# Airport West VCP - Phase I Area
# REMEDIAL ACTION PLAN

Presented to the Utah State Department of Environmental Quality • July 2022

**NT DEVELOPMENT, LLC • 1700 SOUTH 4650 WEST • SALT LAKE CITY, UTAH 84104**

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# 1.0 EXECUTIVE SUMMARY

This Remedial Action Plan (RAP) has been prepared for the initial phase of the North Temple Landfill (NTL) clean-up effort identified as Phase I. The NTL is a closed municipal landfill that was operated by Salt Lake City Corporation between 1959 and 1979. During its operation waste was deposited in shallow trenches and when filled, covered with native soil. Since the time that the landfill operations ceased, the waste that was originally deposited within the cells has undergone decomposition and has, in certain cells, interacted with water that has infiltrated into the cells to form leachate. The decomposing waste and the corresponding leachate together create the “source” of potential contamination to the soil and groundwater within the site itself and the adjacent property’s groundwater.

The intent of this RAP is to effectuate the remedy to minimize these potential risks through; (1) the removal of the source material by excavating the waste from the cells and evacuating the standing leachate from the cell bottoms, (2) reconsolidating the waste within a new on-site repository that incorporates a modern engineered repository cap, (3) the evaporation, treatment and appropriate disposal of the collected leachate, (4) the establishment of a groundwater monitoring program for the area including and surrounding Phase I as well as the entire site and (5) the establishment of environmental covenants within a site management plan which will incorporate a post O&M plan to guide the future development of the property.

## 1.1 SITE HISTORY

As mentioned above, Phase I is part of the 770-acre North Temple Landfill site that was operated as a trench landfill. The landfill operation began in the eastern portion of the landfill and moved west as the landfilling operation extended across the site. During the life of the landfill, the site received the majority of Salt Lake City’s municipal waste stream. This waste stream consisted primarily of household municipal waste, commercial waste and construction debris.

In the late 1970’s the LDS Church received a grant of a large tract of land in Salt Lake City’s northwest quadrant which included the land that was then being utilized by Salt Lake City for the landfill. After Salt Lake City closed the landfill in 1979, the site lay fallow. Since the closing of the landfill, numerous studies were performed at the landfill to understand the nature of potential contamination and possible clean up alternatives to return the land back into productive use. One of the most extensive studies was performed by Suburban Land Reserve (SLR, an entity of the LDS Church). That study, in addition to supplementing environmental data for site, evaluated possible alternative approaches to remove the waste from the site and transport the waste to an offsite disposal location. The transportation road impacts, and safety considerations associated with transporting the waste off-site combined with the economic realities of such an undertaking eliminated offsite disposal as a viable option to reclaim the old landfill.

In 2017 Utah’s State Institutional Trust Land Administration (SITLA) obtained title from SLR to a 770-acre parcel (the Property) that encompasses the footprint of the old landfill. The plan has been to redevelop the Property and enhance the Trust Fund for its stated beneficiaries (Permanent School Fund). The proposed plan is to have SITLA clean-up the landfill under a brownfield development concept whereby the landfill would be remediated in a series of phases with waste being consolidated on-site to allow for future development. These remediation efforts will be undertaken in close coordination with Utah Department of Environmental Quality (UDEQ) Division of Environmental Response & Remediation (DERR) under their Voluntary Cleanup Program (VCP), in a similar mode as the Site Characterization efforts have been performed to date. Information regarding the project can be found on DERR's website under the names Airport West and North Temple Landfill.

## 1.2 REMEDIAL ACTION PLAN

This RAP sets forth the details of the means and methods to be utilized in this initial Phase of the landfill clean-up. As identified in recent site characterization reports, the waste within Phase I is relatively shallow with minimal leachate. To date, there have been over one hundred investigative sample locations established and utilized (wells, test pits, soil borings) across the landfill and adjacent properties in an effort to characterize the nature of the waste cells, groundwater and soil conditions. In addition, the most recent Phase I Area Site Investigation was developed with UDEQ to provide specific additional site condition information to be utilized to produce the remedial designs and approaches for this initial clean-up phase. Similarly, additional characterization studies will be performed to support the development of subsequent phases of the landfill remediation.

As stated above, the waste within the Phase I area is relatively shallow and contains minimal leachate within the cells. These factors support beginning the landfill clean-up efforts in this location as it permits the applicant as well as UDEQ an opportunity to refine the remediation means and methods in an area of the landfill that is less complicated. The in-field experiences can then be evaluated, critiqued and modified as appropriate for later phases of the clean-up in areas where the waste may be deeper and with the presence of more leachate. The "Phase I Area" also includes the repository for Phase I which will incorporate the area identified as the Bonneville Pile. The Bonneville Pile contains waste that was previously relocated from the former NTL East Landfill (waste was removed to allow for development within the Salt Lake International Center) under an approved plan with UDEQ which conforms with this current waste consolidation approach. The Bonneville Pile, which is a 50/50 mix of soil and dry waste will be screened (and soil reclaimed) prior to being incorporated into the new repository.

In addition to the means and methods to be utilized for the Phase I clean-up efforts, this RAP also identifies the environmental safeguards that will be implemented. While the landfill is located in a relatively remote location away from sensitive receptors, odor control measures have been incorporated into the plan to minimize effects from the active waste excavation as well as the waste placement within the repository. Odor monitoring stations across the balance of the Property have also been established to provide the required feedback and allow for any necessary modifications to the field activities. The groundwater in the area of the site is classified as a Class 4 groundwater, due to its high salinity content and limited beneficial use. However, the RAP incorporates multiple components that are specifically designed to minimize future impacts on the site and the surrounding area groundwater. Leachate currently existing in the bottom of the waste cells will be collected, evaporated and treated prior to offsite disposal. The development of a new repository for Phase I, incorporating a modern landfill impermeable cap, will eliminate the further generation of leachate from precipitation infiltration into the newly consolidated waste while addressing stormwater management requirements. As subsequent phases of the landfill remediation are advanced, additional groundwater impact mitigation methods will be evaluated including a physical barrier on the western boundary of the landfill to help minimize off-site migration of impacted groundwater. Other means and procedures to control site access, impacts on wildlife, fugitive dust or other air quality impacts are detailed in the report sections to follow. **In addition, each of the figures contained within the text of this report is presented in full format in Appendix A of this report and are identified in a consistent manner as the same figure number**.

This Remedial Action Plan has been developed as part of the Voluntary Cleanup Program (VCP) administered by UDEQ's Division of Environmental Response and Remediation (DERR). The Program was created to promote the voluntary cleanup of contaminated sites encouraging the redevelopment of Brownfield sites back into productive use. While SITLA had no involvement in the waste previously being disposed of in the landfill, upon obtaining title to the property, SITLA entered the VCP program and began to undertake the additional site characterization studies requested by DERR. Those studies, which helped formulate the remedial approaches set forth in the RAP, can be found on DERR's website under the project's name "Airport West VCP" and "North Temple Landfill". Prior to initiating the proposed clean up under this RAP, public participation is encouraged through a 30-day public comment period. The public notice will be placed in a local paper and communicated directly with the adjacent landowners and various stakeholders that have shown an interest in this project and which SITLA has maintained communication with over the past few years. A copy of the proposed public notice can be found in **Appendix D-3**.

# 2.0 DESCRIPTION OF REMEDIAL INVESTIGATION FINDINGS

## 2.1 SITE LOCATION AND DESCRIPTION

### 2.1.1 North Temple Landfill

The North Temple Landfill is located between downtown Salt Lake City and the Great Salt Lake, along US Interstate 80 (I-80) on the North Temple Frontage Road approximately 6100 West and 7500 West, within the northwest portion of Salt Lake County, Utah **(Figure 1/Appendix A-1)**. The Property is approximately 770 acres in area. The property encompasses the former landfill which occupies approximately 660 acres. NTL is a closed municipal landfill that was operated by Salt Lake City Corporation from 1959 until 1979. The topography of the landfill is relatively flat, with mounding and depressions due to trenching cell construction and varying landfill practices during operation.

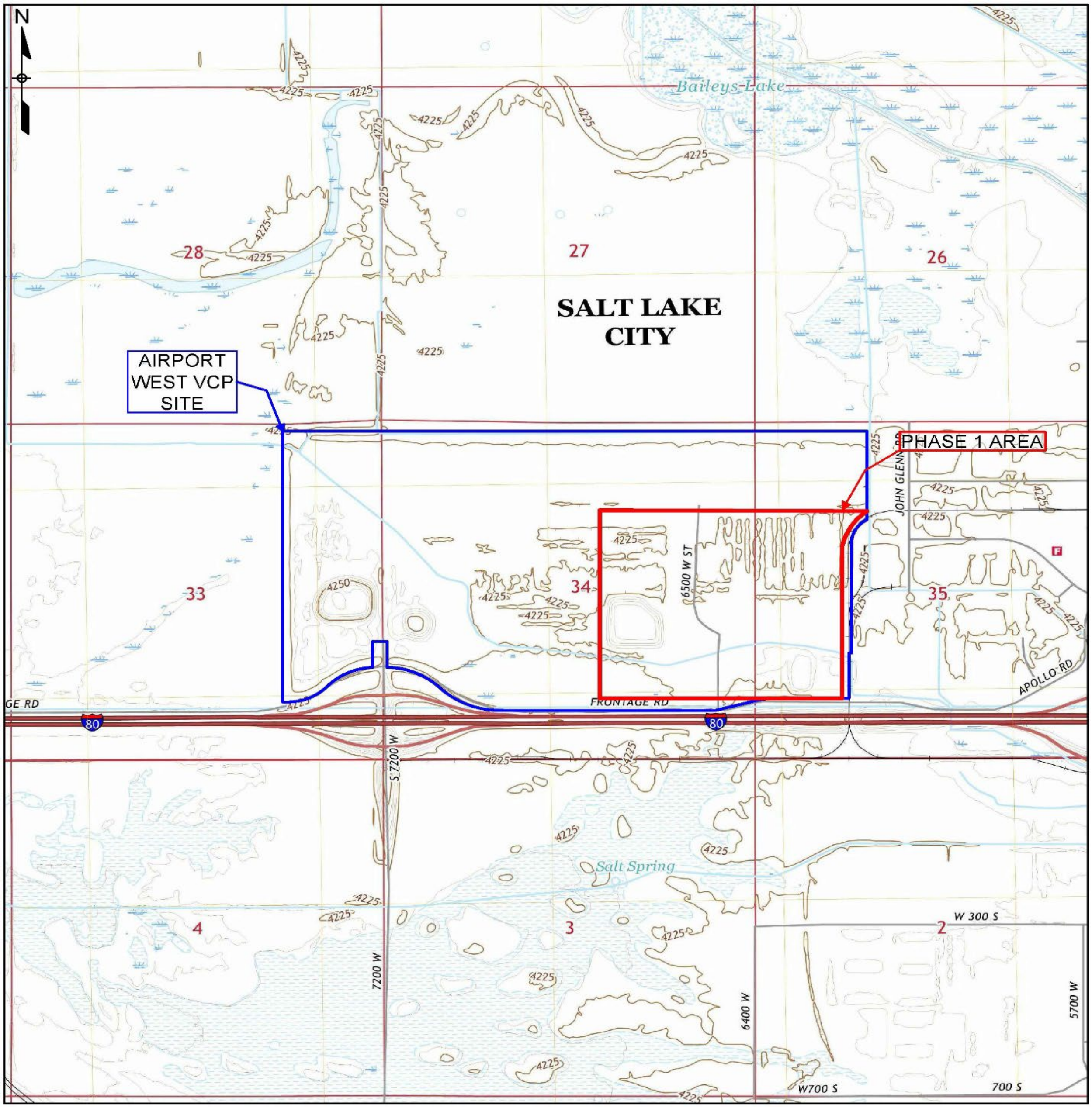


*Figure 1 – Site Location (See Also Appendix A-1)*

### 2.1.2 Phase I Remediation Area

Phase I of the landfill remediation, and the subject of this RAP, is located in the southeast corner of the Property **(Figure 2/Appendix A-2)**. The Phase I designation includes three distinct areas; (1) 130 acres of the former landfill operation containing buried Municipal Solid Waste (MSW), (2) 45 acres south of the Brighton Canal which does not contain MSW and (3) 41 acres upon which the new repository will be constructed and receive the waste excavated out of the 130 acres identified above. As discussed in more detail in the following sections of the report, the MSW within the waste cells in Phase I is relatively shallow, between three and six feet deep, with minor quantities of leachate in the cell bottoms. Portions of the area south of the Brighton Canal, while not containing MSW, does have some lead shot contamination from a former sporting clay operation which will also be addressed as part of this RAP.

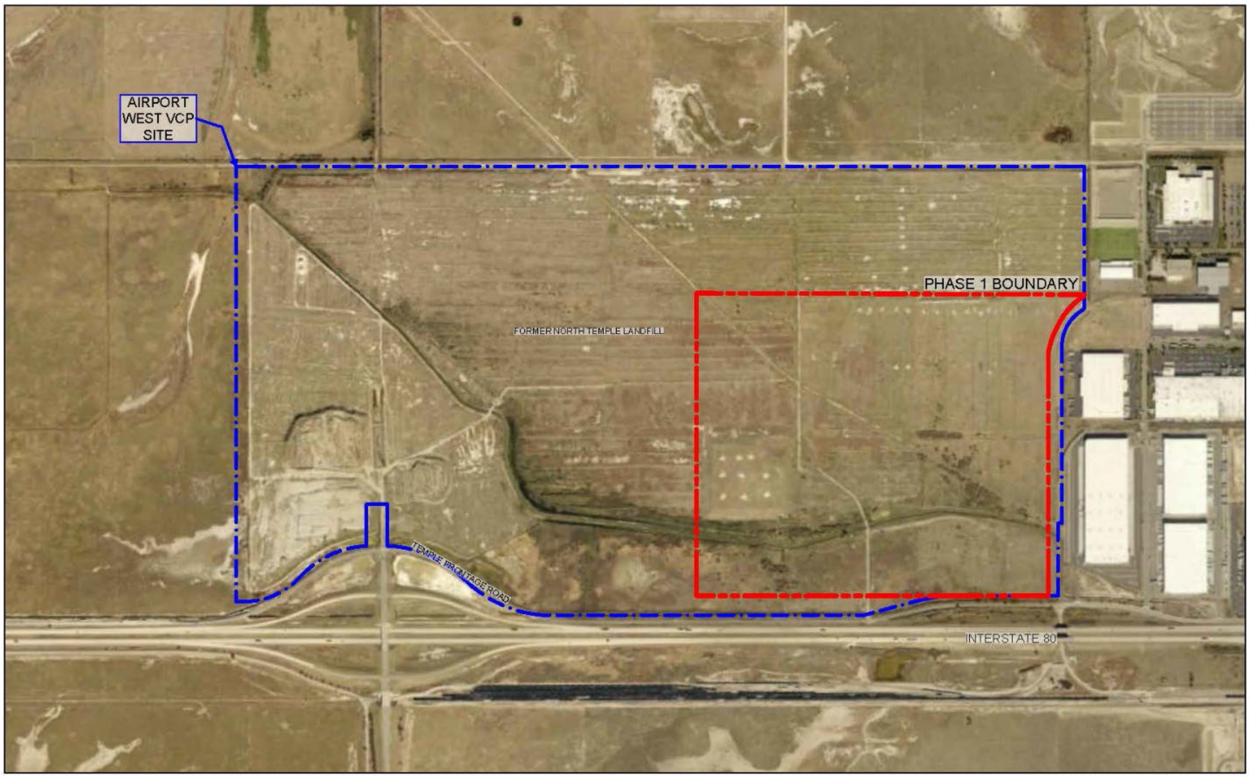


*Figure 2 – Phase I Location Boundary (See Also Appendix A-2)*

## 2.2 SUMMARY OF REMEDIAL INVESTIGATIONS

### 2.2.1 Waste Composition and Depth of Waste

Waste depths across the Phase I area of the landfill as well as the period of time the waste was deposited there vary slightly. The depth of waste ranges from 3 to 6 feet with the cover material overlaying the waste averaging 1.5 feet. The original waste cell preparation in most areas within Phase I has the bottom of the cells corresponding slightly above the local elevation of the surrounding groundwater. Waste deposited in Phase I during the era of 1959-1963 was placed in relatively shallow trenches. These trenches were likely dug with a dozer or dragline leaving a native soil levee in-place between each successive trench functioning as a cell wall **(Figure 3/Appendix A-3)**.

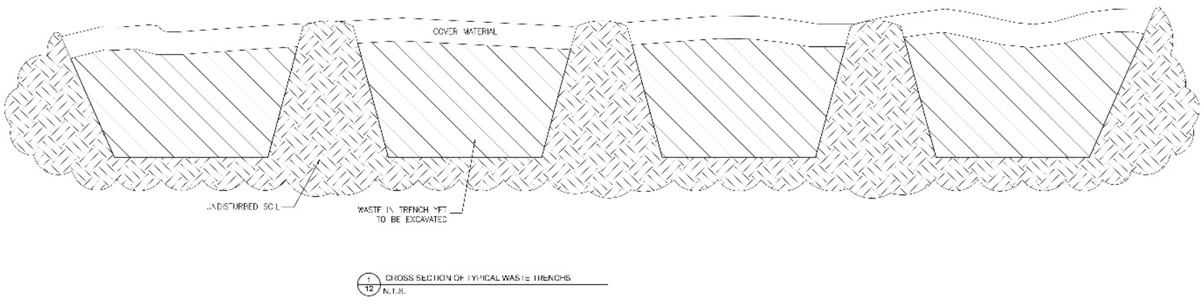


*Figure 3 – Typical Trench Cell Cross Section (See Also Appendix A-3)*

Actual records of waste accepted during the City's operation of the NTL are limited and, as such, the available waste composition data has been developed through exploratory excavations undertaken by means of several studies throughout the years. Within the Phase I area, waste constituents have been identified mainly as typical household municipal waste products including tires, wood debris, soils, plastics, paper, glass, cardboard, rubble and other unrecognizable decomposed materials. While a significant number of tires have been identified during the test pitting efforts, other suspect/special waste has been minimal or non-existent.

Among the data recorded in the most recent field investigation activities as a part of the expanded subsurface investigation performed in September of 2021, the following table provides a detailed summary of test pit excavation data including the visual characteristics of the waste in each test pit, the measured cover material, waste profile, depth to water and overall depth of each test pit located within the Phase I area **(Table 1)**. An aerial graphic depicting the location of each of the test pits labeled with each corresponding Test Pit ID number within this area of the landfill are identified on **Figure 4/Appendix A-4**.

| TEST PIT ID | VISUAL WASTE CHARACTERISTICS | | | | | | | MEASURED DATA | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | PLASTICS | TIRES | WOOD | GLASS | PAPER | METALS | OTHERS | COVER MATERIAL (FT) | WASTE PROFILE (FT) | DEPTH TO WATER (FT) | OVERALL DEPTH (FT) |
| TP-RR10 | 0% | 0% | 25% | 20% | 0% | 0% | 55% | 2 | 4 | N/A | 6 |
| TP-RR11 | 10% | 10% | 30% | 10% | 20% | 0% | 20% | 2.5 | 4 | 6.5 | 6.5 |
| TP-RR12 | 25% | 10% | 25% | 10% | 20% | 0% | 10% | 2.5 | 2.5 | N/A | 5 |
| TP-RR13 | 5% | 10% | 25% | 30% | 20% | 0% | 5% | 1.5 | 3 | N/A | 4.5 |
| TP-RR14 | 10% | 5% | 25% | 40% | 10% | 0% | 10% | 1 | 2.5 | N/A | 3.5 |
| TP-RR15 | 10% | 5% | 25% | 40% | 10% | 0% | 10% | 1 | 3 | N/A | 4 |
| TP-RR16 | 10% | 5% | 10% | 30% | 25% | 0% | 20% | 1.5 | 3 | N/A | 4.5 |

*Table 1 – Test Pit Excavation Results – Phase I Area – September 2021*

| TEST PIT ID | IN-FIELD COMMENTS/NOTES |
|---|---|
| TP-RR10 | Black charcoal looking waste here. No plastics and very little municpal waste. Mostly C&D debris with bricks and concrete. Very odorous waste. No water here even below the clay layer. |
| TP-RR11 | Water was barely seeping in at the bottom. The waste is black and rusty brown in color. Odorous waste. Some oily sheen at the bottom. Mostly decomposed indiscernible waste but includes wood, paper, glass. |
| TP-RR12 | Dark brown colored waste looking more like traditional MSW. Waste is wet at the bottom of the cell, but very little water. The waste is more damp than wet. Waste is somewhat odorous. |
| TP-RR13 | Rusty brown colored waste and a lot of glass bottles here. Waste is significantly decomposed. Very little odor. No water encountered even below the clay bottom. |
| TP-RR14 | Waste is rusty brown in color. Black clay on the bottom of the cell. The waste is mostly decomposed. Almost no water encountered only a small amount beyond the clay bottom. |
| TP-RR15 | The waste is rusty brown in color, similar to other test pits in the area. The waste is mostly decomposed and somewhat damp at the bottom. No odor. No water at bottom or beyond the clay layer. Dark clay on bottom. |
| TP-RR16 | Shallow cover material. The waste is rusty brown in color. Highly decomposed waste. Mostly glass bottles and paper. No odor. No water. |

*Table 1 – Test Pit Excavation Results – Phase I Area – September 2021 (cont.)*

### 2.2.2 Site Groundwater Level and Gradients

Based on results from previous studies, the direction of localized shallow groundwater flow within the Phase I area of the landfill has been shown to have a northerly direction. The direction and gradients within this area are consistent with the surrounding regional areas. The shallow lower profile of waste cells in Phase I have less impact on the underlying groundwater direction than the western portion of the Site. Review of the previous data from groundwater wells surrounding the landfill indicates regional groundwater flow is to the North.

