" (e.g., relocating a sampling station a short distance away from the target location), and both ERM and EPA agree in "real time" that the change is appropriate, the change may be implemented and subsequently documented (e.g., later that day) by completion of a Field Modification Form. Note that agreement must be reached before implementing any such change. This may be accomplished by a consultation between the field team leader and an EPA oversight representative present at the Site, or by calling an appropriate EPA staff member by phone, as identified below:

Name	Office Phone	Cell Phone
Ken Wangerud	303-312-6703	720-951-0955
Dan Wall	303-312-6560	720-347-5520
Wendy O'Brien	303-312-6712	720-951-0970

> In the event that an EPA representative cannot be reached, or if the EPA representative cannot issue a decision in "real time," then no change shall be implemented until authorization is granted.
>
> In the event of a proposed "major" change in the Phase 1A-B RI SAP (e.g., a substantial revision to a sampling or processing method), the proposing party (either ERM or the EPA) shall complete a Field Modification Form for review and consideration by both parties. After a decision is reached and authorization for the change is approved, then the revision may be implemented.
>
> In the event that a change is proposed and agreement between the parties cannot be reached, then the procedure for dispute resolution defined in the AOC shall be followed.

SAP Modification and Field Modification Request Forms are included as Attachments 14A and 14B of this SAP.

14.7 ASSESSMENT/AUDIT TASKS:

Assessment and audit tasks include field readiness reviews, field sampling surveillance, laboratory surveillance, and the evaluation of data adequacy.

- A field readiness review will be completed by ERM prior to initiation of Phase 1A-B Sampling (see WS#31 and WS#32).

- Field sampling surveillance will be performed by ERM and EPA (or their contractor) at least twice, or as needed, during the Phase 1A-B Sampling (see WS#31 and WS#32).
- Laboratory surveillance will be performed by ERM and EPA (or their contractor) once, or as needed based on laboratory performance or other data quality issues, during the laboratory program (see WS#31 and WS#32).
- The evaluation of data adequacy will be performed as described in WS #11 and WS#37. Data adequacy evaluations will include an assessment of whether sampling locations and intervals satisfied the sample design criteria, and whether the analytical data achieved project quality objectives for precision, accuracy, representativeness, completeness, comparability, and sensitivity (PARCCS).

14.8 DATA REVIEW TASKS

All analytical results will be validated by a third-party independent validation contractor. All data will undergo a cursory data review. In addition, a full data validation (Stage 4) will be performed on 10 percent of the data packages for the Phase 1A-B RI. Data verification and validation are described in WS#35 and WS#36.

14.9 REPORTING

Results from this investigation will be summarized by ERM in a Draft ~~OU-1~~ Phase 1A-B for PRI Areas 1 and 3 through 7 RI Data Report. The draft data report will be provided to EPA for review and will include information regarding the six PRI Areas included in this Phase 1A-B RI SAP. The Draft ~~OU-1~~ Phase 1A-B RI Data Report will:

- Describe tasks completed and procedures followed during the investigation, including sampling, analyses, QC procedures, and data management;
- Summarize samples collected, including sampling locations and coordinate data;
- Include tables presenting analytical results for Phase 1A-B samples;
- Include ~~prevalence tables presenting~~ statistical summaries for each Sampling Area (e.g., each Inner PRI Area, background/reference Sampling Area, and/or background/reference sampling setting);
- Include laboratory analytical reports and data validation reports;
- Include copies of field notes, sampling forms, and other relevant sample collection and tracking information;
- Identify any discrepancies between the actual procedures followed and the Phase 1A-B RI SAP;
- Summarize and include as an attachment all EPA-approved field modification and SAP modification forms;
- Include maps and interpretations of chemical constituent concentrations appropriate to the range of concentrations ~~-~~for HCB, total PCBs, and mammal TEQs in each Inner PRI Area, incorporating data from the Phase 1A-B RI and the historical/DMA data described in the Final Inner PRI Data Report (ERM 2014a);

- Include results and interpretation of geostatistical modeling (e.g., kriging) conducted for HCB, total PCBs, and mammal TEQs for each Inner PRI Area~~, where the data permit~~;

- Provide results and interpretation of statistical evaluations (e.g., scatter plots, outlier tests, Q-Q plots) to analyze preliminary N&E of expected risk drivers within Inner PRI Areas;

- Include an attachment presenting results of bulk versus fines analyses for Inner PRI Area surface solids;

- Include an attachment presenting the data usability assessment for Inner PRI Area samples, including comparisons to measurement quality objectives (MQOs) and an evaluation of data adequacy for COPC selection; and

- Include an attachment presenting the data usability assessment for background/reference samples, including (1) comparisons to MQOs; (2) the identification and rationale for selected datasets for potential use in identifying elevated (Site-related) metals and organics (D/Fs, total PCBs and HCB); (3) an evaluation of data adequacy; and (4) the identification of non-impacted background soil/sediment reference locations that may be suitable for subsequent sampling (during Phase 2 RI) to characterize tissue burdens at reference locations.

15.0 REFERENCE LIMITS AND EVALUATION (SAP WORKSHEET #15)

15.1 OVERVIEW

WS#15 identifies the Target Quantitation Limit (TQL) for each analyte in each medium, and provides the anticipated laboratory Method Detection Limit (MDL) or Practical Quantitation Limit (PQL) for each analyte in each medium. This allows a comparison of the TQL to the MDL/PQL in order to judge whether the analytical method selected for use is sufficiently sensitive to measure each analyte at concentrations of potential concern.

~~Conceptually, t~~The process for identifying a TQL consists of the following steps:

1. Select an RBC for each analyte for human and ecological receptors for each Site medium (soil and sediment for this Phase 1A-B SAP) to which each receptor is exposed. For human receptors, the RBC for carcinogenic chemicals is equal to the 1E-06 risk level. For non-carcinogenic chemicals, the human health RBC is set equal to an HQ of 0.1 to account for potential additivity across chemicals. For ecological receptors, the RBC is ~~generally~~ set equal to an HQ of 1.0.
2. ~~As available~~For most analytes, the RBCs derived as above ~~are~~ were used as the human health and ecological TQLs. However, for D/Fs and co-planar PCB congeners, -risk evaluation is based on the calculated TEQ. For this reason, the TQL for each D/F and coplanar PCB congener was calculated from the human or ecological TQL for TCDD using the following equation:

   $$TQL_i = TQL(TCDD) / (TEF_i \cdot N)$$

   where TEF_i is the toxicity equivalency factor for congener i and N is the total number of congeners included in the sum. Likewise, the MDL and PQL for TEQ were calculated as follows:

   $$MDL(TEQ) = \sum (MDL_i * TEF_i)$$

   $$PQL(TEQ) = \sum (PQL_i * TEF_i)$$

   ~~TQLs for the total TEQ (mammalian) were calculated and compared to TEQs calculated for the MDLs/PQLs, to ensure the TQLs for individual congeners are sufficiently low.~~

For the purposes of the Phase 1A-B investigation, the RBCs adopted as TQLs for WS#15 were those identified in the SLRA Technical Memorandum -(ERM 2014b). Updates to RBCs identified in ERM 2014b were made if the underlying source documents were updated by the author. A brief description of these source documents is provided in the next section.

15.2 RBC SOURCES AND SELECTION

This section presents the sources of RBCs for solid media used for WS#15 and describes the procedure used for RBC selection. Solid media of potential concern at the Site include soil, sediment, and solid waste. Screening level RBC values were provided for both human and ecological receptors, and derived from a variety of federal and state sources as described in the SLRA Technical Memorandum- (ERM 2014b). Human health TQLs were taken from a single source. Ecological risk TQLs were selected from various sources based on a hierarchy. The sources of the soil and sediment screening values are presented below.

Human Health

EPA Regional Screening Table. EPA has developed regional screening levels (RSL) for residents and workers exposed to soil (EPA 2015). RSLs are developed using risk assessment guidance from the EPA Superfund program. They are risk-based concentrations derived from standardized equations combining exposure information assumptions with EPA toxicity data. RSLs are considered by the EPA to be protective for humans (including sensitive groups) over a lifetime. RSLs are considered generic as these are calculated without Site-specific information. For the Phase 1A-B RI, human RSLs for exposure to solid media were based on industrial RSLs. ~~As noted above, industrial soil RSLs were divided by a factor of 10 if the analytes were non-carcinogenic compounds. RSLs for carcinogenic compounds were not modified.~~

Ecological Risk

TQLs for ecological risk were developed for soil, freshwater sediment and saltwater sediment. Risk-based ecological screening levels (RBESLs) were selected from among recognized, reputable sources of environmental benchmarks protective of biota. A hierarchical approach was used to select RBESLs based on:

- Applicable or relevant and appropriate requirements;
- State, regional, or national application;
- Transparency in documentation and/or derivation;
- Account for exposure via ingestion of food items (i.e., food web exposures); and
- Regularly used (standard) practices in screening-level ecological risk assessments (SLERAs).

The ecological TQLs are described by solid media below.

Soil

The hierarchy for soil RBESLs presented in ERM 2014b, and adopted for WS#15 TQLs is presented below:

1. EPA Ecological Soil Screening Levels (EcoSSL). (EPA 2005-2007) http://www.epa.gov/ecotox/ecossl/.
2. Oakridge National Laboratory (ORNL) Preliminary Remediation Goals (PRG) for Ecological Endpoints. (Efroymson et al. 1997) http://rais.ornl.gov/documents/tm162r2.pdf
3. EPA Region 5 RCRA Ecological Screening Levels (ESLs). http://www.epa.gov/Region5/waste/cars/esl.htm.
4. EPA Region 6 Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities (EPA 1999). http://www.epa.gov/osw/hazard/tsd/td/combust/eco-risk/volume3/appx-e.pdf
5. Model Toxics Control Act (MTCA) Ecological Indicator Soil Concentrations for Protection of Terrestrial Plants and Animals. (WDOE 2007) https://fortress.wa.gov/ecy/publications/publications/9406.pdf

Freshwater Sediment

The hierarchy for freshwater sediment RBESLs presented in ERM 2014b, and adopted for WS#15 TQLs is presented below.

1. Consensus-based threshold/probable effect concentrations (TECs/PECs). (MacDonald et al. 2000)
2. Canadian Council of Ministers of the Environment (CCME) threshold/probable effect levels (TELs/PELs). (CCME 1999, 2003)
3. Ontario Ministry of the Environment lowest/severe effect levels (LELs/SELs). (Persaud et al. 1993)
4. EPA Region 5 RCRA Ecological Screening Levels (ESLs). http://www.epa.gov/Region5/waste/cars/esl.htm

Saltwater Sediment

The hierarchy for saltwater sediment RBESLs presented in ERM 2014b, and adopted for WS#15 TQLs is presented below.

1. Effect response low/median (ER-L/ER-M). (Long and Morgan 1991)
2. Canadian Council of Ministers of the Environment (CCME) threshold/probable effect levels (TELs/PELs). (CCME 1999; CCME 2003)
3. EPA Region 6 Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities (EPA 1999). http://www.epa.gov/osw/hazard/tsd/td/combust/eco-risk/volume3/appx-e.pdf
4. State of Washington apparent effect thresholds (AETs). (as listed in National Oceanic and Atmospheric Administration [NOAA] 2008 Screening Quick Reference Tables [SQuiRTs]) http://response.restoration.noaa.gov/sites/default/files/ SQuiRTs.pdf

16.0 PROJECT SCHEDULE / TIMELINE (WORKSHEET #16)

The framework for the Phase 1-A-B RI schedule for completion of specific tasks and deliverables ~~provided~~ in the following table ~~was developed~~is commensurate with ~~jointly~~ joint discussions between ~~by~~ ERM, EPA, and UDEQ during a project manager's meeting held on 15 April 2015. This section establishes the key project milestones and deliverables for Phase 1A-B completion in order to maintain progress consistent with overall project RI/FS objectives~~. Due to the interdependency of many of these tasks, the milestone completion dates provided herein may change due to actual completion dates of critical path milestones~~. ~~An enforceable updated detailed Gantt chart schedule that includes actual completion dates for specific tasks and shows the how these completion date affect the overall timeline to complete the Phase 1-A-B RI will be provided in monthly progress reports as required by Section VIII Paragraph 37 of the AOC.~~

No.	Activity	Organization	Start Date	Completion Date	Deliverable	Deliverable Due Date
	~~Cultural Resources Survey for BG Locations on State/Federal lands~~	~~ERM, Logan Simpson Design~~	~~20 July 2015 – Pending EPA approval of BG/Reference sampling locations~~	~~24 July 2015~~	~~Cultural Resources Report to BLM~~	~~7 Aug 2015~~
	~~Utility locating/clearance at subsurface sampling locations~~	~~ERM, Direct Push Services~~	~~3 Aug 2015~~	~~7 Aug 2015~~	~~Subsurface Clearance Project Plan (ERM Internal)~~	~~14 Aug 2015~~
1	~~OU-1~~ Phase 1A-B RI SAP Issued *	EPA	--	7 Sept 2015	~~OU-1~~ Phase 1A-B RI SAP, Rev 0	7 Sept 2015
	~~Background Area Sampling Readiness Review~~	~~ERM~~	~~8 Sept 2015~~	~~8 Sept 2015~~	~~Memo to ERM Project File, including Corrective Actions~~	~~14 Sept 2015~~
2	Surface solids sampling at Background/Reference Areas	ERM	15 Sept 2015 (Pending BLM approval for ground disturbance)	5 October 2015	Daily Report with notice of completion	6 October 2015
	~~Inner PRI Areas Sampling Readiness Review~~	~~ERM~~	~~28 Sept 2015~~	~~28 Sept 2015~~	~~Memo to ERM Project File, including Corrective Actions~~	~~2 Oct 2015~~

No.	Activity	Organization	Start Date	Completion Date	Deliverable	Deliverable Due Date
3	Surface solids sampling at Inner PRI Areas (excluding inundated areas at PRI Areas 5, ~~and~~ 6, and 7 ~~waste lagoons~~)	ERM	6 Oct 2015	2~~0~~ Nov 2015	Daily Report with notice of completion	3 Nov 2015
4	Subsurface solids sampling (drilling) at Inner PRI Areas	ERM, Drilling Subcontractor (TBD)	13 Oct 2015	26 Oct 2015	Daily Report with notice of completion	27 Oct 2015
5	Inundated waste area sampling (helicopter)	ERM, Reeder Flying Service	27 Oct 2015	9 Nov 2015	Daily Report with notice of completion	10 Nov 2015
6	Daily Progress Reports (per WS#33)	ERM	15 Sept 2015	20 Nov 2015	Daily reports	Daily
7	Monthly Progress Reports, including all results of sampling and all other data received by the Respondent (per AOC Sec. 37)	ERM	Upon SAP issuance	Ongoing monthly	Monthly report, with monthly data uploads to EQuIS.	30 May 2016
8	Background/Reference Areas samples laboratory analysis	ERM (TestAmerica, Alpha Analytical, GeoStrata)	22 Sept 2015	9 Nov 2015 (approximate – assumes 5-week TAT for HRMS analyses)	Laboratory Data Packages and EDDs	Upon completion of analysis and internal QA review
9	Background/Reference Areas field and analytical data (lab-EDDs) uploaded to online EQuIS database as EDDs are sent by labs, per DMP page 15.	ERM	1 Nov 2015, with ongoing EDDs uploaded weekly	8 Dec 2015	EQuIS database	8 Dec 2015
10	Inner PRI Areas samples laboratory analysis (30% complete)	ERM (TestAmerica, Alpha Analytical, GeoStrata)	7 Oct 2015	~~21 Dec 2015 (approximate – assumes 6-week TAT for HRMS analysis, including drying for fines analysis)~~15 Nov 2015	Laboratory Data Packages and EDDs	~~Upon completion of analysis and internal QA review~~25 Nov 2015
11	Inner PRI Areas samples laboratory analysis (60% complete)	ERM (TestAmerica, Alpha Analytical, GeoStrata)	7 Oct 2015	1 Dec 2015	Laboratory Data Packages and EDDs	10 Dec 2015

No.	Activity	Organization	Start Date	Completion Date	Deliverable	Deliverable Due Date
12	Inner PRI Areas samples laboratory analysis (100% complete)	ERM (TestAmerica, Alpha Analytical, GeoStrata)	7 Oct 2015	21 Dec 2015	Laboratory Data Packages and EDDs	4 Jan 2016
13	Inner PRI field and analytical data (lab-EDDs) uploaded to online EQuIS database as EDDs are sent by labs, per DMP page 15.	ERM	1 Nov 2015, with ongoing EDDs uploaded weekly	11 Jan 2016	EQuIS database	11 Jan 2016
14	Data validation	LDC	27 Oct 2015	4 Jan 2016	Data Validation Reports and EDDs	Upon completion of data validation
15	Data uploads to EPA Scribe Database	ERM	Per Data Management Plan			
	~~Field data and laboratory analytical data uploads to Project Database~~	~~ERM~~	~~Per Data Management Plan~~			
16	Prepare Draft ~~OU-1~~ Phase 1A-B RI Data and Preliminary Nature and Extent Report	ERM	5 Jan 2016	29 Feb 2016	Draft ~~OU-1~~ Phase 1A-B RI Data and Preliminary Nature and Extent Report	29 Feb 2016
17	Review Draft ~~OU-1~~ Phase 1A-B RI Data and Preliminary Nature and Extent Report **	EPA	1 Mar 2016	28 Mar 2016	EPA Comment Letter	28 Mar 2016
18	Prepare responses to EPA comments on Draft ~~OU-1~~ Phase 1A-B RI Data and Preliminary Nature and Extent Report	ERM	29 Mar 2016	18 April 2016	ERM Response to Comment Letter	18 April 2016
19	Review ERM Responses to Comments **	EPA	19 April 2016	2 May 2016	EPA Approval of Responses to Comments	2 May 2016
20	Prepare Final ~~OU-1~~ Phase 1A-B RI Data and Preliminary Nature and Extent Report	ERM	3 May	30 May 2016	Final ~~OU-1~~ Phase 1A-B RI Data and Preliminary Nature and Extent Report	30 May 2016

** Final WS#16 dates to be adjusted (plus or minus) to reflect actual Final SAP issuance date by EPA.*
*** Subsequent ERM deliverables will be extended in accordance with Agency comment transmittal.*

17.0 SAMPLING DESIGN AND RATIONALE (SAP WORKSHEET #17)

This WS describes the technical approach used to develop the sample designs for the ~~OU-1~~ Phase 1A-B RI. The sample designs described below were developed to collect data designed to satisfy the DQOs identified for the project (as described in WS#11). The objective of Phase 1A-B RI ~~for OU-1~~ is to obtain sufficient data to support:

1. Reliable identification of COPCs for human and ecological receptors within PRI Areas 1 and 3 through 7.
2. Initial risk calculations to evaluate whether sufficient data have been collected within PRI Areas 1 and 3 through 7 to support confident risk characterization.
3. Preliminary evaluation of the N&E of Site-related impacts within PRI Areas 1 and 3 through 7.
4. Estimation of background (ambient) concentrations for metals and organics including D/Fs, total PCBs and WHO congeners, and HCB.
5. Identification of suitable reference areas (i.e., non-impacted areas) for biota sampling that may be conducted during 2016 Phase 2 RI activities.

Broadly, these objectives are combined into two principal DQOs of “COPC Selection and Preliminary N&E at Inner PRI Areas,” and “Evaluation of Background.” The sample design and rationale for these two principal DQOs differ, thus are discussed separately in the following sections.

17.1 SAMPLE DESIGN FOR COPC SELECTION AND PRELIMINARY N&E AT INNER PRI AREAS

The sample design described in this section supports both COPC selection and preliminary N&E study goals. The data obtained during Phase 1A-B to support COPC selection and preliminary N&E will also be used to perform initial risk calculations to evaluate whether sufficient data have been collected to support confident risk characterization and adequate characterization of the N&E of areas that exceed a level of concern. To achieve these goals, the sample design was developed that incorporated statistical and spatial elements. The approach for the sample design was applied to each PRI Area independently.

For COPC selection, a minimum of 14 surface samples are required for each PRI Area. The statistical basis for a minimum sample size of 14 for COPC selection is described in WS#11, Section 11.2.6.1 and is founded on the concept that, given a dataset of adequate size, the maximum concentration value in that dataset will have a high probability (greater than or equal to 95 percent) of exceeding the true mean concentration across the PRI Area. Actual numbers of surface samples for the Inner PRI Areas range from 14 to 20, and include a combination of systematic/gridded locations and biased/judgmental locations:

	Systematic Grid Surface Sample Locations	Biased/Judgmental Surface Sample Locations	Total Number of Surface Sample Locations
PRI Area 1	0	14	14
PRI Area 3	13	1	14
PRI Area 4	14	0	14
PRI Area 5	15	5	20
PRI Area 6	15	0	15
PRI Area 7	15	2	17

The rationale for the increased number of gridded sampling locations within PRI Areas 5, 6, and 7 and the rationale for all biased/judgmental sampling locations are provided in WS#11, Section 11.2.7.3. Gridded sampling locations for PRI Areas 3 through 7 were generated using the software program VSP v7 (http://vsp.pnnl.gov/). The "pre-determined number of samples" module was used in conjunction with project Geographic Information System (GIS) files of PRI Area boundaries to generate target sample coordinates. A systematic grid (triangular) was used to project target sampling locations. To preserve the assumption of random sample placement, the coordinates of the starting node upon which the grid was projected was selected at random by VSP. Surface solids sampling locations are shown in Figures 11-2 through 11-7 and are listed in WS#18. The rationale for each biased surface solids sampling location is provided in in WS#11, Section 11.2.7.3 and is repeated in WS#18.

Subsurface solids sampling will be performed to evaluate chemical concentrations at depth and for characterizing vertical N&E within key waste release locations (shown in Figure 11-1) and other locations identified by the EPA. Subsurface solids sampling will be performed at one or more locations in each Inner PRI Area. Subsurface solids sampling locations are shown in Figures 11-2 through 11-7 and are listed in WS#18. The rationale for each subsurface solids sampling location is provided in in WS#11, Section 11.2.7.3, and is repeated in WS#18.

17.~~3~~2 SAMPLE DESIGN FOR EVALUATION OF BACKGROUND

This section presents the sample design to estimate ~~of~~ background (ambient) concentrations for metals and selected organics and for the identification of suitable reference areas (i.e., non-impacted areas) for biota sampling. As described in WS#11, two general classes of compounds are relevant to characterizing background for the US Magnesium RI/FS: "metals" and "organics." Organics include D/Fs, total PCBs, WHO co-planar PCB congeners, and HCB.

During the DQO development process, it was recognized that surface soils within the RI/FS Study Area vary by lithology and soil classification. Metals data collected from different lithologies and soil classes were evaluated statistically to identify similarities and differences between soil lithology and classification. From these evaluations, two metal background populations, "Upland" and "Lakebed," were identified for the background comparisons.

~~O~~It is expected that location (lakebed vs upland) is not an important distinction for organics. This assumption will be tested once the data are collected. If there is no important difference, then comparisons of site to background for organics will use the combined background data set. If there is an important difference, then the background data set for upland and lakebed will be treated independently and used for comparisons to the corresponding upland and lakebed site samples.~~rganic constituents in background are not expected to be a product of lithology or soil type, thus Upland and Background designations were deemed not applicable to organics.~~ Details on the procedure used to investigate and classify Upland and Lakebed populations are presented in WS#11.

The statistical design for background/reference area sampling was based on anticipated analyte-by-analyte comparisons of Site to background concentration data. In addition, the design will also support the identification of suitable (non-impacted) areas for anticipated future tissue sampling. Site-to-background comparisons will include statistical hypothesis testing. The minimum number of background samples needed to ensure that statistical testing will have adequate power (ability to discern elevated concentrations at the site as compared to background) was calculated based on estimates of natural variability (using site-specific data) in solid media concentrations. The "Compare Average to Reference Average" module in VSP v7 was used to calculate minimum number of samples. Details on the calculations method, as well as the source data and statistical assumptions employed, are presented in WS#11. For metals, a sample size of 30 samples per background population was derived to help ensure adequate statistical power. This results in a total of 60 metals samples will be collected (30 samples in Upland and 30 in Lakebed). A sample size of 36 samples was selected for organics. As this chemical class is not expected to be influenced by lithology or soil type, the 36 samples will be divided equally between metals populations (18 samples in Upland and 18 in Lakebed).

In addition to the 60 metals and 36 organic background samples discussed above, five “contingency” background samples will be collected in the BRMBR. The BRMBR contingency Background Sampling Area will only be utilized for tissue collection if the Lakebed or Upland Background Sampling Areas are found to be impacted.

The background/reference sampling locations for Upland, Lakebed, and BRMBR areas are presented in Attachment 11 to this SAP. Multiple off-Site candidate areas for collecting background samples were identified for Upland and Lakebed solid media types during the DQO process (WS#11). Selection of final areas for collecting background samples will be determined based on the findings from a reconnaissance survey conducted in June 2015. The goal of the field trip was to identify candidate Background Sampling Areas where reference biological tissue could likely be collected at a later date (e.g., during Phase 2 RI sampling in 2016). Attachment 11 to this SAP presents the results of the June 2015 candidate Background Sampling Areas survey.

Observations on field forms and photologs from the reconnaissance survey were used to select three Upland Background Sampling Areas, three Lakebed Background Sampling Areas, and one contingency Background Sampling Area in the BRMBR, as described in Attachment 11. As it is assumed that biological samples will be collected in these Background Sampling Areas during the Phase 2 of the RI, it is important to confirm the Background Sampling Areas are suitable for collection of biota, in particular bird eggs, at a later date. It is also critical to confirm the reference areas are a sufficient distance from the RI/FS Study Area to ensure nesting birds are not foraging within the study area.

Criteria for selection of Background Sampling Areas for Upland habitat include:

1. Located beyond the 5-mile radius of the Site and at least 500 feet from the edge of the 5-mile radius to ensure the horned lark is not foraging within the RI/FS Site boundary;
2. Contains minimally disturbed IMB greasewood flat or annual invasive grassland land cover;
3. Collection of bird eggs (e.g., horned lark), small mammals, plants, and invertebrates is very likely; and
4. The location was accessible for sampling.

Criteria for selection of Background Sampling Areas for Lakebed habitat include:

1. Located beyond the 5-mile radius of the Site and at least 1,000 feet from the edge of the 5-mile radius to ensure the snowy plover and American avocet are not foraging within the RI/FS Site boundary;
2. Contains minimally disturbed IMB playa land cover;
3. Collection of bird eggs (e.g., snowy plover and/or American avocet), plants, and invertebrates is very likely; and
4. Location was accessible for sampling.

Phase 1A-B sample coordinates, the rationale for sample placement, and the methods used to develop the sampling locations are presented in Attachment 11.

17.3 QUALITY CONTROL MEASURES FOR PHASE 1A-B SAMPLE DESIGNS

QC measures conducted in the field will include collection of field duplicate samples (one per 10 samples collected), equipment blanks (one per week per type of equipment used), and trip blanks (one per cooler containing samples for VOC analysis). The number of equipment blanks collected will depend on the number of days in the field and the types of equipment being used. The number of trip blanks will depend on the number of coolers used to ship samples to the analytical laboratories. Specifics regarding field quality control measures are presented in WS#12. Chain of custody (COC) will be maintained throughout the transition between field and analytical phases as described in WS#27.

QC measures for the analytical program will be performed by the contract laboratories. These measures will include instrument calibration, maintenance, testing and inspection described in WS#24 and WS#25. The analytical program also will include a regiment of QC samples (e.g., method blanks, laboratory duplicates, laboratory control samples/blank spikes, matrix spikes, etc.) as described in WS#12 and WS#28.

All analytical data will verified and validated in accordance with WS#34, WS#35, and WS#36. Data produced in Phase 1A-B will be subject to a data usability assessment (WS#37) that will confirm data precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS) relative to project MQOs.

18.0 SAMPLING LOCATIONS AND METHODS/SOP REQUIREMENTS TABLE (SAP WORKSHEET #18)

Area	Location (a)	UTM Zone 12 NAD 1983		Utah State Plane Central		Sample Type: SS = Surface SB = Sub-surface	Location Basis	Rationale for Biased or Subsurface Locations	Analytical Group (b)
		m N	m E	X feet	Y feet				
PRI Area 1 - Ditches	1-01	4530985	353753	1298598	7505121	SS	Biased	Near head of Western Ditch	A
	1-02	4531210	353757	1298606	7505859	SS	Biased	Approx. midpoint of N-S segment of Western Ditch	A
	1-03	4531398	353931	1299174	7506479	SS and SB	Biased	W of bridge at confluence of Western and Main ditches	B
	1-04	4531019	353970	1299309	7505236	SS	Biased	Near head of Central Ditch	A
	1-05	4531267	353967	1299294	7506050	SS	Biased	Central Ditch downstream of Sanitary Lagoon	A
	1-06	4530986	354071	1299641	7505130	SS	Biased	Near head of Chlorine Ditch	A
	1-07	4531158	354078	1299661	7505695	SS and SB	Biased	Chlorine Ditch downstream of Boron Plant discharge and S of bridge	B
	1-08	4531389	354148	1299886	7506454	SS and SB	Biased	Main Ditch after confluence with Chlorine Ditch and E of bridge	B
	1-09	4531396	354309	1300415	7506478	SS	Biased	Main Ditch adjacent to Landfill	A
	1-10	4531513	354486	1300992	7506868	SS	Biased	Main Ditch below Landfill	A
	1-11	4531658	354634	1301477	7507346	SS	Biased	Main Ditch near current outlet to PRI Area 5 waste pond	A
	1-12	4531793	354769	1301915	7507792	SS	Biased	Main Ditch alignment adjacent to PRI Area 5 waste pond	A
	1-13	4531961	354947	1302496	7508347	SS and SB	Biased	Former Main Ditch near historical outlet to PRI Area 7 waste pond	B

Area	Location (a)	UTM Zone 12 NAD 1983		Utah State Plane Central		Sample Type: SS = Surface SB = Sub-	Location Basis	Rationale for Biased or Subsurface Locations	Analytical Group (b)
	1-14	4531241	354122	1299802	7505968	SS and SB	Biased	Former Boron Ditch	B
PRI Area 3 - Sanitary Lagoon	3-01	4531162	353998	1299398	7505705	SS	Grid	n/a	A
	3-02	4531162	354023	1299479	7505705	SS	Grid	n/a	A
	3-03	4531162	354047	1299560	7505705	SS	Grid	n/a	A
	3-04	4531183	354010	1299438	7505776	SS	Grid	n/a	A
	3-05	4531183	354035	1299520	7505776	SS	Grid	n/a	A
	3-06	4531205	353998	1299398	7505846	SS	Grid	n/a	A
	3-07	4531205	354023	1299479	7505846	SS	Grid	n/a	A
	3-08	4531205	354048	1299560	7505846	SS	Grid	n/a	A
	3-09	4531226	354011	1299438	7505916	SS	Grid	n/a	A
	3-10	4531226	354035	1299520	7505916	SS	Grid	n/a	A
	3-11	4531248	353998	1299398	7505987	SS	Grid	n/a	A
	3-12	4531248	354023	1299479	7505987	SS	Grid	n/a	A
	3-13	4531247	354048	1299560	7505987	SS	Grid	n/a	A
	3-14	4531152	354023	1299479	7505672	SS and SB	Biased	Presumed inlet to lagoon	B
PRI Area 4 - Gypsum Pile	4-01	4531590	353784	1298687	7507105	SS	Grid	n/a	A
	4-02	4531581	354034	1299508	7507082	SS	Grid	n/a	A
	4-03	4531580	354291	1300351	7507082	SS	Grid	n/a	A
	4-04	4531805	353907	1299086	7507812	SS	Grid	n/a	A
	4-05	4531803	354164	1299930	7507812	SS and SB	Grid	Subsurface sample at top-center of the Gypsum Pile, where historical gypsum waste is expected to be present at depth	B
	4-06	4531802	354421	1300773	7507812	SS	Grid	n/a	A
	4-07	4531796	354679	1301621	7507799	SS	Grid	n/a	A
	4-08	4532028	353780	1298664	7508543	SS	Grid	n/a	A
	4-09	4532027	354037	1299508	7508543	SS	Grid	n/a	A

Area	Location (a)	UTM Zone 12 NAD 1983		Utah State Plane Central		Sample Type: SS = Surface SB = Sub-	Location Basis	Rationale for Biased or Subsurface Locations	Analytical Group (b)
	4-10	4532025	354294	1300351	7508543	SS	Grid	n/a	A
	4-11	4532023	354551	1301195	7508543	SS	Grid	n/a	A
	4-12	4532250	353909	1299086	7509273	SS	Grid	n/a	A
	4-13	4532248	354167	1299930	7509273	SS	Grid	n/a	A
	4-14	4532247	354424	1300773	7509273	SS	Grid	n/a	A
PRI Area 5 - Southeast Ponded Waste Lagoon	5-01	4530915	355052	1302861	7504917	SS	Grid	n/a	A
	5-02	4530913	355373	1303914	7504917	SS	Grid	n/a	A
	5-03	4530911	355693	1304966	7504917	SS	Grid	n/a	A
	5-04	4530910	356014	1306018	7504917	SS	Grid	n/a	A
	5-05	4530908	356335	1307071	7504917	SS	Grid	n/a	A
	5-06	4531194	354893	1302335	7505828	SS	Grid	n/a	A
	5-07	4531192	355214	1303388	7505828	SS	Grid	n/a	A
	5-08	4531190	355535	1304440	7505828	SS	Grid	n/a	A
	5-09	4531188	355855	1305492	7505828	SS	Grid	n/a	A
	5-10	4531186	356176	1306545	7505828	SS	Grid	n/a	A
	5-11	4531473	354735	1301809	7506739	SS	Grid	n/a	A
	5-12	4531471	355055	1302861	7506739	SS	Grid	n/a	A
	5-13	4531469	355376	1303914	7506739	SS	Grid	n/a	A
	5-14	4531749	354897	1302335	7507651	SS and SB	Grid	Subsurface sampling at location nearest the inlet to the waste lagoon from the Main Ditch	B
	5-15	4531748	355217	1303388	7507651	SS	Grid	n/a	A
	5-16	4531049	354881	1302299	7505352	SS and SB	Biased	Former Wastewater Diversion Ditch near/at an inlet of the ditch into the PRI Area 5 waste lagoon.	B

Area	Location (a)	UTM Zone 12 NAD 1983		Utah State Plane Central		Sample Type: SS = Surface SB = Sub-	Location Basis	Rationale for Biased or Subsurface Locations	Analytical Group (b)
	5-17	4530728	355151	1303190	7504304	SS	Biased	Lower reach of the Former Wastewater Diversion Ditch (representing the eastward leg draining into the PRI Area 5 waste lagoon).	A
	5-18	4530707	355136	1303142	7504234	SS	Biased	Star Pond Ditch downgradient of the discharge point from the Star Pond.	A
	5-19	4530741	355416	1304058	7504353	SS	Biased	Skull Valley Diversion at area of influent seepage.	A
	5-20	4530749	355360	1303875	7504377	SS	Biased	Star Pond Ditch at downstream (east) reach where Star Pond discharges appear to have comingled with Former Diversion Ditch and PRI Area 5 waste lagoon waters.	A
PRI Area 6 - Northwest Ponded Waste Lagoon	6-01	4532087	353711	1298439	7508736	SS	Grid	n/a	A
	6-02	4532077	354636	1301474	7508720	SS	Grid	n/a	A
	6-03	4532071	354859	1302206	7508704	SS	Grid	n/a	A
	6-04	4532292	353599	1298065	7509406	SS	Grid	n/a	A
	6-05	4532279	353812	1298766	7509366	SS	Grid	n/a	A
	6-06	4532274	354511	1301059	7509366	SS	Grid	n/a	A
	6-07	4532483	353464	1297619	7510028	SS	Grid	n/a	A
	6-08	4532481	353697	1298384	7510028	SS	Grid	n/a	A
	6-09	4532480	353930	1299148	7510028	SS	Grid	n/a	A
	6-10	4532478	354163	1299913	7510028	SS	Grid	n/a	A
	6-11	4532477	354396	1300677	7510028	SS	Grid	n/a	A
	6-12	4532682	353814	1298766	7510690	SS	Grid	n/a	A
	6-13	4532681	354047	1299530	7510690	SS	Grid	n/a	A
	6-14	4532679	354280	1300295	7510690	SS	Grid	n/a	A

Area	Location (a)	UTM Zone 12 NAD 1983		Utah State Plane Central		Sample Type: SS = Surface SB = Sub-	Location Basis	Rationale for Biased or Subsurface Locations	Analytical Group (b)
	6-15	4532882	354165	1299913	7511352	SS	Grid	n/a	A
	6-16	4532023	354551	1301195	7508543	SB	Biased	Within the historical inlet of the PRI Area 6 waste lagoon, co-located with surface solids sampling location 4-11 in PRI Area 4	C
PRI Area 7 - Northeast Ponded Waste Lagoon	7-01	4531237	356527	1307696	7506002	SS	Grid	n/a	A
	7-02	4531674	355781	1305238	7507422	SS	Grid	n/a	A
	7-03	4531671	356280	1306877	7507422	SS	Grid	n/a	A
	7-04	4532111	355034	1302779	7508841	SS and SB	Grid	Subsurface sampling at the location nearest the historical inlet	B
	7-05	4532108	355534	1304418	7508841	SS	Grid	n/a	A
	7-06	4532105	356033	1306057	7508841	SS	Grid	n/a	A
	7-07	4532545	354787	1301960	7510260	SS	Grid	n/a	A
	7-08	4532542	355286	1303599	7510260	SS	Grid	n/a	A
	7-09	4532539	355786	1305238	7510260	SS	Grid	n/a	A
	7-10	4532536	356285	1306877	7510260	SS	Grid	n/a	A
	7-11	4532979	354540	1301141	7511680	SS	Grid	n/a	A
	7-12	4532976	355039	1302779	7511680	SS	Grid	n/a	A
	7-13	4532973	355539	1304418	7511680	SS	Grid	n/a	A
	7-14	4532970	356038	1306057	7511680	SS	Grid	n/a	A
	7-15	4532972	356525	1307655	7511693	SS	Grid	n/a	A
	7-16	4533145	355386	1303913	7512241	SS	Biased	Barrow ditch N of the OWP due to the potential for ecological receptor exposures	A
	7-17	4533159	356196	1306571	7512303	SS	Biased	Barrow ditch N of the OWP due to the potential for ecological receptor exposures	A

Area	Location (a)	UTM Zone 12 NAD 1983	Utah State Plane Central	Sample Type: SS = Surface SB = Sub-	Location Basis	Rationale for Biased or Subsurface Locations	Analytical Group (b)
Lakebed Background/ Reference Areas	See SAP Attachment 11			SS	Grid	n/a	D
Upland Background/ Reference Areas	See SAP Attachment 11			SS	Grid	n/a	D
Bear River Migratory Bird Refuge	See SAP Attachment 11			SS	Grid	n/a	E

Notes:

Surface samples will be collected as described in SOPs USM-01 (outside of inundated areas of PRI Areas 5, 6, and 7 as appropriate) or USM-12 (within inundated areas of PRIs 5, 6, and 7 as appropriate). Subsurface solids samples will be collected as described in SOP USM-09. See WS#21 for sample collection SOP references.

(a) Sampling locations are shown in WS#11 Figures 11-2 through 11-7 for PRI Areas 1 and 3 through 7. See SAP Attachment 11 for background/reference area sampling locations. Biased sampling locations will be determined in the field at the time of sampling based on the sampling rationale (provided in WS#11 and WS#17) and the approximate coordinates provided above. See WS#14 for sampling location surveying requirements.

(b) Analytical groups include the following:

Group A = Inner PRI Area surface solids sampling locations. Analyses include: VOCs, SVOCs, PCBs, PCDDs/PCDFs, PAHs, metals, cyanide, perchlorate, pH, TOC, and grain size. Extra volume collected for possible fines analysis (SVOCs, PCBs, PCDDs/PCDFs, PAHs, metals, TOC) based on grain size results.

Group B = Inner PRI Area surface and subsurface solids sampling locations. Surface solids analyzed for Group A. Subsurface solids analyzed for: VOCs, SVOCs, PCBs, PCDDs/PCDFs, PAHs, metals, cyanide, perchlorate, pH, TOC, and grain size.

Group C = Inner PRI Area subsurface sampling location. Analyses include: VOCs, SVOCs, PCBs, PCDDs/PCDFs, PAHs, metals, cyanide, perchlorate, pH, TOC, and grain size.

Group D = Background/reference sampling location from Lakebed or Upland areas. All background/reference samples will be analyzed for metals and pH. A subset of samples will also be analyzed for PCBs, PCDDs/PCDFs, HCB, and TOC. See SAP Attachment 11.

Group E = Background/reference sampling location at BRMBR. All BRMBR samples will be analyzed for metals, pH, PCBs, PCDDs/PCDFs, HCB, and TOC.

19.0 ANALYTICAL SOP REQUIREMENTS TABLE (SAP WORKSHEET #19)

Matrix	Analytical Group	Analytical and Preparation Method/SOP Reference [1]	Containers (Number, Size, and Type)	Sample Preparation/ Analysis Volume	Preservation Requirements (Chemical, Temperature, Light Protected)	Maximum Holding Time (Preparation/ Analysis) [2]
Solids	HRMS PCB	EPA Method 1668A WS-IDP-0013 WS-ID-0013	1x4-ounce glass jar with Teflon®-lined lid	10 g	Cool to 4 ± 2 °C in field and for transport; Cool to < -10 °C upon receipt at lab [6]	1 year (frozen at -20°C)/ 45 days (1 year stored at -10°C) [3]
Solids	LRMS PCB	EPA Method 3570 SOP 2172 EPA Method 680 SOP 2162	1x4-ounce glass jar with Teflon®-lined lid	10 g	Cool to 4 ± 2 °C in field and for transport; Cool to < -10 °C upon receipt at lab [6]	1 year (frozen at -20°C)/ 40 days [3]
Solids	VOC	EPA Method 5035 / 8260B WS-MS-0007	3-EnCore® devices or equivalent	5 g	Cool to 4 ± 2 °C	48 hours for unpreserved, 14 days for preserved (can be frozen upon receipt for 7 days)
Solids	SVOC	EPA Method 3550B / 8270C WS-OP-0001, WS-MS-0005	1x8-ounce glass jar with Teflon®-lined lid [4]	30 g	Cool to 4 ± 2 °C [6]	14 days at 4 ± 2 °C (1 year frozen at -20°C)/ for extraction /40 days for analysis [3]
Solids	PAH	EPA Method 3550B / 8270C WS-OP-0001, WS-MS-0008	1x8-ounce glass jar with Teflon®-lined lid [4]	30 g	Cool to 4 ± 2 °C [6]	14 days at 4 ± 2 °C (1 year frozen at -20°C)/14 days for extraction/40 days for analysis [3]
Solids	HRMS PCDD/PCDF	EPA Method 8290 WS-IDP-0005 WS-ID-0005	1x8-ounce glass jar with Teflon®-lined lid [4]	30 g	Cool to 4 ± 2 °C [6]	30 days for extraction and 45 days for analysis [3]
Solids	LRMS PCDD/PCDF	EPA Method 8280 WS-IDP-0011 WS-ID-0011	1x8-ounce glass jar with Teflon®-lined lid [4]	10 g	Cool to 4 ± 2 °C [6]	30 days for extraction and 45 days for analysis [3]

Matrix	Analytical Group	Analytical and Preparation Method/SOP Reference [1]	Containers (Number, Size, and Type)	Sample Preparation/ Analysis Volume	Preservation Requirements (Chemical, Temperature, Light Protected)	Maximum Holding Time (Preparation/ Analysis) [2]
Solids	ICP Metals	EPA Method ~~3050A~~3050B/6010B WS-IP-0002, WS-MT-0003	1x8-ounce glass jar with Teflon®-lined lid [4]	30 g	Cool to 4 ± 2 °C [6]	180 days
Solids	ICP MS Metals	EPA Method 3050~~A~~B/6020 WS-IP-0002, WS-MT-0001	1x8-ounce glass jar with Teflon®-lined lid [4]	30 g	Cool to 4 ± 2 °C [6]	180 days
Solids	Mercury	EPA Method 7471A WS-MT-0007	1x8-ounce glass jar with Teflon®-lined lid [4]	30 g	Cool to 4 ± 2 °C [6]	28 days
Solids	TOC	EPA Method 9060 DV-WC-0048	1x8-ounce glass jar with Teflon®-lined lid [4]	10 g	Cool to 4 ± 2 °C [6]	28 days
Solids	Cyanide	EPA Method 9012A SOP SA-GE-040	1x8-ounce glass jar with Teflon®-lined lid [4]	10 g	Cool to 4 ± 2 °C	14 days
Solids	Perchlorate by IC	EPA Method 314 WS-WC-0010	1x4-ounce amber glass jar with Teflon®-lined lid[5]	50 g	Leave approximately 1/3 volume headspace, Cool to 4 ± 2 °C	28 days
Solids	Perchlorate by LC MS (confirmation analysis)	EPA Method 6850 WS-LC-0012	1x4-ounce amber glass jar with Teflon®-lined lid [5]	50 g	Leave approximately 1/3 volume headspace, Cool to 4 ± 2 °C	28 days
Solids	pH	EPA Method 9045D WS-WC-0044	1x8-ounce glass jar with Teflon®-lined lid [4]	20 g	Cool to 4 ± 2 °C	As soon as possible, not to exceed 28 days
Solids	Grain Size	Grain Size Analysis: percent passing 0.25 mm (#60) sieve) (based on ASTM C135/C117)	1x8-ounce glass jar with Teflon®-lined lid	8 ounces	None	None

Matrix	**Analytical Group**	**Analytical and Preparation Method/SOP Reference** [1]	**Containers (Number, Size, and Type)**	**Sample Preparation/ Analysis Volume**	**Preservation Requirements (Chemical, Temperature, Light Protected)**	**Maximum Holding Time (Preparation/ Analysis)** [2]
Solids	Fines Analysis	WS-WI-0040	2x16-ounce glass jar with Teflon®-lined lid	As needed for Methods (SVOCs, PCBs, PCDD/PCDF, PAHs, metals, TOC)	Fines samples will be dried and sieved prior to analysis [6]	Due to the time required for sample drying, fines samples may not meet some holding times for extraction [6]
Aqueous (Field QC Sample)	See September 2013 Phase 1A SAP					

[1] See WS#23.

[2] Maximum holding time is calculated from the time the sample is collected to the time the sample is prepared/extracted (not VDTSR).

[3] Assumes samples are stored at 4 ± 2 °C. Samples stored at -20°C do not show significant loss of target analytes for PAHs, SVOCs, and PCBs (EPA 2005c). Assumes PCB extracts are stored at room temperature. PCB extracts stored at -10°C (frozen) can be analyzed up to 1 year after extraction (EPA 2007, 2009).

[4] Two 8-ounce glass jars should be collected for analyses for SVOCs, PAHs, dioxins, ICP metals, ICP-MS metals, mercury, TOC, pH, and cyanide.

[5] One 4-ounce jar should be collected for perchlorate analysis of solids; both IC and LC-MS analytical methods can be performed using the same sample container.

[6] Samples for fines (< 0.25 mm) analysis per WS#11 will be preserved at 4 ± 2 °C until air drying begins. Air drying will be performed at 80° F (27° C); therefore, samples for fines analysis cannot be preserved at 4 ± 2 °C continuously prior to preparation (extraction or digestion). In addition, due to time needed to determine whether analysis of the fines fraction is necessary and then the time required for drying, the hold time for some methods may not be met (for example, 14 days for SVOCs and PAHs).

20.0 FIELD QUALITY CONTROL SAMPLE SUMMARY TABLE (SAP WORKSHEET #20)

Matrix	Analytical Group (Method)	No. of Samples Collected	No. of Field Duplicates[a]	No. of MXS/MSDs Inorganic Only[b]	No. of Equip. Blanks[c]	No. of Trip Blanks[d]	Approximate/ Estimated Total No. of Samples[e]
Inner PRIs							
Solids	PCB, D/F, SVOC, PAH, pH, TOC, grain size	138 (approx.) [f]	14 (approx.) [f]	0	5 (estimated)	0	157
Solids	VOC	138 (approx.) [f]	14 (approx.) [f]	0	5 (estimated)	10 (estimated)	167
Solids	Metals, cyanide, perchlorate	138 (approx.) [f]	14 (approx.) [f]	14/14 (approx.) [f]	5 (estimated)		185
Background/Reference Areas							
Solids	Metals	65	7	7/7	3 (estimated)	0	89
Solids	PCB, D/F, HCB, TOC	41	5	0	3 (estimated)	0	49

Notes:

a Per WS#12, field duplicates will be collected at a frequency of 10% (minimum).

b MXS/MSD will be performed for inorganic analyses only: metals, cyanide, and perchlorate. Per WS#12, MXS/MSD for inorganic analyses will be performed at a frequency of 10% (minimum).

c The number of equipment blanks will depend on the number of weeks and/or sampling teams, as indicated in WS#12. Values shown are for estimating purposes only. Equipment blank (water) samples will be analyzed as described in the September 2013 Phase 1A SAP.

d Trip blanks will be analyzed for VOCs only. The number of trip blanks will depend on the number of coolers containing samples for VOC analysis, as indicated in WS#12. The values shown are for estimating purposes only. Trip blank (water) samples will be analyzed as described in the September 2013 Phase 1A SAP.

e The total number of samples will be a function of the number of subsurface sampling intervals (affects number of samples collected, number of field duplicates, and number of MXS/MSD), the number of sampling teams/duration of sampling (affects number of equipment blanks), and the number of coolers shipped containing samples for VOC analysis (affects number of trip blanks). The actual number of subsurface sampling intervals will be a function of waste thickness and the presence/absence of inhomogeneities within subsurface borings.

f Values shown assume 94 surface solids sampling locations and 4 sampling intervals at each of 11 subsurface sampling locations.

21.0 PROJECT SAMPLING SOP REFERENCES TABLE (SAP WORKSHEET #21)

The following is a reference list of all relevant ERM SOPs to be used in support of sampling activities at the Site. The SOPs are found in Attachment 21.

SOP Reference Number	Title, Revision Date and/or Number	Equipment Type	Modified for Project Work?
USM-01	SURFACE SOIL, SEDIMENT, AND WASTE SAMPLING, Rev 4, July 2015	Hand Auger, Flat-bottom Scoop/Shovel	Yes
USM-03	EQUIPMENT DECONTAMINATION, Rev 2, September 2013	Refer to SOP	Yes
USM-04	SAMPLE MANAGEMENT, Rev 2, September 2013	Refer to SOP	Yes
USM-06	FIELD DOCUMENTATION, Rev 2, September 2013	Refer to SOP	Yes
USM-09	SUBSURFACE SOIL, SEDIMENT, AND WASTE SAMPLING, Rev 0, September 2013	Refer to SOP	Yes
USM-11	GLOBAL POSITIONING SYSTEM (GPS) FIELD DATA COLLECTION, Rev 0, September 2013	Refer to SOP	Yes
USM-12	SURFACE SOLIDS SAMPLING WITHIN CURRENT WASTEWATER PONDS, Rev 0, July 2015	Ponar and Box Corer Samplers	Yes
S1-ERM-007-WI	ERM GLOBAL SUBSURFACE CLEARANCE PROCESS, Version 3.2, May 2015	Refer to SOP	No

SECTION E: QUALITY ASSURANCE

SAP WORKSHEETS #22-37

22.0 FIELD EQUIPMENT CALIBRATION, MAINTENANCE, TESTING, AND INSPECTION TABLE (SAP WORKSHEET #22)

MiniRae 3000 Photoionization Detector (PID)
Parameters: The MiniRAE 3000 is a battery powered, microcomputer controlled, photoionization detector suitable for measuring concentrations of volatile organic compound (VOCs) vapor in ambient air. The instrument is capable of continuously monitoring for over 200 VOC gases at ppm concentrations ranging from 0.1 to 15,000 ppm with a resolution of 0.1 ppm.
Calibration: Calibration should be performed daily prior to use, or if any maintenance has been performed on the unit. Calibration procedures are outlined in the MiniRAE 3000 PID user's guide, included as an attachment to SOP USM-09 for calibration procedures. Calibration should be documented daily and performed in accordance with MiniRAE 3000 PID procedures. Ensure that the sample intake and exhaust are free of obstructions before performing calibrations. All calibration activities should be appropriately documented in the field logbook.
Maintenance: The rechargeable battery should be fully charged prior to use. If the battery can no longer function while in the field, 4 AA batteries can be inserted into the unit to continue operation. Internal components of the PID are sensitive to moisture; therefore, care should be taken to make sure liquid does not enter the inlet probe. If internal components become wet or soiled, they will require cleaning or replacement in accordance with the MiniRAE 3000 PID user's guide. Indications that cleaning or replacement is required include: inaccurate readings after calibration, readings sensitive to air moisture or liquid has entered the inlet probe. Common replacement parts that will be immediately available during MiniRAE 3000 PID use are a 10.6 eV Lamp, a sensor detector, or AA batteries. The MiniRAE 3000 PID digital display should be kept from overexposure to water and sunlight to maximize display longevity. All maintenance activities should be appropriately documented in the field logbook.
Testing: Battery voltage indicator on the LCD screen should be monitored throughout the day to ensure operation in appropriate levels. Calibration should be performed before conducting any field work and following any maintenance activities to ensure accurate readings are recorded. These checks should be performed to ensure that the unit is functioning properly. All testing activities should be documented in the field logbook.
Inspection: Visually inspect the contacts at the base of the instrument, on the battery, and on the charging cradle to make sure they are clean. The external surfaces, buttons, and the display screen on the unit should be inspected and kept clean of debris and liquids. Additionally, the sample intake and exhaust ports should be inspected for objects that could prevent airflow. Occasional cleaning of the unit with a soft cloth is recommended for longevity.
Frequency: Calibration should be performed daily prior to conducting any field work, and following any maintenance activities on the unit.
Acceptance: Acceptable readings will be within ±3% at the calibration point using isobutylene as a reference gas.
Corrective Action: Recalibration is required if readings are outside acceptance criteria outlined above and in the MiniRAE 3000 PID user's guide. Batteries will be replaced in the field, as needed. Error code prompts on the LCD screen will direct the user to the user's manual. A copy of the MiniRAE 3000 PID user's guide should be kept on-Site by field personnel to assist with corrective actions and troubleshooting. The user's guide is included as an attachment to SOP USM-09. All corrective actions should be appropriately documented in the field logbook
Responsible Person: Field Team Leader
SOP Reference: USM-09

23.0 ANALYTICAL SOP REFERENCES (SAP WORKSHEET #23)

Table 23-1 provides a list of analytical SOPs for solid media. In addition, Table 23-1 provides a summary of project-specific work instructions that are discussed in more detail in attachments to the Project-Specific Work Instructions (WS-WI-0037).

Table 23-1: Analytical SOP References for Solid Media

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix	Analytical Group	Instrument	Organization Performing Analysis	Summary of Project-Specific Work Instructions (refer to Lab SOP for details)
WS-WI-0037	Project-Specific Work Instructions for Phase 1A-B Investigation, Revision 2, Effective 070/2/2015	Definitive	Solid	Multiple	Multiple	TestAmerica ~~West~~ Sacramento	• Special sample preparation instructions for high level samples for selected methods; specific cleanup methods for selected methods; SVOC-SIM analysis for selected analytes.
WS-WI-0040	Project-Specific Work Instructions for Determination of the Percent (%) Fines (FP) in Soil/Sediment Samples, Revision 0.1, Effective 06/30/2015	Definitive	Solid	Multiple	NA	TestAmerica ~~West~~ Sacramento	• Per WS11, samples with <75% fines will be dried, sieved, and then the fines (<0.25 mm) fraction will be analyzed for PCDD/PCDF, PCB, SVOC, PAH, metals, and TOC.

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix	Analytical Group	Instrument	Organization Performing Analysis	Summary of Project-Specific Work Instructions (refer to Lab SOP for details)
WS-IDP-0005	Preparation of Samples for Analysis of Polychlorinated Dioxins and Furans for HRGC/HRMS, Method 8290, 8290A, & TO-9A, Revision 2.2, Effective 05/28/2015	Definitive	Solid	PCDD/ PCDF	NA	TestAmerica ~~West~~ Sacramento	A. All Project samples should be extracted by toluene Soxhlet extraction for solids and methylene chloride liquid-liquid extraction for aqueous samples. B. Note whether sample is designated as high-level or low-level per COC form. High level samples will be identified by ERM if they meet one or more of the following criteria: i. Water sample is from the Central, Chlorine, or Main wastewater ditch; ii. Water sample is from an active wastewater pond; iii. Solid sample is from the landfill and contains predominantly gypsum waste; iv. Solid sample exhibits field indications of high waste content. C. *For high-level samples*, reduce sample volume or mass of sample to be extracted so as to reduce the mass of the target analytes in the extract and minimize need for dilution of extract). i. Reduce solid sample extraction mass to 1 gram (from default mass of 10 g). ii. Reduce aqueous sample extraction volume to 100 ml (from default volume of 1 L) iii. Perform sulfuric acid cleanup on extracts from high-level samples.~~Low-level samples will be prepared and analyzed as indicated on the associated chain-of-custody, which is based on criteria in Attachment 1 to WS-WI-0037. As appropriate for high-level samples, some reduction of mass of sample to be extracted is allowed so as to reduce the mass of the target analytes in the initial extracts. However, multiple dilutions and analyses may be required to meet project specific requirements. Additional dilutions should be prepared as described in Attachment 1 to WS-WI-0037.~~

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix	Analytical Group	Instrument	Organization Performing Analysis	Summary of Project-Specific Work Instructions (refer to Lab SOP for details)
WS-ID-0005	Analysis of Samples for Polychlorinated Dioxins and Furans by HRGC/HRMS (Methods 8290, 8290A & TO-9A), Revision 7.6, Effective 6/6/2014	Definitive	Solid	PCDD/ PCDF	HRGC/HRMS	TestAmerica ~~West~~ Sacramento	A. As appropriate for high-level samples, dilute extracts to the maximum extent possible while still retaining quantitation by isotope dilution in order to mitigate detector saturation. B. For high-level protocol results greater than the calibration range at the maximum dilution, but less than 400 ug/kg for any individual congener, qualify results as estimated. C. For high-level sample results that exceed the linear response range of the detector or are greater than 400 ug/kg for any individual congener, analyze re-extracted sample by LRMS method (EPA Method 8280, SOP WS-ID-0011). D. If results from high-level sample analysis are not-detected for all analytes or the highest concentration constituent is within the calibration range for the low-level protocol and no Potentially damaging matrix interferences are evident, sample analysis should be performed using the low-level protocol. E. If results for any low-level samples indicate that concentrations are higher than expected and the high-level protocol is more appropriate, re-extract and analyze the sample following the high-level protocol. Re-extraction and analysis for isotope dilution methods is indicated if detector response for any analyte exceeds the linear response range of the detector (i.e., detector saturation) at the maximum possible dilution (approximately 20X).~~As appropriate for high-level samples, dilute extracts to the degree necessary, provided the analyses still meet project data use requirements and retain quantitation by isotope dilution as described in Attachment 1 to WS-WI-0037.~~ ~~If results for a high-level sample for one or more congeners is greater than 400~~

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix	Analytical Group	Instrument	Organization Performing Analysis	Summary of Project-Specific Work Instructions (refer to Lab SOP for details)
WS-IDP-0011	Extraction of Polychlorinated Dibenzo-p-dioxins and Dibenzofurans for Low Resolution GC/MS Analysis (Method 8280A and 8280B), Revision 2.~~4~~6, Effective ~~5/24/2013~~4/21/2015	Definitive	Solid	PCDD/ PCDF	GC/MS	TestAmerica ~~West~~ Sacramento	• If results for a high-level sample indicate one or more congener concentrations greater than 400 µg/kg, then re-extract for analysis using LRMS method (SOP WS-IDP-0011), as described in Attachment 1 to WS-WI-0037.
WS-ID-0011	Analysis of Polychlorinated Dibenzo-p-dioxins and Dibenzofurans (Method 8280A & 8280B), Revision 4.4, Effective 03/08/2013	Definitive	Solid	PCDD/ PCDF	GC/MS	TestAmerica ~~West~~ Sacramento	• As appropriate for high-level samples that exceed 400 µg/kg for one or more congeners in the HRMS analysis, re-extract and reanalyze the samples by LRMS method, as described in Attachment 1 to WS-WI-0037.

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix	Analytical Group	Instrument	Organization Performing Analysis	Summary of Project-Specific Work Instructions (refer to Lab SOP for details)
WS-IDP-0013	PCB Preparation for Analysis by HRGC/HRMS, (Method 1668A,~~ &~~ 1668C, & CBC01.2), Revision ~~4.4~~3.1, Effective ~~05/07/2014~~10/17/2014	Definitive	Solid	PCB	HRGC/HRMS	TestAmerica West Sacramento	A. All Project samples should be extracted by toluene Soxhlet extraction for solids and methylene chloride liquid-liquid extraction for aqueous samples. B. Note whether sample is designated as high-level or low-level per COC form. High level samples will be identified by ERM if they meet one or more of the following criteria: i. Water sample is from the Central, Chlorine, or Main wastewater ditch; ii. Water sample is from an active wastewater pond; iii. Solid sample is from the landfill and contains predominantly gypsum waste; iv. Solid sample exhibits field indications of high waste content. C. *For high-level samples*, reduce sample volume or mass of sample to be extracted so as to reduce the mass of the target analytes in the extract and minimize need for dilution of extract. (High-level solid samples in Phase 1A-B will be submitted to Alpha Analytical for analysis by EPA Method 680.) i. Reduce solid sample extraction mass to 1 gram (from default mass of 10 g). ii. Reduce aqueous sample extraction volume to 100 ml (from default volume of 1 L). iii. Perform sulfuric acid cleanup on high level extracts.~~Log sample for low-level analysis as indicated on the associated chain-of-custody, which is based on criteria in Attachment 2 to WS-WI-0037.~~ ~~If sample concentrations require dilution greater than 10X, re-extract sample with reduced mass, as described in Attachment 2 to WS-WI-0037.. If concentrations are greater than can be accommodated by the HRMS analysis, submit sample to~~

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix	Analytical Group	Instrument	Organization Performing Analysis	Summary of Project-Specific Work Instructions (refer to Lab SOP for details)
WS-ID-0013	PCB Analysis by HRGC/HRMS (Method 1668A and 1668C), Revision 4.4, Effective 5/07/2014~~(Method 1668A and 1668C), Revision 4.41 Effective 05/07/2014~~	Definitive	Solid	PCB	HRGC/HRMS	TestAmerica ~~West~~ Sacramento	A. As appropriate, dilute extracts to the maximum extent possible while still retaining quantitation by isotope dilution in order to mitigate detector saturation. B. For high-level protocol results greater than the calibration range at the maximum dilution, qualify results as estimated. C. For results that exceed the upper calibration range of the detector (2 ug/kg) at maximum dilution (10X), i.e., are greater than 20 ug/kg for any individual congener, re-extract sample at a minimum of 10X dilution based on sample matrix and/or results from initial analysis. D. If results from high-level sample analysis are not-detected for all analytes or the highest concentration constituent is within the calibration range for the low-level protocol and no potentially damaging matrix interferences are evident, sample analysis should be performed using the low-level protocol. E. If results for any low-level samples indicate that concentrations are higher than expected and the high-level protocol is more appropriate, re-extract and analyze the sample following the high-level protocol. Re-extraction and analysis for isotope dilution methods is indicated if detector response for any analyte exceeds the linear response range of the detector (i.e., detector saturation) at the maximum possible dilution (approximately 10X). ~~As needed, dilute extracts to the degree necessary, provided the analyses still meet project data use requirements and retaining quantitation by isotope dilution as described in Attachment 2 to WS-WI-0037.~~ ~~For samples with concentrations greater than the calibration range or the linear response range of the detector, reanalyze the samples at a~~

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix	Analytical Group	Instrument	Organization Performing Analysis	Summary of Project-Specific Work Instructions (refer to Lab SOP for details)
2172-MSEPrep	Microscale Solvent Extraction (MSE), Revision 9, Effective 02/17/2015~~Microscale Solvent Extraction (MSE, Sample Preparation for Analysis by LRMS) , Revision 12~~9~~, Effective 02/23~~17~~/2015~~	Definitive	Solid	PCB	HRGC/LRMS	Alpha Analytical~~,~~ ~~Mansfield, MA~~	• Log sample for high-level analysis as indicated on the associated chain-of-custody, which is based on criteria in Attachment 2 to WS-WI-0037. • As appropriate for high-level samples, some reduction of sample volume or mass of sample to be extracted is allowed so as to reduce the mass of the target analytes in the initial extracts.
2162-SOP	Determination of PCB Homologs, 136/209 Individual Congeners, and Pesticides Confirmation by GC/MS-SIM~~ (Method 680)~~,Revision 12, Effective 02/23/2015	Definitive	Solid	PCB	HRGC/LRMS	Alpha Analytical~~,~~ ~~Mansfield, MA~~	• As appropriate, dilute extracts to the degree necessary, provided the analyses still meet project data use requirements and retaining quantitation by isotope dilution. • For high-level results greater than the calibration range or the linear response range of the detector, reanalyze the samples at a more appropriate dilution. • If LRMS sample has no congener detected above 50 µg/kg, then ERM will request ~~TestAmerica to~~ analysis~~ze sample~~ by HRMS.
2169	Sulfuric Acid Cleanup (EPA Method 3665A), Effective 3/2/2012	Definitive	Solid	PCB	NA	Alpha Analytical~~,~~ ~~Mansfield, MA~~	• Cleanup of extracts for high-level samples.

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix	Analytical Group	Instrument	Organization Performing Analysis	Summary of Project-Specific Work Instructions (refer to Lab SOP for details)
WS-OP-0001	Extraction of Semivolatile Organic Compounds for Analysis by Method 8270C, Based on SW-846 3500 Series and 3600 Series, and PAH-SIM by Internal Standard and Isotope Dilution Procedures, Method 8270C, Revision 4.1, Effective 08/22/2014	Definitive	Solid	SVOC / PAH	NA	TestAmerica ~~West~~ Sacramento	A. Log sample for high-level or low-level analysis per designation on COC form. High level samples will be identified by ERM if they meet one or more of the following criteria: i. Water sample is from the Central, Chlorine, or Main wastewater ditches ii. Water sample is from an active wastewater pond iii. Solid sample is from the landfill and contains predominantly gypsum waste; iv. Solid sample exhibits field indications of high waste content. B. Extraction methods: i. Aqueous samples will be prepared by Separatory Funnel Liquid/Liquid Extraction ii. Solid samples will be prepared by Sonication C. As appropriate for high-level samples: i. Reduce sample volume or mass of sample to be extracted so as to reduce the mass of the target analytes in the extract. a. Reduce solid sample extraction mass to 3 grams (from default mass of 30 g). b. Reduce aqueous sample extraction volume to 100 ml (from default volume of 1 L). ii. Increase final extract volume to 10-milliliter equivalent or more. I.e., dilute an aliquot of the final extract by 10X and adjust IS concentration prior to analysis. iii. Apply maximum number of sample extract cleanup techniques. HLB cleanup GPC cleanup per WS-OP-0012. HLB and GPC cleanup is indicated for all soil and high-level aqueous samples requiring analysis for SVOCs by Method 8270. ~~Log sample for high-level or low-level analysis as indicated on the associated chain-of-custody, which is based on criteria in Attachments 3 and 8 of WS-WI-0037.~~ ~~Perform an initial 10X dilution to expected high-level solid samples.~~

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix	Analytical Group	Instrument	Organization Performing Analysis	Summary of Project-Specific Work Instructions (refer to Lab SOP for details)
WS-OP-0012	Gel Permeation Cleanup (Method 3640A), Revision 4.2, Effective 05/10/2013	Definitive	Solid	SVOC / PAH	NA	TestAmerica ~~West~~ Sacramento	None
WS-MS-0005	Semivolatile Organic Compounds (Base/Neutral and Acids) by GC/MS (Methods 8270C, 8270D, 625, and TO-13A), Revision 5.1, Effective 03/20/2015~~GC/MS Analysis Based on Method 8270C, 8270D, 625, and TO-13A, Revision 5.1, Effective 3/20/2015~~	Definitive	Solid	SVOC	GC/MS	TestAmerica ~~West~~ Sacramento	A. Analyze sample in full scan B. If any of the 5 analytes listed is not detected during analysis in full scan mode, perform confirmation analysis using SIM for analytes listed. C. Calibrate the GC/MS using calibration standard concentrations in Table 4 of the SOP to support the reporting limits for each of the analytes listed. ~~If select SVOCs are not detected above adjusted practical quantitation limits or method reporting limits during analysis in Full Scan mode, perform confirmation analysis using SIM for the following SVOCs: 2,4,6-trichlorophenol, hexachlorobenzene, hexachlorobutadiene, N-nitrosodimethylamine, and pentachlorophenol.~~ ~~As appropriate for high-level samples, dilute extracts to the degree necessary, provided the analyses still meet project data use requirements and retaining quantitation by isotope dilution as described in Attachment 3 to WS-WI-0037.~~ ~~For high-level results greater than the calibration range or the linear response range of the detector, reanalyze the samples at a more appropriate dilution as described WS-MS-0005.~~ ~~If results from high-level sample analysis are less than the sample specific practical quantitation limits, the analysis should be performed using a lower-level approach as described.~~

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix	Analytical Group	Instrument	Organization Performing Analysis	Summary of Project-Specific Work Instructions (refer to Lab SOP for details)
WS-MS-0007	Determination of Volatile Organics and Total Purgeable Petroleum Hydrocarbons by GC/MS (Methods 8260B, 8260C, 624, CA-LUFT, and AK101), Revision 5.1, Effective 9/5/2014	Definitive	Solid	VOC	GC/MS	TestAmerica ~~West~~ Sacramento	None
WS-MS-0008	Determination of Polycyclic Aromatic Hydrocarbons (PAH) by GC/MS-SIM Internal Standard Technique (Method 8270C and 8270D), Revision 2.6, Effective 03/20/2015	Definitive	Solid	PAH	GC/MS	TestAmerica ~~West~~ Sacramento	• Section 10.2- Use the MS operating conditions indicated in Table 9 below • Section 10.2.2- Use GC operating conditions as indicated in Table 8 below. Disregard criteria for PAH valley height. • Section 10.3.1- Disregard reference to PAH-specific internal standards. • Section 11.3.1- Disregard reference to addition of internal standards • Sections 11.3.6 and 11.5- Perform dilutions only as needed for target analytes not detected in the initial 8270 full scan analysis, or as required to minimize carry-over or prevent instrument damage. • Section 11.5.3- Refortify diluted extracts with 8270 internal standard solution to maintain the 8270 default concentration.~~When silica gel cleanup is used, the surrogate nitrobenzene-d5 is not reported. Extraction efficiency is monitored using 2-fluorobiphenyl and terphenyl-d14 as surrogates.~~
WS-IP-0002	Acid Digestion of Soils, SW-846 Method 3050B, Revision 5.3, Effective 01/19/2012	Definitive	Solid	ICP / ICP MS Metals	NA	TestAmerica ~~West~~ Sacramento	• Based on previous results, salinity levels will necessitate designating all samples as high-level samples. As appropriate for high-level samples, increase final digestate volume to 500 mL equivalent (5X dilution) for ICP and 200 mL equivalent (2X dilution) for ICPMS (for solid samples).