Based upon the most recent data collected, groundwater flow direction in the Phase I area of the Site is toward the North-Northwest with a gradient of approximately .0011 feet/foot measured between NTL-GW10 and NTL-GP69. The gradients along the western boundary of the NTL Site are four to six times higher than those on the eastern area of the Site, encompassing the Phase I area. The direction and gradients on the eastern area of the Site appear to be more indicative of the surrounding regional areas. Site groundwater gradient flows for the Phase I area can be seen in the following figure **(Figure 4/Appendix A-4).**

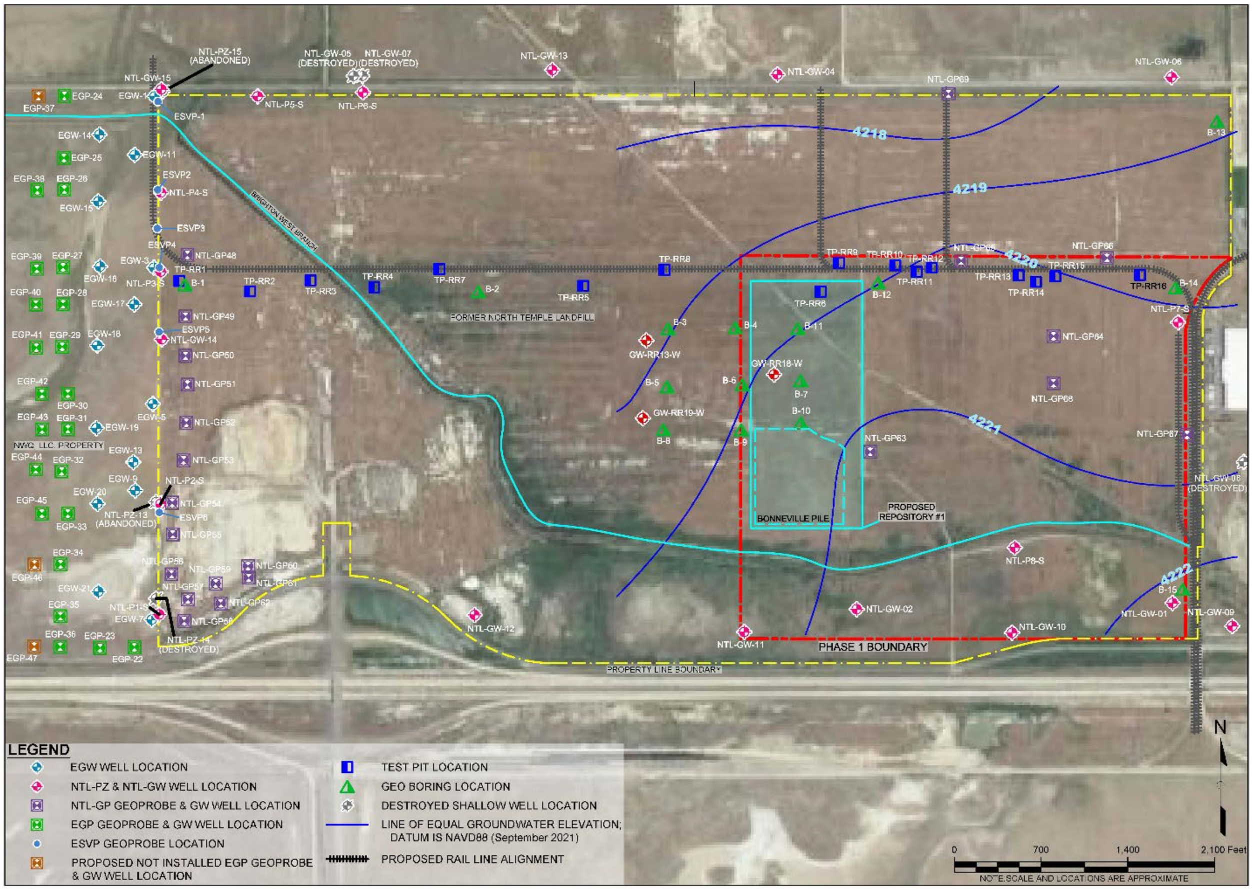


*Figure 4 – Phase I Groundwater Elevations & Testing Locations (See Also Appendix A-4)*

## 2.2.3 On-Site Groundwater Contamination

The western NTL Site is characterized by deeper, thicker and wetter MSW cells. The groundwater in the west area of the NTL is characterized as having more detections of constituents at the highest levels throughout the NTL Site. The east area of the NTL Site in particular the Phase I area is drier, shallow waste profiles with fewer constituents detected, and at the lowest levels throughout the NTL Site.

### *2.2.3.1 Investigation Well Groups*

A total of 70 well locations have been sampled as part of the overall characterization of the Airport West VCP for the NTL site (2018-2019). These are grouped in the following areas and are briefly described below in proximity to the Phase I area.

| | | |
|---|---|---|
| **PHASE I AREA** | Southeast Wells –Upgradient | **6-WELLS** |
| | Northeast Perimeter Wells – North and East Downgradient | **5-WELLS** |
| | Phase I Area Wells – Interior Source | **9-WELLS** |
| **SOUTH WEST** | Southwest NTL Site Boundary Wells – West and South Cross gradient | **15-WELLS** |
| | Southwest NTL Offsite Wells - West Downgradient | **16-WELLS** |
| **NORTH WEST** | Northwest NTL Boundary Wells – West and North Cross gradient | **9-WELLS** |
| | Northwest NTL Offsite Wells – West Downgradient | **14-WELLS** |

***Phase I Southeast Wells (Upgradient) – 6 Wells***
The Southeast wells NTL-GW01; NTL-GW02; NTL-P8; NTL-GW09; NTL-GW10 and NTL-GW11 are hydrologically upgradient of the landfill waste cells. These wells are grouped together and are considered upgradient wells to the underlying groundwater at the Site.

***Phase I Northeast Boundary Wells (Perimeter and Off-site Downgradient) – 5 Wells***
The Northeast wells NTL-GW04; NTL-GW06; NTL-P7; NTL-GW13; and the 2019 Airport West VCP Expanded Subsurface Investigation (2019 ESI) well NTL-GP69 are hydrologically downgradient of the Phase I area and located along the north and east boundary of the former landfill. These wells are grouped together and are considered perimeter downgradient wells to the shallower older waste cells associated with the Phase I area and downgradient from the Phase I area wells. See **Figure 4/Appendix A-4**.

***Phase I Interior Wells (Phase I Development Area) – 9 Wells***
A group of six wells which were installed during the 2019 ESI are the wells in the area described as the Phase I area wells. These are NTL-GP63 through NTL-GP68 and are located in the north half of the Phase I area, within the eastern area of former waste cells. Also, three new GW monitoring wells were installed and sampled during the 2021 Airport West VCP Phase I Subsurface Investigation (2021 Phase I SI), (GW-RR13, RR18 and RR19). These were located in the general area being proposed for a new repository waste cell for the Phase I area. See **Figure 4/Appendix A-4**. Seven of these Phase I area interior wells were sampled in the 2021 Phase I SI (NTL63, 65-67) and the three new wells (GW-RR13, RR18 and RR19).

***Southwest NTL Boundary Wells (Perimeter, Interior and Off-Site Downgradient) – 31 Wells***
These wells are all located west and cross gradient from the Phase I area. See **Figure 4/Appendix A-4**.

***Northwest NTL Boundary Wells (Perimeter, Interior and Off-Site Downgradient) – 23 Wells***
These wells are all located west and cross gradient from the Phase I area. Northwest boundary NTL Site well NTL-GP48 from this group was sampled during the 2021 Phase I SI. This well was included within the area of a future proposed railroad alignment which was sampled for soil, leachate and vapor during the 2021 Phase I SI. See **Figure 4/Appendix A-4**.

#### *2.2.3.2 Phase I Groundwater Analytical Results (2021 SI)*

The 2021 Phase I SI focused on the Phase I area of the landfill. Of the eight major analyte groups analyzed including dissolved metals, TDS, VOCs, SVOCs, TPH-GRO, TPH- DRO, TRPH, and PFAS, three of the groups were reported in well locations above their PSL, including dissolved metals, TDS, and VOCs. Based on the hydrogeologic gradient and flow direction, the furthest downgradient Site well NTL-GP69 exhibited PSL exceedances of TDS, As, 1,4 dioxane, 1-1,DCA and VC while the Phase I area wells did not report any PSL exceedances of 1-1,DCA or VC . While the contaminants of TDS, As and 1- 4,dioxane may exceed their respective PSLs in groundwater beneath the Phase I area, other regional environmental factors also exist that affect their presence, concentration, and distribution in both shallow and deeper regional water-bearing zones. A more in-depth discussion of the analytical testing/results can be found in the 2021 Phase I SI report.

### 2.2.4 Phase I Test Pit Investigation

As a part of the 2021 Phase I SI, nine test pits were excavated in the MSW located in the Phase I area (TP-RR6, TP-RR9 through TP-RR16). The test pits were excavated to observe and monitor the waste characteristics and moisture content of the waste cells. Ten samples were collected from the soil/waste matrix at the bottom of the waste profile. Samples of the leachate when present were collected for laboratory analysis. A leachate sample was collected and analyzed from the Phase I test pit where leachate was present. No TCLP analysis was performed based on the reported low total concentration ranges.

### 2.2.5 Test Pit Results – Air Monitoring

#### *2.2.5.1 Soil/Waste Vapor Gas Monitoring*

During excavation of the test pits located in the MSW cells, field monitoring of the soil/waste vapor gas was measured. A MultiRAE Five-Gas Monitor (multi-gas meter) with Advanced VOC Detection Capability, model PGM-6228 was used. Five gas parameters were monitoring during excavation and within the stockpiled soil/waste material. These parameters included hydrogen sulfide, methane, carbon monoxide, oxygen and volatile organic compounds. The test pits were continually monitored during the excavation and sampling process, with measurements recorded at spaced intervals. Test pit gas measurement readings were recorded between 2 to 5 times depending on the duration of the locations process time.

Two test pits (TP-RR10 and TP-RR11) were measured with average detections of $H_2S$ and VOCs above background. TP-RR10 was measured at 35.93 ppm for VOCs. TP-RR11 was measured at 1.1 ppm for $H_2S$.

#### *2.2.5.2 Field Olfactometer Measurement*

Half of the test pits were recorded as very weak to weak for odor measurements with the Nasal Ranger Field Olfactometer. Test Pit TP-RR12 was recorded as moderate. Test Pit TP-RR3 was recorded as strong and Test Pits TP-RR(10 and 11) were recorded as very strong. Tabular field olfactometer data is included in the field measurement section of the 2021 Phase I SI.

### 2.2.6 Test Pit Results – Analytical Testing

#### *2.2.6.1 Soil/Waste Solids Test Results*

Arsenic was the only solids result in the soil/waste matrix to report exceeding the PSL (3 mg/kg).

#### *2.2.6.2 Leachate Test Results – Metals*

The arsenic PSL (0.01 mg/L) was exceeded in the test pits sampled. With very little leachate present in the Phase I test pits, the sole location with an exceedance for the arsenic PSL was TP-RR11L with a concentration of 0.0178 mg/L. The cadmium PSL (0.005 mg/L) was reported as exceeded in the sole location of TP-RR11L with a concentration of 0.00519 mg/L.

#### *2.2.6.3 Leachate Test Results – VOCs*

Benzene was not exceeded in any of the leachate samples within the Phase I test pits. The Phase I TP-RR11 was reported exceeding the methylene chloride PSL with a concentration of 6.4 µg/L. The sole Phase I TP reporting exceeding the 1,4-dioxane PSL was TPRR11 with a concentration of 3.7 µg/L.

#### *2.2.6.4 Leachate Test Results – SVOCs*

The PSL for the SVOC of benzo(a)pyrene (0.2 µg/L) was exceeded in TP-RR11, at a concentration of 0.23 µg/L. No other PSL for SVOCs was exceeded in the Phase I test pits.

#### *2.2.6.5 Leachate Test Results – TDS*

The PSL for the Phase I area TDS (2,200 mg/L) was established to characterize the shallow groundwater within the Phase I area TDS compared to the upgradient groundwater quality. The PSL for TDS in the leachate should only be applied as a reference. It is assumed MSW leachate will be elevated in TDS values. There is little movement of the leachate and high contact with the decomposing waste material. The leachate TDS values can be useful when developing leachate treatment designs for the handling and disposal of the leachate during excavation of the waste and remediation of the landfill. The concentration of TDS was 26,000 mg/L in NTL-TP11.

### 2.2.7 Site Geotechnical Conditions

This site has been investigated using a variety of field exploratory methods over the last few decades. The subsurface condition can be generalized as ancient deltaic deposits primarily fine sands, silts and clays which are underlain by Pleistocene age Lake Bonneville lacustrine deposits.

The trench excavations for waste burial in Phase I were shallow (3-6 ft) and were normally terminated in silty clays. It is inferred that the depths were limited in many cases by the intersection of the trench bottom by shallow groundwater. The shallow groundwater zone is underlain by a lower aquifer, generally separated in the Phase I area by a deeper confining clay layer.

The soils expected to be encountered during the remedial action work will be silty clays in the bottom and sides of trenches.

The cross-section view of the site **(Figure 5/Appendix A-5)** is located along the proposed rail alignment from west to east and represents eight (8) Cone Penetrometer Test locations. The CPT logs are included (for expanded detail) from CPT locations CPT2, CPT4, CPT6, and CPT8 **(Figure 6/Appendix A-6)**. The generalized profile is shallow sand and silts, grading to deeper mixtures of clay to silty clay, interspersed with lenses of more permeable sands and silts occurring more frequently below 15 feet BGS.

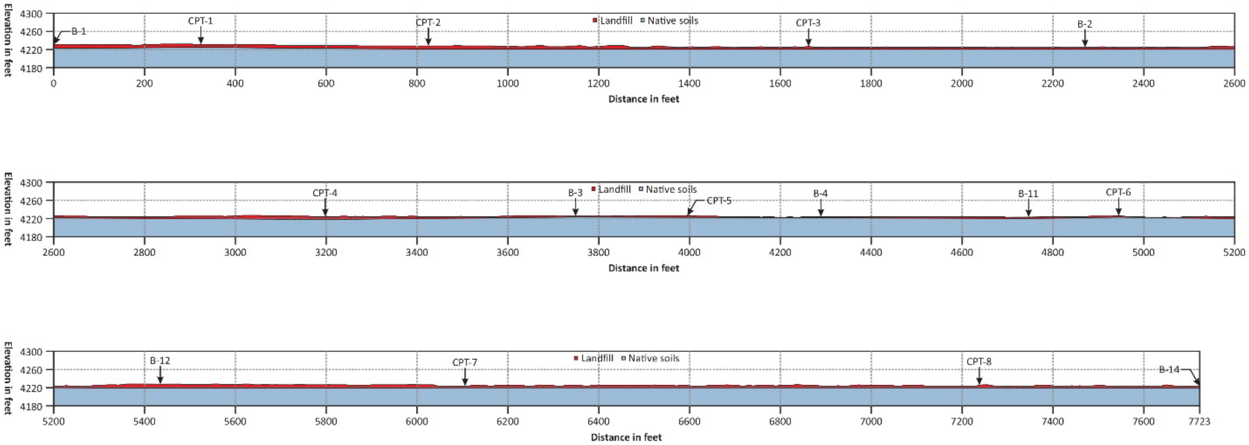
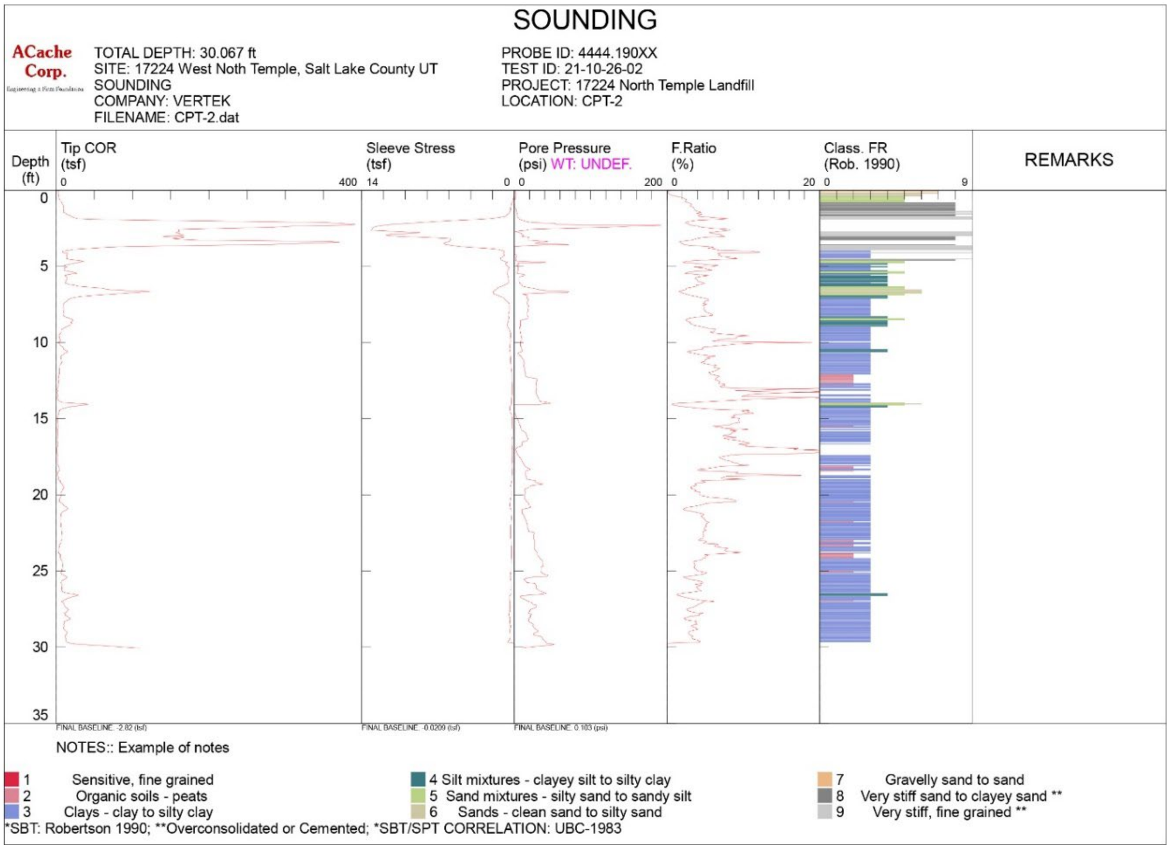


*Figure 5 – CPT Cross Section (See Also Appendix A-5)*



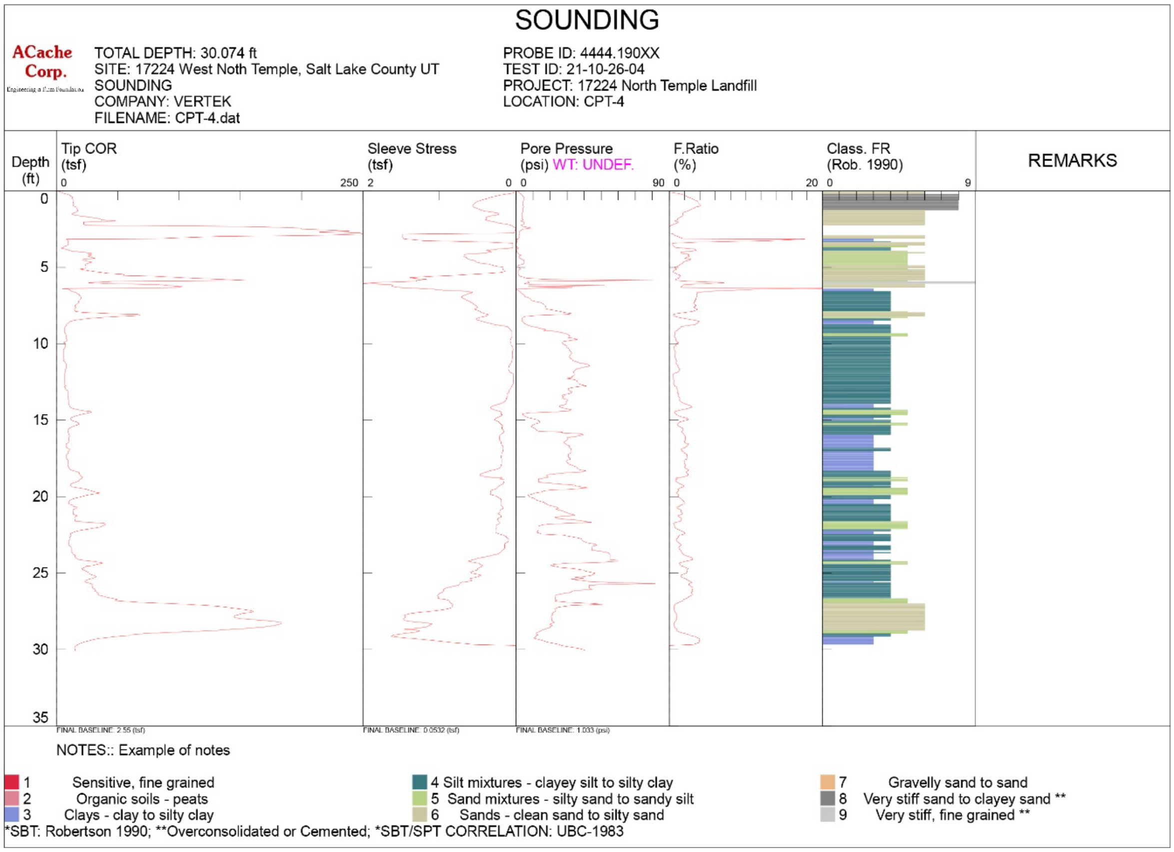


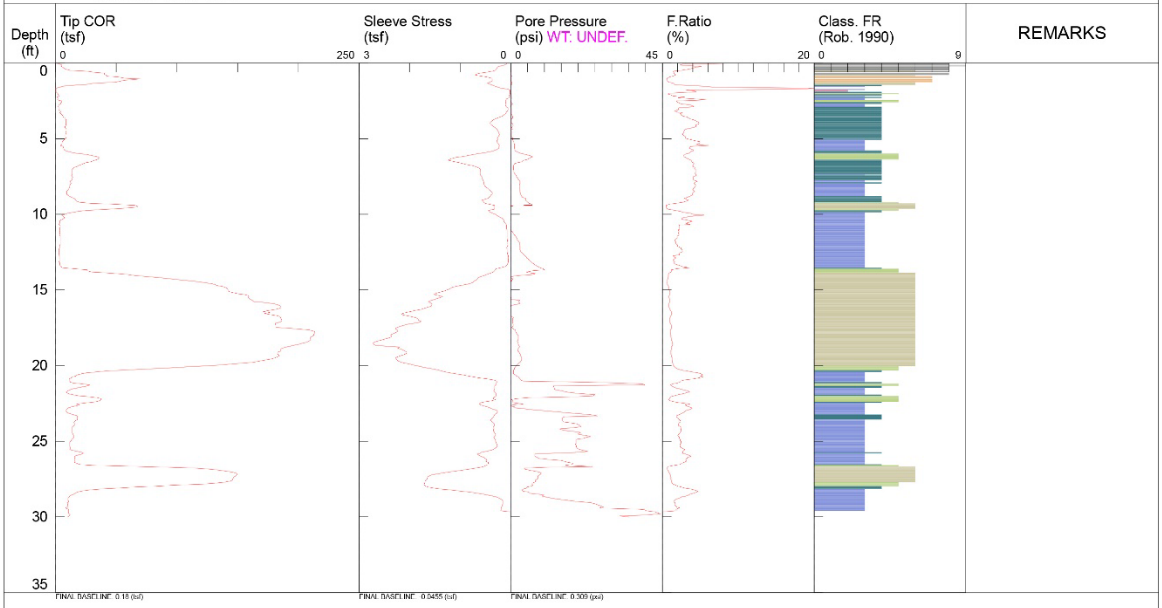
*Figure 6 – CPT Boring Logs (See Also Appendix A-6)*

## SOUNDING

**ACache Corp.**
Engineering & Firm Foundations

TOTAL DEPTH: 30.006 ft
SITE: 17224 West Noth Temple, Salt Lake County UT
SOUNDING
COMPANY: VERTEK
FILENAME: CPT-6.dat

PROBE ID: 4444.190XX
TEST ID: 21-10-27-01
PROJECT: 17224 North Temple Landfill
LOCATION: CPT-6



NOTES:: Example of notes

🟥 1 Sensitive, fine grained
🟥 2 Organic soils - peats
🟦 3 Clays - clay to silty clay
🟦 4 Silt mixtures - clayey silt to silty clay
🟩 5 Sand mixtures - silty sand to sandy silt
🟫 6 Sands - clean sand to silty sand
🟧 7 Gravelly sand to sand
⬛ 8 Very stiff sand to clayey sand **
⬜ 9 Very stiff, fine grained **

*SBT: Robertson 1990; **Overconsolidated or Cemented; *SBT/SPT CORRELATION: UBC-1983

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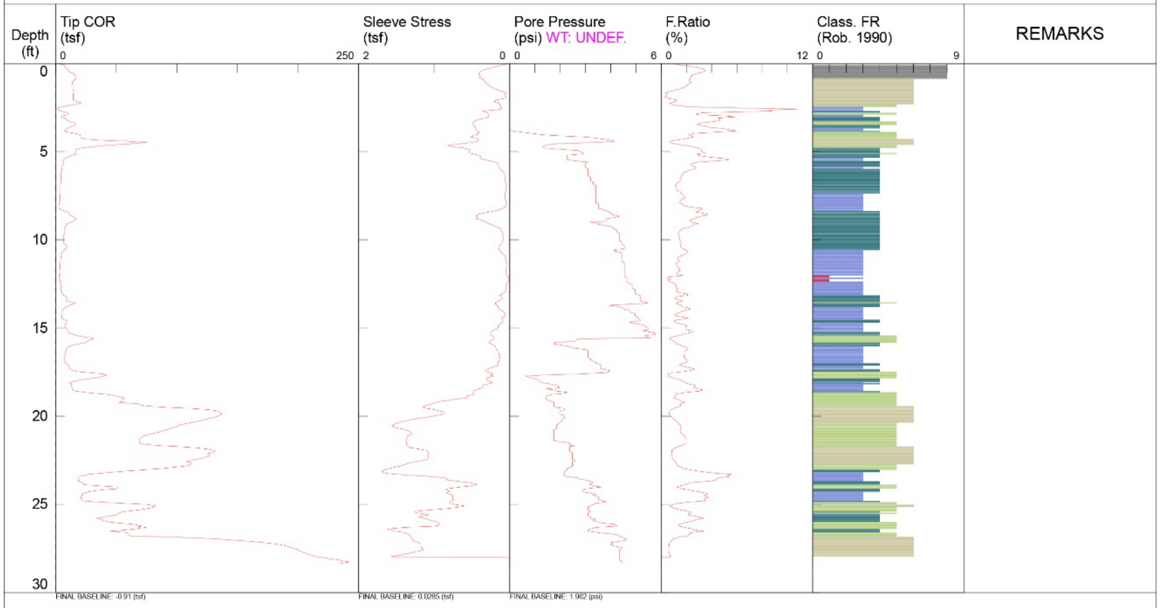
## SOUNDING

**ACache Corp.**
Engineering & Firm Foundations

TOTAL DEPTH: 28.357 ft
SITE: 17224 West Noth Temple, Salt Lake County UT
SOUNDING
COMPANY: VERTEK
FILENAME: CPT-8.dat

PROBE ID: 4444.190XX
TEST ID: 21-10-27-03
PROJECT: 17224 North Temple Landfill
LOCATION: CPT-8



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🟥 1 Sensitive, fine grained
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🟩 5 Sand mixtures - silty sand to sandy silt
🟫 6 Sands - clean sand to silty sand
🟧 7 Gravelly sand to sand
⬛ 8 Very stiff sand to clayey sand **
⬜ 9 Very stiff, fine grained **

*SBT: Robertson 1990; **Overconsolidated or Cemented; *SBT/SPT CORRELATION: UBC-1983

*Figure 6 – CPT Boring Logs (Cont.) (See Also Appendix A-6)*

## 2.3 ENVIRONMENTAL AND PUBLIC HEALTH ASSESSMENTS

Soil and groundwater studies have been conducted since the mid-1970s at the NTL Site. Studies have been completed by Salt Lake County (SLCo) Health Department, Salt Lake City Corporation (SLC), Utah Department of Health, United States Environmental Protection Agency (USEPA), and a number of environmental and geotechnical engineering consulting firms as part of several agency oversight cleanup programs and private development studies. See the Summary of Previous Investigations table below for a list of the studies conducted between 1975 and 2021.

### 2.3.1 Site History and Previous Work

The earliest record of information on the NTL Site is a SLCo Health Department report in October 1975. The report summarizes an investigation conducted at the landfill by the SLCo and Utah State Division of Health on what at the time was referred to at the time as the Salt Lake City Landfill. The report identified the landfill operations occurring for the previous 20 years. At the time of the inspection the trench method of landfilling was used with trenches being excavated approximately 8 feet deep. The report provides a map of the landfill showing the areas and during what periods the areas of the landfill had been developed. During the 1975 investigation, the area of the landfill being developed would have been the far west areas, west of the north-west trending Brighton Canal which bisects the site. The report identifies the presence of groundwater at the bottom of the trenches and states the waste is pushed from the top down to depths of 8 feet before the equipment can attempt to compact the waste due to the water in the bottom of the trench. The report records the existing method of landfilling does not prevent the direct contact with the groundwater. The Airport West VCP Phase I area is identified on the 1975 report map as being developed in the period from 1959 to 1963.

In 1977, Salt Lake City and EMCON Associates did an initial groundwater and geotechnical study at the NTL. The 5 wells were sampled for six water quality parameters. Apparent downgradient wells northwest of the landfill indicated impacts to the groundwater from the landfill operation. An USEPA potential hazardous waste site preliminary assessment (PA) was conducted in 1986 by the Utah Department of Health. The PA identified changes in the development of the landfill over the operational period between 1959 through 1979. From 1959 to 1963, trenches 2 to 4 feet deep were dug with a dozer and/or dragline and filled with refuse. The wastes were covered with 1-2 feet of native material (UDH 1986). This period coincides with the period of time that the waste cells were being developed in the Phase I area. In 1963, cells began to be excavated to a depth in excess of 10 feet. This is reflected in the waste cell profiles west of the Phase I area which were developed during the period following the Phase I area development. Around 1971, landfill operations continued to be excavated to those deeper depths. However, refuse began to be placed in the cells to a height of 3-5 feet above the former ground surface. The cells were covered with 1 to 2 feet of the surrounding native material. This is consistent with the waste cells located west of the Brighton Canal along the western area of the NTL Site, characterized as within the underlying groundwater and higher waste profiles compared to the earlier waste cells being above the groundwater and shallower, in the east side of the NTL Site. The PA recommended to combine the NTL and NTL-East due to their similarities in waste composition and hydrogeological settings. It was recommended that the combined sites be given a “medium-high” priority for conducting an USEPA Site Inspection. Waste types reported in previous CERCLA forms for the NTL Sites include: acids, bases, solvents, oily wastes, leather tanning wastes, plating/polishing wastes, oil refinery wastes, and sanitary refuse wastes. Septic tank and sump sludge were also disposed at the landfill.

From 1989 to 1995 the USEPA conducted Site Inspection Prioritization (SIP) Studies based on the UDH PA recommendations. The 1989 UDH initial Site Inspection (SI) study reported the presence of metals within both the downgradient wells and surface water. Chloride and sulfate were reported in higher concentrations in the downgradient surface water when compared to upgradient sample water. Metals concentrations in the North Point Drain and Brighton Canal did not appear to be impacted by the landfill (UDH 1989). The results of the SIP studies were a low priority for inclusion on the National Priority List (NPL). Following these initial USEPA CERCLA driven studies the Salt Lake City Landfill, now referred to in more recent studies as the North Temple Landfill (NTL), has gone through numerous studies for the last 20 years primarily the result of voluntary actions driven by development potential. The NTL East landfill (Bonneville Center Development) received a Certificate of Completion through the UDEQ VCP following cleanup of the buried MSW. The NTL-East underwent an approved waste removal and consolidation effort with UDEQ, where the waste from the NTL-East landfill was relocated to the NTL Site in an area located in the south-west area on the Phase I area referred to as the Bonneville Pile. This location is shown on the previous **Figure 4/Appendix A-4**.

The characterization studies performed at the NTL over the last 20 years continued to refine the extent and levels of contamination within the groundwater, waste, leachate, canals, soils and areas downgradient of the landfill. Additional wells were installed both in, around and downgradient of the landfill. Significant to these studies were investigations and pilot studies into the feasibility of remediation alternatives to clean up the landfill. Refinement of the waste profiles throughout the different areas of the landfill and the interaction the waste cells had on the underlying groundwater was performed. The studies between 2005 and 2006 by UTEX and others investigated the waste characteristics, leachate dewatering designs and groundwater contamination. Studies were conducted on the area used as a shotgun sporting shooting range following the closure of the landfill. This area was investigated for lead shot contamination. The lead shot impacted areas have been identified for cleanup as part of the overall remediation efforts of the re-development of the former landfill.

The characterization studies have in general identified the levels of contamination to be associated with the development of waste during the latter periods of operation from 1963 through 1979 when the waste cells were thicker and deeper. Some being placed near or in the shallow groundwater. These areas have been identified in the western half of the NTL. The focus of the characterization of the groundwater has traditionally been along the western and northwest boundaries. These areas are the downgradient areas to the areas developed after 1963. The extent of the groundwater contamination has been identified as continuing downgradient to the west and northwest off-site into the adjoining properties. The impacts, however, for most of the range of contamination has been limited to the landfill and the areas of MSW. Impacts within the Phase I area include VOC, PFAS and arsenic. Impacts along the downgradient western boundary include VOC, TPH DRO, PFAS and arsenic. There are less and lower detections of SVOCs and barium. The off-site impacts are the VOCs 1,4-dioxane and arsenic with a few detections of 1,1-DCA. Along the northern boundary, the impacts are fewer and lower, with arsenic, 1,4-dioxane, 1,1-DCA, vinyl chloride and the SVOC 1,1-biphenyl, being detected in various locations.

### 2.3.2 Summary of Previous Investigations

The following listing of reports below illustrate the extent of characterization studies that have been performed on the site.

| Title | Author | Year | Description |
|---|---|---|---|
| Report on the Salt Lake City Disposal Site – Old Salt Lake City Landfill | SLCo Health/Utah State Division of Health | 1975 | Investigation on landfilling operations |
| Geotechnical Investigation and Evaluation of the West North Temple Street Landfill (Old Salt Lake City Landfill) | Salt Lake City Corporation/EMCON Associates | 1977 | 5 new groundwater monitoring wells for the North Temple Landfills |
| Site Investigation, Bonneville Center (North Temple East Landfill) | Bingham Engineering | 1982 | Geotechnical boring and test pit investigation for the NTL East |
| Preliminary Assessment (PA) – NTL | Utah Department of Health | 1986 | CERCLA Potential Hazardous Waste Site PA |
| Analytical Results Report (ARR) - Site Inspection (SI) – NTL | Utah Department of Health | 1989 | CERCLA SI; 7 new groundwater monitoring wells; 7 surface water;<br>7 sediment samples. |
| Site Inspection Prioritization (SIP) - NTL | USEPA/URS, Inc. | 1994 | Review existing 1989 SI ARR for CERCLA SIP |
| Analytical Results Report - Site Inspection Prioritization (SIP) - NTL | USEPA/URS, Inc. | 1995 | ARR for 5 new sediment and 2 new surface water samples for CERCLA SIP |
| Groundwater Sampling Event - NTL | Salt Lake County Health Department/Maxim Technologies, Inc. | 1998 | Groundwater Sampling of 4 existing NTL GW wells |
| Semi-Annual GW Monitoring Reporting – Voluntary Cleanup Program (VCP) – Bonneville Center | DERR/Bingham Environmental, Inc. | 1998-2004 | Periodic groundwater monitoring of NTL East and GW-03. Semi-annual groundwater levels for east half of NTL. |
| Site Investigation and Sampling Summary Report - NTL | Montgomery Watson | 2000 | Soil and water quality investigation for 12 new piezometers; 4 new upgradient wells, 5 sediment and 5 surface water samples. |
| Semi-Annual GW Monitoring Reporting - Voluntary Cleanup Program (VCP) - Bonneville Center | DERR/Kennedy/Jenks Consultants | 2005-2006 | Periodic groundwater monitoring of NTL East and GW-03. Semi-annual groundwater levels for east half of NTL. |

| Title | Author | Year | Description |
|---|---|---|---|
| Solid Waste Excavation and Sampling – NTL | HKC & Associates, Inc./UTEX Environmental Services, LLC | 2005 | Landfill characterization of waste cells (MSW, soil, leachate). |
| Revised - Groundwater Monitoring and Sampling (OCT05) NTL | HKC & Associates, Inc./UTEX Environmental Services, LLC | 2006 | Groundwater Monitoring of 9 existing wells. |
| Sporting Clay Shooting Area - NTL | HKC & Associates, Inc./UTEX Environmental Services, LLC | 2006 | Preliminary lead soil investigation -32 surface and near surface soil sample |
| Groundwater Monitoring and Sampling (FEB06) NTL | HKC & Associates, Inc./UTEX Environmental Services, LLC | 2006 | Groundwater Monitoring of 9 existing wells. |
| Phase II ESA, 712 Acre Parcel North of NTL | HI Environmental, Inc | 2006 | Five sediment, four soil and four groundwater samples collected. |
| Report of Water Analysis from Pilot Dewatering Area | UTEX Environmental Services, LLC | 2006 | Analytical results of dewatering pilot study |
| Planning Level Geotechnical Study - NW Quadrant Development Planning | URS/CDM/SLR | 2008 | Planning level geotechnical study; 10 new groundwater monitoring wells |
| NTL Former Sporting Shotgun Shooting Range Remedial Investigation | CDM/SLR/DERR | 2010 | Assess lead contamination in surficial soil and canal sediments. 129 soil, 9 sediment locations |
| Subsurface Investigation Epperson Property | Cardno/SLR/DERR | 2015 | Groundwater sampling off-site 200 ft. off west boundary downgradient of NTL |
| Expanded Subsurface Investigation –Epperson Property | Cardno/SLR/DERR | 2017 | Groundwater sampling off-site 500 ft. off west boundary downgradient of NTL. Soil vapor west perimeter |
| Supplemental Site Characterization | Ninigret/DERR | 2018 | New nested deep/shallow well sets installed, soil and groundwater sampling Site wide |
| Expanded Subsurface Investigation | Cardno/SLR/DERR | 2019 | Groundwater sampling off-site 900 ft. off west boundary downgradient. Site wide perimeter wells, new Phase I wells. Soil vapor wells |

| Title | Author | Year | Description |
|---|---|---|---|
| Site Investigation | Cardno/NT/DERR | 2021 | Phase I wells. East perimeter wells, 16 waste test pits. |
| Geotechnical Study | CMT/NT | 2021 | Soil Borings, CPT and test pits geotechnical testing. |

## 2.4 CONCEPTUAL SITE MODEL AND EXPOSURE PATHWAYS

A Conceptual Site Model (CSM) has been prepared to identify the following:

- Historical Sources
- Primary Contamination
- Transport Pathways
- Contaminated Media
- Exposure Route
- Exposed Receptor Population

See **Figure 7/Appendix A-7** below for a graphical representation of the following description of the CSM.

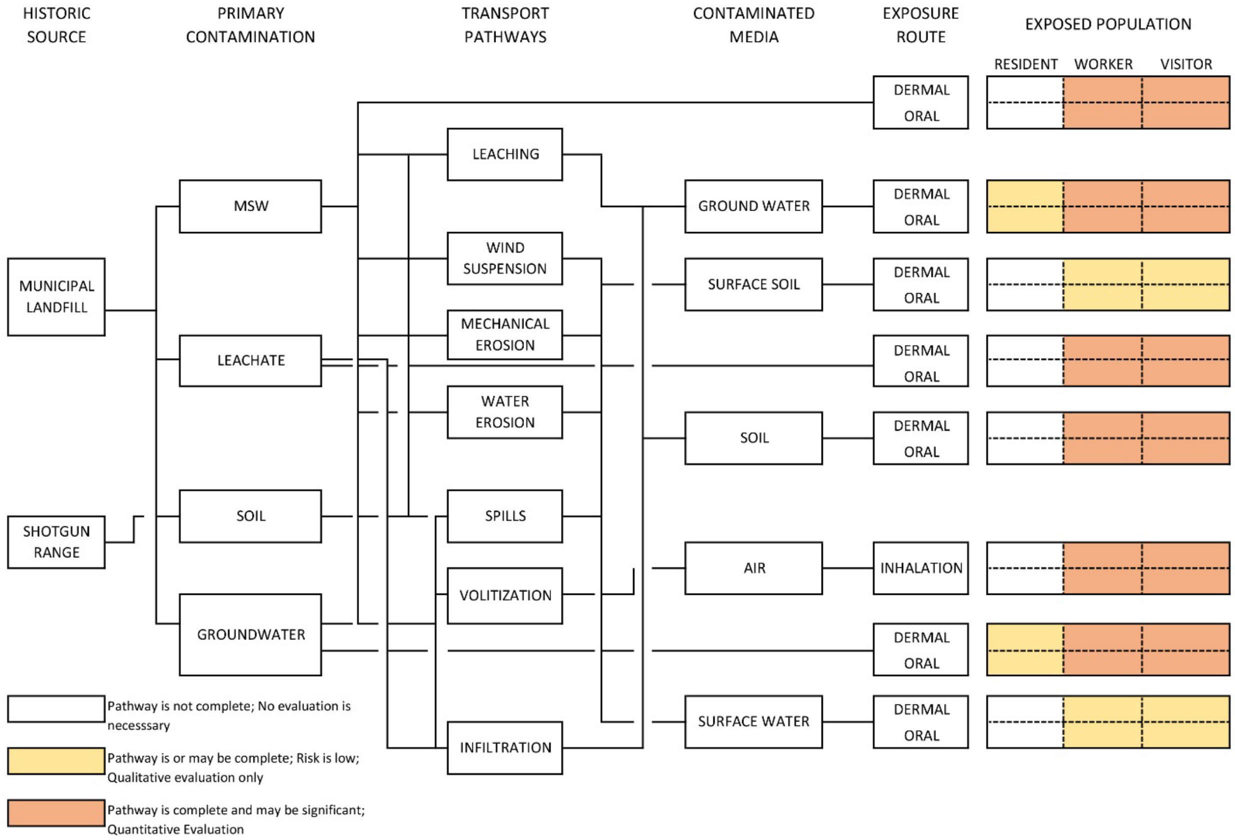


*Figure 7 – CSM Model (See Also Appendix A-7)*

### 2.4.1 Historical Sources

The Phase I area is a portion of the larger NTL Site that received municipal waste during the initial phase of the landfill's operation, a period of time from 1959 to 1963. The NTL Site continued expanding generally to the west of the Phase I area until Salt Lake City ceased operating the Landfill in 1979. As the landfill expanded beyond the Phase I area, the development of the landfill changed. As the waste cells continued to the west, they were placed in deeper and thicker profiles up until the landfill ceased operation.

Historically prior to the federally promulgated solid waste rules adopted and put into law in 1976, it was common for a range of waste, including liquid wastes to be placed into municipal waste landfills which today's RCRA Subtitle D landfill requirements would limit.

The historical source of the Phase I waste is MSW. The Phase I waste has been characterized as shallower and dryer, and although there has been detection of regulated compounds within the underlying groundwater, there has been to date no sources of hazardous, liquid or other waste restricted in landfilling operation pre-dating the RCRA Subtitle D rules identified.

Visual waste characteristics were recorded for the waste composition in excavated stockpiles during investigations of the test pit waste. Seven primary categories of waste were recorded by percent composition (plastics, tires, wood, glass, paper, metal and other). Plastics ranged between 0 to 25 percent. Tires ranged between 0 to 10 percent. Wood ranged between 10 to 40 percent. Paper ranged between 0 to 25 percent. Metal was 0 percent in all test pits. Other was 5 to 55 percent.
Cover material ranged between 1 and 2 feet in thickness for the Test Pits (TP's), located in Phase I. The waste profiles ranged between 3 to 6 feet in thickness, within the TPs located in Phase I. Depth to a saturation zone in the TPs ranged between 0 to 6.5 feet, with 7 of the 8 TPs in Phase I showing no water in the excavations.

### 2.4.2 Primary Contamination

Site Characterization Studies conducted on the buried MSW, leachate, soil, and groundwater for the Phase I area has identified the detection of elevated arsenic in the buried soil/waste matrix at the bottom of the cells. Lead has been identified in surface soil within portions of the southern area of Phase I used historically as a shotgun shooting range. The metals arsenic, cadmium and VOCs methylene chloride and 1,4-dioxane were elevated above their site investigation PSLs in the waste leachate. The metals (arsenic, cadmium, lead); VOCs (1,4-DCB, 1,4-dioxane); SVOCs (1,1-Biphenyl, bis(2-ethylhexyl)phthalate,1-methylnaphthalene); and TPH-DRO were detected above the investigation PSLs in 1 to 4 of the Phase I wells.

In addition to the buried MSW, waste leachate, shooting range soil, and groundwater as having detections of COCs as identified in site investigations, other areas of contamination will potentially be present during remedial activities. These areas include temporary waste stockpiles, haul roads and newly constructed leachate collection impoundments.

### 2.4.3 Transport Pathways

The transport pathways identified at the Phase I include the following:

- Leaching of the MSW by infiltration of precipitation; and drainage of pore water during excavation and or transport.
- Wind suspension of the MSW in opened trench cells, temporary stockpiles, spillage during transport of waste, and exposed consolidated waste in newly constructed repository cells.
- Water erosion from the run-on and run-off of contacted surface water or precipitation.
- Spills during transport of waste and or transport of leachate.
- Infiltration by leaks or run-off from leachate collection impoundments or containers.
- Volatilization and decomposition of organic compounds from the MSW or contaminated groundwater and soil.