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix	Analytical Group	Instrument	Organization Performing Analysis	Summary of Project-Specific Work Instructions (refer to Lab SOP for details)
WS-MT-0001	Analysis of Metals by Inductively Coupled Plasma/Mass Spectrometry (Methods 200.8, 6020, and 6020A), Revision 3.8, Effective 12/12/2014	Definitive	Solid	ICP MS Metals	ICP MS	TestAmerica ~~West~~ Sacramento	• Perform all ICPMS analyses using Collision Cell Technology. • The nominal starting dilution for high level samples will be 2X. • If results from the 2X dilution are < PQL for all analytes and no matrix interferences are evident, analysis should be performed using the low-level approach as described in Attachment 4 to WS-WI-0037.
WS-MT-0003	Inductively Coupled Plasma-Atomic Emission Spectroscopy, Spectrometric Method for Trace Element Analyses, SW-846, Methods 6010B, 6010C, & EPA Method 200.7, Revision 5.5, Effective 12/05/2014	Definitive	Solid	ICP Metals	ICP	TestAmerica ~~West~~ Sacramento	• If diluted sample results are < PQL for all analytes and no matrix interferences are evident, analysis should be performed using the low-level approach as described in Attachment 4 to WS-WI-0037.
WS-MT-0007	Preparation and Analysis of Mercury in Solid Samples by Cold Vapor Atomic Absorption (Method 7471A & 7471B), Revision 5.3, Effective 01/07/2014	Definitive	Solid	Mercury	CVAA	TestAmerica ~~West~~ Sacramento	None
WS-WC-0010	Determination of Perchlorate by Ion Chromatography [Method 314.0], Revision 5.1, Effective 05/30/2014	Definitive	Solid	Perchlorate	Ion chromatography (IC)	TestAmerica ~~West~~ Sacramento	• Apply cleanup using Ba/Ag/H cartridge up to two times. • Apply dilutions as appropriate to comply with maximum conductivity requirements. • Use MXS/MSD aliquots to verify cleanup method performance. • Confirm all detections above the method detection limit via Method 6850.
WS-LC-0012	Determination of Perchlorate by Liquid Chromatography-Coupled with Tandem Mass Spectrometry (LC/MS/MS) by Method 6850, Revision 6.3, Effective 02/10/2014	Definitive	Solid	Perchlorate	High-performance liquid chromatography /MS/MS	TestAmerica ~~West~~ Sacramento	• Use method 6850 for solid samples with positive detections above the method detection limit using Method 314.0. • Apply cleanup using Ba/Ag/H cartridge up to two times. • Use MXS/MSD aliquots to verify cleanup method performance.

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix	Analytical Group	Instrument	Organization Performing Analysis	Summary of Project-Specific Work Instructions (refer to Lab SOP for details)
DV-WC-0048	Carbon in Soil (TOC, TC, TIC) [SW846 9060, 9060A], Revision 6, Effective 5/31/14	Definitive	Solid	TOC	Carbonaceous Analyzer	TestAmerica Denver	None
WS-WC-0044	EPA Method 9045C, 9045D pH Soils and Manual pH Aqueous (Method 9045C, 9045D, SM4500H+ -B and 9040B); Revision 6.4, Effective 08/07/2014~~Determination of pH (EPA Method 9045C, 9045D, SM4500H+ -B, 9040B); Revision 6.4, Effective 08/07/2014~~	Definitive	Solid	pH	Autotitrator	TestAmerica ~~West~~ Sacramento	None
SA-GE-040	Cyanide: Total, Amenable, and Weak Acid Dissociable (SW-846 9012A), Revision 11, Effective 12/01/14	Definitive	Solid	Cyanide	Lachat Autoanalyzer	TestAmerica Savannah	None
Grain Size Analysis	Grain Size Analysis: percent passing 0.25 mm (#60) sieve) Final 01, Effective ~~.~~06/25/2015	Definitive	Solid	Physical Parameters	Sieve	GeoStrata	None
WS-OP-0013	Determination of Percent Moisture, (ASTM D2216), Revision 4.2, Effective 03/29/2013	Definitive	Solid	Physical Parameters	Balance	TestAmerica ~~West~~ Sacramento	None
WS-QA-0018	Subsampling and Compositing of Samples, (ASTM D6323-98), Revision 4.0, Effective 04/04/2014	NA	Solid	Multiple	NA	TestAmerica ~~West~~ Sacramento	None
WS-QA-0003	Sample Receipt and Procedures (Quality Assurance Procedure), Revision 11.9, Effective 09/30/2014	NA	NA	NA	NA	TestAmerica ~~West~~ Sacramento	• As appropriate, sample fractions for SVOCs, PCBs, Dioxins, and metals will be identified based on historical information as high- or low-level samples. When samples are designated as high-level, special sample processing will be required as discussed above and in the appropriate SOPs.
WS-QAM	Quality Assurance Manual, TestAmerica ~~West~~ Sacramento, Revision 5.3, Effective 02/02/2015	NA	NA	NA	NA	TestAmerica ~~West~~ Sacramento	None

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix	Analytical Group	Instrument	Organization Performing Analysis	Summary of Project-Specific Work Instructions (refer to Lab SOP for details)
TAL Denver QAM	Quality Assurance Manual, TestAmerica Denver, Revision 6, Effective 7/31/2014	NA	NA	NA	NA	TestAmerica Denver	None
SA-QAM	Quality Assurance Manual, TestAmerica Savannah, Revision 4, Effective 07/18/2014	NA	NA	NA	NA	TestAmerica Savannah	None
1558 QSM	Quality Systems Manual, Revision 7, Effective 04/01/2015	NA	NA	NA	NA	Alpha Analytical ~~Westborough, MA and Mansfield, MA~~	None

24.0 ANALYTICAL INSTRUMENT CALIBRATION TABLE (SAP WORKSHEET #24)

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
Autotitrator	Soil pH	Minimum three point calibration with buffers of known pH.	Initial calibration prior to sample analysis	r ≥ 0.995	Evaluate buffers and instrument response. If problem found with above, correct as appropriate, then repeat initial calibration.	Lab Manager / Analyst [b]	WS-WC-0044
Autotitrator	Soil pH	Initial calibration verification (ICV, Second Source) buffer solution	Immediately following ICAL.	Result within ± 0.1 pH unit.	Evaluate data. If problem (e.g., concentrated buffer, autosampler error) found, correct, then repeat second source verification. If still fails, repeat initial calibration.	Lab Manager / Analyst [b]	WS-WC-0044
Autotitrator	Soil pH	Daily calibration verification	Prior to sample analysis, after every 10 field samples, and at the end of the sequence.	Result within ± 0.1 pH unit.	Evaluate buffer and instrument response. If problem found with above, correct as appropriate, then repeat CCV. If still fails, repeat initial calibration. Reanalyze all samples since the last successful calibration verification	Lab Manager / Analyst [b]	WS-WC-0044
Carbonaceous Analyzer	TOC	Demonstrate instrument stability and low background with reagent blanks.	Daily, prior to use	3 consecutive blanks show less than 1000 counts.	Repeat until criterion is met. If difficulty in meeting criterion (high background), evaluate reagents.	Lab Manager / Analyst [b]	WS-WC-0017
Carbonaceous Analyzer (Solid Analysis Only)	TOC	Minimum five-point initial calibration for target analytes, with one point at or below the reporting limit.	Initial calibration prior to sample analysis	Correlation coefficient, r, ≥ 0.995	Evaluate standards and detector response. If problem found with above, correct as appropriate then repeat initial calibration.	Lab Manager / Analyst [b]	WS-WC-0017

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
Carbonaceous Analyzer	TOC	Initial calibration verification (ICV, Second Source)	Immediately following ICAL.	Measured response within ± 10% of the expected value based on the ICAL.	Evaluate data. If problem (e.g., concentrated standard, blocked sparger, plugged gas line) found, correct, then repeat second source verification. If still fails, repeat initial calibration.	Lab Manager / Analyst [b]	WS-WC-0017
Carbonaceous Analyzer	TOC	Calibration Blanks (ICB/CCB)	ICB: Immediately following ICV, CCB: Immediately following CCV.	Measured response within ± reporting limit from zero.	NA	Lab Manager / Analyst [b]	WS-WC-0017
Carbonaceous Analyzer	TOC	Daily calibration verification (CCV)	After every 10 field samples, and at the end of the sequence.	Solid Analysis: Measured response within ± 15% of the expected value based on the ICAL.	Evaluate standard and detector response. If problem found with above, correct as appropriate, then repeat CCV. If still fails, repeat initial calibration. Reanalyze all samples since the last successful calibration verification	Lab Manager / Analyst [b]	WS-WC-0017
CVAA	Mercury	IC per manufacturer's instructions, with a minimum of five standards and a calibration blank	Initial calibration prior to sample analysis	Correlation coefficient >0.995; accepted if the ICV passes	Evaluate standard and instrument response. If problem with instrument (autosampler failure, response poor, etc.) or standards, correct as appropriate, then repeat initial calibration.	Lab Manager / Analyst [b]	WS-MT-0007
CVAA	Mercury	Second-source ICV, prepared at the calibration midpoint	Once per initial calibration	Less than 10% difference from IC for all target analytes	Evaluate standards and instrument response. If standard issue, repeat or remake then repeat standard as appropriate. If still fails, repeat initial calibration.	Lab Manager / Analyst [b]	WS-MT-0007

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
CVAA	Mercury	CCV, same source as IC	Following IC, after every 10 samples and the end of the sequence	Less than 20% difference from IC for all target analytes	Evaluate standard and instrument response. If problem with instrument (autosampler failure, response poor, etc.) or standards, correct as appropriate, then repeat. If still fails, repeat initial calibration. Reanalyze all samples since the last successful calibration verification.	Lab Manager / Analyst [b]	WS-MT-0007
HRGC/HRMS	Dioxins	Tune / Mass Resolution Check (PFK)	At the beginning and the end of each 12-hour period of analysis.	Resolving power ≥ 10,000 at mass to charge ratio m/z=304.9842 & m/z=380.9760 + 5 parts per million (ppm) of expected mass. Lock-mass ion between lowest and highest masses for each descriptor and level of reference ≤ 10% full-scale deflection.	Retune instrument & verify. Assess data for impact if end resolution is less than 10,000 narrate or reinject as necessary.	Lab Manager / Analyst [b]	WS-ID-0005

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
HRGC/HRMS	Dioxins	GC Column Performance Check Solution (CPSM/WDM per method)	Prior to ICAL or calibration verification.	Peak separation between 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) and other TCDD isomers result in a valley of ≤ 25%; <u>and</u> identification of all first and last eluters of the eight homologue retention time windows and documentation by labeling (first/last) on the chromatogram; <u>and</u> absolute retention times for switching from one homologous series to the next ≥ 10 seconds for all components of the mixture.	1) Readjust windows. 2) Evaluate system. 3) Perform maintenance. 4) Reanalyze CPSM. 5) No corrective action is necessary if 2,3,7,8-TCDD is not detected and the % valley is greater than 25%.	Lab Manager / Analyst [b]	WS-ID-0005
HRGC/HRMS	Dioxins	Minimum five-point initial calibration for target analytes, lowest concentration standard at or near the reporting limit. (ICAL)	ICAL prior to sample analysis, as needed by the failure of calibration verification, and when a new lot is used as a standard source for calib verification, ISTD or recovery standard solutions.	RSD ≤ 20% for response factors for 17 unlabeled isomers & 9 labeled isomers, <u>and</u> ion abundance ratios within limits specified in SOP; <u>and</u> signal to noise ratio (S/N) ≥ 10:1 for target analytes.[c]	Evaluate standard and instrument response. If problem with instrument (autosampler failure, response poor, etc.) or standards, correct as appropriate, then repeat initial calibration.	Lab Manager / Analyst [b]	WS-ID-0005

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
HRGC/HRMS	Dioxins	Second-source calibration verification	Immediately following ICAL.	All project analytes within ± 30% of the expected value from the ICAL.	Evaluate standards and instrument response. If standard issue, repeat or remake then repeat standard as appropriate. If still fails, repeat initial calibration	Lab Manager / Analyst [b]	WS-ID-0005
HRGC/HRMS	Dioxins	Calibration Verification (CCV)	At the beginning of each 12-hour period, and at the end of each analytical sequence.	Ion abundance ratios in accordance with SOP; <u>and</u> response factor (RF) (unlabeled standards) within ± 20%D of average RF from ICAL; <u>and</u> RF (labeled standards) within ± 30%D of average RF from ICAL.	Correct problem, repeat calibration verification. If fails, repeat ICAL and reanalyze all samples analyzed since last successful CCV <u>End of Run CCV:</u> If RF (unlabeled standards) > ± 20%D and ≤ ± 25%D and/or RF (labeled standards) > ± 30%D and ≤ ± 35%D of the average RF from ICAL, use mean RF from bracketing CCVs to quantitate impacted samples. If bracketing CCVs differ by more than 25% RPD (unlabeled) or 35% RPD (labeled), run a new ICAL within 2 hours, and requantitate samples. Otherwise, reanalyze samples with positive detections.	Lab Manager / Analyst [b]	WS-ID-0005
LRMS	Dioxins	Tuning	Prior to analyzing calibration standards	Verify MS calibration per the method	Retune instrument and verify. Rerun affected samples.	Lab Manager / Analyst [b]	WS-ID-0011

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
LRMS	Dioxins	GC Column Performance Check (CPSM/WDM per method)	Prior to ICAL or calibration verification.	Peak separation between 2,3,7,8-TCDD and other TCDD isomers result in a valley of ≤ 25%; <u>and</u> identification of all first and last eluters of the eight homologue retention time windows and documentation by labeling (F/L) on the chromatogram; <u>and</u> absolute retention times for switching from one homologous series to the next ≥ 10 seconds for all components of the mixture.	1) Readjust windows. 2) Evaluate system. 3) Perform maintenance. 4) Reanalyze CPSM. 5) No corrective action is necessary if 2,3,7,8-TCDD is not detected and the % valley is greater than 25%.	Lab Manager / Analyst [b]	WS-ID-0011
LRMS	Dioxins	Minimum five-point initial calibration for target analytes, lowest concentration standard at or near the reporting limit. (ICAL)	ICAL prior to sample analysis, as needed by the failure of calibration verification, and when a new lot is used as a standard source for calib verification, ISTD or recovery standard solutions.	RSD ≤ 15% for response factors for 17 unlabeled isomers & 9 labelled IS, <u>and</u> ion abundance ratios within limits specified in SOP; <u>and</u> S/N ≥ 10:1for target analytes.	Evaluate standard and instrument response. If problem with instrument (autosampler failure, response poor, etc.) or standards, correct as appropriate, then repeat initial calibration.	Lab Manager / Analyst [b]	WS-ID-0011

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
LRMS	Dioxins	Second-source calibration verification	Immediately following ICAL.	All project analytes within ± 30% of the expected value from the ICAL.	Evaluate standards and instrument response. If standard issue, repeat or remake then repeat standard as appropriate. If still fails, repeat initial calibration	Lab Manager / Analyst [b]	WS-ID-0011
LRMS	Dioxins	Calibration Verification (CCV)	At the beginning of each 12-hour period.	RF % difference within +/- 20%. S/N > 2.5 for unlabeled analytes and >10:1 for internal and recovery standards. All ion ratios must meet method criteria.	Correct problem, repeat calibration verification. If fails, repeat ICAL and reanalyze all samples analyzed since last successful CCV.	Lab Manager / Analyst [b]	WS-ID-0011
LRMS	Dioxins	Sensitivity check	At the end of the 12-hour sample analysis period or the end of analysis (whichever comes first).	Retention times, ion ratios and S/N must meet method criteria.	Repeat analysis.	Lab Manager / Analyst [b]	WS-ID-0011
HRGC/HRMS	PCBs	Tune / Mass Resolution Check (PFK)	At the beginning and the end of each 12-hour period of analysis.	Resolving power ≥ 10,000 at m/z=304.9842 & m/z=380.9760 + 5ppm of expected mass. Lock-mass ion between lowest and highest masses for each descriptor and level of reference ≤ 10% full-scale deflection. End of run check must be ≥ 5,000	Retune instrument & verify. Assess data for impact—if end resolution is less than 10,000, narrate or reinject as necessary.	Lab Manager / Analyst [b]	WS-ID-0013

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
HRGC/HRMS	PCBs	GC Column Performance Check (CPSM/WDM per method)	Prior to ICAL or calibration verification.	The congener pairs 23/34 and 182/187 are checked for chromatographic resolution. The valley between each pair must be less than 40% of the shorter of the two peaks. The CS-3 (CCV) is used to define chromatographic windows. First and last eluter must be present in each window.	1) Readjust windows. 2) Evaluate system. 3) Perform maintenance. 4) Reanalyze CPSM.	Lab Manager / Analyst [b]	WS-ID-0013
HRGC/HRMS	PCBs	Minimum five-point initial calibration for target analytes, lowest concentration standard at or near the reporting limit. (ICAL)	ICAL prior to sample analysis, as needed by the failure of calibration verification, and when a new lot is used as a standard source for calib verification, ISTD or recovery standard solutions.	RSD ≤ 20% for response factors for Toxic/limit of chlorination (LOC) compounds [a]	Evaluate standard and instrument response. If problem with instrument (autosampler failure, response poor, etc.) or standards, correct as appropriate, then repeat initial calibration.	Lab Manager / Analyst [b]	WS-ID-0013
HRGC/HRMS	PCBs	Second-source calibration verification	Immediately following ICAL.	All project analytes within ± 30% of the expected value from the ICAL.	Evaluate standards and instrument response. If standard issue, repeat or remake then repeat standard as appropriate. If still fails, repeat initial calibration	Lab Manager / Analyst [b]	WS-ID-0013

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
HRGC/HRMS	PCBs	CCV	At the beginning of each 12-hour period.	Ion abundance ratios in accordance with SOP; <u>and</u> RF (unlabeled standards) within ± 30%D of average RF from ICAL for Toxic/LOC compounds; <u>and</u> RF (labeled standards) within ± 50%D of average RF from ICAL.	Correct problem, repeat calibration verification. If fails, repeat ICAL and reanalyze all samples analyzed since last successful CCV	Lab Manager / Analyst [b]	WS-ID-0013
LRMS	PCBs	Decafluorotri-phenylphosphine (DFTPP) tune	Prior to each ICAL; At the beginning of analytical sequence; Every 12-18 hrs	Maximum Sensitivity criteria (See SOP)	Perform instrument/injection port maintenance as necessary; Retune instrument	Lab Manager / Analyst [b]	2162
LRMS	PCBs	Initial Calibration (ICAL) Minimum of 5 standards; Low standard must be ≤ RL;	Initial instrument setup; After non-routine instrument service; CCV/ICV criteria are not met	%RSD ≤20 Up to 10% of compounds may exceed criteria of 20%, but must be <30%	Review integrations and calculations; Perform and document remedial action as required; Repeat calibration	Lab Manager / Analyst [b]	2162
LRMS	PCBs	Initial Calibration Verification (ICV)	Immediately after each ICAL	+/- 30% of true value Prepared using standard source different than used for initial calibration	Re-analyze ICV if analytical error is suspected; Recalibrate as needed;	Lab Manager / Analyst [b]	2162
LRMS	PCBs	Continuing Calibration Verification (CCV)	At the beginning of every analytical sequence; Every 12-18 hours	%D ≤ 20 Up to 20% of compounds may exceed 20%, but must be <30%	Review integrations and calculations; Evaluate samples bracketed by failing CCV for obvious matrix interference; Re-analyze samples as needed	Lab Manager / Analyst [b]	2162

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS	PAHs	Check of mass tuning	Prior to ICAL and at the beginning of each 12-hour period.	Values for masses 69, 219, and 264 (if using perfluorotributylamine [PFTBA]) within ± 0.50 atomic mass unit (amu) of the target mass.	Retune instrument and verify.	Lab Manager / Analyst [b]	WS-MS-0008
GC/MS	PAHs	Minimum five-point initial calibration for target analytes, lowest concentration standard at or near the reporting limit. (ICAL)	Initial calibration prior to sample analysis	a) RSD for each analyte ≤ 15%; or b) linear least squares regression r ≥ 0.995; or c) non-linear regression chemical oxygen demand (COD) r-sq ≥ 0.99, min 6 points for second order.	Evaluate standards, chromatography, and MS response. If problem found with above, correct as appropriate, then repeat initial calibration.	Lab Manager / Analyst [b]	WS-MS-0008
GC/MS	PAHs	Second-source calibration verification	Once after each ICAL	All project analytes within ± 20% of true value.	Evaluate data. If problem (e.g., concentrated standard, plugged syringe) found, correct; then repeat second source verification. If it still fails, then repeat initial calibration.	Lab Manager / Analyst [b]	WS-MS-0008
GC/MS	PAHs	Retention Time Window Position Establishment	Once per ICAL, for each analyte and surrogate.	Set position using the mid-point standard of the ICAL when ICAL is performed. On days when ICAL is not performed, use initial CCV.	NA	Analyst	WS-MS-0008
GC/MS	PAHs	Daily calibration verification	Daily, prior to sample analysis and every 12 hours of analysis time.	%Difference/%Drift for all target compounds and surrogates: %D ≤ 20%	Evaluate standard, chromatography, and MS response. If problem found with above, correct as appropriate, then repeat CCV. If still fails, repeat initial calibration.	Lab Manager / Analyst [b]	WS-MS-0008
GC/MS	PAHs	ISTD	During acquisition of calibration standard.	Areas within -50% to +100% of last ICAL mid-point for each CCV	Inspect MS and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning	Lab Manager / Analyst [b]	WS-MS-0008

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS	Semivolatiles	Check of mass spectral ion intensities (tuning procedure) using decafluorotriphenylphosphine (8270C)	Prior to ICAL and at the beginning of each 12-hour period.	Refer to method/SOP for specific ion criteria.	Retune instrument and verify.	Lab Manager / Analyst [b]	WS-MS-0005
GC/MS	Semivolatiles	Minimum five-point initial calibration for target analytes, lowest concentration standard at or near the reporting limit. (ICAL)	Initial calibration prior to sample analysis	1) Average Response factor (RF) for SPCCs: > 0.050 2) RSD for RFs for calibration check compounds (CCCs): <30% and one option below: a) RSD for each analyte <15%, b) linear least squares regression r > 0.995; c) non-linear regression COD r-sq > 0.99, min 6 points for second order.	Correct problem, then repeat initial calibration	Lab Manager / Analyst [b]	WS-MS-0005
GC/MS	Semivolatiles	Second-source calibration verification	Once after each ICAL	All project analytes within ± 20% of true value.	Correct problem, and verify second source standard. Rerun verification. If still fails, repeat initial calibration.	Lab Manager / Analyst [b]	WS-MS-0005
GC/MS	Semivolatiles	Retention Time Window Position Establishment	Once per ICAL, for each analyte and surrogate.	Set position using the mid-point standard of the ICAL when ICAL is performed. On days when ICAL is not performed, use initial CCV.	NA	Analyst	WS-MS-0005

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS	Semivolatiles	Daily calibration verification	Daily, prior to sample analysis and every 12 hours of analysis time.	1. Min relative RF for SPCCs: >0.050 2. %Difference/%Drift for all target compounds and surrogates: %D < 20%	Correct problem, then repeat. If still fails, repeat initial calibration. Reanalyze all samples since last successful calibration verification.	Lab Manager / Analyst [b]	WS-MS-0005
GC/MS	Semivolatiles	ISTDs	During acquisition of calibration standard.	Areas within -50% to +100% of last ICAL mid-point for each CCV	Inspect MS and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning	Lab Manager / Analyst [b]	WS-MS-0005
GC/MS	Volatiles	Check of mass spectral ion intensities (tuning procedure) using bromofluorobenzene (BFB) (8260B)	Prior to ICAL and at the beginning of each 12-hour period.	Refer to method/SOP for specific ion criteria.	Retune instrument and verify.	Lab Manager / Analyst [b]	WS-MS-0007
GC/MS	Volatiles	Minimum five-point initial calibration for target analytes, lowest concentration standard at or near the reporting limit. (ICAL)	Initial calibration prior to sample analysis	1) Average RF for SPCCs: VOCs > 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane, > 0.10 for chloromethane, bromoform, and 1,1-dichloroethane 2) RSD for RFs for CCCs: <30% and one option below: a) RSD for each analyte <15%, b) linear least squares regression r > 0.995; c) non-linear regression COD r-sq > 0.99, min 6 points for second order.	Evaluate standards, chromatography, and MS response. If problem found with above, correct as appropriate, then repeat initial calibration.	Lab Manager / Analyst [b]	WS-MS-0007

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS	Volatiles	Second-source calibration verification	Once after each ICAL	All project analytes within ±20% of true value.	Evaluate data. If problem (e.g., concentrated standard, plugged purge line) found, correct; then repeat second source verification. If it still fails, then repeat initial calibration.	Lab Manager / Analyst [b]	WS-MS-0007
GC/MS	Volatiles	Retention Time Window Position Establishment	Once per ICAL, for each analyte and surrogate.	Set position using the mid-point standard of the ICAL when ICAL is performed. On days when ICAL is not performed, use initial CCV.	NA	Analyst	WS-MW-0007
GC/MS	Volatiles	Daily calibration verification	Daily, prior to sample analysis and every 12 hours of analysis time.	1. Min relative RF for SPCCs: relative RF > 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane, > 0.10 for chloromethane, bromoform, and 1,1-dichloroethane. 2. %Difference/%Drift for all target compounds and surrogates: %D < 20%	Evaluate standard, chromatography, and MS response. If problem found with above, correct as appropriate, then repeat CCV. If still fails, repeat initial calibration.	Lab Manager / Analyst [b]	WS-MS-0007
GC/MS	Volatiles	ISTDs	During acquisition of calibration standard.	Areas within -50% to +100% of last ICAL mid-point for each CCV	Inspect MS and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning	Lab Manager / Analyst [b]	WS-MS-0007
ICP	ICP Metals	Initial calibration per manufacturer's instructions, with a minimum of one standard and a calibration blank	Initial calibration prior to sample analysis	Correlation coefficient >0.995 (if more than one point); accepted if the ICV passes.	Evaluate standard and instrument response. If problem with instrument (autosampler failure, response poor, etc.) or standards, correct as appropriate; then repeat initial calibration.	Lab Manager / Analyst [b]	WS-MT-0003

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
ICP	ICP Metals	Low concentration standard at or near the reporting limit	Daily, after one point calibration	Within ± 20% of the true value for all target analytes.	Evaluate standard and instrument response. If problem with instrument (autosampler failure, response poor, etc.) or standards, correct as appropriate, then repeat. If still fails, repeat initial calibration.	Lab Manager / Analyst [b]	WS-MT-0003
ICP	ICP Metals	Second-source ICV, prepared at the calibration midpoint	Once per initial calibration	Within ± 10% of the true value for all target analytes.	Evaluate standards and instrument response. If standard issue, repeat or remake then repeat standard as appropriate. If still fails, repeat initial calibration.	Lab Manager / Analyst [b]	WS-MT-0003
ICP	ICP Metals	CCV, same source as initial calibration	Following IC, after every 10 samples and the end of the sequence	Within ± 10% of the true value for all target analytes.	Evaluate standard and instrument response. If problem with instrument (autosampler failure, response poor, etc.) or standards, correct as appropriate; then repeat. If still fails, repeat initial calibration. Reanalyze all samples since the last successful calibration verification.	Lab Manager / Analyst [b]	WS-MT-0003

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
ICP	ICP Metals	Interference check standard (ICS)	At the beginning of an analytical run	Interference check standard A (ICSA-A): Absolute values of concentration for all non-spiked analytes < limit of detection (LOD) (unless they are a verified trace impurity from one of the spiked analytes); ICS-AB: Within ±20% of true value in accordance with National Functional Guidelines requirements.	Terminate analysis, then reanalyze ICS and all affected samples in accordance with National Functional Guidelines requirements.	Lab Manager / Analyst [b]	WS-MT-0003
ICP MS	ICP MS Metals	Tuning	Prior to initial calibration	Mass calibration ≤ 0.1 amu from true value; Resolution < 0.9 amu full width at 10% peak height; For stability, RSD ≤ 5% for at least four replicate analyses.	Correct problem, then repeat tuning.	Lab Manager / Analyst [b]	WS-MT-0001
ICP MS	ICP MS Metals	Instrument Detection Limit (IDL) Study	At initial set-up, and after significant change in instrument type, personnel, test method, or sample matrix.	Calculated IDLs < LOD	NA	Lab Manager / Analyst [b]	WS-MT-0001

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
ICP MS	ICP MS Metals	Initial calibration per manufacturer's instructions, with a minimum of one standard and a calibration blank	Initial calibration prior to sample analysis	Correlation coefficient >0.995 (if more than one point).	Evaluate standard and instrument response. If problem with instrument (autosampler failure, response poor, etc.) or standards, correct as appropriate; then repeat initial calibration.	Lab Manager / Analyst [b]	WS-MT-0001
ICP MS	ICP MS Metals	Low concentration standard at or near the reporting limit	Daily, after one point calibration	Within ±20% of the true value for all target analytes.	Evaluate standard and instrument response. If problem with instrument (autosampler failure, response poor, etc.) or standards, correct as appropriate; then repeat. If still fails, repeat initial calibration.	Lab Manager / Analyst [b]	WS-MT-0001
ICP MS	ICP MS Metals	Linear dynamic range or high-level check standard	Every 6 months	Within ±10% of the true value for all target analytes.	Adjust dynamic range downward and repeat.	Lab Manager / Analyst [b]	WS-MT-0001
ICP MS	ICP MS Metals	Second-source ICV, prepared at the calibration midpoint	Once per initial calibration	Within ±10% of the true value for all target analytes.	Evaluate standards and instrument response. If standard issue, repeat or remake then repeat standard as appropriate. If still fails, repeat initial calibration.	Lab Manager / Analyst [b]	WS-MT-0001
ICP MS	ICP MS Metals	CCV, same source as initial calibration	Following initial calibration, after every 10 samples and the end of the sequence	Within ±10% of the true value for all target analytes.	Evaluate standard and instrument response. If problem with instrument (autosampler failure, response poor, etc.) or standards, correct as appropriate; then repeat. If still fails, repeat initial calibration. Reanalyze all samples since the last successful calibration verification.	Lab Manager / Analyst [b]	WS-MT-0001

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
ICP MS	ICP MS Metals	ISTDs	Every CCV/CCB.	ISTD intensity within 80-120% of the ISTD in the initial calibration blank.	Evaluate analyses prior to failing ISTD to determine if matrix carryover or instrument failure. If instrument, correct as appropriate and repeat initial calibration. Reanalyze all samples since the last successful calibration verification.	Lab Manager / Analyst [b]	WS-MT-0001
Ion Chromatograph	Perchlorate	Minimum five-point initial calibration for target analytes, lowest concentration standard at or near the reporting limit	Initial calibration prior to sample analysis	Linear least squares regression: $r \geq 0.995$;	Evaluate standards, chromatography, and detector response. If problem found with above, correct as appropriate, then repeat initial calibration	Lab Manager / Analyst [b]	WS-WC-0010
Ion Chromatograph	Perchlorate	Initial calibration verification (ICV, Second Source)	Immediately following ICAL.	All project analytes within ± 10% of the expected value from the ICAL.	Evaluate data. If problem (e.g., concentrated standard, plugged injector needle) found, correct, then repeat second source verification. If still fails, repeat initial calibration.	Lab Manager / Analyst [b]	WS-WC-0010
Ion Chromatograph	Perchlorate	Daily calibration verification	Prior to sample analysis, after every 10 field samples, and at the end of the sequence.	All project analytes within ± 15% of the expected value from the ICAL.	Evaluate standard, chromatography, and detector response. If problem found with above, correct as appropriate, then repeat CCV. If still fails, repeat initial calibration. Re-analyze all samples since the last successful calibration verification	Lab Manager / Analyst [b]	WS-WC-0010
LC/MS/MS	Perchlorate	Tuning (Mass Calibration Verification)	Prior to ICAL and after any mass calibration or maintenance is performed.	Quantitation ions within 0.3 m/z of expected mass.	Perform mass calibration on the MS/MS. If required, consult with instrument engineer for further maintenance.	Lab Manager / Analyst [b]	WS-LC-0012

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
LC/MS/MS	Perchlorate	Minimum six-point initial calibration for target analytes, lowest concentration standard at or below the reporting limit	Initial calibration prior to sample analysis	Linear: $r^2 > 0.990$ (r>0.995) with intercept ≤ LOD, or Average Response Factor: RSD≤ 20%.	Evaluate standards, chromatography, and MS. If problem found with above, correct as appropriate, then repeat initial calibration.	Lab Manager / Analyst [b]	WS-LC-0012
LC/MS/MS	Perchlorate	Second-source calibration verification	Once per six-point initial calibration	Perchlorate within ±15% of the true value	Evaluate data. If problem (e.g., concentrated standard, plugged transfer line) found, correct, then repeat second source verification. If it still fails, then repeat initial calibration.	Lab Manager / Analyst [b]	WS-LC-0012
LC/MS/MS	Perchlorate	Daily calibration verification	Mid-range standard analyzed before sample analysis, after every 10 samples, and at the end of the sequence.	Perchlorate within ±15% of the true value	Correct problem, then repeat. If still fails, repeat initial calibration	Lab Manager / Analyst [b]	WS-LC-0012
LC/MS/MS	Perchlorate	Limit of Detection verification (LODv) (per batch)	Prior to sample analysis and at the end of the analysis sequence.	Perchlorate within ± 30% of the true value	Correct problem. Evaluate samples. Samples with results > RL (limit of quantitation [LOQ]) may be reported. Samples since the last passing LODv with results ≤ RL (LOQ) must be reanalyzed.	Lab Manager / Analyst [b]	WS-LC-0012
LC/MS/MS	Perchlorate	Laboratory Reagent Blank	Prior to ICAL, following samples with overrange concentration of perchlorate, and at the end of the analytical sequence.	No perchlorate detected > quantitation limit (QL)	Reanalyze reagent blank (until no carryover seen), and any samples with perchlorate detections since the contaminated blank.	Lab Manager / Analyst [b]	WS-LC-0012

Instrument	Analytical Group	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
LC/MS/MS	Perchlorate	ISTD	Every Calibration Standard	ICAL: ISTD for each standard must be within ± 50% of the average area of the ICAL. ICV, CCV: Within ± 50% of the average area of the ICAL or within ± 50% of the 1st CCV of the run, if the ICAL is not run the same day.	Evaluate the system. Reanalyze/repeat the calibration.	Lab Manager / Analyst [b]	WS-LC-0012
Lachat Autoanalyzer	Cyanide	ICAL	Daily, prior to sample analysis. - Minimum 6 standards and blank	r ≥ 0.995	Re-calibrate instrument	Analyst	SA-GE-040
Lachat Autoanalyzer	Cyanide	Distilled Standards (Low and High)	After each ICAL	Within ±15% of true value	Reanalyze ICV; Re-calibrate instrument	Analyst	SA-GE-040
Lachat Autoanalyzer	Cyanide	ICV	After each ICAL, prior to sample analysis - Second Source	Within ±15% of true value	Reanalyze ICV; Re-calibrate instrument	Analyst	SA-GE-040
Lachat Autoanalyzer	Cyanide	CCV	After every 10 field samples and at the end of the sequence	Within ±10% of true value	Reanalyze CCV; Re-calibrate & re-analyze affected samples	Analyst	SA-GE-040
Lachat Autoanalyzer	Cyanide	Calibration Blank (ICB/CCB)	After ICV and CCV	<MDL	Reanalyze affected samples	Analyst	SA-GE-040

[a] The toxics/level of chlorination (LOC) are the 27 congeners that are calibrated by a multipoint curve. They encompass the World Health Organization (WHO) list of toxic congeners and the first and last eluter for each LOC. All other congeners are quantified off of a daily single point standard.

[b] The analyst initiates the corrective action and the lab manager and analyst are responsible for the corrective action.

[c] % recovery for each ISTD in the original sample (prior to dilutions) must be within limits in Table per method.

25.0 ANALYTICAL INSTRUMENT AND EQUIPMENT MAINTENANCE, TESTING, AND INSPECTION TABLE (SAP WORKSHEET #25)

Instrument/ Equipment	Analytical Group	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Carbonaceous Analyzer	TOC	Replace indicating drying tube	Sensitivity check	Verify color of indicating desiccant	Daily or as needed	CCV pass criteria	Recalibrate	TestAmerica Chemist	WS-WC-0016 WS-WC-0017
Carbonaceous Analyzer	TOC	Check nondispersive infrared (NDIR) baseline adjustment, tubing in pump housing, inspect digestion vessel and condensation chamber; clean or replace permeation tube.	Sensitivity check	Instrument performance and sensitivity	Every 3 months (NDIR), 6 months for other items.	CCV pass criteria	Recalibrate	TestAmerica Chemist	WS-WC-0016 WS-WC-0017
CVAA	Mercury	Replace disposables, flush lines	Sensitivity check	Instrument performance and sensitivity	Daily or as needed	CCV pass criteria	Recalibrate	TestAmerica Chemist	WS-MT-0005 WS-MT-0007
HRGC/HRMS/ LRMS	Dioxins, HRGC/HRMS PCBs	Parameter Setup	Physical check	Physical check	Initially; prior to DCC	Correct Parameters	Reset if incorrect	TestAmerica Chemist	WS-ID-0005 WS-ID-0013 WS-ID-0011
HRGC/HRMS/ LRMS	Dioxins, HRGC/HRMS PCBs	Tune Check	Instrument performance	Conformance to instrument tuning.	Initially; prior to DCC	Compliance to ion abundance criteria	Correct the problem and repeat tune check	TestAmerica Chemist	WS-ID-0005 WS-ID-0013 WS-ID-0011

Instrument/ Equipment	Analytical Group	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
LRMS	LRMS PCBs	Inlet maintenance; column	Passing tune/CCAL/ ICAL/ICV; overall chromate-gram	Instrument performance and sensitivity	Frequency is dependent on degree of contamination and standard recovery	See SOP	See SOP	Alpha Analytical Chemist	2162
LRMS	LRMS PCBs	Source cleaning: filaments, insulators	Tuning	Instrument performance and sensitivity	Frequency is dependent on degree of contamination and standard recovery	See SOP	See SOP	Alpha Analytical Chemist	2162
LRMS	LRMS PCBs	Pump	Complete MS pump down	Air and water check	Frequency is dependent on vacuum within instrument	See SOP	See SOP	Alpha Analytical Chemist	2162
GC/MS	Semivolatiles, Volatiles, PAHs	Clean sources, maintain vacuum pumps	Tuning	Instrument performance and sensitivity	Service vacuum pumps twice per year, other maintenance as needed	Tune and CCV pass criteria	Recalibrate instrument	TestAmerica Chemist	WS-MS-0005 WS-MS-0007 WS-MS-0008
GC/MS	Semivolatiles, Volatiles, PAHs	Change septum, clean injection port, change or clip column, install new liner, change trap	Sensitivity check	Instrument performance and sensitivity	Daily or as needed	Tune and CCV pass criteria	Reinspect injector port, cut additional column, reanalyze CCV, recalibrate instrument	TestAmerica Chemist	WS-MS-0005 WS-MS-0007 WS-MS-0008

Instrument/ Equipment	Analytical Group	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
ICP	ICP Metals	Replace disposables, flush lines, clean injector and torch	Intensity of 1 ppm manganese standard (STD) within criteria	Check connections	Daily or as needed	Intensity of 1 ppm manganese STD within criteria	Replace, investigate injector, reanalyze	TestAmerica Chemist	WS-MT-0003
ICP	ICP Metals	Replace pump windings	Monitor ISTD counts for variation	Instrument performance and sensitivity	As needed	Monitor ISTD counts for variation	Replace windings, recalibrate and reanalyze	TestAmerica Chemist	WS-MT-0003
ICP MS	ICP MS Metals	Clean sample and skimmer cones	Sensitivity check	Instrument performance and sensitivity	Daily or as needed	Intensity of Daily performance check for Rh at least 200000 counts	Check pump tubing, clean lenses as needed.	TestAmerica Chemist	WS-MT-0001
ICP MS	ICP MS Metals	Replace pump windings	Monitor ISTD counts for variation	Instrument performance and sensitivity	As needed	Monitor ISTD counts for variation	Replace windings, recalibrate and reanalyze	TestAmerica Chemist	WS-MT-0001
Ion Chromatograph	Perchlorate	Check plumbing/leaks, eluent, gases, pump pressure & conductivity meter.	Sensitivity check	Instrument performance and sensitivity	Daily	CCV pass criteria	Recalibrate	TestAmerica Chemist	WS-WC-0010r5
Ion Chromatograph	Perchlorate	Clean micromembrane suppressor, change column or degas pump head.	Sensitivity check	Instrument performance and sensitivity	As needed	CCV pass criteria	Recalibrate	TestAmerica Chemist	WS-WC-0010r5

Instrument/ Equipment	Analytical Group	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
LC/ MS / MS	Perchlorate	Replace columns as needed, check eluent reservoirs	Sensitivity check	Instrument performance and sensitivity	Daily or as needed	CCV pass criteria	Recalibrate	TestAmerica Chemist	WS-LC-0012
Lachat Autoanalyzer	Cyanide	Inspect flow cell, pump tubes, pump oil, and tubing	Detector signals	Instrument performance and sensitivity	Daily	CCV passes criteria	Re-perform as needed; reanalyze CCV; recalibrate instrument	Analyst	SA-GE-040

26.0 SAMPLE HANDLING SYSTEM (SAP WORKSHEET #26)

This worksheet describes the sample handling system requirements for samples. WS#3 contains full contact information for key personnel listed below and Attachment 21 contains field SOPs, specifically USM-04, Sample Management.

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT:

Sample Collection (Personnel/Organization): Field Crew Leader/ERM, Salt Lake City, UT (see WS#3)

Sample Packaging (Personnel/Organization): Field Crew Leader/ERM, Salt Lake City, UT (see WS#3)

Coordination of Shipment (Personnel/Organization): Field Crew Leader/ERM, Salt Lake City, UT (see WS#3)

Type of Shipment/Carrier: Courier and overnight shipping

SAMPLE RECEIPT AND ANALYSIS:

Sample Receipt (Personnel/Organization):
Jeremy Sadler/TestAmerica, West Sacramento, CA
Marilyn Kicklighter / Todd Baumgarner/TestAmerica, Savannah, GA
Mike Dedio/TestAmerica, Denver, CO
Kim Bailey/Alpha Analytical, Mansfield, MA

Sample Custody and Storage (Personnel/Organization):
Jeremy Sadler/TestAmerica, West Sacramento, CA
Marilyn Kicklighter / Todd Baumgarner/TestAmerica, Savannah, GA
Mike Dedio/TestAmerica, Denver, CO
Kim Bailey/Alpha Analytical, Mansfield, MA

Sample Preparation (Personnel/Organization):
Manager of Extractions/TestAmerica, West Sacramento, CA
Celia Vasques/TestAmerica, Savannah, GA
Drew Allen/TestAmerica, Denver, CO
Wayne Reid/Alpha Analytical, Mansfield, MA

Sample Determinative Analysis (Personnel/Organization):
Robert Hrabak/TestAmerica, West Sacramento, CA
Josh Kellar/TestAmerica, Savannah, GA
Drew Allen/TestAmerica, Denver, CO
Nathan Sorelle/Alpha Analytical, Mansfield, MA

SAMPLE ARCHIVING:

Field Sample Storage (No. of days from sample collection):
TestAmerica and Alpha Analytical: Field samples are typically disposed of 30 days past invoice date unless otherwise directed. All Phase 1A-B samples will be archived for one year.

Sample Extract/Digestate Storage (No. of days from extraction/digestion):
TestAmerica and Alpha Analytical: Sample extracts/digestates are kept for 40 days after analysis.

Biological Sample Storage (No. of days from sample collection): N/A

SAMPLE DISPOSAL

Personnel/Organization:
Jeremy Sadler/TestAmerica, West Sacramento, CA
Charlton Riegner/TestAmerica, Savannah, GA
Adam Alban/TestAmerica, Denver, CO
Jay Troy/Alpha Analytical, Mansfield, MA

Number of Days from Analysis:
TestAmerica and Alpha Analytical: Field samples are disposed of 30 days past invoice date unless otherwise directed.

27.0 SAMPLE CUSTODY REQUIREMENTS (SAP WORKSHEET #27)

This worksheet describes sample custody requirements for Site and background solid media samples.

27.1 FIELD SAMPLE CUSTODY PROCEDURES

Sample custody procedures are described in SOP USM-04 along with detailed field sample management procedures (including sample packaging and shipment to the laboratory). Generally, field sample management procedures for solids samples include the following:

- Collect sample into laboratory-provided containers and tightly cap.
- Wrap glass sample jars in bubble-wrap to protect from breakage.
- Place samples upright in a waterproof cooler with inert cushioning material lining the cooler bottom.
- Place wet ice into double plastic bags (to prevent leakage) and place bagged ice around, among, and on top of the sample containers. Enough ice will be used so that the samples will be chilled and maintained at 4 degrees Celsius (°C) ± 2 °C prior to and during transport to the laboratory.
- Fill any remaining space in cooler with inert cushioning material.
- Tape the original copy of the completed COC Record to the cooler lid inside a waterproof plastic bag.
- Place custody seals across the cooler closure in two locations.
- Label the cooler with the shipping address and return address.

COC procedures require a written record of the possession of individual samples from the time of collection through laboratory analyses. A sample is considered to be in custody if it is:

- In a person’s possession;
- In view after being in physical possession;
- In a secured condition after having been in physical custody; or
- In a designated secure area, restricted to authorized personnel.

A COC Record will be used to document the samples collected, sample custody, and the required analyses. A COC Record will be used to document the samples collected, sample custody, and the required analyses. Information recorded by field personnel on the COC Record will include the following:

- Client name (ERM) and ERM project number (1032320);
- Signature of sampler(s);
- Sample identification numbers;
- Date and time of sample collection;
- Signature of individuals involved in custody transfer (including date and time of transfer);
- Airbill number;
- Number of samples collected for each analysis;
- Type of analysis and laboratory method number; and
- Any comments or special instructions regarding individual samples.

All COC entries will be made using waterproof, indelible, black ink and will be legible. Any errors will be corrected by drawing a single line through the incorrect entry, entering the correct information, and then initialing and dating the change. If multiple coolers are sent in one shipment to the laboratory, one cooler will have the original COC Record and the other coolers will have copies. The plastic bag in which the COC Records are placed will be marked “ORIGINAL” or “COPY,” as appropriate. In addition, the outside of the coolers will be marked to indicate how many coolers are in the shipment. The COC Record will also indicate the number of coolers and/or the specific cooler identification number covered under the chain of custody.

Coolers will be delivered to the Federal Express shipping center in Salt Lake City on an as-needed basis to ensure that holding times listed in WS#19 are met. Custody seals will be used on each shipping container to ensure custody and will consist of security tape with the date and initials of the sampler. Shipping addresses for the laboratories are provided in WS #30. The sampler will retain copies of the COC Record and Federal Express airbill. Hard copies of COC Records and airbills/bills of lading will be provided to the Field Team Leader and will be managed in accordance with the Data Management Plan (ERM 2013b).

27.2 SAMPLE IDENTIFICATION PROCEDURES

Each sample collected will have a unique sample identification (ID) number. A sample label will be affixed to each sample container. The sample label, at a minimum, will be completed with the following information:

- Client name (ERM) and ERM project number (0132320)
- Sample ID number
- Date and time of sample collection
- Initials of sampler
- Analysis to be performed

Field QC samples are identified in WS #20 and include field duplicates, trip blanks, and equipment rinsate blanks. Field QC samples should have a sequential numbers so they are blind to the laboratory, rather than appending with a “D” or an “FB.”

Sample ID numbers will conform to the following format:

Surface Solids Samples

LOC-SS-YY-MMDDYY

where:

LOC is the location ID. These are identified in WS#18 for Inner PRI Area samples and SAP Attachment 11 for background/reference area samples.

SS denotes the sample as “surface solids.”

YY is a sequential number for the sample type:
Primary sample – 01
Field Duplicate (Field QC Sample) – 11
Trip Blank (Field QC Sample) – 21
Equipment Rinsate Blank (Field QC Sample) – 31

MMDDYY is the date the sample was collected.

Subsurface Solids Samples

LOC-SB-YY-SD-ED-MMDDYY

where:

LOC is the location ID. These are identified in WS#18 for Inner PRI Area samples. Subsurface samples will not be collected at background/reference areas.

SB denotes the sample as "subsurface solids."

YY is a sequential number for the sample type:
Primary sample – 01
Field Duplicate (Field QC Sample) – 11
Trip Blank (Field QC Sample) – 21
Equipment Rinsate Blank (Field QC Sample) – 31

SD is the starting depth of the sample interval (feet bgs).

ED is the ending depth of the sample interval (feet bgs).

MMDDYY is the date the sample was collected.

27.3 LABORATORY SAMPLE CUSTODY PROCEDURES

Each analytical laboratory has internal SOPs describing custody procedures. For example, TestAmerica SOP WS-QA-0003 describes the procedures for laboratory COC, including receipt and acceptance of sample shipments, storage requirements, generation of computer records, and corrective actions for sample receipt anomalies. Laboratory sample custody procedures will follow the laboratories' internal SOPs. Sample handling procedures, including receipt, archival, and disposal of samples, are described in WS#26.

28.0 LABORATORY QC SAMPLES TABLE (SAP WORKSHEET #28)

Matrix	Solid
Analytical Group	HRMS PCBs
Analytical Method/ SOP Reference	EPA Method 1668A WS-ID-0013

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank (MB)	One per preparation batch	No target analytes ≥ QL or 1/10 the concentration in the sample, whichever is greater	Verify instrument clean (evaluate calibration blank & samples prior to MB); then reanalyze. Evaluate to determine if systematic issue within laboratory, correct, then reprep and reanalyze the MB and all samples processed with the contaminated blank in accordance with Quality Systems Management requirements. “Totals” are not considered “target analytes” – no corrective action or flagging is necessary for "totals".	Chemist	Accuracy/Bias Contamination	Same as Method / SOP QC Acceptance Limits
ISTD Spike	Every field sample, standard and QC sample	% recovery for each ISTD in the original sample (prior to dilutions) must be limits in Table VIII of SOP.	Correct problem, then reprep and reanalyze the samples with failed ISTD.	Lab Manager / Analyst	Precision and Accuracy/BiasLab Manager / Analyst	Same as Method / SOP QC Acceptance Limits
LCS	One per sample preparation batch	Recovery 50-150%	Reanalyze LCS once. If acceptable, report. Otherwise, evaluate and reprep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Lab Manager / Analyst	Accuracy/Bias Contamination	Same as Method / SOP QC Acceptance Limits

Matrix	Solid
Analytical Group	LRMS PCBs
Analytical Method/ SOP Reference	EPA Method 680 2162

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per preparatory batch of up to 20 samples	No analyte at or above the reporting limit.	Identify source and attempt to eliminate. Re-extract and/or reanalyze blank and affected samples (if sufficient sample remains). Qualify data as needed. Report data if sample results >5x blank or sample results ND. If contamination is widespread or reoccurring, analyses must be stopped and the source of contamination must be eliminated or reduced before analyses can continue.	Analyst/ Laboratory Quality Assurance Officer	Accuracy/Bias Contamination	Same as Method / SOP QC Acceptance Limits
Field Duplicate	One per preparatory batch of up to 20 samples. Per Client's Request	RPD ≤ 30% for compounds > than 5x the RL	Evaluate during data validation.	Data validation staff	Precision	Same as Method / SOP QC Acceptance Limits
LCS/LCSD	One each per preparatory batch of up to 20 samples.	40-140% Recovery. 30% RPD	Correct problem, reprep and reanalyze LCS/LCSD and all samples in associated batch for failed analytes. If problem persists, contact Project Manager.	Analyst/ Laboratory Quality Assurance Officer	Accuracy	Same as Method / SOP QC Acceptance Limits

Matrix	Solid
Analytical Group	Volatiles
Analytical Method/ SOP Reference	EPA Method 8260B WS-MS-0007

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
Check of mass spectral ion intensities (tuning procedure) using BFB (8260B)	Prior to initial calibration and calibration verification	Must meet the method requirements before samples are analyzed	Retune instrument and verify the tune acceptability.	Lab Manager / Analyst	Sensitivity	Meets all EPA Method requirements
ISTDs	During acquisition of calibration standard, samples, and QC check samples	Areas within -50% to +100% of midpoint of the last ICAL for each sample and QC	Inspect mass spec and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning.	Lab Manager / Analyst	Precisions and Accuracy/Bias	Meets all EPA Method requirements
MB	One per analytical batch (8260B)	No target analytes ≥ QL or 1/10 the concentration in the sample, whichever is greater	Verify instrument clean (evaluate calibration blank & samples prior to MB), then reanalyze. Evaluate to determine if systematic issue within laboratory, correct, then reprep and reanalyze the MB and all samples processed with the contaminated blank.	Lab Manager / Analyst	Accuracy/Bias Contamination	Same as Method / SOP QC Acceptance Limits
LCS	One LCS per analytical/preparation batch	Laboratory control limits are statistically-derived for each analyte and subject to periodic updates[1]	Reanalyze LCS once. If acceptable, report. Otherwise, evaluate and reprep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Lab Manager / Analyst	Precision and Accuracy/Bias	Same as Method / SOP QC Acceptance Limits
Surrogate standards	All field and QC samples	Laboratory control limits are statistically-derived for each analyte and subject to periodic updates[1]	Evaluate matrix, then analytical data, then re-extract and reanalyze all affected samples as appropriate. Qualify outliers.	Lab Manager / Analyst	Accuracy/Bias	Same as Method / SOP QC Acceptance Limits

Matrix	Solid
Analytical Group	Semivolatiles
Analytical Method/ SOP Reference	EPA Method 8270C WS-MS-0005

QC Sample	**Frequency / Number**	**Method / SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**DQI**	**Measurement Performance Criteria**
ISTDs	During acquisition of calibration standard, samples, and QC check samples	Areas within -50% to +100% of midpoint of the last ICAL for each sample and QC	Inspect mass spec and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning	Lab Manager / Analyst	Precisions and Accuracy/Bias	Meets all EPA Method requirements
MB	One per batch	No target analytes ≥ QL or 1/10 the concentration in the sample, whichever is greater	Verify instrument clean (evaluate calibration blank & samples prior to MB), then reanalyze. Evaluate to determine if systematic issue within laboratory, correct, then reprep and reanalyze the MB and all samples processed with the contaminated blank.	Lab Manager / Analyst	Accuracy/Bias Contamination	Same as Method / SOP QC Acceptance Limits
LCS	One LCS per batch	Recovery 50 -150% for HCB. For other constituents, laboratory control limits are statistically-derived for each analyte and subject to periodic updates[1]	Reanalyze LCS once. If acceptable, report. Otherwise, evaluate and reprep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Lab Manager / Analyst	Precision and Accuracy/Bias	Same as Method / SOP QC Acceptance Limits
Surrogate standards	All field and QC samples.	Laboratory control limits are statistically-derived for each analyte and subject to periodic updates[1]	Evaluate data; if preparation problem noted, reextract and reanalyze. Otherwise, qualify data in accordance with method requirements.	Lab Manager / Analyst	Accuracy/Bias	Same as Method / SOP QC Acceptance Limits

Matrix	Solid
Analytical Group	PAHs
Analytical Method/ SOP Reference	EPA Method 8270C WS-MS-0008

QC Sample	**Frequency / Number**	**Method / SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**DQI**	**Measurement Performance Criteria**
ISTDs	During acquisition of calibration standard, samples, and QC check samples	Areas within -50% to +100% of midpoint of the last ICAL for each sample and QC	Inspect mass spec and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning	Lab Manager / Analyst	Precisions and Accuracy/Bias	Meets all EPA Method requirements
MB	One per analytical batch	No target analytes ≥ QL or 1/10 the concentration in the sample, whichever is greater	Verify instrument clean (evaluate calibration blank & samples prior to MB), then reanalyze. Evaluate to determine if systematic issue within laboratory, correct, then reprep and reanalyze the MB and all samples processed with the contaminated blank.	Lab Manager / Analyst	Accuracy/Bias Contamination	Same as Method / SOP QC Acceptance Limits
LCS	One LCS per analytical/preparation batch	Laboratory control limits are statistically-derived for each analyte and subject to periodic updates[1]	Reanalyze LCS once. If acceptable, report. Otherwise, evaluate and reprep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Lab Manager / Analyst	Precision and Accuracy/Bias	Same as Method / SOP QC Acceptance Limits
Surrogate standards	All field and QC samples.	Laboratory control limits are statistically-derived for each analyte and subject to periodic updates[1]	Evaluate data; if preparation problem noted, reextract and reanalyze. Otherwise, qualify data in accordance with method requirements.	Lab Manager / Analyst	Accuracy/Bias	Same as Method / SOP QC Acceptance Limits

Matrix	Solid
Analytical Group	HRMS Dioxins
Analytical Method/ SOP Reference	EPA Method 8290 WS-ID-0005

QC Sample	**Frequency / Number**	**Method / SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**DQI**	**Measurement Performance Criteria**
MB	One per preparation batch	No target analytes ≥ QL or 1/10 the concentration in the sample, whichever is greater (OCDD is considered a common laboratory contaminant and treated accordingly).	Verify instrument clean (evaluate calibration blank & samples prior to MB), then reanalyze. Evaluate to determine if systematic issue within laboratory, correct, then reprep and reanalyze the MB and all samples processed with the contaminated blank in accordance with method requirements. “Totals” are not considered “target analytes” – no corrective action or flagging is necessary for "totals".	Chemist	Accuracy/Bias Contamination	Same as Method / SOP QC Acceptance Limits
ISTD Spike	Every field sample, standard and QC sample	% recovery for each ISTD in the original sample (prior to dilutions) must be limits in Table per method.	Correct problem, then reprep and reanalyze the samples with failed ISTD.	Lab Manager / Analyst	Precisions and Accuracy/Bias	Meets all EPA Method requirements (40-135% Recovery)
LCS	One per sample preparation batch	Recovery 50-150%	Reanalyze LCS once. If acceptable, report. Otherwise, evaluate and reprep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Lab Manager / Analyst	Accuracy/Bias Contamination	Same as Method / SOP QC Acceptance Limits

Matrix	Solid
Analytical Group	LRMS Dioxins
Analytical Method/ SOP Reference	EPA Method 8280A WS-ID-0011

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
MB	One per preparation batch	Project specific criteria, if available. Otherwise, no target analytes detected ≥ RL or ≥ 20% of the associated regulatory limit or ≥ 5% of the sample result for the analyte, whichever is greater. (OCDD is considered a common laboratory contaminant and treated accordingly).	Verify instrument clean (evaluate calibration blank & samples prior to method blank), then reanalyze. Evaluate to determine if systematic issue within laboratory, correct, then re-prepare and reanalyze the method blank and all samples processed with the contaminated blank. “Totals” are not considered “target analytes” – no corrective action or flagging is necessary for "totals".	Chemist	Accuracy/Bias Contamination	No target analytes ≥ RL.
ISTD Spike (Isotope Dilution Analytes)	Every field sample, standard and QC sample	% recovery for each ISTD in the original sample (prior to dilutions) must be within limits per method (Section 7.15.5.2).	Evaluate impact on data. If negligible, or a result of matrix effects, narrate. If a result of laboratory error, correct problem, then reprep and reanalyze the samples with failed IS.	Lab Manager / Analyst	Precisions and Accuracy/Bias	Meets all EPA Method requirements (25-150% Recovery)
LCS	One per sample preparation batch	Laboratory statistically derived control limits	Reanalyze LCS once. If acceptable, report. Otherwise, evaluate for impact (high bias and non-detects, or sporadic marginal exceedence may be narrated and reported). If impact too great, reprep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Lab Manager / Analyst	Accuracy/Bias Contamination	Laboratory statistically derived control limits

Matrix	Solid
Analytical Group	ICP Metals
Analytical Method/ SOP Reference	EPA Method 6010B WS-MT-0003

QC Sample	**Frequency / Number**	**Method / SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**DQI**	**Measurement Performance Criteria**
Calibration blank	After IC, after CCV calibration, after every 10 samples, and at the end of the sequence	No target analytes detected > QL.	Evaluate blank to determine if instrument or solution caused, then correct. Reprep and reanalyze the blank. All samples following the last acceptable calibration blank must be reanalyzed.	Lab Manager / Analyst	Accuracy	No target analytes > QL
MB	One per digestion batch	No target analytes ≥ QL or 1/10 the concentration in the sample, whichever is greater	Verify instrument clean (evaluate calibration blank & samples prior to MB), then reanalyze. Evaluate to determine if systematic issue within laboratory, correct, then reprep and reanalyze the MB and all samples processed with the contaminated blank.	Lab Manager / Analyst	Accuracy/Bias Contamination	Same as Method / SOP QC Acceptance Limits
LCS	One LCS per each preparation batch	Recovery 80-120%	Evaluate LCS data and reanalyze if bias appears instrument related. If bias appears preparation related, determine if trend requires correction prior to reprep and reanalysis of the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Lab Manager / Analyst	Precisions and Accuracy/Bias	Same as Method / SOP QC Acceptance Limits
MXS/MSD for all analytes	One MXS/MSD pair per preparation batch	Recovery 80-120%; RPD ≤ 20	Examine the project specific DQOs. Evaluate the data, and reprep and reanalyze the native sample and MXS/MSD pair as indicated.	Lab Manager / Analyst	Precision and Accuracy/Bias	Same as Method / SOP QC Acceptance Limits
Dilution test	Each new sample matrix	1:5 dilution must agree within ±10% of the original determination	Perform post-digestion spike addition in accordance with SOP requirements	Lab Manager / Analyst	Accuracy	Same as Method / SOP QC Acceptance Limits
Post-digestion spike addition	When dilution test fails or analyte concentration in all samples < 50 x MDL.	Recovery within 75-125% of expected results	Flag	Lab Manager / Analyst	Accuracy	Same as Method / SOP QC Acceptance Limits

Matrix	Solid
Analytical Group	ICP MS Metals
Analytical Method/ SOP Reference	EPA Method 6020 WS-MT-0001

QC Sample	**Frequency / Number**	**Method / SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**DQI**	**Measurement Performance Criteria**
Calibration blank	After IC, after CCV calibration, after every 10 samples, and at the end of the sequence	No target analytes detected > QL.	Evaluate blank to determine if instrument or solution caused, then correct. Reprep and reanalyze the blank. All samples following the last acceptable calibration blank must be reanalyzed.	Lab Manager / Analyst	Accuracy	No target analytes > QL
MB	One per digestion batch	No target analytes ≥ QL or 1/10 the concentration in the sample, whichever is greater	Verify instrument clean (evaluate calibration blank & samples prior to MB), then reanalyze. Evaluate to determine if systematic issue within laboratory, correct, then reprep and reanalyze the MB and all samples processed with the contaminated blank.	Lab Manager / Analyst	Accuracy/Bias Contamination	Same as Method / SOP QC Acceptance Limits
ICS	At the beginning of the analytical run and every 12 hours.	ICSA-A: Absolute values of concentration for all non-spiked analytes < QL (unless they are a verified trace impurity from one of the spiked analytes); ICS-AB: Within ±20% of true value	Terminate analysis, correct problem, then reanalyze ICS and all affected samples	Lab Manager / Analyst	Accuracy	Within ±20% of expected value
LCS	One LCS per each preparation batch	Recovery 80-120%	Evaluate LCS data and reanalyze if bias appears instrument related. If bias appears preparation related, determine if trend requires correction prior to reprep and reanalysis of the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Lab Manager / Analyst	Precisions and Accuracy/Bias	Same as Method / SOP QC Acceptance Limits
MXS/MSD for all analytes	One MXS/MSD pair per preparation batch	Recovery 80-120%; RPD ≤ 20	Examine the project-specific DQOs. Evaluate the data, and re-extract and reanalyze the native sample and MXS/MSD pair as indicated.	Lab Manager / Analyst	Precision and Accuracy/Bias	Same as Method / SOP QC Acceptance Limits
Dilution test	Each new sample matrix	1:5 dilution must agree within ±10% of the original determination	Perform post-digestion spike addition	Lab Manager / Analyst	Accuracy	Same as Method / SOP QC Acceptance Limits
Post digestion spike addition	When dilution test fails or analyte concentration in all samples < 50 x LOD.	Recovery within 75-125% of expected results	Flag.	Lab Manager / Analyst	Accuracy	Same as Method / SOP QC Acceptance Limits
ISTDs	Every sample.	ISTD intensity within 30-120% of the ISTD in the ICAL	Reanalyze sample at a 5X dilution with the addition of appropriate amounts of ISTDs.	Lab Manager / Analyst	Accuracy/Bias	ISTD outside limits is an indicator of matrix effects.