### 2.4.4 Contaminated Media

The contaminated media identified at the Phase I included the following:

- Leachate due to infiltration of precipitation or shallow groundwater.
- Surface soil impacted by deposition of wind-blown suspended MSW or dried contaminated fine-grained soil or sediments from handling or treatment of leachate.
- Air impacted from the volatilization of MSW, leachate, contaminated groundwater, surface water or the suspension of dust particles from the dried MSW or impacted surface soil.
- Groundwater impacted through contact or infiltration through the MSW.
- Surface water or seeps receiving recharge from the underlying contaminated groundwater.
- Aviary and aquatic life impacted through the bio uptake from impacted surface water.

### 2.4.5 Exposure Route

The three routes of exposure are contact, ingestion and inhalation. These routes are identified by the following possible exposures

- Ingestion of contamination by cross contamination of food sources or ingestion by contact to mouth due to the deposition of suspended wind-blown dust particles on hands, clothing or vehicles.
- Inhalation of volatile compounds suspended in air or other contaminates through wind-blown dust.
- Dermal contact with contaminated MSW, leachate, groundwater, surface water or soil.

### 2.4.6 Exposed Receptor Population

The following exposed receptor populations are identified with their particular stage during the remedial action phases.

- The Phase I area will be developed in accordance with its current zoning as a commercial/light industrial development and therefore does not include any complete pathway to a residential receptor and therefore does not require any further evaluation.
- During remedial activities of excavating, transporting and handling of the MSW, leachate and groundwater, one or more pathways of exposure exist for a short-term construction worker or visitor and a quantitative evaluation is required.

- Following remedial activities, there will remain in Phase I consolidated waste within engineered impoundments, and while greatly reduced, residual impacts may remain to groundwater which may include one or more pathways to a long term or site worker and a quantitative evaluation is required. The short-term worker or visitor during this period of post closure is not included in a quantitative evaluation due to the evaluation of the long term or site worker with the higher exposure.
- Local wildlife population that frequents the site and surrounding area have a pathway for exposure as a result of the Phase I remedial activities from the possible exposure to leachate, contaminated groundwater and exposed waste. Special operating procedures and design elements have been incorporated into the RAP to minimize such potential and are discussed in more detail in Section 3.0.

## 2.5 SUMMARY OF RISK ASSESSMENT

In 2018 a risk assessment report was prepared on the North Temple Landfill which at the time utilized sampling data that had been collected during previous site characterization studies. While the risk assessment provides good information relative to the protectiveness of the proposed remedy for Phase I, this risk assessment does not intend to be a final document for the entire North Temple Landfill site as additional characterization is still necessary for the areas outside of Phase I **(See Appendix B).**

### 2.5.1 Risk Calculation Results – Phase I Area

#### *2.5.1.1 Municipal Use of Shallow Groundwater*

Phase I Area groundwater concentrations are compared to PSLs in Table 4 of the 2021 Phase I SI. PSL values are based on MCL values. In the absence of MCL values, groundwater concentrations are compared to tap water RSLs. The PSLs are exceeded for several chemicals in the Phase I wells. These include 1,1-dichloroethane (DCA), 1,4-dioxane, vinyl chloride, arsenic, and cadmium. Additionally, the sample results from the Phase I area TPs collected from the leachate identified several chemicals exceeding the PSLs. These are presented in Table 5 of the 2021 Phase I SI. These included methylene chloride, 1,4-dioxane, benzo(a)pyrene, arsenic and cadmium.

An inspection of Tables 4 and 5 of the 2021 Phase I SI shows that the exceedances of the greatest magnitude were for 1,1-DCA, and 1,4-dioxane. These chemicals exceeded their PSLs by over one to two orders of magnitude, respectively. An inspection of these same tables show that arsenic and 1,4-dioxane exceeded their PSLs most frequently. The number of chemicals exceeding PSLs and the magnitude and/or frequency of some of these exceedances results in a conclusion that the shallow groundwater immediately downgradient of the Phase I area is not suitable for municipal purposes. The use of the local groundwater, independent of these exceedances, in negated by the high salinity of the groundwater in the area and its classification as Class IV groundwater.

#### *2.5.1.2 Indoor Site Worker Exposure Via Vapor Intrusion*

Groundwater concentrations of 1,1-DCA, and vinyl chloride were at least one-tenth of EPA's VISLs. Further analysis has been performed regarding the potential of these compounds to create a health hazard to site workers via vapor intrusion. The Johnson and Ettinger model has been used to calculate risks for these compounds using site-specific geology. The output spreadsheets for the Johnson and Ettinger model are presented in the Risk Assessment Report attached as **Appendix B**.

The total cancer risk was 1 x $10^{-8}$, while the hazard index was 0.0001 (Table 5-2 of the Risk Assessment Report). However, no compound had a cancer risk above 1 x $10^{-6}$. The highest cancer risks were 2.9 x $10^{-8}$ for 1,1-DCA, 1.8 x $10^{-8}$ for vinyl chloride.

#### *2.5.1.3 Construction Worker Contact with Groundwater*

For a construction worker in contact with groundwater, the total cancer risk was 4 x $10^{-8}$ and the total hazard index was 0.0017 (Table 5-3 of the Risk Assessment Report). The total cancer was derived from two chemicals with risks in the $10^{-8}$ range (1,4-dioxane, vinyl chloride). Dermal exposure accounted for over 50 percent of the total cancer risk estimate.

As with site worker exposure to vapor intrusion, the level of concern is diminished by the fact that there is no single chemical with a cancer risk above 1 x $10^{-6}$. For the construction worker, this conclusion is emphasized by the fact that many of these chemicals have rarely been detected. The total risk from the chemicals that were detected with greater frequency (1,4-dioxane, vinyl chloride, and arsenic) is only 4 x $10^{-8}$.

Blood-lead levels for the fetus of a pregnant construction worker are calculated in Table 5-4 of the Risk Assessment Report. The 95 percentile level is 2.4 µg/dl, which is well less than the benchmark of 10 µg/dl. No adverse effects are anticipated as a result of the presence of lead in groundwater.

### 2.5.2 Uncertainty Analysis

The primary uncertainty with the municipal use of shallow groundwater is that it is highly unlikely that the shallow groundwater in the vicinity of the Phase I area would ever be used for such a purpose. Groundwater concentrations exceed PSLs by a sufficient margin (by over a factor of 100 in a third of the instances and over 1,000 in one) that there is a high degree of certainty in the conclusion that there could be adverse health effects from such use if it were to occur.

When evaluating vapor intrusion risks that would be associated with an indoor site worker, it was assumed that the worker would be present for 25 years. This is the 95th percentile for how long workers stay at a job (EPA, 2014). Most workers change jobs more frequently. In 2016, the median time a person had been with their current employer was 4.2 years (U.S. Bureau of Labor Statistics (BLS), 2016).

Modeling was used to estimate indoor air exposure concentrations. The indoor air modeling made use of EPA's implementation of the Johnson and Ettinger model (EPA, 2004a). Using this model requires assumptions regarding building size, soil-building pressure differential, the floor-wall seam crack width, the vapor flow rate into the building, and the indoor air exchange rate. EPA and model default values were used for these parameters.

EPA has designed these defaults to be conservative but within the range of possible values. Taken as a whole, these assumptions are likely to overestimate total risk. For example, the air exchange rate of one change per four hours is typical of winter conditions in areas of the country with a cold climate, and that will be more conservative than data averaged over an entire year (EPA, 2004a). It is also based on residential data and will overestimate indoor air concentrations for facilities such as warehouses. Also, a small building of about 1,100 square feet is assumed; larger ones typical of office complexes and warehouses allow for greater mixing with outdoor air. When these uncertainties are juxtaposed with risk estimates that are below 1 x $10^{-6}$, the conclusion is that there is no significant vapor intrusion risk.

Construction worker risk estimates required assumptions regarding the amount of contact workers will have with groundwater. Highly conservative assumptions were made, including that such contact would occur daily over the course of a year-long construction project (this assumption was made to match up with the EPA standard default assumption for construction worker exposure duration (EPA, 2002). Obviously, much of any construction project takes place above ground with no contact with groundwater. This assumption can only be at all plausible if it is assumed that several buildings are constructed in this area, and one group of workers goes from building site to building site, excavating and installing each of these foundations.

However, if a worker is at multiple construction sites, they will be in contact with groundwater over a much larger area. The assumption that a worker is in contact with maximum detected groundwater concentrations is no longer tenable. In other words, one can assume a construction worker is in contact with the highest concentrations in groundwater or have contact over the course of a year, but not both. Nonetheless, the assumption of maximum recent groundwater concentrations was made for simplicity. Even for chemicals detected frequently, the highest concentrations are one to two orders of magnitude higher than those found in any other wells. The only exception is 1,4-dioxane, and by itself it does not significantly contribute to site or construction worker risks. Thus, the use of the maximum detected concentration substantially overestimates site risks.

The highest concentration of a chemical detected during the 2021 Phase I SI was used in this risk assessment. Only when a chemical was detected by the 2019 ESI, but not in the 2021 Phase I SI, was the 2019 data utilized. There were chemicals which were detected at higher concentrations in the 2019 ESI. The lower concentrations in the 2021 Phase I SI could have resulted from degradation/dispersion over the years between the two investigations. However, it is also possible that the greater number of sampling rounds/locations encompassed by the 2019 ESI uncovered higher concentrations that are representative of current conditions.

The most significant discrepancy is for 1,1-biphenyl in three of the Phase I wells (NTL-GP65-67). In 2019 all three wells exceeded the PSL. In 2021 none of these wells exceeded the PSL. The results of the 2019 Risk Assessment did not result in a cancer risk greater than 1 x $10\text{-}^{6}$ for 1,1-biphenyl.

Some of the chemicals detected in groundwater may not be solely related to the landfill operations. Some (and potentially all) of the metals detected will be naturally occurring. The maximum concentrations of 326 and 7 µg/l of these metals, respectively, are higher than the normal range that is present in Salt Lake Valley groundwater. It is unlikely that these levels are naturally occurring concentrations at this site. However, neither arsenic nor cadmium at these levels were associated with risks and/or above benchmarks for one or more receptors.

### 2.5.3 Summary and Conclusions

This section reviews the results of this risk assessment and draws conclusions that will be useful in determining what types of development are appropriate given the environmental conditions. The conclusions are based on the quantitative risk results, but also on qualitative information, including information in the Uncertainty Analysis.

Three receptors were evaluated in this risk assessment of groundwater at the NTL. These are a municipal user of tap water, an indoor site worker exposed via vapor intrusion, and a construction worker that comes in contact with groundwater during the course of site excavation. For the construction worker, potential exposure pathways are dermal contact with groundwater and incidental ingestion. The receptors were chosen based on potential commercial development of the property.

For a municipal user of tap water, groundwater concentrations were compared to MCLs and EPA residential RSLs, identified as PSLs. Several chemicals exceeded their PSLs by over two orders of magnitude at several locations within the Phase I groundwater and/or leachate. These included 1,1-DCA, 1,4-dioxane, methylene chloride, vinyl chloride, arsenic and cadmium. Using the groundwater as a source of tap water would be accompanied by significant risks.

However, the shallow groundwater is unlikely to be used for this purpose. The groundwater is classified as Class IV groundwater. The aquifer is tight, consisting of clay, silt, and fine sand, and would have a low yield. The nearest residence is over four miles distant, making even a private well an unlikely receptor.
For an indoor site worker exposed to groundwater via vapor intrusion, the cancer risk was 5 x $10^{-8}$ and the hazard index was 0.0001.

For a construction worker exposed to groundwater via dermal contact and incidental ingestion, the calculated cancer risk was 4 x $10^{-8}$ and the hazard index was 0.0017.

In summary, calculated groundwater risks associated with the NTL for site and construction workers is less than the 1 x $10^{-6}$ cancer risk benchmark.

While the groundwater inhalation pathway was evaluated for the site worker, the soil inhalation pathway was not evaluated since the remedy will include removal of soil and Municipal Solid Waste to an engineered Repository. However, to ensure protectiveness of the remedy, confirmation samples will also be collected and the results compared against current EPA Regional Screening Levels (for a commercial land use) or cleanup levels derived in a Risk Assessment. In addition, clean backfill will be placed across the site meeting commercial criteria and the phase I area will ultimately consist of hardscape and other cover features removing future risk via the soil pathway.

The Risk Assessment Report is attached in its entirety as **Appendix B**

# 3.0 DESCRIPTION OF REMEDIAL ACTION PLAN

## 3.1 EVALUATION OF REMEDIAL ALTERNATIVES

Over the history of the landfill various cleanup alternatives have been considered. These remedial alternatives have included; (1) waste removal and disposal at an offsite landfill, (2) capping the landfill with the waste remaining in space and (3) adoption of a Brownfield approach where existing waste would be consolidated into a new on-site repository.

One of the more extensive remedial alternative evaluations was conducted by SLR, the previous property owner. SLR had envisioned a master-plan development that encompassed the landfill property in combination with surrounding land that was at that time under their ownership. This masterplan included a residential development component which necessitated the removal of the landfill waste off of the site to meet the appropriate risk management objectives. The costs associated with the waste excavation, loading and transport of the waste from the site and the associated disposal costs at an off-site landfill far exceeded the inherent value of the land and rendered the project uneconomical. The study also identified major safety environmental concerns with transporting the wet waste from the site and as well as the impacts on the local road system and the I-80 Interstate Highway.

Capping the landfill leaving the waste in place was also a remedial alternative considered. During the operation of the landfill when a particular waste cell was filled, the operator would cover the waste with native soil and move onto construct the next waste cell. There were no additional capping efforts prior to the landfill being closed, so over time, precipitation infiltrated into the landfill cells interacting with the waste and generating leachate. Applying a clay soil cap or application of a synthetic liner cap across the existing landfill would help minimize the infiltration of precipitation into the waste cells and the generation of leachate. However, just capping the landfill does not address the ongoing interaction of the existing leachate in the cell bottoms with the site's groundwater or provide or provide a means to mitigate off-site migration.  As such, capping the waste in place was considered to be only a partial fix and nonetheless very costly. Without the removal of the waste the value of the property and its functionality is greatly reduced and therefore does not provide a source of funds to help pay for the cost of applying a new cap which in turn has prevented this approach from being implemented.

The brownfield approach allows for waste from the old landfilling efforts to be excavated and consolidated in a new repository facilitating areas of the old landfill to be redeveloped. This removal and consolidation of waste approach was previously successfully implemented for waste from NTL East whereby historical portions of that landfill were preventing development with Salt Lake City's International Commerce Center. Under an UDEQ approved plan waste from the NTL East was relocated and consolidated onto the NTL in what is now referred to as the Bonneville Pile. In a similar approach the waste within the Phase I waste cells would be excavated and transported for consolidation into the new repository. The new repository would include a modern engineered cap that would eliminate future infiltration into the repository waste cutting off the creation of additional leachate. The redevelopment of the areas of the landfill would unlock the inherent value of the land creating a source of funds that could assist in funding the landfill cleanup.

## 3.2 REMEDIAL ACTION OBJECTIVES

The remedial action objectives of this RAP are two-fold; (1) relocate the waste from the old landfill operation into a new properly engineered repository that incorporates modern environmental safeguards and (2) allow for areas of the old landfill to be brought back into productive use through the redevelopment of those areas. Excavating the waste from the existing cells and removing/processing the leachate will remove a source of contamination to the surrounding groundwater. Consolidating the excavated waste into a new repository with a proper cap will eliminate the future generation of leachate from that waste. Adopting a variety of environmental safeguards, discussed herein, during the waste repository construction will ensure that the process will be completed with minimal impacts on the surrounding area.

## 3.3 SUMMARY OF SELECTED REMEDIAL ACTIONS

Remedial actions that are incorporated into this RAP and discussed in more detail throughout this document include:

- Excavation of waste from existing waste cells
- Transportation of excavated waste to new repository
- Design and construction of new repository with proper engineering components
- Air monitoring and odor control at waste excavation locations, repository and Phase I perimeter
- Dewatering, leachate collection, evaporation, treatment and disposal
- Suspect/Special waste handling, testing and offsite disposal
- Stormwater Pollution Prevention
- Vector control
- Site security
- Wildlife security to ensure that site-indigenous animals (birds/mammals) are excluded from direct contact with waste or leachate
- Weekly meetings/reporting with UDEQ, Site Contractors and third-party observer

# 4.0 REMEDIAL ACTION PROGRAM

## 4.1 GOVERNING DOCUMENTS

The following is a list of governing documents intended to be developed and implemented in order to help shape the details concerning each segment of the remediation work effort. Sample copies of each of these documents can be found in **Appendix C**. As noted in our ongoing Stakeholder meetings, certain of these documents will require actual permits and/or approvals from other agencies prior to the initiation of site work. As such, these plans are presented here as a framework for additional review and comment prior to implementation.

- Site Specific Health & Safety Plan (HASP)
    - The planned Phase I remediation efforts will incorporate a Level D PPE based upon the results of the previous site characterization efforts. The HASP set forth in Appendix C-1 sets forth specific details to be followed on the Site inclusive of measure to be taken should special waste be identified during the excavation efforts.

- Quality Assurance Project Plan (QAPP)
    - The QAPP set for in Appendix C-2 is consistent with the procedures that have been developed during the various site characterization investigations at the site and includes special provisions for the mass excavation, on-site transport and placement of the waste.

- Soil/Waste Materials Management Plan (So MMP)
    - The SWMP identifies the movement and use of various material that will be incorporated into and made use of during the Phase I remediation efforts. **Figure 14/Appendix A-14** presented later in the report illustrates the sources and disposition of soil, concrete aggregate, and waste movement on-site.

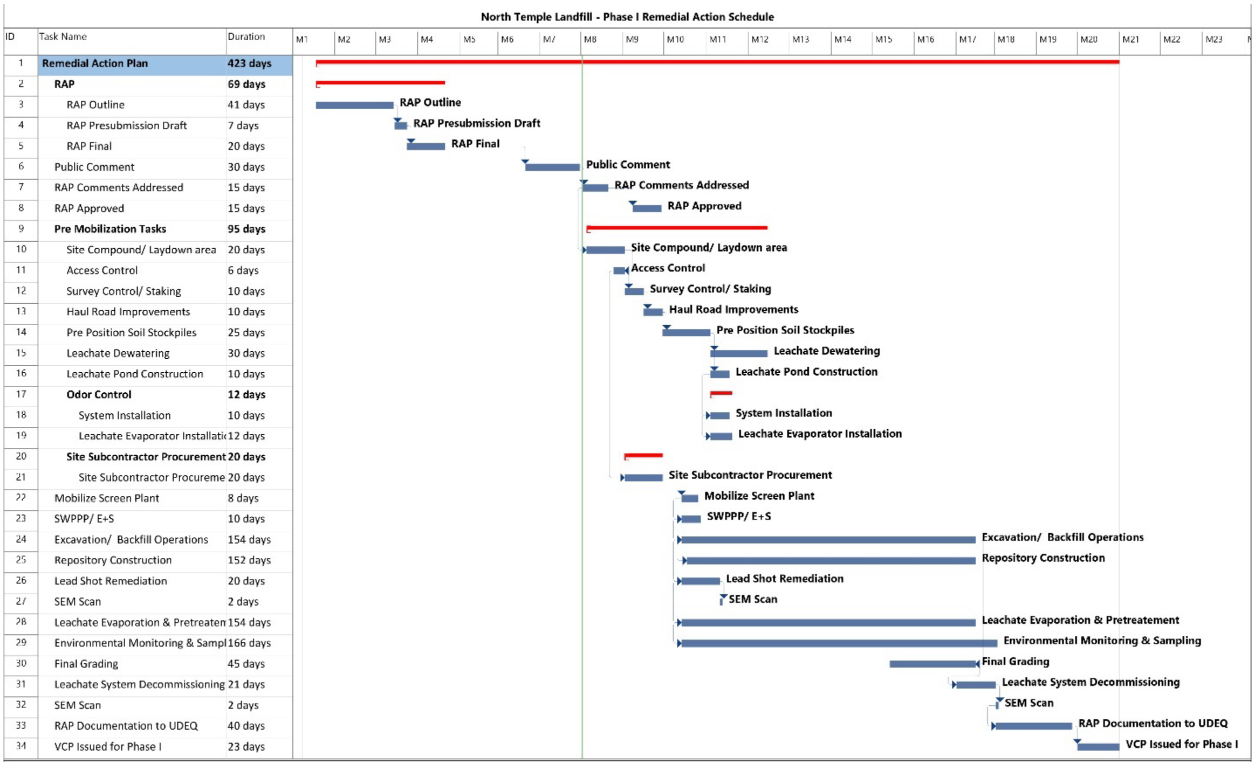
- Storm-Water Pollution Prevention Plan (SWPPP)
    - The SWPPP identifies the existing site conditions and the means that will be implemented to minimize impacts to the surface water and drainage canals that are proximate to the Phase I area. The SWPPP plan when finalized will conform with the template from the Division of Water Quality and will be coordinated with Salt Lake City to ensure the UPDES permit requirements, if any, are met. The SWPP will be completed and approved prior to the start of construction.

- Special Waste Handling and Off-Site Management
    - While the site characterization efforts have not uncovered any suspect/special waste, other than tires, that would require off-site disposal the RAP incorporates provisions and procedures that will be put in place prior to the initiation of waste excavation efforts to address such a contingency.

- Community Air Monitoring Plan (CAMP)
    - Air monitoring will be an integral component of the site operations. As set forth in more detail in Appendix C-6, emissions monitoring and an active odor control system will be employed at the active waste excavation locations as well as at the repository. In addition, air and odor monitoring locations will be established at the perimeter of the site in proximity to sensitive receptors to monitor the ongoing work effort.