Matrix	Solid
Analytical Group	Mercury
Analytical Method/ SOP Reference	EPA Method 7470A/7471A WS-MT-0005 / WS-MT-0007

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
Calibration blank	After IC, after CCV calibration, after every 10 samples, and at the end of the sequence	Measured value within ± QL from zero.	Evaluate blank to determine if instrument or solution caused, then correct. Re-prep and reanalyze the blank. All samples following the last acceptable calibration blank must be reanalyzed.	Lab Manager / Analyst	Accuracy	Measured value within ± QL from zero.
MB	One per digestion batch	No target analytes ≥ QL or 1/10 the concentration in the sample, whichever is greater	Verify instrument clean (evaluate calibration blank & samples prior to MB), then reanalyze. Evaluate to determine if systematic issue within laboratory, correct, then re-prep and reanalyze the MB and all samples processed with the contaminated blank.	Lab Manager / Analyst	Accuracy/Bias Contamination	Same as Method / SOP QC Acceptance Limits
MXS/MSD	One MXS/MSD pair per preparation batch	Laboratory control limits are statistically-derived for each analyte and subject to periodic updates[1]	Examine the project-specific DQOs. Evaluate the data, and re-extract and reanalyze the native sample and MXS/MSD pair as indicated.	Lab Manager / Analyst	Precisions and Accuracy/Bias	Same as Method / SOP QC Acceptance Limits
LCS	One LCS per each preparation batch	Laboratory control limits are statistically-derived for each analyte and subject to periodic updates[1]	Terminate analysis, identify and correct the problem, then re-prep and reanalyze all affected samples and QC checks.	Lab Manager / Analyst	Precisions and Accuracy/Bias	Same as Method / SOP QC Acceptance Limits

Matrix	Solid
Analytical Group	Inorganics TOC
Analytical Method/ SOP Reference	EPA 9060 WS-WC-0016 (water) WS-WC-0017 (solids)

QC Sample	**Frequency / Number**	**Method / SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**DQI**	**Measurement Performance Criteria**
MB	One per batch	No target analytes ≥ QL or 1/10 the concentration in the sample, whichever is greater	Correct problem, then repeat blank. Once instrument demonstrated clean, restart analysis sequence with MB, and continue analysis.	Lab Manager / Analyst	Accuracy/Bias Contamination	Same as Method / SOP QC Acceptance Limits
LCS	One LCS per preparation batch	Recovery 90-110% for water samples; based on provider's recovery limits for solid samples. (Solids are a reference material from an outside vendor, due to the nature of the analysis)	Reanalyze LCS once. If acceptable, report. Otherwise, evaluate and re-prep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Lab Manager / Analyst	Precisions and Accuracy/Bias	Same as Method / SOP QC Acceptance Limits
MXS/MSD for all analytes	One MXS/MSD pair per preparation batch	Recovery 75-125% RPD ≤ 25	Examine the project-specific DQOs. Evaluate the data, and re-prep and reanalyze the native sample and MXS/MSD pair as indicated.	Lab Manager / Analyst	Precision and Accuracy/Bias	Same as Method / SOP QC Acceptance Limits

Matrix	Solid
Analytical Group	Perchlorate by IC
Analytical Method/ SOP Reference	EPA Method 314.0 WS-WC-0010

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
MB	One per batch	No target analytes ≥ QL or 1/10 the concentration in the sample, whichever is greater	Correct problem, then reprep and reanalyze the method blank and all samples processed with the contaminated blank.	Lab Manager / Analyst	Accuracy/Bias Contamination	Same as Method / SOP QC Acceptance Limits
LCS	One LCS per preparation batch	Recovery 75-125% for solid samples	Reanalyze LCS once. If acceptable, report. Otherwise, evaluate and reprep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Lab Manager / Analyst	Precisions and Accuracy/Bias	Same as Method / SOP QC Acceptance Limits
MXS/MSD for all analytes	One MXS/MSD pair per preparation batch	Recovery 75-125% for solid samples; RPD ≤ 20 between MXS and MSD	Examine the project specific DQOs. Evaluate the data, and reprep and reanalyze the native sample and MXS/MSD pair as indicated.	Lab Manager / Analyst	Precision and Accuracy/Bias	Same as Method / SOP QC Acceptance Limits

Matrix	Solid
Analytical Group	Perchlorate
Analytical Method/ SOP Reference	EPA Method 6850 WS-LC-0012

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
MB	One per preparation batch	No target analytes ≥ QL or 1/10 the concentration in the sample, whichever is greater	Correct problem, then re-extract and reanalyze MB and all samples processed with the contaminated blank.	Lab Manager / Analyst	Accuracy/Bias Contamination	Same as Method / SOP QC Acceptance Limits
ICS	One per preparation batch	70% -130%	Reanalyze once. If still outside the acceptance limits, evaluate to determine if cleanup filters or column degradation are suspect, replace appropriate materials and reprep (filters) or reanalyze (column). Repeat the Interference Threshold Study to deter. If problem still exists, recalibrate.	Lab Manager / Analyst	Accuracy/Bias	70-130%
ISTD	During acquisition of calibration standard, samples, and QC check samples	Areas within -50% to +100% of the midpoint of the last ICAL for each sample and QC	Inspect LC mass spec for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning.	Lab Manager / Analyst	Accuracy/Bias	Meets all EPA Method requirements
Isotope Ratio ^{35}CL/^{37}CL	Every sample, batch QC sample and standard	Monitor for either the parent ion at masses 99/101 or the daughter ion at masses 83/85 depending on which ions are quantified.	Re-extract, re-clean, and/or reanalyze affected sample(s). If problem persists, perform post-spike or dilution as appropriate to confirm presence of perchlorate.	Lab Manager / Analyst	Accuracy/Bias	Theoretical ratio approx. 3.06 Must fall within 2.3 to 3.8
LCS	One LCS per analytical/preparation batch, spiked at the QL.	Recovery 80-120%;RPD ≤ 15	Reanalyze LCS once. If acceptable, report. Otherwise, evaluate and reprep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Lab Manager / Analyst	Accuracy/Bias	Same as Method / SOP QC Acceptance Limits
MXS/MSD	One MXS/MSD per batch, spiked at the QL.	Recovery 80-120%;RPD ≤ 15	Identify problem; if not related to matrix interference, re-extract and reanalyze MXS/MSD in accordance with QSM requirements.	Lab Manager / Analyst	Precision and Accuracy/Bias	Same as Method / SOP QC Acceptance Limits

Matrix:	Solid
Analytical Group:	Cyanide
Analytical Method / SOP Reference:	EPA 9012A SOP SA-GE-040

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
MB	1 / prep batch	No target analytes ≥ QL or 1/10 the concentration in the sample, whichever is greater	Reprep batch.	Analyst	Laboratory Contamination	Same as Method / SOP QC Acceptance Limits
LCS	1 / prep batch	Water: Recovery 85 - 115% Solid: Recovery 75 - 125%	Correct problem; then reprep and reanalyze LCS and all affected samples.	Analyst	Accuracy	Same as Method / SOP QC Acceptance Limits
LCSD	1 / prep batch, if insufficient sample provided for MXS/MSD	Water: Recovery 85 - 115% RPD ≤ 20 Solid: Recovery 75 - 125% RPD ≤ 30	Correct problem; then reprep and reanalyze LCS and all affected samples.	Analyst	Accuracy Precision	Same as Method / SOP QC Acceptance Limits
MXS	1 / sample	Water: Recovery 85 - 115% Solid: Recovery 75 - 125%	Evaluate for matrix interferences. Report and qualify, if LCS is acceptable.	Analyst	Accuracy	Same as Method / SOP QC Acceptance Limits
MSD	1 / sample	Water: Recovery 85 - 115% RPD ≤ 20 Solid: Recovery 75 - 125% RPD ≤ 30	Evaluate for matrix interferences. Report and qualify, if LCS is acceptable.	Analyst	Accuracy Precision	Same as Method / SOP QC Acceptance Limits
Lab Duplicate	1/ sample	Water: RPD ≤ 20 Solid: RPD ≤ 30	Evaluate for matrix interferences. Report and qualify, if LCS is acceptable.	Analyst	Precision	Same as Method / SOP QC Acceptance Limits
Sample Duplicate	0	No target analytes ≥ QL or 1/10 the concentration in the sample, whichever is greater	Reprep batch	Analyst	Laboratory Contamination	Same as Method / SOP QC Acceptance Limits

Matrix:	Solid
Analytical Group:	pH
Analytical Method / SOP Reference:	EPA 9045D WS-WC-0044

QC Sample	**Frequency / Number**	**Method / SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**DQI**	**Measurement Performance Criteria**
LCS	One LCS per preparation batch	Within 0.1 pH unit of true value.	Reanalyze LCS once. If acceptable, report. Otherwise, reanalyze the LCS and all samples in the associated batch, if sufficient sample material is available.	Lab Manager / Analyst	Accuracy/Bias	Same as Method / SOP QC Acceptance Limits
Sample Duplicate	One duplicate per analysis batch	Difference ≤ 0.1 pH units	Evaluate instrument stability, then reanalyze once. Narrate if still out of control.	Lab Manager / Analyst	Precision	Same as Method / SOP QC Acceptance Limits

[1] Unless otherwise noted in table, laboratory control limits for LCS and MXS/MSD QC aliquots are statistically-derived for each analyte and subject to periodic updates in accordance with SOPs that are identified in the analytical procedures in Attachment 19. Each laboratory data report provides the control limits in effect at the time of sample analysis. Current control limits for precision and accuracy of LCS and MXS/MSD aliquots are available upon request.

29.0 PROJECT DOCUMENTS AND RECORDS (SAP WORKSHEET #29)

Documentation and records will be managed as described in this worksheet and in the Data Management Plan (ERM 2013).

29.1 STORAGE OF PROJECT-RELATED DOCUMENTS

Table 29-1 indicates where project-related documents will be stored and how they will be filed.

Table 29-1: Storage of Project-Related Documents

Document	Where Maintained
SAP, Work Plan, and Health and Safety Plan	ERM Scottsdale
Field records/data	ERM Salt Lake City. All hard copy forms will also be scanned and will be retained in the electronic project file located on the Scottsdale server as backup.
Chain-of-custody records	ERM Salt Lake City
Field forms	ERM Salt Lake City
Laboratory data packages	ERM Scottsdale and EQuIS database
Audit/assessment checklists/reports	ERM Scottsdale
Corrective action forms/reports	ERM Scottsdale
Laboratory calibration/maintenance logs	Included in Laboratory Data Packages
Sample preparation logs	Included in Laboratory Data Packages
Run logs	Included in Laboratory Data Packages
Sample disposal records	Laboratory
Electronic data deliverables (EDD)	ERM Scottsdale
Validated Scribe database	EPA Region 8
Data validation and QA reports	ERM Scottsdale
Survey and GIS data	EQuIS database
Correspondence and meeting notes	ERM Scottsdale
Project reports	ERM Scottsdale

29.2 REQUIREMENTS FOR LABORATORY DATA PACKAGES

Full (Level IV) data packages, including raw data, will be provided by the laboratories for all analyses performed for the Phase 1A-B RI. Table 29-2 identifies the requirements for laboratory data packages for organic and inorganic analyses. Not all items listed in Table 29-2 are applicable for all analytical methods to be used for the Phase 1A-B RI.

Table 29-2: Requirements for Laboratory Data Packages

Requirements for Data Packages – Organic Analysis (as appropriate per method)	Requirements for Data Packages – Inorganic Analysis (as appropriate per method)
1. Case narrative	1. Case narrative
2. Copies of nonconformance and corrective action forms	2. Copies of nonconformance and corrective action forms
3. Chain-of-custody forms	3. Chain-of-custody forms
4. Copies of sample receipt notices	4. Copies of sample receipt notices
5. Internal tracking documents, as applicable	5. Internal tracking documents, as applicable
6. Sample results for environmental samples, including dilutions and reanalysis, reported on a dry-weight basis	6. Sample results for environmental samples, including dilutions and reanalysis, reported on a dry-weight basis
7. System monitoring compound and surrogate recoveries	7. Initial and continuing calibration verifications
	8. Method blanks, continuing calibration blanks, and preparation blanks
8. Blank spike or LCS recoveries	9. Inductively coupled plasma (ICP) interference-check samples
9. Method blanks	10. MXS and MSD recoveries and RPD, and post-digestion spikes
10. Performance check	11. Sample duplicates
11. Initial calibrations with retention time information	12. LCSs
12. Continuing calibrations with retention time information	13. Method of standard additions
13. Internal standard areas and retention times	14. ICP serial dilution
14. Analytical sequence	15. ICP inter-element correction factors
15. Single component analyte identification	16. ICP linear working range
16. Multicomponent analyte identification	17. Raw Data for the following, where applicable:
17. Raw data for the following, where applicable:	a. Environmental samples, including dilutions and reanalysis
a. Analytical results, including dilutions and reanalysis	b. Initial calibration
b. Method blanks	c. Initial and continuing calibration verifications
	d. Detection limit standards
c. Blank spikes or LCSs	e. Method blanks, continuing calibration blanks, and preparation blanks
d. Performance check	f. ICP interference check samples
e. Initial calibrations, with retention-time information	g. MXS, MSD, and post-digestion spikes
f. Continuing calibrations, with retention-time information	h. Sample duplicates
g. Quantitation-limit standard	i. LCSs
h. Percent moisture for solids	j. Method of standard additions
i. Sample extraction and cleanup logs	k. ICP serial dilution

Requirements for Data Packages – Organic Analysis (as appropriate per method)	**Requirements for Data Packages – Inorganic Analysis (as appropriate per method)**
j. Instrument analysis log for each instrument used	l. Percent moisture for solids samples
k. Standard preparation logs, including initial and final concentrations for each standard used	m. Sample digestion, distillation, and preparation logs, as necessary
l. Formula and a sample calculation for the initial calibration	n. Instrument analysis logs for each instrument used
m. Formula and a sample calculation for solids sample results	o. Standard preparation logs, including initial and final concentrations for each standard used
	p. Formula and a sample calculation for the initial calibration
	q. Formula and a sample calculations for solids sample results

29.3 GIS DATA DELIVERY REQUIREMENTS

As prescribed by EPA Region 8, GIS data, maps, and figures to be provided as deliverables by US Magnesium/ERM will adhere to a specific format. Establishment of this format is intended to specify file delivery formats for all materials developed in support of CERCLA-related site work within EPA Region 8.

EPA Region 8 intends to acquire all GIS work products produced in support of project work in order to catalog and manage all site-specific GIS files comprehensively across all active CERCLA sites. The attached GIS Guidance in Attachment 29 specifies the format in which all GIS data, maps, and figures deliverables will be presented to EPA Region 8.

30.0 ANALYTICAL SERVICES TABLE (SAP WORKSHEET #30)

Matrix	Analytical Group [1]	Sampling locations/ ID Number	Analytical Method	Data Package Turnaround Time	Laboratory / Organization [2] (name and address, contact person and telephone number)
Solid	HRMS PCB	Refer to WS#18	EPA Method 1668A WS-ID-0013	Standard	TestAmerica - West Sacramento 880 Riverside Parkway West Sacramento, CA 95605 David Alltucker (916) 374-4383
Solid	LRMS PCB	Refer to WS#23	EPA Method 680 Modified 2162-SOP	Standard	Alpha Analytical, Inc. – Woods Hole Lab Facility 320 Forbes Blvd Mansfield, MA 02048 Liz Porta (508) 844-4124
Solid	HRMS PCDD/ PCDF	Refer to WS#18	SW846 8290 WS-ID-0005	Standard	TestAmerica - West Sacramento 880 Riverside Parkway West Sacramento, CA 95605 David Alltucker (916) 374-4383
Solid	LRMS PCDD/ PCDF	Refer to WS#23	SW846 8280 WS-ID-0011	Standard	TestAmerica - West Sacramento 880 Riverside Parkway West Sacramento, CA 95605 David Alltucker (916) 374-4383
Solid	VOC	Refer to WS#18	SW846 8260B WS-MS-0007	Standard	TestAmerica- West Sacramento 880 Riverside Parkway West Sacramento, CA 95605 David Alltucker (916) 374-4383
Solid	SVOC	Refer to WS#18	SW846 8270C WS-MS-0005	Standard	TestAmerica - West Sacramento 880 Riverside Parkway West Sacramento, CA 95605 David Alltucker (916) 374-4383
Solid	PAH	Refer to WS#18	SW846 8270C WS-MS-0008	Standard	TestAmerica - West Sacramento 880 Riverside Parkway West Sacramento, CA 95605 David Alltucker (916) 374-4383
Solid	ICP Metals	Refer to WS#18	SW846 6010B WS-MT-0003	Standard	TestAmerica - West Sacramento 880 Riverside Parkway West Sacramento, CA 95605 David Alltucker (916) 374-4383
Solid	ICPMS Metals	Refer to WS#18	SW846 6020 WS-MT-0001 (solid)	Standard	TestAmerica- West Sacramento 880 Riverside Parkway West Sacramento, CA 95605 David Alltucker (916) 374-4383

Matrix	Analytical Group [1]	Sampling locations/ ID Number	Analytical Method	Data Package Turnaround Time	Laboratory / Organization [2] (name and address, contact person and telephone number)
Solid	Mercury	Refer to WS#18	SW846 7471A WS-MT-0007 (solid)	Standard	TestAmerica - West Sacramento 880 Riverside Parkway West Sacramento, CA 95605 David Alltucker (916) 374-4383
Solid	pH	Refer to WS#18	SW846 9045D WS-WC-0044	Standard	TestAmerica - West Sacramento 880 Riverside Parkway West Sacramento, CA 95605 David Alltucker (916) 374-4383
Solid	TOC	Refer to WS#18	SW846 9060 DV-WC-0048 (solid)	Standard	TestAmerica – Denver [3] 4955 Yarrow Street Arvada, CO 80002 David Alltucker (916) 374-4383
Solid	Cyanide	Refer to WS#18	SW846 9012A SA-GE-040	Standard	TestAmerica – Savannah [3] 5102 LaRoche Avenue Savannah, GA 31404 David Alltucker (916) 374-4383
Solid	Perchlorate by IC	Refer to WS#18	EPA Method 314 WS-WC-0010	Standard	TestAmerica - West Sacramento 880 Riverside Parkway West Sacramento, CA 95605 David Alltucker (916) 374-4383
Solid	Perchlorate by LCMS/MS	Refer to WS#18	SW846 6850 WS-LC-0012	Standard	TestAmerica - West Sacramento 880 Riverside Parkway West Sacramento, CA 95605 David Alltucker (916) 374-4383
Solid	Grain Size	Refer to WS#18	Grain Size Analysis based on ASTM C135/C117	Standard	GeoStrata 14425 South Center Point Way Bluffdale, UT 84065 Sy Winkelman (801) 501-0583

[1] The laboratories contracted to provide analytical services have the appropriate accreditation or certification (National Environmental Laboratory Accreditation Program [NELAP] or State of Utah) for each analytical method. Some specialized analytical methods employed to attain greater sensitivity and/or accuracy for selected analytes are not yet included in NELAP or State of Utah accreditation/certification programs. Laboratory accreditations, where available, are provided in Attachment 30. Certifications will be updated in ERM files as needed upon renewal.

[2] The selected laboratories are active, commercial laboratories with current demonstration of proficiency in the analytical methods identified for analysis of Phase 1A-B Samples. Backup laboratories are not available. Only laboratories listed are approved for project samples, based in part on Phase 1A DMA studies. Laboratory contact information, including address, contact person, and telephone number, are provided in WS#3.

3 Analyses performed by TestAmerica Denver and Savannah will be performed under subcontract to TestAmerica West Sacramento. All samples for analysis by any TestAmerica lab will be shipped to the West Sacramento, CA laboratory.

31.0 PLANNED PROJECT ASSESSMENTS TABLE (SAP WORKSHEET #31)

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Responding to Assessment Findings	Person(s) Responsible for Identifying and Implementing Corrective Action	Person(s) Responsible for Monitoring Effectiveness of Corrective Action
Field Readiness Review	Prior to field sampling	Internal	ERM	ERM QA Manager	ERM Field Team Leader	ERM Field Team Leader	ERM QA Manager
Field Sampling Surveillance	2X during the field sampling	Internal	ERM	ERM QA Manager	ERM Field Team Leader	ERM Field Team Leader	ERM QA Manager
Field Sampling Surveillance	Per Oversight QAPP	External	EPA	EPA RPM or QC staff	ERM Field Team Leader	ERM Field Team Leader	EPA RPM or QC staff
Laboratory Surveillance	Once during laboratory program	Internal	ERM	ERM Analytical Coordinator	Laboratory Project Manager	Laboratory Project Manager	ERM QA Manager/Analytical Coordinator
Laboratory Surveillance	Per Oversight QAPP	External	EPA	EPA RPM or QC staff	Laboratory Project Manager, ERM QA Manager	Laboratory Project Manager, ERM QA Manager	EPA RPM or QC staff

32.0 ASSESSMENT FINDINGS AND CORRECTIVE ACTION RESPONSES TABLE (SAP WORKSHEET #32)

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Timeframe of Notification	Nature of Corrective Action (CA) Response Documentation	Individual(s) Receiving CA Response	Timeframe for Response
Field Readiness Review (Internal by ERM QA Manager)	Email documentation from ERM QA Manager	ERM Project Coordinator, ERM Field Team Leader	2 days	Email documentation from ERM Field Team Leader	ERM Project Coordinator, ERM QA Manager	2 days
Field Sampling Surveillance (Internal, by ERM QA Manager)	Email documentation from ERM QA Manager	ERM Project Coordinator, ERM Field Team Leader	2 days	Email documentation from ERM Field Team Leader	ERM Project Coordinator, ERM QA Manager	2 days
Field Sampling Surveillance (External, by EPA RPM or QC staff)	Email documentation and audit report from EPA RPM or QC staff	ERM Project Coordinator, ERM Field Team Leader	2 days	CA memorandum from ERM Field Team Leader	EPA RPM, ERM Project Coordinator	2 days
Laboratory Surveillance (Internal, by ERM Analytical Coordinator)	Email documentation from ERM Analytical Coordinator	ERM Project Coordinator, Laboratory Project Manager	5 days	Email documentation from Laboratory Project Manager	ERM Project Coordinator, ERM QA Manager/ Analytical Coordinator,	5 days
Laboratory Surveillance (External, by EPA RPM or QC staff)	Email documentation and audit report from EPA RPM or QC staff	ERM Project Coordinator, ERM QA Manager, Laboratory Project Manager	5 days	Email documentation and CA memorandum from laboratory project manager	EPA RPM, ERM Project Coordinator, ERM QA Manager	5 days

[1] Documentation of ERM's internal surveillances, deficiencies, and/or corrective action response will be available for EPA review upon request.

33.0 QA MANAGEMENT REPORTS TABLE (SAP WORKSHEET #33)

Type of Report	Frequency	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation	Report Recipient(s)
Daily Progress Report	Daily	At the end of each field day	ERM RI Field Team Leader	US Magnesium Contact, ERM Project Coordinator, EPA RPM
Monthly Status Report	Monthly	At the end of each month	ERM Project Coordinator	EPA RPM
QC Summary Report	With Report Submittal	Submitted in Final Report	ERM RI Field Team Leader	EPA RPM

34.0 VERIFICATION (STEP I) PROCESS TABLE (SAP WORKSHEET #34)

Verification Input	Description	Internal/ External	Responsible for Verification (Name, Organization)
Audit reports	When each audit report is complete, a copy will be placed in the project file. If corrective actions are required, a copy of the documented corrective action taken will be attached to the appropriate audit report in the project file. At the beginning of each week and at the completion of the Site work, project file audit reports will be reviewed internally to ensure that all appropriate corrective actions have been taken and that corrective action reports are attached. If corrective actions have not been taken, the project manager will be notified to ensure action is taken.	I	ERM Project Coordinator, ERM QA Manager
Field notes/logbook	Field notes will be reviewed internally and placed in the project file. Field notes will be scanned on a weekly basis and placed into the online data management system, or otherwise provided to the EPA, on a weekly basis. A copy of the field notes will also be attached to the final report.	I	ERM Field Team Leader
Sample Receipt	For samples shipped via commercial carrier, the analytical coordinator will verify receipt of samples by the laboratory the day following shipment.	I	ERM Analytical Coordinator
Sample Logins	Sample login information will be reviewed and verified for completeness in accordance with the chain-of-custody forms.	I, E	ERM Analytical Coordinator Laboratory Project Manager
Chain-of-Custody Records	Chain-of-custody forms will be reviewed internally when they are completed and verified against the packed sample coolers they represent. A copy of the chain-of-custody form will be retained in the project file, and the original and remaining copies will be taped inside the cooler for shipment.	I	ERM Field Team Leader
Laboratory Data Prior to Release	Laboratory data will be reviewed and verified for completeness against analyses requested on the chain-of-custody forms.	E	Laboratory Project Manager
Laboratory Data due at Turnaround Time Listed on Chain of Custody	Laboratory data will be verified for consistency of analyses reported with the analytical suite requested on the chain-of-custody forms.	I	ERM Analytical Coordinator
Laboratory Data	All laboratory data packages will be verified for completeness by the laboratory performing the work. Data packages will then be reviewed by the analytical coordinator for completeness. Subsequently, data packages will be evaluated externally by undergoing data validation according to the procedures specified in WS#36.	I, E	Laboratory Project Manager ERM Analytical Coordinator Third-party data validator
Field and Electronic Data	One hundred percent of manual entries will be reviewed against the hard copy information, and 100 percent of electronic uploads will be checked against the hard copy.	I	ERM Database Manager

Note:

~~Data quality will be verified to be legally and technically defensible by performing the actions and documentation procedures described in this Worksheet~~Project data will undergo the verification procedure described in this worksheet in order to ensure it is both legally and technically defensible.

35.0 VALIDATION (STEPS IIA AND IIB) PROCESS TABLE (SAP WORKSHEET #35)

Step IIa / IIb[1]	Validation Input	Description	Responsible for Validation (name, organization)
IIa	Field logbook	Field logbooks will be reviewed weekly for accuracy associated with each sampling event~~.~~ and completeness with the minimum documentation requirements described in the Phase 1A-B RI SAP and applicable SOPs. The inspection will be documented by uploading field notes to the project database.	ERM Field Team Leader
IIa	COC Records	COC Records will be reviewed daily to ensure that project information, sample identifiers, sample analyses requested, and field QC samples are accurate and completed in accordance with the requirements in this Phase 1A-B RI SAP and Data Management Plan.	ERM Analytical Coordinator or ERM Field Team Leader
IIa	Sample receipt	The sample cooler will be checked for compliance with temperature and packaging requirements, sample security, and custody seals.	Laboratory Project Manager
IIa	Sample logins	Sample login will be reviewed for accuracy against the chain-of-custody form.	ERM Analytical Coordinator, Laboratory Project Manager

Step IIa / IIb[1]	Validation Input	Description	Responsible for Validation (name, organization)
IIa	Laboratory data prior to release	Laboratory data will be reviewed to ensure that the data are accurate and meet the requirements in this Phase 1A-B RI SAP. Before laboratory data are released, the data will be validated as follows: • Results will be reviewed to confirm that the data meet analytical method and Phase 1A-B RI SAP requirements, and were collected in accordance with EPA-approved SOPs. • 100 percent of the data will be checked for completeness of deliverables. 10 percent of the data will be fully validated (Level 4). 90 percent of the results will undergo a Level 3 validation. A validation report will summarize results and include qualified results.100 percent of manual entries will be reviewed to assure that they are free of transcription errors and manual calculations are accurate; computer calculations will be spot-checked.	Laboratory Project Manager
IIa	Laboratory data due at turnaround time listed on COC Record	Laboratory data will be reviewed to ensure that the data reported include the required chemicals and meet laboratory practical quantitation limits listed in WS#15. Laboratory practical quantitation limits that vary from the WS#15 requirements should be documented in the verification/validation reports along with the reason for the deviation.	ERM Analytical Coordinator
	Laboratory data packages	All laboratory data packages will be validated by the laboratory performing the work for technical accuracy before they are submitted.	Laboratory Project Manager
		Data packages will then be reviewed for accuracy against the laboratory data that were faxed or e-mailed at the turnaround time listed on the chain of custody.	ERM Analytical Coordinator
		Data packages will be evaluated externally by undergoing data validation.	Third-party data validator
IIb	Data validation reports	Data validation reports will be reviewed in conjunction with the project DQOs and data quality indicators (DQI).	ERM QA Manager

Notes:

[1] IIa = compliance with methods, procedures, and contracts (Table 10, page 117, UFP-QAPP manual, V.1, March 2005).
IIb = comparison with measurement performance criteria in the Phase 1A-B RI SAP (Table 11, page 118, UFP-QAPP manual, V.1, March 2005).

36.0 ANALYTICAL DATA VALIDATION (STEPS IIA AND IIB) SUMMARY (SAP WORKSHEET #36)

This section describes the minimum procedures that US Magnesium/ERM will use to review, verify, and validate field and laboratory data. This section also discusses procedures for verifying that the data are adequate to meet project quality objectives (PQOs) and measurement quality objectives (MQOs) for the project. Validation and verification of the data generated during field and laboratory activities are essential to obtaining defensible data of acceptable quality. Verification and validation methods for field and laboratory activities are presented below.

36.1 FIELD DATA VERIFICATION

Project personnel will verify field data through reviews of data sets to identify inconsistencies or anomalous values. Any inconsistencies discovered will be resolved as soon as possible by seeking clarification from field personnel responsible for data collection. All field personnel will be responsible for following the sampling and documentation procedures described in this Phase 1A-B RI SAP so that defensible and justifiable data are obtained.

Data values that are significantly different from the population are called “outliers.” A systematic effort will be made to identify any outliers or errors before field personnel report the data. Outliers can result from improper sampling or measurement methodology, data transcription errors, calculation errors, or natural causes. Outliers that result from errors found during data verification will be identified and corrected; outliers that cannot be attributed to errors in sampling, measurement, transcription, or calculation will be clearly identified in project reports.

36.2 LABORATORY DATA VERIFICATION

Laboratory personnel will verify analytical data at the time of analysis and reporting and through subsequent reviews of the raw data for any nonconformances to the requirements of the analytical method and any project specific adjustments required by this SAP. Laboratory personnel will make a systematic effort to identify any outliers or errors before reporting the data. Outliers that result from errors found during data verification will be identified, corrected, and documented by corrective action procedures; outliers that cannot be attributed to errors in analysis, transcription, or calculation will be clearly identified in the case narrative section of the analytical data package.

36.3 LABORATORY DATA VALIDATION

An independent third-party contractor will validate all laboratory data in accordance with current EPA National Functional Guidelines (EPA 2011a, 2014a, 2014b). Ninety percent of the data for the Phase 1A-B RI will undergo cursory verification/validation, and 10 percent of the data for the Phase 1A-B RI will undergo full validation for this project. Requirements for cursory and full validation are listed below.

Cursory Data Validation

Cursory verification/validation (Stage 2B) will be completed on 90 percent of the summary data packages for the Phase 1A-B RI. This verification/validation requires a completeness review of the data packages for all deliverables required in WS#29 with particular attention to the confirmation by the laboratory contained in the case narrative that the methods were performed according to this Phase 1A-B RI SAP. The Stage 2A verification/validation will confirm the QC portion of the package meets the stated performance ranges or are specifically cited in the narrative. (The remaining 10 percent of the packages will be subjected to full validation.) The third-party data reviewer will request any missing information needed from the laboratory. Missing information will be saved in the project files and incorporated as addenda to the laboratory data packages stored on the ERM Scottsdale server. Elimination of the data from the review process is not allowed. All data will be qualified as necessary in accordance with established criteria. Data summary packages will consist of sample results and QC summaries, including calibration and internal standard data. EDD verification with the laboratory package data will be consistent with the Data Management Plan (ERM 2013b). Results that have validation qualifiers added will also have an associated reason code recorded in the EDD at validation (cursory and full). These reason codes will be stored in the EQuIS project database and are listed in Table 36-2.

Full Data Validation

Full validation (Stage 4) will be completed on 10 percent of the full data packages for the Phase 1A-B RI. The third-party data reviewer will request any missing information needed from the laboratory. Missing information will be saved in the project files and incorporated as addenda to the laboratory data packages stored on the ERM Scottsdale server. Elimination of data from the review process is not allowed. All data will continue through the validation process and will be qualified in accordance with established criteria. Data packages will consist of sample results, QC summaries, and all raw data associated with the sample results and QC summaries.

36.1.4 DATA VALIDATION CRITERIA

Data validation criteria are presented in Table 36-1. WSs #12, #24, #25, #28, and #36, along with the analytical methods and laboratory SOPs, list the QC checks and criteria that will be reviewed for both cursory and full data validation. The data validation criteria selected from Table 36-1 will be consistent with the project-specific analytical methods referenced in WS#19. A list of the reason codes associated with precision and accuracy qualifiers is included in Table 36-2.

Table 36-1: Data Validation Criteria

Step	Matrix	Analytical Group	Validation Criteria	Data Validator (title and organizational affiliation)
IIa	Solids	PCBs	In accordance with this SAP, the method SOP, and Work Instructions established through the DMA	Laboratory QA Manager
IIa	Solids	Dioxins	In accordance with this SAP, the method SOP, and Work Instructions established through the DMA	Laboratory QA Manager
IIa	Solids	Semi-volatiles	In accordance with this SAP, the method SOP, and Work Instructions established through the DMA	Laboratory QA Manager
IIa	Solids	PAHs	In accordance with this SAP, the method SOP, and Work Instructions established through the DMA	Laboratory QA Manager

Step	Matrix	Analytical Group	Validation Criteria	Data Validator (title and organizational affiliation)
IIa	Solids	Volatiles	In accordance with this SAP, the method SOP, and Work Instructions established through the DMA	Laboratory QA Manager
IIa	Solids	ICP Metals	In accordance with this SAP, the method SOP, and Work Instructions established through the DMA	Laboratory QA Manager
IIa	Solids	ICP/MS Metals	In accordance with this SAP, the method SOP, and Work Instructions established through the DMA	Laboratory QA Manager
IIa	Solids	Mercury	In accordance with this SAP and the method SOP	Laboratory QA Manager
IIa	Solids	Cyanide	In accordance with this SAP and the method SOP	Laboratory QA Manager
IIa	Solids	Perchlorate by LCMS	In accordance with this SAP, the method SOP, and Work Instructions established through the DMA	Laboratory QA Manager
IIa	Solids	Perchlorate by IC	In accordance with this SAP, the method SOP, and Work Instructions established through the DMA	Laboratory QA Manager
IIa	Solids	pH	In accordance with this SAP and the method SOP	Laboratory QA Manager
IIb	Solids	HRGC/HRMS PCBs	In accordance with this SAP, EPA Method 1668A (SOP WS-ID-0013), and EPA National Functional Guidelines (2011a). See note [1]	Data Validation Contractor Project Manager
IIb	Solids	Dioxins	In accordance with this SAP, the EPA Method 8290 (SOP WS-ID-0005), and EPA National Functional Guidelines (2011a). See note [1]	Data Validation Contractor Project Manager
IIb	Solids	Semi-volatiles	In accordance with this SAP, EPA Method 8270C (SOP WS-MS-0005), and EPA National Functional Guidelines (2014b)	Data Validation Contractor Project Manager
IIb	Solids	PAHs	In accordance with this SAP, EPA Method 8270-SIM (SOP WS-MS-0008), and EPA National Functional Guidelines (2014b)	Data Validation Contractor Project Manager
IIb	Solids	Volatiles	In accordance with this SAP and EPA Method 8260B (SOP WS-MS-0007) and EPA National Functional Guidelines (2014b)	Data Validation Contractor Project Manager

Step	Matrix	Analytical Group	Validation Criteria	Data Validator (title and organizational affiliation)
IIb	Solids	ICP Metals	In accordance with this SAP and EPA Method 6010 (SOP WS-MT-0003), and EPA National Functional Guidelines (2014a)	Data Validation Contractor Project Manager
IIb	Solids	ICP/MS Metals	In accordance with this SAP and EPA Method 6020 (SOP WS-MT-0001), and EPA National Functional Guidelines (2014a)	Data Validation Contractor Project Manager
IIb	Solids	Mercury	In accordance with this SAP and EPA Methods 7470/7471 (SOP WS-MT-0005, SOP WS-MT-0007), and EPA National Functional Guidelines (2014a)	Data Validation Contractor Project Manager
IIb	Solids	Cyanide	In accordance with this SAP and EPA Method 9012 (SOP SA-ME-040), and EPA National Functional Guidelines (2014a)	Data Validation Contractor Project Manager
IIb	Solids	Perchlorate by LCMS	In accordance with this SAP and EPA Method 6850 (SOP WS-LC-0012) and EPA National Functional Guidelines (2014a)	Data Validation Contractor Project Manager
IIb	Solids	Perchlorate by IC	In accordance with this SAP and EPA Method 314 (SOP WS-WC-0010) and EPA National Functional Guidelines (2014a)	Data Validation Contractor Project Manager
IIb	Solids	pH	In accordance with this SAP and EPA Method 9045D (SOP WS-WC-0044) and EPA National Functional Guidelines (2014a)	Laboratory QA Manager

[1] Validation of Estimated Maximum Potential Concentration (EMPC) Results - PCB and D/F data qualified by the laboratory as an EMPC will be qualified during data validation as not-detected, with the detection limit reported as the EMPC concentration. EMPC results will be assigned a “UQ” qualifier to differentiate them from other not-detected results. The qualification of EMPC results as not-detected is based on the following considerations:

- There is no consistent guidance available from EPA on the validation/qualification of EMPC values or the use of EMPC values in the calculation of TEQ values;
- The absence of a clear understanding of how the “out of control” ion abundance ratios may be related to matrix effects and how this affects EMPC calculations; and
- A review of the Phase 1A-B DMA data which found that the potential contribution of EMPC data to overall calculated TEQ for both PCBs and dioxins/furans for samples is low, generally about 10 percent or less, which is within the normal method variability.

EMPC qualification of concentration data was formulated to account for the potential presence of D/F isomers in circumstances where the criteria for positive identification were not met. EMPC qualification has been extended to PCBs; however, there is no guidance on how to qualify PCB concentrations as EMPC. The term EMPC was reportedly created by Triangle Labs to indicate the detected presence of a compound above zero but not meeting QA/QC reporting level criteria. EPA has confirmed the EMPC data may be conservatively high because they do not meet the usual high degree of QA/QC. A summary of the available procedures for handling EMPC data available from analytical methods and data review/validation guidance documents is provided below.

Analytical Methods

- SW-846 Dioxin/Furan Methods 8280B revision 7, February 2007 and 8290A revision 1 February 2007 include directions for the calculation of EMPCs for 2,3,7,8-dioxin and -furan isomers that meet all identification criteria except ion abundance ratio criteria or when polychlorinated diphenyl ethers (PCDPE) have been detected in the sample. Method 8280B states, "*Do not include EMPC values in the TEQ calculation;"*
- Method 8290A does not indicate whether EMPC values are to be included in TEQ calculations.
- EPA Method 1613 for the analysis of Tetra- through Octa-chlorinated Dioxins and Furans by Isotope Dilution HRGC/HRMS does not include the calculation of EMPC concentrations.
- EPA's Method 1668C for the analysis of Polychlorinated Biphenyl Congeners in Water, Soil, Sediment, Biosolids and Tissue by HRGC/HRMS does not contain directions for qualifying data from analyses using qualifiers such as EMPC. If the criteria for identification in Sections 16.1-16.5 are not met, the PCB has not been identified and the result for that congener may not be reported or used for permitting or regulatory compliance purposes. If interferences preclude identification, a new aliquot of sample must be extracted, further cleaned up, and analyzed (EPA Method 1668C Section 16.6).

Data Review / Data Validation Guidance

- The *National Functional Guidelines for Chlorinated Dibenzo-p-Dioxin (CDDs) and Dibenzofurans (CDFs) Data Review* states that use of EMPC data will depend on Regional Policies. EPA Region 8 has not issued validation guidelines for EMPC data. EPA Region 2 Validation Guidelines indicate that EMPCs are to be calculated in cases where ion abundance and other quality assurance criteria (such as the presence of PCDPE) are not met. The Region 2 Guidance does however, indicate that only positive data are to be included in TEQ calculations and the guidance specifically instructs the validator to ensure the EMPC values were not included in the TEQ. Region 3 Validation Guidance also indicates that EMPC values are not to be included in TEQ calculations.
- The EPA National Functional Guidelines for SOM Data Review Chapter on Aroclor Data Review does not include use of the EMPC qualifier.
- The User Guide for the UFP-QAPP Template for Soils Assessment of Dioxin Sites (EPA, 2011b) notes that the CLP SOW excludes EMPC values from the TEQ. It also provides a possible method for incorporating nondetect congeners into the TEQ in cases where the congener may be influential (high concentration EMPC, high-toxicity/TEF close to 1), using the Kaplan-Meier mean instead of using 1/2 the DL.
- There are no National Functional Guidelines for PCB Congener Review. EPA Region 2 has Guidance on Validation of PCB Congeners using Method 1668, and these guidelines do not include use of the EMPC qualifier. EPA Region 3 has a PCB Congener Data Review Guideline that indicates that if the ion abundance ratio for a particular congener is greater than 25 percent, the concentration of that congener should be reported as EMPC. However, there is no guidance on using the EMPC value in TEQ calculations.

Table 36-2: Data Validation Reason Codes

Validation Reason Code	Definition
1	The sample preparation and/or analytical holding time was exceeded.
2	The analyte was detected below the quantitation limit but above the detection limit.
3	The analyte was detected in an associated laboratory blank sample.
4	The MS/MSD recovery was outside of control limits.
5	The LCS recovery was outside of control limits.
6	The MS/MSD RPD was outside of control limits.
7	The LCS RPD was outside of control limits.
8	The surrogate recovery was outside of control limits.
9	Result identified as an EMPC.

Validation Reason Code	Definition
10	The sample chromatogram did not resemble the standard hydrocarbon pattern.
11	The sample concentration was greater than the instrument's calibration range.
12	The calibration criterion of RRF, %D, and/or %RSD was not met.
13	The analyte was detected in field blank, rinsate blank, and/or trip blank sample.
14	The internal standards did not meet control criteria.
15	The serial dilution did not meet control criteria.
16	The difference between columns did not meet control criteria.
17	Field duplicates did not meet the 50% RPD control criterion.
18	Sample receipt temperature exceeded the acceptable range of from 4 to 6 °C.
19	Analytical duplicate precision did not meet control criteria.
20	Headspace in vials containing water samples to be analyzed for volatiles.
99	Other

37.0 USABILITY ASSESSMENT (SAP WORKSHEET #37)

The evaluation of data usability of the Phase 1A-B data will include comparison of results to MQOs with subsequent evaluation against the DQOs, as described in the following sections.

37.1 MEASUREMENT QUALITY OBJECTIVES FOR COPC SELECTION

All analytical results will be evaluated in accordance with precision, accuracy, representativeness, completeness, comparability, and sensitivity (PARCCS) parameters to document the quality of the data and to ensure that the data are of sufficient quality to meet the project objectives. Of these PARCCS parameters, precision and accuracy will be evaluated quantitatively by collecting the QC samples at the frequencies listed in WS#12. Precision and accuracy MQO goals for the project are listed in WS#12.

The following subsections describe each PARCCS parameter and how it will be assessed within this project.

37.1.1 PRECISION

Precision is the degree of mutual agreement between individual measurements of the same property under similar conditions. Combined sampling and analytical precision are evaluated by collecting and analyzing field duplicates and then calculating the variance between the samples, typically as an RPD:

$$RPD = \frac{|A-B|}{(A+B)/2} \ x \ 100\%$$

where:

A = First duplicate concentration
B = Second duplicate concentration

Laboratory analytical precision is evaluated by comparing analytical results of laboratory duplicates, or by analyzing MXS of field samples along with MSD. For this project, MXS/MSD samples will be generated for inorganic analytes only. Laboratory duplicates will be used to assess precision for organic and inorganic analytes. The results of the analysis of each MXS/MSD or duplicate pair will be used to calculate an RPD for evaluating precision. WS#12 presents the precision MQO goals for this project.

Tables will be included in the data report to summarize the number of results that did not meet MQOs by analyte by PRI Area /background area, with one table for each validation reason code pertaining to precision MQOs (see WS#36).

37.1.2 ACCURACY

Accuracy is the degree of agreement between an observed value (sample result) and an accepted reference value. Field accuracy (bias) will be assessed by collecting and analyzing equipment rinsate blank, source water blank, and trip blank QC samples. These QC samples will be used to evaluate the potential for target analytes to enter samples as a result of sampling processes.

A program of sample spiking will be conducted to evaluate laboratory accuracy. This program includes analysis of the MXS samples (inorganic analyses only), LCS or blank spikes, and method blanks. MXS samples will be prepared and analyzed at a frequency of 5 percent for samples that will require analysis for inorganic chemicals. LCS or blank spikes are also analyzed at a frequency of 5 percent or per extraction batch, whichever is most frequent. System monitoring compounds (surrogate standards) or internal standards are added to every sample analyzed for organic constituents.

The results of the spiked samples are used to calculate percent recovery (%R) for evaluating accuracy.

$$\%R = \frac{S - C}{T} \ x \ 100$$

where:

S = Measured concentration in the spiked water or soil sample
C = Unspiked water or soil sample concentration
T = True or actual concentration of the spike

WS#12 presents accuracy MQO goals for this investigation based on percent recovery of laboratory, matrix, and surrogate spikes. Results that fall outside the accuracy goals will be evaluated further on the basis of the results of other QC samples, and appropriate data qualifiers will be applied. QC acceptance limits for system monitoring compounds and internal standards for organic analyses are presented in WS#28.

Tables will be included in the data report to summarize the number of results that did not meet accuracy MQOs by analyte by PRI Area/background area, with one table for each validation reason code pertaining to accuracy MQOs.

37.1.3 REPRESENTATIVENESS

Representativeness expresses the degree to which sample data accurately and precisely represent the characteristics of a population, variations in a parameter at a sampling point, or an environmental condition that they are intended to represent. For this project, representative data will be obtained through careful selection of sampling locations and analytical parameters. Representative data will also be obtained through proper collection and handling of samples to avoid interference and minimize contamination.

Representativeness of data will also be ensured through consistent application of established field and laboratory procedures. Laboratory blank samples will be evaluated for presence of contaminants to aid in evaluating representativeness of sample results.

37.1.4 COMPLETENESS

Completeness is a measure of the percentage of project-specific data that are valid. Valid data are obtained when samples are collected and analyzed in accordance with QC procedures outlined in this Phase 1A-B RI SAP, and when results are found to be usable (with or without qualification) based on comparison to QC criteria. When all data validation is completed, the percent completeness value will be calculated by dividing the number of useable sample results by the total number of sample results planned for this investigation.

As discussed further in Section 37.2, completeness will also be evaluated as part of the data quality assessment (DQA) process (EPA 2006b). This evaluation will help determine whether any limitations are associated with the decisions to be made based on the data obtained.

37.1.5 COMPARABILITY

Comparability expresses the confidence with which one data set can be compared with another. Comparability of data will be achieved by consistently following standard field and laboratory procedures and by using standard measurement units in reporting analytical data. Field procedures are standardized to help ensure comparability. Comparability of laboratory data will be assured by use of established and approved analytical methods, consistency in the basis of analysis (wet weight, volume, or similar units), and consistency in reporting units (ppm, ppb, and so forth).

37.1.6 SENSITIVITY

Sensitivity is the ability of the method or instrument to detect the target analytes at the level of interest. As defined in the UFP-QAPP Manual (EPA 2005a):

- "The quantitation limit (QL) is the minimum concentration of an analyte that can be routinely identified and quantified above the MDL by a laboratory."
- "The MDL is a statistically derived detection limit that represents a 99 percent confidence level that the reported signal is different from a blank sample. The MDL is lower than the concentration at which the laboratory can quantitatively report."
- Sample quantitation limits are QLs that are adjusted for dilutions, percent moisture, and cleanup procedures, sample size, or extract /digestate volumes.

QLs are typically several times higher than the MDL to allow for matrix effects. Project QLs and MDLs shown in WS #15 represent the expected sensitivity the laboratory can achieve for specific analytical methods in a typical solid matrix. Analytical methods have been selected for this project so that the QL for each target analyte is below the applicable comparison criteria wherever practical. WS#15 compares the QLs and MDLs reported by the project-specified laboratories for the selected analytical methods with comparison criteria. The comparison criteria are generally RBCs as compiled in the SLRA Technical Memorandum (ERM 2014b). This comparison shows that the associated QLs for the analytical methods selected are generally less than the applicable ecological and human health RBCs, in most cases. If a reported value is less than the QL but greater than the sample detection limit (DL), the result will be reported as an estimated value. This procedure is being adopted to help ensure that analytical results can effectively be compared with comparison criteria for certain compounds if the screening criteria are near or below the QL. RBCs are calculated values and may be lower than the QL and, in some cases, also the MDL, due to the limitations of analytical technology. This reporting procedure will help to ensure that subsequent statistical evaluations of the data will not be biased by high-value nondetect results. Because results will be reported to the DL, for this project, sensitivity will be assessed based on DLs of laboratory analytical results.

37.2 DATA QUALITY ASSESSMENT APPROACH

After environmental data have been reviewed, verified, and validated in accordance with the procedures, the data must be further evaluated to determine whether DQOs have been met. To the extent possible, US Magnesium/ERM will follow EPA's DQA process to verify that the type, quality, and quantity of data obtained are appropriate for their intended use. The DQA methods and procedures outlined in EPA's *Data Quality Assessment: Statistical Methods for Practitioners* (EPA 2006b) will be used for evaluating quantitative DQOs. This DQA process includes five steps: (1) review the DQOs and sampling design; (2) conduct a preliminary data review; (3) select a statistical test; (4) verify the assumptions of the statistical test; and (5) draw conclusions from the data. Quantitative, i.e. statistically based, DQOs for the Phase 1A-B RI include:

- Reliable identification of COPCs for human and ecological receptors within PRI Areas 1 and 3 through 7; and
- Estimation of background (ambient) concentrations for metals and organics including, D/Fs, total PCBs and WHO congeners, and HCB.

The DQA procedures to determine data adequacy for COPC selection and background (ambient) concentration DQOs are described in Sections 37.3 and 37.4, respectively.

US Magnesium/ERM will systematically assess data quality and data usability when the five-step DQA process cannot be completely followed because the DQOs are qualitative. This assessment will include the following elements, as appropriate:

- A review of the sampling design and sampling methods to verify that these were implemented as planned and are adequate to support project objectives
- A review of project-specific data quality indicators for PARCCS to evaluate whether MQO goals have been met
- A review of project-specific DQOs to determine whether they have been achieved by the data obtained
- An evaluation of any limitations associated with the decisions to be made based on the data obtained.

Qualitative DQOs for which data quality will be assessed systematically using the elements listed above include the following:

- Initial risk calculations performed in the OU-1 SLRA to evaluate whether sufficient data have been collected within PRI Areas 1 and 3 through 7 to support confident risk characterization.

- Preliminary evaluation of the N&E of Site-related impacts within PRI Areas 1 and 3 through 7.

- Identification of suitable reference areas (i.e., non-impacted areas) for biota sampling that may be conducted during 2016 Phase 2 RI activities.

The Phase 1A-B RI data report will discuss any potential impacts of data quality assessments on data usability, and will clearly define any limitations associated with the data. Laboratory managers are responsible for day-to-day identification of laboratory data issues and resolution of those issues, as identified in WS #6 and WS#7. Data collected under this Phase 1A-B RI SAP shall be reported by US Magnesium/ERM; therefore, the Project Manager and Field Team Leader (WS#3) will ensure proper documentation of data usability through the final reports and subsequent meetings as needed.

37.3 DATA ADEQUACY FOR COPC SELECTION

The number of samples to collect per PRI was determined as described in WS#11. If the maximum detected concentration exceeds the lowest risk-based screening level (RBSL)/risk-based ecological screening level (RBESL), the dataset will be deemed adequate for COPC selection. If the maximum detect does not exceed the lowest RBSL/RBESL, if at least 50 percent of the results are detected concentrations, the distribution will be tested by comparing the mean concentration of the results for an analyte in a PRI to the 80th percentile concentration. The mean will be calculated using one-half the DL for non-detect results. If the mean concentration is less than or equal to the 80th percentile concentration, the dataset will be deemed adequate for COPC selection. If the mean is greater than the 80th percentile concentration, the dataset is skewed and will be deemed inadequate for COPC selection. In this case, the uncertainty may be addressed by selecting the analyte as a COPC and/or chemical of potential environmental concern (COPEC) (depending whether the DL exceeds the RBSL or lowest RBESL, or both) in the SLRA, or collection of additional data.

If less than 50 percent of the results are detected concentrations, DLs for non-detect results will be compared to RBSLs/RBESLs for each analyte dataset. If the maximum DL is less than the lowest of the RBSL/RBESLs, the dataset will be deemed adequate for COPC selection. If the maximum DL is greater than the lowest of the RBSL/RBESLs, the DLs in each analyte dataset will be reviewed to determine how frequently the DL exceeds the WS #15 ~~MDL~~TQL. An exceedance of the WS #15 ~~MDL~~ TQL is defined as a DL that is more than 20 percent higher, to allow for analytical variability. In addition, it is appropriate to include only undiluted samples in the evaluation. Samples are diluted due to either high concentrations of one or more analytes and/or a challenging matrix that contains interfering compounds or would cause damage to the analytical instrument; the DL is adjusted for the dilution factor. The MQO for sensitivity will be evaluated as follows:

- If the DL is less than 120 percent of the WS #15 ~~MDL~~ TQL in at least 50 percent of the undiluted samples, the MQO for sensitivity will have been met.
- If the DL is more than 120 percent of the WS #15 ~~MDL~~ TQL in more than 50 percent of the undiluted samples, the rate of exceedance of the lowest RBC will be reviewed.
  - If the DL is less than the lowest RBC in more than 50 percent of the undiluted samples, the MQO for sensitivity will have been met, and the dataset will be deemed adequate for COPC selection.
  - If the DL exceeds the lowest RBC in more than 50 percent of undiluted samples, the sensitivity MQO will not have been met, and uncertainty remains regarding adequacy for COPC selection. The uncertainty may be resolved by:
    - Selection of the analyte as a COPC and/or COPEC (depending whether the DL exceeds the RBSL or lowest RBESL, or both) in the SLRA; or
    - Collection of additional data.

37.4 BACKGROUND DATA USABILITY ASSESSMENTS

In addition to the PARCCS data usability evaluations described in Section 37.1, Phase 1A-B analytical data collected from background locations will undergo additional assessment to confirm that 1) soil sampling locations are not impacted by Site activities, 2) an adequate number of background samples were collected to support background evaluations. The DQA for metals results will be conducted on Lakebed and Upland datasets separately (see WS#11). It is expected that location (lakebed vs upland) is not an important distinction for organics. This assumption will be tested once the data are collected. If there is no important difference, that comparisons of site to background for organics will use the combined background data set. If there is an important difference, then the background data set for upland and lakebed will be treated independently and used for comparisons to the corresponding upland and lakebed site samples.~~Organics will be treated as a single dataset.~~

There are a number of methods that may be used to evaluate whether background samples have been impacted by Site activities. The exact methods that will have the highest reliability and utility cannot be identified with certainty prior to collecting the data. However the following data evaluations are proposed to confirm background samples have not been impacted by the Site, and will include the following DQA elements:

- Metals Evaluations

  - Identify statistical outliers
  - Evaluate Q-Q plots
  - Evaluate geochemical associations
- Organics Evaluations
  - Identify statistical outliers
  - Evaluate Q-Q plots
  - Evaluate dioxin/furan congener fingerprinting

These elements will be used in background data retention decision making (i.e. whether or not a sample should be excluded from the background dataset.) In general, none of these elements will be used to exclude background data on its own. Instead, these elements will be utilized holistically and applied to a decision tree.

Once data retention decision making is complete, the final datasets will be evaluated to confirm the background sample sizes (metals and organics) are sufficient for background evaluations. The DQA elements and decision making methodologies that will be used for establishing the metals and organics background datasets are presented below in Sections 37.4.1 and 37.4.2, respectively. The DQA for confirming adequate background area sample sizes is presented in Section 37.4.3.

37.4.1 EVALUATION OF METALS IN BACKGROUND DATASETS

Metals are a natural component of the earth's crust. As such, it is critical to differentiate between naturally occurring concentrations, and those that are elevated as a result of Site operations. The following sections describe the DQA elements and data retention decision making methodology that will be used to evaluate the background metal datasets for Lakebed and Upland settings. The basis for evaluating metals separately for Lakebed and Upland setting is described in WS#11.

37.4.1.1 Identify Statistical Outliers

Outliers in background sample results will identified statistically. EPA software ProUCL (http://www2.epa.gov/land-research/proucl-software) will be used to performed the Rosner test (sample sizes will have n>25) to identify outliers in the background datasets. Statistical outliers will be considered anomalous concentrations, as they are elevated relative to the population in general. However, anomalous results will not necessarily be excluded from the background dataset; additional lines of evidence will be considered (as presented in the following sections) before deciding to exclude an anomalous result. Outliers will be tabulated and used in conjunction with the results of the other DQA investigations presented below.

37.4.1.2 Evaluate Q-Q Plots Graphical

The background DQA will utilize Q-Q plots to examine populations of individual metals and organics. In a Q-Q plot, the x-axis is arranged such that a dataset's theoretical quantiles will plot (ideally) as a straight line with relatively flat tails. A curve with an apparent inflection point (a point on the curve where a change in direction occurs) is commonly produced when the plotted data set contains multiple populations (either multiple background populations from different geological units, or background plus anomalous populations due to Site releases). Q-Q plots will be developed for each compound in the background dataset. The plots will also include 95% upper confidence intervals (UCIs).

In the DQA Q-Q plots will be examined, and the 95% UCI on the Q-Q plots used to refine conclusions about "anomalous samples" identified by outlier testing (Section 37.4.1.1). Samples that fall outside the 95% UCI will be considered statistical outliers. However, as with the outlier testing the findings of the Q-Q plots graphical evaluation will be evaluated in conjunction with the other lines of evidence presented in Section 37.4.1 to determine if results should be excluded from the background dataset.

37.4.1.3 Evaluate Geochemical Associations

The geochemical DQA methods only apply to metals, because organic compounds are generally not expected to exhibit linear relationships with metals. Geochemical correlations of trace versus major elements are predicated on the natural elemental associations in soil. Linear trends are expected for scatterplots of specific trace versus reference metals in uncontaminated samples. Individual samples that may contain contamination are identified by their positions off the trend formed by uncontaminated samples. A complete description of the geochemical evaluation process is presented in WS#11.

The DQA for background will use geochemical evaluations to identify samples results that do not follow the geochemical relationship between a trace and reference metal. The geochemical relationship between reference and trace metal will be established using correlation analysis (see WS#11). For those metals that have a quantifiable geochemical correlation, a linear regression model will be developed with a 95% upper prediction limit (UPL) constructed on the regression (see WS#11). Samples that do not follow the predicted relationship will be candidates for removal from the background dataset if they fall outside the upper 95% UPL.

37.4.1.~~3~~4 Background Metal Data Retention Methodology

The DQA elements above will be integrated to decide which data, if any, should potentially be excluded from the background dataset for metals. Figure 37-1 presents the decision tree that summarizes how data retention decision making will be performed for metals. The approach will be applied on a metal-by-metal basis, independently for Lakebed and Upland background datasets. This approach is stepwise and described below.

1. Initially, anomalous concentrations will be identified using statistical outlier tests (Section 37.4.1.1).
    a. If outliers are identified, the DQA for that metal will move to Step 2.
    b. If no outliers are identified, the DQA for that metal will be complete, with no samples being excluded.
2. In Step 2, a Q-Q plot with a 95% UCI will be generated for the metal's data and examined (Section 37.4.1.2).
    a. If the Q-Q plot has samples that are outside the 95% UCI, the DQA for that metal will move to Step 3.
    b. If the Q-Q plot does not have samples that are outside the upper 95% CI line, the DQA for that metal will be complete, with no samples being excluded.
3. In Step 3, a geochemical relationship will be established if a quantifiable correlation is present (Section 37.4.1.3).
    a. If the geochemical relationship is present the DQA for that metal will move to Step 4.
    b. If a geochemical relationship is not present, the anomalous result for that analyte in that sample(s) will be excluded from the background dataset based on Steps 1 and 2.
4. In Step 4, a geochemical evaluation will be performed (Section 37.4.1.3).
    a. If the geochemical evaluation demonstrates that the anomalous result for that analyte in that sample(s) do not follow the geochemical relationship for that metal, those ~~sample(s)~~results will be excluded from the background dataset based on Steps 1, 2 and 3.
    b. If the geochemical evaluation demonstrates that the anomalous result for that analyte in that sample(s) follow the geochemical relationship for that metal, the DQA for that metal will be complete, with no ~~samples~~ results being excluded.

The Phase 1A-B RI data report will present the results of the background metal data evaluation. The evaluation will present the selected background metals datasets for Lakebed and Upland settings and will identify any metals results that are excluded and the rationale for exclusion.

37.4.2 EVALUATION OF ORGANICS IN BACKGROUND DATASETS

The organic compounds PCDD/PCDF, PCBs, and HCB in background may be the result of either anthropogenically produced or combustion byproducts (wildfires), both of which are ubiquitous in the environment due to wind dispersal and aerial deposition. Because these organic compounds are by-products of magnesium production at the Site, proposed background samples will be evaluated for Site impacts. Three approaches will be used to evaluate whether background samples are impacted by Site operations. These include: 1) identifying anomalous concentrations 2) graphical evaluation using Q-Q plots; and 3) comparison of D/F and ~~coplanar~~ congener fingerprints between background samples, Site data, and other regional background datasets (where available). The approaches used will vary depending on organic compound. The following sections describe the DQA elements and data retention decision making methodology that will be used to evaluate the background organics dataset.

37.4.2.2 Identify Statistical Outliers

The identification of anomalous samples will use the same outlier testing procedure discussed in Section 37.4.1.1 for metals. This evaluation will be applied to total PCBs and HCB only; application to PCDD/PCDF and coplanar PCB congeners is not expected to be useful these results will be assessed using fingerprinting.

37.4.2.3 Evaluate Q-Q Plots

The Q-Q plot graphical evaluation for organic background sample results will be performed and used in the same manner as discussed in Section 37.3.1.2 for metals. This evaluation will be applied to total PCBs and HCB only; application to PCDD/PCDF is not expected to be useful because those results will be assessed using fingerprinting.

37.4.2.4 Evaluate Dioxin/Furan Congener Fingerprinting

Background D/F and ~~coplanar~~ PCB congener results will be compared to Site data and regional reference data (EPA 2002a) using congener fingerprinting techniques. This will include calculating the relative proportions of congener in each sample, and comparing the patterns of proportions exhibited by the Site and background datasets (EPA 2004). The congener fingerprint for a background sample will be examined to determine if it appears more similar to Site sample fingerprints or regional reference samples (i.e. the pattern and relative proportions of congeners appear similar). If a background sample has a pattern similar to both, it suggests that a Site sample may be similar to background. This evaluation will be used in determining if a sample should be excluded from the background data set.

37.4.2.5 Organics Background Data Retention Methodology

The DQA elements above will be integrated to decide which data, if any, should be excluded from the background dataset for organics. Figure 37-2 presents the decision tree that summarizes how data retention decision making will be performed for organics in the background dataset. The approach will be applied on an organic-by-by-organic basis. This approach is stepwise and described below.

1. Initially, organic data will be segregated into one of two tracks based on the compound:
   - Dioxin, furan and ~~coplanar~~ PCB congener data will move to DQA Track A
   - Total PCB and HCB data will move to DQA Track B

Track A (PCDD/PCDF and ~~coplanar~~ PCB congeners)

2A. In Step 2A, *PCDD/PCDF* and ~~coplanar~~ PCB congener fingerprints from background samples will be compared to Site data fingerprints.

- If congener fingerprint sample(s) appears similar to Site data fingerprints, those samples will move to Step 3A of the DQA.

- If a sample congener fingerprints do not appear similar to Site data fingerprints, the DQA for dioxin, furan and PCB coplanar data will be complete, with no samples being excluded from the background dataset.

3A. In Step 3A, PCDD/PCDF and coplanar PCB congener fingerprints from background samples that appeared similar to Site fingerprints will be compared to regional reference fingerprint data (EPA 2004).

- If congener fingerprints appears similar to regional reference data fingerprints, those samples will be retained and the DQA will be complete.
- If a sample congener fingerprint similar to Site fingerprints does not appear similar to regional reference fingerprints, those samples will be excluded from the background dataset.

Track B (Total PCBs and HCB)

2B. In Step 2B, anomalous concentrations will be identified using statistical outlier tests (Section 37.4.1.1).

- If outliers are identified, the DQA for that organic will move to Step 3.
- If no outliers are identified, the DQA for that organic will be complete, with no samples being excluded.

3B. In Step 3B, a Q-Q plot with a 95% UCI will be generated for the organic data and examined (Section 37.4.1.2).

- If the Q-Q plot has outlier samples that are outside the upper 95% UCI, those samples will be excluded from the background dataset.
- If the Q-Q plot does not have samples that are outside the upper 95% UCI, the DQA for that organic will be complete, with no samples being excluded.

The Phase 1A-B RI data report will present the results of the background organics data evaluation. The evaluation will present the selected background organics dataset and will identify any metals results that are excluded and the rationale for exclusion.

37.4.3 CONFIRMATION OF BACKGROUND SAMPLE SIZE ADEQUACY

The next step in the background DQA will be confirming that adequate power under a Form II hypothesis is achievable by the background dataset sample size. This will be conducted on the final Phase 1A-B dataset, following the elimination of metal and organic results that are not consistent with background (Sections 37.4.1 and 37.4.2).

This DQA step will utilize the following procedure:

1. The standard deviation and mean will be calculated for each metal and organic dataset.
2. The "Compare Site Average to Reference Average" module in Visual Sample Plan (VSP) v7.2 (http://vsp.pnnl.gov/) will be used to calculate sample sizes using the following assumptions:
    a. Samples do not follow a normal distribution
    b. Alpha = 0.1
    c. Beta = 0.2
    d. S (detectable difference) = 50% of the mean of background data

If the calculated sample size is less than or equal to the sample size of the Phase 1A-B dataset, then the Phase 1A-B dataset is assumed to have adequate power with respect to a Type II error. If the calculated samples size is greater than the sample size of the Phase 1A-B dataset, then there may be reduced power to reject a false null and an increased probability of committing a Type II error. In this case, either more samples could be collected with the aim of increasing power, or the null Form II hypothesis could be accepted and the metal or organic would not be eliminated based on background (ambient) concentrations.

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FIGURES

ATTACHMENT 9:
PHASE 1A-B RI SCOPING DOCUMENTATION

ATTACHMENT 10:
HISTORICAL AERIAL PHOTOGRAPHS

ATTACHMENT 11:

BACKGROUND/REFERENCE AREA IDENTIFICATION TECHNICAL MEMORANDUM

ATTACHMENT 14A:
SAP MODIFICATION FORM

ATTACHMENT 14B:
FIELD MODIFICATION FORM

ATTACHMENT 15:
REFERENCE LIMITS AND EVALUATION TABLE (Excel Workbook)

ATTACHMENT 19
LABORATORY STANDARD OPERATING PROCEDURES

ATTACHMENT 21
FIELD STANDARD OPERATING PROCEDURES

ATTACHMENT 29A
DATA MANAGEMENT PLAN

ATTACHMENT 29B

EPA REGION 8 GIS DELIVERABLE REQUIREMENTS

ATTACHMENT 30
LABORATORY QUALIFICATIONS AND CERTIFICATIONS

Attachment 9AA

29 July 2015 Response to Agency Modifications to ERM's Draft Phase 1A-B SAP (document submittal date 2 July 2015)

Environmental
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ERM

29 July 2015

Via Electronic Mail

Mr. Ken Wangerud
Remedial Project Manager
Superfund Remedial Program
USEPA Region 8 – EPR-SR
1595 Wynkoop Street
Denver, CO 80202-1129

Subject: Response to Agency Modifications to ERM's Draft Phase 1A-B SAP (document submittal date 2 July 2015)

Dear Mr. Wangerud:

The *Draft OU-1 Phase 1A-B RI SAP* was submitted via upload to the United States Environmental Protection Agency (USEPA) US Mag Sharepoint site on 2 July 2015. The USEPA provided comments on this submittal on behalf of the USEPA and Utah Department of Environmental Quality (collectively "the Agencies") via e-mail on 17 July 2015, and this letter presents ERM-West, Inc.'s (ERM's) responses to the Agencies' suggested modifications to the Phase 1 A-B SAP.

The Agencies provided a summary of 15 specific technical comments (Enclosure 1), a GIS guidance document (Attachment 1 to Enclosure 1), and a Project Plan (Attachment 2 to Enclosure 1), as well as pdf and MS Word files of the SAP with numerous editorial modifications and insertions in redline strikeout format (Enclosures 2a and 2b). The cover letter to these enclosures suggests that the Agencies have modified the Phase 1 A-B in accordance with Section 39(c) of the AOC "to cure deficiencies." ERM and US Mag take exception to the USEPA's reference to this provision of the AOC and we do not believe that the Agencies can demonstrate that any of these comments point out technical errors or inconsistencies with applicable USEPA guidance. In fact, we believe that the majority of the suggested insertions and modifications are inconsistent with the content requirements provided in the UFP-QAPP Manual. Furthermore, this is inconsistent with the collaborative SAP development process that was mutually agreed upon at the OU-1 Phase 1B Scoping meeting held 11 and 12 March 2015.

Each Agency SAP insertion and/or modification that ERM believes is inappropriate or for which we require additional information to understand its necessity is provided below in italic font, followed by ERM's suggested resolution in green font.

Most of the USEPA edits to the draft Phase 1A-B SAP appear to be editorial in nature and, unless listed below, ERM does not disagree with these changes. However, as stated above, ERM objects to the corrected text being characterized as deficient. But, in order to cooperatively advance the Phase 1 A-B RI planning with the Agencies, we agree to incorporate them into the final SAP.

1. *<u>PREFACE</u>:*

   USEPA added a preface to provide a summary of the activities leading up to the development of the Phase 1 A-B SAP and to give the reader context for how the sample design was developed.

Resolution: ERM is in general agreement with the Preface text provided by the USEPA; however, there were several inaccuracies, omissions, and unnecessary and/or redundant statements that need to be corrected. ERM proposes the following text be included as the Preface of the final Phase 1 A-B SAP:

> The U.S. Environmental Protection Agency (EPA) placed the US Magnesium Site (Site) on the National Priorities List (NPL) for remedial response pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) in November 2009. The U.S. Court of Appeals for the Washington D.C. Circuit upheld EPA's action for the listing in August 2010.
>
> The US Magnesium plant electro-chemically processes magnesium chloride (derived from Great Salt Lake brine waters)

in melt-reactors and electrolytic cells to produce primary magnesium-metal and chlorine. The volume of by-product waste streams being released has increased since the start of the remedial investigation and feasibility study (RI/FS) and includes: (1) acidic liquid and slurry streams containing hexachlorobenzene (HCB), polychlorinated biphenyls (PCBs), and dioxins/furans, and (2) liquid and gaseous releases of chlorine (Cl_2) and hydrogen-chloride (HCl), as well as particulates/aerosols containing chlorinated organic compounds. While the entire Site is included on the NPL, which requires that the Site undergo an RI/FS and potential remedial action pursuant to CERCLA, the plant proper remains in continuous operation and is subject to various requirements under the Clean Air Act and the Resource Conservation and Recovery Act.

Administrative Settlement Order on Consent for Remedial Investigation/Feasibility Study. In August 2011, EPA and US Magnesium entered into an Administrative Order on Consent (AOC) for RI/FS, under which US Magnesium (supported by Environmental Resources Management [ERM]) is to carry out the work required for RIs, data management, risk assessment (RA), and FS for consideration of remedial action. The AOC and Appendix A: Statement-of-Work (SOW) for RI/FS call for scoping meetings during which US Magnesium/ERM engages in planning and technical discussions with the EPA for EPA's consideration in developing particular phases and stages of Sampling and Analysis Plans (SAPs). Numerous planning and scoping meetings to develop a site-wide Phase 1A SAP (described below) were held from October 2011 through March 2013. Subsequent discussions addressing the Inner PRI areas (the most contaminated portions of the Site) and refinement of RI activities for the Inner PRI areas occurred between August 2014 and March 2015; final development of this Phase 1A-B RI SAP (see below) is summarized in this document. Upon EPA approval and issuance of this Phase 1A-B RI SAP, US Magnesium/ERM is required to implement the Inner PRI areas and Background Study investigations as specified in this SAP.