## 4.2 GENERAL REMEDIAL CONSTRUCTION SCHEDULE

The Phase I field operations are scheduled to occur over a twelve-month period starting with preconstruction activities and mobilization of support components. The waste excavation, hauling and placement efforts are anticipated to continue for a six-month period with ongoing Phase I site activities extending until the end of 2022. The schedule has been constructed to begin the waste excavation efforts in late spring/early summer in order to take advantage of the dry conditions typically experienced on the site during those months. Prior to onset of waste excavation activities, key support components will have been constructed (i.e., haul roads, leachate holding pond, leachate evaporator) to allow the waste excavation to proceed safely and efficiently. The following schedule (**Figure 8/Appendix A-8)** provides the framework for how these activities are anticipated to proceed.



| ID | Task Name | Duration |
|---|---|---|
| 1 | **Remedial Action Plan** | **423 days** |
| 2 | **RAP** | **69 days** |
| 3 | RAP Outline | 41 days |
| 4 | RAP Presubmission Draft | 7 days |
| 5 | RAP Final | 20 days |
| 6 | Public Comment | 30 days |
| 7 | RAP Comments Addressed | 15 days |
| 8 | RAP Approved | 15 days |
| 9 | **Pre Mobilization Tasks** | **95 days** |
| 10 | Site Compound/ Laydown area | 20 days |
| 11 | Access Control | 6 days |
| 12 | Survey Control/ Staking | 10 days |
| 13 | Haul Road Improvements | 10 days |
| 14 | Pre Position Soil Stockpiles | 25 days |
| 15 | Leachate Dewatering | 30 days |
| 16 | Leachate Pond Construction | 10 days |
| 17 | **Odor Control** | **12 days** |
| 18 | System Installation | 10 days |
| 19 | Leachate Evaporator Installati | 12 days |
| 20 | **Site Subcontractor Procurement** | **20 days** |
| 21 | Site Subcontractor Procureme | 20 days |
| 22 | Mobilize Screen Plant | 8 days |
| 23 | SWPPP/ E+S | 10 days |
| 24 | Excavation/ Backfill Operations | 154 days |
| 25 | Repository Construction | 152 days |
| 26 | Lead Shot Remediation | 20 days |
| 27 | SEM Scan | 2 days |
| 28 | Leachate Evaporation & Pretreaten | 154 days |
| 29 | Environmental Monitoring & Sampl | 166 days |
| 30 | Final Grading | 45 days |
| 31 | Leachate System Decommissioning | 21 days |
| 32 | SEM Scan | 2 days |
| 33 | RAP Documentation to UDEQ | 40 days |
| 34 | VCP Issued for Phase I | 23 days |

*Figure 8 – General Remediation Schedule (See Also Appendix A-8)*

# 4.3 SITE PREPARATION

## 4.3.1 Mobilization

### *4.3.1.1 Site Access Control*

The Site will have three gated access points and one additional access point for the rail entrance to the property **(Figure 9/Appendix A-9)**. The balance of potential vehicle entry points will be closed with temporary barriers. Appropriate signage will be posted at all entry points. Access to the working areas associated with the Phase I remediation will be limited to construction and field personnel that will be required to check in to the Operations Trailer prior to gaining access to the Site. The eastern property boundary is bordered by a rail spur that runs the distance of the Phase I area. The rail spur is secured by a four-foot wire fence limiting access to the rail from both sides of the spur. Should this fence need to be removed as part of the waste excavation efforts the area will be secured with a portable chain link fence.

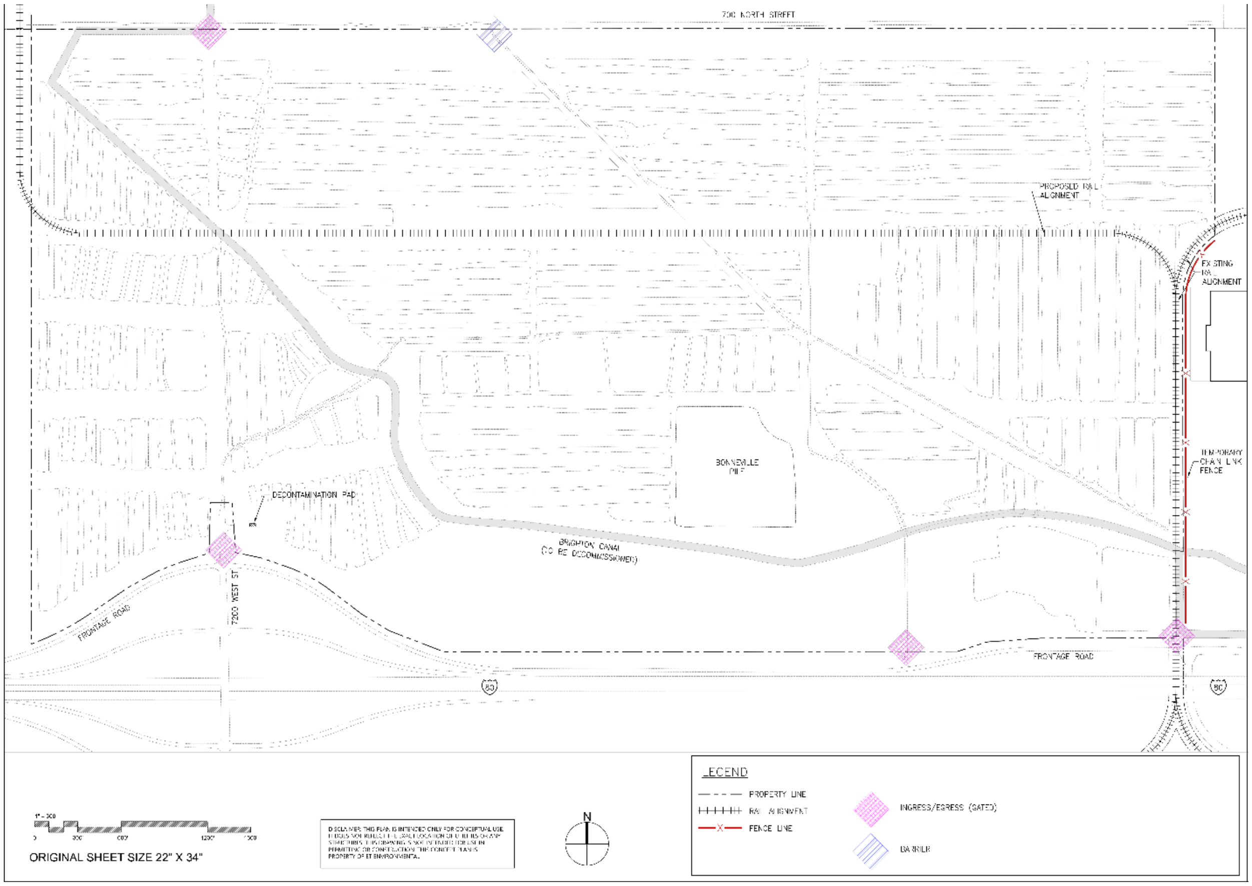


*Figure 9 – Gated Access Locations & Barriers (See Also Appendix A-9)*

#### *4.3.1.2 Wildlife Access Control*

A site perimeter cattle fence will be utilized to aid in minimizing local wildlife populations from accessing the Site. While the daily use of heavy equipment will likely discourage the wildlife population from frequenting the Phase I remediation area, additional safeguards have been incorporated into the design and operational plans. To reduce the potential exposure to waste, all excavated waste will be covered with tarps at the completion of each workday minimizing access to exposed waste. In addition, temporary construction fencing will be placed around any waste cell that has been excavated but not yet backfilled at the completion of the day **(Figure 10/Appendix A-10).**

To reduce the potential exposure to the leachate, bird wires have been incorporated into the design of the leachate collection pond (utilized to collect cell leachate prior to introduction to the evaporation system) **(Figure 12/Appendix A-12)**. Other bird deterrents may be utilized based upon the infield experience once operations begin. The potential pathway to contaminated groundwater is remote. Other than contaminated groundwater that could be exposed during the excavation of the waste cells (and which will be treated and leachate and directed to the leachate collection and evaporation system), there is no pathway to groundwater as a result of the Phase I remediation efforts.

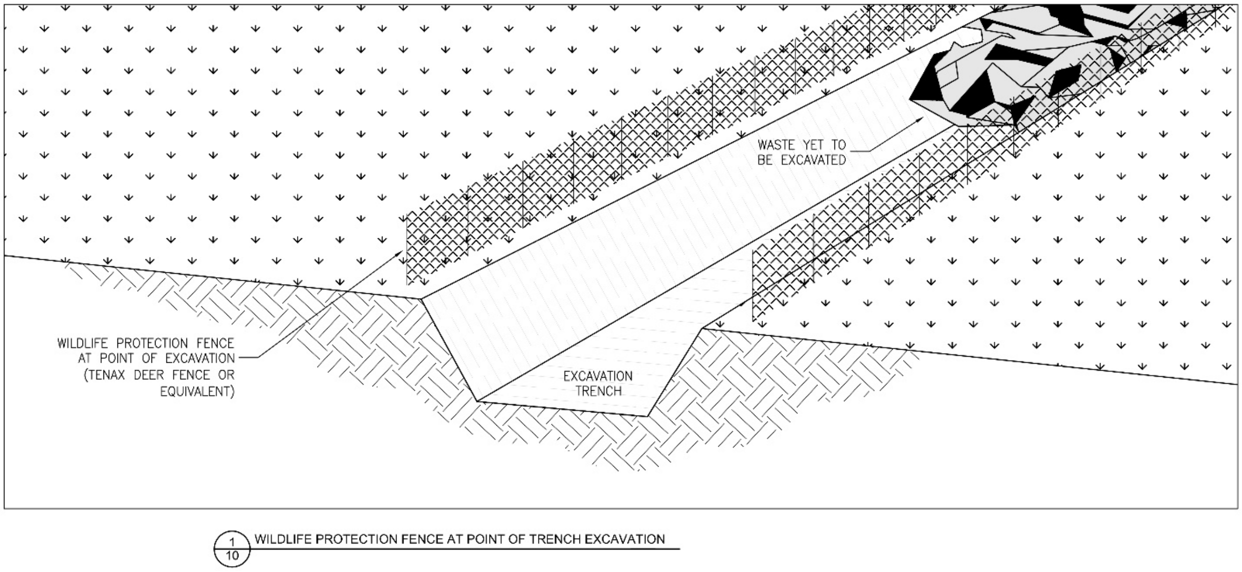


*Figure 10 – Wildlife Protection Fence (See Also Appendix A-10)*

#### 4.3.1.3 Site Office Compound

The Operations Trailer **(Figure 11/Appendix A-11)** will house supervisory personnel and will serve as check-in for any vendors, subcontractors, or visitors to the site. All visitors as well as site workers will be required to check in at the Operations Trailer. Visitors to the site will be required to attend a health and safety briefing and wear the appropriate safety gear commensurate with their activity on the site. There will be an equipment compound and lay down area located adjacent to the Operations Trailer that will be a secured fenced area. Certain deliveries of material or equipment will be directed to the Operations Trailer and compound to insure proper tracking and inventorying of materials and equipment.

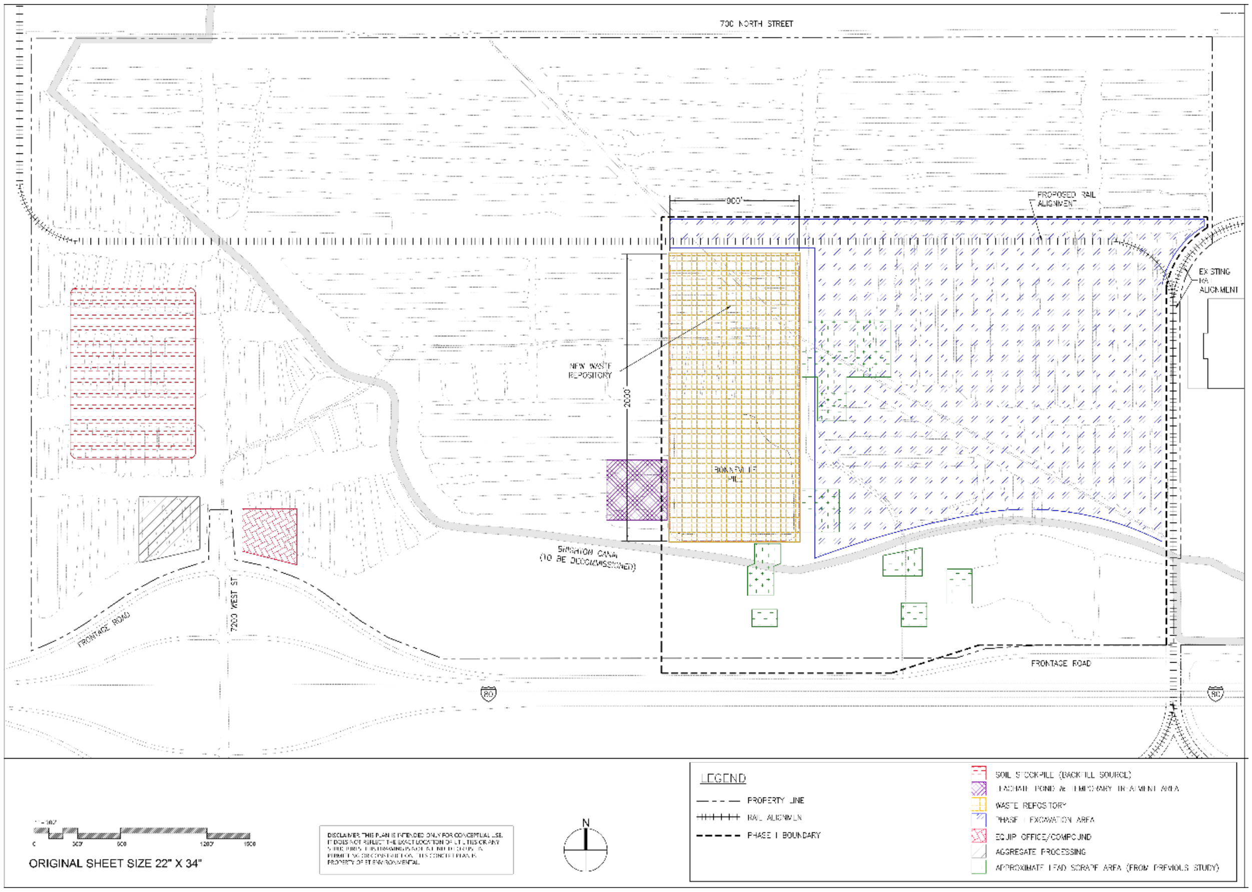


*Figure 11 – Site Logistics Plan (See Also Appendix A-11)*

### 4.3.2 Erosion and Sedimentation Controls

During the Phase I RAP, there will be no site wide elevation changes which will alter the existing surface water drainage patterns. There are three active water bodies on or adjacent to the site; Brighton Canal, Little Goggin Drain and North Point Drain. These areas will be protected with erosion control devices in cases where excavation operation approach 200 ft of the drains. These control devices may include silt fencing, hay bales or other appropriate control measures. A third-party stormwater engineer (i.e., Accena Group) will be retained to ensure proper Best Management Practices (BMP) and conduct periodic stormwater compliance inspections. The repository construction (where soil covers are installed), will be protected with hydroseeding soil slopes and other measures (refer to Section 5.2.7 and **Figure 24/Appendix A-24** for repository cover design).

Stormwater sediment control will be provided primarily by the temporary and permanent stormwater detention features such as:

- Maintaining topographically higher ground where practical between the Frontage Drain and the disturbed areas in the southern portion of the project area to prevent direct stormwater and sediment discharge to the Frontage Drain, and to areas of the Brighton Canal that have not been decommissioned and filled.
- Where possible, retaining the existing vegetation barriers around peripheral areas of the site including along the frontage drain and southern portion of the property.

### 4.3.3 Stormwater Management

A Storm Water Pollution Prevention Plan (SWPPP) will be implemented for the Phase I remedial activities. This plan has been prepared in a draft format and attached in Appendix C-4. This plan will be revised, finalized and approved with Salt Lake City prior to the onset of the site remedial construction activities. This plan is not intended to address the Storm Water Pollution Prevention efforts for the subsequent development of this parcel as the development details are not known at this time. Those measures will be developed during the master planning of the development and in accordance with Salt Lake City's regional stormwater masterplan. Instead, the stormwater management approaches set forth in this RAP are intended to identify the measures that will be implemented to ensure that the construction activities necessary to remediate the Phase I area do not negatively impact the existing stormwater infrastructure.

#### *4.3.3.1 Existing Site Conditions*

The site and surrounding areas are relatively level, with elevations typically ranging from approximately 4,224 to 4,234 feet msl. The slope across the site is generally flat and falls within the 0-7% range, which corresponds with a low erosion hazard. Surrounding areas to the east have already been permanently stabilized by new development, which incorporates City-approved stormwater detention systems. Local topographic lows occur along the frontage road canal to the south of the site. These features are protected from uncontrolled stormwater runoff and sedimentation by the existing vegetated buffer zones along the perimeter of the project area, and by the presence of topographically higher ground between the drainage canal and the southern portion of the project area. Because areas of the project site are not developed, stormwater accumulates in, and evaporates from, locations within the project area. Stormwater also accumulates in a series of sloughs throughout the site where most evaporates or infiltrates into the ground.

#### *4.3.3.2 Management of Stormwater at Active Waste Excavations and Repository Fill Efforts*

Any stormwater that collects within the active waste excavation areas, including stormwater that enters an open cell, will be collected and pumped to the leachate storage pond for introduction into the leachate treatment system.

Similarly, during the active repository fill efforts and prior to construction of the waste repository, a small stormwater containment berm (2 ft above existing elevations) will be constructed around the outside perimeter of the repository footprint. Any stormwater runoff collected prior to installation of the repository cap will be pumped to the leachate pond for evaporation and treatment.

### 4.3.4 Utility Marker and Easements Layout

Any active easements and utility locations will be located by survey when the site datum & benchmarks are established. An ALTA survey was performed for the North Temple Landfill site in 2018 by Dominion Engineering. Several utility, road and power easements are identified within the Phase I area of the landfill. The Utah Power & Light (UP&L) pole easement running south to north through this area will be vacated.

An underground utility locate request will be submitted through Blue Stakes of Utah to identify any potential underground utility conflicts within the work areas of Phase I. Since prior work efforts on the landfill have not identified any underground utilities, none are to be expected. However, if any conflicts do arise, a concerted effort with each utility will be implemented to ensure the safety of the excavation crews and the underground utility itself.

### 4.3.5 Equipment and Material Staging

There will be an equipment compound and lay down area located adjacent to the Operations Trailer that will be a secured fenced area. Certain deliveries of material or equipment will be directed to the Operations Trailer and compound to insure proper tracking and inventorying of materials and equipment. Other materials and or equipment may be brought directly to the active working areas though one of the authorized access points. Equipment leaving the site will be inspected to ensure the equipment has been cleaned and free of potential contamination from its use on the site.

### 4.3.6 Decontamination Area

The site compound area will contain a decontamination pad for cleaning of equipment and vehicles prior to leaving site. The decontamination pad is shown on **Figure 9/Appendix A-9**.

### 4.3.7 Leachate Storage & Odor Control System

Prior to beginning waste excavation, the leachate storage pond will be excavated. The pond will have a capacity of 50,000 gallons and a depth of 4ft. The pond will be lined with a 20 mil PVC liner. Bird wires (for bird deterrence) will be mounted on poles around the pond **(Figure 12/Appendix A-12)**. This pond will be situated to the west of the new repository (and not included in the Phase I legal description) but operate only through the Phase I RAP completion and thereafter will be decommissioned. Concurrently with leachate pond construction, we will mobilize an auger drill to place 12” diameter holes in the waste trenches in the area of the Bonneville Pile. The auger drill will advance to the estimated bottom of the trenches and upon withdrawal an 8” diameter slotted PVC pipe vise will be installed. Portable pumps will be used to extract the accessible leachate and discharge it to the leachate pond.

The leachate pond is intended to provide temporary storage for leachate which, when encountered during the waste cell excavations, will be pumped into the pond prior to being directed to the evaporation system. Upon completion of the Phase I activities the temporary pond will be decommissioned.

The pond is sized for 50,000 gallons of storage. The pond location is outside of the Phase I work area and will be constructed over MSW trenches. The construction will entail over-excavation of the pond footprint by three feet, removing existing cover and MSW. The three feet of over-excavation will be backfilled with compacted structural fill to the invert of the pond bottom. The excavated MSW will be placed in the repository. The pond liner, 20 mil PVC (or equivalent), will be placed and seams will be solvent welded. The perimeter liner will terminate into a perimeter anchor trench.
Should leachate volume be greater than anticipated, or the treatment process (evaporation) prove slower than expected, a second pond (identical to initial pond) will be built. During operation, the pond liner and the liquid levels will be monitored and documented in the construction manager’s weekly report to make sure the liner integrity is maintained.

Given the temporary service life of the pond(s) and that they are built over area of future remediation, a double pond liner with a leak detection zone is not warranted. When the Phase I remediation is completed, the leachate ponds and the evaporation pre-treatment system will be decommissioned. Thus, the pond location will not be included in the survey and legal description for the requested administrative letter for the Phase I remediation efforts.

At the conclusion of the Phase I activities the liquid fraction remaining in the pond will either be processed for off-site disposal, subject to meeting the pretreatment standard of the receiving Publicly Owned Treatment Works (POTW), or will be pumped back through the evaporator for further volume reduction. Any remaining precipitate solids or brines will be subject to analytical testing to meet the industrial pretreatment discharge requirements of the final disposal facility. A two-pass granulated activated carbon filtration system will treat the remaining liquid and will be handled by a Salt Lake County permitted waste hauler to the accepting POTW. Any solids (after testing/characterization) will be either placed in the repository, or if hazardous, be transported to an approved TSD facility. The liner material will be scavenged, cleaned, and disposed in an off-site MSW landfill.

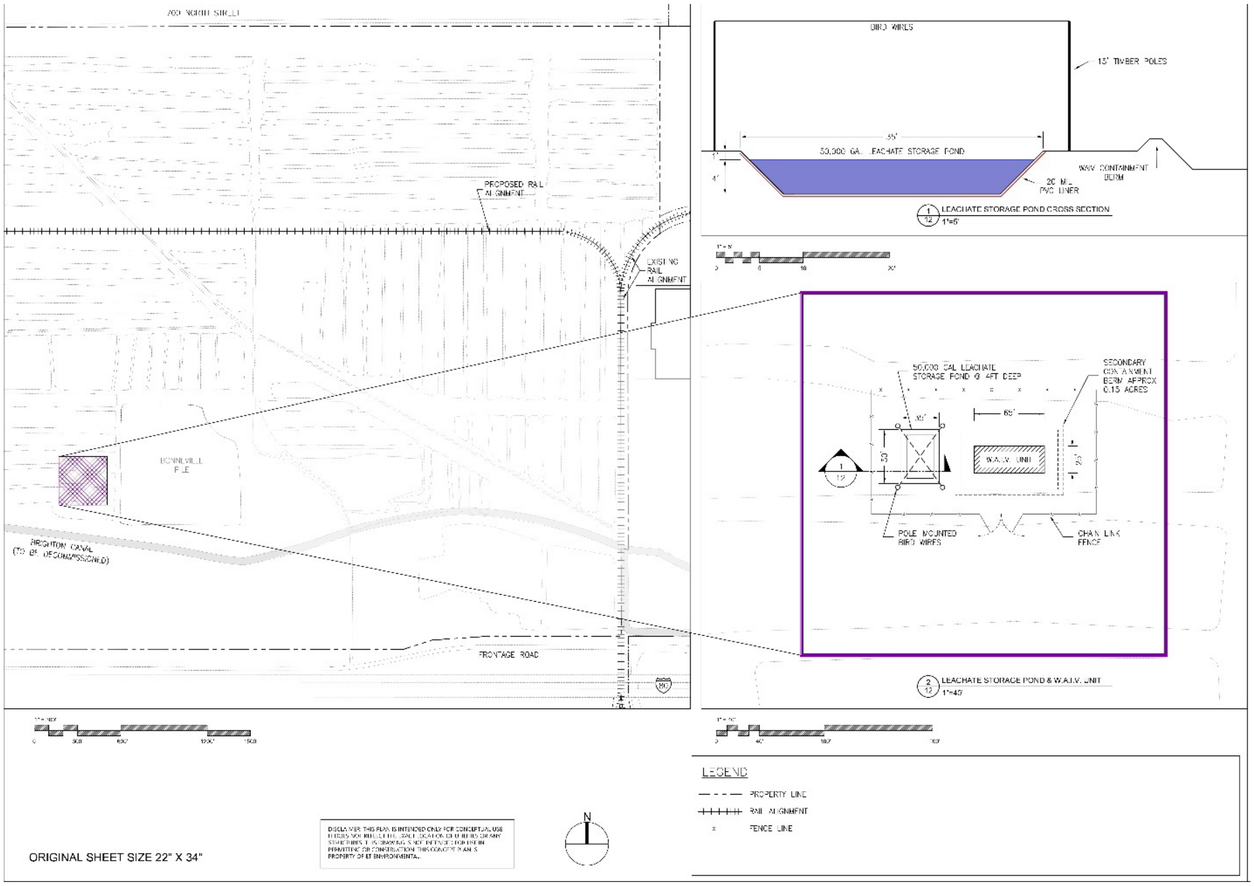


*Figure 12 – Leachate Storage Detail (See Also Appendix A-12)*

The odor control system will be constructed prior to onset of excavation activities. The detailed description of the system is in Section 5.5.1.