Phase 1A RI SAP. In accordance with the AOC-SOW, the EPA issued the *Phase 1A Remedial Investigation Sampling and Analysis Plan to Identify Chemicals of Potential Concern in Soils, Sediment, Solid Waste, Water and Air, and Receptor Surveys (Revision 0) for PRI Areas 2 and 8 through 17* (EPA 2013) (Phase 1A RI SAP) (with Quality Assurance Project Plan [QAPP]) in September 2013, laying out the technical specifications to implement Phase 1A investigations (identification of chemicals of potential concern [COPCs]) across the Site. However, ERM identified numerous technical issues associated with sampling and analysis in PRI Areas 1 and 3 through 7 (Inner PRI areas) included in the Phase 1A SAP (Revision 0) that needed to be resolved prior to initiating this portion of the SAP. In order to initiate sampling and data collection activities in 2013 and begin remedial investigations of PRI Areas 2 and 8 through 17 (Outer PRI areas), as well as reduce the need for multiple sampling plan documents, the EPA issued the Phase 1A RI SAP as Revision 0 without addressing the technical issues needed to commence sampling in the Inner PRI areas, depending on the outcome of deliberations regarding the Inner PRI areas.

Upon completion of the Air DMA, the EPA approved the *Phase 1A Remedial Investigation Sampling and Analysis Plan for Operable Unit 2 – Ambient Air* (ERM 2014), which finalized the basis for standard operating procedures and worksheets pertinent to commencing the air investigations in PRI Area 18.

Development of the Phase 1A-B RI SAP. While the EPA was finalizing the Phase1A RI SAP, ERM and US Magnesium (having reviewed data from DMA investigations of Inner PRI areas indicating high concentrations of numerous constituent contaminant chemicals, and presuming little chance of eliminating suites of chemicals as COPCs (therefore not eliminating analytical methods from the RI)) asserted that Phase 1A investigations of the Inner PRI areas (for COPC identification) were not necessary, and instead proposed proceeding with Phase 1B investigations to determine preliminary nature and extent. Accordingly, the EPA sent a

September 2013 cover letter and accompanying Attachment 5 for issuance of the Final Phase 1A RI SAP, to accommodate the request by US Magnesium and ERM to postpone implementation of Phase 1A sampling for the most contaminated areas of the Site until 2014, allowing US Magnesium to consider an alternative offer by EPA for a more streamlined risk assessment and for accomplishing FS objectives for the Inner PRI areas.

When the Phase 1A SAP was issued, EPA offered US Magnesium an alternative, streamlined RI/FS framework using appropriate data collected during previous RCRA investigations (and limited samples collected during initial Superfund [DMA] investigations), along with "conservative" screening risk assessments, in order to forego detailed remedial investigations and risk assessment and proceed to cleanup feasibility studies for Inner PRI areas (the most contaminated areas of the Site). EPA agreed to defer the Inner PRI area sampling scheduled under the Phase 1A SAP while ERM carried out assessment of historic data and addressed technical issues for completing a screening level risk assessment (SLRA) for the Inner PRI areas. Under the Phase 1A SAP, US Magnesium and ERM were to decide by June 2014 whether to proceed with the streamlined RI/FS or go back to the process set out in the Phase 1A Sampling Plan.

On October 30, 2013, ERM (for US Magnesium) accepted the EPA-proposed streamlined RI/RA approach for the Inner PRI areas, with a SLRA technical memorandum and Inner PRI data report to be provided by the end of December 2013. EPA replied on November 8, 2013, indicating ERM should have sufficient time to discuss preliminary remediation goals (PRGs; i.e., preliminary action levels) and reach a decision on EPA's offer in June 2014, enabling RI/FS activity for Inner PRI areas to commence in 2014.

On March 20, 2014, the EPA replied to another ERM request to delay sampling of the Inner PRI areas until after waste lagoons dried out (following a RCRA settlement, after which waters would presumably no longer be discharged into Inner PRI area ponds). With a final SLRA report for the Inner PRI areas (to include PRGs) to be delivered in May 2014, EPA reminded US Magnesium that unless it decided in June 2014 to implement the streamlined FS process, considerable Inner PRI area work pursuant to the Phase 1A SAP needed to proceed in 2014.

During June/July 2014, US Magnesium indicated it would likely discontinue pursuing the SLRA and streamlined RI/FS approach and implement the original SOW included in the AOC. In a letter dated August 1, 2014, EPA noted that reverting to the AOC SOW could be more costly and the time required for RI/FS completion and remedy selection would be extended considerably. EPA further noted that given ERM's completion of the SLRA technical memorandum, final historic data report, and preliminary risk-estimate summaries, there was little additional effort required to complete a SLRA report as a basis for establishing PRGs for the Inner PRI areas.

In a meeting on August 20, 2014, ERM outlined a process for completing COPC refinement and PRG development for an Inner PRI areas SLRA report to be submitted by the end of December 2014, for a final decision regarding the streamlined FS approach by US Magnesium in January 2015. At this meeting, ERM proposed to immediately initiate DQO development to complete a Phase 1B (nature and extent) investigation of the Inner PRI areas in 2015. In a letter dated November 3, 2014, EPA emphasized that completing PRG development in 2014 was paramount and that ERM was to submit by December 2014 a draft agenda for an Inner PRI areas Phase 1B scoping meeting to be held in February 2015.

In a December 2, 2014 meeting, EPA reviewed ERM's draft *Preliminary Data Quality Objective Framework, OU1 Phase 1B for Nature and Extent* and highlighted a number of inconsistencies in the document and its lack of a clear DQO rationale. ERM agreed to update the document after US Magnesium's late January decision deadline and prepare for review at the February 2015 scoping meeting. In late 2014, the EPA acceded that US Magnesium/ERM could develop a draft Phase 1A-B RI SAP for EPA review and approval.

In late January 2015, US Magnesium declined EPA's streamlined FS offer. On February 20, 2015, ERM submitted a scoping meeting agenda and a revised DQO document. At the March 11-12, 2015, scoping meeting, ERM requested that EPA provide in MS Word format the pertinent sections of the Phase 1A SAP worksheets, which ERM could use as a template for the Phase 1A-B SAP.

The OU-1 Phase 1A-B SAP accomplishes the objectives of the original Phase 1A SAP of 2013 and also includes a major section dealing with the startup of Background Study investigations and the approach to data evaluation for initial mapping of nature and extent of contamination.

State and Federal Consultation. The EPA has a State Superfund Memorandum of Agreement with the Utah Department of Environmental Quality (UDEQ) Division of Environmental Response and Remediation (DERR) (per National Oil and Hazardous Substances Pollution Contingency Plan [NCP] Part 300.505). The State and the EPA have agreed that EPA Region 8 would be the lead agency for site management and remedial response actions at the Site and the EPA maintains a close working partnership with UDEQ-DERR throughout the RI/FS planning process. The EPA has also engaged in consultations with federal and state trustees for natural resources in accordance with NCP Parts 300.600 and .615.

The format of this document is generally consistent with specifications of the Intergovernmental Data Quality Task Force Uniform Federal Policy (UFP) for QAPPs, *Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs, Part 1: UFP-QAPP Manual* (EPA 2005b). The manual is available at the following website:

http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

2. *Cover Page: Edit to the SAP title:*

*PHASE 1A-B
REMEDIAL INVESTIGATION
SAMPLING AND ANALYSIS PLAN
for
Soil, Sediment, and Solid Wastes PRI Areas 1 and 3 through 7,
Preliminary Site Characterization Mapping,
and*

Background Chemical and Biota Study

Resolution: The change to the SAP title is not appropriate because it does not accurately describe the document content or scope of work as agreed to by ERM and USEPA during the DQO development process. The Phase 1 A-B SAP is applicable to all of OU-1 and does not include a biotic study. None of the data quality planning requirements listed in AOC paragraph 47 or in the SOW support that the original SAP title was inadequate or deficient. The final SAP will retain the original title.

The near wholesale replacement of "OU-1" with "PRI Areas 1 and 3 through 7" is inconsistent with the description of the investigation as agreed to during the DQO process and as stipulated by USEPA, on 2 June 2015, in the final edits to DQO Sections 11.1 and 11.2 for the Inner PRI area and background investigations. As such, use of the term "OU-1" is not a deficiency in the SAP and the term OU-1 will not be deleted or replaced with "PRI Areas 1 and 3 through 7" in the SAP per USEPA's suggestions. This includes Sections 11.1 and 11.2, which included the final DQO language as previously stipulated by USEPA, and Worksheets 9, 11, 14, and 16.

3. *2.0 SAP IDENTIFYING INFORMATION (SAP WORKSHEET #2):* *USEPA modified this section to include a timeline of the Remedial Investigation (RI) and Feasibility Study (FS) activities since EPA's issuance of the Phase 1A RI Sampling and Analysis Plan (SAP) in September 2013.*

   Resolution: Section 2.0 of the final Phase 1 A-B SAP will include the following text:

   > The Remedial Investigation (RI), Risk Assessment (RA), and Feasibility Study (FS) include a 5-mile radius area around the plant stack. The EPA (as set forth in the 2011 AOC and Statement of Work) anticipated US Magnesium and its contractor Environmental Resources Management (ERM) to implement RI, RA, and FS activities for the study area in phases under plans issued and/or approved by the EPA. Risk assessment work being conducted by ERM and EPA is proceeding concurrently with each phase and element of the RI/FS.
   >
   > During planning and scoping meetings with ERM in 2011 and early 2012, initial plans were for a Phase 1 investigation to identify chemicals of potential concern (COPCs) and evaluate preliminary nature and extent for site characterization covering preliminary remedial investigation areas (PRIs) across the Site. ERM collected limited samples in 2012 to carry out a demonstration of methods applicability (DMA) to evaluate the suitability of sampling and analytical methods. Scoping considerations by ERM during 2012 were the basis to initiate site investigations in two phases: a Phase 1A Sampling and Analysis Plan (SAP) to ascertain COPCs, to be followed by a Phase 1B SAP to characterize the nature and extent of COPCs.
   >
   > The initial Phase 1A RI objectives for the entire Site included the following:
   >
   > - Develop preliminary Conceptual Site Model (CSM) and RI/Risk Scoping.

- Develop SAP specifications for the RI to identify COPCs in media types and pathways across all PRI areas of the Site.
- Conduct surveys to assess ecological habitats, types of human and ecological receptors, and potential exposures threatening human health and the environment, as noted in the preliminary CSM.
- Develop a Screening-Level Ecological Risk Assessment (SLERA) and refine the Preliminary CSM for potential human and ecological risk.

In accordance with the AOC-SOW and beginning in May 2013, EPA prepared a Phase 1A SAP (with Quality Assurance Project Plan [QAPP]) issued in September 2013, which laid out the preliminary conceptual specifications necessary to commence Phase 1A investigations (to identify COPCs) across the Site. However, numerous technical problems and inconsistencies essential for implementing the portion of the Phase 1A SAP in the most contaminated areas of the Site (the Inner PRI areas), identified by ERM in a comment letter dated 28 June 2013, were not addressed in Revision 0 of the Final Phase 1A SAP.

In comments on the draft SAP and as EPA was finalizing the site-wide Phase 1A SAP in August 2013, ERM and US Magnesium (having reviewed data from the DMA investigations of Inner-PRIs indicating high concentrations of numerous constituent contaminant chemicals, and presuming little chance of eliminating any chemicals as COPCs) asserted that Phase 1A investigations of the Inner PRI areas (for COPC identification) were not necessary and proposed instead to proceed to Phase 1B investigations to determine preliminary nature and extent. The EPA (as noted in the September 2013 Final Phase 1A SAP cover letter) accommodated US Magnesium and ERM's request to postpone implementation of Phase 1A sampling for the Inner PRI areas.

When the Phase 1A SAP was originally issued in September 2013, EPA offered US Magnesium an alternative, streamlined RI/FS framework using appropriate data collected during previous RCRA investigations (and limited samples collected during initial Superfund [DMA] investigations), along with “conservative” screening risk assessments, in order to forego detailed RI/RA and proceed directly to cleanup feasibility studies for Inner PRI Areas 1 and 3 through 7 (the most contaminated areas of the Site). EPA agreed to further defer the Inner PRI areas sampling scheduled under the Phase 1A SAP while ERM carried out assessment of historic data and addressed technical issues for completing a screening level risk assessment (SLRA) for the Inner PRI areas. US Magnesium and ERM were to decide in 2014 whether to proceed with the streamlined RI/FS or go back to the process set out in the Phase 1A SAP.

In August 2014, as US Magnesium further considered EPA’s streamlined FS offer, ERM, responding to EPA’s concerns about continuing delay of Inner PRI area investigations, committed to carry out in 2015 an investigation that would entail the components of both Phase 1A and Phase 1B sampling investigations for the Inner PRI areas. In January 2015, US Magnesium declined EPA’s streamlined FS offer.

At a scoping meeting in March 2015, EPA reviewed ERM’s draft DQO document and proposed sampling plans for the Inner PRI areas. ERM then began to develop DQOs for a Draft SAP for Phase 1A (COPCs) and Phase 1B (preliminary nature and extent) investigations of the Inner PRI areas — the subject of this document.

During 2014, as part of the implementation of the Phase 1A SAP, ERM completed an Ecological Habitat Survey and was near completion of a Human Exposure Survey. ERM had completed the Phase 1A solid media sampling for the Outer PRI Areas 2 and 8 through 16, groundwater sampling for PRI Area 17, and sampling for chronic COPCs in air (chlorine and hydrochloric acid). Given ongoing Inner PRI considerations by US Magnesium and ERM during 2014, the EPA again agreed to defer Phase 1A sampling of surface waters until 2015.

In parallel with the CERCLA site investigations, US Magnesium, EPA Region 8 RCRA Program, and the US Department of Justice (DOJ) are in settlement negotiations to address those aspects of Site operations to be subject to RCRA Corrective Action. While EPA's Superfund Program anticipates that certain aspects or portions of the site will be addressed under jurisdiction of RCRA, this Phase 1A-B SAP proceeds with site investigations pursuant to the CERCLA AOC-SOW until a RCRA settlement can be reached and the parties know which portions of the Site will be addressed by RCRA. In any case, the information collected will be used to help identify chemicals of concern and understand the nature and extent of contamination at the Site that will be addressed under RCRA and CERCLA, respectively.

The Phase 1A-B investigation will identify OU-1 COPCs and determine preliminary nature and extent. In addition, preliminary mapping of COPCs will be conducted to characterize the potential scope and scale of contaminant distribution within the Inner PRI areas.

While reviewing data for the Phase 1A Outer PRI areas and during Phase 1A-B scoping discussions, ERM and EPA recognized the need for a Background Study of contaminant concentrations that may be unrelated to Site releases. The Phase 1A-B SAP, therefore, will evaluate abiotic chemical constituents at select "off-site" locations. The Phase 1A-B Background Study will:

- Identify locations (beyond the RI study area) as reference areas; and
- Collect data to compare naturally occurring chemicals of concern to constituents within the RI study areas.

This Phase 1A-B SAP is project-specific and pertains only to the Phase 1A-B activities and implementation. Briefing and planning sessions that have been held are identified in Worksheet (WS) #9.

Phase 1A-B activities will include acquisition of data allowing

> development of a refined list of chemicals in order to select COPCs; these acquired data also will be necessary to prepare a plan for more complete investigations of the Site. Additional phases of the RI will be planned after completion of the Phase 1A-B RI and SLERA by ERM/US Magnesium, and determination by EPA of any need for additional data to complete the baseline human health and ecological RAs.
>
> Phase 1A-B activities will include sampling Site media to evaluate the nature and extent of contaminants within the soils, sediments and wastes of the Inner PRI areas, and to obtain preliminary data to support initial risk calculations. Phase 2 will include additional sampling of Site media to fill data gaps and to reduce uncertainties in the Phase 1A-B data sets.

The RI/FS Project Plan provided by the USEPA will not be included as Attachment 2 to the SAP because it is mostly irrelevant to the sampling and analysis activities for the OU-1 Phase 1A-B RI and is not required or suggested by any of the data quality planning requirements listed in AOC paragraph 47 or in the SOW.

4. <u>*Worksheet 10, Section 10.1, 2nd paragraph:*</u> *The text was modified to revise the stated basis used by USEPA for establishing PRI areas in the Phase 1A SAP.*

Resolution: The SAP text will not be revised per the USEPA's suggestion because the description provided in the SAP is correct and the USEPA's proposed revision does not accurately reflect the stated basis for PRI areas provided in the Phase 1A SAP, Worksheet 10, Section 10.7:

> "The PRI areas were established based on similarities of wastes in terms of COPCs and their previously identified concentrations, and on locations and sizes of the areas to be studied."

5. <u>*Worksheet 10, Section 10.1, 3rd paragraph:*</u> *The text was modified to add the Gypsum Pile to the list of areas where historical data have shown the highest concentrations of HCB, PCB, and PCDD/PCDF.*

Resolution: The suggested edit would make the SAP internally inconsistent, as the description of PRI Area 4 later in Section 10.1 states that "[h]istorical data suggest that concentrations of PCB, PCDD/PCDF, and HCB are lower in the gypsum pile than in the wastewater ditches and wastewater ponds." Furthermore, the original description is consistent with the USEPA's preliminary CSM from the Phase 1A SAP (Section 10.3.1.1), which states:

> "Concentrations of these contaminants appear to be highest in the Site ditches (the Central Ditch, Chlorine Ditch, Western Ditch, and Main Ditch), the Old Waste Lagoon (Northeast Ponded Waste Lagoon), and the Active Waste Lagoon (Southeast and Northwest Ponded Waste Lagoons)."

6. *<u>Worksheet 10, Section 10.1, 2nd to last paragraph:</u> The text was modified to omit a reference to the NPDS permit for the old Waste Pond and add descriptions for times when PRI Area 7 has standing water*

Resolution: ERM believes the fact that USEPA permitted the original waste pond is relevant information and should be retained in the SAP. Furthermore, the USEPA found it necessary and relevant to include multiple references to the UPDES permit for the ATI discharge in Worksheet 10 the Phase 1A SAP. ERM agrees that PRI Area 7 typically has standing water during springtime and during large rain events. The USEPA has suggested that standing water may also be due to spring runoff and groundwater infiltration. Runoff is a presumed effect of large rain events; therefore, it is unnecessary to list runoff in the text. Groundwater infiltration (or groundwater recharge) would remove water from the waste lagoon and is therefore not a plausible explanation for standing water. The meaning of '"site-water inflows" is not provided, nor is it clear how these inflows would differ from the groundwater seeps and intermittent flooding by wastewater from PRI Area 5, which are already listed.

The sentence will therefore be revised as follows:

> Currently, the waste lagoon intermittently has standing water during springtime and following large rain events.

7. 13.0 *SECONDARY DATA CRITERIA AND LIMITATIONS (SAP WORKSHEET #13), Header: USEPA changed the header of column 4 to read "How Data Where/Will Be Used."*

Resolution: The header of column 4 will not be changed. This column identifies how secondary data were used (e.g., during DQO development) or will be used (e.g., during contaminant mapping for preliminary nature and extent evaluations).

8. 13.0 *SECONDARY DATA CRITERIA AND LIMITATIONS (SAP WORKSHEET #13), last row: USEPA revised the description for how historical Inner PRI data will be used for nature and extent mapping. The Draft SAP stated that historical data will be included in chemical concentration maps and geostatistical evaluations. The revision by USEPA states that these data "may be" used "once comparability of the data sets has been determined."*

Resolution: The modifications suggested by the USEPA would make the SAP internally inconsistent and are not implementable. The USEPA previously stipulated in the final edits to the DQOs for preliminary nature and extent that historical data will be used for chemical mapping. Worksheet 11, Sections 11.2.5.3 states:

> "Chemical mapping will include data from the Phase 1A-B RI and the historical/DMA data described in the Final Inner PRI Data Report (ERM 2014a)."

Additionally, Worksheet 11.2.6.3 states:

> "The validated and verified Phase 1A-B data will be combined with historical/DMA data and used to prepare chemical concentration maps and perform geostatistical modeling and statistical evaluations as described in Section 11.2.5.3."

Furthermore, the determination of "comparability of the data sets" is not an objective of the OU-1 Phase 1A-B RI, nor is there any explanation for how this determination would be made. For these reasons, the modifications suggested by the USEPA for the last row in Worksheet 13 will not be made to the SAP.

9. *Worksheet 14, Section 14.4, first bullet: USEPA revised the description to state that historical/DMA data "may" be used for chemical mapping instead of "will" be used, and noted that limitations on the use of such secondary data are identified in Worksheet 12.*

Resolution: As described above under the Resolution for Worksheet 13, final row, to be consistent with the final USEPA edits to the DQO, the SAP will not be changed to state that historical/DMA data "may" be used. The USEPA's suggested edit incorrectly references Worksheet 12 for the limitations on existing use of secondary data; this reference should be to Worksheet 13. The SAP will be revised as follows:

> The Phase 1A-B RI Data Report will include maps showing chemical constituent concentrations for the primary risk drivers in each Inner PRI Area. Maps will include historical/DMA data presented in the Final Inner PRI Data Report (ERM 2014a). Worksheet 13 identifies limitations on use of secondary data.

10. *16.0 PROJECT SCHEDULE / TIMELINE (WORKSHEET #16): USEPA heavily edited the project schedule, eliminating essential Phase 1A-B RI tasks that are identified in Worksheet 14 and adding purported "milestones" which are neither specified in the AOC nor agreed to by ERM.*

Resolution: Worksheet 16 is the subject of ongoing discussions between ERM and USEPA and will be revised to include mutually agreed to milestones for the Final OU-1 Phase 1A-B RI SAP.

11. 23.0 *ANALYTICAL SOP REFERENCES (SAP WORKSHEET #23), column at right "Summary of Project-Specific Work Instructions (Refer to Lab SOP for Details": USEPA selectively made extensive modifications to the "summary" of work instructions, apparently replacing the summary provided in the SAP with the complete text from the Laboratory Work Instructions SOP WS-WI-0037 included in SAP Attachment 19.*

Resolution: It is inappropriate to include the entire Work Instructions in the "Summary of Work Instructions" column of Worksheet 23. By including this information, the column would no longer constitute a "summary." In addition, not all of the Work Instruction items are relevant to OU-1 Phase 1A-B RI sample analysis. For example, no high-level aqueous samples will be analyzed as part of the OU-1 Phase 1A-B RI; therefore, it is not relevant to include these Work Instructions in the Worksheet 23 summary.

After reviewing SOP WS-WI-0037 and the summary provided in Worksheet 23, ERM has identified the following changes be made to SAP Worksheet 23:

WS-IDP-0005 – replace text with:

- Note whether sample is designated as high-level or low-level per COC form, based on criteria in Attachment 1 to WS-WI-0037. Samples will be prepared and analyzed as indicated in Attachment 1 to WS-WI-0037.
- As appropriate for high-level samples, some reduction in sample extraction mass is allowed so as to reduce the mass of the target analytes in the initial extracts. Additional dilutions should be prepared as described in Attachment 1 to WS-WI-0037.

WS-ID-0005 – Retain summary from draft SAP; it is not appropriate or necessary to repeat the Work Instructions in their entirety.

WS-IDP-0013 - Retain summary from draft SAP; it is not appropriate or necessary to repeat the Work Instructions in their entirety.

WS-ID-0013 – Replace text with:

- As appropriate, dilute extracts to the maximum extent possible while still retaining quantitation by isotope dilution as described in Attachment 2 to WS-WI-0037.
- For sample extracts with concentrations greater than the calibration range at maximum dilution, re-extract the samples

at a minimum 10X dilution based on original results, as described in Attachment 2 to WS-WI-0037.

- After re-extraction at dilution, if results are greater than the calibration range at the maximum dilution, qualify results as estimated.

2162-SOP – It is important to note that HRMS analysis will be performed by TestAmerica, not Alpha Analytical. Replace text with:

- As appropriate, dilute extracts to the degree necessary, provided the analyses still meet project data use requirements and retaining quantitation by isotope dilution.

- For high-level results greater than the calibration range or the linear response range of the detector, re-extract the samples at a more appropriate dilution.

- If LRMS sample has no congener detected above 20 µg/kg, then ERM will request TestAmerica to analyze sample by HRMS.

WS-OP-0001 – Retain summary from draft SAP; it is not appropriate or necessary to repeat the Work Instructions in their entirety.

WS-MS-0005 – Retain summary from draft SAP; the information shown in the draft SAP is the same as in the Phase 1A SAP. No changes have been made to Attachment 3 of the Work Instructions.

WS-MS-008 – Retain summary from draft SAP; the USEPA edited text is from Attachment 3, which applies to SVOC–SIM screen analyses and is part of the WS-MS-0008 SOP for PAH analysis and is not a special work instruction.

12. *Worksheet 37, Section 37.2.4.2: Recent discussions between ERM and USEPA have identified that clarity or modifications are required for the specific process by which fingerprinting would be performed for background, regional reference, and Site dioxin and PCB data. This is captured in USEPA Comment No. 11.*

***Resolution**:* A revised/clarified fingerprinting evaluation will be included in Worksheet 37 of the revised SAP. This process was discussed with the USEPA and is summarized in the attached process diagram, which will replace SAP Worksheet 37, Figure 37-3.

13. *Attachment 21, SOP USM-12, Surface Solids Sampling within Current Wastewater Ponds: In USEPA Comment No. 13, USEPA has requested a revision to the helicopter sampling SOP to increase the number of the minimum number of attempts required at each SAP location from three to six and to clearly define "what constitutes a successful attempt."*

Resolution: The SOP as written reflects the level of effort that was discussed by ERM and the Agencies at the OU-1 Phase 1B Scoping meeting, as summarized in the scoping meeting outcome notes (SAP Attachment 9H) and as modified by the USEPA in their revisions to the scoping outcomes (SAP Attachment 9M):

> The following protocol was formulated as a potential methodology to be included in the Phase 1A/1B SAP:
>
> - First, attempt to collect a sample at the planned location with a grab sampler deployed from a helicopter (two to three attempts per location).
> - Second, attempt to collect a sample by helicopter at a nearby location (e.g., approximately 100 feet from the original; two to three attempts per location).
> - Third, relocate the sampling location to the vicinity of a submerged sample that was successfully collected (two to three attempts per location).
> - Finally, if and only if all attempts above fail, seek USEPA approval to relocate sampling location to the nearest shoreline

Because the SOP reflects the agreed-upon level of effort and there is no technical basis provided for requiring six attempts at each SAP location, ERM does not agree with the proposed change. The SOP will therefore not be revised to include the suggested six attempts at each SAP location.

Step 17 of the SOP will be revised per the Agency comment to clarify that a sampler malfunction (such as pin-release failure) does not count as a valid attempt; however, Step 17 will not be revised to include speculation about box corer performance as a function of the number of supplemental weights used. Box corer testing completed in June 2015 and observed by the USEPA showed that increasing weight of the box marginally improved performance. Because USEPA appears concerned that insufficient weight may cause inadequate penetration, the SOP will be revised to require that the box corer be equipped with the maximum number of supplemental weights.

The revised SOP will be submitted as an attachment to the Sediment Sampler Testing Results Technical Memorandum.

If you have any questions regarding these proposes modification to the Phase 1 A-B SAP, please contact me at (480) 998-2401. We look forward to completing the SAP and initiating the planning tasks necessary to initiate field work in the fall of 2015.

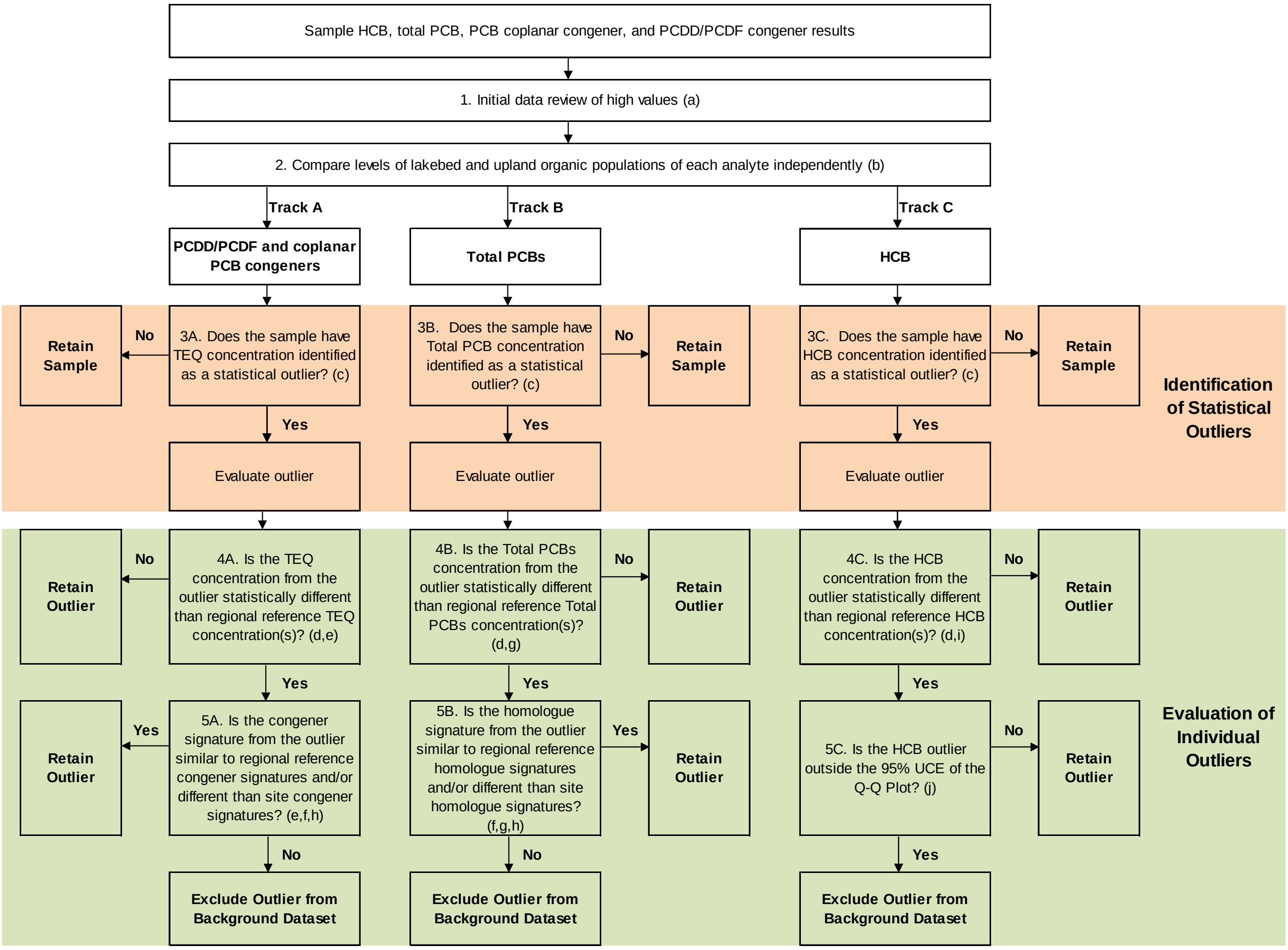
Sincerely,

David J. Abranovic, P.E.
Project Coordinator (ERM)

DJA/jcb/0132320
Attachments

cc: David Gibby (US Mag)
Mark Ransom (ERM)

Attachment



Notes
(a) An initial data review of background data will be conducted to confirm anomalous or high results are not the result of transcription or other error.
(b) The organic results from the Lakebed population will be compared to the Upland population using nonparametric statistics (Wilcoxon Rank Sum or Gehan Test) to determine if the populations are significantly different. If populations are significantly different, the remaining DQA steps will be performed on Lakebed and Upland populations separately. Otherwise, the remaining steps will be conducted on the organic population as a whole.
(c) Statistical outliers will be identified using the Rosner test in ProUCL. TEQs will be calculated using mammalian TEFs.
(d) The statistical method that will be used to compare outliers to regional datasets will be determined based on what the regional reference data support.
(e) TEQ concentrations and congener pattern signatures from regional reference data will be from the Front Range Dioxin Study (USEPA 2002) and/or other studies if available.
(f) Congener and homologue pattern signatures will be calculated as the relative proportions of each congener (dioxin, furan and coplanar PCB) or PCB homologue samples. Ordination and statistical evaluations will be used to examine individual outliers relative to the congener and homologue signatures of the site population and available regional reference populations.
(g) Regional reference data for total PCB concentrations and homologue pattern signatures will be identified and utilized if available. If regional reference data are not available, the decision process will skip Step 4B and advance to Step 5B, where background homologue signatures will be compared to site homologue signatures only.
(h) Site signatures for congener patterns (dioxin, furan and coplanar PCB) and PCB homologue patterns will be developed using data collected from the site.
(i) Regional reference data for HCB will be identified and utilized if available. If regional reference data are not available, the decision process will skip Step 4C and advance to Step 5C, where statistical outliers will be evaluated using Q-Q plots.
(j) Q-Q plots with a 95% confidence envelope will be generated in the statistical software R. If the statistical outlier falls outside the 95% UCE, and also occurs after a discontinuity in the data plot, the samples will be considered elevated relative to the background population.

DQA - Data Quality Assessment
HCB - Hexachlorobenzene
PCB - Total Polychlorinated Biphenyls
PCDD/PCDF - Polychlorinated dibenzo-p-dioxin/polychlorinated dibenzofuran
TEF - Toxic Equivalency Factor
TEQ - Toxic Equivalents
UCE - Upper Confidence Envelope

USEPA. 2002. Denver Front Range Study of Dioxin in Surface Soil. Prepared for and jointly by: U.S. Environmental Protection Agency, Region 8; Remediation Venture Office of the Rocky Mountain Arsenal; Colorado Department of Public Health and Environment; SRC; and Gannett Fleming Inc. July.

Figure 37-3 (Revised 29 July 2015)
Decision Tree for Background Organics Data Evaluation
OU-1 Phase 1A-B RI SAP
US Magnesium LLC
Tooele County, Utah

Attachment 9BB

5 August 2015 Background sample depth proposal

From: Jennifer Holder
Sent: Thursday, August 13, 2015 4:39 PM
To: Kevin Lundmark
Subject: FW: BG sample depth proposal

From: Jennifer Holder
Sent: Wednesday, August 05, 2015 2:54 PM
To: Dan Wall (wall.dan@epa.gov); Wendy O'Brien (obrien.wendy@epa.gov); brattin@srcinc.com; Scott Everett (SEVERETT@utah.gov); mstorck@utah.gov; Chris Cline (Chris_Cline@fws.gov); dcox@blm.gov; Sherry Skipper (sherry_skipper@fws.gov); Mark Jones; Mark Shibata; Karen Cejas; Judy Nedoff
Subject: BG sample depth proposal

Hello all,
On the risk call of 7/30, a request was made by EPA to consider soil sampling at depth at the reference locations to provide some site-specific evidence that the reference locations do not have subsurface contamination. We have considered this request and present the following proposal. Please let us know if this adequately addresses your concern. If so, we will modify the Phase 1a/b SAP to reflect this change.

Proposal -
Objective: Confirm that sub-surface soil at reference locations does not contain anthropogenic contamination that is not present in surface soil (e.g., due to waste dumping or burial).

Plan: At each sampling area, including BRMBR, collect a sample from 1 to 3 feet bgs for analysis of HCB, PCBs, D/F, and total metals. The sample would be collected following SOP USM-09, *SUBSURFACE SOIL, SEDIMENT, AND WASTE SAMPLING* using a portable flighted auger with soil sampling probe or a compressed-gas powered direct push corer. The subsurface sample would be co-located with a sample location near the center of each of the sampling areas. The 3-foot sample depth was selected based on the shallow depth to groundwater within lakebed areas and to be representative of the soil horizon over which most ecological receptors would be exposed.

Thanks,
-Jen

Jennifer Holder, Ph.D.
Partner
Sediments and Watershed Integrated Management (SWiM)
ERM

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+1 805 680 8484 - mobile

Email: jennifer.holder@erm.com

Visit our new website at www.erm.com

Attachment 9CC

10 August 2015 Re: ERM's July 29, 2015 letter regarding EPA's July 17, 2015 Modifications to ERM's Draft Phase 1A-B SAP, Submitted July 2, 2015

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8
1595 Wynkoop Street
Denver, CO 80202-1129
Phone 800-227-8917
www.epa.gov/region08

AUG 10 2015

Attachment to Electronic Mail

Ref: 8ENF-L

Mr. M. Lindsay Ford
Parsons Behle & Latimer
South Main Street, Suite 1800
Salt Lake City, Utah 84111

Re: ERM's July 29, 2015 letter regarding EPA's July 17, 2015 Modifications to ERM's Draft Phase 1A-B SAP, submitted July 2, 2015.

Dear Mr. Ford:

As you may know, Environmental Resources Management (ERM) submitted a "Draft Phase 1A-B SAP" to the U.S. Environmental Protection Agency (EPA) and the State of Utah on July 2, 2015. The Agencies responded to this submittal on July 17, 2015, approving the submittal with modifications, in accordance with paragraph 39 of the August 4, 2011, Administrative Order on Consent (AOC) between EPA and US Magnesium (US Mag) for the US Magnesium Superfund Site. Mr. David J. Abranovic of ERM responded to the Agencies' modifications by letter dated July 29, 2015, in which ERM objected to, revised, or did not include a number of the modifications in a final submittal. ERM also required the Agencies to provide additional information justifying certain modifications and challenged certain modifications as inconsistent with EPA guidance.

A number of ERM's responses to the Agencies' modification of the submittal were presented in the context of the AOC and the Statement of Work attached to the AOC. I am writing to clarify the process under the AOC. EPA Region 8's Superfund Program will communicate separately with Mr. Abranovic about the technical aspects of ERM's response to EPA's modification of ERM's Draft Phase 1A-B Sampling and Analysis Plan.

As you know, Section X of the AOC sets forth a process under which US Mag (or ERM as US Mag's designated contractor), submits plans and submissions to EPA, and how EPA responds to those submissions. Under AOC paragraph 39 of Section X, once EPA has reviewed a submittal from US Mag, the Agency must do one of the following:

(1) approve the submittal in whole or in part,
(2) modify the submittal to cure deficiencies,
(3) disapprove the submittal in whole or in part with directions for modifications, or
(4) any combination of the above.

Also under paragraph 39, if EPA modifies a submission, US Mag is provided with an "opportunity to cure" within twenty days. Otherwise, if EPA approves, approves upon conditions, or modifies a submittal, US Mag is to "take any action required . . . subject only to its right to invoke the Dispute Resolution procedures set forth in Section XV . . . ."

Thus far, EPA, US Mag and ERM have not strictly followed the submittal/approval process set out in the AOC. The parties have continued to discuss submittals after the Agencies have provided modifications. Sometimes these continued discussions have led to improved submittals; however, these additional discussions inevitably delay the site remedial investigation and increase costs for both EPA and USM.

Mr. Abranovic's July 29, 2015, letter refers to EPA's "suggested modifications" to the Phase 1 A-B SAP. However, as the approval process is set out under paragraph 39(c) of the AOC, EPA's modifications would not be suggestions, and would not be subject to additional examination or resolution, unless, of course, USM believes it is necessary to invoke dispute resolution.

To date EPA has worked collaboratively with ERM to discuss the terms of submissions, schedules and other aspects of the CERCLA investigation at the US Mag Site. For example, as Mr. Abranovic's letter points out, EPA and ERM have held a number of scoping meetings at different stages of the investigation process, even though the Statement of Work under the AOC calls only for one scoping meeting for any given phase of the investigation.

Site investigations have also been delayed, in part, by ERM's practice of issuing multiple drafts of submittals for discussion, rather than a document that ERM considers an official submittal to be approved by EPA under AOC. EPA has not specifically objected to this practice, although the Agency has noted that in some cases these drafts, too, cause delay. Nonetheless, EPA has worked with ERM to discuss these drafts and agree on submittals, to the extent it can, before they become final and approvable under the AOC process.

US Mag has in the past expressed concern over the cost of investigating contamination at the company's Utah facility. US Mag should understand that, whenever the parties continue to discuss individual submissions beyond the process set out under the AOC, all of the investigation activities are delayed, and the associated costs are increased.

EPA believes that discussing its modification of ERM's submittals can add value to the end product, and, generally, we do not want to discourage interaction with ERM; however, ERM should not interpret EPA's willingness to participate in these additional discussions as the process as it is set out under the AOC. EPA's submittal modifications are intended to keep the remedial investigation process on track and proceeding as efficiently and effectively as possible.

EPA will continue to respond to US Mag's submittals in accordance with the AOC; and, to the extent it is appropriate, EPA will continue to discuss its modifications of ERM's submittals. However, US Mag should appreciate that, making an effort to continue with the remedial investigation schedule under the process set out in the AOC is to both parties' benefit.

If you have any questions about the submittal approval process under the AOC, please feel free for you, or Mr. Abranovic, to contact me.

Sincerely,

Steven B. Moores
EPA Region 8 Legal Enforcement Program

cc: David J. Abranovic
David Gibby (US Mag)
Mark Ransom (ERM)
Michael Storck (UDEQ)

AGENCY FINAL MODIFICATIONS TO
ERM'S RESPONSE (29 July 2015)
TO AGENCY MODIFICATIONS (17 July 2015)
TO ERM'S
DRAFT PHASE 1A-B REMEDIAL INVESTIGATION SAMPLING AND ANALYSIS PLAN
(ERM document date: 2 July 2015)

U.S. MAGNESIUM NPL SITE, TOOELE COUNTY, UTAH
10 August 2015

INTRODUCTION

The U.S. Environmental Protection Agency and the Utah Department of Environmental Quality (the Agencies) provide the following determinations for ERM to prepare a final *Phase 1A-B Remedial Investigation Sampling and Analysis Plan* (Phase 1A-B RI SAP) for EPA approval.

The introductory text of ERM's letter dated 29 July 2015, ERM referred to the Agencies correspondence of 17 July 2015 as "suggested modifications" to the Phase 1A-B RI SAP. Further, in the introductory text, ERM and US Magnesium noted exception to the USEPA's reference to the AOC.

The final modifications required herein clarify the facts surrounding the activities at the Site and will ensure a thorough and complete Phase 1A-B RI SAP.

The EPA is including the text of ERM's 29 July 2015 submittal below, illustrated by *italic* and/or green font. The agencies require the modifications indicated by red font to be included in a final Phase 1A-B RI SAP for EPA approval. Rationale for each modification is presented in *italic* and blue font.

The Agency rationale included as 'Comment notes' included herein are not to be a part of the Phase 1A-B RI SAP document.

****

1. *PREFACE: USEPA added a preface to provide a summary of the activities leading up to the development of the Phase 1 A-B SAP and to give the reader context for how the sample design was developed.*

Resolution: ERM is in general agreement with the Preface text provided by the USEPA; however, there were several inaccuracies, omissions, and unnecessary and/or redundant statements that need to be corrected. ERM proposes the following text be included as the Preface of the final Phase 1 A-B SAP:

> The U.S. Environmental Protection Agency (EPA) placed the US Magnesium Site (Site) on the National Priorities List (NPL) for remedial response pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) in November 2009. The U.S. Court of Appeals for the Washington D.C. Circuit upheld EPA's action for the listing in August 2010.
>
> The US Magnesium plant electro-chemically processes magnesium chloride (derived from Great Salt Lake brine waters) in melt-reactors and electrolytic cells (adding petroleum-coke and hydrochloric-acid) to produce primary magnesium-metal and chlorine. The volume of by-product waste streams being released has increased 20 percent since the start of ~~the~~ remedial investigation and feasibility study (RI/FS) sampling in 2013, and includes: (1) acidic liquid and slurry streams containing hexachlorobenzene (HCB), polychlorinated biphenyls (PCBs), and dioxins/furans, and (2) liquid and gaseous releases of chlorine (Cl_2) and hydrogen-chloride (HCl), as well as particulates/aerosols containing chlorinated organic compounds. While the entire Site is included on the NPL, which requires that the Site undergo an RI/FS and potential remedial action pursuant to CERCLA, the plant proper remains in continuous operation and is subject to various requirements under the Clean Air Act and the Resource Conservation and Recovery Act.

Comment note: EPA is: (a) re-inserting the language that more fully describes the manufacturing process (as was in the 2013 EPA-issued Phase 1A RI SAP); and (b) including the percentage of increased production since 2013 to provide a more complete picture of the associated waste stream changes that have occurred.

Administrative Settlement Order on Consent for Remedial

Investigation/Feasibility Study. In August 2011, EPA and US Magnesium entered into an Administrative Order on Consent (AOC) for RI/FS, under which US Magnesium (supported by Environmental Resources Management [ERM]) is to carry out the work required for RIs, data management, risk assessment (RA), and FS for consideration of remedial action. The AOC and Appendix A: Statement-of-Work (SOW) for RI/FS call for scoping meetings during which US Magnesium/ERM engages in planning and technical discussions with the EPA for EPA's consideration in developing particular phases and stages of Sampling and Analysis Plans (SAPs). Numerous planning and scoping meetings to develop a site-wide Phase 1A SAP (described below) were held from October 2011 through March 2013. Subsequent discussions addressing the Inner PRI areas (the most contaminated portions of the Site) and refinement of RI activities for the Inner PRI areas occurred between August 2014 and March 2015; final development of this Phase 1A-B RI SAP (see below) is summarized in this document. Upon EPA approval and issuance of this Phase 1A-B RI SAP, US Magnesium/ERM is required to implement the Inner PRI areas and Background Study investigations as specified in this SAP.

Phase 1A RI SAP. In accordance with the AOC-SOW, the EPA issued the *Phase 1A Remedial Investigation Sampling and Analysis Plan to Identify Chemicals of Potential Concern in Soils, Sediment, Solid Waste, Water and Air, and Receptor Surveys (Revision 0) for PRI Areas 2 and 8 through 17* (EPA 2013) (Phase 1A RI SAP) (with Quality Assurance Project Plan [QAPP]) in September 2013, laying out the technical specifications to implement Phase 1A investigations (identification of chemicals of potential concern [COPCs]) across the Site. However, ~~ERM identified numerous~~ technical issues (health and safety and sampling method considerations for highly acidic and inundated areas of the waste ponds) associated with sampling and analysis in PRI Areas 1 and 3 through 7 (Inner PRI areas) included in the Phase 1A SAP (Revision 0) ~~that~~ needed to be resolved prior to initiating this portion of the SAP. In order to initiate sampling and data collection activities in 2013 and begin remedial investigations of PRI Areas 2 and 8 through 17 (Outer PRI areas), as well as reduce the need for multiple sampling plan documents, the EPA issued the Phase 1A RI SAP as Revision 0 without ~~addressing the technical issues needed to commence sampling in the Inner PRI areas, depending on the outcome of deliberations regarding~~ the Inner PRI areas. The general framework of the Phase 1A RI SAP provided for simple modification which would enable start-up of investigations of the Inner PRI areas.

Comment note: The technical issues for which EPA had agreed to delay sampling in the Inner PRI areas were: (a) ERM selecting a sampling methodology for the highly acidic and inundated areas (albeit difficult, but achievable); (b) addressing analytical cost concerns (which EPA recognized by accommodating an evaluation of less costly, low resolution mass spectroscopy methods); and (c) submittal of a different plan for the Inner PRI areas (as ERM had proposed) to investigate the nature and extent of contamination.

Upon completion of the Air DMA, the EPA approved the *Phase 1A Remedial Investigation Sampling and Analysis Plan for Operable Unit 2 – Ambient Air* (ERM 2014), which finalized the basis for standard operating procedures and worksheets pertinent to commencing the air investigations in PRI Area 18.

Development of the Phase 1A-B RI SAP. While the EPA was finalizing the Phase1A RI SAP, ERM and US Magnesium (having reviewed data from DMA investigations of Inner PRI areas indicating high concentrations of numerous constituent contaminant chemicals, and presuming little chance of eliminating suites of chemicals as COPCs (therefore not eliminating analytical methods from the RI)) asserted that Phase 1A investigations of the Inner PRI areas (for COPC identification) were not necessary, and instead proposed proceeding with Phase 1B investigations to determine preliminary nature and extent. Accordingly, the EPA sent a September 2013 cover letter and accompanying Attachment 5 for issuance of the Final Phase 1A RI SAP, to accommodate the request by US Magnesium and ERM to postpone implementation of Phase 1A sampling for the most contaminated areas of the Site until 2014, allowing US Magnesium to consider an alternative offer by EPA for a more streamlined risk assessment and for accomplishing FS objectives for the Inner PRI areas.

When the Phase 1A SAP was issued, EPA offered US Magnesium an alternative, streamlined RI/FS framework using appropriate data collected during previous RCRA investigations (and limited samples collected during initial Superfund [DMA] investigations), along with “conservative” screening risk assessments, in order to forego detailed remedial investigations and risk assessment and proceed to cleanup feasibility studies for Inner PRI areas (the most contaminated areas of the Site). EPA agreed to defer the Inner PRI area sampling scheduled under the Phase 1A SAP while ERM carried out assessment of historic data and addressed technical issues for completing a screening level risk assessment (SLRA) for the Inner PRI areas. Under the Phase 1A SAP, US Magnesium and ERM were to decide by June 2014 whether to proceed with the streamlined RI/FS or go back to the process set out in the Phase 1A Sampling Plan.

On October 30, 2013, ERM (for US Magnesium) accepted the EPA-proposed streamlined RI/RA approach for the Inner PRI areas, with a SLRA technical memorandum and Inner PRI data report to be provided by the end of December 2013. EPA replied on November 8, 2013, indicating ERM should have sufficient time to discuss preliminary remediation goals (PRGs; i.e., preliminary action levels) and reach a decision on EPA’s offer in June 2014, enabling RI/FS activity for Inner PRI areas to commence in 2014.

On March 20, 2014, the EPA replied to another ERM request to delay sampling of the Inner PRI areas until after waste lagoons dried out (following a RCRA settlement, after which waters would presumably no longer be discharged into Inner PRI area ponds). With a final SLRA report for the Inner PRI areas (to include PRGs) to be delivered in May 2014, EPA reminded US Magnesium that unless it decided in June 2014 to implement the streamlined FS process, considerable Inner PRI area work pursuant to the Phase 1A SAP needed to proceed in 2014.

During June/July 2014, US Magnesium indicated it would likely discontinue pursuing the SLRA and streamlined RI/FS approach and implement the original SOW included in the AOC. In a letter dated August 1, 2014, EPA noted that reverting to the AOC SOW could be more costly and the time required for RI/FS completion and remedy selection would be extended considerably. EPA further noted that given ERM’s completion of the SLRA technical memorandum, final historic data report, and preliminary risk-estimate summaries, there was little additional effort required to complete a SLRA report as a basis for establishing PRGs for the Inner PRI areas.

In a meeting on August 20, 2014, ERM outlined a process for completing COPC refinement and PRG development for an Inner PRI areas SLRA report to be submitted by the end of December 2014, for a final decision regarding the streamlined FS approach by US Magnesium in January 2015. ~~At this meeting, ERM proposed to immediately initiate DQO development to complete a Phase 1B (nature and extent) investigation of the Inner PRI areas in 2015.~~ At this meeting, responding to EPA concerns about continuing delay of Inner PRI areas investigations, ERM also proposed to immediately initiate DQO development to complete a Phase 1B (nature and extent) investigation of the Inner PRI areas in 2015, and complete a Phase 2 (detailed site-characterization) investigation for baseline risk assessment in 2016. In a letter dated November 3, 2014, EPA emphasized that completing PRG development in 2014 was paramount and that ERM was to submit by December 2014 a draft agenda for an Inner PRI areas Phase 1B scoping meeting to be held in February 2015.

Comment note: The text required by the EPA is necessary to explain the delays experienced in commencing the investigation of the Inner PRI areas and highlight commitments made by US Magnesium and ERM to complete such work. The EPA text also supports the RI/FS timeline discussed in Section 2.0 and in Attachment 2.

In a December 2, 2014 meeting, EPA reviewed ERM's draft *Preliminary Data Quality Objective Framework, OU1 Phase 1B for Nature and Extent* and highlighted a number of inconsistencies in the document and its lack of a clear DQO rationale. ERM agreed to update the document after US Magnesium's late January decision deadline and prepare for review at the February 2015 scoping meeting. In late 2014, the EPA acceded that US Magnesium/ERM could develop a draft Phase 1A-B RI SAP for EPA review and approval.

In late January 2015, US Magnesium declined EPA's streamlined FS offer. Absent ERM's submittal of a draft agenda and scheduling of a February scoping meeting, EPA pressed ERM for the submittal and scheduled the meeting for March 11-12, 2015. On February 20, 2015, ERM submitted a scoping meeting agenda and a revised DQO document. At the March 11- 12, 2015, scoping meeting, ERM requested that EPA provide in MS Word format the pertinent sections of the Phase 1A SAP worksheets, which ERM could use as a template for the Phase 1A-B SAP.

Comment note: The required text re-inserted by the EPA provides necessary context for the delays in start-up of Inner PRI investigations at this Site.

The OU-1 Phase 1A-B SAP, while essentially the same approach to sampling as that in the Phase 1A SAP, accomplishes the objectives of the original Phase 1A SAP of 2013 and enables start-up of Inner PRI investigations. This Phase 1A-B RI SAP also includes a major section dealing with the startup of Background Study investigations and the approach to data evaluation for initial mapping of nature and extent of contamination.

Comment note: The required text re-inserted by the EPA explains the transition and pertinent differences between the original Phase 1A RI SAP and this Phase 1A-B RI SAP for initiating the start-up of Inner PRI investigations and additional important RI/FS elements.

State and Federal Consultation. The EPA has a State Superfund Memorandum of Agreement with the Utah Department of Environmental Quality (UDEQ) Division of Environmental Response and Remediation (DERR) (per National Oil and Hazardous Substances Pollution Contingency Plan [NCP] Part 300.505). The State and the EPA have agreed that EPA Region 8 would be the lead agency for site management and remedial response actions at the Site and the EPA maintains a close working partnership with UDEQ-DERR throughout the RI/FS planning process. The EPA has also engaged in consultations with federal and state trustees for natural resources in accordance with NCP Parts 300.600 and .615.

The format of this document is generally consistent with specifications of the Intergovernmental Data Quality Task Force Uniform Federal Policy (UFP) for QAPPs, *Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs, Part 1: UFP-QAPP Manual* (EPA 2005b). The manual is available at the following website: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

2. *Cover Page: Edit to the SAP title:*

PHASE 1A-B
REMEDIAL INVESTIGATION
SAMPLING AND ANALYSIS PLAN
for
Soil, Sediment, and Solid Wastes PRI Areas 1 and 3 through 7,
Preliminary Site Characterization Mapping,
and
Background Chemical and Biota Study

Resolution: The change to the SAP title is not appropriate because it does not accurately describe the document content or scope of work as agreed to by ERM and USEPA during the DQO development process. The Phase 1 A-B SAP is applicable to all of OU-1 and does not include a biotic study. None of the data quality planning requirements listed in AOC paragraph 47 or in the SOW support that the original SAP title was inadequate or deficient. The final SAP will retain the original title.

Comment note: The EPA has revised the title (based on pertinent suggestions provided by ERM) to more accurately describe the contents, scope, and applicability of the document. The document will be referred to as the Phase 1A-B RI SAP for short.

The EPA notes that the Inner PRI areas encompassed by the Phase 1A-B RI SAP represent only approximately 0.5 percent of the entire land area of the US Magnesium Site Study Area (OU-1). The revised title provides the necessary clarification of the applicability to PRI Areas 1 and 3 through 7 (for COPCs and preliminary mapping) and for Site-wide OU-1 (background chemicals reference areas). It is true the Phase 1A-B RI SAP does not include an actual biota study; however, the background chemical component is being done to support potential biota studies as part of an ecological risk assessment. Accordingly, the document title will be as follows:

OU-1 REMEDIAL INVESTIGATIONS
PHASE 1A-B SAMPLING AND ANALYSIS PLAN
for
1) Chemicals of Potential Concern in Soil, Sediment, and Solid Wastes in PRI Areas 1 and 3 through 7;
2) Preliminary Site Characterization Mapping of PRI Areas 1 and 3 through 7;
and
3) Background Chemical Assessment of Biotic Reference Areas for Site-wide Ecological Risk Assessment

The near wholesale replacement of “OU-1” with “PRI Areas 1 and 3 through 7” is inconsistent with the description of the investigation as agreed to during the DQO process and as stipulated by USEPA, on 2 June 2015, in the final edits to DQO Sections 11.1 and 11.2 for the Inner PRI area and background investigations. As such, use of the term “OU-1” is not a deficiency in the SAP and the term OU-1 will not be deleted or replaced with “PRI Areas 1 and 3 through 7” in the SAP per USEPA’s suggestions. This includes Sections 11.1 and 11.2, which included the final DQO language as previously stipulated by USEPA, and Worksheets 9, 11, 14, and 16.

Comment note: ERM is correct when noting that the text provided by the EPA for the DQOs stated “OU-1.” However, in context with the entire draft Phase 1A-B RI SAP, the use of “OU-1” in Sections 11.1 and 11.2 is not accurate. The Phase 1A-B RI SAP will be revised to accurately reflect the scope of the specific objective or sampling program. Therefore, ERM shall use “PRI Areas 1 and 3 through 7” when discussing Inner PRI activities and “OU-1” when discussing background activities.

3. <u>2.0 SAP IDENTIFYING INFORMATION (SAP WORKSHEET #2):</u> *USEPA modified this section to include a timeline of the Remedial Investigation (RI) and Feasibility Study (FS) activities since EPA's issuance of the Phase 1A RI Sampling and Analysis Plan (SAP) in September 2013.*

Resolution*: Section 2.0 of the final Phase 1 A-B SAP will include the following text:*

The Remedial Investigation (RI), Risk Assessment (RA), and Feasibility Study (FS) include a 5-mile radius area around the plant stack. The EPA (as set forth in the 2011 AOC and Statement of Work) anticipated US Magnesium and its contractor Environmental Resources Management (ERM) to implement RI, RA, and FS activities for the study area in phases under plans issued and/or approved by the EPA. Risk assessment work being conducted by ERM and EPA is proceeding concurrently with each phase and element of the RI/FS.

During planning and scoping meetings with ERM in 2011 and early 2012, initial plans were for a Phase 1 investigation to identify chemicals of potential concern (COPCs) and evaluate preliminary nature and extent for site characterization covering preliminary remedial investigation areas (PRIs) across the Site. ERM collected limited samples in 2012 to carry out a demonstration of methods applicability (DMA) to evaluate the suitability of sampling and analytical methods. Scoping considerations by ERM during 2012 were the basis to initiate site investigations in two phases: a Phase 1A Sampling and Analysis Plan (SAP) to ascertain COPCs, to be followed by a Phase 1B SAP to characterize the nature and extent of COPCs.

The initial Phase 1A RI objectives for the entire Site included the following:

- Develop preliminary Conceptual Site Model (CSM) and RI/Risk Scoping.
- Develop SAP specifications for the RI to identify COPCs in media types and pathways across all PRI areas of the Site.
- Conduct surveys to assess ecological habitats, types of human and ecological receptors, and potential exposures threatening human health and the environment, as noted in the preliminary CSM.
- Develop a Screening-Level Ecological Risk Assessment (SLERA) and refine the Preliminary CSM for potential human and ecological risk.

In accordance with the AOC-SOW and beginning in May 2013, EPA prepared a Phase 1A SAP (with Quality Assurance Project Plan [QAPP]) issued in September 2013, which laid out the preliminary conceptual specifications necessary to commence Phase 1A investigations (to identify COPCs) across the Site. ~~However, numerous technical problems and inconsistencies essential for implementing the portion of the Phase 1A SAP in the most contaminated areas of the Site (the Inner PRI areas), identified by ERM in a comment letter dated 28 June 2013, were not addressed in Revision 0 of the Final Phase 1A SAP~~.

Comment note: The sentence inserted by ERM and the assertion that the EPA did not address previously-raised concerns is not supportable. The EPA in fact addressed these technical issues by agreeing to delay sampling in the Inner PRI areas to enable ERM to: (a) select and submit a sampling methodology for inundated waste-lagoons (albeit difficult, but achievable); (b) address analytical cost concerns (which EPA recognized by accommodating an evaluation of the suitability of less-costly low-resolution mass spectroscopy methods and its use); and (c) submit a different plan for the Inner PRI areas (as ERM had proposed) to investigate the nature and extent of contamination. The Phase 1A SAP provided for these matters to be addressed in follow-on submittals to be prepared and submitted by ERM in a timely manner for the Inner PRI investigations. ERM did address item (b), but was not forthcoming with information regarding (a) and (c), and finally addressed those matters in the draft Phase 1A-B RI SAP.

In comments on the draft SAP and as EPA was finalizing the site-wide Phase 1A SAP in August 2013, ERM and US Magnesium (having reviewed data from the DMA investigations of Inner-PRIs indicating high concentrations of numerous constituent contaminant chemicals, and presuming little chance of eliminating any chemicals as COPCs) asserted that Phase 1A investigations of the Inner PRI areas (for COPC identification) were not necessary and proposed instead to proceed to Phase 1B investigations to determine preliminary nature and extent. The EPA (as noted in the September 2013 Final Phase 1A SAP cover letter) accommodated US Magnesium and ERM's request to postpone implementation of Phase 1A sampling for the Inner PRI areas for the most contaminated areas of the Site (the Inner PRI areas) until 2014. ERM was to submit sampling method specifications and proceed with Inner PRI RI work in mid-2014.

Comment note: The schedule laid out in Worksheet #16 of the Phase 1A SAP responded to the ERM concerns noted above. The schedule also included place-holders for ERM to provide deliverables that would address ERM's stated concerns by US Magnesium/ERM either providing technical submittals or responding affirmatively to EPA's offer for proceeding to a streamlined risk assessment and FS. Neither occurred in accordance with the Phase 1A SAP timeline.

When the Phase 1A SAP was originally issued in September 2013, EPA offered US Magnesium an alternative, streamlined RI/FS framework using appropriate data collected during previous RCRA investigations (and limited samples collected during initial Superfund [DMA] investigations), along with "conservative" screening risk assessments, in order to forego detailed RI/RA and proceed directly to cleanup feasibility studies for Inner PRI Areas 1 and 3 through 7 (the most contaminated areas of the Site). EPA agreed to further defer the Inner PRI areas sampling scheduled under the Phase 1A SAP while ERM carried out assessment of historic data and addressed technical issues for completing a screening level risk assessment (SLRA) for the Inner PRI areas. US Magnesium and ERM were to decide in 2014 whether to proceed with the streamlined RI/FS or go back to the process set out in the Phase 1A SAP.

In August 2014, as US Magnesium further considered EPA's streamlined FS offer, ERM, responding to EPA's concerns about continuing delay of Inner PRI area investigations, committed to carry out in 2015 an investigation that would entail the components of both Phase 1A and Phase 1B sampling investigations for the Inner PRI areas. In January 2015, US Magnesium declined EPA's streamlined FS offer.

At a scoping meeting in March 2015, EPA reviewed ERM's draft DQO document and proposed sampling plans for the Inner PRI areas. ERM then began to develop DQOs for a Draft SAP for Phase 1A (COPCs) and Phase 1B (preliminary nature and extent) investigations of the Inner PRI areas — the subject of this document. US Magnesium and ERM have further agreed to carry out detailed site-characterization investigations in 2016 and baseline risk assessment in 2017.

Comment note: The EPA agrees that references to an FS in 2018 and the RI/FS report in 2020 are unnecessary in this section and otherwise noted in Attachment 2 (Site Management and Project Plan). The 2016 – 2017 dates are relevant because this Phase 1A-B RI SAP is the document intended to enable Phase 2 scoping for risk assessment completion.

During 2014, as part of the implementation of the Phase 1A SAP, ERM completed an Ecological Habitat Survey and was near completion of a Human Exposure Survey. ERM had completed the Phase 1A solid media sampling for the Outer PRI Areas 2 and 8 through 16, groundwater sampling for PRI Area 17, and sampling for chronic COPCs in air (chlorine and hydrochloric acid). Given ongoing Inner PRI considerations by US Magnesium and ERM during 2014, the EPA again agreed to defer Phase 1A sampling of surface waters until 2015.

By late 2013, US Magnesium and ERM recognized the importance of evaluating the risks from airborne chlorine (Cl2) and hydrochloric acid (HCl) as COPCs. An aspect of site-investigations which

ERM completed in 2014 pursuant to the Phase 1A SAP was air pathway sampling to obtain data to identify other potential COPCs in air. These data are under review by ERM and EPA. Accordingly, EPA has designated air pathway investigations as a separate Operable Unit (OU2), and air investigations and risk assessment of airborne Cl2/HCl releases are proceeding on a separate and independent track from site investigations and risk assessment addressing contamination in the soils, sediments, wastes, and waters of OU1 (PRI Areas 1 through 17).

Comment note: The EPA included this aspect of RI/FS activity because OU2 Air Investigations are an important element of site-wide investigations and site-characterization. While OU2 investigations are not directly addressed by this Phase 1A-B RI SAP, there is an indirect connection in that the reference areas being sampled as part of the Background Study may contain traces of anthropogenic chemicals that are similar to site-contaminants found within the Inner PRI areas. The Background Study may also provide data directly pertinent to the Phase 1A and Phase 1B investigations of Outer PRI areas potentially impacted by facility releases. The overall site-management and project plan Attachment 2 recognizes this aspect of the overall RI/FS. Therefore, for clarity and completeness, the paragraph is retained.

In parallel with the CERCLA site investigations, US Magnesium, EPA Region 8 RCRA Program, and the US Department of Justice (DOJ) are in settlement negotiations to address those aspects of Site operations to be subject to RCRA Corrective Action. While EPA's Superfund Program anticipates that certain aspects or portions of the site will be addressed under jurisdiction of RCRA, this Phase 1A-B SAP proceeds with site investigations pursuant to the CERCLA AOC-SOW until a RCRA settlement can be reached and the parties know which portions of the Site will be addressed by RCRA. In any case, the information collected will be used to help identify chemicals of concern and understand the nature and extent of contamination at the Site that will be addressed under RCRA and CERCLA, respectively.

While reviewing data for the Phase 1A Outer PRI areas and during Phase 1A-B scoping discussions, ERM and EPA recognized the need for a Background Study of contaminant concentrations that may be unrelated to Site releases. This study (as part of this Phase 1A-B RI SAP) will initially evaluate abiotic chemical constituents at select 'off-site' locations, and is preparatory to subsequent detailed biological chemical constituent investigations during Phase 2.

Phase 1A-B: Background Study of Chemical Constituents (2015)

- Identify locations (beyond the RI study area) as reference areas.
- Collect data to compare naturally occurring chemicals of concern to constituents within the RI study areas.

While addressed under a separate workplan from this Phase 1A-B RI SAP, an additional aspect of RI/FS work began in 2014 in response to US Magnesium's desire to conduct a treatability study to evaluate a 'Salt Cap' as a potential remedial alternative or portion of a remedial alternative. ERM agreed with EPA to also begin a screening-level FS to identify other remedial alternatives that should be evaluated in a detailed FS along with a 'Salt-Cap' alternative. In November 2014, EPA, UDEQ and ERM held a scoping meeting to discuss ERM's preparation of a Salt Cap Treatability Study (including a salt cap accumulation test which began in June 2015). ERM committed to developing a screening-level FS during 2015-2016.

Subsequent phases of the RIFS will include:

Phase 2: Detailed RI, Screening FS, and Baseline Risk Assessment (late-2015, 2016 and 2017)

- Develop DQOs and SAP specifications for detailed Site characterization and risk assessment.
- Perform detailed Site characterization and biotic studies.
- Complete screening-level FS, identifying RAOs and ARARs.
- Complete a Baseline Risk Assessment.
- Select screened alternatives to carry forward into detailed FS.

Phase 3: Detailed Feasibility Study (2018-2020)

- Establish preliminary risk-reduction goals (EPA and UDEQ).
- Develop specifications for the FS.
- Conduct FS for a range of remedial alternatives.

Phase 4: Remedial Response Decision (2021-2022)

- Prepare a Proposed Plan and Record of Decision (ROD).

Attachment 2 is a chart that summarizes RI/FS activities to date and shows the schedule for completing RI/FS activities and a Baseline Risk Assessment, followed by development of detailed Feasibility Study(s) and a Record of Decision selecting a cleanup remedy.

Comment note: The above text has been re-inserted while considering ERM's statement (below) that the RI/FS project plan is "…is mostly irrelevant…" ; however, the EPA believes the modification is relevant and appropriate. The AOC accommodates that this project may require numerous phases and elements of RI/FS activity as described above. As already being implemented at this complex site, the multiple and inter-related RI, risk-assessment, and FS activities as further outlined in Attachment 2 are otherwise not readily apparent to other Federal and State agencies or other interested stakeholders. It is within key documents (such as SAPs for major components of the RI) that interested parties can obtain a synopsis and understand the context for how plans (and outcome reports) fit within the overall RI/FS project under the NCP. For that reason, the EPA will include this overview in this SAP.

The Phase 1A-B investigation will identify OU-1 COPCs and determine preliminary nature and extent. In addition, preliminary mapping of COPCs will be conducted to characterize the potential scope and scale of contaminant distribution within the Inner PRI areas.

While reviewing data for the Phase 1A Outer PRI areas and during Phase 1A-B scoping discussions, ERM and EPA recognized the need for a Background Study of contaminant concentrations that may be unrelated to Site releases. The Phase 1A-B SAP, therefore, will evaluate abiotic chemical constituents at select "off-site" locations. The Phase 1A-B Background Study will:

- Identify locations (beyond the RI study area) as reference areas; and
- Collect data to compare naturally occurring chemicals of concern to constituents within the RI study areas.

This Phase 1A-B SAP is project-specific and pertains only to the Phase 1A-B activities and implementation. Briefing and planning sessions that have been held are identified in Worksheet (WS) #9.

Phase 1A-B activities will include acquisition of data allowing development of a refined list of chemicals in order to select COPCs; these acquired data also will be necessary to prepare a plan for more complete investigations of the Site. Additional phases of the RI will be planned after completion of the Phase 1A-B RI and SLERA by ERM/US Magnesium, and determination by EPA of any need for additional data to complete the baseline human health and ecological RAs.