## 4.4 REPORTING

### 4.4.1 Weekly Remediation Construction Meetings and Reports

Weekly on-site construction meetings will be held with representatives of UDEQ, SITLA, Salt Lake City, Salt Lake County Health Department (as appropriate) and selected remediation contractors and the third-party observer. Weekly progress reports will accompany the meetings identifying that week's work progress, the following week's work schedule, ongoing environmental management program and testing efforts, unexpected occurrences and identification of proposed modifications to the work effort.

### 4.4.2 Stakeholder Management Plan

SITLA will maintain communication of the cleanup process with stakeholders including Salt Lake City Public Works Department and Salt Lake County Health Department, and local community groups. These communications will occur regularly over the course of the projects twelve-month duration initially planned prior to the start of new field construction activity (i.e., mobilization of equipment, waste excavation).

### 4.4.3 Reported Deviations from the Remedial Action Work Plan

Given the nature of the field efforts and the scope of the project we would anticipate that certain modifications to the means and methods set forth in this RAP will need to be adjusted or modified. These adjustments will be discussed with UDEQ and documented in the weekly reports as well as the final remedial action report to be submitted to UDEQ at the conclusion of the Phase I field efforts.

# 5.0 REMEDIAL ACTION

## 5.1 REMEDIAL PERFORMANCE EVALUATION

### 5.1.1 Methodology, Reporting and QA/QC

The Phase I remediation efforts incorporate three distinct field operations; excavation of waste, construction of a new waste repository and the collection, evaporation, treatment and disposal of leachate which is discussed in detail within this section 5.0.

Prior to waste excavation, cover material will be removed from on top of the cells and segregated for subsequent use as cell backfill material or cover material in the repository. Waste material will be excavated from the trench (cell) along the cell wall and down to the underlying cell clay bottom. Photo documentation will be kept for each cell to confirm that the waste was removed before trench backfilling efforts with clean fill material begin.

Periodic inspections of the waste repository will be performed by UDEQ and Salt Lake County Health Department as waste is being placed and the repository features are being constructed. The final cap of the repository will be inspected by both UDEQ and Salt Lake County Health Department to ensure that the cap has been constructed in accordance with the design criteria set forth in this RAP.

Leachate extracted from the waste cells or collected as contact stormwater will be evaporated and treated as necessary per pretreatment standards at the local POTW prior to disposal. Utilization of activated carbon as a final treatment application (as established in the leachate pilot study) has been demonstrated to be an effective approach to meet the industrial pretreatment standards. Specific volumes, timing and industrial pretreatment criteria will be discussed and negotiated with the individual POTW.

Weekly on-site construction meetings will be held with representatives of UDEQ, Project Sponsor, selected remediation contractors and the third-party observer. Weekly progress reports will accompany the meetings identifying that week's work progress, the following week's work schedule, critical action items, unexpected occurrences and identification of proposed modifications to the work effort.

A final report will be produced at the completion of the field activities documenting the work that has been performed and submitted in support of the request for the Administrative Letter for the Phase I remediation efforts to be issued by UDEQ.

The work will be completed in accordance with the governing documents set forth in Appendix C. The QA/QC for the project will be administered by the environmental professionals from Cardo Stantec, ET Environmental and Ninigret Construction all of which have had a 10 year plus history working on this landfill.

## 5.2 WASTE EXCAVATION

### 5.2.1 Repository Design and Operation

The fundamental concept in the Phase I waste excavation is to relocate the waste to an onsite repository instead of exporting the waste to offsite landfills. Plan view details of the repository are included in **Figure 13/Appendix A-13**. The operation of the repository will mimic that of all operating MSW landfills in as much as many of the operating and environmental controls will be very similar:

- Waste will be covered daily using alternate daily cover tarps.
- Soil cover will be used in intermediate lifts.
- Exposed soil cover will be protected from erosion with hydroseeding or other measures.
- Odor control devices will operate in the vicinity of the working areas.
- Air emission monitoring will take place during waste placement.
- The repository will be inside the compliance boundary of Phase I and within the proposed groundwater monitoring well network.
- A RCRA Subtitle-D compliant cap system will be completed when waste filling operations are complete **(see Figure 24/Appendix A-24).**
- The completed cap will be vegetated and maintained as greenspace.

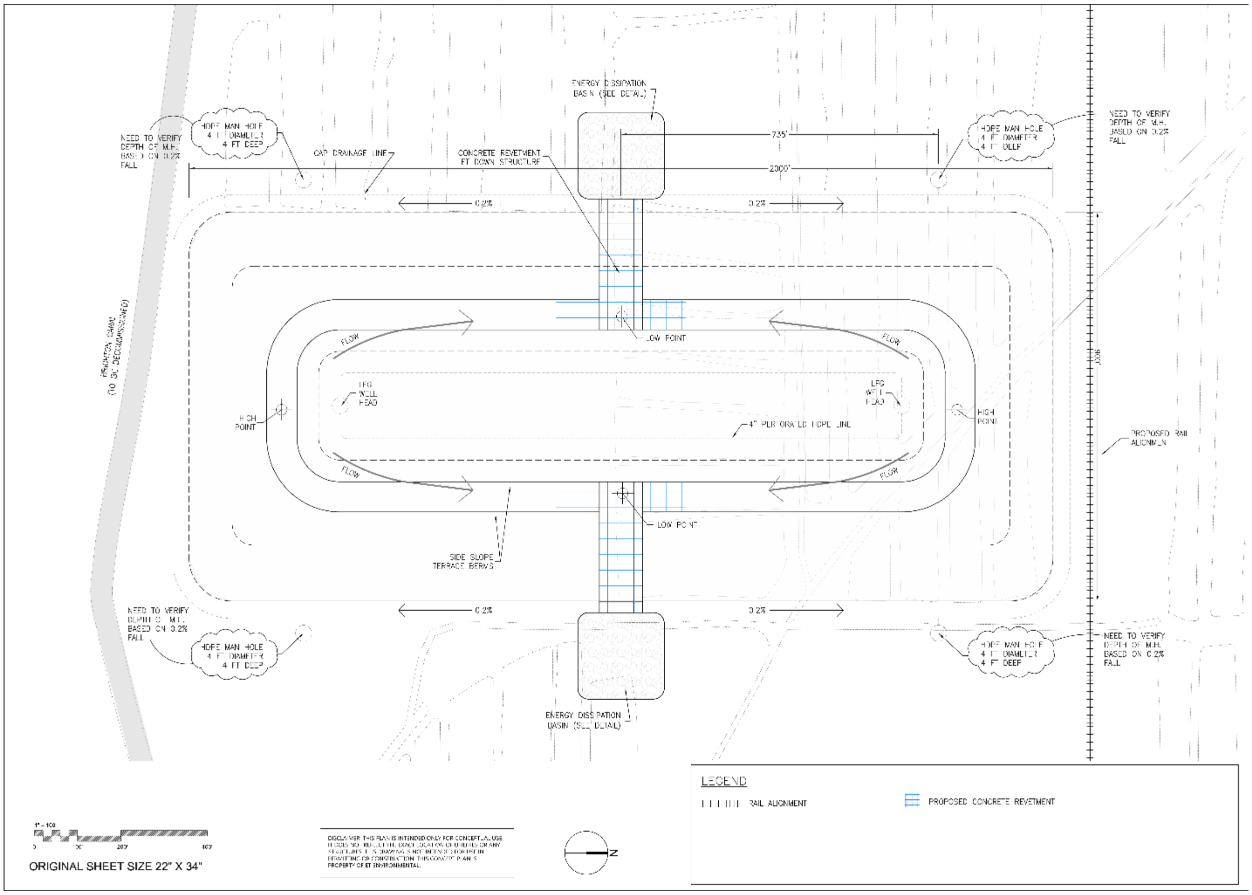


*Figure 13 – Repository Plan View (See Also Appendix A-13)*

Upon mobilization, the excavation operations will commence simultaneously in the Bonneville Pile area and the Northern section of Phase I. The Initial site operation will be to prepare the waste repository. This will consist of minor excavation and leveling of the footprint of the repository, and if needed, the placement of (previously) crushed concrete up to a depth of 12" to provide a stable foundation for waste placement. The clearing and grubbing materials will be stockpiled for future disposal and or composted. Any waste exhumed in the base preparation will be placed into the repository footprint **(See Figure 14/Appendix A-14).**

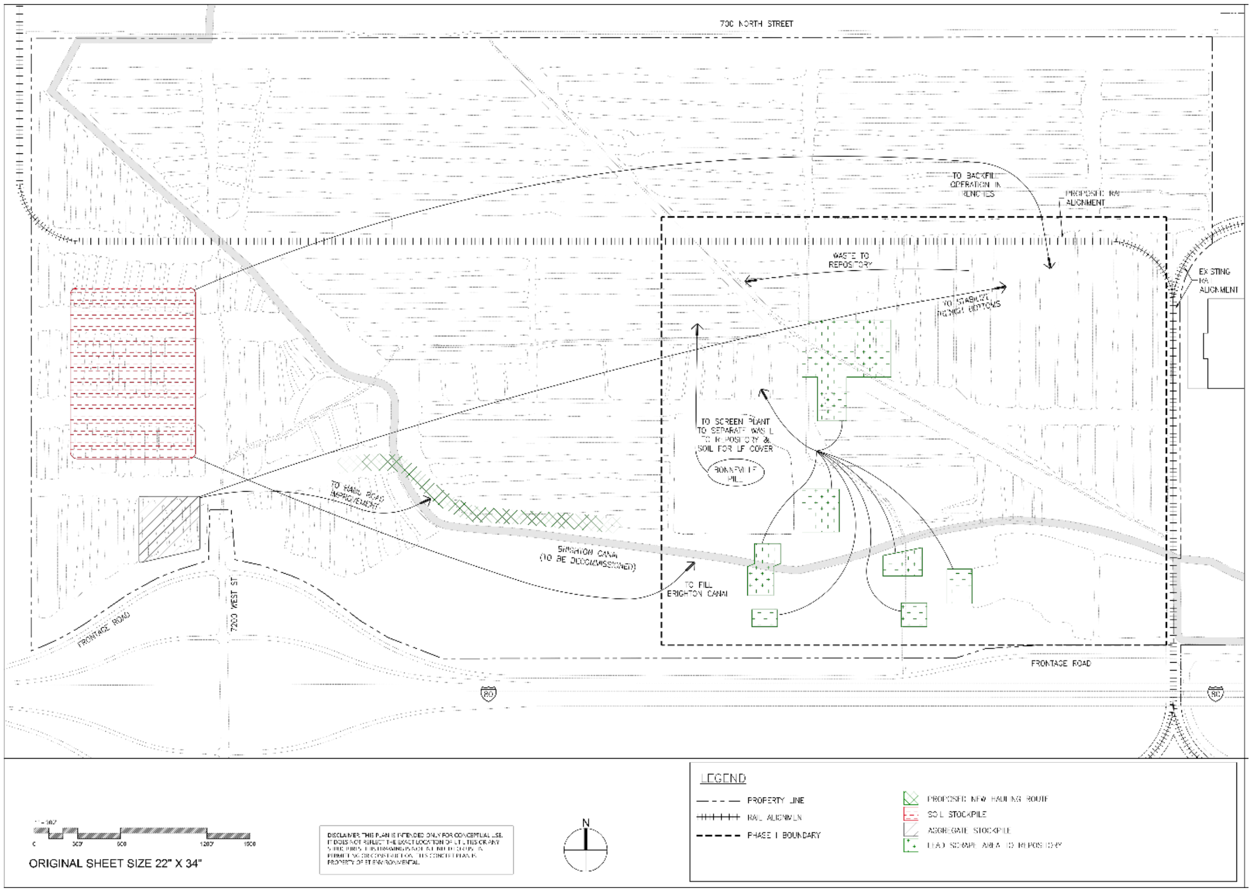


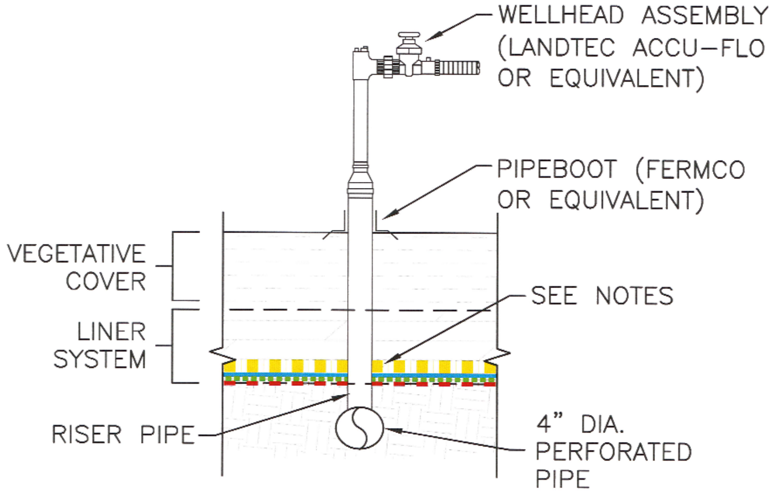
*Figure 14 – Material Flow Diagram (See Also Appendix A-14)*

Once the MSW is removed and placed in the repository, the repository will be capped with an intermediate layer of soil (6" minimum). The intermediate soil layer may be hydroseeded depending on climatic conditions, as we anticipated delaying final cap construction for 60 days following topping out to allow for settlement to occur.

When the final cap construction begins, the intermediate soil cover layers and any existing vegetation will be regraded to a minimum of 6" soil cover. The soil cover will comply with the specifications suggested in Appendix D. This layer will be subgrade for the placement of the geo-composite clay layer (GCL) (See product information in Appendix D) and it will be inspected for presence of any rocks or other sharp material prior to placement of the GCL. Only clean non-environmentally impacted material will be utilized in the soil layer supporting the final vegetative cover of the cap.

The final repository cover will have a geonet wet drainage layer which will terminate into a toe drain, consisting of a 4" PVC pipe. The pipe will be sloped for gravity drainage to HDPE manholes which will function as temporary storage. This liquid is percolate through the vegetative cap and should be stormwater. It will be tested and if clean, can be disposed in the future stormwater management system when the Phase I Development is complete. During the interim period of time, the HDPE manholes will be pumped when full and disposed off-site.

The repository also features perforated LFG collection piping to be installed in the highest portion of the repository crest **(See Figure 15)**. These collector pipes will exit the final liner in vertical wellheads with sampling ports. LFG accumulation (if present) can be monitored and tested for methane and pressure periodically. If a significant amount of internal pressure builds up, then the well heads can be connected to a solar powered utility flare for combustion. Based on previous studies, very little LFG accumulation is expected.



NOTES:
RISER PENETRATIONS
- GCL – BENTONITE CLAY SEAL AROUND RISER
- LLDPE LINER – PE BOOT (FERNCO OR EQUIVALENT)
- GEO NET – PE BOOT

LEGEND:

| | |
|---|---|
| ▪ ▪ ▪ ▪ ▪ ▪ | GEO NET |
| ━━━━━ | 40 MIL LLDPE |
| ┈┈┈┈┈ | GCL |
| – – – – – – | TOP OF 6" SOIL LAYER |

SCALE: N.T.S.

DISCLAIMER: THIS PLAN IS INTENDED ONLY FOR CONCEPTUAL USE. IT DOES NOT REFLECT THE EXACT LOCATION OF UTILITIES OR ANY STRUCTURES. THIS DRAWING IS NOT INTENDED FOR USE IN PERMITTING OR CONSTRUCTION. THIS CONCEPT PLAN IS PROPERTY OF ET ENVIRONMENTAL.

*Figure 15 – Landfill Gas Wellhead (See Also Appendix A-15)*

### 5.2.2 Waste Excavation

Waste excavation efforts will begin with the removal of the soil cover material which will be placed and stockpiled adjacent to the trench to be utilized as backfill or cover material in the repository. Waste will then be removed from the cell exposing the side cell walls and the cell clay bottom.

The northern boundary of Phase I will be adjusted, if necessary, to allow for the complete excavation of the waste cells. The presence of MSW is suspected adjacent to the short line rail track along the eastern border but is not believed to exist under the rail. The excavation will progress to the east, approaching the rail and the determination will be made as to whether the rail bed is underlain with MSW or not. If waste is determined to exist under the rail spur, we will consult with the property owner (Patriot Rail) to determine the best course of action in consultation with UDEQ.

#### *5.2.2.1 Dry Waste Operations*

As the excavation of waste from the old landfill commences, the dry waste will be placed in off-road haul vehicles, covered and transported to the repository and placed. The dry waste will be compacted by a Caterpillar 836 LF compactor (or similar). Geosynthetic polyethylene tarps will be used to cover waste. The tarp covers will remain until a soil cover layer is placed. In this application, and in every other application of tarps used as daily cover, sandbags will be placed on the tarps at the end of the day to prevent dislocation by wind. This excavation operation will continue as described until the waste excavation encounters leachate (see below).

The second operation will be the excavation and relocation of the "Bonneville Pile", waste which was previously relocated from the former NTL East Landfill and placed on the NTL site under a previously approved plan with UDEQ. The clean cover material will be removed from the Bonneville Pile and stockpiled and used in the backfilling operation of the waste cells as discussed in Section 5.2.8. Previous investigation of the material within the Bonneville Pile indicates the waste is both dry and mixed with approximately 50% soil fines. The intent will be to segregate the soil fraction and the waste fraction by processing the excavated material through a trommel screen. The soil fines will be stockpiled and either used as trench backfill or utilized within the repository construction as appropriate, with the waste being placed in the repository in a similar fashion as the waste being excavated from the cells. Soil recovered from the Bonneville Pile trommel process, Bonneville Pile cover material, and existing MSW trench cover material to be utilized as trench backfill will first be tested for RCRA 8 metals, VOCs, and SVOCs every 5,000 cubic yards following standard procedures to ensure the material is suitable for backfill. The stockpiled soil to be utilized as trench backfill will also be evaluated in accordance with Utah asbestos regulations.

#### *5.2.2.2 Wet Waste Operations*

As the excavation progresses to the north and west in Phase I, it is anticipated that leachate will be encountered in the excavation, thus a fraction of waste to be excavated will be wet. Wet waste removed from the trenches will be placed trench-side on geosynthetic tarps to drain free liquids back into the excavation. The trench side waste will be covered with tarps and left for 48-72 hours to drain before transportation to the repository.

The remnant leachate in the cell will be pumped to the leachate storage pond prior to being directed to the leachate evaporation system. The leachate pond is sized for 50,000 gallons of storage based on the estimation of leachate to be generated in Phase I.

The leachate, if any, contained within the waste cells beneath the repository will be dewatered using displacement pumps. Approximate locations of these displacement pumps are included in **Figure 16/Appendix A-16.** 12" diameter sumps will be drilled into each trench and insert slotted 8" diameter PVC casings. Pump intakes will be situated at the bottom of the casing and the pumpage will be collected in the leachate pond which will supply the evaporator. These details are included in **Figure 17/Appendix A-17** below. This process will begin before the repository footprint is developed to ensure sump/trench access is maintained. The waste trenches will be dewatered along with the immediate area surrounding perimeter of the Bonneville Pile. Multiple pumping attempts will be made until a measurable quantity of leachate can no longer be extracted. The well points will be decommissioned as the site excavation process proceeds.