Phase 1A-B activities will include sampling Site media to evaluate the nature and extent of contaminants within the soils, sediments and wastes of the Inner PRI areas, and to obtain preliminary data to support initial risk calculations. Phase 2 will include additional sampling of Site media to fill data gaps and to reduce uncertainties in the Phase 1A-B data sets. In addition, Phase 2 may include biota sampling, as well as further lateral and vertical sampling of soil, sediment, water and waste across areas subjected to the preliminary remedial investigation.

Comment note: EPA's re-inserted text addresses the additional potential for sampling of biotic media along with Site media sampling for complete Site characterization.

The RI/FS Project Plan provided by the USEPA will not be included as Attachment 2 to the SAP because it is mostly irrelevant to the sampling and analysis activities for the OU-1 Phase 1A-B RI and is not required or suggested by any of the data quality planning requirements listed in AOC paragraph 47 or in the SOW.

4. *Worksheet 10, Section 10.1, 2nd paragraph: The text was modified to revise the stated basis used by USEPA for establishing PRI areas in the Phase 1A SAP.*

Resolution: The SAP text will not be revised per the USEPA's suggestion because the description provided in the SAP is correct and the USEPA's proposed revision does not accurately reflect the stated basis for PRI areas provided in the Phase 1A SAP, Worksheet 10, Section 10.7:

> "The PRI areas were established based on similarities of wastes in terms of COPCs and their previously identified concentrations, and on locations and sizes of the areas to be studied."

The second paragraph of Section 10.1 shall read as follows:

> In the subsections that follow, a summary is provided for each Inner Preliminary Remedial Investigation (PRI) Area that includes a general description of the PRI Area and the known sources of wastes discharged to the PRI Area, and also to reflect changed site conditions since 2013. As described in the Phase 1A SAP, PRI Areas were established by EPA based on similarities to historic waste 'management' units and their previously identified contaminants, as well as locations and sizes of the areas to be studied.

Comment note: EPA's modified text for the Phase 1A-B RI SAP more appropriately conveys the meaning and intent of the entire context of the Ph1A SAP Sec. 10.7 which specifically states:

> *Based on the information presented in this CSM, EPA has classified the Site into PRI areas (shown on Figure 10-34) so that sampling efforts can be divided and sequenced in a logical manner. The PRI areas were established based on similarities of wastes in terms of COPCs and their previously identified concentrations, and on locations and sizes of the areas to be studied.*
>
> *These PRI areas and the specific strategies to be implemented within each are discussed in more detail in WS#11, WS#14, and WS#18. These units were established based in part on past investigations and previously identified WMAs identified by MWH and others, and on need for sampling outside the boundaries of the Magnesium Plant. The PRI areas outlined in this Phase 1A RI SAP are consistent with sources, depositions, media, and constituents as understood from the Preliminary CSM. After completion of activities specified in the Phase 1A RI SAP, including the human health survey and wildlife survey, EPA may consider reformulating the RI exposure or decision units. Upon completion of the Phase 1A investigations and screening-level RAs, EPA will consider the merits of revising PRI areas into decision units to optimize and better achieve objectives for subsequent investigations and RA estimation tasks.*

5. *Worksheet 10, Section 10.1, 3rd paragraph: The text was modified to add the Gypsum Pile to the list of areas where historical data have shown the highest concentrations of HCB, PCB, and PCDD/PCDF.*

Resolution: The suggested edit would make the SAP internally inconsistent, as the description of PRI Area 4 later in Section 10.1 states that "[h]istorical data suggest that concentrations of PCB, PCDD/PCDF, and HCB are lower in the gypsum pile than in the wastewater ditches and wastewater ponds." Furthermore, the original description is consistent with the USEPA's preliminary CSM from the Phase 1A SAP (Section 10.3.1.1), which states:

> "Concentrations of these contaminants appear to be highest in the Site ditches (the Central Ditch, Chlorine Ditch, Western Ditch, and Main Ditch), the Old Waste Lagoon (Northeast Ponded Waste Lagoon), and the Active Waste Lagoon (Southeast and Northwest Ponded Waste Lagoons)."

ERM suggested revision is acceptable.

6. *<u>Worksheet 10, Section 10.1, 2nd to last paragraph</u>: The text was modified to omit a reference to the NPDS permit for the old Waste Pond and add descriptions for times when PRI Area 7 has standing water*

Resolution: ERM believes the fact that USEPA permitted the original waste pond is relevant information and should be retained in the SAP. Furthermore, the USEPA found it necessary and relevant to include multiple references to the UPDES permit for the ATI discharge in Worksheet 10 the Phase 1A SAP.

Comment note: ERM has not indicated how this information is relevant to the purpose & objectives of the Phase 1A-B RI SAP. Even so, EPA will accept this 'historical-note' to be included in the PRI 7 description; however, a footnote presenting the complete facts about this permit will be included as follows:

> The facility operated under an NPDES Permit beginning in April 1979. The State of Utah was authorized by the EPA to manage their state NPDES program in July 1987. The permit UT-0000779 was issued by the State of Utah and was a zero discharge permit, with all effluent being pumped to the old waste water evaporation pond. At the time of a 1988 inspection (DMA-04571690) the new waste water pond was in operation and replaced the old waste water pond. There was some question as to the occurrence of seepage from the new evaporation pond, but the facility was not cited (DMA-0457169). The NPDES permit was renewed in 1989; however, it was not renewed by the State of Utah when it expired in 1994. The Utah Division of Water Quality in the non-renewal letter stated they were not permitting 'no-discharge' facilities.

ERM agrees that PRI Area 7 typically has standing water during springtime and during large rain events. The USEPA has suggested that standing water may also be due to spring runoff and groundwater infiltration. Runoff is a presumed effect of large rain events; therefore, it is unnecessary to list runoff in the text. Groundwater infiltration (or groundwater recharge) would remove water from the waste lagoon and is therefore not a plausible explanation for standing water.

The meaning of '"site-water inflows" is not provided, nor is it clear how these inflows would differ from the groundwater seeps and intermittent flooding by wastewater from PRI Area 5, which are already listed.

The sentence will therefore be revised as follows:

> Currently, the waste lagoon intermittently has standing water during springtime and following large rain events.

The second to last paragraph of Section 10.1 shall read as follows:

> PRI Area 7 (Northeast Ponded Waste Lagoon) is the former wastewater disposal pond, also referred to as the OWP. It is approximately 800 acres in size and was constructed concurrently with the initial construction of the plant in the early 1970s. In 1984, it was flooded by the GSL and closed to discharges. Currently, the waste lagoon intermittently has standing water during springtime (runoff and possible related to groundwater infiltration), large rain events, and increased site-water inflows. Groundwater seepage into the pond occurs at multiple locations along the southeastern edge of the pond. The OWP has intermittently been flooded by wastewater from PRI 5 due to undermining of the dyke separating PRI Areas 5 and 7.

Comment note: It is entirely plausible that there could be seasonal upward gradients of groundwater flow that intermittently discharge into the lagoon. ERM is making it sound as if the ONLY sources of inflow are either direct precipitation or 'leakages' from PRI 5. This statement also ignores the observed seeps coming into PRI 7 from the PRI 6 area as well as groundwater inflows. The exact sources and proportions of inflows are presently unknown.

7. *<u>13.0 SECONDARY DATA CRITERIA AND LIMITATIONS (SAP WORKSHEET #13), Header</u>: USEPA changed the header of column 4 to read "How Data Where/Will Be Used."*

Resolution: The header of column 4 will not be changed. This column identifies how secondary data were used (e.g., during DQO development) or will be used (e.g., during contaminant mapping for preliminary nature and extent evaluations).

ERM's resolution is acceptable. This appears to have been a typographical error from the agencies.

8. *<u>13.0 SECONDARY DATA CRITERIA AND LIMITATIONS (SAP WORKSHEET #13), last row:</u> USEPA revised the description for how historical Inner PRI data will be used for nature and extent mapping. The Draft SAP stated that historical data will be included in chemical concentration maps and geostatistical evaluations. The revision by USEPA states that these data "may be" used "once comparability of the data sets has been determined."*

Resolution: The modifications suggested by the USEPA would make the SAP internally inconsistent and are not implementable. The USEPA previously stipulated in the final edits to the DQOs for preliminary nature and extent that historical data will be used for chemical mapping. Worksheet 11, Sections 11.2.5.3 states:

> "Chemical mapping will include data from the Phase 1A-B RI and the historical/DMA data described in the Final Inner PRI Data Report (ERM 2014a)."

Additionally, Worksheet 11.2.6.3 states:

> "The validated and verified Phase 1A-B data will be combined with historical/DMA data and used to prepare chemical concentration maps and perform geostatistical modeling and statistical evaluations as described in Section 11.2.5.3."

Furthermore, the determination of "comparability of the data sets" is not an objective of the OU-1 Phase 1A-B RI, nor is there any explanation for how this determination would be made. For these reasons, the modifications suggested by the USEPA for the last row in Worksheet 13 will not be made to the SAP.

The original text of Worksheet 13 (last row of the table) is acceptable with the inclusion of the following footnote:

> Relevance of historic data maps will be determined based on the degree to which historic data are deemed to be representative of current site conditions.

Comment note: EPA agrees that maps which include the historic data will be prepared as part of the Phase 1A-B Data Report. However, the interpretation of the meaning and significance of any such maps will be contingent upon the degree to which the historic data are judged to be representative of current site conditions. As discussed previously, this judgment will be based on several considerations, including: (a) the comparability of the analytical data (specificity, sensitivity); and (b) statistical tests that compare the historic data to the Phase 1A-B data set.

9. *<u>Worksheet 14, Section 14.4, first bullet</u>: USEPA revised the description to state that historical/DMA data "may" be used for chemical mapping instead of "will" be used, and noted that limitations on the use of such secondary data are identified in Worksheet 12.*

***Resolution**:* As described above under the Resolution for Worksheet 13, final row, to be consistent with the final USEPA edits to the DQO, the SAP will not be changed to state that historical/DMA data "may" be used. The USEPA's suggested edit incorrectly references Worksheet 12 for the limitations on existing use of secondary data; this reference should be to Worksheet 13. The SAP will be revised as follows:

> The Phase 1A-B RI Data Report will include maps showing chemical constituent concentrations for the primary risk drivers in each Inner PRI Area. Maps will include historical/DMA data presented in

the Final Inner PRI Data Report (ERM 2014a). Worksheet 13 identifies limitations on use of secondary data.

With the inclusion of the footnote on Worksheet 13 as required above, ERM's proposed text for Section 14.4 is acceptable.

10. *<u>16.0 PROJECT SCHEDULE / TIMELINE (WORKSHEET #16):</u> USEPA heavily edited the project schedule, eliminating essential Phase 1A-B RI tasks that are identified in Worksheet 14 and adding purported "milestones" which are neither specified in the AOC nor agreed to by ERM.*

Resolution: Worksheet 16 is the subject of ongoing discussions between ERM and USEPA and will be revised to include mutually agreed to milestones for the Final OU-1 Phase 1A-B RI SAP.

ERM's path forward is acceptable subject to EPA finalizing appropriate milestones.

11. *<u>23.0 ANALYTICAL SOP REFERENCES (SAP WORKSHEET #23), column at right "Summary of Project-Specific Work Instructions (Refer to Lab SOP for Details":</u> USEPA selectively made extensive modifications to the "summary" of work instructions, apparently replacing the summary provided in the SAP with the complete text from the Laboratory Work Instructions SOP WS-WI-0037 included in SAP Attachment 19.*

Resolution: It is inappropriate to include the entire Work Instructions in the "Summary of Work Instructions" column of Worksheet 23. By including this information, the column would no longer constitute a "summary." In addition, not all of the Work Instruction items are relevant to OU-1 Phase 1A-B RI sample analysis. For example, no high-level aqueous samples will be analyzed as part of the OU-1 Phase 1A-B RI; therefore, it is not relevant to include these Work Instructions in the Worksheet 23 summary.

ERM's resolution is acceptable.

12. *<u>Worksheet 37, Section 37.2.4.2:</u> Recent discussions between ERM and USEPA have identified that clarity or modifications are required for the specific process by which fingerprinting would be performed for background, regional reference, and Site dioxin and PCB data. This is captured in USEPA Comment No. 11.*

Resolution: A revised/clarified fingerprinting evaluation will be included in Worksheet 37 of the revised SAP. This process was discussed with the USEPA and is summarized in the attached process diagram, which will replace SAP Worksheet 37, Figure 37-3.

The agencies accept Figure 37-3.

13. *<u>Attachment 21, SOP USM-12, Surface Solids Sampling within Current Wastewater Ponds:</u> In USEPA Comment No. 13, USEPA has requested a revision to the helicopter sampling SOP to increase the number of the minimum number of attempts required at each SAP location from three to six and to clearly define "what constitutes a successful attempt."*

Resolution: The SOP as written reflects the level of effort that was discussed by ERM and the Agencies at the OU-1 Phase 1B Scoping meeting, as summarized in the scoping meeting outcome notes (SAP Attachment 9H) and as modified by the USEPA in their revisions to the scoping outcomes (SAP Attachment 9M):

> The following protocol was formulated as a potential methodology to be included in the Phase 1A/1B SAP:
>
> - First, attempt to collect a sample at the planned location with a grab sampler deployed from a helicopter (two to three attempts per location).
> - Second, attempt to collect a sample by helicopter at a nearby location (e.g., approximately 100 feet from the original; two to three attempts per location).

- Third, relocate the sampling location to the vicinity of a submerged sample that was successfully collected (two to three attempts per location).
- Finally, <u>if and only if all attempts above fail, seek</u> USEPA approval to relocate sampling location to the nearest shoreline

Because the SOP reflects the agreed-upon level of effort and there is no technical basis provided for requiring six attempts at each SAP location, ERM does not agree with the proposed change. The SOP will therefore not be revised to include the suggested six attempts at each SAP location.

Step 17 of the SOP will be revised per the Agency comment to clarify that a sampler malfunction (such as pin-release failure) does not count as a valid attempt; however, Step 17 will not be revised to include speculation about box corer performance as a function of the number of supplemental weights used. Box corer testing completed in June 2015 and observed by the USEPA showed that increasing weight of the box marginally improved performance. Because USEPA appears concerned that insufficient weight may cause inadequate penetration, the SOP will be revised to require that the box corer be equipped with the maximum number of supplemental weights.

The revised SOP will be submitted as an attachment to the Sediment Sampler Testing Results Technical Memorandum.

ERM's resolution is acceptable.

Attachment 9DD

12 August 2015 Agency Approval of Phase 1A-B Background Sample Locations

---

From: Wangerud, Ken <wangerud.ken@epa.gov>
Sent: Wednesday, August 12, 2015 5:44 PM
To: Kevin Lundmark; David Abranovic
Cc: Skipper, Sherry; Bill Brattin; severett@utah.gov; Wall, Dan; OBrien, Wendy; Chris Cline
Subject: Agency Approval of Phase 1A-B Background Sample Locations

Kevin and David:

Thank you for our conversation morning about the pre-sampling clearances ERM needs to carry out in the Background Study sampling areas.

This email conveys EPA's approval of the proposed background study sampling locations.

Based on my consultations with the EPA technical team later this afternoon, I also understand that discussions they held today with ERM's staff should have resolved the remaining technical points to enable ERM to finalize and submit the 'Reconnaissance of Candidate Background Sampling Areas Technical Memorandum' for Agency approval.

Lastly, I anticipate likewise being able tomorrow to provide you with EPA approval of the BG study 'subsurface' field-sampling protocol.

I appreciate your diligence and efforts in moving the Draft Ph1A-B SAP toward complete and final EPA approval. Please contact me if you encounter problems with NHPA/SHPO clearances that could impact the startup of your field activities.

Ken

Ken Wangerud, Remedial Project Manager
Superfund Remedial Program
Office of Ecosystems Protection and Remediation
USEPA Region 8 - EPR/SR
1595 Wynkoop, Denver CO 80202-1129
- -
ofc. tel. 303-312-6703
fax 303-312-7151
wangerud.ken@epa.gov

From: Kevin Lundmark [mailto:Kevin.Lundmark@erm.com]
Sent: Wednesday, August 12, 2015 11:58 AM
To: Wangerud, Ken
Cc: David Abranovic
Subject: Phase 1A-B Background Sample Locations

Ken –
As we discussed this morning, ERM is prepared to finish Draft Reconnaissance of Candidate Background Sampling Areas Technical Memorandum to be submitted for EPA review/approval as Attachment 11 to the OU-1 Phase 1A-B SAP. We are waiting on Agency comments on the preliminary draft Tech Memo, but we understand that you will be following up with your technical team to help expedite their review/comments.

Because the Phase 1A-B RI sampling schedule for background areas is contingent on the completion of an archaeological survey and review by BLM per Section 106 of the NHCPA is required for sampling on BLM lands, we are requesting that EPA consider providing approval of the proposed background sampling locations prior to the finalization/approval of the Tech Memo. These locations and the rationale for selection have been discussed in detail with Chris Cline, Sherry

Skipper, and Scott Everett and were provided to the greater Risk Assessment group prior to the 30 July 2015 Risk Assessor call. To date we have received no objections to the proposed background sampling locations. The background sampling locations shown in the attached figures (numbered as Figures 4 – 8) and listed in the attached table (identified as Attachment D), were extracted from the Tech Memo. Advanced approval of these locations would enable us to promptly complete the archaeological survey as required by the BLM and help avoid potential delay for the background areas sampling. If you are not comfortable approving the background sample locations prior to the finalization/approval of the Reconnaissance of Candidate Background Sampling Areas Technical Memorandum, then we initiate the archaeological survey until after the Tech Memo is approved.

Please contact me or David if you have any questions or would like additional information.

Than you,
Kevin

. . . .

Kevin Lundmark
ERM

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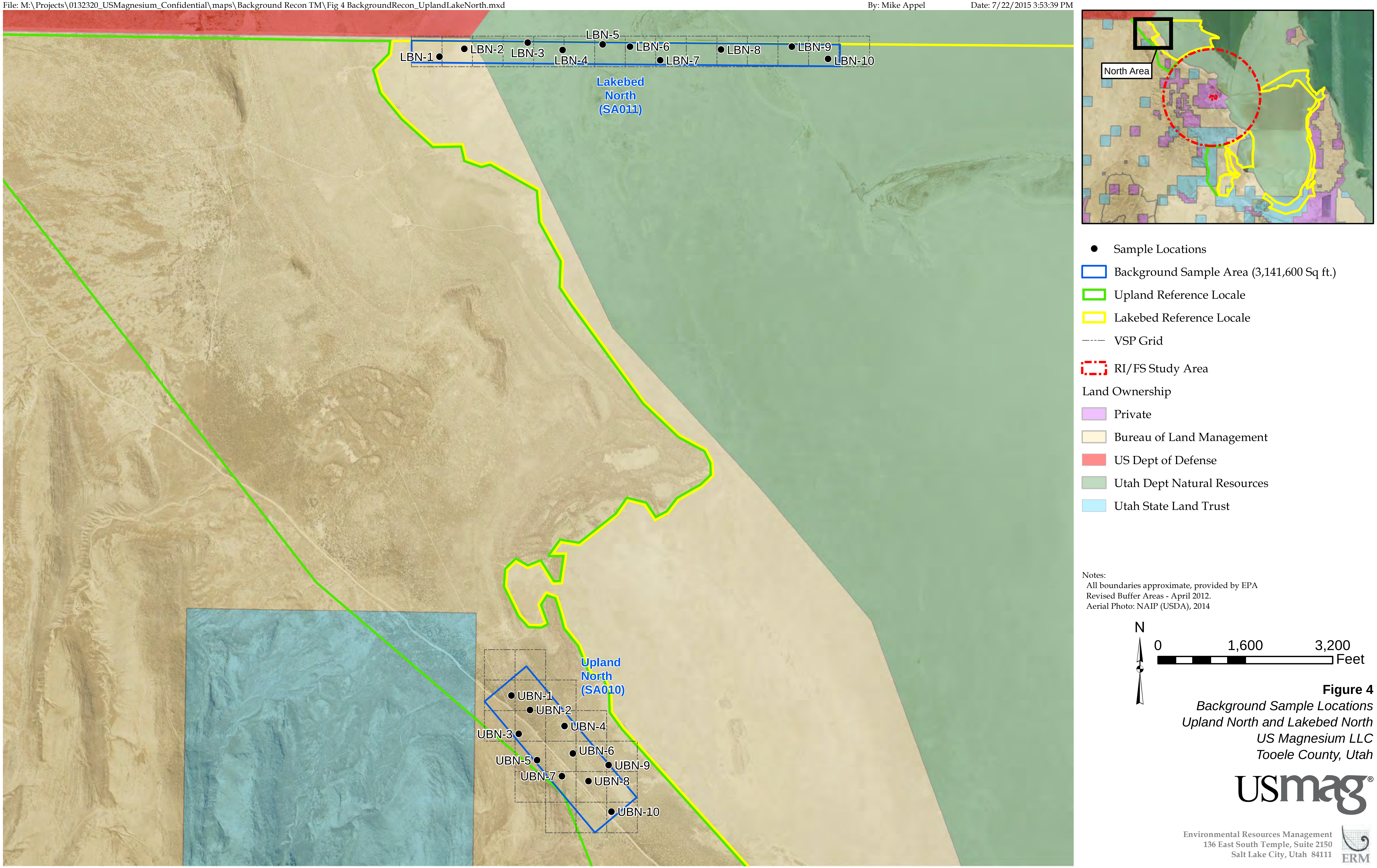
File: M:\Projects\0132320_USMagnesium_Confidential\maps\Background Recon TM\Fig 4 BackgroundRecon_UplandLakeNorth.mxd By: Mike Appel Date: 7/22/2015 3:53:39 PM



● Sample Locations
▭ Background Sample Area (3,141,600 Sq ft.)
▭ Upland Reference Locale
▭ Lakebed Reference Locale
- - - VSP Grid
▭ RI/FS Study Area

Land Ownership
▭ Private
▭ Bureau of Land Management
▭ US Dept of Defense
▭ Utah Dept Natural Resources
▭ Utah State Land Trust

Notes:
All boundaries approximate, provided by EPA
Revised Buffer Areas - April 2012.
Aerial Photo: NAIP (USDA), 2014

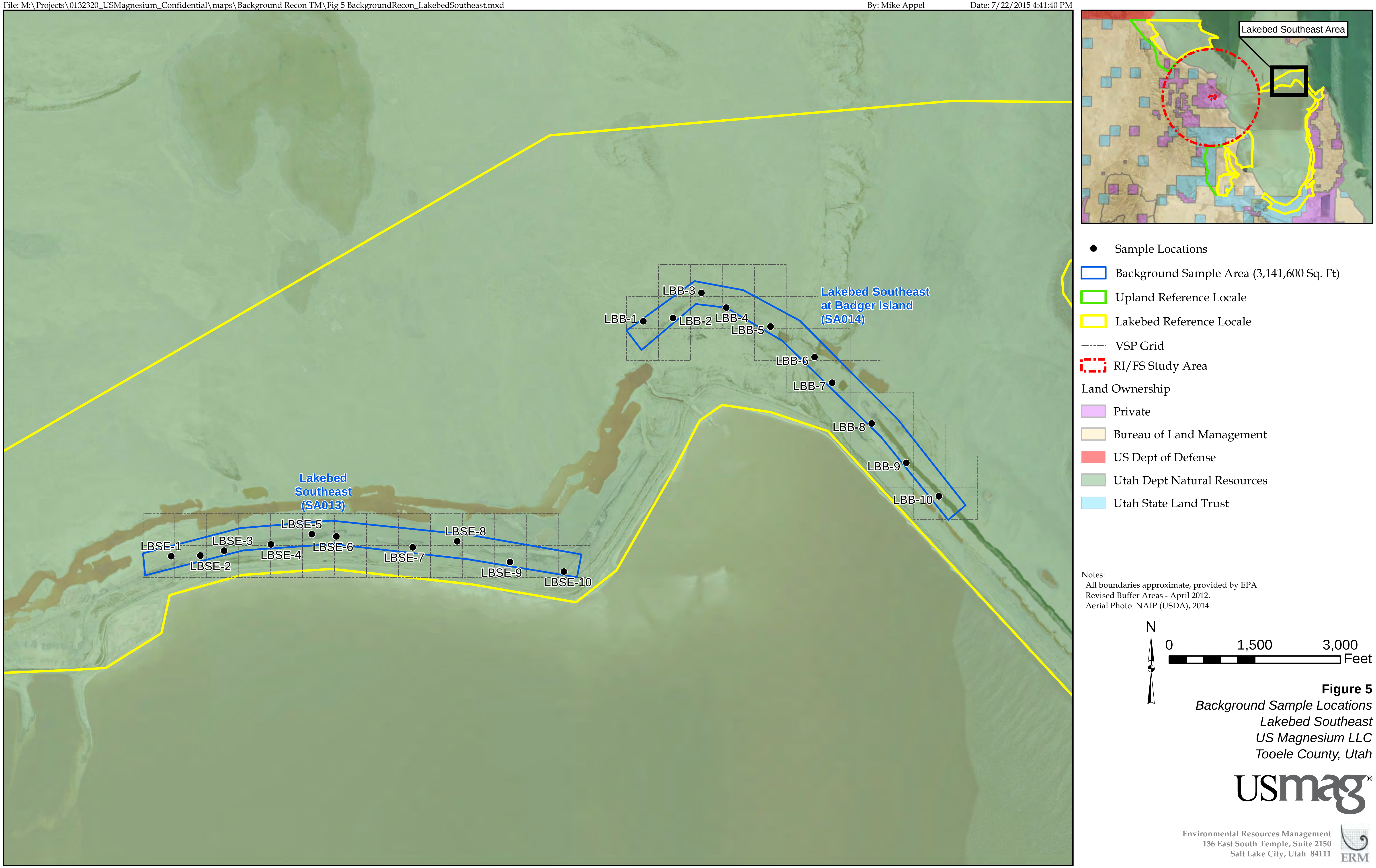
Figure 4

Background Sample Locations
Upland North and Lakebed North
US Magnesium LLC
Tooele County, Utah

USmag®

Environmental Resources Management
136 East South Temple, Suite 2150
Salt Lake City, Utah 84111
ERM

File: M:\Projects\0132320_USMagnesium_Confidential\maps\Background Recon TM\Fig 5 BackgroundRecon_LakebedSoutheast.mxd By: Mike Appel Date: 7/22/2015 4:41:40 PM



● Sample Locations
▭ Background Sample Area (3,141,600 Sq. Ft)
▭ Upland Reference Locale
▭ Lakebed Reference Locale
- - - VSP Grid
▭ RI/FS Study Area

Land Ownership

🟪 Private
🟨 Bureau of Land Management
🟥 US Dept of Defense
🟩 Utah Dept Natural Resources
🟦 Utah State Land Trust

Notes:
All boundaries approximate, provided by EPA
Revised Buffer Areas - April 2012.
Aerial Photo: NAIP (USDA), 2014

Figure 5
Background Sample Locations
Lakebed Southeast
US Magnesium LLC
Tooele County, Utah

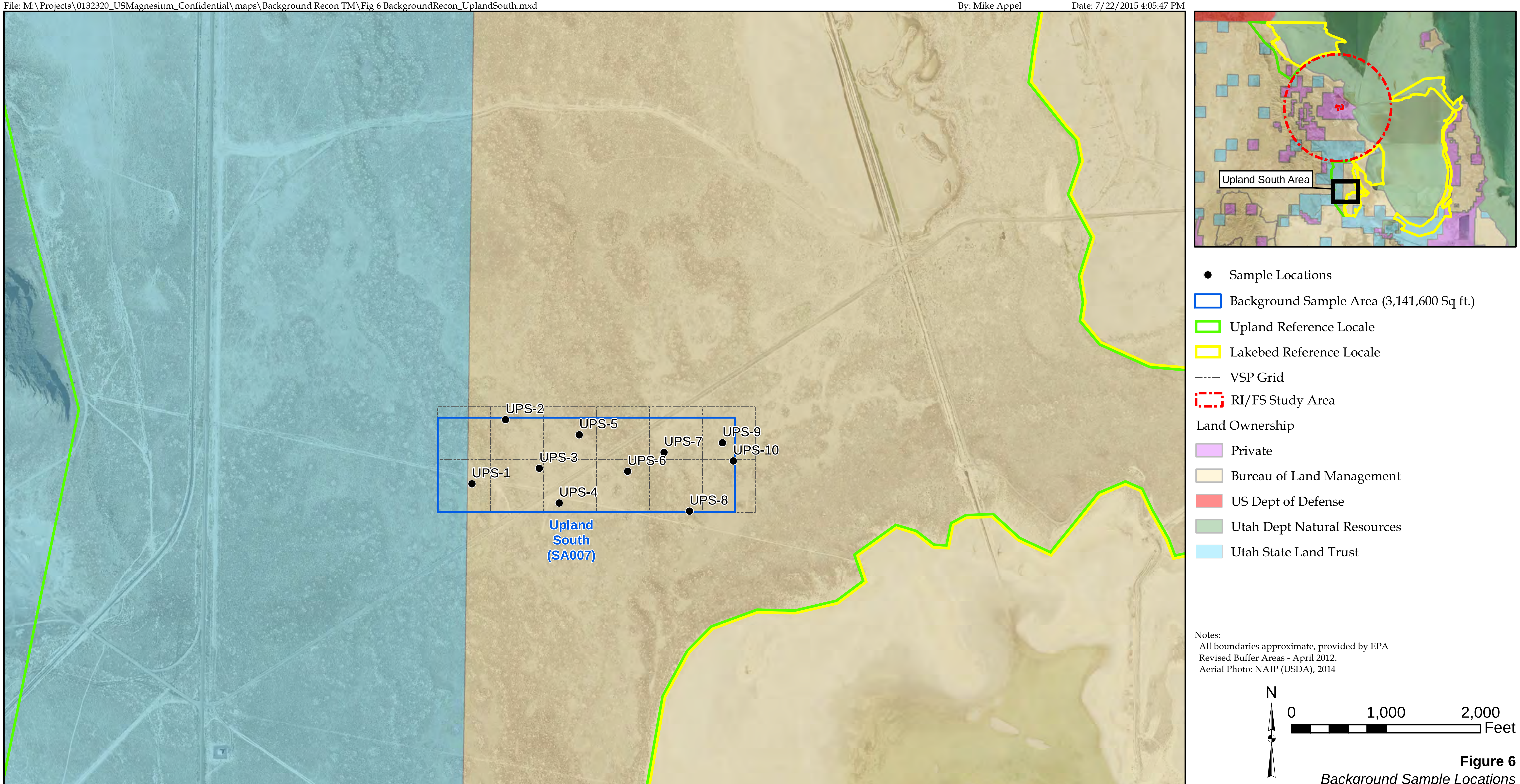
usmag®

Environmental Resources Management
136 East South Temple, Suite 2150
Salt Lake City, Utah 84111
ERM

File: M:\Projects\0132320_USMagnesium_Confidential\maps\Background Recon TM\Fig 6 BackgroundRecon_UplandSouth.mxd

By: Mike Appel

Date: 7/22/2015 4:05:47 PM



Notes:
All boundaries approximate, provided by EPA
Revised Buffer Areas - April 2012.
Aerial Photo: NAIP (USDA), 2014

Figure 6

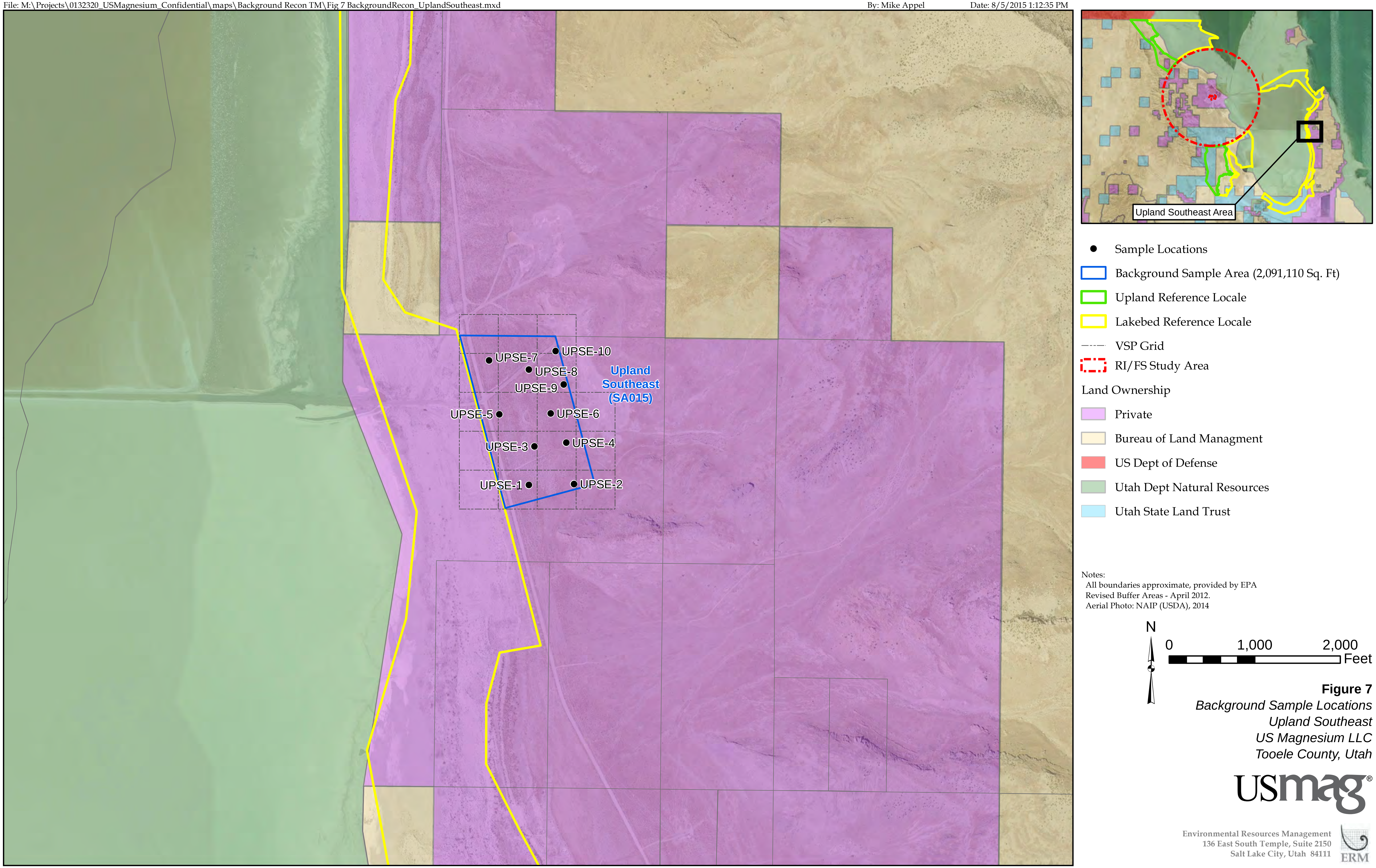
Background Sample Locations
Upland South
US Magnesium LLC
Tooele County, Utah

USmag®

Environmental Resources Management
136 East South Temple, Suite 2150
Salt Lake City, Utah 84111

ERM

File: M:\Projects\0132320_USMagnesium_Confidential\maps\Background Recon TM\Fig 7 BackgroundRecon_UplandSoutheast.mxd By: Mike Appel Date: 8/5/2015 1:12:35 PM



Notes:
All boundaries approximate, provided by EPA
Revised Buffer Areas - April 2012.
Aerial Photo: NAIP (USDA), 2014

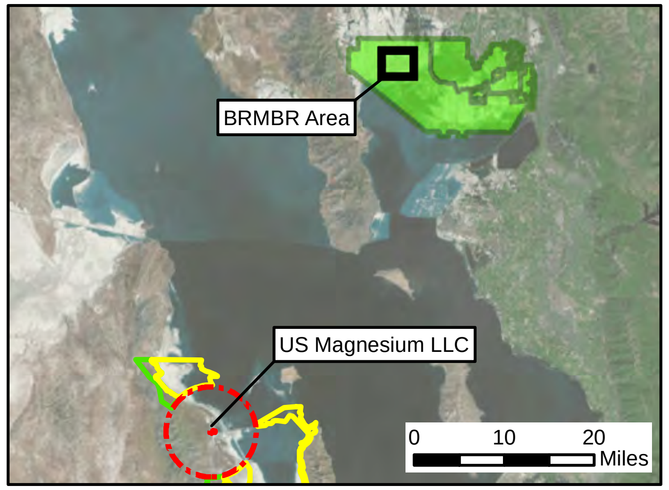
Figure 7
Background Sample Locations
Upland Southeast
US Magnesium LLC
Tooele County, Utah

USmag®

Environmental Resources Management
136 East South Temple, Suite 2150
Salt Lake City, Utah 84111
ERM

File: M:\Projects\0132320_USMagnesium_Confidential\maps\Background Recon TM\Fig 8 BackgroundRecon_BRMBR.mxd

By: Mike Appel Date: 7/22/2015 4:10:05 PM



● Sample Locations
🟦 Background Sample Area (3,141,600 Sq ft.)
🟩 Upland Reference Locale
🟨 Lakebed Reference Locale
🟩 Bear River Migratory Bird Refuge
- - - VSP Grid
🟥 RI/FS Study Area

Notes:
Bear River Migratory Bird Refuge layer provided by United States Fish and Wildlife Service.
Aerial Photo: Provided by ESRI web mapping service.

N

0 1,500 3,000 Feet

Background Sample Locations
Bear River Migratory Bird Refuge
US Magnesium LLC
Tooele County, Utah

usmag®

Environmental Resources Management
136 East South Temple, Suite 2150
Salt Lake City, Utah 84111
ERM

Attachment D
Background Sample Location Coordinates

Background Sampling Area	Location (a)	UTM Zone 12 NAD 1983		Utah State Plane Central		Sample Type: SS = Surface	Location Basis	Analytical Group (b)
		m N	m E	X feet	Y feet			
Upland North (SA010)	UPN-1	4540070	344098	1266734	7534738	SS	Grid	A
	UPN-2	4539988	344201	1267074	7534474	SS	Grid	B
	UPN-3	4539856	344137	1266868	7534037	SS	Grid	A
	UPN-4	4539897	344393	1267707	7534178	SS	Grid	B
	UPN-5	4539708	344239	1267205	7533554	SS	Grid	A
	UPN-6 *	4539744	344439	1267861	7533676	SS	Grid	C
	UPN-7	4539618	344377	1267660	7533261	SS	Grid	B
	UPN-8	4539589	344525	1268145	7533171	SS	Grid	A
	UPN-9	4539678	344638	1268514	7533465	SS	Grid	B
	UPN-10	4539418	344653	1268567	7532610	SS	Grid	B
Upland South (SA007)	UPS-1	4518159	354646	1301781	7463051	SS	Grid	B
	UPS-2	4518366	354756	1302136	7463731	SS	Grid	B
	UPS-3	4518209	354863	1302493	7463217	SS	Grid	A
	UPS-4	4518096	354927	1302703	7462849	SS	Grid	B
	UPS-5	4518316	354993	1302916	7463570	SS	Grid	A
	UPS-6 *	4518197	355148	1303428	7463183	SS	Grid	C
	UPS-7	4518258	355266	1303813	7463387	SS	Grid	A
	UPS-8	4518068	355347	1304084	7462764	SS	Grid	B
	UPS-9	4518287	355454	1304431	7463486	SS	Grid	B
	UPS-10	4518229	355489	1304545	7463295	SS	Grid	A

Background Sampling Area	Location (a)	UTM Zone 12 NAD 1983		Utah State Plane Central		Sample Type:	Location Basis	Analytical Group (b)
Upland Southeast (SA015)	UPSE-1	4524867	370357	1353205	7485369	SS	Grid	B
	UPSE-2	4524870	370518	1353732	7485382	SS	Grid	A
	UPSE-3	4525005	370378	1353269	7485821	SS	Grid	B
	UPSE-4	4525017	370491	1353643	7485864	SS	Grid	A
	UPSE-5 *	4525120	370253	1352860	7486197	SS	Grid	C
	UPSE-6	4525121	370437	1353461	7486206	SS	Grid	B
	UPSE-7	4525312	370219	1352742	7486827	SS	Grid	A
	UPSE-8	4525278	370359	1353204	7486718	SS	Grid	B
	UPSE-9	4525224	370483	1353612	7486543	SS	Grid	A
	UPSE-10	4525344	370456	1353519	7486935	SS	Grid	B
Lakebed North (SA011)	LBN-1	4543644	343718	1265414	7546461	SS	Grid	A
	LBN-2	4543686	343856	1265869	7546599	SS	Grid	B
	LBN-3	4543718	344211	1267032	7546714	SS	Grid	A
	LBN-4	4543677	344406	1267672	7546582	SS	Grid	B
	LBN-5	4543706	344629	1268404	7546682	SS	Grid	A
	LBN-6 *	4543694	344783	1268909	7546646	SS	Grid	C
	LBN-7	4543616	344950	1269460	7546393	SS	Grid	A
	LBN-8	4543674	345291	1270577	7546589	SS	Grid	B
	LBN-9	4543688	345686	1271874	7546644	SS	Grid	B
	LBN-10	4543617	345889	1272540	7546416	SS	Grid	B
Lakebed Southeast (SA013)	LBSE-1	4532833	364999	1335465	7511406	SS	Grid	B
	LBSE-2	4532836	365154	1335974	7511418	SS	Grid	A
	LBSE-3	4532861	365281	1336391	7511504	SS	Grid	B
	LBSE-4	4532893	365531	1337209	7511614	SS	Grid	A
	LBSE-5	4532947	365750	1337929	7511794	SS	Grid	B
	LBSE-6	4532934	365881	1338358	7511756	SS	Grid	A
	LBSE-7 *	4532874	366288	1339696	7511565	SS	Grid	C
	LBSE-8	4532904	366527	1340478	7511669	SS	Grid	A
	LBSE-9	4532791	366809	1341406	7511305	SS	Grid	B
	LBSE-10	4532738	367096	1342349	7511135	SS	Grid	B

Background Sampling Area	Location (a)	UTM Zone 12 NAD 1983		Utah State Plane Central		Sample Type:	Location Basis	Analytical Group (b)
Lakebed Southeast at Badger Island (SA014)	LBB-1	4534074	367528	1343740	7515529	SS	Grid	B
	LBB-2	4534090	367687	1344261	7515585	SS	Grid	A
	LBB-3	4534223	367840	1344761	7516023	SS	Grid	B
	LBB-4	4534145	367972	1345197	7515769	SS	Grid	A
	LBB-5	4534041	368207	1345970	7515434	SS	Grid	B
	LBB-6	4533876	368442	1346745	7514897	SS	Grid	A
	LBB-7 *	4533740	368535	1347050	7514452	SS	Grid	C
	LBB-8	4533520	368744	1347743	7513735	SS	Grid	A
	LBB-9	4533309	368929	1348354	7513046	SS	Grid	B
	LBB-10	4533129	369101	1348921	7512458	SS	Grid	B
Bear River Migratory Bird Refuge (SA003)	BR-1	4596253	386500	1404772	7719985	SS	Grid	B
	BR-2	4596167	386897	1406078	7719712	SS	Grid	B
	BR-3 *	4596193	387281	1407336	7719803	SS	Grid	C
	BR-4	4596433	387625	1408460	7720599	SS	Grid	B
	BR-5	4596956	387762	1408900	7722318	SS	Grid	B

Notes:

* Denotes location for sub-surface screening sample

(a) Sampling locations are shown in Figures 4 through 8 for background sampling areas.

(b) Analytical groups include the following:

Group A = Surface solids analyzed for metals, pH, total organic carbon, and grain size.

Group B = Surface solids analyzed for: metals, organics (polychlorinated biphenyls, polychlorinated dibenzo-p-dioxins / dibenzofurans, and hexachlorobenzene), pH, total organic carbon, and grain size.

Group C = Surface solids analyzed for: metals, organics (polychlorinated biphenyls, polychlorinated dibenzo-p-dioxins / dibenzofurans, and hexachlorobenzene), pH, total organic carbon, and grain size; subsurface solids analyzed for metals and organics.

Attachment 9EE

13 August 2015, 1 of 2 Consolidated Agency Comments on ERM Document "Preliminary COPC/COPEC Screen and Preliminary Risk Calculations – Methodology and Test Case" Dated 29 July 2015

Consolidated Agency Comments on ERM Document
"Preliminary COPC/COPEC Screen and Preliminary Risk Calculations – Methodology and Test Case"
Dated 29 July 2015

1.0 Comments on Text

Page 2, Step 2: ..The text says that bioaccumulatives will be retained as COPCs/COPECs, whether detected or not (e.g., hexachlorobutadiene). In a recent risk assessor call, the idea that bioaccumulatives that were never detected might be excluded was discussed. Because of the priorities and time-demands due to recent response events, the Agency risk assessors have not been able to work though the pros and cons of this idea. Consequently, the Agencies recommend that ERM maintain course with the original plan (all bioaccumulatives will be retained as COPCs/COPECs), with the understanding that this issue (which could consequently simplify the COPC assessment) will be re-considered as soon as possible.

Page 2, Step 4b. The Agencies agree that a background comparison is an appropriate component of the COPC selection process, but a comparison based solely on Cmax is not optimal. The background comparison should be performed based on the entire data set for the PRI, not just Cmax, and should be performed as described in EPA (2002) using a Form II null hypothesis.

Page 2 Step 4c. Application of a frequency of detection (FOD) criterion to COPC selection seems to be moot, since there are no PRIs where there will be more than 20 samples collected during the Phase 1A-B study. Based on this, the Agencies suggest dropping the FOD criterion from the selection protocol. If the FOD step is to be retained, this step must include a) an assessment of detection limit adequacy, b) an assessment of spatial clustering (hot spots), and c) consideration of concentrations detected in other media, as was described in the final SLRA Tech memo (July 2014) (see text below in bold and italicized for emphasis):

> Frequency of detection (FOD) is another criterion that may warrant COPC reduction. Chemicals exhibiting a low FOD within a specific exposure area generally will not contribute significantly to risk and hazard estimates when hot spots are not present. The USEPA (1989a) provides an example using a FOD of less than or equal to 5 percent. That is, chemicals with a FOD of less than or equal to 5 percent will generally not be retained as COPCs, considering the conditions discussed below. ***Prior to proposing to eliminate a COPC based on FOD criteria, (1) any elevated detection limits (i.e., greater than the risk-based concentration of concern) would be addressed and (2) data distributions within exposure areas would be considered (e.g., potential hot spots would be assessed). Additionally, the detection of the COPC in all sampled media would be considered. For example, a chemical infrequently detected in soil should not be eliminated if it is frequently detected in groundwater and exhibits mobility in soil.***

2.0 Comments on Figure 1

Each of the comments above applies to Figure 1. In addition:

1. There appears to be an error in Figure 1 on the pathway used for identification of human COPCs (left side of the figure). Near the bottom, there is box that asks “Is Mean ≤ 80th Percentile?”. Both arrows emanating fr0om this box are labeled “No”, which is inherently illogical. The Agencies recommend that the arrow pointing to the left should be labeled “Yes”, and lead to a box that says “Not a COPC”.

3.0 Comments on Table 1

1. The human RBSL values for soil and sediment shown in Table 1 should be based on the most recent version of EPA’s Regional Screening level (RSL) tables, using the values for industrial soil. EPA has noted several values that appear to be incorrect, including:
   a. TEQ/TCDD (2.2E-02 ug/kg vs 7.2E-02 ug/kg)
   b. Mercury. The value shown (4.0E-03 ug/kg) appears to be based on elemental mercury. The Agencies recommend that mercury in site soil and sediment be assumed to exist as inorganic salts, with an industrial RBSL of 3.5E-02 ug/kg.
   c. Antimony. The value used in the table (47 mg/kg) appears to be based on antimony tetroxide. The Agencies recommend that antimony in site soil and sediment be assumed to exist as inorganic salts, and recommends use of the industrial RBSL value for antimony potassium tartrate (110 mg/kg).
   d. Total Chromium. The value shown (1.8E+05 mg/kg) is based on Cr(III). For all results based on total chromium, the value for Cr(VI) (6.3 mg/kg) should be used in the COPC screen. Whenever data provide independent measures of Cr(III) and Cr(IV), the valence-specific values should be used.

2. It might be helpful to split Table 1 into 2 parts: Human and Eco. While a few columns would be redundant, most columns would be unique, and it would help reduce the table width and make it easier to track the COPC/COPEC selection process.

3. Column Headings

   a. Some headings do not seem to be needed, including:
      i. Location with maximum detect
      ii. RBSL Available (this can be determined by seeing if there is a numeric value listed)
      iii. RBESL Available (this can be determined by seeing if there is a numeric value listed)
   b. In order to implement the evaluation of detection limit adequacy, Some new column headings should be added, including:

        i. Number of undiluted samples
        ii. Number of undiluted samples with DL < RBSL
    c. Other headings that will be needed include
        i. Site > Bkg?
        ii. If DF is retained as part of the selection protocol (see comment above), then a column called "Are detects clustered?" is needed. This would have to be entered manually based on visual inspection of maps, rather than derived from an Excel formula.

4.0 Other Comments

1. Re Sampling at depth from background areas

In a recent risk assessor call, the topic of sub-surface sampling at depth at candidate background area was discussed. On 8/5/15, ERM sent a proposal (via e-mail) to collect one sample from 1-3 feet bgs at each candidate background area. The Agencies advise that this depth sample include the full interval from 2 inches to 36 inches bgs rather than omitting the depth from 2-12 inches.

2. Range-finding risk characterization

Once COPC/COPC selection is implemented, the next step is an initial "range-finding" characterization of the risks for the selected COPCs/COPECs. The Agencies recommend that this initial risk characterization be performed in much the same way as would be expected in the risk assessment documents. For human receptors and mobile ecological receptors, the most important value is the ratio of the Mean concentration (or the 95% UCL, or both) to the RBSL. This is much more informative that an assessment based only on the maximum value.

For small home range or sessile ecological receptors, the most useful information is the fraction of all samples that exceed the RBC, and by how much (e.g.: 20% exceed by a factor of 2-5, 5% exceed by a factor of 5-10, and 0% exceed by a factor of > 10). As above, this type of information is much more informative that a finding based only on Cmax.

In this regard, these initial risk characterizations could simply utilize the same RBCs as were used in the COPC selection protocol. However, it seems more appropriate to perform the initial risk characterization using site-specific exposure parameters for human receptors, and refined RBC values for selected COPECs, based on the refinement efforts that have been completed to date.

Attachment 9FF

13 August 2015, 2 of 2 Followup RE: Summary of 12 August 2015 Phase 1 AB SAP Schedule Discussion

Kevin Lundmark

From:	Wangerud, Ken <wangerud.ken@epa.gov>
Sent:	Thursday, August 13, 2015 9:47 AM
To:	David Abranovic; Kevin Lundmark
Cc:	Mark Ransom; R. David Gibby (dgibby@usmagnesium.com); Justin Burning; Catherine D. LeCours; Bill Brattin; Skipper, Sherry; severett@utah.gov; Mike Storck (mstorck@utah.gov)
Subject:	Follwoup RE: Summary of 12 August 2015 Phase 1 AB SAP Schedule Discussion

David and Kevin:

As follow-up, you received from me yesterday EPA approval for the BG study sampling-locations per (gray) bullet#1 below.

Re your bullet#2 (yellow) below stating that EPA's August 10th modification correspondence was not complete-- Note that EPA sent ERM final comments on the DQO Sec. 11.3 Background Study on June 2nd, and as further noted in Comment #6 of Enclosure 1 of EPA's July 17th Draft-SAP modification letter. The only remaining issues at that time were finalization of the 'reconn-findings tech-memo' (which I'm advised was resolved in a call with ERM staff yesterday), final sampling locations (resolved), and sub-surface sampling depth(s). In a recent risk assessor call, the topic of sampling at depth at candidate background area was discussed. On 8/5/15, ERM sent a proposal (*via* e-mail) to collect one sample from 1-3 feet bgs at each candidate background area. This is now resolved as follows.

The Agencies advise that this depth sample include the full interval from 2 inches to 36 inches bgs rather than omitting the depth from 2-12 inches.

This should resolve all outstanding issues pertinent to ERM finalizing Ph1A-B SAP Sec. 11.3 matters regarding Background Study and associated worksheets.

Thanks.

Ken Wangerud, Remedial Project Manager
Superfund Remedial Program
Office of Ecosystems Protection and Remediation
USEPA Region 8 - EPR/SR
1595 Wynkoop, Denver CO 80202-1129
- -
ofc. tel. 303-312-6703
fax 303-312-7151
wangerud.ken@epa.gov

From: David Abranovic [mailto:David.Abranovic@erm.com]
Sent: Wednesday, August 12, 2015 12:49 PM
To: Wangerud, Ken
Cc: Kevin Lundmark; Mark Ransom; R. David Gibby (dgibby@usmagnesium.com); Justin Burning
Subject: Summary of 12 August 2015 Phase 1 AB SAP Schedule Discussion

Ken,

I appreciate the time you spent with Kevin and me today discussing the Phase 1 A-B SAP schedule and the path forward for finalizing the document. The outcomes and action items from our call are as follows:

- Ken to find out and report what is delaying EPA review/approval of the Draft Reconnaissance of Candidate Background Sampling Areas Technical Memorandum (Attachment 11 to the OU-1 Phase 1A-B SAP) and when ERM will receive comments/approval.
- ERM noted that the modifications to the Phase 1 A-B SAP provided to ERM on 10 August were not complete and there are changes to the background DQO that were discussed and agreed to by the EPA technical team need to be incorporated in the final SAP. The DQO changes also effect several other worksheets so several changes that have not yet been reviewed by EPA will need to be made to the SAP. Ken stated that these changes could be made by ERM in the final version of the document and that providing a revised draft is not necessary.
- EPA acknowledged that there is a need to recognized the interdependency of Phase 1 A-B tasks and accommodate a procedure to modify the milestones in WS-16 based on actual completion dates. Ken will review the revised OU-1 Phase 1A-B SAP WS-16 provided by ERM and provide feedback on a call scheduled for 11 am MST on 13 August 2015.
- ERM discussed the necessity of including a data comparability criteria in the Phase 1 A-B SAP for use of the historical data in N&E mapping and suggested that establishing that the new and old data sets are “comparable” is not a necessary for mapping and is not related to the Phase 1 A-B N&E DQO. EPA agreed that if the criteria is included in the SAP, the details regarding the statistical tests and data adequacy evaluation must be discussed with the ERM technical team and included in the Phase 1 A-B SAP. Ken agreed to reevaluate EPA Comment 8 provided to ERM on 10 August 2015 with the EPA technical team and report back to David.
- The modifications to WS-2 were discussed and ERM stated that the EPA modifications do not appear to be consistent with UFP QAPP guidance and present a “selective” history and inaccurate path forward for the RI. ERM suggested that the unnecessary elements should be omitted from this section of the SAP and could be included in the EPA Project Plan. Alternately ERM would need to spend significant time and effort to modify worksheet 2 to accurately describe the project history. David will evaluate if the EPA’s changes to WS-2 need to be discussed at an EPA/ERM consultation meeting.

Let me know if you have any questions of need any additional information to resolve the outstanding issues and expedite the development of the final Phase 1 A-B SAP.

david

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Attachment 9GG

14 August 2015 RE: Summary of 12 August 2015 Phase 1 AB SAP Schedule Discussion

Kevin Lundmark

From:	Wangerud, Ken <wangerud.ken@epa.gov>
Sent:	Friday, August 14, 2015 11:04 AM
To:	David Abranovic; Kevin Lundmark
Cc:	Mark Ransom; R. David Gibby (dgibby@usmagnesium.com); Justin Burning; Mike Storck (mstorck@utah.gov); Catherine D. LeCours
Subject:	RE: Summary of 12 August 2015 Phase 1 AB SAP Schedule Discussion

David:

Thank you for the very productive discussion yesterday regarding finalization of the Worksheet #16 Schedule/Timeline. I look forward to receiving and reviewing the revised worksheet per our discussion.

In addition, we discussed your bullet #4 below regarding ERM's concerns about EPA's reference to statistical-assessment of the comparability and use of historical data for site-characterization mapping. As I said, this concern can be addressed most simply by developing and comparing three preliminary nature-&-extent maps-- 1) a map based on the validated historic data, 2) a map based on the Ph1A-B data , and 3) a map based on the 'merged' historic and Ph1A-B data. These maps (prepared using methods as described in Secs. 11.2.5.3 and 11.2.6.3) will suffice as an assessment of data comparability for nature and extent site characterization. Kevin suggested that this could be clarified in minor text revision to these sections. In that case, I believe the 'qualifying' statement that EPA provided in Comment #8 on Aug 10th with a footnote reference into the last line of Table 13 can be deleted.

I hope this resolves the issue noted in yellow-highlight below.

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From: David Abranovic [mailto:David.Abranovic@erm.com]
Sent: Wednesday, August 12, 2015 12:49 PM
To: Wangerud, Ken
Cc: Kevin Lundmark; Mark Ransom; R. David Gibby (dgibby@usmagnesium.com); Justin Burning
Subject: Summary of 12 August 2015 Phase 1 AB SAP Schedule Discussion

Ken,

I appreciate the time you spent with Kevin and me today discussing the Phase 1 A-B SAP schedule and the path forward for finalizing the document. The outcomes and action items from our call are as follows:

- Ken to find out and report what is delaying EPA review/approval of the Draft Reconnaissance of Candidate Background Sampling Areas Technical Memorandum (Attachment 11 to the OU-1 Phase 1A-B SAP) and when ERM will receive comments/approval.
- ERM noted that the modifications to the Phase 1 A-B SAP provided to ERM on 10 August were not complete and there are changes to the background DQO that were discussed and agreed to by the EPA technical team need to be incorporated in the final SAP. The DQO changes also effect several other worksheets so several

changes that have not yet been reviewed by EPA will need to be made to the SAP. Ken stated that these changes could be made by ERM in the final version of the document and that providing a revised draft is not necessary.

- EPA acknowledged that there is a need to recognized the interdependency of Phase 1 A-B tasks and accommodate a procedure to modify the milestones in WS-16 based on actual completion dates. Ken will review the revised OU-1 Phase 1A-B SAP WS-16 provided by ERM and provide feedback on a call scheduled for 11 am MST on 13 August 2015.
- ERM discussed the necessity of including a data comparability criteria in the Phase 1 A-B SAP for use of the historical data in N&E mapping and suggested that establishing that the new and old data sets are "comparable" is not a necessary for mapping and is not related to the Phase 1 A-B N&E DQO. EPA agreed that if the criteria is included in the SAP, the details regarding the statistical tests and data adequacy evaluation must be discussed with the ERM technical team and included in the Phase 1 A-B SAP. Ken agreed to reevaluate EPA Comment 8 provided to ERM on 10 August 2015 with the EPA technical team and report back to David.
- The modifications to WS-2 were discussed and ERM stated that the EPA modifications do not appear to be consistent with UFP QAPP guidance and present a "selective" history and inaccurate path forward for the RI. ERM suggested that the unnecessary elements should be omitted from this section of the SAP and could be included in the EPA Project Plan. Alternately ERM would need to spend significant time and effort to modify worksheet 2 to accurately describe the project history. David will evaluate if the EPA's changes to WS-2 need to be discussed at an EPA/ERM consultation meeting.

Let me know if you have any questions of need any additional information to resolve the outstanding issues and expedite the development of the final Phase 1 A-B SAP.

david

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Attachment 9HH

14 August 2015 Final Ph1A-B SAP preparations - resolution of remaining issues

Kevin Lundmark

From: Wangerud, Ken <wangerud.ken@epa.gov>
Sent: Friday, August 14, 2015 2:49 PM
To: David Abranovic; Kevin Lundmark
Cc: Wharton, Steve; Catherine D. LeCours
Subject: Final Ph1A-B SAP preparations… resolution of remaining issues

David:

Per our discussion yesterday, it appears that all issues for ERM's preparation of the Final Ph1A-B SAP for Agency review/approval have been resolved.

1. The Background Study points have been cleared up.
2. The issue regarding nature-&-extent mapping of 'historic' data and Ph1A-B data has been resolved (KevinL will run that final language by me).
3. The WS#16 Schedule/Timeline (per discussion yesterday) will be revised & finalized by you for EPA approval for insertion in the Final SAP.

and lastly,

4. ERM's issue regarding the Site Management & Project Plan being included in the SAP is a matter that I advised you to immediately respond in writing to EPA and if necessary a teleconference involving Steve Wharton needs to be scheduled ASAP next week.

I appreciate it if Kevin will continue to dialogue with Catherine LeCours regarding the final document(s) to be submitted for Agency review and final approval. Except of item 4 above, it seems that the Ph1A-B SAP could be ready for issuance immediately after September 1st Labor Day.

Ken

Ken Wangerud, Remedial Project Manager
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Attachment 9II

18 August 2015 Supporting information for ERM/EPA Consultation - 20 Aug 2015

From:	David Abranovic
Sent:	Tuesday, August 18, 2015 6:12 PM
To:	Ken Wangerud (Wangerud.Ken@epamail.epa.gov); Wharton, Steve (Wharton.Steve@epa.gov); Mike Storck (mstorck@utah.gov)
Cc:	Justin Burning; Mark Ransom; R. David Gibby (dgibby@usmagnesium.com); Kevin Lundmark
Subject:	Supporting information for ERM/EPA Consultation - 20 Aug 2015
Attachments:	US Mag RTC to EPA modifications to Ph 1 A-B SAP 081015_sg.pdf
Follow Up Flag:	Follow up
Flag Status:	Flagged

Gentlemen,

As agreed on the weekly RPM call yesterday, ERM's proposed modifications to the Phase 1 A-B SAP Preface and Worksheet-2 are provided in the attached letter. The letter includes redline strikeout versions of the text that EPA provided to ERM on 10 August 2015. We look forward to reviewing these changes with you on Thursday morning and are hopeful that we can quickly reach a consensus and finalize the SAP.

david

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ERM

18 August 2015

Via Electronic Mail

Mr. Ken Wangerud
Remedial Project Manager
Superfund Remedial Program
USEPA Region 8 – EPR-SR
1595 Wynkoop Street
Denver, CO 80202-1129

Subject: Response to Agency Modifications Received on 10 August 2015 to ERM's proposed changes to Draft Phase 1A-B SAP (document submittal date 29 July 2015)

Dear Mr. Wangerud:

The Draft OU-1 Phase 1A-B RI SAP was submitted via upload to the United States Environmental Protection Agency (USEPA) US Mag Sharepoint site on 2 July 2015. The USEPA provided comments on this submittal on behalf of the USEPA and Utah Department of Environmental Quality (collectively "the Agencies") via e-mail on 17 July 2015, and ERM-West, Inc.'s (ERM's) presented responses to the Agencies' suggested modifications to the Phase 1 A-B SAP on 29 July 2015.

The Agencies provided comments on the 13 specific technical comments and modifications suggested by ERM in the 29 July 2015 letter. EPA agreed to ERM's suggested modifications to address technical comment numbers 5, 7, 9, 10, 11, 12, and 13. ERM agreed to accept EPA modifications to address comment numbers 2, 4, and 6. ERM suggested additional discussion with EPA to resolve the Phase 1 A-B RI schedule (comment 10) and the approach EPA suggested to evaluate the usability of historic data for nature and extent mapping (comment 8). Telephone calls were conducted between ERM and the Agencies on 12 and 13 August 2015 regarding comments 8 and 10 and an acceptable resolution for both of these comments was formulated for the inclusion in the final Phase 1 A-B SAP.

The purpose of this letter is to provide EPA with proposed modifications to the Preface and Worksheet-2 of the Phase 1 A-B

SAP that we believe satisfies the UFP QAPP guidance referenced in the AOC, preserves most of the EPA's modifications provided in their 10 August 2015 letter, and accurately presents the project history.

The QAPP guidance referenced in the AOC is *Requirements for Quality Assurance Project Plans* (2001 EPA/QA-R5). This guidance does not specifically reference many of the project planning elements that EPA included the Preface and Worksheet-2. Therefore ERM does not believe that is necessary to include lengthy discussions of the over-arching project structure nor provide detailed explanations of timelines that are not related to the Phase 1 A-B RI. Furthermore, the modifications proposed by EPA for Worksheet-2 deleted several elements included by ERM that are required by the R5 guidance (e.g., Site Location). The applicable identifying information required for Worksheet-#2 by the R5 guidance includes:

- Site name/project name
- Site location
- Site number/code
- Operable unit
- Contractor name
- Guidance used to prepare QAPP
- Regulatory program (e.g., RCRA, CERCLA)
- Approval entity
- Data users
- Identification as a generic or project-specific QAPP
- Scoping session dates

ERM’s proposed modifications to the text that EPA and the State provided in their 10 August 2015 letter ensures that all required elements are included in the Phase 1 A-B SAP. Modified versions of EPAs final Preface and Worksheet-2 text are provided below in redline-strikeout format.

1. *<u>PREFACE</u>:*

The U.S. Environmental Protection Agency (EPA) placed the US Magnesium Site (Site) on the National Priorities List (NPL) for remedial response pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) in November 2009. The U.S. Court of Appeals for the Washington D.C. Circuit upheld EPA's action for the listing in August 2010.

The US Magnesium plant electro-chemically processes magnesium chloride (derived from Great Salt Lake brine waters) in melt-reactors and electrolytic cells (adding petroleum-coke and hydrochloric-acid) to produce primary magnesium-metal and chlorine. The volume of by-product waste streams being ~~released~~produced has increased ~~20 percent~~ since the start of the remedial investigation and feasibility study (RI/FS) ~~sampling in 2013,~~ and includes: (1) acidic liquid and slurry streams containing hexachlorobenzene (HCB), polychlorinated biphenyls (PCBs), and dioxins/furans, and (2) liquid and gaseous releases of chlorine (Cl_2) and hydrogen-chloride (HCl), as well as particulates/aerosols containing chlorinated organic compounds. While the entire Site is included on the NPL, which requires that the Site undergo an RI/FS and potential remedial action pursuant to CERCLA, the plant proper remains in continuous operation and is subject to various requirements under the Clean Air Act and the Resource Conservation and Recovery Act.

Administrative Settlement Order on Consent for Remedial Investigation/Feasibility Study.

In August 2011, EPA and US Magnesium entered into an Administrative Order on Consent (AOC) for RI/FS, under which US Magnesium (supported by Environmental Resources Management [ERM]) is to carry out the work required for RIs, data management, risk assessment (RA), and FS for consideration of remedial action. The AOC and Appendix A: Statement-of-Work (SOW) for RI/FS call for scoping meetings during which US Magnesium/ERM engages in planning and technical discussions with the EPA for EPA's consideration in developing particular phases and stages of Sampling and Analysis Plans (SAPs). Numerous planning and scoping meetings to develop a site-wide Phase 1A SAP (described below) were held from October 2011 through March 2013. Subsequent discussions addressing the Inner PRI areas (the most contaminated portions of the Site) and refinement of RI activities for the Inner PRI areas occurred between August 2014 and March 2015; final development of this Phase 1A-B RI SAP (see below) is summarized in this document. Upon EPA approval and issuance of this Phase 1A-B RI SAP, US Magnesium/ERM is required to implement the Inner PRI areas and Background Study investigations as specified in this SAP.

Phase 1A RI SAP.

In accordance with the AOC-SOW, the EPA issued the *Phase 1A Remedial Investigation Sampling and Analysis Plan to Identify Chemicals of Potential Concern in Soils, Sediment, Solid Waste, Water and Air, and Receptor Surveys (Revision 0) for PRI Areas 2 and 8 through 17* (EPA 2013) (Phase 1A RI SAP) (with Quality Assurance Project Plan [QAPP]) in September 2013, laying out the technical specifications to implement Phase 1A investigations (identification of chemicals of potential concern [COPCs]) across the Site. However, ERM identified technical issues (health and safety ~~and~~as well as sampling and laboratory method considerations for highly acidic and inundated areas of the waste ponds) associated with sampling and analysis in PRI Areas 1 and 3 through 7 (Inner PRI areas) included in the Phase 1A SAP (Revision 0) needed to be resolved prior to initiating this portion of the SAP. In order to initiate sampling and data collection activities in 2013 and begin remedial investigations of PRI Areas 2 and 8 through 17 (Outer PRI areas), as well as reduce the need for multiple sampling plan documents, the EPA issued the Phase 1A RI SAP as Revision 0 without addressing the technical issues needed to commence sampling in the Inner PRI areas. ~~The~~However, the general framework of the Phase 1A RI SAP provided ~~for simple~~a framework that could be used, with appropriate modification ~~which would enable start-up~~ of ~~investigations~~the sample collection and laboratory SOPs, to initiate investigation of the Inner PRI areas.

Upon completion of the Air DMA, the EPA approved the *Phase 1A Remedial Investigation Sampling and Analysis Plan for Operable*

Unit 2 – Ambient Air (ERM 2014), which finalized the basis for standard operating procedures and worksheets pertinent to commencing the air investigations in PRI Area 18.

Development of the Phase 1A-B RI SAP.

While the EPA was finalizing the Phase1A RI SAP, ERM and US Magnesium (having reviewed data from DMA investigations of Inner PRI areas indicating high concentrations of numerous constituent contaminant chemicals, and presuming little chance of eliminating suites of chemicals as COPCs (therefore not eliminating analytical methods from the RI)) asserted that Phase 1A investigations of the Inner PRI areas (for COPC identification) were not necessary, and instead proposed proceeding with Phase 1B investigations to determine preliminary nature and extent. Accordingly, the EPA sent a September 2013 cover letter and accompanying Attachment 5 for issuance of the Final Phase 1A RI SAP, to accommodate the request by US Magnesium and ERM to postpone implementation of Phase 1A sampling for the most contaminated areas of the Site until 2014, allowing US Magnesium to consider an alternative offer by EPA for a more streamlined risk assessment and for accomplishing FS objectives for the Inner PRI areas.

When the Phase 1A SAP was issued, EPA offered US Magnesium an alternative, streamlined RI/FS framework using appropriate data collected during previous RCRA investigations (and limited samples collected during initial Superfund [DMA] investigations), along with "conservative" screening risk assessments, in order to forego detailed remedial investigations and risk assessment and proceed to cleanup feasibility studies for Inner PRI areas (the most contaminated areas of the Site). EPA agreed to defer the Inner PRI area sampling scheduled under the Phase 1A SAP while ERM carried out assessment of historic data and addressed technical issues for completing a screening level risk assessment (SLRA) for the Inner PRI areas. Under the Phase 1A SAP, US Magnesium and ERM were to decide by June 2014 whether to proceed with the streamlined

RI/FS or go back to the process set out in the ~~Phase 1A Sampling Plan~~AOC SOW.

On October 30, 2013, ERM (for US Magnesium) accepted the EPA-proposed streamlined RI/RA approach for the Inner PRI areas, with a SLRA technical memorandum and Inner PRI data report to be provided by the end of December 2013. EPA replied on November 8, 2013, indicating ERM should have sufficient time to discuss preliminary remediation goals (PRGs; i.e., preliminary action levels) and reach a decision on EPA's offer in June 2014, enabling RI/FS activity for Inner PRI areas to commence in 2014.

On March 20, 2014, the EPA replied to another ERM request to delay sampling of the Inner PRI areas until after waste lagoons dried out (following a RCRA settlement, after which waters would ~~presumably~~ no longer be discharged into Inner PRI area ponds). With a final SLRA report for the Inner PRI areas (to include PRGs) to be delivered in May 2014, EPA reminded US Magnesium that unless it decided in June 2014 to implement the streamlined FS process, considerable Inner PRI area work pursuant to the Phase 1A SAP needed to proceed in 2014.

During June/July 2014, US Magnesium indicated it would likely discontinue pursuing the SLRA and streamlined RI/FS approach and implement the original SOW included in the AOC. In a letter dated August 1, 2014, EPA noted that reverting to the AOC SOW could be more costly and the time required for RI/FS completion and remedy selection would be extended considerably. EPA further noted that given ERM's completion of the SLRA technical memorandum, final historic data report, and preliminary risk-estimate summaries, there was little additional effort required to complete a SLRA report as a basis for establishing PRGs for the Inner PRI areas.

In a meeting on August 20, 2014, ERM outlined a process for completing COPC refinement and PRG development for an Inner PRI areas SLRA report to be submitted by the end of December 2014, for a final decision regarding the streamlined FS approach by US Magnesium in January 2015. At this meeting, responding to EPA concerns about ~~continuing delay of~~the Inner PRI areas ~~investigations~~investigation schedule, ERM ~~also~~ proposed to immediately initiate DQO development to complete a Phase 1B (nature and extent) investigation of the Inner PRI areas in 2015, and complete a Phase 2 (detailed site-characterization) investigation for baseline risk assessment ~~in~~ according to the schedule stipulated by the AOC. In a letter dated November 3, 2014, EPA emphasized ~~that~~ the importance of completing PRG development as part of a COPC refinement that EPA requested be included in the draft Inner PRI Screening Level Risk Assessment scheduled to be completed in 2014 ~~was paramount and that.~~ ERM was also to submit by December 2014 a draft agenda for an Inner PRI areas Phase 1B scoping meeting to be held in February 2015.

In a December 2, 2014 meeting, EPA reviewed ERM's draft *Preliminary Data Quality Objective Framework, OU1 Phase 1B for Nature and Extent* and ~~highlighted a number of inconsistencies in the document and its lack of a clear DQO rationale~~provided ERM conceptual verbal comments. ERM agreed to ~~update~~ revise the document after US Magnesium's late January decision ~~deadline~~ to either perform the streamlined RI/FS or go back to the process set out in the AOC SOW. ~~and prepare for review at the February 2015 scoping meeting.~~ In late 2014, the EPA ~~acceded~~agreed that US Magnesium/ERM could develop a draft Phase 1A-B RI SAP for EPA review and approval.

In late January 2015, US Magnesium declined EPA's streamlined FS offer. ~~Absent ERM's submittal of a draft agenda and scheduling of a February scoping meeting, EPA pressed ERM for the submittal and scheduled the meeting for March 11-12, 2015.~~ On February 20, 2015, ERM submitted a scoping meeting agenda and a revised DQO document. ~~At the March 11–12, 2015, scoping meeting, ERM requested that was scheduled for~~ On March 11-12, 2015, ERM and EPA held a scoping meeting~~On~~ , ~~ERM and EPA held a scoping meeting~~. A significant outcome of the scoping meeting was an agreement to combine the Phase 1A investigation goals (i.e. COPC selection) with ERM's proposed Phase 1B goal of preliminary nature and extent. EPA also delegated the preparation of the Phase 1A-B RI SAP to ERM and agreed to provide, in MS Word format, the pertinent sections of the Phase 1A SAP worksheets, which ERM could use as a template for the Phase 1A-B SAP.

The OU-1 Phase 1A-B SAP, ~~while essentially the same approach to sampling as that in the Phase 1A SAP,~~ accomplishes the objectives of the original Phase 1A SAP of 2013 and enables ~~start-up of Inner PRI investigations. This~~ the investigation to be completed during the 2015 field season. The Phase 1A-B ~~RI~~ SAP also includes a major section dealing with the startup of Background Study investigations and the approach to data evaluation for initial mapping of nature and extent of contamination.

State and Federal Consultation.

The EPA has a State Superfund Memorandum of Agreement with the Utah Department of Environmental Quality (UDEQ) Division of Environmental Response and Remediation (DERR) (per National Oil and Hazardous Substances Pollution Contingency Plan [NCP] Part 300.505). The State and the EPA have agreed that EPA Region 8 would be the lead agency for site management and remedial response actions at the Site and the EPA maintains a close working partnership with UDEQ-DERR throughout the RI/FS planning process. The EPA has also engaged in consultations with federal and state trustees for natural resources in accordance with NCP Parts 300.600 and .615.

The format of this document is generally consistent with specifications of the Intergovernmental Data Quality Task Force Uniform Federal Policy (UFP) for QAPPs, *Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs, Part 1: UFP-QAPP Manual* (EPA 2005b). The manual is available at the following website: http://www.epa.gov/fedfac/pdf/ufp qapp v1 0305.pdf.

2.0 SAP IDENTIFYING INFORMATION (SAP WORKSHEET #2):

US Magnesium LLC (US Magnesium) is a commercial producer of magnesium and magnesium alloys and operates a facility in Rowley, Tooele County, Utah (Figure 2-1). The Site includes an active primary magnesium production facility, which has been in operation since 1972. The facility includes employee offices and process buildings and other ancillary structures and facilities. Surrounding the process buildings is a series of waste evaporation ponds, a concentrator pond, a landfill, and smut and calcium sulfate (gypsum) disposal areas. A series of earthen, open-air ditches conveys liquid waste from the process facility to earthen wastewater evaporation ponds. An engineered disposal site for cast house residues containing barium sulfate and an inactive wastewater evaporation pond are located northwest and northeast of the facility, respectively.

On 4 August 2011, an Administrative Settlement Agreement and Order on Consent (AOC) for a Remedial Investigation and Feasibility Study (RI/FS) was entered into by US Magnesium and U.S. Environmental Protection Agency (EPA) Region 8. The AOC defines the roles, responsibilities, schedule, and administration of the RI/FS to be performed.

The Remedial Investigation (RI), Risk Assessment (RA), and Feasibility Study (FS) include a 5-mile radius area around the plant stack. The EPA (as set forth in the 2011 AOC and Statement of Work) anticipated US Magnesium and its contractor Environmental Resources Management (ERM) to implement RI, RA, and FS activities for the study area in phases under plans issued and/or approved by the EPA. Risk assessment work being conducted by ERM and EPA is proceeding concurrently with each phase and element of the RI/FS.

During planning and scoping meetings with ERM in 2011 and early 2012, initial plans were for a Phase 1 investigation to identify chemicals of potential concern (COPCs) and evaluate preliminary nature and extent for site characterization covering preliminary remedial investigation areas (PRIs) across the Site. ERM collected limited samples in 2012 to carry out a demonstration of methods applicability (DMA) to evaluate the suitability of sampling and analytical methods. Scoping considerations by ERM during 2012 were the basis to initiate site investigations in two phases: a Phase 1A Sampling and Analysis Plan (SAP) to ascertain COPCs, to be followed by a Phase 1B SAP to characterize the nature and extent of COPCs.

The initial Phase 1A RI objectives for the entire Site included the following:

- Develop preliminary Conceptual Site Model (CSM) and RI/Risk Scoping.
- Develop SAP specifications for the RI to identify COPCs in media types and pathways across all PRI areas of the Site.
- Conduct surveys to assess ecological habitats, types of human and ecological receptors, and potential exposures threatening human health and the environment, as noted in the preliminary CSM.
- Develop a Screening-Level Ecological Risk Assessment (SLERA) and refine the Preliminary CSM for potential human and ecological risk.

In accordance with the AOC-SOW and beginning in May 2013, EPA prepared a Phase 1A SAP (with Quality Assurance Project Plan [QAPP]) issued in September 2013, which laid out the preliminary conceptual specifications necessary to commence Phase 1A investigations (to identify COPCs) across the Site. However, ERM identified numerous technical issues (health and safety as well as sampling and laboratory method considerations for highly acidic and inundated areas of the waste ponds) associated with sampling and analysis in PRI Areas 1 and 3 through 7 (Inner PRI areas) included in the Phase 1A SAP (Revision 0) that needed to be resolved prior to initiating this portion of the SAP. In order to initiate sampling and data collection activities in 2013 and begin remedial investigations of PRI Areas 2 and 8 through 17 (Outer PRI areas), as well as reduce the need for multiple sampling plan documents, the EPA issued the Phase 1A RI SAP as Revision 0 without addressing the technical issues needed to commence sampling in the Inner PRI areas, depending on the outcome of deliberations regarding the Inner PRI areas. However the general framework of the Phase 1A RI SAP provided a framework that could be used, with appropriate modification -of the sample collection and laboratory SOPs, to initiate investigation of the Inner PRI areas.

In comments on the draft SAP and as EPA was finalizing the site-wide Phase 1A SAP in August 2013, ERM and US Magnesium (having reviewed data from the DMA investigations of Inner-PRIs indicating high concentrations of numerous constituent contaminant chemicals, and presuming little chance of eliminating any chemicals as COPCs) asserted that Phase 1A investigations of the Inner PRI areas (for COPC identification) were not necessary and proposed instead to proceed to Phase 1B investigations to determine preliminary nature and extent. The EPA (as noted in the September 2013 Final Phase 1A SAP cover letter) accommodated US Magnesium and ERM's request to postpone implementation of Phase 1A sampling for the Inner PRI areas~~ for~~, the most contaminated areas of the Site~~ (the Inner PRI areas) until 2014. ERM was~~, in order to ~~submit sampling method specifications and~~provide US Mag time to decide whether to proceed with ~~Inner PRI~~the streamlined RI~~ work in mid-2014.~~/FS alternative presented by EPA (described below), or to continue to implement the AOC SOW.

When the Phase 1A SAP was originally issued in September 2013, EPA offered US Magnesium an alternative, streamlined RI/FS framework using appropriate data collected during previous RCRA investigations (and limited samples collected during initial Superfund [DMA] investigations), along with "conservative" screening risk assessments, in order to forego detailed RI/RA and proceed directly to cleanup feasibility studies for Inner PRI Areas 1 and 3 through 7 (the most contaminated areas of the Site). EPA agreed to further defer the Inner PRI areas sampling scheduled under the Phase 1A SAP while ERM carried out assessment of historic data and addressed technical issues for completing a screening level risk assessment (SLRA) for the Inner PRI areas. US Magnesium and ERM were to decide in 2014 whether to proceed with the streamlined RI/FS or go back to the process set out in the Phase 1A SAP.

In August 2014, as US Magnesium further considered EPA's streamlined FS offer, ERM, responding to EPA's concerns about continuing delay of Inner PRI area investigations, committed to carry out in 2015 an investigation that would entail the components of both Phase 1A and Phase 1B sampling investigations for the Inner PRI areas. In January 2015, US Magnesium declined EPA's streamlined FS offer.

At a scoping meeting in March 2015, EPA reviewed ERM's draft DQO document and proposed sampling plans for the Inner PRI areas. ERM then began to develop DQOs for a Draft SAP for Phase 1A (COPCs) and Phase 1B (preliminary nature and extent) investigations of the Inner PRI areas — the subject of this document. US Magnesium and ERM have further agreed to carry out detailed site-characterization investigations ~~in 2016~~ and baseline risk assessment according to the schedule stipulated in the AOC SOW, anticipated to occur in in 2016 and 2017~~.~~, respectively.

During 2014, as part of the implementation of the Phase 1A SAP, ERM completed an Ecological Habitat Survey and was near completion of a Human Exposure Survey. ERM had completed the Phase 1A solid media sampling for the Outer PRI Areas 2 and 8 through 16, groundwater sampling for PRI Area 17, and sampling for chronic COPCs in air (chlorine and hydrochloric acid). Given ongoing Inner PRI considerations by US Magnesium and ERM during 2014, the EPA again agreed to defer Phase 1A sampling of surface waters until 2015.

~~By late 2013,~~ US Magnesium and ERM ~~recognized the importance of evaluating the risks from~~agreed in late 2013 to evaluate airborne chlorine (Cl2) and hydrochloric acid (HCl) as COPCs. ~~An aspect of site investigations which~~ ERM completed in 2014, pursuant to the Phase 1A SAP~~ was~~, air pathway sampling to obtain data to identify other potential COPCs in air. These data are currently under review by ERM and EPA. Accordingly, EPA has designated air pathway investigations as a separate Operable Unit (OU2), and air investigations and risk assessment of airborne Cl2/HCl releases are proceeding on a separate and independent track from site investigations and risk assessment addressing contamination in the soils, sediments, wastes, and waters of OU1 (PRI Areas 1 through 17).

In parallel with the CERCLA site investigations, US Magnesium, EPA Region 8 RCRA Program, and the US Department of Justice (DOJ) are in settlement negotiations to address those aspects of Site operations to be subject to RCRA Corrective Action. While EPA's Superfund Program anticipates that certain aspects or portions of the site will be addressed under jurisdiction of RCRA, this Phase 1A-B SAP proceeds with site investigations pursuant to the CERCLA AOC-SOW until a RCRA settlement can be reached and the parties know which portions of the Site will be addressed by RCRA. In any case, the information collected will be used to help identify chemicals of concern and understand the nature and extent of contamination at the Site that will be addressed under RCRA and CERCLA, respectively.

While reviewing data for the Phase 1A Outer PRI areas and during Phase 1A-B scoping discussions, ERM and EPA recognized the need for a Background Study of contaminant concentrations that may be unrelated to Site releases. This study (as part of this Phase 1A-B RI SAP) will initially evaluate abiotic chemical constituents at select 'off-site' locations, and is preparatory to subsequent ~~detailed~~ biological chemical constituent investigations that will be conducted during Phase 2.

Phase 1A-B: Background Study of Chemical Constituents ~~(2015)~~

- Identify locations (beyond the RI study area) as reference areas.
- Collect data to compare naturally occurring chemicals of concern to constituents within the RI study areas.

While addressed under a separate workplan from this Phase 1A-B RI SAP, an additional aspect of RI/FS work began in 2014 in response to US Magnesium's desire to conduct a treatability study to evaluate a 'Salt Cap' as a potential remedial alternative or portion of a remedial alternative. ERM agreed with EPA to also begin a screening-level FS to identify other remedial alternatives that should be evaluated in a detailed FS along with a 'Salt-Cap' alternative. In November 2014, EPA, UDEQ and ERM held a scoping meeting to discuss ERM's preparation of a Salt Cap Treatability Study (including a salt cap accumulation test which began in June 2015). ERM committed to developing ~~a~~the technical memorandum documenting initial screening~~-level FS~~ of technology types and process options stipulated in Section 6.2 of the AOC SOW during 2015-2016.

~~Subsequent phases of the RIFS will include:~~

Phase 2: Detailed RI, Screening FS, and Baseline Risk Assessment ~~(late 2015, 2016 and 2017)~~

- Develop DQOs and SAP specifications for detailed Site characterization and risk assessment.
- Perform detailed Site characterization and biotic studies.
- Complete screening-level FS, identifying RAOs and ARARs.
- Complete a Baseline Risk Assessment.
- Select screened alternatives to carry forward into detailed FS.

Phase 3: Detailed Feasibility Study ~~(2018-2020)~~

- Establish preliminary risk-reduction goals (EPA and UDEQ).
- Develop specifications for the FS.
- Conduct FS for a range of remedial alternatives.

Phase 4: Remedial Response Decision ~~(2021-2022)~~

- Prepare a Proposed Plan and Record of Decision (ROD).

Attachment 2 is a chart that summarizes RI/FS activities to date and shows the current schedule for completing RI/FS activities and a Baseline Risk Assessment, followed by development of detailed Feasibility Study(s) and a Record of Decision selecting a cleanup remedy.

The Phase 1A-B investigation will identify OU-1 COPCs and determine preliminary nature and extent. In addition, preliminary mapping of COPCs will be conducted to characterize the potential scope and scale of contaminant distribution within the Inner PRI areas.

While reviewing data for the Phase 1A Outer PRI areas and during Phase 1A-B scoping discussions, ERM and EPA recognized the need for a Background Study of contaminant concentrations that may be unrelated to Site releases. The Phase 1A-B SAP, therefore, will evaluate abiotic chemical constituents at select "off-site" locations.

The Phase 1A-B Background Study will:

- Identify locations (beyond the RI study area) as reference areas; and
- Collect data to compare naturally occurring chemicals of concern to constituents within the RI study areas.

This Phase 1A-B SAP is project-specific and pertains only to the Phase 1A-B activities and implementation. Briefing and planning sessions that have been held are identified in Worksheet (WS) #9.

Phase 1A-B activities will include acquisition of data allowing development of a refined list of chemicals in order to select COPCs; these acquired data also will be necessary to prepare a plan for more complete investigations of the Site. Additional phases of the RI will be planned after completion of the Phase 1A-B RI and SLERA by ERM/US Magnesium, and determination by EPA of any need for additional data to complete the baseline human health and ecological RAs.

Phase 1A-B activities will include sampling Site media to evaluate the nature and extent of contaminants within the soils, sediments and wastes of the Inner PRI areas, and to obtain preliminary data to support initial risk calculations. Phase 2 will include additional sampling of Site media to fill data gaps and to reduce uncertainties in the Phase 1A-B data sets. In addition, Phase 2 may include biota sampling, as well as further lateral and vertical sampling of soil, sediment, water and waste across areas subjected to the preliminary remedial investigation.

> ~~The RI/FS Project Plan provided by the USEPA will not be included as Attachment 2 to the SAP because it is mostly irrelevant to the sampling and analysis activities for the OU 1 Phase 1A-B RI and is not required or suggested by any of the data quality planning requirements listed in AOC paragraph 47 or in the SOW.~~

We look forward to discussion these additional modifications to the Phase 1 A-B SAP with you during the ERM/EPA consultation schedule for 20 August 2015. If you have any questions regarding these proposes modifications, please contact me at (480) 998-2401. We are optimistic that we can quickly resolves these remaining items and quickly complete the SAP and initiate the planning tasks necessary to initiate field work in the fall of 2015.

Sincerely,

David J. Abranovic, P.E.
Project Coordinator (ERM)

DJA/xxx/0132320
Attachments

cc: David Gibby (US Mag)
Mark Ransom (ERM)

Attachment 9JJ

19 August 2015 Revised WS-16 and Text from WS-11 and 13

From:	David Abranovic
Sent:	Wednesday, August 19, 2015 4:30 PM
To:	Ken Wangerud (Wangerud.Ken@epamail.epa.gov); Mike Storck (mstorck@utah.gov)
Cc:	Kevin Lundmark
Subject:	Revised WS-16 and Text from WS-11 and 13
Attachments:	WS16 ERM Revision 18 Aug 2015.docx

Ken,

Please find attached a revised Phase 1 A-B SAP WS-16 that reflects the changes we discussed last week (20 Aug). Also, the modifications that Kevin is proposing to make to SAP WS-11 and WS-13 to address the methodology qualitative method for evaluating the representativeness of the historical data are provided below. These revisions are currently being incorporated into the final Phase 1 A-B SAP, so please let me know ASAP if there is anything that you believe is not in line with what we agreed on last week. Seems to me like we are very close to resolving all of the outstanding SAP items.

Thanks,

david

11.2.5.3 Preliminary Nature and Extent

The Phase 1A-B RI Data Report will include maps showing chemical constituent concentrations for toxic equivalency quotients (TEQs), HCB, and PCBs, and may also include maps for other COPCs that are determined to be of significant interest based on the Phase 1A-B data 2. Chemical mapping will include data from the Phase 1A-B RI and the historical/DMA data 3 described in the Final Inner PRI Data Report (ERM 2014a). If concentrations of a constituent in surface samples are similar across a PRI Area, then additional N&E data may not be required for that constituent. However, additional N&E information may be subsequently needed to delineate specific areas to support risk assessment or remedy decision to more clearly delineate the spatial distribution of chemicals for Site characterization or for FS evaluations. If constituent concentrations are highly variable across a PRI Area, and/or additional delineation is necessary to support remedy selection, then additional sampling to characterize and delineate N&E may be performed during the Phase 2 RI.

\- - - - - - - - - - - - -

Footnote 2: Additional chemical constituent maps for Phase 2 RI scoping will be prepared for Outer PRI Areas and for other Inner PRI Area risk drivers based on the results of the OU-1 SLRA

Footnote 3: The relevance of historical/DMA data for use in N&E mapping will be determined based on the degree to which historic data are deemed to be representative of current site conditions. To make this determination three maps will be developed and compared for chemical constituents: 1) a map based on the historical/DMA data, 2) a map based on the Ph1A-B data , and 3) a map based on the combined historical/DMA and Ph1A-B data.

\- - - - - - - - - - - - -

11.2.6.3 Preliminary Nature and Extent

The need for additional sampling to delineate N&E at the Site will be determined for OU-1 during the Phase 2 RI scoping process. Site-characterization DQOs for the Phase 2 RI may be identified based on waste types and expected thickness, PRI Area boundaries or other important spatial boundaries (e.g., geologic, hydrologic, waste, etc.) and/or remedy-scoping considerations (e.g., decision units). Chemical concentration maps, geostatistical modeling output, and statistical evaluations provided in the Phase 1A-B Data Report will be used to support the Phase 2 RI scoping process and associated DQO development.

The validated and verified Phase 1A-B data will be combined with historical/DMA data deemed to be representative of current site conditions 4 and used to prepare chemical concentration maps and perform geostatistical modeling and statistical evaluations as described in Section 11.2.5.3. The degree to which the combined datasets delineate the N&E of Site-related contamination within the Inner PRI Areas will be described by the variability of concentrations, relationship of results to risk thresholds, the spatial distribution of chemical concentrations, and level of uncertainty for unsampled locations as predicted by geostatistical modeling. The mapping, geostatistical modeling, and statistical evaluations provided for D/F TEQs, HCB, and total PCBs in the Phase 1A-B Data Report will support scoping of Phase 2 investigations for the collection of additional data to complete Site-characterization and support remedy-scoping and FS evaluations.

- - - - - - - - - - - - -

Footnote 4: The degree to which historical/DMA data are representative of current site conditions will be determined qualitatively by comparing maps of historical/DMA data, Phase 1A-B RI data, and combined historical/DMA and Phase 1A-B RI data (per Section 11.2.5.3).

- - - - - - - - - - - - -

13.0 Secondary Data Criteria And Limitations

The following footnote will be added: “Relevance of historic data maps will be determined based on the degree to which historic data are deemed to be representative of current site conditions.”

David J. Abranovic P.E.
Partner

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16.0 PROJECT SCHEDULE / TIMELINE (WORKSHEET #16)

The Phase 1A-B RI schedule for completion of specific tasks and deliverables in the following table is commensurate with joint discussions between ERM, EPA, and UDEQ during a project manager's meeting held on 15 April 2015. This section establishes the key project milestones and deliverables for Phase 1A-B completion in order to maintain progress consistent with overall project RI/FS objectives.

Completion dates provided herein may change with EPA approval. If EPA approves any changes in completion dates, ERM will provide, in monthly progress reports, an enforceable updated detailed Gantt chart schedule with completion dates for specific tasks and an explanation of how changed completion dates will affect the overall timeline for completing the Phase 1 A-B RI, as required by Section VIII Paragraph 37 of the AOC. Due to the interdependency of many of these tasks, the adjustment of a milestone completion may or will necessitate adjustments to dependent milestones. These adjustments will not require EPA approval, and will be accounted for in updated Gantt charts, which will include adjusted milestones for future/dependent tasks that are affected by approved changes in completion dates.

No.	Activity	Organization	Start Date *	Completion Date *	Deliverable	Deliverable Due Date *
1	Phase 1A-B RI SAP Issued *	EPA	--	7 Sept 2015	Phase 1A-B RI SAP, Rev 0	7 Sept 2015
2	Cultural Resources Survey for BG Locations on State/Federal lands	ERM, Logan Simpson Design	Upon EPA approval of BG/Reference sampling locations	September 2015	Cultural Resources Report to BLM	September 2015
3	Surface solids sampling at Inner PRI Areas (excluding inundated areas at PRI Areas 5, 6, and 7 as appropriate)	ERM	September 2015	October 2015	Daily Report with notice of completion	October 2015
4	Subsurface solids sampling (drilling) at Inner PRI Areas	ERM, Drilling Subcontractor (TBD)	October 2015	October 2015	Daily Report with notice of completion	October 2015
5	Surface solids sampling at Background/Reference Areas	ERM	Upon BLM/USFWS approval for ground disturbance – Expected October 2015	October 2015	Daily Report with notice of completion	October 2015
6	Inundated waste area sampling (helicopter)	ERM, Reeder Flying Service	October 2015	November 2015	Daily Report with notice of completion	November 2015

No.	Activity	Organization	Start Date *	Completion Date *	Deliverable	Deliverable Due Date *
7	Daily Progress Reports (per WS#33)	ERM	Upon initiation of Phase 1A-B Sampling Activities	Completion of Phase 1A-B Sampling Activities (expected November 2015)	Daily reports	Completion of Phase 1A-B Sampling Activities (expected November 2015)
8	Monthly Progress Reports, including all results of sampling and all other data received by ERM/US Magnesium unless otherwise provided to EPA (per AOC Paragraph 37)	ERM	Ongoing monthly	Ongoing monthly	Monthly report, including: • Updated laboratory data (Sample Delivery Group) tracking table • List of Phase 1A-B RI sample data uploaded to EQuIS Project Database and available to EPA; and • Sampling results and other data that have not been uploaded to the EQuIS Project Database.	By the 15th Day of the Following Month

No.	Activity	Organization	Start Date *	Completion Date *	Deliverable	Deliverable Due Date *
9	Background/Reference Areas field data and Unvalidated analytical data	ERM	November 2015	December 2015 (approximate – assumes 5-week TAT for HRMS analyses)	Data uploaded to EQuIS per DMP: • Copies of hard copy field sheets will be provided to the EPA on a weekly basis (DMP Page 9); • Analytical data available as Draft/Unverified in EQuIS after EDD passes quality check (DMP Page 14); • Analytical data available as Final/Verified in EQuIS At the conclusion of the verification process (DMP Page 16)	January 2016

No.	Activity	Organization	Start Date *	Completion Date *	Deliverable	Deliverable Due Date *
10	Inner PRI field data and Unvalidated analytical data	ERM	September 2015	January 2016 (approximate – assumes 6-week TAT for HRMS analysis, including drying for fines analysis and no re-extraction/re-analysis)	Data uploaded to EQuIS per DMP: • Copies of hard copy field sheets will be provided to the EPA on a weekly basis (DMP Page 9); • Analytical data available as Draft/Unverified in EQuIS after EDD passes quality check (DMP Page 14); • Analytical data available as Final/Verified in EQuIS At the conclusion of the verification process (DMP Page 16)	January 2016
11	Data validation	LDC	October 2015	January 2016 (approximate)	Data Validation Reports and EDDs	Upon completion of data validation
12	Data uploads to EPA Scribe Database	ERM	Per Data Management Plan: • Publish data to "Draft" Scribe database within 4 weeks of the receipt of the final delivered sampling data (EDDs and laboratory reports) for each phase of data collection (DMP page 16); and • Publish validated data to the "Final" Scribe database via Scribe.net at the completion of each phase of data collection after data validation is completed (DMP Page 17).			
13	Prepare Draft Phase 1A-B RI Data and Preliminary Nature and Extent Report	ERM	January 2016	February 2016	Draft Phase 1A-B RI Data and Preliminary Nature and Extent Report	February 2016
14	Review Draft Phase 1A-B RI Data and Preliminary Nature and Extent Report **	EPA	March 2016	March 2016	EPA Comment Letter	March 2016

No.	Activity	Organization	Start Date *	Completion Date *	Deliverable	Deliverable Due Date *
15	Prepare responses to EPA comments on Draft Phase 1A-B RI Data and Preliminary Nature and Extent Report	ERM	April 2016	April 2016	ERM Response to Comment Letter	April 2016
16	Review ERM Responses to Comments **	EPA	April 2016	May 2016	EPA Approval of Responses to Comments	May 2016
17	Prepare Final Phase 1A-B RI Data and Preliminary Nature and Extent Report	ERM	May 2016	May 2016	Final Phase 1A-B RI Data and Preliminary Nature and Extent Report	May 2016

** Final WS#16 dates to be adjusted (plus or minus) to reflect actual Final SAP issuance date by EPA and approval by BLM and USFWS to perform ground disturbance (sampling) on Federal lands.*

*** Subsequent ERM deliverables will be extended in accordance with Agency comment transmittal.*

Attachment 9KK

20 August 2015 RE: Revised WS-16 and Text from WS-11 and 13

From: Wangerud, Ken <wangerud.ken@epa.gov>
Sent: Thursday, August 20, 2015 1:36 PM
To: David Abranovic; Mike Storck (mstorck@utah.gov)
Cc: Kevin Lundmark; Catherine D. LeCours
Subject: RE: Revised WS-16 and Text from WS-11 and 13

Follow Up Flag: Follow up
Flag Status: Flagged

David and Kevin: Thanks for sending this.

All text/footnote changes for 11.2.5.3, 11.2.6.3 and 13.0 are acceptable.

The revised WS#16 is largely consistent with our discussion of Aug 12th, except for the following points:

- Intro: Your retention of the sentence "Due to the interdependency of many of these tasks,…" is understandable, but because this project will be proceeding at a relatively fast pace, and changes could occur with potential to affect milestone completion, revise the sentence to read as follows:

  > "Because of the interdependency of many of these tasks, ERM shall advise EPA as early as possible of task delays that may necessitate adjustments to completion and dependent milestones."

  ERM's practice of raising 'potential issues' with EPA-UDEQ during weekly calls has been excellent, and this change is consistent with that practice.

- No. 8: During our consult, you indicated that you could report on the %-completion of lab-analytical work in the Monthly Progress Report; that appears to be an oversight in the deliverable bullets-list. Please include.

- No. 11: Consistent with your current OU1 PhA-B RI schedule, the completion date should be January 2016 (delete 'approximate') and the deliverable due date should likewise be January 2016. If deviations from these dates are warranted, that can be discussed with EPA per the procedures outlined above.

With the above items, and the discussion we had this morning on the SAP Preface and Sec. 2, it seems to me that we have resolved everything needed for ERM to prepare and submit a final SAP for agency review/approval. If there is anyting remaining, please contact me or Catherine LeCours at PWT.

Cheers,
Ken

Ken Wangerud, Remedial Project Manager
Superfund Remedial Program
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wangerud.ken@epa.gov

From: David Abranovic [mailto:David.Abranovic@erm.com]
Sent: Wednesday, August 19, 2015 4:30 PM
To: Wangerud, Ken; Mike Storck (mstorck@utah.gov)

Cc: Kevin Lundmark
Subject: Revised WS-16 and Text from WS-11 and 13

Ken,

Please find attached a revised Phase 1 A-B SAP WS-16 that reflects the changes we discussed last week (20 Aug). Also, the modifications that Kevin is proposing to make to SAP WS-11 and WS-13 to address the methodology qualitative method for evaluating the representativeness of the historical data are provided below. These revisions are currently being incorporated into the final Phase 1 A-B SAP, so please let me know ASAP if there is anything that you believe is not in line with what we agreed on last week. Seems to me like we are very close to resolving all of the outstanding SAP items.

Thanks,

david

11.2.5.3 Preliminary Nature and Extent

The Phase 1A-B RI Data Report will include maps showing chemical constituent concentrations for toxic equivalency quotients (TEQs), HCB, and PCBs, and may also include maps for other COPCs that are determined to be of significant interest based on the Phase 1A-B data 2. Chemical mapping will include data from the Phase 1A-B RI and the historical/DMA data 3 described in the Final Inner PRI Data Report (ERM 2014a). If concentrations of a constituent in surface samples are similar across a PRI Area, then additional N&E data may not be required for that constituent. However, additional N&E information may be subsequently needed to delineate specific areas to support risk assessment or remedy decision to more clearly delineate the spatial distribution of chemicals for Site characterization or for FS evaluations. If constituent concentrations are highly variable across a PRI Area, and/or additional delineation is necessary to support remedy selection, then additional sampling to characterize and delineate N&E may be performed during the Phase 2 RI.

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Footnote 2: Additional chemical constituent maps for Phase 2 RI scoping will be prepared for Outer PRI Areas and for other Inner PRI Area risk drivers based on the results of the OU-1 SLRA

Footnote 3: The relevance of historical/DMA data for use in N&E mapping will be determined based on the degree to which historic data are deemed to be representative of current site conditions. To make this determination three maps will be developed and compared for chemical constituents: 1) a map based on the historical/DMA data, 2) a map based on the Ph1A-B data , and 3) a map based on the combined historical/DMA and Ph1A-B data.

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11.2.6.3 Preliminary Nature and Extent

The need for additional sampling to delineate N&E at the Site will be determined for OU-1 during the Phase 2 RI scoping process. Site-characterization DQOs for the Phase 2 RI may be identified based on waste types and expected thickness, PRI Area boundaries or other important spatial boundaries (e.g., geologic, hydrologic, waste, etc.) and/or remedy-scoping considerations (e.g., decision units). Chemical concentration maps, geostatistical modeling output, and statistical evaluations provided in the Phase 1A-B Data Report will be used to support the Phase 2 RI scoping process and associated DQO development.

The validated and verified Phase 1A-B data will be combined with historical/DMA data deemed to be representative of current site conditions 4 and used to prepare chemical concentration maps and perform geostatistical modeling and statistical evaluations as described in Section 11.2.5.3. The degree to which the combined datasets delineate the N&E of Site-related contamination within the Inner PRI Areas will be described by the variability of concentrations, relationship of results to risk thresholds, the spatial distribution of chemical concentrations, and level of uncertainty for unsampled locations as predicted by geostatistical modeling. The mapping, geostatistical modeling, and statistical evaluations provided for D/F TEQs, HCB, and total PCBs in the Phase 1A-B Data Report will support scoping of Phase 2 investigations for the collection of additional data to complete Site-characterization and support remedy-scoping and FS evaluations.

- - - - - - - - - - - - -

Footnote 4: The degree to which historical/DMA data are representative of current site conditions will be determined qualitatively by comparing maps of historical/DMA data, Phase 1A-B RI data, and combined historical/DMA and Phase 1A-B RI data (per Section 11.2.5.3).

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13.0 Secondary Data Criteria And Limitations

The following footnote will be added: "Relevance of historic data maps will be determined based on the degree to which historic data are deemed to be representative of current site conditions."

David J. Abranovic P.E.
Partner

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Attachment 9LL

23 August 2015 RE: Follow-up re discussion/resolution of Preface & Sec.2 language

Kevin Lundmark

From: David Abranovic
Sent: Monday, August 24, 2015 12:16 PM
To: Kevin Lundmark
Subject: FW: Follow-up re discussion/resolution of Preface & Sec.2 language ...

FYI

David J. Abranovic P.E.
Partner

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From: Wangerud, Ken [mailto:wangerud.ken@epa.gov]
Sent: Sunday, August 23, 2015 7:18 AM
To: David Abranovic
Cc: Mark Ransom; Mike Storck (mstorck@utah.gov)
Subject: RE: Follow-up re discussion/resolution of Preface & Sec.2 language ...

I presume you saw my Thurs 20Aug 10:38am email 'Follow-up re discussion/resolution of Preface & Sec.2 language ...' As we discussed, there are two problematic sentences in the paragraphs at pps. 4 and 10 that need correction/clarification. Your sentence below is correct. However, I look forward to seeing that appropriately crafted that into each of the problematic and poorly worded phrases highlighted below. If you want me to edit this for you, please advise.

In order to initiate sampling and data collection activities in 2013 and begin remedial investigations of PRI Areas 2 and 8 through 17 (Outer PRI areas), as well as reduce the need for multiple sampling plan documents, the EPA issued the Phase 1A RI SAP as Revision 0 without addressing the technical issues needed to commence sampling in the Inner PRI areas. However, the general framework of the Phase 1A RI SAP provided for simple a framework that could be used, with appropriate modification which would enable start-up of investigationsthe sample collection and laboratory SOPs, to initiate investigation of the Inner PRI areas.

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wangerud.ken@epa.gov

From: David Abranovic [mailto:David.Abranovic@erm.com]
Sent: Thursday, August 20, 2015 4:42 PM
To: Wangerud, Ken
Subject: RE: Follow-up re discussion/resolution of Preface & Sec.2 language ...

Ken,

I wordsmith the sentence we struggled with on this morning's call. I don't think this is the exact phrasing we discussed but how does this look?

However, the terms and conditions provided by EPA with the Phase 1A RI SAP (Revision 0) provided a framework to resolve the remaining technical issues associated with sampling the Inner PRI areas.

I think that this sentence can replace both of the sentences on the bottom of page 4 and page 10 of my 18 August letter that begin with "However".

david

David J. Abranovic P.E.
Partner

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From: Wangerud, Ken [mailto:wangerud.ken@epa.gov]
Sent: Thursday, August 20, 2015 9:38 AM
To: David Abranovic; Mark Ransom; R. David Gibby (dgibby@usmagnesium.com); mstorck@utah.gov
Subject: Follow-up re discussion/resolution of Preface & Sec.2 language ...

ERM-USMag:

The main point with which EPA and UDEQ took issue in ERM's Aug 18th submittal was ERM's language at pages 4 and 10 asserting that EPA issued the Ph1A SAP 'without addressing the technical issues'. I pointed out that this statement was untrue and unacceptable. EPA described and clarified in its Aug 10th required SAP modifications (and specifically its comment on this point) the fact that the Ph1A SAP had recognized (with terms and conditions) that these matters be resolved before commencing Inner PRI investigations.

I also noted that the follow-up ERM sentence ("…the general framework of the Ph1A RI SAP…provided a framework that could be used…"), used in the same paragraphs at both pages, was very cumbersome and that the phrase 'general framework' be replaced with 'the terms and conditions'.

In our discussion, ERM recognized that ERM's Aug 18th text did not address EPA's concern, and Mark Ransom suggested that the text could be revised to recognize that 'EPA issued the Ph1A SAP with terms and conditions that would enable remaining technical issues to be addressed in order to commence sampling of the Inner PRI areas'. I agreed, subject to final review.

We also discussed minor text-edits to pp.7-para.2 to delete the word 'conceptual'. Also, at pp.7, para.3, the second sentence would read "On February 20, 2015, ERM (per EPA's request), submitted…"

ERM is to resubmit the final text-changes for the pp.4 and 10 sections, and upon my review/approval would then proceed to incorporate the remaining text from ERM's Aug 18th version into a final SAP submittal.

EPA appreciates the work and resolution of the Preface and Sec. 2 SAP contents.

Sincerely,
Ken

Ken Wangerud, Remedial Project Manager
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Attachment 9MM

24 August 2015, 1 of 2 Revisions to Worksheet 16

From: David Abranovic
Sent: Monday, August 24, 2015 5:30 PM
To: Wangerud, Ken; Mike Storck (mstorck@utah.gov)
Cc: Kevin Lundmark; Catherine D. LeCours
Subject: RE: Revised WS-16 and Text from WS-11 and 13

Ken,

Per our discussion on the weekly call today, ERM will make all of the WS-16 changes that you requested in your e-mail below, with the exception of the inclusion of a summary of %-completion of lab-analytical in the monthly reports. This comment will be addressed by changing the first bullet of the item 8 to read:

- Updated laboratory progress (Sample Delivery Group) tracking table showing completion status of laboratory analytical work

David J. Abranovic P.E.
Partner

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7272 E. Indian School Road, Suite 108
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david.abranovic@erm.com
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From: Wangerud, Ken [mailto:wangerud.ken@epa.gov]
Sent: Thursday, August 20, 2015 12:36 PM
To: David Abranovic; Mike Storck (mstorck@utah.gov)
Cc: Kevin Lundmark; Catherine D. LeCours
Subject: RE: Revised WS-16 and Text from WS-11 and 13

David and Kevin: Thanks for sending this.

All text/footnote changes for 11.2.5.3, 11.2.6.3 and 13.0 are acceptable.

The revised WS#16 is largely consistent with our discussion of Aug 12th, except for the following points:

- Intro: Your retention of the sentence “Due to the interdependency of many of these tasks,…” is understandable, but because this project will be proceeding at a relatively fast pace, and changes could occur with potential to affect milestone completion, revise the sentence to read as follows:

> "Because of the interdependency of many of these tasks, ERM shall advise EPA as early as possible of task delays that may necessitate adjustments to completion and dependent milestones."

ERM's practice of raising 'potential issues' with EPA-UDEQ during weekly calls has been excellent, and this change is consistent with that practice.

- No. 8: During our consult, you indicated that you could report on the %-completion of lab-analytical work in the Monthly Progress Report; that appears to be an oversight in the deliverable bullets-list. Please include.

- No. 11: Consistent with your current OU1 PhA-B RI schedule, the completion date should be January 2016 (delete 'approximate') and the deliverable due date should likewise be January 2016. If deviations from these dates are warranted, that can be discussed with EPA per the procedures outlined above.

With the above items, and the discussion we had this morning on the SAP Preface and Sec. 2, it seems to me that we have resolved everything needed for ERM to prepare and submit a final SAP for agency review/approval. If there is anyting remaining, please contact me or Catherine LeCours at PWT.

Cheers,
Ken

Ken Wangerud, Remedial Project Manager
Superfund Remedial Program
Office of Ecosystems Protection and Remediation
USEPA Region 8 - EPR/SR
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- -
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wangerud.ken@epa.gov

From: David Abranovic [mailto:David.Abranovic@erm.com]
Sent: Wednesday, August 19, 2015 4:30 PM
To: Wangerud, Ken; Mike Storck (mstorck@utah.gov)
Cc: Kevin Lundmark
Subject: Revised WS-16 and Text from WS-11 and 13

Ken,

Please find attached a revised Phase 1 A-B SAP WS-16 that reflects the changes we discussed last week (20 Aug). Also, the modifications that Kevin is proposing to make to SAP WS-11 and WS-13 to address the methodology qualitative method for evaluating the representativeness of the historical data are provided below. These revisions are currently being incorporated into the final Phase 1 A-B SAP, so please let me know ASAP if there is anything that you believe is not in line with what we agreed on last week. Seems to me like we are very close to resolving all of the outstanding SAP items.

Thanks,

david

11.2.5.3 Preliminary Nature and Extent

The Phase 1A-B RI Data Report will include maps showing chemical constituent concentrations for toxic equivalency quotients (TEQs), HCB, and PCBs, and may also include maps for other COPCs that are determined to be of significant interest based on the Phase 1A-B data 2. Chemical mapping will include data from the Phase

1A-B RI and the historical/DMA data 3 described in the Final Inner PRI Data Report (ERM 2014a). If concentrations of a constituent in surface samples are similar across a PRI Area, then additional N&E data may not be required for that constituent. However, additional N&E information may be subsequently needed to delineate specific areas to support risk assessment or remedy decision to more clearly delineate the spatial distribution of chemicals for Site characterization or for FS evaluations. If constituent concentrations are highly variable across a PRI Area, and/or additional delineation is necessary to support remedy selection, then additional sampling to characterize and delineate N&E may be performed during the Phase 2 RI.

\- - - - - - - - - - - - -

Footnote 2: Additional chemical constituent maps for Phase 2 RI scoping will be prepared for Outer PRI Areas and for other Inner PRI Area risk drivers based on the results of the OU-1 SLRA

Footnote 3: The relevance of historical/DMA data for use in N&E mapping will be determined based on the degree to which historic data are deemed to be representative of current site conditions. To make this determination three maps will be developed and compared for chemical constituents: 1) a map based on the historical/DMA data, 2) a map based on the Ph1A-B data , and 3) a map based on the combined historical/DMA and Ph1A-B data.

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11.2.6.3 Preliminary Nature and Extent

The need for additional sampling to delineate N&E at the Site will be determined for OU-1 during the Phase 2 RI scoping process. Site-characterization DQOs for the Phase 2 RI may be identified based on waste types and expected thickness, PRI Area boundaries or other important spatial boundaries (e.g., geologic, hydrologic, waste, etc.) and/or remedy-scoping considerations (e.g., decision units). Chemical concentration maps, geostatistical modeling output, and statistical evaluations provided in the Phase 1A-B Data Report will be used to support the Phase 2 RI scoping process and associated DQO development.

The validated and verified Phase 1A-B data will be combined with historical/DMA data deemed to be representative of current site conditions 4 and used to prepare chemical concentration maps and perform geostatistical modeling and statistical evaluations as described in Section 11.2.5.3. The degree to which the combined datasets delineate the N&E of Site-related contamination within the Inner PRI Areas will be described by the variability of concentrations, relationship of results to risk thresholds, the spatial distribution of chemical concentrations, and level of uncertainty for unsampled locations as predicted by geostatistical modeling. The mapping, geostatistical modeling, and statistical evaluations provided for D/F TEQs, HCB, and total PCBs in the Phase 1A-B Data Report will support scoping of Phase 2 investigations for the collection of additional data to complete Site-characterization and support remedy-scoping and FS evaluations.

\- - - - - - - - - - - - -

Footnote 4: The degree to which historical/DMA data are representative of current site conditions will be determined qualitatively by comparing maps of historical/DMA data, Phase 1A-B RI data, and combined historical/DMA and Phase 1A-B RI data (per Section 11.2.5.3).

\- - - - - - - - - - - - -

13.0 Secondary Data Criteria And Limitations

The following footnote will be added: “Relevance of historic data maps will be determined based on the degree to which historic data are deemed to be representative of current site conditions.”

David J. Abranovic P.E.
Partner

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Please visit ERM's web site: http://www.erm.com

Attachment 9NN

24 August 2015, 2 of 2 Revsions to Preface and Worksheet 2

From:	David Abranovic
Sent:	Monday, August 24, 2015 5:41 PM
To:	Wangerud, Ken
Cc:	Mark Ransom; Mike Storck (mstorck@utah.gov); Kevin Lundmark
Subject:	RE: Follow-up re discussion/resolution of Preface & Sec.2 language ...

Ken,

Per our discussion on the weekly call today, ERM will replace the problematic sentences that you highlighted on page 4 and 10 of my 18 August letter with the following text:

> In order to initiate sampling and data collection activities in 2013 and begin remedial investigations of PRI Areas 2 and 8 through 17 (Outer PRI areas), as well as reduce the need for multiple sampling plan documents, the EPA issued the Phase 1A RI SAP as Revision 0 without resolving the technical issues needed to commence sampling in the Inner PRI areas. However, the terms and conditions provided by EPA with the Phase 1A RI SAP (Revision 0) provided a framework to resolve the remaining technical issues associated with sampling the Inner PRI areas.

David J. Abranovic P.E.
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From: Wangerud, Ken [mailto:wangerud.ken@epa.gov]
Sent: Sunday, August 23, 2015 7:18 AM
To: David Abranovic
Cc: Mark Ransom; Mike Storck (mstorck@utah.gov)
Subject: RE: Follow-up re discussion/resolution of Preface & Sec.2 language ...

I presume you saw my Thurs 20Aug 10:38am email 'Follow-up re discussion/resolution of Preface & Sec.2 language ...' As we discussed, there are two problematic sentences in the paragraphs at pps. 4 and 10 that need correction/clarification. Your sentence below is correct. However, I look forward to seeing that appropriately crafted that into each of the problematic and poorly worded phrases highlighted below. If you want me to edit this for you, please advise.

In order to initiate sampling and data collection activities in 2013 and begin remedial investigations of PRI Areas 2 and 8 through 17 (Outer PRI areas), as well as reduce the need for multiple sampling plan documents, the EPA issued the Phase 1A RI SAP as Revision 0 without addressing the technical issues needed to commence sampling in the Inner PRI areas. However, the general framework of the Phase 1A RI SAP provided for simple a framework that could be used, with appropriate modification which would enable start-up of investigationsthe sample collection and laboratory SOPs, to initiate investigation of the Inner PRI areas.

Ken Wangerud, Remedial Project Manager
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wangerud.ken@epa.gov

From: David Abranovic [mailto:David.Abranovic@erm.com]
Sent: Thursday, August 20, 2015 4:42 PM
To: Wangerud, Ken
Subject: RE: Follow-up re discussion/resolution of Preface & Sec.2 language ...

Ken,

I wordsmith the sentence we struggled with on this morning's call. I don't think this is the exact phrasing we discussed but how does this look?

However, the terms and conditions provided by EPA with the Phase 1A RI SAP (Revision 0) provided a framework to resolve the remaining technical issues associated with sampling the Inner PRI areas.

I think that this sentence can replace both of the sentences on the bottom of page 4 and page 10 of my 18 August letter that begin with "However".

david

David J. Abranovic P.E.
Partner

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From: Wangerud, Ken [mailto:wangerud.ken@epa.gov]
Sent: Thursday, August 20, 2015 9:38 AM
To: David Abranovic; Mark Ransom; R. David Gibby (dgibby@usmagnesium.com); mstorck@utah.gov
Subject: Follow-up re discussion/resolution of Preface & Sec.2 language ...

ERM-USMag:

The main point with which EPA and UDEQ took issue in ERM's Aug 18th submittal was ERM's language at pages 4 and 10 asserting that EPA issued the Ph1A SAP 'without addressing the technical issues'. I pointed out that this statement was untrue and unacceptable. EPA described and clarified in its Aug 10th required SAP modifications (and specifically its comment on this point) the fact that the Ph1A SAP had recognized (with terms and conditions) that these matters be resolved before commencing Inner PRI investigations.

I also noted that the follow-up ERM sentence ("…the general framework of the Ph1A RI SAP…provided a framework that could be used…"), used in the same paragraphs at both pages, was very cumbersome and that the phrase 'general framework' be replaced with 'the terms and conditions'.

In our discussion, ERM recognized that ERM's Aug 18th text did not address EPA's concern, and Mark Ransom suggested that the text could be revised to recognize that 'EPA issued the Ph1A SAP with terms and conditions that would enable remaining technical issues to be addressed in order to commence sampling of the Inner PRI areas'. I agreed, subject to final review.

We also discussed minor text-edits to pp.7-para.2 to delete the word 'conceptual'. Also, at pp.7, para.3, the second sentence would read "On February 20, 2015, ERM (per EPA's request), submitted…"

ERM is to resubmit the final text-changes for the pp.4 and 10 sections, and upon my review/approval would then proceed to incorporate the remaining text from ERM's Aug 18th version into a final SAP submittal.

EPA appreciates the work and resolution of the Preface and Sec. 2 SAP contents.

Sincerely,
Ken

Ken Wangerud, Remedial Project Manager
Superfund Remedial Program
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wangerud.ken@epa.gov

Attachment 9OO

25 August 2015 US Magnesium LLC — EPA's August 10, 2015, letter relating to the submittal review and approval process under the AOC

PARSONS
BEHLE &
LATIMER

201 South Main Street, Suite 1800
Salt Lake City, Utah 84111
Main 801.532.1234
Fax 801.536.6111

A Professional
Law Corporation

M. Lindsay Ford
Attorney at Law
Direct 801.536.6605
LFord@parsonsbehle.com

August 25, 2015

Attachment to email

Steven Moores
Legal Enforcement
U.S. Environmental Protection Agency
1595 Wynkoop Street
Denver, CO 80202

Re: US Magnesium LLC – EPA's August 10, 2015, letter relating to the submittal review and approval process under the AOC

Dear Mr. Moores:

Thank you for your August 10, 2015, letter discussing the submittal review and approval process under the Administrative Order on Consent (AOC). We share the goal of making this process as efficient and cost-effective as possible, but wish to clarify several points from your letter. We also offer suggestions for improving how the parties implement this process moving forward.

The submittal review and response requirements are set forth in Paragraph 39 of the AOC. You paraphrase these requirements in your letter, but the precise AOC language is important so I will repeat it here:

> 39. After review of any plan, report or other item that is required to be submitted for approval pursuant to this Settlement Agreement, in a notice to Respondent EPA shall: (a) approve, in whole or in part, the submission; (b) approve the submission upon specified conditions; (c) modify the submission to cure the deficiencies; (d) disapprove, in whole or in part, the submission, directing that Respondent modify the submission; or (e) any combination of the above. However, EPA shall not modify a submission without first providing Respondent at least one notice of deficiency and an opportunity to cure within twenty (20) days, except where to do so would cause serious disruption to the Work or where previous submission(s) have been disapproved due to material defects.

As noted in your letter, on July 17, 2015, EPA and the State of Utah responded to ERM's July 2, 2015, submittal of a Draft Phase 1 A-B Sampling and Analysis Plan (SAP). Many of the agency "comments" were in the form of redline/strikeout edits to the draft SAP document, often with little or no accompanying comments or explanation. EPA refers to these edits as "modifications" to "cure deficiencies," then invokes Paragraph 39(c) of the AOC: "EPA has modified the submission to cure deficiencies. Accordingly, this comment and notice affords ERM the opportunity to cure the Draft SAP within twenty (20) days."

This practice fails to comply with Paragraph 39 and is inappropriate for several reasons. First, Paragraph 39 specifies that "EPA shall not modify a submission without *first* providing Respondent at least one notice of deficiency and an opportunity to cure …." (Emphasis added) Here, EPA disregards the *prior* notice requirement and jumps straight to suggesting modifications[1] to cure "deficiencies," improperly conflating the notice of deficiency and modification of deficiency steps into one. The agency then attempts to remedy this failure by giving a *post hoc* notice of deficiency and opportunity to cure. This practice does not follow the process set forth in the AOC.

Second, and more fundamentally, in some cases the agency includes little or no explanation for why it considers particular submittal language to be "deficient." In these cases, EPA essentially defines "deficiency" as any variation between the submittal language and the agency's preferred language, which is arbitrary and capricious. Though the AOC does not define the term "deficiency," it must have some meaning beyond the agency's mere whim or fancy. A deficiency should be defined as a failure to adhere to applicable guidance or agreements made during the scoping process. And for ERM/US Mag to have "notice" of a deficiency, EPA must explain the alleged deficiency so that ERM and US Mag can understand it and decide how/whether to "cure" it or invoke dispute resolution. Only after providing such notice, and allowing time for ERM to cure, can EPA modify the submission to cure a deficiency itself.

Finally, this practice has the potential to arbitrarily end technical discussions before important technical issues have been vetted and resolved. As you recognize, "[s]ometimes these continued discussions have led to improved submittals." In some cases, continued technical discussions are imperative to adequately addressing important topics. EPA should not invoke Paragraph 39(c) to prematurely cut off such discussions.

We recognize that it may be easier or seem more efficient for EPA to merely edit a submittal without comment, but this does not comply with the AOC. Unless a change is necessary to comply with applicable guidance or agreements made during the scoping process, EPA should refrain from suggesting that change. We concur that protracted discussions on individual submissions have delayed the RIFS process and should be avoided when possible, but

---

[1] They remain "suggested modifications" until EPA has provided prior notice and explanation of the deficiency and ERM has had an opportunity to cure or seek dispute resolution.

we believe both parties must take responsibility for avoiding this problem.[2] ERM is a capable and competent technical consultant and has been assigned the task of developing the SAP, subject only to EPA's approval (not re-writing) of the document. We urge EPA to follow the AOC process for reviewing and approving submissions and to limit its comments and suggested modifications to addressing only substantive deficiencies as defined above. This is consistent with EPA's role of overseeing the work, not duplicating it, and will expedite the review and approval process.

We reiterate our desire to make the submittal review and approval process, and the RIFS process generally, more efficient and cost effective. Please consider the suggestions in this letter. We would be happy to discuss these issues further if you desire.

Sincerely,

M. Lindsay Ford
Lindsay Ford
Parsons Behle & Latimer
Counsel for US Magnesium LLC

cc: Thomas Tripp, US Mag
David Gibby, US Mag
David Abranovic, ERM
Andrea Madigan, EPA
Ken Wangerud, EPA
Michael Storck, UDEQ

---

[2] I understand that ERM does not routinely submit multiple drafts of submittals for discussion, but that the only "multiple drafts" it has submitted have been versions of data quality objectives that were developed at the request of EPA to support scoping discussions. I am also told that multiple revisions of submittals may have been necessary because of comments by EPA team members, sometimes late in the review process or contrary to agreements reached during scoping.

ATTACHMENT 10:
HISTORICAL AERIAL PHOTOGRAPHS

File: F:\Projects\U\US Magnesium\0132320 US Magnesium RI FS\4.0 Data\GIS\Aerials\1985.mxd

Date: 6/22/2015 3:27:40 PM

▨ Operating Facility

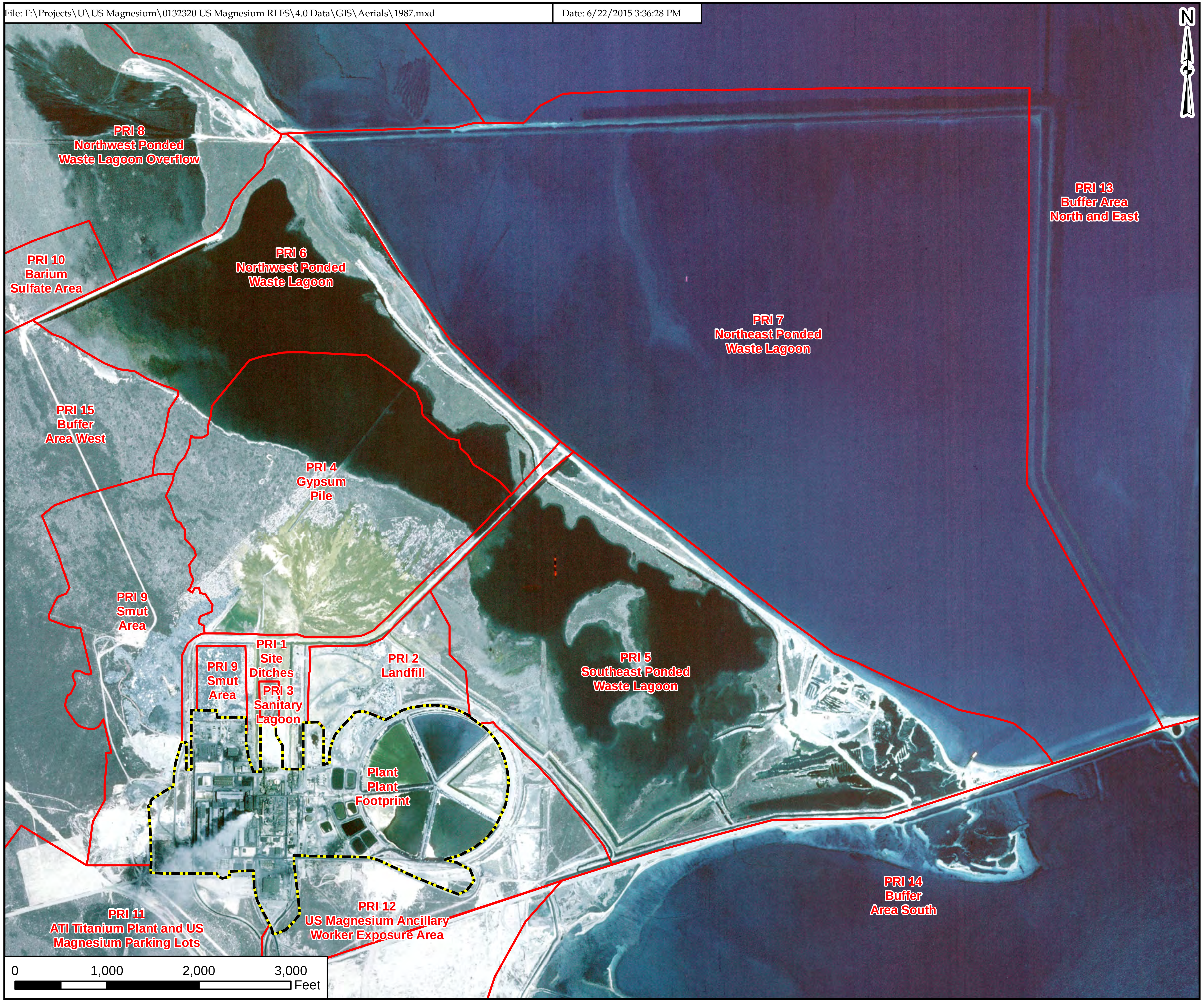
🟥 Preliminary Remedial Investigation Areas

Aerial Photograph Source: USDA NHAP

1985 Aerial Photograph
US Magnesium LLC
Tooele County, Utah

Environmental Resources Management
136 E South Temple
Suite 2150
Salt Lake City, Utah 84111

File: F:\Projects\U\US Magnesium\0132320 US Magnesium RI FS\4.0 Data\GIS\Aerials\1987.mxd | Date: 6/22/2015 3:36:28 PM



⬚ Operating Facility
▭ Preliminary Remedial Investigation Areas

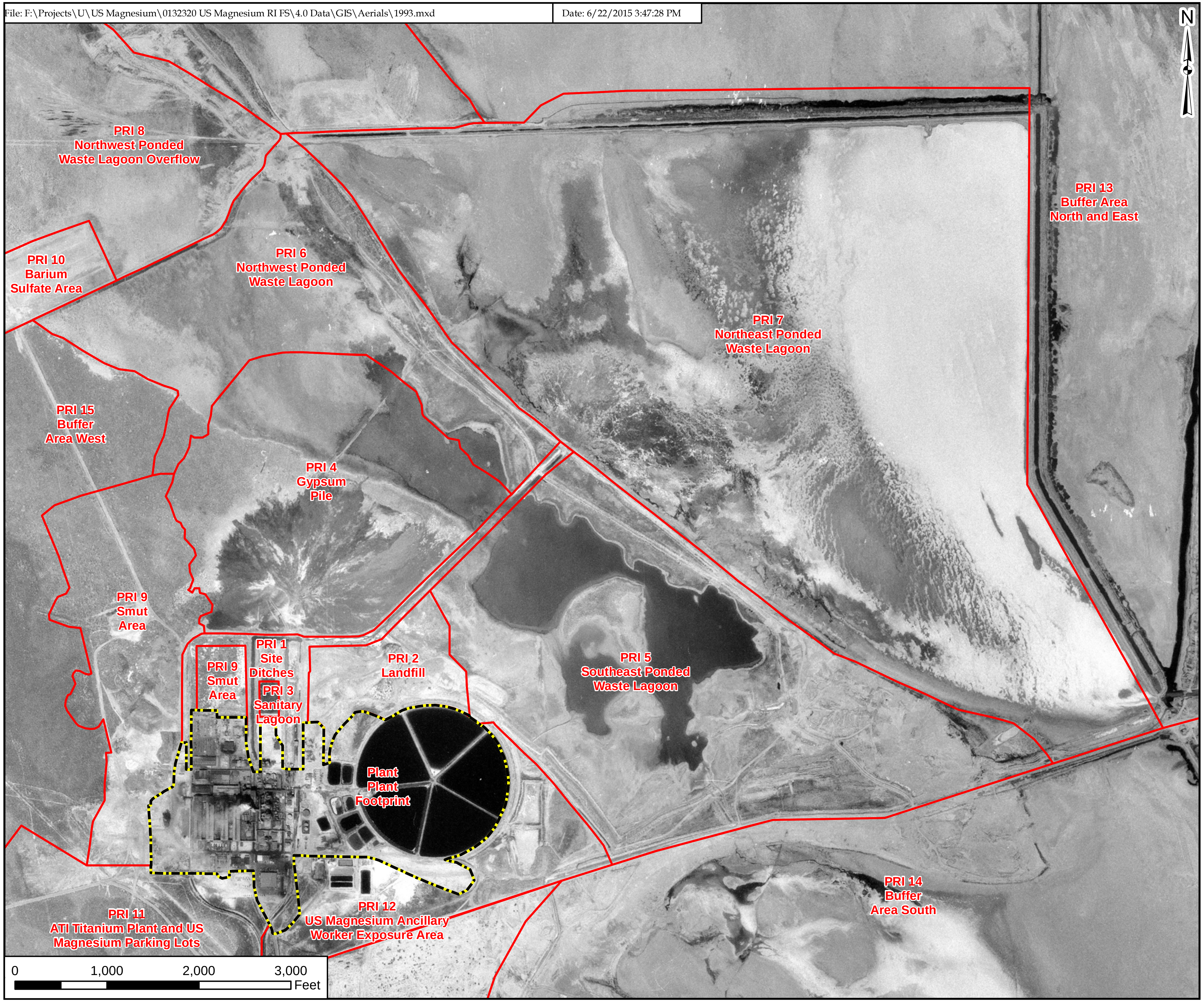
Aerial Photograph Source: USDA NAPP

1987 Aerial Photograph
US Magnesium LLC
Tooele County, Utah

usmag®

Environmental Resources Management
136 E South Temple
Suite 2150
Salt Lake City, Utah 84111
ERM

File: F:\Projects\U\US Magnesium\0132320 US Magnesium RI FS\4.0 Data\GIS\Aerials\1993.mxd | Date: 6/22/2015 3:47:28 PM



⬚ Operating Facility

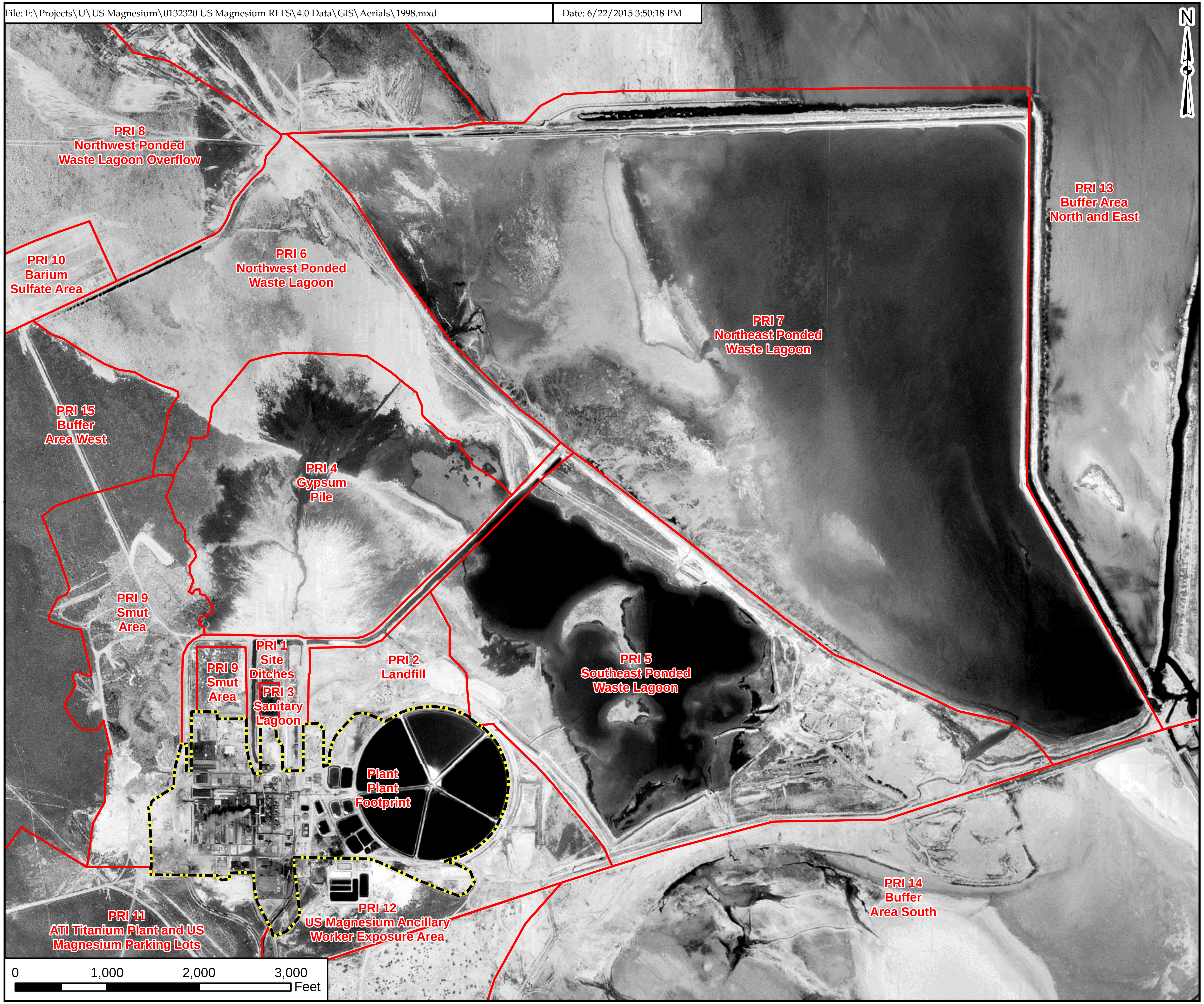
🟥 Preliminary Remedial Investigation Areas