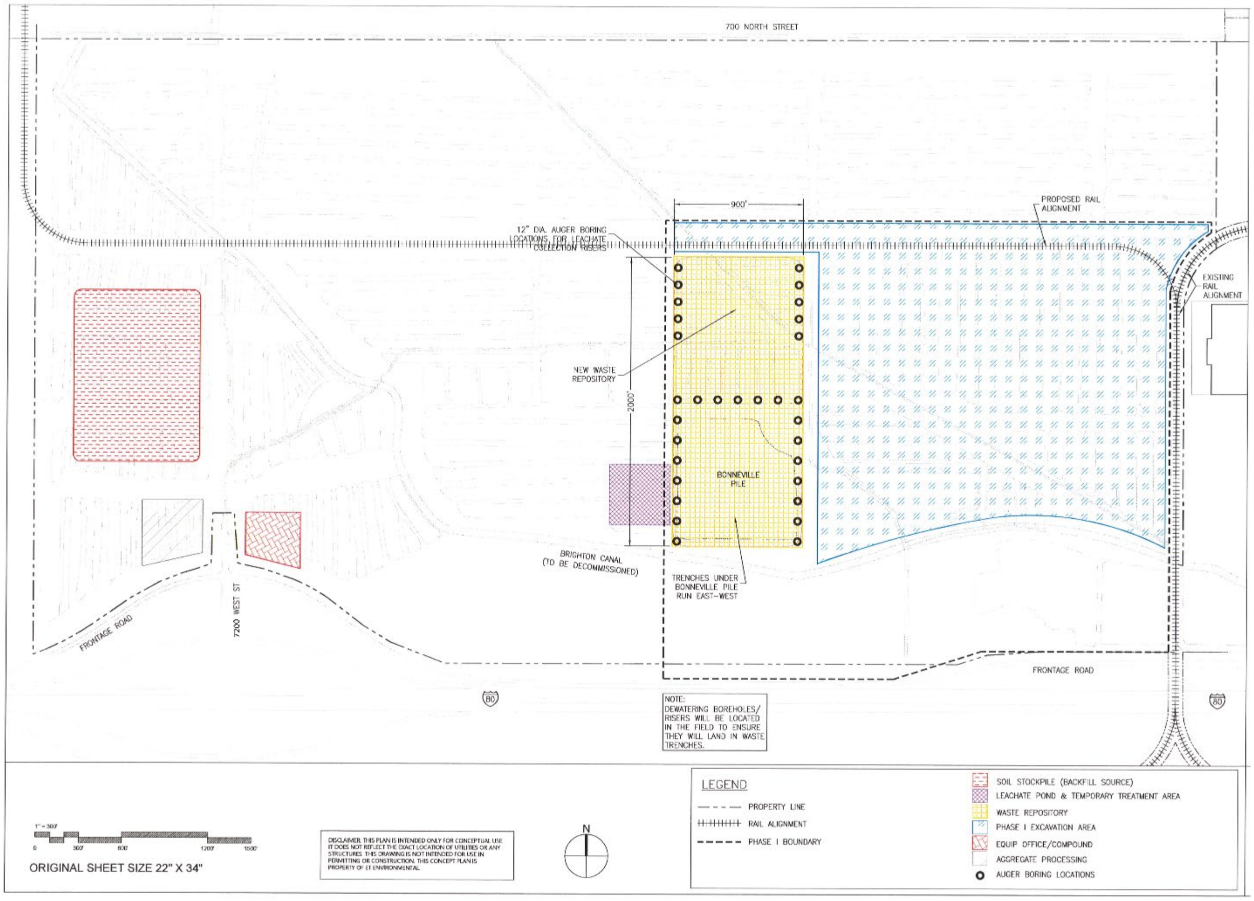


*Figure 16 – Leachate Dewatering Plan (See Also Appendix A-16)*

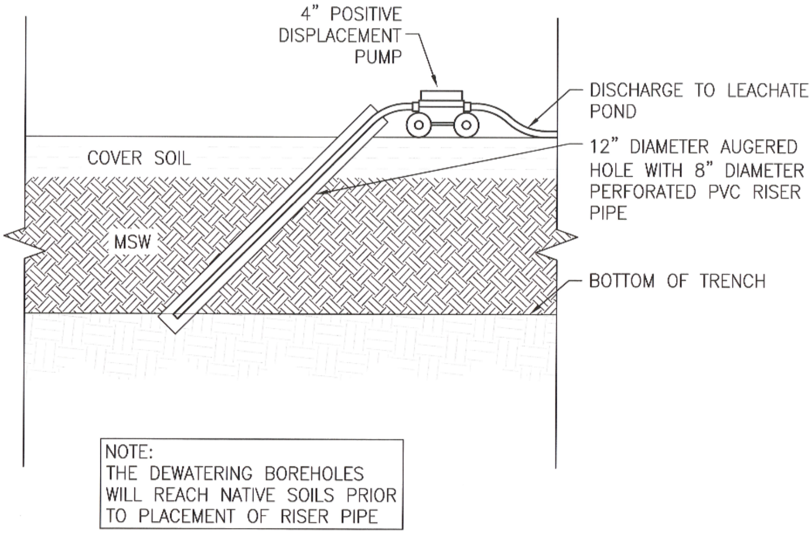


*Figure 17 – Leachate Dewatering Detail (See Also Appendix A-17)*

Prior test pit excavation demonstrated that what we have referred to as “dry waste” (waste that was above the level of leachate saturation) is typically damp and does not generate dust upon the excavation from the waste cells. As such, we do not anticipate having to precondition the MSW with moisture for grading/hauling/depositing the repository.

The haul roads in Phase I will be decommissioned after end of the remediation process. Prior to the aggregate being removed and stockpiled, the X-Ray Fluorescent Scanner (XRF) utilizing EPA Method 6200 will used to scan the haul road surface for potential contamination. If clean, the aggregate will be removed and stockpiled. Where we find exceedances, the materials will be isolated and placed in the repository. Given that no waste will be hauled west of Phase I, the haul roads will not be scraped for lead removal.

### 5.2.3 Lead Shot Removal and Repository Placement

After the commencement of the waste excavation, the portion of the site south of the Brighton Canal (the site of a Sporting Clays Range) will be addressed. The remedy will be removal of the upper 6” of soil and vegetation for those areas identified as containing the lead shot. This material will be placed in the repository. **Figure 18**, which is a zoomed in version of **Figure 11/Appendix A-11,** illustrates the areas in green that have lead shot contamination that will require removal. Prior to this effort, representatives from the owner and UDEQ will conduct a visual reconnaissance of these areas, including the cover of the Bonneville Pile, and determine the estimated boundaries of scraping as needed.

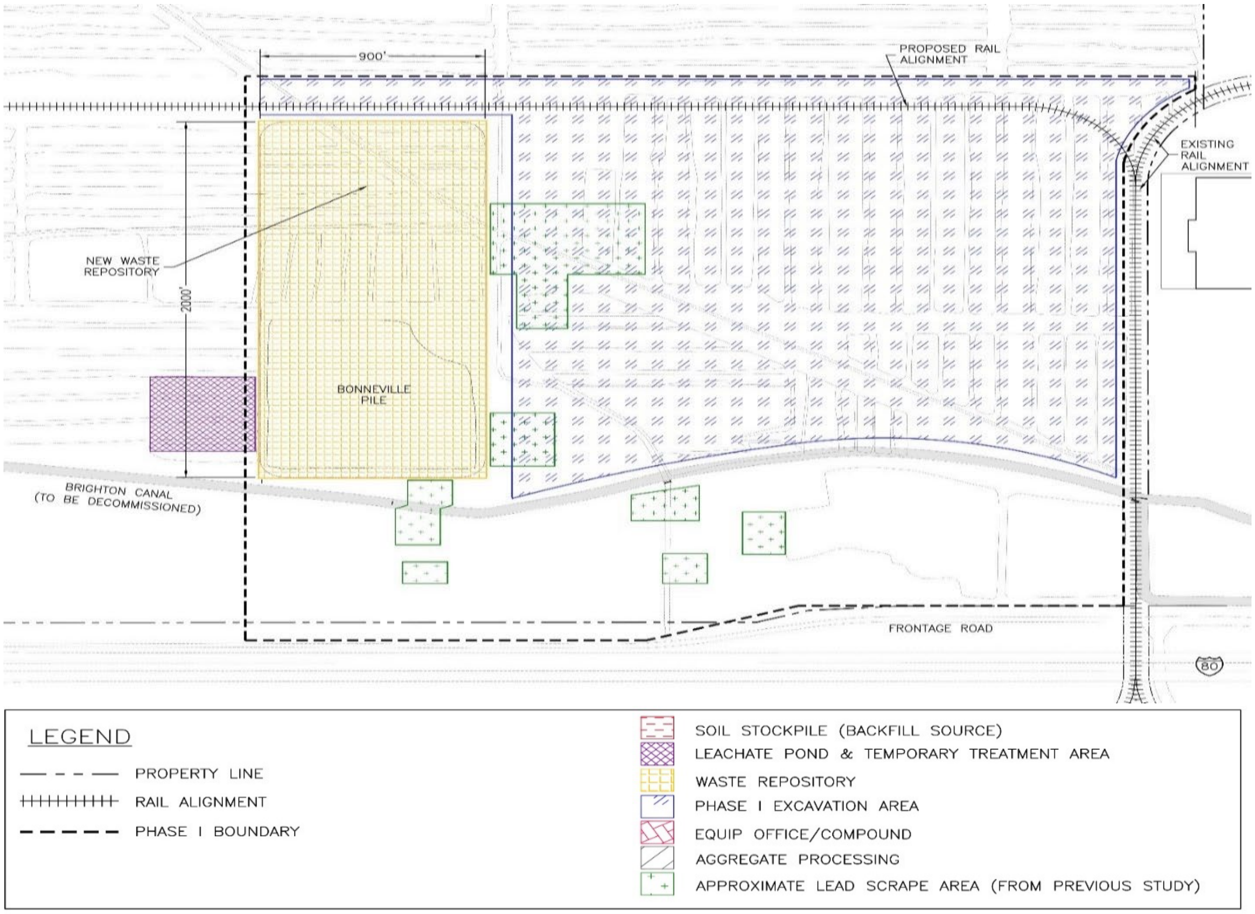


*Figure 18 – Lead Shot Removal Areas (In Green)*

### 5.2.4 Brighton Canal Decommissioning

SITLA, in cooperation with the Brighton Canal Company and Property Reserve, Inc. (PRI), will divert the transport of irrigation water across the NTL site prior to the onset of remediation activities. As such, the Brighton Canal will be decommissioned in its reach within the Phase I area **(Figure 19/Appendix A-19)**. The canal will be dewatered, de-mucked, and backfilled to grade with on-site clean fill material. The goal is to remove sediment down to native soils which we anticipate being at depths between 6 and 12 inches. The de-mucked material will be stored in a stockpile and will subsequently be tested with an XRF utilizing EPA Method 6200. Any impacted soils will be placed in the repository.

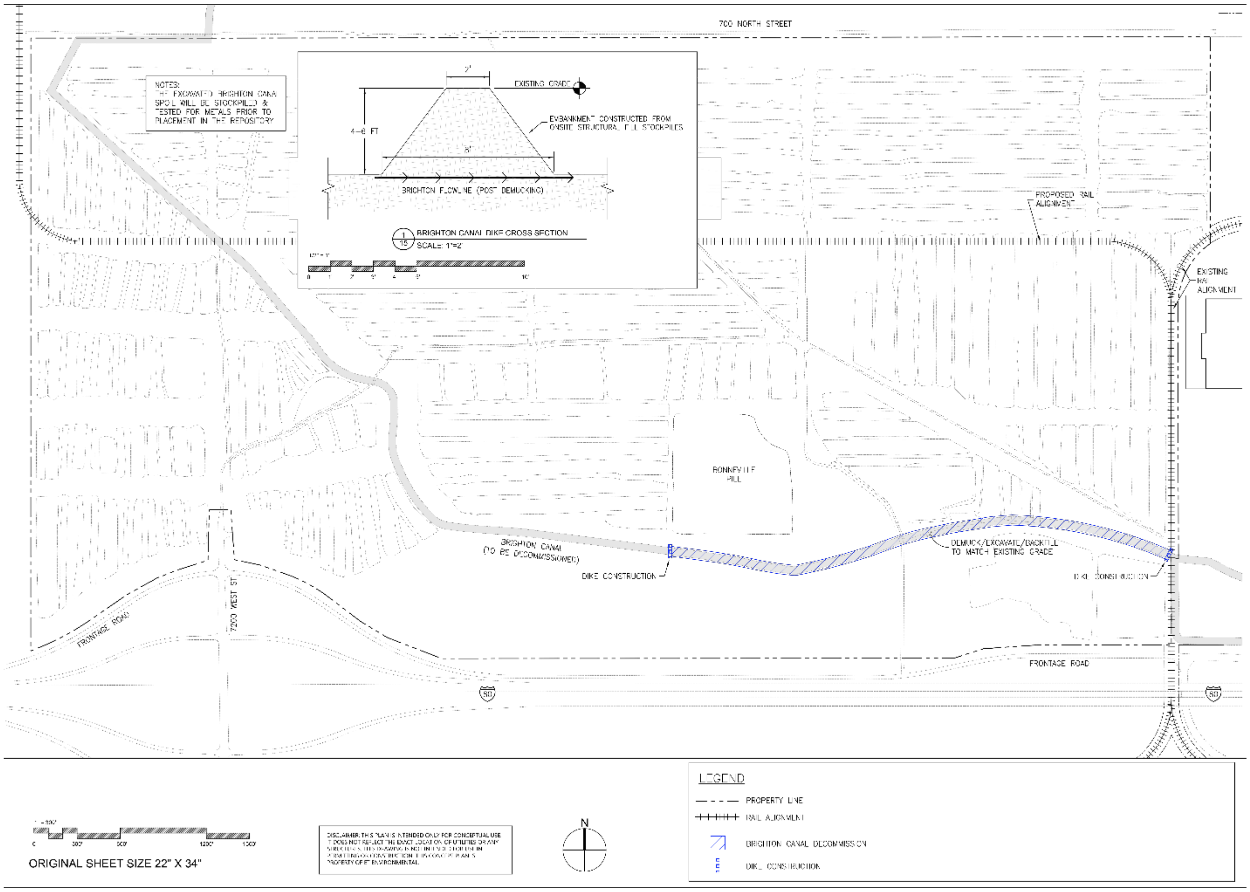


*Figure 19 – Brighton Canal Decommissioning (See Also Appendix A-19)*

### 5.2.5 Leachate Management, Treatment and Disposal

The management leachate program for the Phase I remedial efforts has been designed to facilitate a substantial volume reduction in the leachate collected through enhanced evaporation which is to be followed by on-site treatment of the remaining leachate, as necessary, to meet the established industrial pretreatment standards of one or more local POTW's. As part of the previous site characterization efforts, a leachate treatment pilot study was conducted where leachate from various locations (and disposal periods) was collected in a series of Baker tanks and subjected to a series of alternative treatment methods (see Supplemental Site Characterization Study August 2018). While a variety of methods were successful in treating the leachate to meet local POTW pretreatment standards, the use of carbon treatment after evaporation was selected as the preferred method for Phase I.

The leachate will be reduced in volume using a WAIV® Evaporator System (WAIV-Wind-Aided Intensified Evaporation). This system employs a series of draped fabric sails that are continuously saturated with leachate. This system is capable of evaporating 2000-5000 gallons/day depending on climatic conditions. This system will operate during the primary work shift during daylight hours **(Figure 20/Appendix A-20)**.

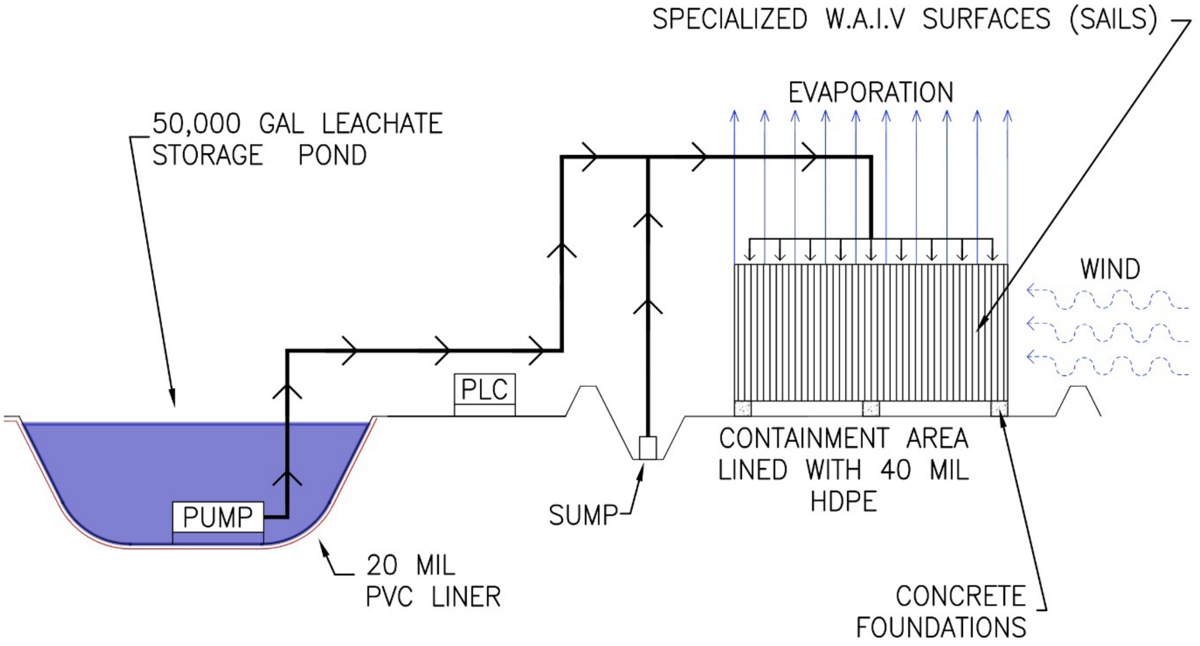


*Figure 20 – WAIV® Evaporator System (See Also Appendix A-20)*

Any leachate not evaporated by the WAIV system or collected in the containment berm (that will be installed around the WAIV system) will be pumped back to the leachate storage pond. The remaining fraction of the leachate that cannot be furthered by the WAIV system will be passed through a two-pass carbon filtration system (similar to that employed in the leachate pilot treatment system C.2019), and either passed back through the WAIV system for further evaporation (volume reduction) or after meeting the applicable pretreatment standards transported off-site by a Salt Lake County permitted waste hauler to a local POTW. Leachate that has passed through the WAIV system, and if necessary, the carbon filtration system, will be analyzed for compliance with the local POTW pretreatment standards and permit requirements and presented to that POTW for confirmation of acceptance. Once accepted, documentation will be presented to DERR. A diagram of the entire leachate management process can be seen in **Figure 21/Appendix A-21.**

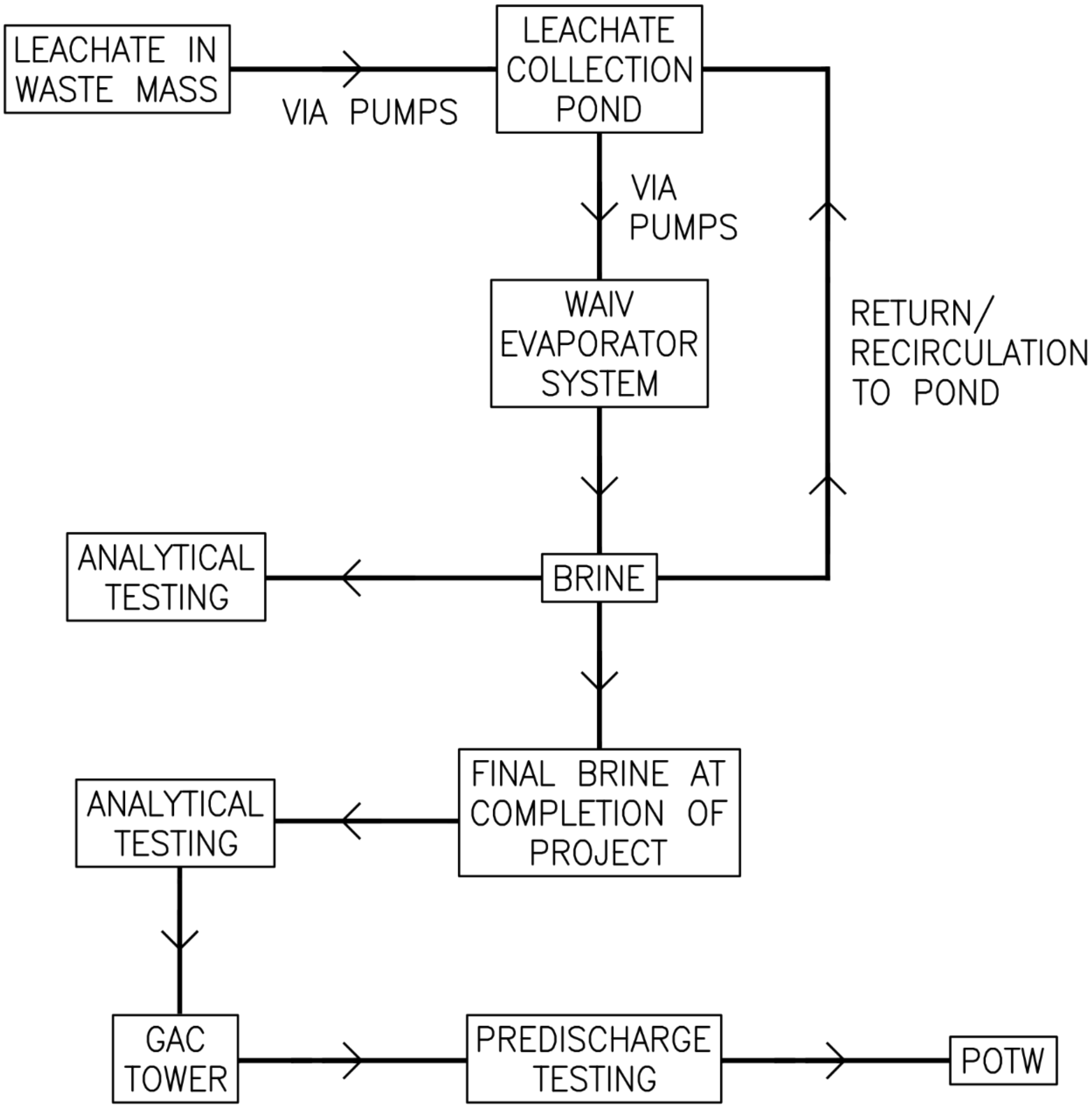


*Figure 21 – Leachate Management Process Flow Diagram (See Also Appendix A-21)*

### 5.2.6 On-Site Waste Transport

A series of haul roads will be constructed on-site to allow for the transport of waste and materials. The haul roads within the Phase I area will have their subgrade soils scraped and that material stockpiled for future disposal in the repository. The haul road surfaces will be crushed recycled aggregate from the western stockpiles, placed and compacted, to support the hauling efforts. Waste will be excavated from the existing trenches by large hydraulic excavators and placed in articulating, off-road dump trucks, where possible, given saturation conditions. If saturated, the waste will be windrowed adjacent to the trench to dry for 24-48 hours and covered with tarps. Because the free liquids will be drained back into the trench and because of the solid body nature of the articulated trucks, the truck beds will not be lined.

Waste transported within off-road vehicles will traverse the site to the location of the new waste repository and be placed. Compaction will occur as landfill-style compactors (ex. Caterpillar 836) make multiple passes over the waste.