Aerial Photograph Source: USDA NAPP

1993 Aerial Photograph
US Magnesium LLC
Tooele County, Utah

Environmental Resources Management
136 E South Temple
Suite 2150
Salt Lake City, Utah 84111

File: F:\Projects\U\US Magnesium\0132320 US Magnesium RI FS\4.0 Data\GIS\Aerials\1998.mxd | Date: 6/22/2015 3:50:18 PM



Operating Facility

Preliminary Remedial Investigation Areas

Aerial Photograph Source: USDA NAPP

1998 Aerial Photograph
US Magnesium LLC
Tooele County, Utah

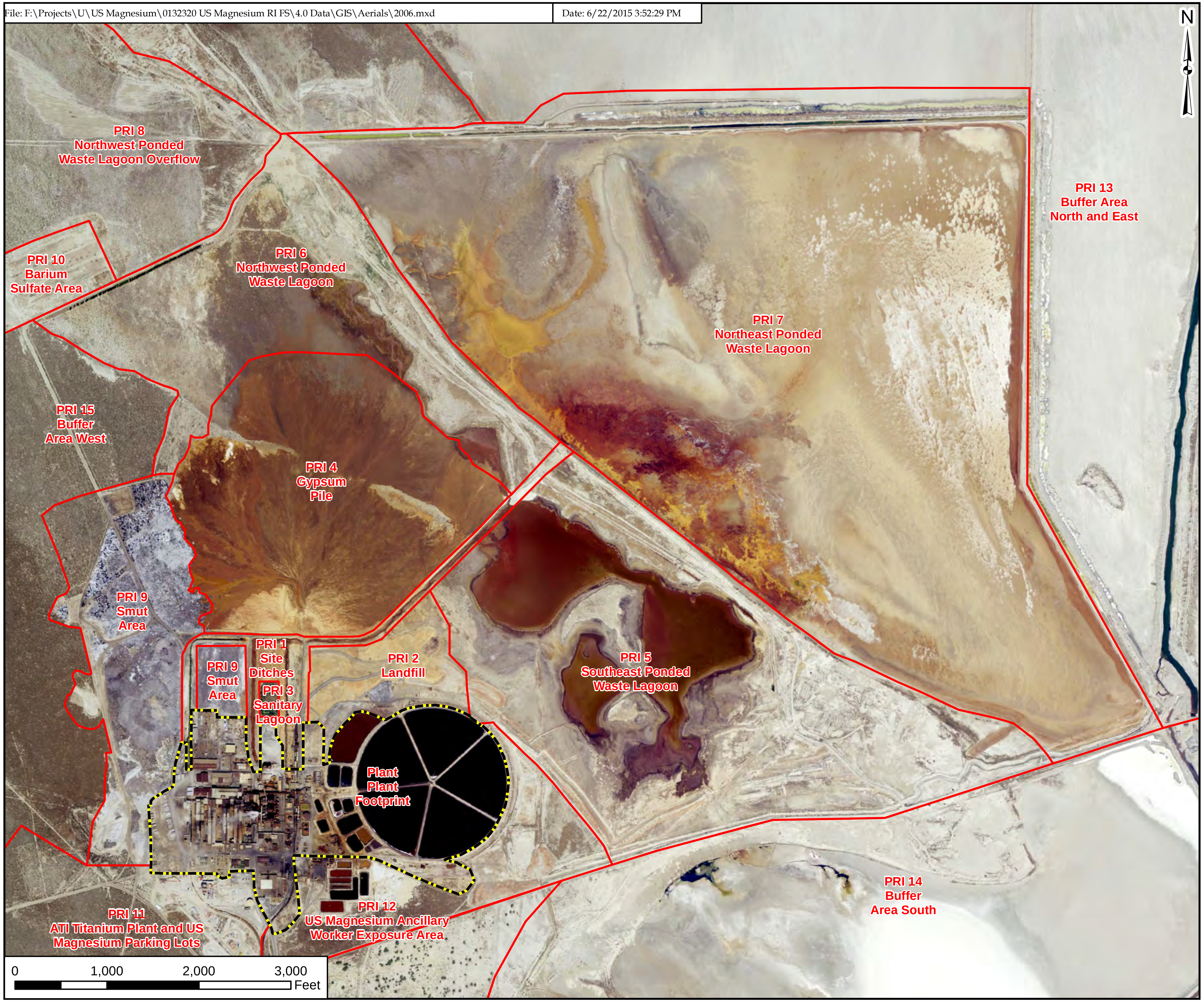
USmag®

Environmental Resources Management
136 E South Temple
Suite 2150
Salt Lake City, Utah 84111

ERM

File: F:\Projects\U\US Magnesium\0132320 US Magnesium RI FS\4.0 Data\GIS\Aerials\2006.mxd

Date: 6/22/2015 3:52:29 PM



⬚ Operating Facility

☐ Preliminary Remedial Investigation Areas

Aerial Photograph Source: USDA NAIP

2006 Aerial Photograph
US Magnesium LLC
Tooele County, Utah

usmag®

Environmental Resources Management
136 E South Temple
Suite 2150
Salt Lake City, Utah 84111

ERM

File: F:\Projects\U\US Magnesium\0132320 US Magnesium RI FS\4.0 Data\GIS\Aerials\2009.mxd | Date: 6/22/2015 3:56:08 PM

▨ Operating Facility

🟥 Preliminary Remedial Investigation Areas

Aerial Photograph Source: USDA

2009 Aerial Photograph
US Magnesium LLC
Tooele County, Utah

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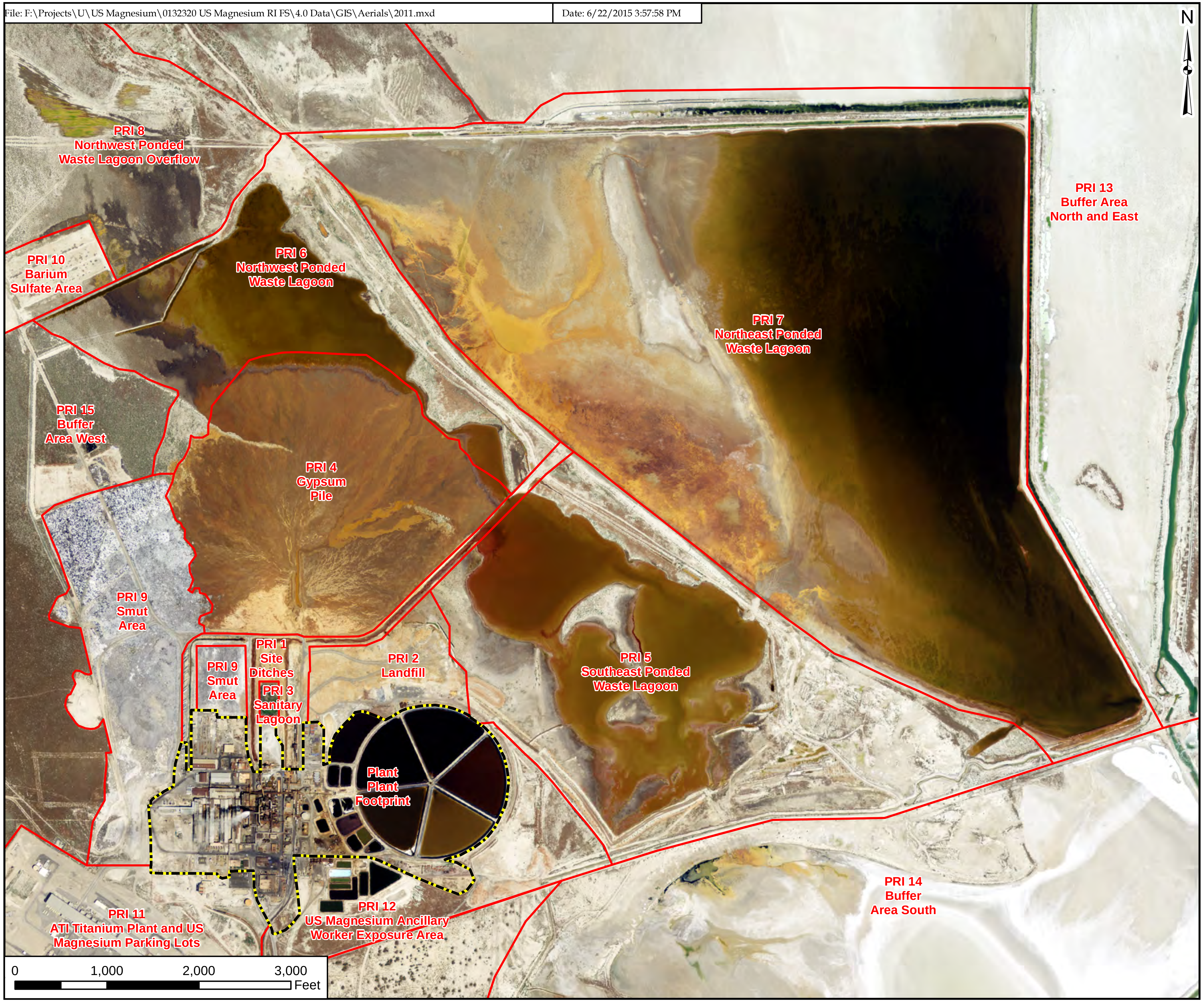
Suite 2150
Salt Lake City, Utah 84111

ERM

File: F:\Projects\U\US Magnesium\0132320 US Magnesium RI FS\4.0 Data\GIS\Aerials\2011.mxd Date: 6/22/2015 3:57:58 PM



Operating Facility
Preliminary Remedial Investigation Areas

Aerial Photograph Source: USDA NAIP

2011 Aerial Photograph
US Magnesium LLC
Tooele County, Utah

Environmental Resources Management
136 E South Temple
Suite 2150
Salt Lake City, Utah 84111

ATTACHMENT 11:

BACKGROUND/REFERENCE AREA IDENTIFICATION TECHNICAL MEMORANDUM

Technical Memorandum

**Environmental
Resources
Management**

7272 E. Indian School Rd.
Suite 108
Scottsdale, AZ 85251
(480) 998-2401
(480) 998-2106 (fax)

To: Chris Cline, USFWS; Sherry Skipper, USFWS; Scott Everett, UDEQ

From: Mark Shibata, Kevin Lundmark, Karen Cejas, ERM

Date: 3 September 2015

Subject: Reconnaissance of Candidate Background Sampling Areas

1.0 INTRODUCTION

As part of the Phase 1A-B sample collection, substrate samples will be collected in reference areas for the characterization of naturally occurring concentrations of metals, as well as ambient concentrations of dioxins/furans, hexachlorobenzene, and total polychlorinated biphenyls (hereafter all referred to as "background"). As described in the Phase 1A-B Sampling and Analysis Plan (SAP), reference locations for background sampling will be selected based on their appropriateness for characterizing naturally occurring concentrations of metals and ambient concentrations of organic chemicals in abiotic and biotic media, keeping in mind that the same locations may be revisited in Phase 2 to characterize background biological information[1]. Since appropriate/relevant biota must be present at background areas for biotic sampling during the Phase 2 remedial investigation (RI), it was determined that a reconnaissance survey was needed prior to Phase 1A-B sampling to evaluate the accessibility and likelihood of collecting biota samples within selected reference locales. [2]

---

[1] Specific types of biological information (e.g., tissue burdens) will be identified in a future Phase 2 SAP.

[2] *reference locales* = larger locales (North, South, Southeast) within which background sampling areas will be established.
background sampling areas = areas (three areas in Upland and three areas in Lakebed settings) within which background sample locations will be established.
background sample locations = locations (10 locations per background sampling area) where background samples will be collected.

This technical memorandum presents the methods and results from the reconnaissance of background areas for Phase 1A-B sampling. Upon approval by the State of Utah and the United States Environmental Protection Agency (USEPA), this technical memorandum will be included as an attachment to the Phase 1A-B SAP. The remainder of this technical memorandum is organized as follows:

- Section 2.0 — describes the methods and notable findings of the background reconnaissance survey;
- Section 3.0 — presents consensus Phase 1A-B investigation background sampling areas; and
- Section 4.0 —presents Phase 1A-B investigation background sample locations.

2.0 BACKGROUND RECONNAISSANCE SURVEY

As described in the Phase 1A-B SAP, substrate (soil/sediment) will be collected in Upland and Lakebed settings. The Upland and Lakebed settings correspond to lithology/soil types relevant to substrate found within the study area for the US Magnesium (US Mag) remedial investigation/feasibility study (hereafter "RI/FS study area").[3] The Upland setting is characterized by Intermountain Basin (IMB) Greasewood Flat/Invasive Annual Grassland, while the Lakebed setting is characterized by IMB Playa.

2.1 Design and Methods

The background reconnaissance survey (hereafter referred to as the 'survey') was designed to identify suitable background sampling areas in Upland and Lakebed settings outside the RI/FS study area that, if needed, could also support the collection of Phase 2 background biological samples.

---

[3] The RI/FS study area is the area contained within a 5-mile radius centered on the US Magnesium facility (or "the site") stack.

2.1.1 Candidate Reference Locales

Lithology[4], soil type[5], and habitat[6] maps were used to identify preliminary reference locales on the western side of Great Salt Lake to the north, south, and southeast of the RI/FS study area as shown on Figure 1. Using literature-based foraging ranges for nesting bird species of interest[7], the boundaries of the Upland and Lakebed reference locales were placed 500 and 1,000 feet, respectively, from the 5-mile radius to ensure nesting birds in reference locales are not foraging within the RI/FS study area.[8]

In the event that biological data cannot be collected from the reference locales (due either to the absence of sufficient biota or to impacts traceable to the site), a contingency reference locale will be utilized. The Bear River Migratory Bird Refuge (BRMBR), located on the northeastern shore of Great Salt Lake, was identified as the contingency reference locale (Figure 2). It is acknowledged that this locale:

- Includes a combination of lithology/soil types, some of which are found within the RI/FS study area and some that are not found in the RI/FS study area; and
- Unlike the RI/FS study area, receives substantial perennial freshwater flows (from the Bear River).

It is further acknowledged that these attributes of the contingency reference locale may confound characterizations of background concentrations (both substrate and biotic) pertinent for the RI/FS study area.

2.1.2 Candidate Background Sampling Areas

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[4] Lithology types from the Utah Geological Survey

[5] Soil types from Natural Resources Conservation Service.

[6] Habitat maps from Southwest Regional Gap Analysis Project (SWReGAP)

[7] Bird species that have been known to nest at/near the site and were the target species of previous nesting surveys at US Mag (Cavitt 2008; 2010).

[8] See Section 11.3.7.3 in the Phase 1A-B SAP for descriptions of bird species of interest and foraging ranges.

The survey was designed to identify suitable background sampling areas. Key features of the survey are as follows:

- Visual surveys of candidate background sampling areas were conducted by the Survey Team (members and affiliations are listed below):

Name	**Organization**
- Chris Cline	United States Fish and Wildlife Services (USFWS)
- Sherry Skipper	USFWS
- Scott Everett	Utah Department of Environmental Quality (UDEQ)
- Mark Shibata	Ecological Risk Assessment Lead, ERM
- John Cavitt	Cavitt Ecological
- Kevin Lundmark	Field Investigation Lead, ERM
- Trent Hamada	Field Investigation, ERM

  To promote a consistent visual/auditory survey, approximately 30 minutes was spent at each background sampling area.

- Observations and conspicuous signs (e.g., songs, scat, burrows) of dominant habitat type and biota were noted. A list of birds and mammals observed/heard was entered onto field data sheets (Attachment A).

- The survey was conducted over a 4-day period, from 1 to 4 June 2015, and included surveys of 15 candidate background sampling areas within BRMBR, Upland, and Lakebed reference locales (Figures 1 and 2).

- The survey timeline was as follows:

Locale Surveyed	**Date**	**Background Sampling Areas Surveyed**	**Survey Time***
BRMBR	1 June 2015	SA001, SA002, SA003	9:00 – 14:00
Upland South	2 June 2015	SA004, SA005, SA007	08:50 – 12:25 13:49 – 14:19
Lakebed South	2 June 2015	SA006, SA008	12:35 – 13:05 15:40 – 16:10
Upland North	3 June 2015	SA009, SA010	11:40 – 13:00

Locale Surveyed	Date	Background Sampling Areas Surveyed	Survey Time*
Lakebed North	3 June 2015	SA011	13:45 – 14:15
Upland Southeast	4 June 2015	SA012, SA013, SA014	10:00 – 12:00
Lakebed Southeast	4 June 2015	SA015	13:05 – 13:35

* Approximate start/stop time of background sampling area surveys in Mountain Daylight Time (MDT). Does not include health and safety tailgate/debrief, technical briefings, travel to/from locale, or reconnaissance of areas not included as candidate background sampling areas.

- Whenever feasible, candidate background sampling areas were identified in areas along the borders farthest from the site. This was done to maximize the distance from areas potentially affected by the site.
- Candidate background sampling areas were surveyed for attributes considered to be fundamental to identifying suitable areas for future collection of background substrate and biological samples and included the following (see also Field Data Sheets, Appendix A):
  - Suitability/accessibility for sampling background substrate;
  - Distance from the site;
  - Dominant habitat type and percent cover of vegetation;
  - Direct observation or signs of invertebrates, birds (in particular, nesting birds), and mammals; and
  - Direct observation or signs of nesting horned larks (*Eremophila alpestris*), American avocets (*Recurvirostra americana*), and/or snowy plover (*Charadrius nivosus*).

Observations of possible drinking water were noted and were based on the presence of *phragmites* and/or drinking birds. However, it was agreed among members of the Survey Team that observed water was due to recent precipitation and was likely to be both temporally and spatially unreliable. Hence, water was noted but considered an uncertain factor when identifying candidate background sampling areas.

2.2 *Summary of Notable General Findings*

Notable general observations/findings at Upland and Lakebed candidate background sampling areas during the survey are described below.

Upland Candidate Background Sampling Areas

- Standing open water was infrequently observed; however, standing water (when present) was used to identify candidate sampling areas.[9]
- Invasive grasses (e.g., cheatgrass) and greasewood were the dominant understory and scrub plants, respectively.
- Vegetation cover typically ranged from 25 to 75 percent.
- Harvester ants[10], beetles, and spiders were notable invertebrates; several prominent anthills were observed at most candidate background sampling areas.
- Observations / songs of horned larks were key in identifying candidate background sampling areas.[11] Generally, other passerines (e.g., meadowlarks, thrashers) were observed/heard in Upland candidate background sampling areas where horned larks were observed/heard.
- With the exception of cottontails/jackrabbits, few mammals were directly observed during the survey. Burrows of small mammals and badger were frequently observed, and scat and tracks[12] further substantiated the presence of mammals. For the most part, signs suggested that small mammals were abundant in Upland candidate background sampling areas.
- Reliable collection of sufficient biological samples is anticipated at nearly all Upland candidate background sampling areas.

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[9] Observed open water was presumed to provide a potential drinking water source based on the presence of indicator vegetation (e.g., phragmites).

[10] Ants are a common prey for horned larks and their occurrence indicates the area would be attractive to horned larks (J.Cavitt—pers. comm.).

[11] A list of birds either directly observed or heard (song) was compiled at each candidate sampling area (see Attachment 2).

[12] Small mammal tracks were observed in Lakebed background sampling areas.

Lakebed Candidate Background Sampling Areas

- Although infrequently observed in the playa, standing open water (when present) was used to identify candidate background sampling areas.[8]
- Sparse vegetation was observed at most candidate background sampling areas. Pickleweed (*Salicornia* sp.) and saltbush (*Atripex* sp.) were typically observed when vegetation was present.
- Flying invertebrates (mosquitos/noseeums (*Ceratopogonidae*)/biting insects) were abundant. Few soil invertebrates were observed, with the possible exception of harvester ants — anthills were observed in Lakebed background sampling areas, but were less abundant as compared to Upland background sampling areas.
- Observations of snowy plover and/or American avocet were key in identifying candidate background sampling areas.
- Signs of mammals (primarily tracks) were observed.
- Reliable collection of sufficient biological samples is not anticipated at most Lakebed candidate background sampling areas.

Locations of candidate background sampling areas in North, South, and Southeast reference locales, and at the BRMBR are provided in Figures 1 and 2, respectively.

2.3 Summary of Notable Findings by Candidate Background Sampling Area

To facilitate comparisons among candidate background sampling areas, a summary of key attributes by candidate background sampling areas is provided on Figure 3. To provide a sense of each candidate background sampling area surveyed, notable features and a photograph (to provide visual impression) for each candidate background sampling area are provided below.

SA001, Bear River Migratory Bird Refuge (Inset 1)

- Located near the O-Line canal, a freshwater diversion of the Bear River.
- A pair of snowy plover was observed. Their behavior suggested the presence of a nest, but a nest was not directly observed.

Inset 1.

SA002, Bear River Migratory Bird Refuge (Inset 2)

- Located in an area between Unit 1 and Unit 10.
- No standing freshwater observed.
- IMB Greasewood transitions to IMB Playa.
- Horned larks were observed.

Inset 2.

SA003, Bear River Migratory Bird Refuge (Inset 3)

- Located in an area between Unit 1 and Unit 10.
- No standing freshwater observed.
- IMB Playa transitions to IMB Greasewood.
- Snowy plover (two pair) and American avocets were observed.

Inset 3.

A004, South (Inset 4)

- Located north of road and power lines.
- No standing freshwater observed.
- A nest containing two Brewer’s sparrow eggs was observed. Horned larks, sage threshers, and sage sparrows were heard.

Inset 4.

SA005, South (Inset 5)

- Located near the Skull Creek diversion ditch.
- Standing freshwater in Upland setting.
- Over 20 adult American avocets were observed and appeared to be nesting along the shoreline and on an isle in an impoundment.

Inset 5.

SA006, South (Inset 6)

- Located near hypersaline evaporation pond.
- No direct observations or signs of mammals were witnessed.
- A snowy plover was observed; however, in general, a marginal site for supporting biota compared to other candidate sampling areas.

Inset 6.

SA007, South (Inset 7)

- Located on main road from Pump Station near US Mag gate.
- Freshwater marsh vegetation (*Phragmites* sp.) observed 0.5 mile to the east.
- Approximately 10 adult horned larks were observed.

Inset 7.

SA008, South (Inset 8)

- Located near hypersaline evaporation pond.
- IMB Greasewood transition to IMB Playa.
- Snowy plovers and American avocets were not observed.
- In general, a marginal site for supporting biota compared to other candidate sampling areas.

Inset 8.

SA009, North (Inset 9)

- Located east of County Road.
- Several birds observed/heard, but no horned larks were observed/heard.
- Cattle scat observed, suggesting use by ranchers.

Inset 9.

SA010, North (Inset 10)

- Located west of County Road.
- IMB Greasewood transition to Invasive Annual Grassland.
- Several birds observed/heard, including horned lark.

Inset 10.

SA011, North (Inset 11)

- Located adjacent (south) of UTTR fence-line.
- Standing water observed approximately one mile east.
- A pair of snowy plover and nest with one egg was observed.

Inset 11.

SA012, North (Inset 12)

- Located north of dike road to Badger Island. US Mag evaporation pond located to south.
- Two pairs of snowy plover were observed and, though not observed, their behavior suggested the presence of nests.

Inset 12.

SA013, Southeast (Inset 13)

- Located north of dike road to Badger Island. US Mag evaporation pond located to south.
- A pair of snowy plover was observed and, though not observed, their behavior suggested the presence of a nest.

Inset 13.

Inset 14.

SA014, Southeast (Inset 14)

- Located on Badger Island. Surveyed by J. Cavitt in past.
- Over 20 adult American avocets were observed.
- No snowy plover were observed, but have been observed in past.

Inset 15.

SA015, Southeast (Inset 15)

- Located on Stansbury Island, west of County Road.
- Several birds were observed/heard, including horned lark (heard).

Field data sheets (Attachment A) and photographs (Attachment B) provide additional information for each candidate sampling area.

3.0 PHASE 1A-B BACKGROUND SAMPLING AREAS

In general, Upland candidate background sampling areas were considered to offer suitable, sufficient, and reliable occurrence of biota for future sampling events. Hence, selection preferences among Upland background sampling areas were primarily based on confidence that an area was situated within the Upland setting and/or was at a greater distance (rather than closer) from the US Mag facility. Lakebed candidate background sampling areas[13] generally supported significantly less diverse and less abundant biota—this is not a shortcoming, but rather is a characteristic of this habitat type. The exact location of biota in Lakebed background sampling areas is considered to be more variable (spatially and temporally), which may result in greater uncertainty with regard to locating biota for future sampling events. Preferences among Lakebed background sampling areas were primarily based on observations of

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[13] With the possible exception of SA014, located on Badger Island.

snowy plover/plover nests, observations of other shorebirds, and/or previous experience that an area offered reliable collection of future biological samples. Based on a consensus of the survey team, the following are proposed as background sampling areas for the Phase 1A-B investigation (see also Figure 3):

Background Sampling Areas	**Locale**	**Rationale**
Upland (IMB Greasewood Flat/Invasive Annual Grassland)		
SA007	South	• Readily accessible • Far from the site (7.9 miles) • Minimally disturbed habitat • Freshwater was observed • Observations/signs of abundant plants, soil invertebrates, birds, and mammals • More than 10 adult horned larks were observed • Preferred over SA005 because clearly within Upland setting and greater distance from Facility
SA010	North	• Readily accessible • Far from the site (8.2 miles) • Minimally disturbed habitat • Observations/signs of abundant plants, soil invertebrates, birds, and mammals • Preferred over SA009 because supports suitable nesting habitat for horned larks
SA015	Southeast	• Readily accessible • Far from the site (10.5 miles) • Minimally disturbed habitat • Observations/signs of abundant plants, soil invertebrates, birds, and mammals • Provides suitable nesting habitat for horned larks
Lakebed (IMB Playa)		
SA011	North	• Readily accessible • Far from the site (10 miles) • Minimally disturbed habitat • Freshwater observed nearby • Observations/signs of few/sparse plants, invertebrates, birds, and mammals • Snowy plover nest and egg observed • Provides suitable nesting habitat for snowy

Background Sampling Areas	**Locale**	**Rationale**
		plover
SA013	Southeast	• Readily accessible • Far from the site (7.5 miles) • Minimally disturbed habitat • Observations/signs of few/sparse plants, invertebrates, birds, and mammals • Snowy plovers observed and exhibited behavior suggesting that a nest was nearby • Snowy plover previous observed near SA013 suggesting some reliability for future collections • Provides suitable nesting habitat for snowy plover
SA014	Southeast	• Readily accessible • Far from the site (9.2 miles) • Minimally disturbed habitat • Observations/signs of few/sparse plants, invertebrates, birds, and mammals • Snowy plovers observed and exhibited behavior suggesting that a nest was nearby • Snowy plover (and other shorebirds) previous observed at SA014 suggesting reliability for future collections • Provides suitable nesting habitat for snowy plover
Contingency		
SA003	BRMBR	• Readily accessible • Far from the site (45.5 miles) • Minimally disturbed habitat • Observations/signs of few/sparse plants, invertebrates, birds, and mammals • Near SA002 (Upland candidate background sampling area) • Provides suitable nesting habitat for horned larks

Note that for the Upland South reference locale, SA007 was preferred over SA005 because SA007 was [a] clearly within the Upland setting soils, [b] at a greater distance from the US Mag facility, and [c] a location where significant number of horned larks were observed.

Upland background sampling areas were identified in each reference locale (North, South, Southeast) to ensure representative coverage of the lithology/soil type. However, given the lack/paucity of habitat, no Lakebed background sampling areas were identified for the South reference locale; on-ground habitat conditions did not match mapped assumptions. Hence, Lakebed background sampling areas were only identified for the North and Southeast reference locales.

4.0 PHASE 1A-B BACKGROUND SAMPLE LOCATIONS

Phase 1A-B background sample locations are specific locations where Phase 1A-B background substrate samples will be collected within each background sampling area (see Section 3). Note that, in Section 3, the general positions of each background sampling areas are presented; however, the size (area) and coverage at these areas were not specified.

4.1 Area / Shape of Background Sampling Areas

The areal extent of background sampling areas was first determined by calculating the area of a circle with a radius equal to the foraging range of the horned lark (representative Upland setting bird)[14] and the snowy plover (representative Lakebed setting bird). To maintain consistency among all background sampling areas, the largest foraging range (approximated to be 1,000-foot radius for the snowy plover)[15] was used to establish the square footage for all background sampling areas. Using this calculation, all background sampling areas were set to equal 3,140,000 square feet.

The shape of the background sampling areas was determined by on-ground features and the shape (from aerial photographs) of the Upland and Lakebed setting habitats at background sampling areas (Figures 4 through 8). For Lakebed background sampling areas, habitat/vegetation/wildlife signs tended to follow the shoreline;

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[14] Territory size for the horned lark was reported as 1.3 to 2.7 hectares (Wiens et al. 1986).

[15] The snowy plover forages an average of 272 meters from the nest (Paton 1995).

therefore, an area defined by the shape of the shoreline and extending 400 feet into the IMB Playa was used (for an example, see Figure 5). For Upland background sampling areas, habitat/vegetation/wildlife signs had a less-defined shape; therefore, for simplicity and consistency, a rectangular shape was used (for an example, see Figure 4). The dimensions of the rectangular shape were kept consistent to maintain comparable sample distributions. The placement of some background sampling area boundaries was slightly altered to accommodate changes in land cover and accessibility within the reference locale. For example, at SA015, a change in shape was made to avoid private lands that are not accessible for sampling and areas potentially affected by apparent quarry activities (Figure 7). Roads and proximal areas were avoided to ensure substrate was representative of naturally occurring conditions. Site-specific descriptions are provided below.

Lakebed Background Sampling Areas

- Lakebed North (SA011) (Figure 4) – Vegetation and likely nesting areas were located near the UTTR fence-line road. Therefore, the background sampling area was set to extend out approximately 400 feet south of the UTTR fence-line road and 7,850 feet along the length parallel to the fence-line road. The total area equals 3,140,000 square feet.
- Lakebed Southeast (SA013) (Figure 5) – The playa and likely nesting areas were located north of the identified sampling area, so the boundary extends 400 feet north of the dike road into the playa and 7,850 feet in length following the curve of the dike road. The total area equals 3,140,000 square feet.
- Lakebed Southeast at Badger Island (SA014) (Figure 5) – Suitable nesting habitat was located along the perimeter of Badger Island and northeast of the dike road. Therefore, the sampling area extends 7,850 feet following a section that is northeast of the dike road and along the southeastern and northern edge of Badger Island with a width of 400 feet. The total area equals 3,140,000 square feet.

Upland Background Sampling Areas

- Upland North (SA010) (Figure 4) – IMB Greasewood Flat is located between the boundary lines for the Upland Northern reference locale, which is close to 1,000 feet. Therefore, the width of the rectangle was set at 1,000 feet and is located in IMB Greasewood Flat between the IMB Mixed Salt Desert Scrub border to the west and the IMB Playa border to the east of SA010. The length of the rectangle was set at 3,140 feet so the total area is equal to 3,140,000 square feet.

- Upland South (SA007) (Figure 6) – There were no resource or habitat restrictions surrounding SA007, so the dimensions were based on those used to define the other Upland background sampling areas (SA010 and SA015), which are 1,000 feet by 3,140 feet. The total area equals 3,140,000 square feet.
- Upland Southeast (SA015) (Figure 7) - The IMB Greasewood Flat/Invasive Annual Grassland surrounding SA0015 is located along the road on Stansbury Island and is bordered between IMB Playa to the west, patches of Invasive Annual to the north, and apparent quarries to the east. The boundaries were also restricted by private lands to the north and changes in topography to the east. Therefore, the boundaries were set within these restrictions with a total area equal to 2,091,110 square feet.

Contingency Background Sampling Area

- BRMBR (SA003) (Figure 8) – Suitable snowy plover nesting habitat was located along the along the southern shoreline of the elevated islet. The sampling area extends 7,850 feet following a section of the southern shoreline with a width of 400 feet. The total area equals 3,140,000 square feet.

4.2 Background Sampling Locations

For metals, it was determined that a sample size of 30 samples per each setting would ensure/promote adequate statistical power to support comparisons to background (Section 11.3.7.2 of the Phase 1A-B SAP). Therefore, 30 samples in Upland and 30 samples in Lakebed settings will be collected. A sample size of 36 samples was determined for organic compounds. As organic compounds were not expected to be influenced by lithology or soil type, the 36 samples will be divided equally between settings (18 samples in Upland and 18 in Lakebed)[16] and will be co-located

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[16] This assumption will be tested once the data are collected. If there is no significant difference, then comparisons of site to background for organics will use the combined (pooled) background dataset. If there is a significant difference, then the background

with a subset of the metals sample locations. In addition to the 60 metals and 36 organic compound background samples discussed above, five (5) "contingency" background samples will be collected in the BRMBR reference locale.

In addition to the surface samples for background characterization, one subsurface soil boring will be completed at each background sampling area to screen subsurface soil for anthropogenic contamination (such as waste dumping or burial) that is not present in surface soil (see Section 4.3). The subsurface soil boring will be co-located with one of the surface soil sample locations at each sampling area. The total number of surface sample locations in each background sampling area and BRMBR is listed below.

Background Sample Area	Systematic Grid Surface Sample Locations
Upland North (SA007)	10
Upland South (SA010)	10
Upland Southeast (SA015)	10
Lakebed North (SA011)	10
Lakebed Southeast (SA013)	10
Lakebed Southeast at Badger Island (SA014)	10
BRMBR (SA003)	5

Background sample locations within background sampling areas were generated using the software program VSP v7 (vsp.pnnl.gov). The "pre-determined number of samples" module was used in conjunction with project Geographic Information System (GIS) files of background sampling area boundaries to generate background sample location coordinates. To accommodate observed sparse shoreline habitat, the

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dataset for Upland and Lakebed will not be pooled in support of background comparisons.

Details of these and other analyses of the results of the background sampling will be described in the Phase 1A-B SAP.

shapes of the Lakebed and BRMBR background sampling areas tended to be narrow with non-linear contours (to follow shoreline vegetation). Given the challenges of VSP to accommodate non-uniform shapes, background sampling areas were not conducive to a simple systematic sampling grid design using VSP. Figures 4 through 8 present the VSP-generated grid design and background sample locations for each background sampling area (see Attachment C for further details). Background sample locations identified by VSP preserved the assumption of random sample placement, while accommodating the unusual sampling area dimensions.

The coordinates for the sample locations were exported from VSP and plotted in GIS. Coordinates for background sample locations are listed in Attachment D. By default, the subsurface sample locations were selected to be co-located with a sample location near the center of the sampling area.

4.3 Background Soil Samples

At all background sample locations, surface substrate (soil or sediment) will be sampled to a depth of 2 inches below ground surface (bgs) using a flat-bottom scoop or shovel as described in SOP USM-01. The basis for collecting / analyzing surficial soils is as follows:

- Influence of the US Mag facility (that is located over 5 miles away from background sampling areas) is likely to be due to aerial deposition
- A surficial sample would likely capture the possible influence by US Mag, whose effect may be lost with mixing with deeper soils.

To address concerns related to the unlikely contamination of subsurface soils by the US Mag facility or any other unexpected sources, a subsurface soil sample will be collected at each background sampling area (including the BRMBR background sampling area). A composite soil sample representing the interval from 2 to 36 inches that will be analyzed for HCB, PCBs, dioxins/furans, and total metals. The sample will be collected following SOP USM-09 using a portable flighted auger with soil sampling probe or a compressed-gas powered direct push corer. Detailed sample collection, analysis, and quality control procedures are provided in the Phase 1A-B RI SAP. The 3-foot sample depth is consistent with the depth of shallow groundwater within Lakebed setting areas and is comparable to average burrow depths of many small mammals (Zeiner et al 1990; Best et al 1990; Reynolds 1960; Kenagy 1973; Fitch 1948; Ingles 1941).

5.0 LITERATURE CITED

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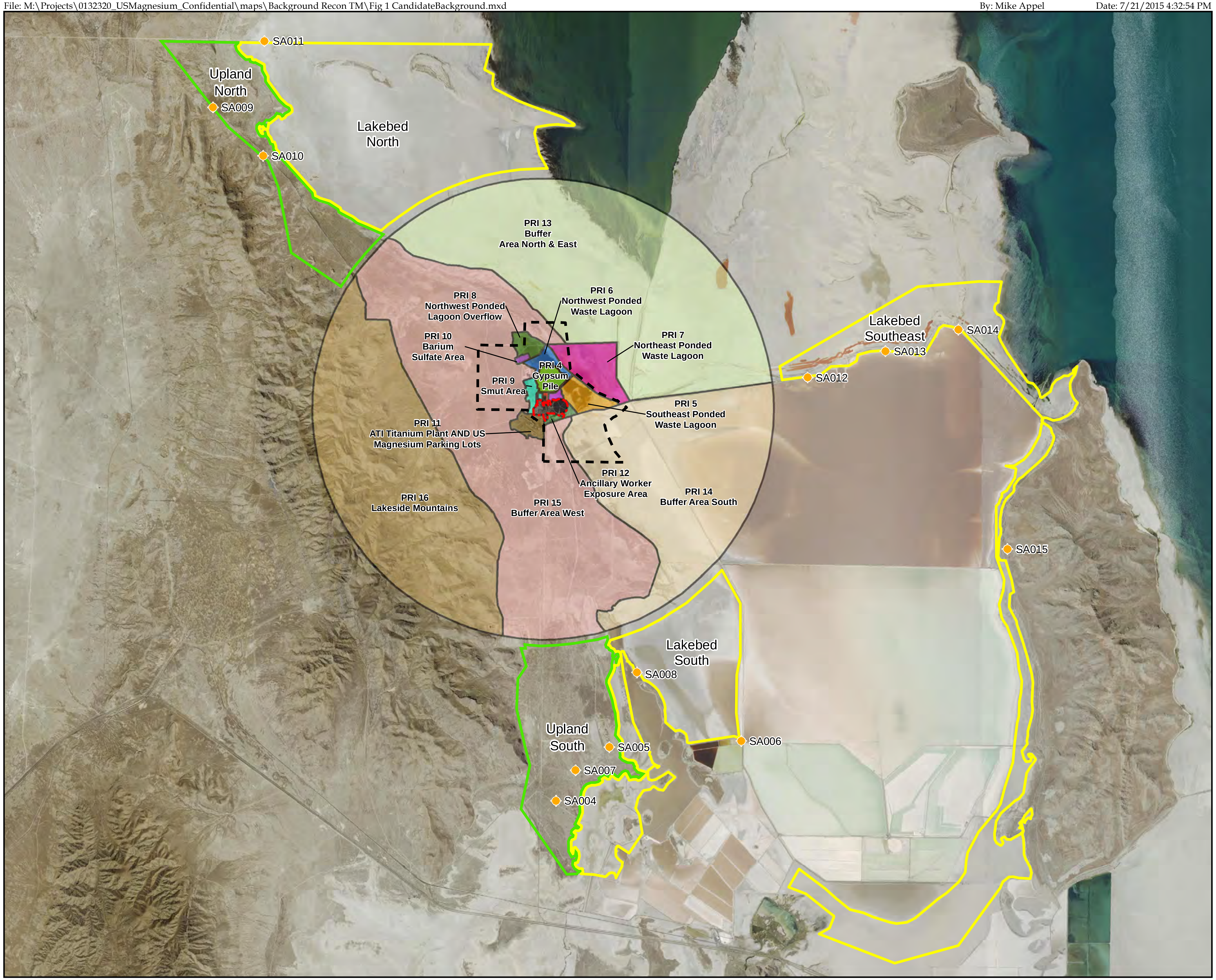
Figures

File: M:\Projects\0132320_USMagnesium_Confidential\maps\Background Recon TM\Fig 1 CandidateBackground.mxd By: Mike Appel Date: 7/21/2015 4:32:54 PM



- ● Eco Survey Background Sampling Location
- 🟩 Preliminary Candidate Area for Upland
- 🟨 Preliminary Candidate Area for Lakebed
- ▨ Operating Facility
- ⌜⌟ US Magnesium Property

Preliminary Remedial Investigation Areas

- 🟥 PRI-1: Site-wide Ditches
- 🟪 PRI-2: Landfill
- 🟨 PRI-3: Sanitary Lagoon
- 🟩 PRI-4: Gypsum Pile
- 🟧 PRI-5: Southeast Ponded Waste Lagoon (CWP)
- 🟦 PRI-6: Northwest Ponded Waste Lagoon (CWP)
- 🟪 PRI-7: Northeast Ponded Waste Lagoon (OWP)
- 🟩 PRI-8: Northwest Lagoon Overflow
- 🟦 PRI-9: Smut Area
- 🟪 PRI-10: Barium Sulfate Disposal Area
- 🟫 PRI-11: ATI Titanium and USM Parking Lots
- 🟩 PRI-12: Ancillary Worker Exposure Area
- ▢ PRI 13: Buffer Area North & East
- ▢ PRI-14: Buffer Area South
- ▢ PRI-15: Buffer Area West
- ▢ PRI-16: Lakside Mountains

Notes:
All boundaries approximate, provided by EPA
Revised Buffer Areas - April 2012.
Aerial Photo: NAIP (USDA), 2014

N
0 2 4 Miles

Figure 1
Candidate Background Sample Areas
Background Reconnaissance Survey
US Magnesium LLC
Tooele County, Utah

USmag®

Environmental Resources Management
136 East South Temple, Suite 2150
Salt Lake City, Utah 84111
ERM

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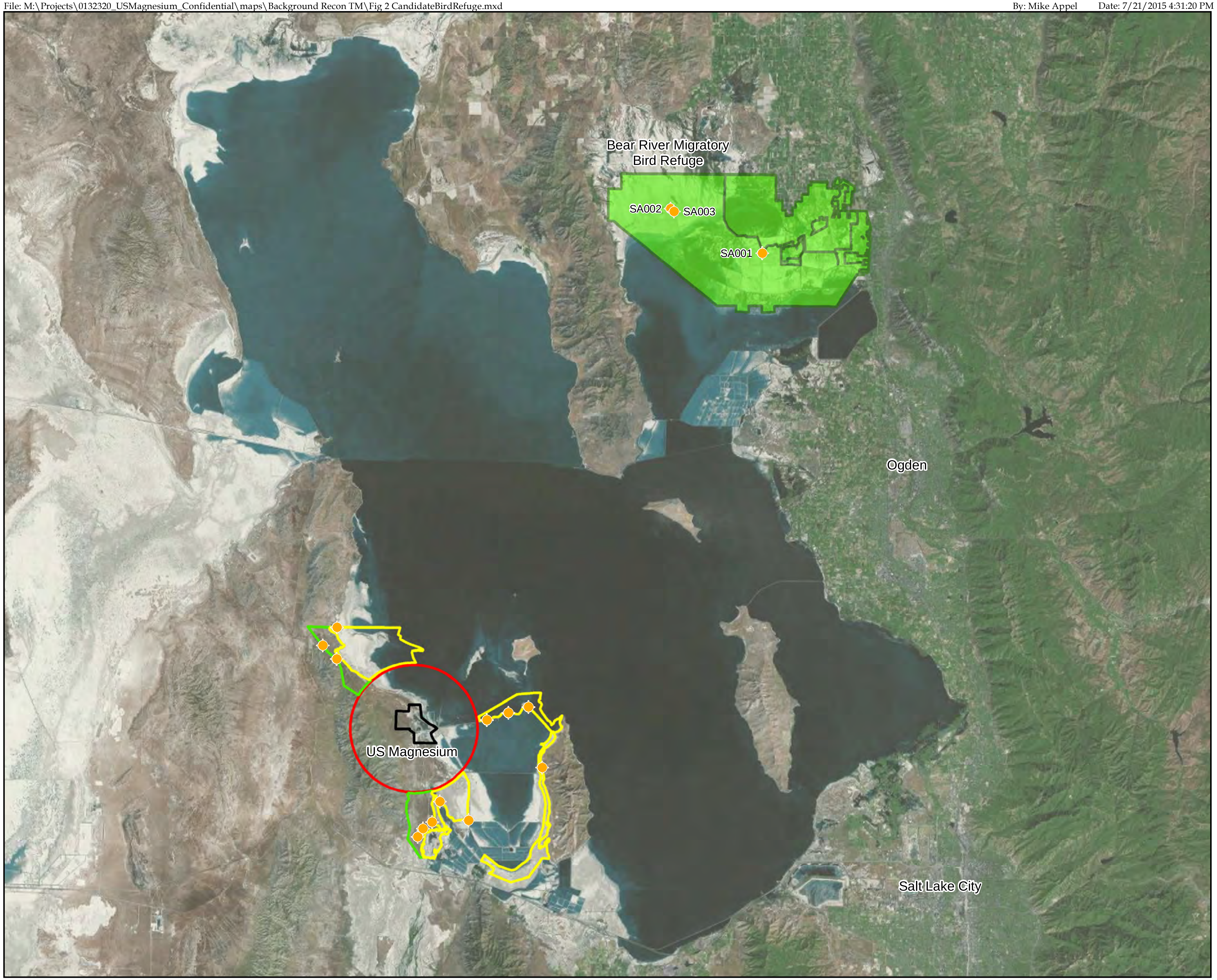


● Eco Survey Background Sampling Location

🟩 Preliminary Candidate Area for Upland

🟨 Preliminary Candidate Area for Lakebed

🟩 Bear River Migratory Bird Refuge

○ RI/FS Study Area Boundary

☐ US Magnesium Property

Notes:
Bear River Migratory Bird Refuge layer provided by United States Fish and Wildlife Service.
Aerial Photo: Provided by ESRI web mapping service.

0 5 10 20 Miles

N

Figure 2
Candidate Background Sample Areas
Bear River Migratory Bird Refuge
Background Reconnaissance Survey
US Magnesium LLC
Tooele County, Utah

Environmental Resources Management
136 East South Temple, Suite 2150
Salt Lake City, Utah 84111

Figure 3. Summary of Key Attributes by Sampling Area

Reference Locale	Sampling Area	Miles From USM	Access	Hydrology	Level of Disturb	Veg (%cover)	Inverts	Birds	Mammals	Suitable Nest			Suitable Wildlife	Notes	Recc
										HL	SP	AA	cover / food		
IMB Greasewood Flat (upland)															
South	SA004	8.5	readily	NO	min	26-50%	A^{obs}	$A^{obs,sign,nest}$	A^{sign}	●			●	Brewer’s sparrow nest + 2 eggs	
South	SA005	7.5	readily	FW obs	min	1-25%	A^{obs}	$A^{obs,sign,chick}$	$A^{obs,sign}$			●^{1}	●	FW impoundment, avocets	
South	SA007	7.9	readily	FW obs	min	51-75%	A^{obs}	A^{obs}	A^{obs}	●			●	10^{+} adult horned larks	✓
North	SA009	9.7	readily	NO	min	51-75%	A^{obs}	$A^{obs,sign}$	$A^{obs,sign}$				●		
North	SA010	8.2	readily	NO	min	76-100%	A^{obs}	$A^{obs,sign}$	$A^{obs,sign}$	●			●		✓
Southeast	SA015	10.5	readily	NO	mod	51-75%	A^{obs}	$A^{obs,sign}$	$A^{obs,sign}$	●			●		✓
Bear River	SA002	45.6	readily*	NO	min	76-100%	P^{obs}	$P^{obs,sign}$	A^{sign}	●			●		
IMB Playa (lakebed)															
South	SA006	8.4	readily	FW obs	subst	1-25%	P^{obs}	P^{obs}	NO		●			hypersaline evap pond	
South	SA008	6.0	readily	NO	subst	NO	NO	S^{obs}	P^{sign}					hypersaline evap pond	
North	SA011	10.0	readily*	FW obs	min	1-25%	NO	$A^{obs,sign,nest}$	S^{sign}		●			near UTTR fence-line snowy plover net + egg	✓
Southeast	SA012	5.8	readily	FW obs	min	1-25%	P^{obs}	$A^{obs, sign}$	A^{sign}	●	●^{1}				
Southeast	SA013	7.5	readily	FW obs	min	1-25%	P^{obs}	$A^{obs, sign}$	A^{sign}	●	●^{1}				✓
Southeast	SA014	9.2	readily	NO	min	76-100%	A^{obs}	$A^{obs, sign}$	A^{sign}	●	●	●	●	Badger Island	✓
Bear River	SA001	46.3	readily	FW obs	min	26-50%	P^{obs}	$P^{obs.sign}$	P^{sign}	●	●^{1}	●	●		
Bear River	SA003	45.5	readily*	FW obs	min	1-25%	P^{obs}	P^{obs}	P^{sign}		●^{1}	●			✓

Legend:

BR = Bear River Migratory Bird Refuge
UTTR = Utah Test & Training Range
FW = freshwater

readily* = may be more challenging to access if during / following rains
●^{1} = possible nesting based on bird behavior

min = minimal
mod = moderate

subst = substantial

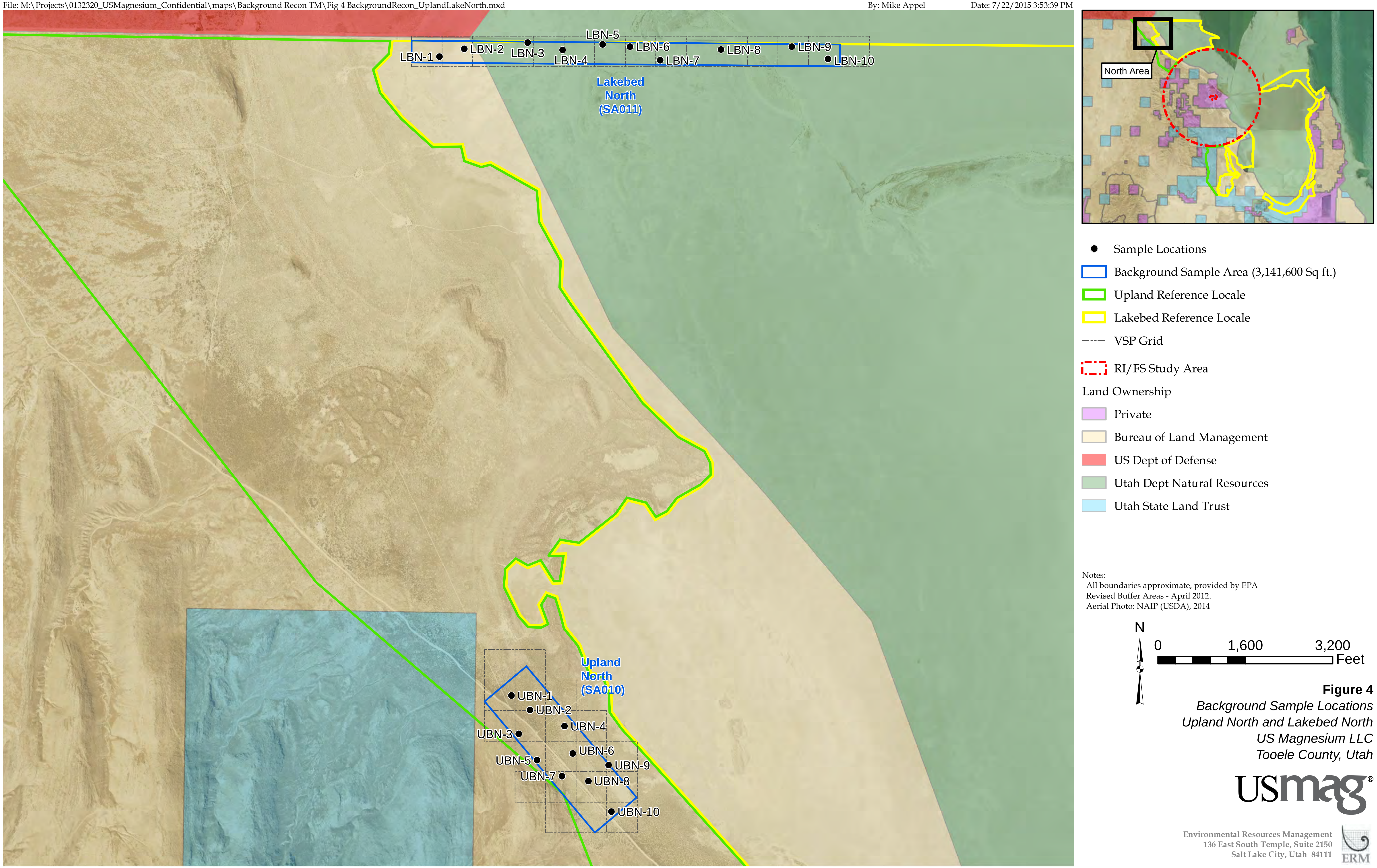
A^{obs} = abundant – observed
A^{sign} = abundant – sign / song
P^{obs} = present – observed
P^{sign} = present – sign / song

S^{obs} = scarce – observed
S^{sign} = scarce – sign / song
NO = not observed
nest = nest observed
chick = chicks / young observed

HL = horned lark
SP = snowy plover

AA = American avocet

File: M:\Projects\0132320_USMagnesium_Confidential\maps\Background Recon TM\Fig 4 BackgroundRecon_UplandLakeNorth.mxd By: Mike Appel Date: 7/22/2015 3:53:39 PM



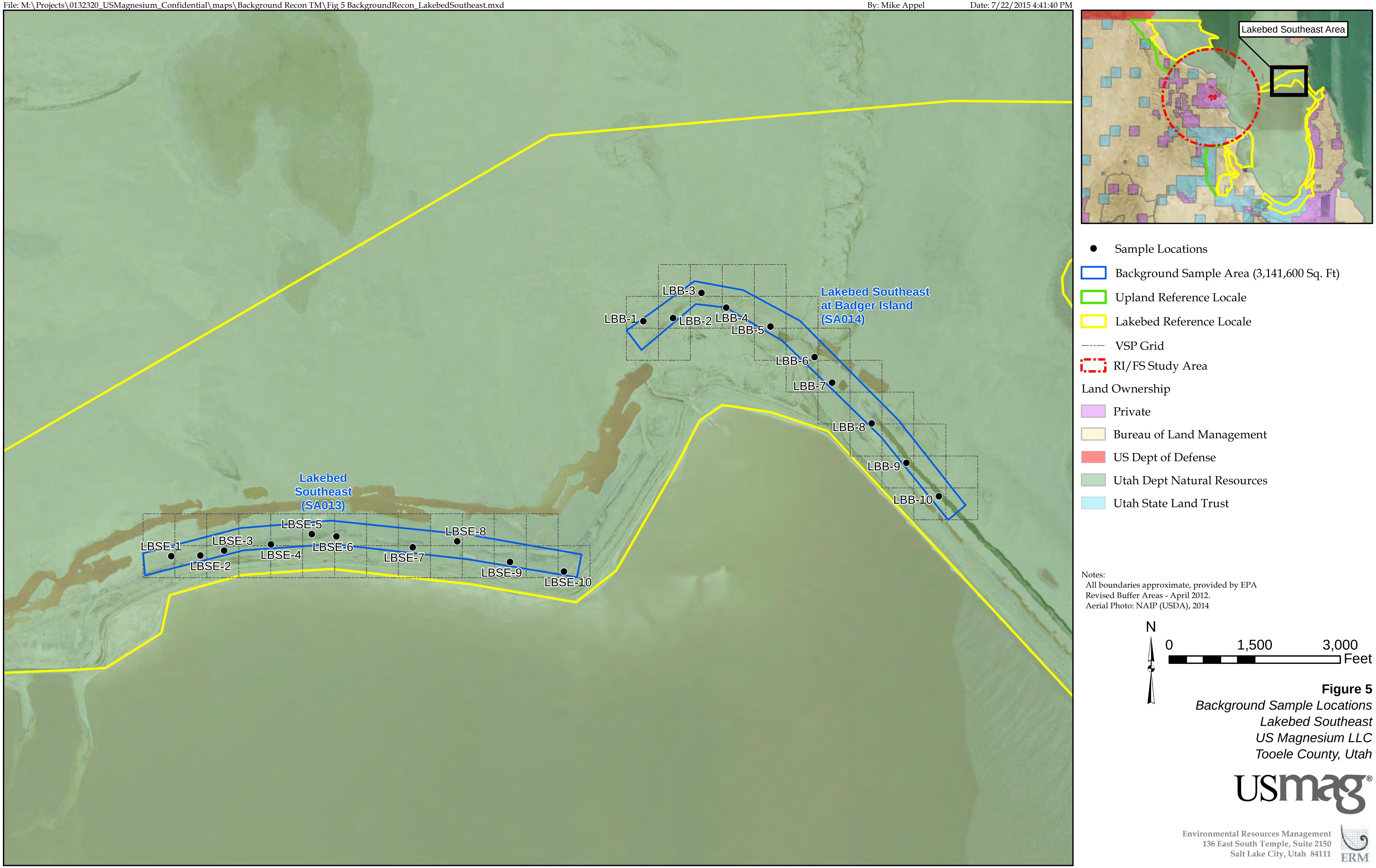
Notes:
All boundaries approximate, provided by EPA
Revised Buffer Areas - April 2012.
Aerial Photo: NAIP (USDA), 2014

Figure 4
Background Sample Locations
Upland North and Lakebed North
US Magnesium LLC
Tooele County, Utah

USmag®

Environmental Resources Management
136 East South Temple, Suite 2150
Salt Lake City, Utah 84111
ERM

File: M:\Projects\0132320_USMagnesium_Confidential\maps\Background Recon TM\Fig 5 BackgroundRecon_LakebedSoutheast.mxd By: Mike Appel Date: 7/22/2015 4:41:40 PM

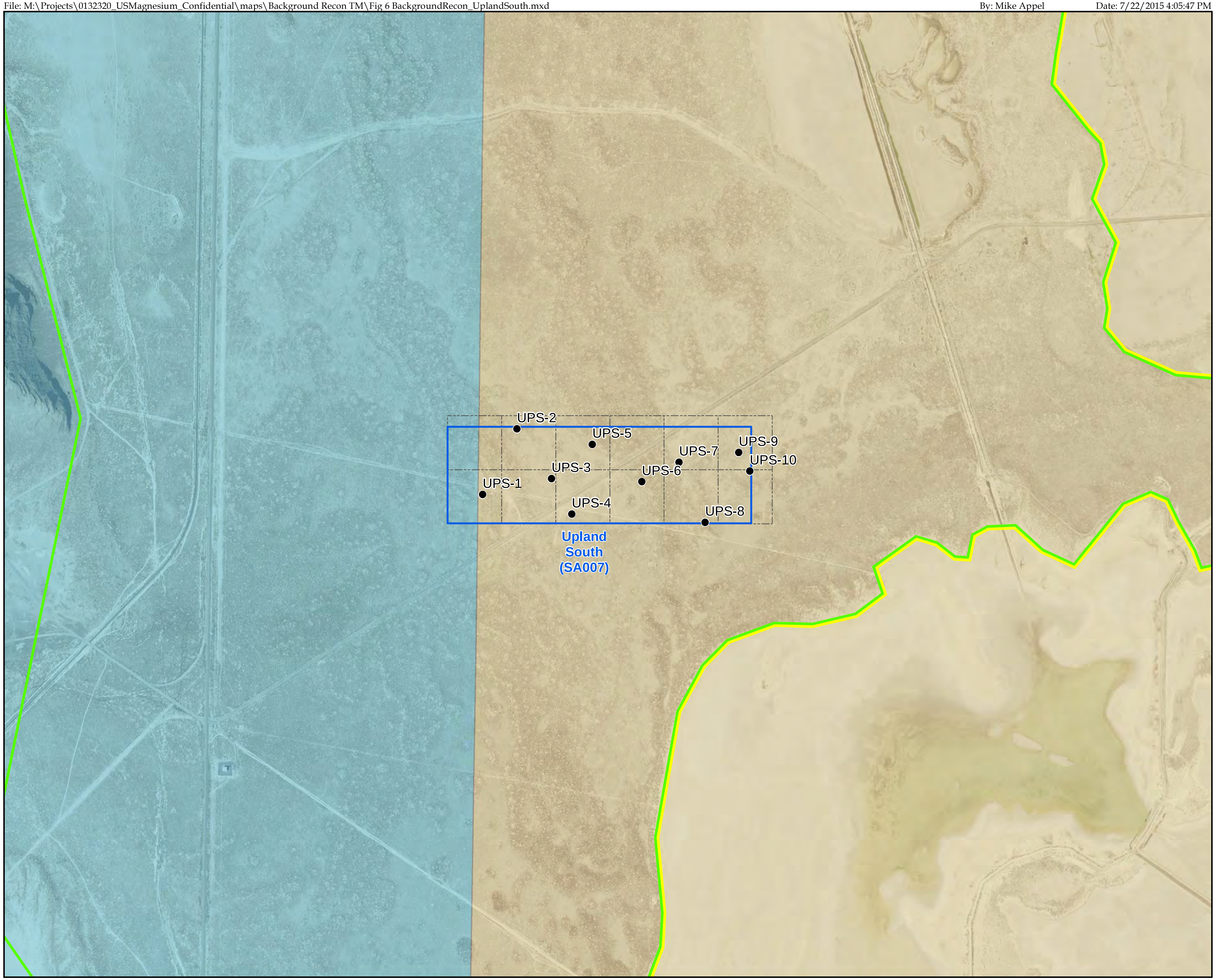


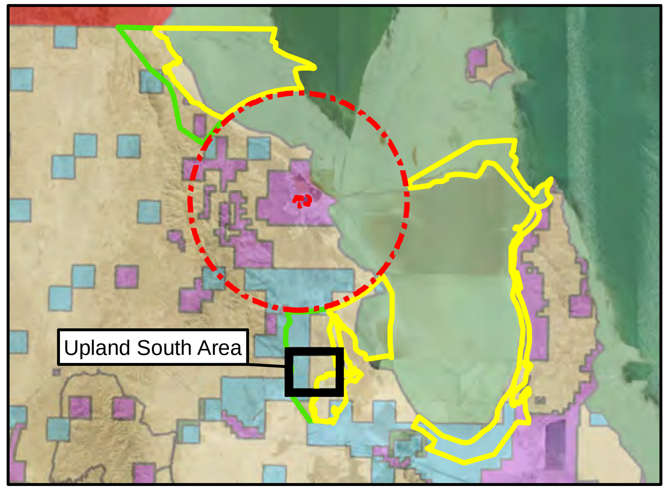
Notes:
All boundaries approximate, provided by EPA
Revised Buffer Areas - April 2012.
Aerial Photo: NAIP (USDA), 2014

Figure 5
Background Sample Locations
Lakebed Southeast
US Magnesium LLC
Tooele County, Utah

usmag®

Environmental Resources Management
136 East South Temple, Suite 2150
Salt Lake City, Utah 84111
ERM





● Sample Locations
🟦 Background Sample Area (3,141,600 Sq ft.)
🟩 Upland Reference Locale
🟨 Lakebed Reference Locale
-·-·- VSP Grid
🟥 RI/FS Study Area

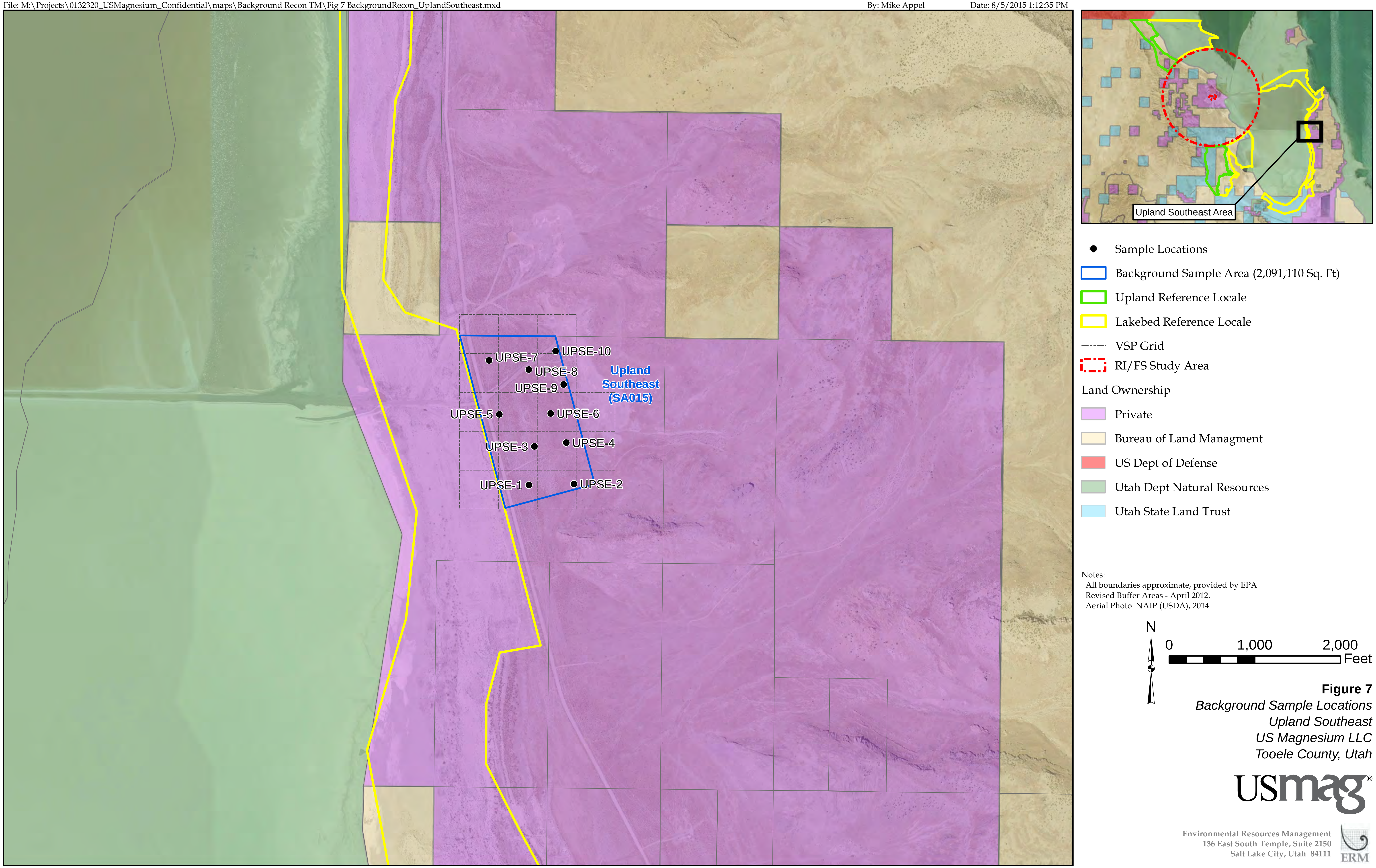
Land Ownership
🟪 Private
⬜ Bureau of Land Management
🟥 US Dept of Defense
🟩 Utah Dept Natural Resources
🟦 Utah State Land Trust

Notes:
All boundaries approximate, provided by EPA
Revised Buffer Areas - April 2012.
Aerial Photo: NAIP (USDA), 2014

Figure 6
Background Sample Locations
Upland South
US Magnesium LLC
Tooele County, Utah

Environmental Resources Management
136 East South Temple, Suite 2150
Salt Lake City, Utah 84111
ERM

File: M:\Projects\0132320_USMagnesium_Confidential\maps\Background Recon TM\Fig 7 BackgroundRecon_UplandSoutheast.mxd By: Mike Appel Date: 8/5/2015 1:12:35 PM

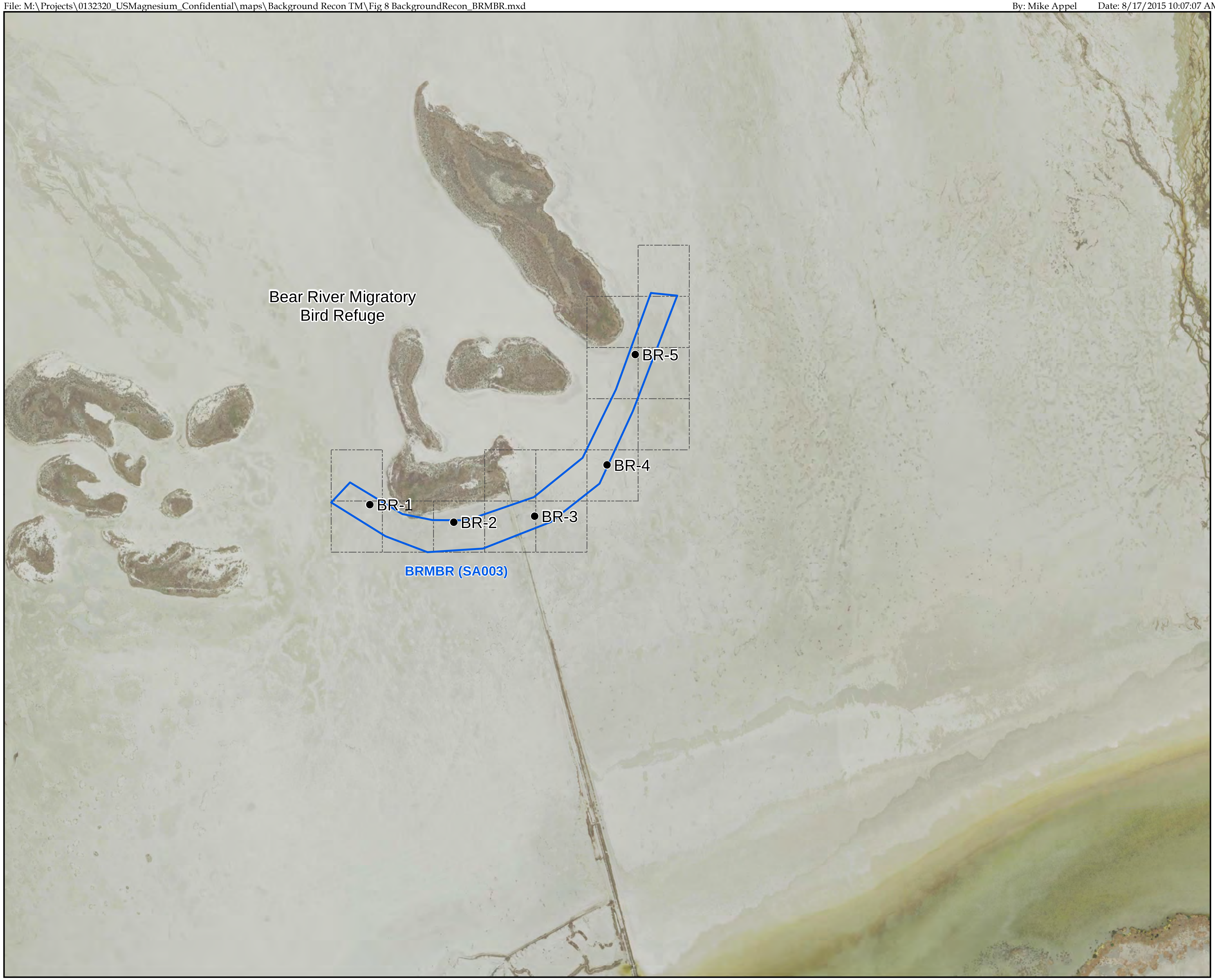


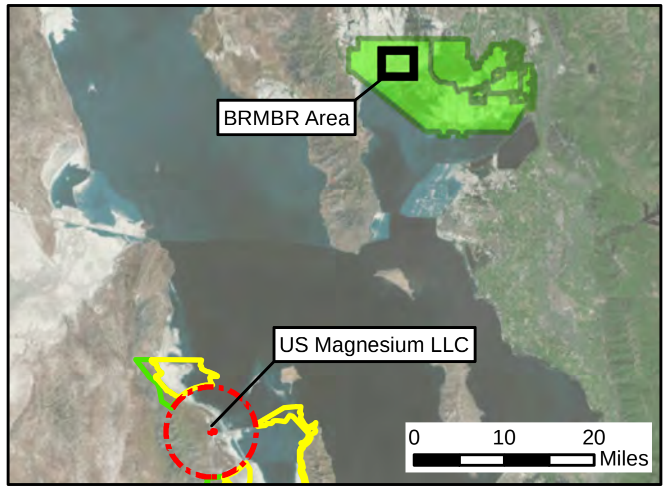
Notes:
All boundaries approximate, provided by EPA
Revised Buffer Areas - April 2012.
Aerial Photo: NAIP (USDA), 2014

Figure 7
Background Sample Locations
Upland Southeast
US Magnesium LLC
Tooele County, Utah

usmag®

Environmental Resources Management
136 East South Temple, Suite 2150
Salt Lake City, Utah 84111
ERM





- ● Sample Locations
- ▭ Background Sample Area (3,141,600 Sq ft.)
- 🟩 Upland Reference Locale
- 🟨 Lakebed Reference Locale
- 🟩 Bear River Migratory Bird Refuge
- - - - VSP Grid
- 🟥 RI/FS Study Area

Notes:
Bear River Migratory Bird Refuge layer provided by United States Fish and Wildlife Service.
Aerial Photo: Provided by ESRI web mapping service.

N

0 1,500 3,000 Feet

Figure 8

Background Sample Locations
Bear River Migratory Bird Refuge
US Magnesium LLC
Tooele County, Utah

usmag®

Environmental Resources Management
136 East South Temple, Suite 2150
Salt Lake City, Utah 84111
ERM

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Attachment A
Field Data Sheets

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Reference Sampling Area Data Sheet	Photo numbers:
Ref. Locale & Sampling Area: BEAR RIVR / SA 001	Surveyor's name: J. CAVITT
Area Surveyed (ha) (estimated):	Land owner: USFWS
Date & Time: 6/1/15 11:13 PN:	Project: US Mag Reference Area
EASTING: 398355.00 Latitude: NORTHING: 4590669.88 Longitude:	Distance from 5 mile radius

Accessibility (describe steps taken to get to sampling area): "O" LINE CANAL ~~DIKE~~

Topography (note general and notable features): IMB PLAYA : FLAT W/ SHALLOW DEPRESSION

Hydrology (note the presence of potential drinking water sources such as standing water, likeliness to accumulate standing water, *etc.*):

CANAL

BEAR RIVR (FW)

Habitat (type, notable features, *etc.*): **Photo numbers:**

Level of Disturbance (circle one): [✓ undisturbed,] minimally disturbed, substantially disturbed

☑ Habitat suitable for nesting snowy plover ☑ Habitat suitable for nesting American avocet

☑ Habitat suitable for nesting horned lark ☐ Habitat suitable for providing food and cover to wildlife

Vegetation (dominant species [overstory, understory, ground cover], *etc.*):: **Photo numbers:**

Percent cover (estimated): 100-76% ☐, 75-51% ☐, 50-26% ☑, 25-1% ☑, no cover ☐

IMB PLAYA ~~[illegible]~~ NEAR DIKE PICKLEWEED

DIKE WHEAT GRASS | NON NATIVE GRASS DIKE

CHEAT GRASS

PEPPER WEED

Reference Sampling Area Data Sheet (cont.)	Surveyor's name: J. CAVITT
Ref. Locale & Sampling Area: BEAR RIVER (BR) SA001	Date & Time: 6/1/15 11:13 a

Invertebrates (direct observations of species, signs of invertebrates [ant hills, molts, burrows], *etc.*):

Photo numbers:

~~NONE OBSERVED~~ TT+

MOSQUITOS

DAMSELFLIES

Birds (direct observations of species, abundance [general], singing/other behaviors, signs, presence of nests, *etc.* Where present, include information specific to American avocet, snowy plover, or horned lark):

Photo numbers:

SNOWY PLOVER (SUSPECT NEST - BEHAVIOR NOT OBSERVED) - PAIR OBSV

HORNED LARK

~~[illegible]~~ CURLEW

GULLS - (FLY OVER)

KILLDEER

CLIFF SWALLOWS

CANADA GOOSE - FLY OVER, SCAT

Mammals (direct observations of species, abundance [general], signs [scat, burrows], *etc.*):

Photo numbers:

NONE OBSV

NO SIGNS OBSV

VOLE

DEER MOUSE (?)

Reference Sampling Area Data Sheet (cont.)	Surveyor's name: J. CAVITT
Ref. Locale & Sampling Area: BEAR RIVER (BR) SA001	Date & Time: 6/1/15 11:13 a

Additional notes (if needed):

PHOTOGRAPHIC LOCATION INFORMATION

Ref. Locale & Sampling Area: BARR EWR - SA 001

Surveyor's name: T. HAMADA

Date and Time: 6/1/15 11:13

Photo Number Series: ______

Photo Location

Latitude: ______

Longitude: ______

Four Cardinal Positions (photos taken rotating clockwise, in sequence (N, S, E, W), from the same orientation, zoom level, and distance from the ground)

Photo Number (North) : 100 - 0003

Photo Number (South): 100 - 0001

Photo Number (East): 100 - 0002

Photo Number (West): 100 - 0004

Describe and photo document important features, disturbance, species, or evidence of animal activity.

Photo #	Description
100 - 0005	@ LINE CANAL [LOOKING S]

Ref. Locale & Sampling Area: ______

Reference Sampling Area Data Sheet	Photo numbers:
Ref. Locale & Sampling Area: BEAR RIVR / SA 021	Surveyor's name: J. CAVITT
Area Surveyed (ha) (estimated):	Land owner: USFWS
Date & Time: 6/1/15 12:52p PN:	Project: US Mag Reference Area
EASTING: Latitude: 386808.76 N: Longitude: 4596385.52	Distance from 5 mile radius

Accessibility (describe steps taken to get to sampling area):

DIKE BTWN UNIT 1 & 10

Topography (note general and notable features): FLAT, SHALLOW DEPRESSIONS

Hydrology (note the presence of potential drinking water sources such as standing water, likeliness to accumulate standing water, *etc.*):

DRY

Habitat (type, notable features, *etc.*): **Photo numbers:**

Level of Disturbance (circle one): undisturbed, minimally disturbed, substantially disturbed

☐ Habitat suitable for nesting snowy plover ☐ Habitat suitable for nesting American avocet

☑ Habitat suitable for nesting horned lark ☑ Habitat suitable for providing food and cover to wildlife

IMB GREASEWOOD

AND NN GRASS

Vegetation (dominant species [overstory, understory, ground cover], *etc.*):: **Photo numbers:**

Percent cover (estimated): 100-76% ☑, 75-51% ☐, 50-26% ☐, 25-1% ☐, no cover ☐

GREASEWOOD

CRYPTO SOIL

NN GRASS

CHEATGRASS

CLASPING PERFOL ~~GRASS~~ WEED

Reference Sampling Area Data Sheet (cont.)	Surveyor's name: J. CAVITT
Ref. Locale & Sampling Area: BR / SA002	Date & Time: 6/1/15 12:52P

Invertebrates (direct observations of species, signs of invertebrates [ant hills, molts, burrows], *etc.*):

Photo numbers:__________

CHIRONOMIDS -

BUTTERFLY (WHITE)

Birds (direct observations of species, abundance [general], singing/other behaviors, signs, presence of nests, *etc.* Where present, include information specific to American avocet, snowy plover, or horned lark):

Photo numbers:__________

HORNED LARK

THRASHER

CURLEW

Mammals (direct observations of species, abundance [general], signs [scat, burrows], *etc.*):

Photo numbers:__________

VOLES (O, SCAT, BURR)

COYOTE (SCAT

BADGER (BURR, SCAT)

Reference Sampling Area Data Sheet (cont.)	Surveyor's name: J. CAVITT
Ref. Locale & Sampling Area: BEAR RIVER (BR) SA002	Date & Time: 6/1/15 12:52p

Additional notes (if needed):

PHOTOGRAPHIC LOCATION INFORMATION

Ref. Locale & Sampling Area: BR / SA002

Surveyor's name: T. HAMADA

Date and Time: 6/1/15 12:52p

Photo Number Series: ______

Photo Location

Latitude: ______

Longitude: ______

Four Cardinal Positions (photos taken rotating clockwise, in sequence (N, S, E, W), from the same orientation, zoom level, and distance from the ground)

Photo Number (North) : 100 - 0008

Photo Number (South): 100 - 0006

Photo Number (East): 100 - 0007

Photo Number (West): 100 - 0009

Describe and photo document important features, disturbance, species, or evidence of animal activity.

Photo #	Description

Ref. Locale & Sampling Area: ______

Reference Sampling Area Data Sheet		Photo numbers:
Ref. Locale & Sampling Area: BR / SA 003		Surveyor's name: J. CAVITT
Area Surveyed (ha) (estimated):		Land owner: USFWS
Date & Time: 6/1/15 1:30p	PN:	Project: US Mag Reference Area
Latitude: E: 387233.36	Longitude: N 4596015.82	Distance from 5 mile radius

Accessibility (describe steps taken to get to sampling area):

DIKE BTWN UNIT 1/10

UNIT 1~~10~~ (EAST OF RD)

Topography (note general and notable features):

FLAT, SHALLOW DEPRESSION

Hydrology (note the presence of potential drinking water sources such as standing water, likeliness to accumulate standing water, *etc.*):

STANDING H_2O

Habitat (type, notable features, *etc.*): **Photo numbers:**

Level of Disturbance (circle one): undisturbed, minimally disturbed, substantially disturbed

☑ Habitat suitable for nesting snowy plover ☑ Habitat suitable for nesting American avocet

☐ Habitat suitable for nesting horned lark ☐ Habitat suitable for providing food and cover to wildlife

IMB PLAYA

Vegetation (dominant species [overstory, understory, ground cover], *etc.*):: **Photo numbers:**

Percent cover (estimated): 100-76% ☐, 75-51% ☐, 50-26% ☐, 25-1% ☑ no cover ☐

ALMOST NONE

NONE ID'ED

Reference Sampling Area Data Sheet (cont.)	Surveyor's name: J. CAVITT
Ref. Locale & Sampling Area: BR / SA 003	Date & Time: 6/1/15 1:30

Invertebrates (direct observations of species, signs of invertebrates [ant hills, molts, burrows], *etc.*):

Photo numbers:__________

MIDGE

Birds (direct observations of species, abundance [general], singing/other behaviors, signs, presence of nests, *etc.* Where present, include information specific to American avocet, snowy plover, or horned lark):

Photo numbers:__________

SNOWY PLOVER (8, 2 PAIR)
AVOCET
CURLEW
IBIS

Mammals (direct observations of species, abundance [general], signs [scat, burrows], *etc.*):

Photo numbers:__________

NONE OBS

SIGN → COYOTE TRACKS IN MUD

Reference Sampling Area Data Sheet (cont.)	Surveyor's name: J. CAVITT
Ref. Locale & Sampling Area: BEAR RIVER (BR) SA003	Date & Time: 6/1/15 1:30p

Additional notes (if needed):

PHOTOGRAPHIC LOCATION INFORMATION

Ref. Locale & Sampling Area: BR SA 003

Surveyor's name: ____

Date and Time: 6/1/15 1:30p

Photo Number Series: ____

Photo Location

Latitude: ____

Longitude: ____

Four Cardinal Positions (photos taken rotating clockwise, in sequence (N, S, E, W), from the same orientation, zoom level, and distance from the ground)

Photo Number (North) : 100-0012

Photo Number (South): 100-0010

Photo Number (East): 100-0011

Photo Number (West): 100-0013

Describe and photo document important features, disturbance, species, or evidence of animal activity.

Photo #	Description

Ref. Locale & Sampling Area: ____

Reference Sampling Area Data Sheet	Photo numbers:
Ref. Locale & Sampling Area: ~~[illegible]~~ SOUTH UP1 SA 004	Surveyor's name: J. CAVITT
Area Surveyed (ha) (estimated):	Land owner:
Date & Time: 6/7/15 8:50A PN:	Project: US Mag Reference Area
E Latitude: 354331.49 N Longitude: 4517158.06	Distance from 5 mile radius

Accessibility (describe steps taken to get to sampling area):

~~[illegible] N OF POLE~~

N OF POLE LINE RD

Topography (note general and notable features): FLAT

Hydrology (note the presence of potential drinking water sources such as standing water, likeliness to accumulate standing water, *etc.*):

NO H2O OBS

Habitat (type, notable features, *etc.*): **Photo numbers:**

Level of Disturbance (circle one): undisturbed, minimally disturbed, substantially disturbed

☐ Habitat suitable for nesting snowy plover ☐ Habitat suitable for nesting American avocet

☑ Habitat suitable for nesting horned lark ☑ Habitat suitable for providing food and cover to wildlife

& IMB GREASEWOOD

Vegetation (dominant species [overstory, understory, ground cover], *etc.*):: **Photo numbers:**

Percent cover (estimated): 100-76% ☐, 75-51% ☐, 50-26% ☑, 25-1% ☐, no cover ☐

GREASEWOOD

NN ANN GRASSES

CHEAT GRASS

Page __ of __

Reference Sampling Area Data Sheet (cont.)	Surveyor's name: J. CAVITT
Ref. Locale & Sampling Area: ~~SWYUP~~ UP.SOM SA 004	Date & Time: 6/2/15 8:50a

Invertebrates (direct observations of species, signs of invertebrates [ant hills, molts, burrows], *etc.*):

Photo numbers:

HARVESTER ANTS (0, HILLS)

DARKLING BEETLES

Birds (direct observations of species, abundance [general], singing/other behaviors, signs, presence of nests, *etc.* Where present, include information specific to American avocet, snowy plover, or horned lark):

Photo numbers:

SAGEBRUSH SPARROW (SONG)

~~SAVANNAH~~ BREWERS SPARROW (SONG); NEST + 2 EGGS

HORNED LARK (SONG)

SAGE THRASHER

6/3 KWC
Brewers
Nest re-visited 6/3 J.C. to confirm by song

Mammals (direct observations of species, abundance [general], signs [scat, burrows], *etc.*):

Photo numbers:

BLACK TAILED JACK R.

VOLE (BURROWS)

~~PRAIRIE DOG~~ Ground Squirrel, possibly Townsend 6/3 KWC

BADGER (BURROW)

Reference Sampling Area Data Sheet (cont.)	Surveyor's name: J. CAVITT
Ref. Locale & Sampling Area: UP SOUTH SA 004	Date & Time: 6/2/15 8:50a

Additional notes (if needed):

REPTILES

W. FENCE LIZ

PHOTOGRAPHIC LOCATION INFORMATION

Ref. Locale & Sampling Area: UP · SOUTH / SA 004

Surveyor's name: ________

Date and Time: 6/2/15 8:50A

Photo Number Series: ________

Photo Location

Latitude: ________ Longitude: ________

Four Cardinal Positions (photos taken rotating clockwise, in sequence (N, S, E, W), from the same orientation, zoom level, and distance from the ground)

Photo Number (North) : 100-00~~16~~ 17

Photo Number (South): 100-00~~14~~ 15

Photo Number (East): 100-00~~15~~ 16

Photo Number (West): 100-00~~17~~ 18

Describe and photo document important features, disturbance, species, or evidence of animal activity.

Photo #	Description
100-00~~18~~ 19	SM MAMMAL (BURROWS)
100-00~~19~~ 20	NEST # 2 EGGS - SAV ~~SAPP~~ SPARROW

Ref. Locale & Sampling Area: ________

Reference Sampling Area Data Sheet		Photo numbers:
Ref. Locale & Sampling Area: UP SOUTH SA005		Surveyor's name: J. CAVITT
Area Surveyed (ha) (estimated):		Land owner: US MAG
Date & Time: 6/2/15 11:55A	PN:	Project: US Mag Reference Area
Latitude: E 356199.77	Longitude: N 4519021.02	Distance from 5 mile radius

Accessibility (describe steps taken to get to sampling area):

~~ROAD~~ N OF ROAD, JUST PAST SKULL CRK DIVERSION

Topography (note general and notable features): FLAT W/ DEPRESSIONS

Hydrology (note the presence of potential drinking water sources such as standing water, likeliness to accumulate standing water, *etc.*):

SKULL CRK DIVERSION CATTLE H2O HOLE (SE

IMPOUNDMENTS (FW?)

Habitat (type, notable features, *etc.*): **Photo numbers:**

Level of Disturbance (circle one): undisturbed, minimally [✓ disturbed], substantially disturbed

☐ Habitat suitable for nesting snowy plover ☑ Habitat suitable for nesting American avocet

☐ Habitat suitable for nesting horned lark ☑ Habitat suitable for providing food and cover to wildlife

IMPOUNDMENT

(NUB GREASEWOOD

Vegetation (dominant species [overstory, understory, ground cover], *etc.*):: **Photo numbers:**

Percent cover (estimated): 100-76% ☐, 75-51% ☐, 50-26% ☐, 25-1% ☑, no cover ☐

ATRIPLEX NO ANN GRASS (~~GD~~ GRND)

GREASEWOOD

Reference Sampling Area Data Sheet (cont.)	Surveyor's name: J. CAVITT
Ref. Locale & Sampling Area: UP SOUTH SA 005	Date & Time: 6/2/15 11:52 A

Invertebrates (direct observations of species, signs of invertebrates [ant hills, molts, burrows], *etc.*):

Photo numbers:__________

HARVESTER ANT

DRAGONFLY

GRASSHOPPER

LADY BUGS

MOS-QUITOS

Birds (direct observations of species, abundance [general], singing/other behaviors, signs, presence of nests, *etc.* Where present, include information specific to American avocet, snowy plover, or horned lark):

Photo numbers:__________

AVOCETS (W/ CHICKS) PROBABLE NEST (BEHAVIOR) - >20 ADULTS

KILLDEER

YELLOW-HEADED BLACKBIRDS IN PHRAGI

WILSON'S PHALROPE

WILLETS

Mammals (direct observations of species, abundance [general], signs [scat, burrows], *etc.*):

Photo numbers:__________

SM MAMM (BURROW)

JACKRABBIT (O, BURROW)

Reference Sampling Area Data Sheet (cont.)	Surveyor's name: J. CAVITT
Ref. Locale & Sampling Area: UP S SA 005	Date & Time: 6/2/15 11:55 A

Additional notes (if needed):

REPTILE

W. FENCE LIZ

PHOTOGRAPHIC LOCATION INFORMATION

Ref. Locale & Sampling Area: UP 5 SA 005

Surveyor's name: ________

Date and Time: 6/2/15 11:52A

Photo Number Series: ________

Photo Location

Latitude: ________

Longitude: ________

Four Cardinal Positions (photos taken rotating clockwise, in sequence (N, S, E, W), from the same orientation, zoom level, and distance from the ground)

Photo Number (North) : 100 - 0023

Photo Number (South): 100 - 0021

Photo Number (East): 100 - 0022

Photo Number (West): 100 - 0024

Describe and photo document important features, disturbance, species, or evidence of animal activity.

Photo #	Description

Ref. Locale & Sampling Area: ________

Reference Sampling Area Data Sheet	Photo numbers:
Ref. Locale & Sampling Area: PLAYA S SA 006	Surveyor's name: J. CAVITT
Area Surveyed (ha) (estimated):	Land owner: US MAG
Date & Time: 6/2/15 12:35p PN:	Project: US Mag Reference Area
Latitude: E 360798.32 Longitude: N 4519205.63	Distance from 5 mile radius

Accessibility (describe steps taken to get to sampling area):

UN-NAMED DIKE ROAD

NORTH OF ROAD - S EVAP POND

Topography (note general and notable features):

FLAT W/ MM BERMS (UNKNOWN SOURCE)

Hydrology (note the presence of potential drinking water sources such as standing water, likeliness to accumulate standing water, *etc.*):

EVAP PONDS - PINK W/ ALGA

NO OBS FW

Habitat (type, notable features, *etc.*): **Photo numbers:**

Level of Disturbance (circle one): undisturbed, minimally disturbed, [✓ substantially disturbed]

☑ Habitat suitable for nesting snowy plover ☐ Habitat suitable for nesting American avocet

☐ Habitat suitable for nesting horned lark ☐ Habitat suitable for providing food and cover to wildlife

HYPER SALINE POND

Vegetation (dominant species [overstory, understory, ground cover], *etc.*):: **Photo numbers:**

Percent cover (estimated): 100-76% ☐, 75-51% ☐, 50-26% ☐, 25-1% ☑ no cover ☐

NN ANN GRASS (CLUMPS)

95% BARE GRND

Reference Sampling Area Data Sheet (cont.)	Surveyor's name: J. CAVITT
Ref. Locale & Sampling Area: PLAYA S SA 006	Date & Time: 6/2/15 12:35p

Invertebrates (direct observations of species, signs of invertebrates [ant hills, molts, burrows], *etc.*):

Photo numbers:

~~NONE OBS~~

HARVESTER ANTS

Birds (direct observations of species, abundance [general], singing/other behaviors, signs, presence of nests, *etc.* Where present, include information specific to American avocet, snowy plover, or horned lark):

Photo numbers:

SNOWY PLOVER (ON BERM) (O)
1 OBSV, POSSIBLE PAIR

Mammals (direct observations of species, abundance [general], signs [scat, burrows], *etc.*):

Photo numbers:

NONE OBS

Reference Sampling Area Data Sheet (cont.)	Surveyor's name: J. CAVITT
Ref. Locale & Sampling Area: PLAYA S SA006	Date & Time: 6/2/15 ~~8:50~~ TH 12:35p

Additional notes (if needed):

POOR BACKGRND SITE

HOWEVER, DID NOT SEE MUCH ATTRACTIVE IMB PLAY SITES IN PLAYA S

MOSTLY BERMS & OPEN H_2O

TOOK REF GIVEN SKIMPY SELECTION OF IMB PLAY IN S LOCALE

W OF SA 006 - WEST SHORE OF IMPOUNDMENT MAY BE SUITABLE 4 BCKGRND PLAYA SOILS

MAYBE ~~SHELL~~ ~~[illegible]~~A FILL

PHOTOGRAPHIC LOCATION INFORMATION

Ref. Locale & Sampling Area: PLAYA S SA006

Surveyor's name: __________

Date and Time: 6/2/15 12:35p

Photo Number Series: __________

Photo Location

Latitude: __________

Longitude: __________

Four Cardinal Positions (photos taken rotating clockwise, in sequence (N, S, E, W), from the same orientation, zoom level, and distance from the ground)

Photo Number (North) : 100 - 0027

Photo Number (South): 100 - 0025

Photo Number (East): 100 - 0026

Photo Number (West): 100 - 0028

Describe and photo document important features, disturbance, species, or evidence of animal activity.

Photo #	Description
100-0029	BERM ROADWAY - S OF SA 006

Ref. Locale & Sampling Area: __________

Reference Sampling Area Data Sheet		Photo numbers:
Ref. Locale & Sampling Area: UPLAND SOUTH SA/007		Surveyor's name: ~~HATHADA~~ J. CAVIT
Area Surveyed (ha) (estimated):		Land owner:
Date & Time: 6/2/15 @ 13:49	PN:	Project: US Mag Reference Area
Latitude: 4518219.03N	Longitude: 355014.58E	Distance from 5 mile radius

Accessibility (describe steps taken to get to sampling area):

N. SIDE OF ROAD TRAVELING EAST FROM PUMP STATION

Topography (note general and notable features):

GENERALLY FLAT LITTLE ELEVATION CHANGE (< 2 m) ACROSS AREA

Hydrology (note the presence of potential drinking water sources such as standing water, likeliness to accumulate standing water, *etc.*):

NONE. MARSH AREA (SA 005) ~ 0.5 mi EAST.

Habitat (type, notable features, *etc.*): **Photo numbers:**

Level of Disturbance (circle one): undisturbed, [✓ minimally disturbed] substantially disturbed

☐ Habitat suitable for nesting snowy plover ☐ Habitat suitable for nesting American avocet

☒ Habitat suitable for nesting horned lark ☐ Habitat suitable for providing food and cover to wildlife

Vegetation (dominant species [overstory, understory, ground cover], *etc.*):: **Photo numbers:**

Percent cover (estimated): 100-76% ☐, 75-51% ☒, 50-26% ☐, 25-1% ☐, no cover ☐

ATRIPLEX / GREASWOOD, NON-NATIVE HERBACEOUS SPECIES NEAR ROAD

Reference Sampling Area Data Sheet (cont.)	Surveyor's name: J. CAVITT
Ref. Locale & Sampling Area: UPLAND SOUTH SA007	Date & Time: 6/2/15 1:49p

Invertebrates (direct observations of species, signs of invertebrates [ant hills, molts, burrows], *etc.*):

Photo numbers:__________

ANTS - HARVESTER ANTS

Birds (direct observations of species, abundance [general], singing/other behaviors, signs, presence of nests, *etc.* Where present, include information specific to American avocet, snowy plover, or horned lark):

Photo numbers:__________

HORNED LARK (~10)

LOGGERHEAD SHRIKE (2)

Mammals (direct observations of species, abundance [general], signs [scat, burrows], *etc.*):

Photo numbers:__________

PRARIE DOG - OBSERVED

BURROWS

Reference Sampling Area Data Sheet (cont.)	Surveyor's name: J. CAVITT
Ref. Locale & Sampling Area: UPLAND SOUTH SA007	Date & Time: 6/2/15 1:49p

Additional notes (if needed):

PHOTOGRAPHIC LOCATION INFORMATION

Ref. Locale & Sampling Area: UPLAND SOUTH SA007

Surveyor's name: ______

Date and Time: 6/2/15 1:49p

Photo Number Series: ______

Photo Location

Latitude: ______ Longitude: ______

Four Cardinal Positions (photos taken rotating clockwise, in sequence (N, S, E, W), from the same orientation, zoom level, and distance from the ground)

Photo Number (North) : 100-0032

Photo Number (South): 100-0030

Photo Number (East): 100-0031

Photo Number (West): 100-0033

Describe and photo document important features, disturbance, species, or evidence of animal activity.

Photo #	Description

Ref. Locale & Sampling Area: ______

Reference Sampling Area Data Sheet

Photo numbers:

Ref. Locale & Sampling Area: PLAYA S SA 00B

Surveyor's name: J. CAVITT

Area Surveyed (ha) (estimated):

Land owner:

Date & Time: 6/2/15 3:40P

PN:

Project: US Mag Reference Area

E Latitude: 357174.05 N Longitude: 4521624.47 Distance from 5 mile radius

Accessibility (describe steps taken to get to sampling area):

~~MAP~~

Topography (note general and notable features):

Hydrology (note the presence of potential drinking water sources such as standing water, likeliness to accumulate standing water, *etc.*):

EVAP POND

FW NOT OBSERV

Habitat (type, notable features, *etc.*): **Photo numbers:**

Level of Disturbance (circle one): undisturbed, minimally disturbed, substantially disturbed

☐ Habitat suitable for nesting snowy plover ☐ Habitat suitable for nesting American avocet

☑ Habitat suitable for nesting horned lark ☑ Habitat suitable for providing food and cover to wildlife

IMB PLAYA (EVAP POND) IMB GREASEWOOD ~~TRA~~

Vegetation (dominant species [overstory, understory, ground cover], *etc.*):: **Photo numbers:**

Percent cover (estimated): 100-76% ☑, 75-51% ☐, 50-26% ☐, 25-1% ☐, no cover ☐

IMB PLAYA
NO VEG

IMB GREASEWOOD

Reference Sampling Area Data Sheet (cont.)	Surveyor's name: J. CAVITT
Ref. Locale & Sampling Area: PLAYA S SA 008	Date & Time: 6/2/15 3:40p

Invertebrates (direct observations of species, signs of invertebrates [ant hills, molts, burrows], *etc.*):

Photo numbers:__________

IMB PLAYA

NONE

IMB GREASEWOOD

HARVESTER ANT

Birds (direct observations of species, abundance [general], singing/other behaviors, signs, presence of nests, *etc.* Where present, include information specific to American avocet, snowy plover, or horned lark):

Photo numbers:__________

LOGGERHEAD SHRIKE | GREASEWOOD

MEADOW LARK

IMB PLAYA | NO PLOVER

NO AVOCET

Mammals (direct observations of species, abundance [general], signs [scat, burrows], *etc.*):

Photo numbers:__________

SM MAMM (BURROW)

BADGER (BURROW)

~~JACK RABBIT (0)~~

COTTON TAIL (0)

Reference Sampling Area Data Sheet (cont.)	Surveyor's name: J. CAVITT
Ref. Locale & Sampling Area: PLAYA S SA008	Date & Time: 6/2/15 3:40p

Additional notes (if needed):

REPTILE

W. FENCE LIZ

SIMILIAR SITE 1MB PLAYA / 1MB GREASEWOOD

1/2 MILE N OF SA 008 = SA 009

PHOTOGRAPHIC LOCATION INFORMATION

Ref. Locale & Sampling Area: PLAYA S SA008

Surveyor's name: ______

Date and Time: 6/2/15 ~~SA008~~ 3:40p

Photo Number Series: ______

Photo Location

Latitude: ______ Longitude: ______

Four Cardinal Positions (photos taken rotating clockwise, in sequence (N, S, E, W), from the same orientation, zoom level, and distance from the ground)

Photo Number (North) : 100 · 00~~33~~ ~~37~~ 36

Photo Number (South): 100 · 00~~31~~ 34

Photo Number (East): 100 · 00~~32~~ 35

Photo Number (West): 100 · 00~~34~~ ~~36~~ 37

Describe and photo document important features, disturbance, species, or evidence of animal activity.

Photo #	Description
100 · 00~~35~~ 38	BADGER BURROW
100 · 0039	BADGER PRINT

Ref. Locale & Sampling Area: ______

Reference Sampling Area Data Sheet	Photo numbers:
Ref. Locale & Sampling Area: UPL N SA009	Surveyor's name: J. CAVITT
Area Surveyed (ha) (estimated):	Land owner:
Date & Time: 6/3/15 11:40A PN:	Project: US Mag Reference Area
Latitude: E 342509.15 Longitude: N 4541431.75	Distance from 5 mile radius 5 MILE FROM ROAD

Accessibility (describe steps taken to get to sampling area):

EAST OF COUNTY RD

Topography (note general and notable features):

SLIGHT DOWNGRADE SLOPE (NN ANN GRASS) GRADES TO FLAT (IMB GREASEWOOD)

Hydrology (note the presence of potential drinking water sources such as standing water, likeliness to accumulate standing water, *etc.*):

NONE - OBSV

Habitat (type, notable features, *etc.*): PHYSICAL **Photo numbers:**

Level of Disturbance (circle one): undisturbed [✓ minimally disturbed] substantially disturbed

☐ Habitat suitable for nesting snowy plover ☐ Habitat suitable for nesting American avocet

☐ Habitat suitable for nesting horned lark ☑ Habitat suitable for providing food and cover to wildlife

MEADOW LARK

NN ANN GRASS GRADES TO IMB GREASEWOOD

Vegetation (dominant species [overstory, understory, ground cover], *etc.*):: **Photo numbers:**

Percent cover (estimated): 100-76% ☑, 75-51% ☐, 50-26% ☐, 25-1% ☐, no cover ☐

NN GRASS (UNDER)

CHEATGRASS

STANDING DEAD SHRUB (GREASEWOOD?)

Reference Sampling Area Data Sheet (cont.)	Surveyor's name: J. CAVITT
Ref. Locale & Sampling Area: UP N SA 009	Date & Time: 6/3/15 11:40a

Invertebrates (direct observations of species, signs of invertebrates [ant hills, molts, burrows], *etc.*):

Photo numbers:

HARVESTER ANT
LOCUST
GRASSHOPPER
BLACK WIDOW (VOLE BURROW)
DRAGON FLIES

IMB GREASE
LADY BUG

Birds (direct observations of species, abundance [general], singing/other behaviors, signs, presence of nests, *etc.* Where present, include information specific to American avocet, snowy plover, or horned lark):

Photo numbers:

MEADOW LARK
THRASHER
SHRIKE
MOCKING BIRD

Mammals (direct observations of species, abundance [general], signs [scat, burrows], *etc.*):

Photo numbers:

SM MAMM ($\overset{\text{SM}}{\text{BURROWS}}$) - LIKELY VOLE [MEADOW]
SM MAMM ($\overset{\text{MED}}{\text{BURROWS}}$) - LIKELY GRND SQUIRREL

ANTELOPE (SCAT)

CATTLE (SCAT)

Page __ of __

Reference Sampling Area Data Sheet (cont.)	Surveyor's name: J. CAVITT
Ref. Locale & Sampling Area: UPLAND NORTH SA009	Date & Time: 6/3/15 11:40a

Additional notes (if needed):

PHOTOGRAPHIC LOCATION INFORMATION

Ref. Locale & Sampling Area: UPLAND NORTH SA009

Surveyor's name: ______

Date and Time: 6/3/15 11:40a

Photo Number Series: 100-040 thru -044

Photo Location

Latitude: ______

Longitude: ______

Four Cardinal Positions (photos taken rotating clockwise, in sequence (N, S, E, W), from the same orientation, zoom level, and distance from the ground)

Photo Number (North) : 100-043

Photo Number (South): 100-042

Photo Number (East): 100-044

Photo Number (West): 100-041

Describe and photo document important features, disturbance, species, or evidence of animal activity.

Photo #	Description

Ref. Locale & Sampling Area: ______

Reference Sampling Area Data Sheet	Photo numbers:
Ref. Locale & Sampling Area: UP N SA 010	Surveyor's name: J. CAVITT
Area Surveyed (ha) (estimated):	Land owner:
Date & Time: 6/3/15 12:30p — PN:	Project: US Mag Reference Area
E: Latitude: 344251.93 — N: Longitude: 4539728.70	Distance from 5 mile radius 3.2 ~~m~~ MI RAD

Accessibility (describe steps taken to get to sampling area):

COUNTY ROAD
^
WEST OF

Topography (note general and notable features):

SLIGHT UPSLOPE - W OF COUNTY RD

Hydrology (note the presence of potential drinking water sources such as standing water, likeliness to accumulate standing water, *etc.*):

NONE - OBSV

Habitat (type, notable features, *etc.*): **Photo numbers:**

Level of Disturbance (circle one): undisturbed, [✓ minimally disturbed] CATTLE, substantially disturbed

☐ Habitat suitable for nesting snowy plover ☐ Habitat suitable for nesting American avocet

☑ Habitat suitable for nesting horned lark ☐ Habitat suitable for providing food and cover to wildlife

NN AND GRASS
UPSLOPE

1MB GREASEWOOD TRANSITION
SLIGHT

Vegetation (dominant species [overstory, understory, ground cover], *etc.*):: **Photo numbers:**

Percent cover (estimated): 100-76% ☑, 75-51% ☐, 50-26% ☐, 25-1% ☐, no cover ☐

NN AND GRASS
CHEATGRASS (>76% GRND COVER)

1MB GREASEWOOD (>75% GRND COVER + SCRUB)

Reference Sampling Area Data Sheet (cont.)	Surveyor's name: J. CAVITT
Ref. Locale & Sampling Area: OP N SA 010	Date & Time: 6/3/15 12:30p

Invertebrates (direct observations of species, signs of invertebrates [ant hills, molts, burrows], *etc.*):

Photo numbers:__________

HARVESTER ANT
LOCUST

Birds (direct observations of species, abundance [general], singing/other behaviors, signs, presence of nests, *etc.* Where present, include information specific to American avocet, snowy plover, or horned lark):

Photo numbers:__________

N. MOCKING BIRD (SONG)
MEADOWLARK (SONG)
HORNED LARK (SONGS, OBS)
LARK SPARROW (SONG)
MOURNING DOVE (O)

Mammals (direct observations of species, abundance [general], signs [scat, burrows], *etc.*):

Photo numbers:__________

SM MAMM BURROWS (MANY)
BADGER BURROW (OLD)
DEER (SCAT)

CATTLE (SCAT)

Reference Sampling Area Data Sheet (cont.)	Surveyor's name: J. CAVITT
Ref. Locale & Sampling Area: UP N SA010	Date & Time: 6/3/15 12:30p

Additional notes (if needed):

PHOTOGRAPHIC LOCATION INFORMATION

Ref. Locale & Sampling Area: UP N SA 010

Surveyor's name: __________

Date and Time: 6/3/15 12:30p

Photo Number Series: __________

Photo Location

Latitude: __________ Longitude: __________

Four Cardinal Positions (photos taken rotating clockwise, in sequence (N, S, E, W), from the same orientation, zoom level, and distance from the ground)

Photo Number (North) : 100 - 0046

Photo Number (South): 100 - 0048

Photo Number (East): 100 - 0049

Photo Number (West): 100 - 0047

Describe and photo document important features, disturbance, species, or evidence of animal activity.

Photo #	Description
100 - 0050	TYPICAL GRND CONDITION

Ref. Locale & Sampling Area: __________

Reference Sampling Area Data Sheet	Photo numbers:
Ref. Locale & Sampling Area: PLAYA N SA 011	Surveyor's name: J. CAVITT
Area Surveyed (ha) (estimated):	Land owner:
Date & Time: 6/3/15 ~~2:00p~~ 1:45 PN:	Project: US Mag Reference Area
E Latitude: 344320.83 N: Longitude: 4543735.74	Distance from 5 mile radius

Accessibility (describe steps taken to get to sampling area):

SOUTH OF N. FENCE·LINE RD - (UTTR FENCE·LINE)

Topography (note general and notable features):

FLAT

Hydrology (note the presence of potential drinking water sources such as standing water, likeliness to accumulate standing water, *etc.*):

WATER TO ~~WEST~~ EAST (~1 MI) OF SA 011

Habitat (type, notable features, *etc.*): **Photo numbers:**

Level of Disturbance (circle one): undisturbed, minimally disturbed, substantially disturbed

☑ Habitat suitable for nesting snowy plover ☐ Habitat suitable for nesting American avocet

☐ Habitat suitable for nesting horned lark ☐ Habitat suitable for providing food and cover to wildlife

IMB PLAYA

Vegetation (dominant species [overstory, understory, ground cover], *etc.*):: **Photo numbers:**

Percent cover (estimated): 100-76% ☐, 75-51% ☐, 50-26% ☐, 25-1% ☑, no cover ☐

~~PICKLEWEED (SALICORNIA)~~

~~[illegible]~~

PICKLEWEED (PATCHY)

Reference Sampling Area Data Sheet (cont.)

Surveyor's name: J. CAVITT

Ref. Locale & Sampling Area: PLAYA N SA 011

Date & Time: 6/3/15 ~~2:00p~~ 1:45p

Invertebrates (direct observations of species, signs of invertebrates [ant hills, molts, burrows], *etc.*):

Photo numbers:

Birds (direct observations of species, abundance [general], singing/other behaviors, signs, presence of nests, *etc.* Where present, include information specific to American avocet, snowy plover, or horned lark):

Photo numbers:

PLOVER + NEST + 1 EGG (O)
(PAIR)

HORNED LARK (O)

CA GULL (FEEDING, O) @ H_2O FEATURE ~~WEST~~ EAST OF SA 011

RAVEN

Mammals (direct observations of species, abundance [general], signs [scat, burrows], *etc.*):

Photo numbers:

NONE OBSRV

~~NO SIGNS~~

COYOTE (TRACKS)

Reference Sampling Area Data Sheet (cont.)	Surveyor's name: J. CAVITT
Ref. Locale & Sampling Area: PLAYA N SA011	Date & Time: 6/3/15 1:45p

Additional notes (if needed):

PHOTOGRAPHIC LOCATION INFORMATION

Ref. Locale & Sampling Area: PLAYA N SA 011

Surveyor's name: ______

Date and Time: 6/3/15 1:45 ~~2:00~~p

Photo Number Series: ______

Photo Location

Latitude: ______

Longitude: ______

Four Cardinal Positions (photos taken rotating clockwise, in sequence (N, S, E, W), from the same orientation, zoom level, and distance from the ground)

Photo Number (North) : 100 - 00~~54~~ 52

Photo Number (South): 100 - 00~~53~~ 54

Photo Number (East): 100 - 00~~52~~ 53

Photo Number (West): 100 - 00~~54~~ 55

Describe and photo document important features, disturbance, species, or evidence of animal activity.

Photo #	Description
4115	S SKIPPER PHOTO - PLOVER NEST + EGG
100 - 0056	H_2O FEATURE EAST OF SA 011
100 - 0057	H_2O FEATURE EAST OF SA 011

Ref. Locale & Sampling Area: ______

Reference Sampling Area Data Sheet		Photo numbers:
Ref. Locale & Sampling Area: PLAYA SE SA012		Surveyor's name: J. CAVITT
Area Surveyed (ha) (estimated):		Land owner:
Date & Time: 6/4/15 10:00A	PN:	Project: US Mag Reference Area
E Latitude: 363191.74	N Longitude: 4531880.83	Distance from 5 mile radius

Accessibility (describe steps taken to get to sampling area):

N OF RD TO BADGER ISL

Topography (note general and notable features):

FLAT

Hydrology (note the presence of potential drinking water sources such as standing water, likeliness to accumulate standing water, *etc.*):

STANDING ~~SALINE H~~ SALINE H2O (GSL WATER) TO NORTH

TO SOUTH US MAG EVAP POND W/ H2O

Habitat (type, notable features, *etc.*): PLAYA

Photo numbers:

Level of Disturbance (circle one): undisturbed, [✓ minimally disturbed], substantially disturbed

☑ Habitat suitable for nesting snowy plover

☐ Habitat suitable for nesting American avocet

☑ Habitat suitable for nesting horned lark

☐ Habitat suitable for providing food and cover to wildlife

IMB PLAYA

ROAD – SUBSTANTIAL DISTURB

Vegetation (dominant species [overstory, understory, ground cover], *etc.*)::

Photo numbers:

Percent cover (estimated): 100-76% ☐, 75-51% ☐, 50-26% ☑, 25-1% ☐, no cover ☐

NW AND GRASS ON DIKE

CHEATGRASS

IMB PLAYA

NO VEG

~~[illegible]~~

(NO PICKLEWEED OBSV'ED)

Reference Sampling Area Data Sheet (cont.)	Surveyor's name: J. CAVITT
Ref. Locale & Sampling Area: ~~[illegible]~~ PLAYA SE SA012	Date & Time: 6/4/15 10:00A

Invertebrates (direct observations of species, signs of invertebrates [ant hills, molts, burrows], *etc.*):

Photo numbers:

BITING GNATS

NO CONSPICUOUS ANTS

BLACK WIDOW (IN WEB @ BURROW)

Birds (direct observations of species, abundance [general], singing/other behaviors, signs, presence of nests, *etc.* Where present, include information specific to American avocet, snowy plover, or horned lark):

Photo numbers:

S PLOVER (O, 2 PAIR) - BEHAVIOR SUGGEST POSSIBLE NEST

HORNED LARK (SONG

Mammals (direct observations of species, abundance [general], signs [scat, burrows], *etc.*):

Photo numbers:

SM MAMM (BURROWS, MANY ~~[illegible]~~) - ESP N SIDE OF RD

Reference Sampling Area Data Sheet (cont.)	Surveyor's name: J. CAVITT
Ref. Locale & Sampling Area: PLAYA SE SA012	Date & Time: 6/4/15 10:00A

Additional notes (if needed):

☑ PHRAG NWB N OF RD TO BADGER

INDICATOR OF FW

NO STANDING H_2O OBSV

E : 365815.

N : 4532798.

PHOTO

100-0064

PHOTOGRAPHIC LOCATION INFORMATION

Ref. Locale & Sampling Area: PLAYA SE 012

Surveyor's name:

Date and Time: 6/4/15 10:00A

Photo Number Series:

Photo Location

Latitude:

Longitude:

Four Cardinal Positions (photos taken rotating clockwise, in sequence (N, S, E, W), from the same orientation, zoom level, and distance from the ground)

Photo Number (North) : 100- 0062

Photo Number (South): 100- 0060

Photo Number (East): 100 - 0061

Photo Number (West): 100 - 0063

Describe and photo document important features, disturbance, species, or evidence of animal activity.

Photo #	Description
100 - 0064	PHRAGMINES N OF RD TO BADGER - INDIC OF FW (SEE SA013)

Ref. Locale & Sampling Area:

Reference Sampling Area Data Sheet

Photo numbers:

Ref. Locale & Sampling Area: PLAYA SE SA013

Surveyor's name: J. CAVITT

Area Surveyed (ha) (estimated):

Land owner:

Date & Time: 6/4/15 11:00A

PN:

Project: US Mag Reference Area

E Latitude: 365915.99 N Longitude: 4532784.95

Distance from 5 mile radius

Accessibility (describe steps taken to get to sampling area):

N OF RD TO BADGER ISL

Topography (note general and notable features):

FLAT

Hydrology (note the presence of potential drinking water sources such as standing water, likeliness to accumulate standing water, *etc.*):

NEAR (300 ft) OF PHRAG

Habitat (type, notable features, *etc.*): PLAYA

Photo numbers:

Level of Disturbance (circle one): undisturbed, [✓ minimally disturbed], substantially disturbed

☑ Habitat suitable for nesting snowy plover ☐ Habitat suitable for nesting American avocet

☑ Habitat suitable for nesting horned lark ☐ Habitat suitable for providing food and cover to wildlife

FORAGE

IMB PLAY

Vegetation (dominant species [overstory, understory, ground cover], *etc.*)::

Photo numbers:

Percent cover (estimated): 100-76% ☐, 75-51% ☐, 50-26% ☐, 25-1% ☑, no cover ☐

NN ANN GRASS

CHEATGRASS (DIKE RD)

IMB PLAYA

NO VEG

Page __ of __

Reference Sampling Area Data Sheet (cont.)	Surveyor's name: J. CAVITT
Ref. Locale & Sampling Area: PLAYA SE SA 013	Date & Time: 6/4/15 11:00A

Invertebrates (direct observations of species, signs of invertebrates [ant hills, molts, burrows], *etc.*):

Photo numbers:________________

HARVESTER ANT

Birds (direct observations of species, abundance [general], singing/other behaviors, signs, presence of nests, *etc.* Where present, include information specific to American avocet, snowy plover, or horned lark):

Photo numbers:________________

PLOVER (~~D~~ OB, 1 PAIR) – POSSIBLE NEST

HORNED LARK (OB, SEVERAL PAIR)

Mammals (direct observations of species, abundance [general], signs [scat, burrows], *etc.*):

Photo numbers:________________

SM MAMM (BURROWS, MANY)

Reference Sampling Area Data Sheet (cont.)	Surveyor's name: J. CAVITT
Ref. Locale & Sampling Area: PLAYA SE SA013	Date & Time: 6/4/15 11:00A

Additional notes (if needed):

PHOTOGRAPHIC LOCATION INFORMATION

Ref. Locale & Sampling Area: PLAYA SE ~~SA012~~ SA013

Surveyor's name: __________

Date and Time: 6/4/15 11:00A

Photo Number Series: __________

Photo Location

Latitude: __________ Longitude: __________

Four Cardinal Positions (photos taken rotating clockwise, in sequence (N, S, E, W), from the same orientation, zoom level, and distance from the ground)

Photo Number (North) : 100 - 0067

Photo Number (South): 100 - 0065

Photo Number (East): 100 - 0066

Photo Number (West): 100 - 0068

Describe and photo document important features, disturbance, species, or evidence of animal activity.

Photo #	Description

Ref. Locale & Sampling Area: __________

Page __ of __

Reference Sampling Area Data Sheet		Photo numbers:
Ref. Locale & Sampling Area: PLAYA SE SA014		Surveyor's name: J. CAVITT
Area Surveyed (ha) (estimated):		Land owner:
Date & Time: 6/4/15 11:30A	PN:	Project: US Mag Reference Area
E Latitude: 368462.75	N Longitude: 4533519.03	Distance from 5 mile radius

Accessibility (describe steps taken to get to sampling area):

BADGER ISL

Topography (note general and notable features):

FLAT (MOSTLY)

SOME SWALES

Hydrology (note the presence of potential drinking water sources such as standing water, likeliness to accumulate standing water, *etc.*):

NONE · OBSV

Habitat (type, notable features, *etc.*): **Photo numbers:**

Level of Disturbance (circle one): undisturbed, minimally disturbed, [✓ substantially disturbed]

☑ Habitat suitable for nesting snowy plover ☑ Habitat suitable for nesting American avocet

☑ Habitat suitable for nesting horned lark ☑ Habitat suitable for providing food and cover to wildlife

PAST STUDIES

IMB PLAYA GRADES TO DISTURBED NN GRASS / SCRUB

Vegetation (dominant species [overstory, understory, ground cover], *etc.*):: **Photo numbers:**

Percent cover (estimated): 100-76% ☑, 75-51% ☐, 50-26% ☐, 25-1% ☐, no cover ☐

UPLAND

ATRIPLEX – SHAD SCALE

– SALTBUSH

NN ANN GRASS (LAND COV)

CHEAT GRASS

PICKLEWEED ALONG SHORELINE

(THIN STRIP, PATCHY)

Reference Sampling Area Data Sheet (cont.)

Surveyor's name: J. CAVITT

Ref. Locale & Sampling Area: IMB PLAYA SE SA014

Date & Time: 6/4/15 11:30a

Invertebrates (direct observations of species, signs of invertebrates [ant hills, molts, burrows], *etc.*):

Photo numbers: ____

BITING GNATS (NO SEEM)

HARVESTER ANTS

Birds (direct observations of species, abundance [general], singing/other behaviors, signs, presence of nests, *etc.* Where present, include information specific to American avocet, snowy plover, or horned lark):

Photo numbers: ____

RAVEN (+ NEST)

HORN LARKS(

AVOCETS (20+)

STILTS (2)

S. PLOVER (NONE OBS, BUT OBS IN PAST)

Mammals (direct observations of species, abundance [general], signs [scat, burrows], *etc.*):

Photo numbers: ____

SM MAMM (BURROWS)

BADGER (BURROW)

Reference Sampling Area Data Sheet (cont.)	Surveyor's name: J. CAVITT
Ref. Locale & Sampling Area: PLAYA SE SA014	Date & Time: 6/4/15 ~~11:00A~~ TH 11:30a

Additional notes (if needed):

PHOTOGRAPHIC LOCATION INFORMATION

Ref. Locale & Sampling Area: PLAYA SE 014

Surveyor's name: _____

Date and Time: 06/4/15 ~~11:00A~~ TH ~~11:~~ 11:30a

Photo Number Series: _____

Photo Location

Latitude: _____ Longitude: _____

Four Cardinal Positions (photos taken rotating clockwise, in sequence (N, S, E, W), from the same orientation, zoom level, and distance from the ground)

Photo Number (North) : 100 - 0071

Photo Number (South): 100 - 0069

Photo Number (East): 100 - 0070

Photo Number (West): 100 - 0071

Describe and photo document important features, disturbance, species, or evidence of animal activity.

Photo #	Description

Ref. Locale & Sampling Area: _____

Reference Sampling Area Data Sheet

Photo numbers:

Ref. Locale & Sampling Area: UPL SE SA015

Surveyor's name: J. CAVITT

Area Surveyed (ha) (estimated):

Land owner:

Date & Time: 6/4/15 1:05p

PN:

Project: US Mag Reference Area

E Latitude: 370128.46 N Longitude: 4525846.72

Distance from 5 mile radius

Accessibility (describe steps taken to get to sampling area):

ROAD ALONG WESTSIDE STANSBURY ISL

Topography (note general and notable features):

SLIGHT SLOPE (

Hydrology (note the presence of potential drinking water sources such as standing water, likeliness to accumulate standing water, *etc.*):

NONE. OBS

Habitat (type, notable features, *etc.*):

Photo numbers:

Level of Disturbance (circle one): undisturbed, minimally disturbed, [✓ substantially disturbed] - CATTLE

☐ Habitat suitable for nesting snowy plover ☐ Habitat suitable for nesting American avocet

☐ Habitat suitable for nesting horned lark ☑ Habitat suitable for providing food and cover to wildlife

IMB GREASEWOOD

Vegetation (dominant species [overstory, understory, ground cover], *etc.*)::

Photo numbers:

Percent cover (estimated): 100-76% ☐, 75-51% ☑, 50-26% ☐, 25-1% ☐, no cover ☐

GREASEWOOD NW ANN GRASS (GRND COVER)

Reference Sampling Area Data Sheet (cont.)	Surveyor's name: J. CAVITT
Ref. Locale & Sampling Area: ~~SE~~ UPLAND SE SA015	Date & Time: 6/4/15 1'05p

Invertebrates (direct observations of species, signs of invertebrates [ant hills, molts, burrows], *etc.*):

Photo numbers:

BITING MIDGES

LOCUST

GRASS HOPPER

HARVESTER ANT

Birds (direct observations of species, abundance [general], singing/other behaviors, signs, presence of nests, *etc.* Where present, include information specific to American avocet, snowy plover, or horned lark):

Photo numbers:

MOCKINGBIRD (O, SONG)
MEADOW LARK (O, SONG)
LOGGERHEAD SHRIKE (O)
RAVEN (O)
RED-TAIL (O)

CHUKAR (SONG,

MOURNING DOVE (SONG, 2)
LARK SPARROW

HORN LARK – UP THE ROAD (SONG)
NONE OBSV

Mammals (direct observations of species, abundance [general], signs [scat, burrows], *etc.*):

Photo numbers:

BLACK-TAILED JACK RABBIT (OBS)

ATRIPLEX – ~~X~~ TH (TENTATIVE)

SM MAMM (BURROWS) EASTSIDE OF ROAD

BADGER (BURROW – OLD)

CATTLE

Reference Sampling Area Data Sheet (cont.)	Surveyor's name: J. CAVITT
Ref. Locale & Sampling Area: UPL SE SA015	Date & Time: 6/4/15 1:05p

Additional notes (if needed):

REPTILE

LIZ (UNKNOWN - LOOK UP)

PHOTOGRAPHIC LOCATION INFORMATION

Ref. Locale & Sampling Area: UPL SE SA 015

Surveyor's name: ______

Date and Time: 6/4/15 1:05p

Photo Number Series: ______

Photo Location

Latitude: ______ Longitude: ______

Four Cardinal Positions (photos taken rotating clockwise, in sequence (N, S, E, W), from the same orientation, zoom level, and distance from the ground)

Photo Number (North) : 100 - 0075

Photo Number (South): 100 - 0073

Photo Number (East): 100 - 0074

Photo Number (West): 100 - 0076

Describe and photo document important features, disturbance, species, or evidence of animal activity.

Photo #	Description

Ref. Locale & Sampling Area: ______

Attachment B
Background Reconnaissance Survey Photographs

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Bear River Migratory Bird Refuge

SA-001

North

East

South

West

Photo 100-005. O-line canal near SA-001.

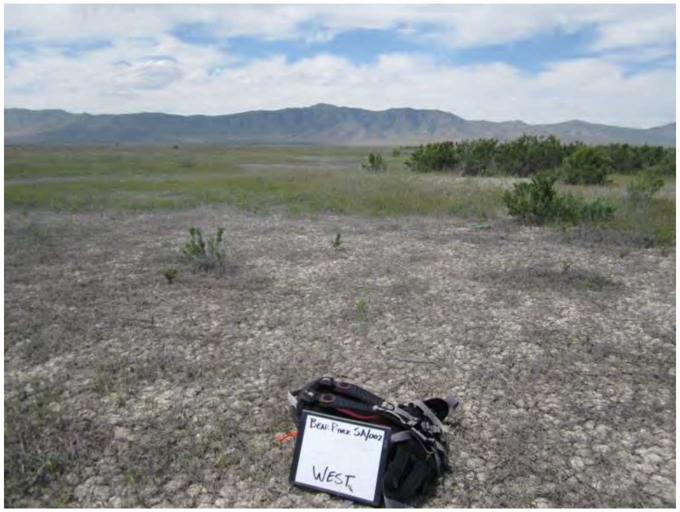
Bear River Migratory Bird Refuge

SA-002

North

East

South



West

Bear River Migratory Bird Refuge

SA-003

North

East

South

West

Upland South

SA-004

North

East

South

West

Photo 100-0019. Small mammal burrows near SA-004.

Photo 100-0020. Sparrow nest with two eggs at SA-004.

Upland South

SA-005

North

East

South

West

Lakebed South

SA-006

North

East

South

West

Photo 100-0029. Berm roadway south of SA006.

Lakebed South

SA-007

North

East

South

West

Lakebed South

SA-008

North

East

South

West

Photo 100-0039. Badger burrow at SA008.

Photo 100-0039. Badger prints at SA008.

Upland North

SA-009

North

East

South

West

Upland North

SA-010

North

East

South

West

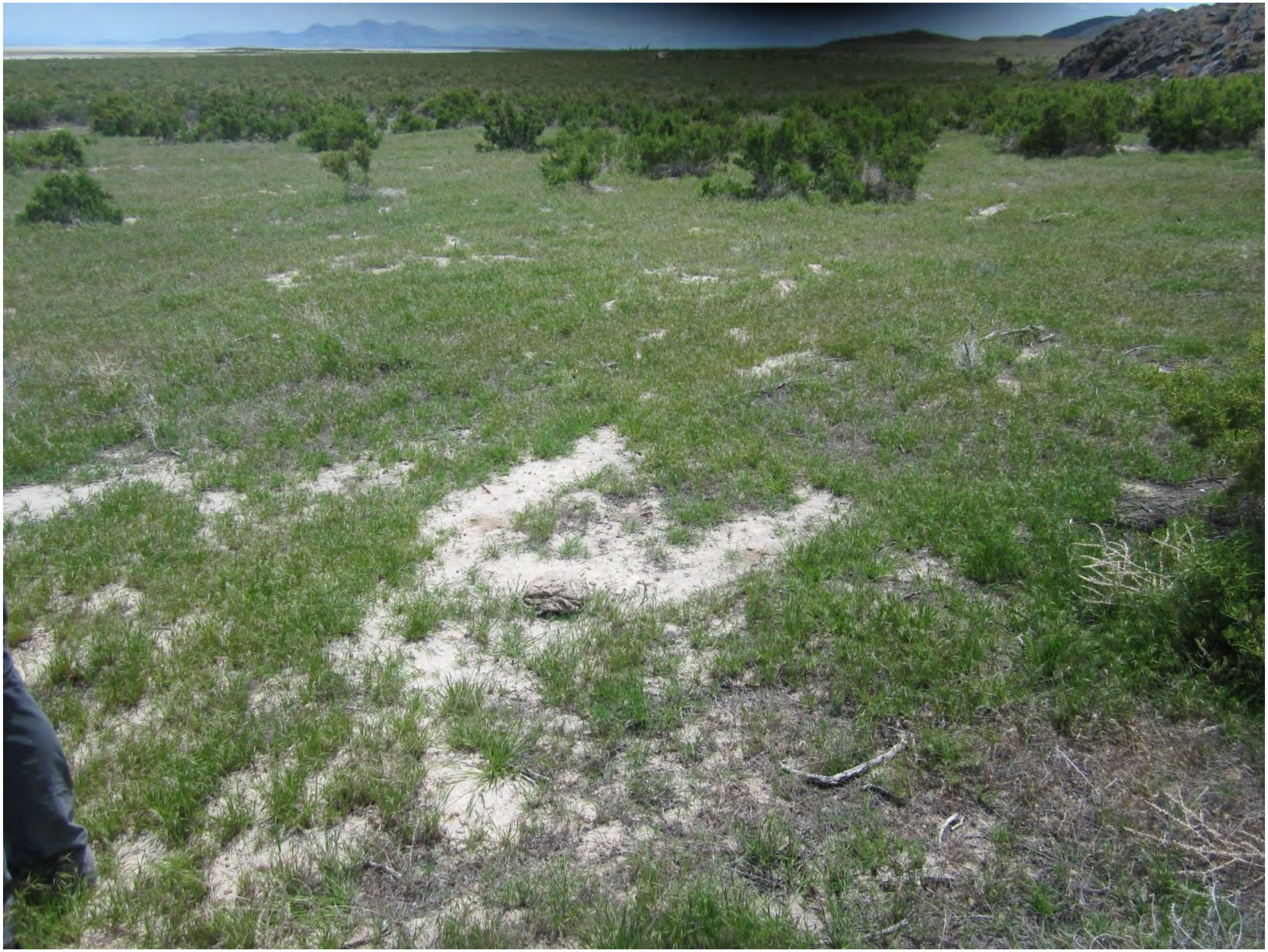


Photo 100-0050. Typical ground condition at SA010.

Lakebed North

SA-011

North

East

South

West

Photo 4115. Snowy plover nest and egg at SA-011.

Photo 100-0056. Water feature east of SA-011.

Photo 100-0057. Water feature east of SA-011.

Lakebed Southeast

SA-012

North

East

South

West

Photo 100-0064. ***Phragmites*** **north of the road to Badger Island.**

Lakebed Southeast

SA-013

North

East

South

West

Lakebed Southeast

SA-014

North

East

South

West

Lakebed Southeast

SA-015

North

East

South

West

Attachment C
VSP Systematic Grid

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VSP had difficulty accommodating sampling areas at angles or that are oddly shaped. Instead, VSP overlays a uniform grid on the sampling areas. The grid is restricted such that the axes are aligned north-south-east-west. Grid squares generated to [a] minimize the number of squares needed to completely cover the sampling area, while [b] maximizing the amount of sampling area captured by each grid square. VSP then selects grid squares at random locations, equivalent to the user-defined number of samples to be collected from the area. One sample is placed at random inside the portion of the grid square that includes the sampling area.

Hence, in each Upland and Lakebed sampling area, a background sampling location was located in each of ten (10) grid boxes. In the BRMBR area, a background sampling location was located in each of five (5) grid boxes.

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Attachment D

Background Sample Location Coordinates

Background Sampling Area	Location (a)	UTM Zone 12 NAD 1983		Utah State Plane Central		Sample Type**	Location Basis	Analytical Group (b)
		m N	m E	X feet	Y feet			
Upland North (SA010)	UPN-1	4540070	344098	1266734	7534738	SS	Grid	A
	UPN-2	4539988	344201	1267074	7534474	SS	Grid	B
	UPN-3	4539856	344137	1266868	7534037	SS	Grid	A
	UPN-4	4539897	344393	1267707	7534178	SS	Grid	B
	UPN-5	4539708	344239	1267205	7533554	SS	Grid	A
	UPN-6 *	4539744	344439	1267861	7533676	SS / SB	Grid	C
	UPN-7	4539618	344377	1267660	7533261	SS	Grid	B
	UPN-8	4539589	344525	1268145	7533171	SS	Grid	A
	UPN-9	4539678	344638	1268514	7533465	SS	Grid	B
	UPN-10	4539418	344653	1268567	7532610	SS	Grid	B
Upland South (SA007)	UPS-1	4518159	354646	1301781	7463051	SS	Grid	B
	UPS-2	4518366	354756	1302136	7463731	SS	Grid	B
	UPS-3	4518209	354863	1302493	7463217	SS	Grid	A
	UPS-4	4518096	354927	1302703	7462849	SS	Grid	B
	UPS-5	4518316	354993	1302916	7463570	SS	Grid	A
	UPS-6 *	4518197	355148	1303428	7463183	SS / SB	Grid	C
	UPS-7	4518258	355266	1303813	7463387	SS	Grid	A
	UPS-8	4518068	355347	1304084	7462764	SS	Grid	B
	UPS-9	4518287	355454	1304431	7463486	SS	Grid	B
	UPS-10	4518229	355489	1304545	7463295	SS	Grid	A

Background Sampling Area	Location (a)	UTM Zone 12 NAD 1983		Utah State Plane Central		Sample Type**	Location Basis	Analytical Group (b)
Upland Southeast (SA015)	UPSE-1	4524867	370357	1353205	7485369	SS	Grid	B
	UPSE-2	4524870	370518	1353732	7485382	SS	Grid	A
	UPSE-3	4525005	370378	1353269	7485821	SS	Grid	B
	UPSE-4	4525017	370491	1353643	7485864	SS	Grid	A
	UPSE-5 *	4525120	370253	1352860	7486197	SS / SB	Grid	C
	UPSE-6	4525121	370437	1353461	7486206	SS	Grid	B
	UPSE-7	4525312	370219	1352742	7486827	SS	Grid	A
	UPSE-8	4525278	370359	1353204	7486718	SS	Grid	B
	UPSE-9	4525224	370483	1353612	7486543	SS	Grid	A
	UPSE-10	4525344	370456	1353519	7486935	SS	Grid	B
Lakebed North (SA011)	LBN-1	4543644	343718	1265414	7546461	SS	Grid	A
	LBN-2	4543686	343856	1265869	7546599	SS	Grid	B
	LBN-3	4543718	344211	1267032	7546714	SS	Grid	A
	LBN-4	4543677	344406	1267672	7546582	SS	Grid	B
	LBN-5	4543706	344629	1268404	7546682	SS	Grid	A
	LBN-6 *	4543694	344783	1268909	7546646	SS / SB	Grid	C
	LBN-7	4543616	344950	1269460	7546393	SS	Grid	A
	LBN-8	4543674	345291	1270577	7546589	SS	Grid	B
	LBN-9	4543688	345686	1271874	7546644	SS	Grid	B
	LBN-10	4543617	345889	1272540	7546416	SS	Grid	B
Lakebed Southeast (SA013)	LBSE-1	4532833	364999	1335465	7511406	SS	Grid	B
	LBSE-2	4532836	365154	1335974	7511418	SS	Grid	A
	LBSE-3	4532861	365281	1336391	7511504	SS	Grid	B
	LBSE-4	4532893	365531	1337209	7511614	SS	Grid	A
	LBSE-5	4532947	365750	1337929	7511794	SS	Grid	B
	LBSE-6	4532934	365881	1338358	7511756	SS	Grid	A
	LBSE-7 *	4532874	366288	1339696	7511565	SS / SB	Grid	C
	LBSE-8	4532904	366527	1340478	7511669	SS	Grid	A
	LBSE-9	4532791	366809	1341406	7511305	SS	Grid	B
	LBSE-10	4532738	367096	1342349	7511135	SS	Grid	B

Background Sampling Area	Location (a)	UTM Zone 12 NAD 1983		Utah State Plane Central		Sample Type**	Location Basis	Analytical Group (b)
Lakebed Southeast at Badger Island (SA014)	LBB-1	4534074	367528	1343740	7515529	SS	Grid	B
	LBB-2	4534090	367687	1344261	7515585	SS	Grid	A
	LBB-3	4534223	367840	1344761	7516023	SS	Grid	B
	LBB-4	4534145	367972	1345197	7515769	SS	Grid	A
	LBB-5	4534041	368207	1345970	7515434	SS	Grid	B
	LBB-6	4533876	368442	1346745	7514897	SS	Grid	A
	LBB-7 *	4533740	368535	1347050	7514452	SS	Grid	C
	LBB-8	4533520	368744	1347743	7513735	SS	Grid	A
	LBB-9	4533309	368929	1348354	7513046	SS	Grid	B
	LBB-10	4533129	369101	1348921	7512458	SS	Grid	B
Bear River Migratory Bird Refuge (SA003)	BR-1	4596253	386500	1404772	7719985	SS	Grid	B
	BR-2	4596167	386897	1406078	7719712	SS	Grid	B
	BR-3 *	4596193	387281	1407336	7719803	SS	Grid	C
	BR-4	4596433	387625	1408460	7720599	SS	Grid	B
	BR-5	4596956	387762	1408900	7722318	SS	Grid	B

Notes:

* Denotes location for subsurface screening sample

** Sample Type
SS = background surface soil (0-2″ bgs) sample
SB = background subsurface soil (2″-36″ bgs) sample

(a) Sampling locations are shown in Figures 4 through 8 for background sampling areas.

(b) Analytical groups include the following:

Group A = Surface solids analyzed for metals and pH.

Group B = Surface solids analyzed for: metals, organics (polychlorinated biphenyls, polychlorinated dibenzo-p-dioxins / dibenzofurans, and hexachlorobenzene), pH, and total organic carbon.

Group C = Surface solids analyzed for: metals, organics (polychlorinated biphenyls, polychlorinated dibenzo-p-dioxins / dibenzofurans, and hexachlorobenzene), pH, and total organic carbon; subsurface solids analyzed for metals and organics.