Concurrently, off-road dump trucks will transport processed concrete aggregate and structural fill materials from the existing stockpiles on the western edge of the site, to be placed as stabilization stone for soft subgrades, or trench backfill, respectively. A material hauling plan including haul routes is provided below as **Figure 22/Appendix A-22.**

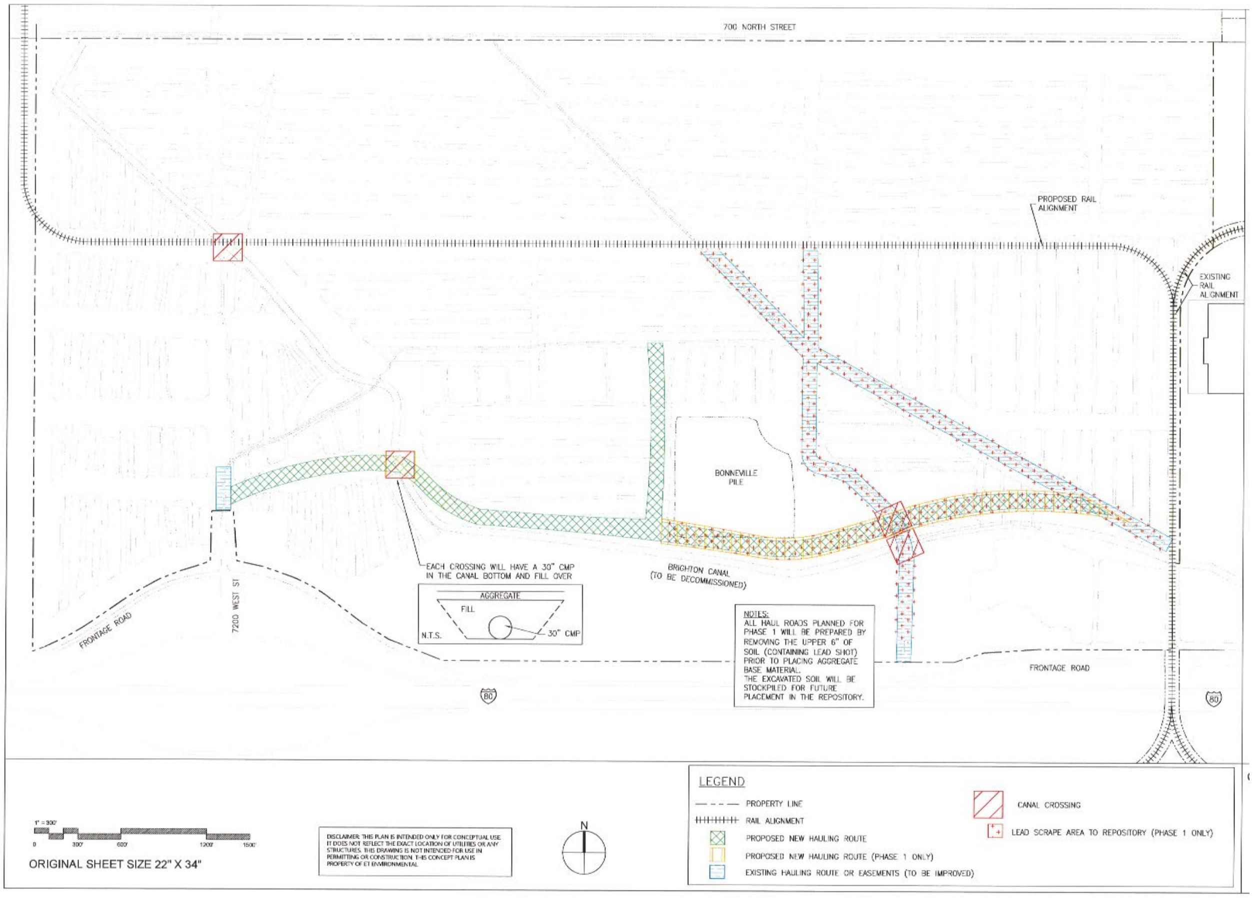


*Figure 22 – Material Hauling Plan (See Also Appendix A-22)*

### 5.2.7 Waste Placement in Repository

The waste will be placed in the repository as the excavation proceeds. Concurrently, excavation and screening will begin in the Bonneville pile, located in the southern portion of repository footprint. The dry waste (as confirmed by previous exploration) will be hauled northward to be co-placed with freshly excavated waste, and the soil fraction will be temporarily stockpiled west of the repository and used as intermediate soil cover.

**Figure 23/Appendix A-23** depicts the gradual cell/layer style of construction, sequentially raising the repository elevation as excavation proceeds. Temporary alternate daily cover tarps will be periodically replaced with soil covers and the entire repository will have a soil cover layer prior to final cap construction. The final cap structure will be constructed on the final repository fill excavations. The cap will consist of select granular fill overlain by a geo-composite clay layer (GCL) and a 40-mil low linear density polyethylene (LLDPE) membrane. The cover over the liner will consist of a drainage layer and three feet (3') of vegetative cover. No soil mined from the Bonneville Pile will be used in the vegetative cover layer.

The vegetative cover will be compiled of drought-tolerance grasses. Salt Lake County guidance on native plant cover suggests a mixture of India Rice grass, Mutton Grass, and Blue Bunch wheatgrass will succeed in this drought-prone environment. Permanent cover will be maintained as part of the O&M efforts maintaining at least an 80% coverage across the vegetative cap. Any deep-rooted vegetation that could occur in the future will be eradicated.

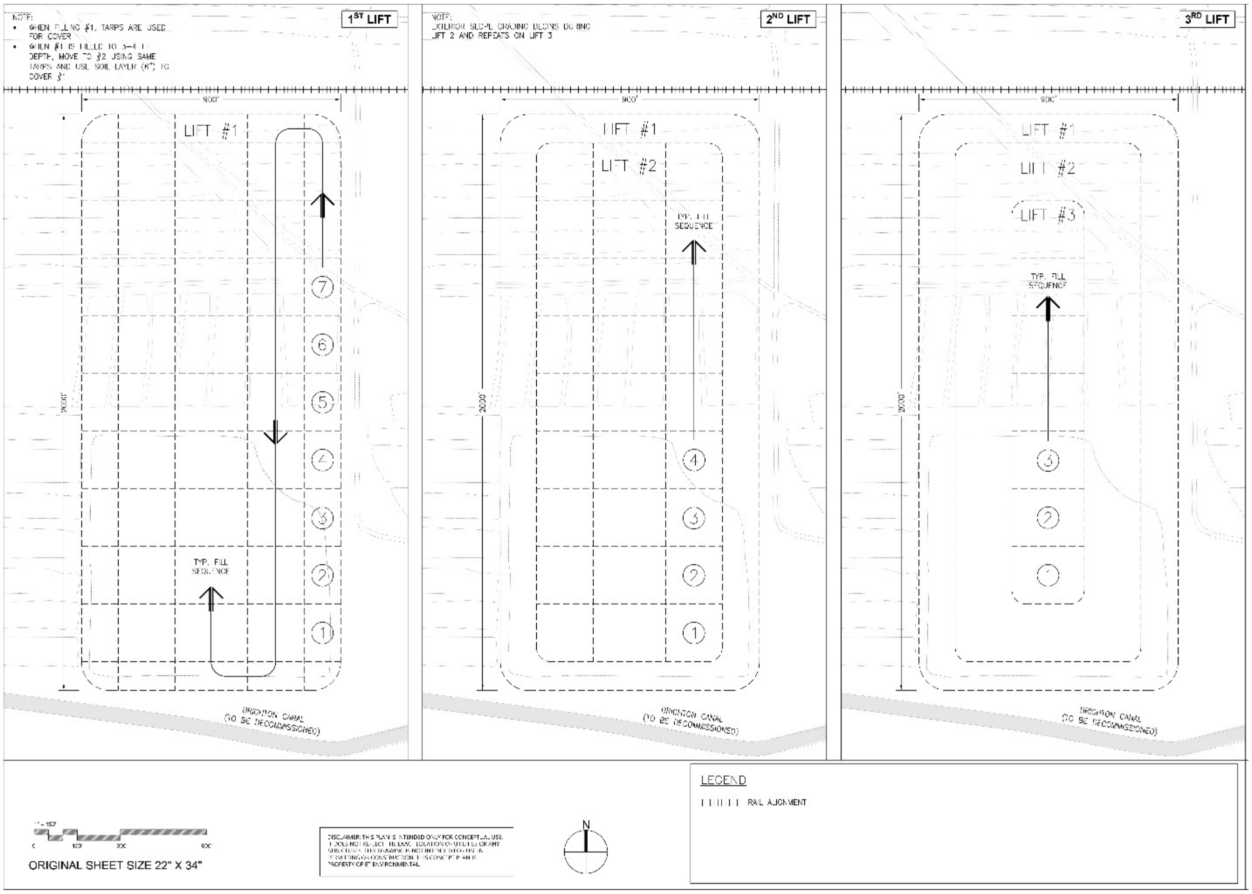


*Figure 23 – Repository Fill Sequence (See Also Appendix A-23)*

## 5.2.8 Cell Backfill from On-Site Sources

There is a large quantity of crushed concrete and granular borrow stockpiled on the western edge of the site which can be utilized as necessary as structural backfill in the trenches following waste removal when necessary. The granular borrow material is clean native material that was imported from the excavations associated with the construction of the parking structure for City Creek. The concrete was generated by the demolition of those buildings to allow for the same development. The concrete was segregated at the site, environmental tested on-site to be clean and manifested for delivery to be stockpiled and later processed. The material was again checked at the point of entry confirming the delivery with the materials manifest. This material will again be tested using an XRF (EPA Method 6200) every 5,000 cubic yards prior to use as trench backfill or cover for the repository.

It is not anticipated that any off-site borrow material will be needed for these Phase I efforts. However, should additional fill be needed for future phases from off-site sources that material will be appropriately tested to ensure the material is acceptable for future commercial/industrial land use.

Removal of waste materials will include 6" of cut of the trench bottom/waste interface. In those instances where the exposed trench bottom requires additional stabilization prior to backfilling of the trench, the stockpiled material will be utilized to provide a sufficient material bridge to allow the trench filling operations to begin. Structural fill soil will then be placed up to the existing grade.

As discussed in Section 5.2.2.1 previously, soil recovered from the Bonneville Pile trommel process, Bonneville Pile cover material, and existing MSW trench cover material to be utilized as trench backfill will first be tested for RCRA 8 metals, VOCs, and SVOCs every 5,000 cubic yards following standard procedures to ensure the material is suitable for backfill. The stockpiled soil to be utilized as trench backfill will also be evaluated in accordance with Utah asbestos regulations.

## 5.3 WASTE EXCAVATION CONTROLS AND SUPPORT

### 5.3.1 Vapor/Air Monitoring

As referenced in several sections of the plan, various types of air and vapor monitoring will be used in the active remediation phase.

- The multi-gas meter will be deployed during all excavation operations. The device(s) will monitor the air emissions at the excavation trench side, the temporary stockpiles of the waste trench side, and in the repository at point of MSW deposition. These emission readings will be utilized to identify the appropriate level of PPE for potential exposure associated with the particular work zone in accordance with the Health and Safety Plan (HASP) found in **Appendix C**.
- Emission monitoring at point of excavation. Using a hand-held Photoionization Detector (PID) monitor, site personnel will be at trench-side monitoring for off gassing of vapor/LFG emissions.
- Concurrent air emission monitoring for fugitive ACM dust/fiber will be ongoing at point of excavation and processing (see Section 5.4.2).
- Emission monitoring at repository. The same procedure as above will take place at the point of waste placement.
- Leachate pond/evaporation. Periodically, emissions will be monitored at the pond and evaporator.
- Odor/emission monitoring at sensitive perimeter receptors. The PID and the field olfactometer will be used together (to objectively characterize odor reading with PID readings) at both trench excavation and along the sensitive receptors at the north, east, and south property boundaries.
- Aerial drone scans to measure LFG emissions will be performed at the onset of trench excavation, the mid-point of remediation, and at the end when the landfill cap is complete.

### 5.3.2 Confirmation Sampling

As discussed above, the waste excavation will extend to the side berms removing the layer of waste/soil interface. At the bottom of the trench cell, an additional six inches of the bottom waste/clay interface will be removed ensuring that all the waste is removed from the cell. Photographic logs will be included in the daily field reports, documenting the removal of the waste within each trench.

Analytical sampling of the soil beneath the waste in the previous site characterization studies has documented that the soil beneath the waste cells have experienced minimal impact. The soil tests within Test Pit soil samples within the Phase I area exceeded the PSL for arsenic in soil. No other analytes exceeded their PSL in soils. The PSL for arsenic in soil used was the EPA RSL (3.0 mg/kg) for an industrial land use soil with no engineering or institutional controls. The proposed Remedial Action Level (RAL) for arsenic in soil is 300 mg/kg for the industrial land use with engineering controls identified in the SMP.

To ensure the complete removal of waste and potentially impacted soil beneath the waste, confirmation sampling will be collected to demonstrate the remaining soil is below the established RALs. RALs have been proposed for the analyte groups for VOCs, SVOCs, PFAS and RCRA metals (See **Table 2/Appendix A-29**). Certain compounds within these analyte groups, while not identified in the soil, were identified in the groundwater samples within the characterization studies for the Phase I area (see 2021 Phase I SI). Including these groups, which were detected in the groundwater, as part of the soil confirmation sampling list will minimize the risk of leaving potential ongoing impacts to the groundwater. Including these analytes as part of the soil confirmation sampling will ensure that potentially hazardous concentrations, if any, not previously identified in the soil have been tested for.

In general, the RALs are based on the EPA RSL calculated values using the lifetime carcinogenic risk of 1 x $10^{-4}$ and an HQ of 1.0. Testing for PAHs will be included in the SVOC method list. During the initial excavation process north and northwest of the proposed new repository (located in the northwest area of Phase I), confirmation soil samples will also include PFAS compounds. Approximate sample locations are shown on **Figure 28/Appendix A-28**. This area of the Phase I area has been identified as having the higher concentrations of the detected PFAS compounds in the groundwater. If the sample results are below the RALs, the PFAS testing will be suspended and considered not necessary for the remainder of the Phase I area. The PFAS RALs will also be based on the EPA RSL calculated values using the lifetime carcinogenic risk of 1 X $10^{-4}$ and an HQ of 1.0.

The confirmation soil samples will be collected at a frequency of one sample per every 300 linear feet of trench. The samples will be discrete samples and will be collected by the bucket of the track excavator. The sample will be collected by removing two 4-ounce portions from the larger bulk sample in the bucket. Each of the 4-ounce samples will be placed in new clean glass sample jars identified by a unique sample ID. The ID will include the sequential sample number of the trench, the unique trench ID number and be identified as a soil confirmation sample. Care will be taken to not collect any portion of the bulk sample which may have been in contact with the bucket.

Soil gas sampling will be conducted to determine the potential for indoor air concentrations resulting from the post waste removal areas. The areas where MSW was removed and backfilled will be monitored for the TO-15 volatile compounds and compared to the EPA VISL target sub-slab and exterior soil gas concentrations. These levels will be based on their HQ of 1 and a carcinogenic risk at 1 in $10^{-4}$. Soil confirmation sampling data will be used to identify areas of elevated potential for soil gas vapor intrusion for indoor air.

### 5.3.3 Stormwater Management at the Repository

Prior to construction of the waste repository, a small stormwater containment berm (2 ft above existing elevations) will be constructed around the outside perimeter of the repository footprint. Where stormwater impacts waste, any stormwater runoff collected prior to installation of the repository cap will be pumped to the leachate pond for evaporation and treatment.

The repository (when final elevations are achieved) will be capped with a multi-layer impervious cap structure to prevent infiltration. The repository will be shaped to drain water from the crown to a perimeter, side slope terrace which will shed rainfall and snow melt off the repository slope onto concrete revetment mattresses draining to original grades **(Figure 24/Appendix A-24)**. Stormwater management on the completed repository will consist of side slope terrace berms around the perimeter to intercept and channel sheet flow drainage to specific let down structures. The floor of the drainage terraces will be sloped to drain the letdown structure. These structures will feature segmented concrete revetment blankets lining a down drain. Details of the repository revetment can be seen in **Figure 25/Appendix A-25.** The revetments will also be used in the terrace within 100 feet of the letdown structures. Since the infrastructure in Phase I will not yet be completed, the letdown structures will outfall to rip-rap lined energy dissipation basins. Details of these energy dissipation basins can be seen in **Figure 26/Appendix-26.**

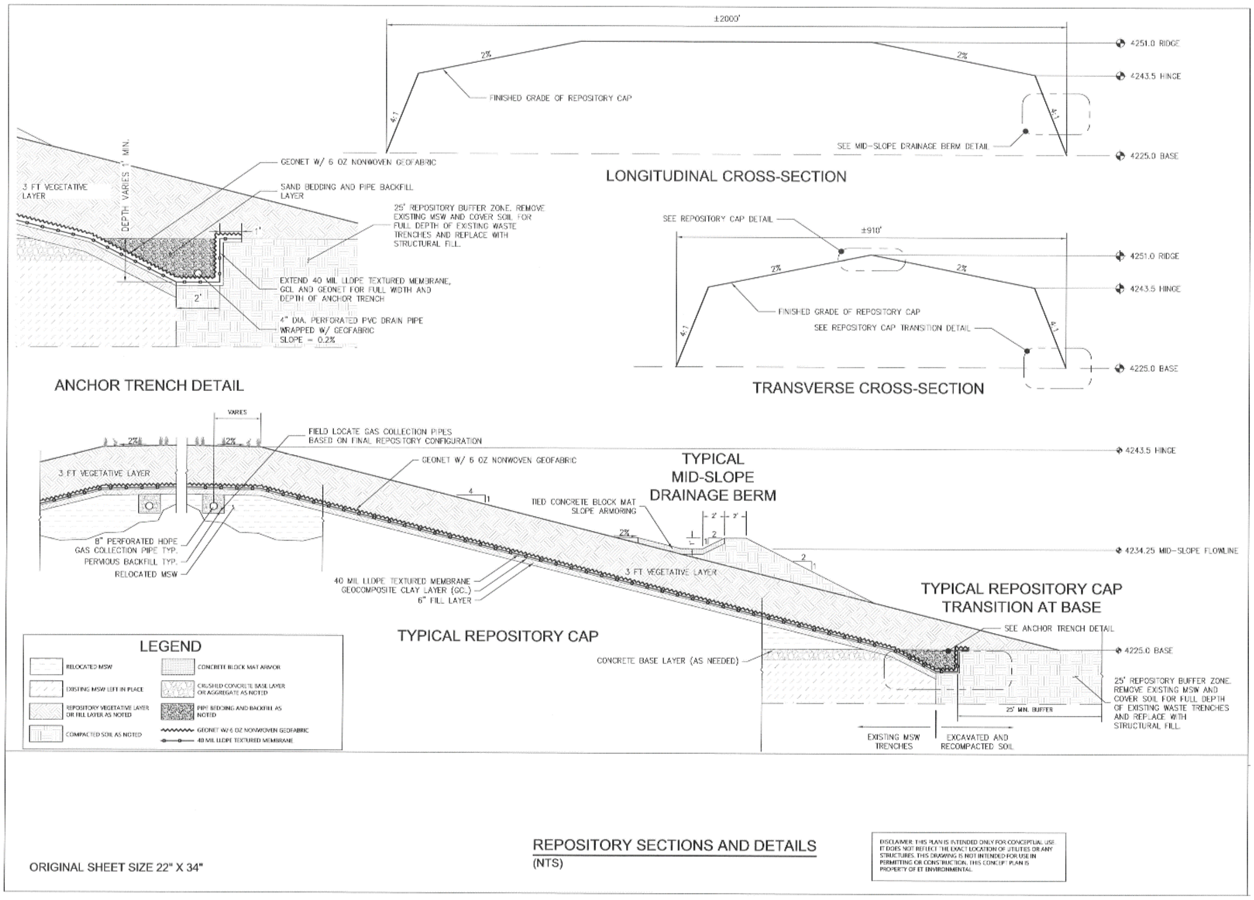


*Figure 24 – Repository Sections & Details (See Also Appendix A-24)*

Where precipitation events occur outside the repository boundary, detention of excess stormwater will temporarily be provided through a series of existing sloughs in the southern portion of the site. These sloughs function as temporary detention basins to catch excess stormwater runoff and allow infiltration, while preventing sediment-laden stormwater from leaving the site. Upon completion of the repository and the future development of Phase I, the storm drain system installed on the repository will be integrated into the development's stormwater system in coordination with Salt Lakes City's Department of Public Works.

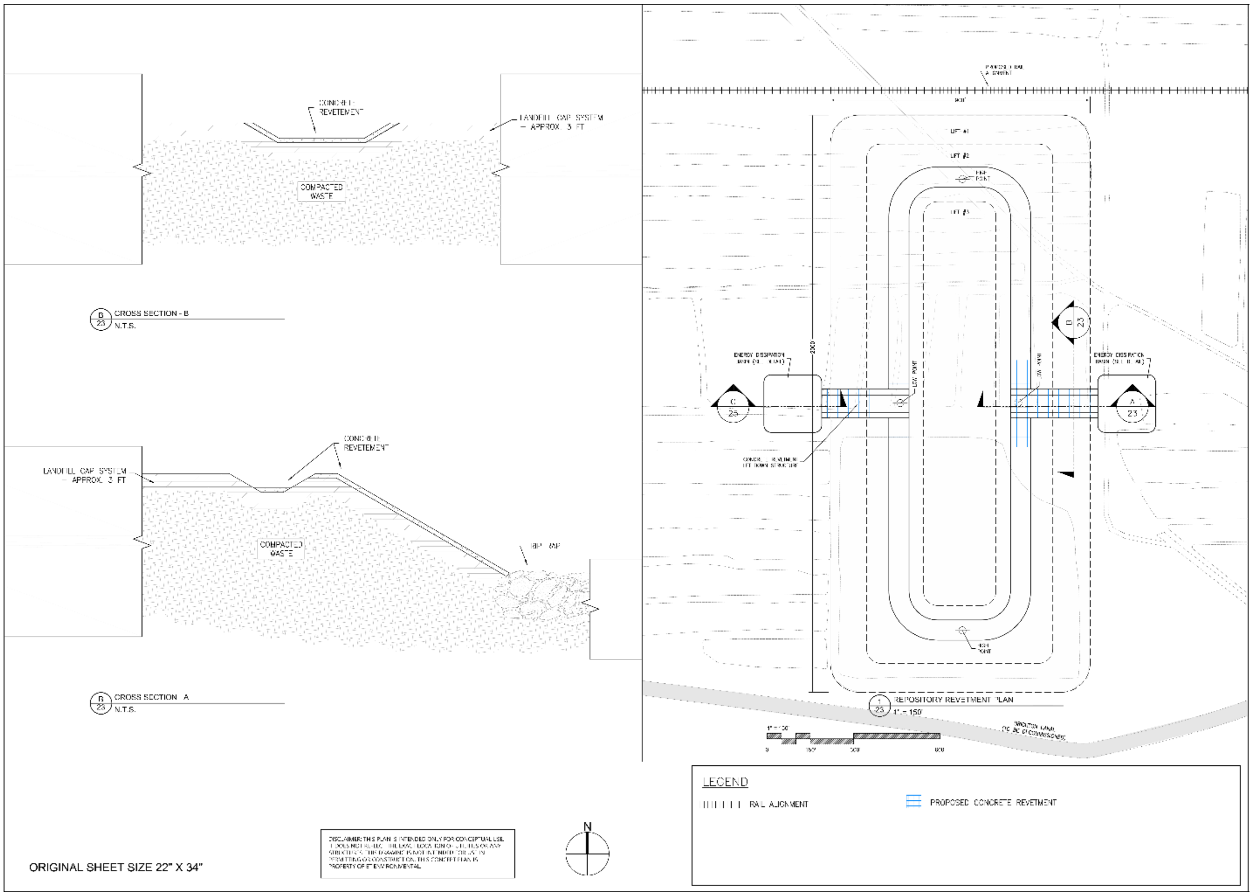
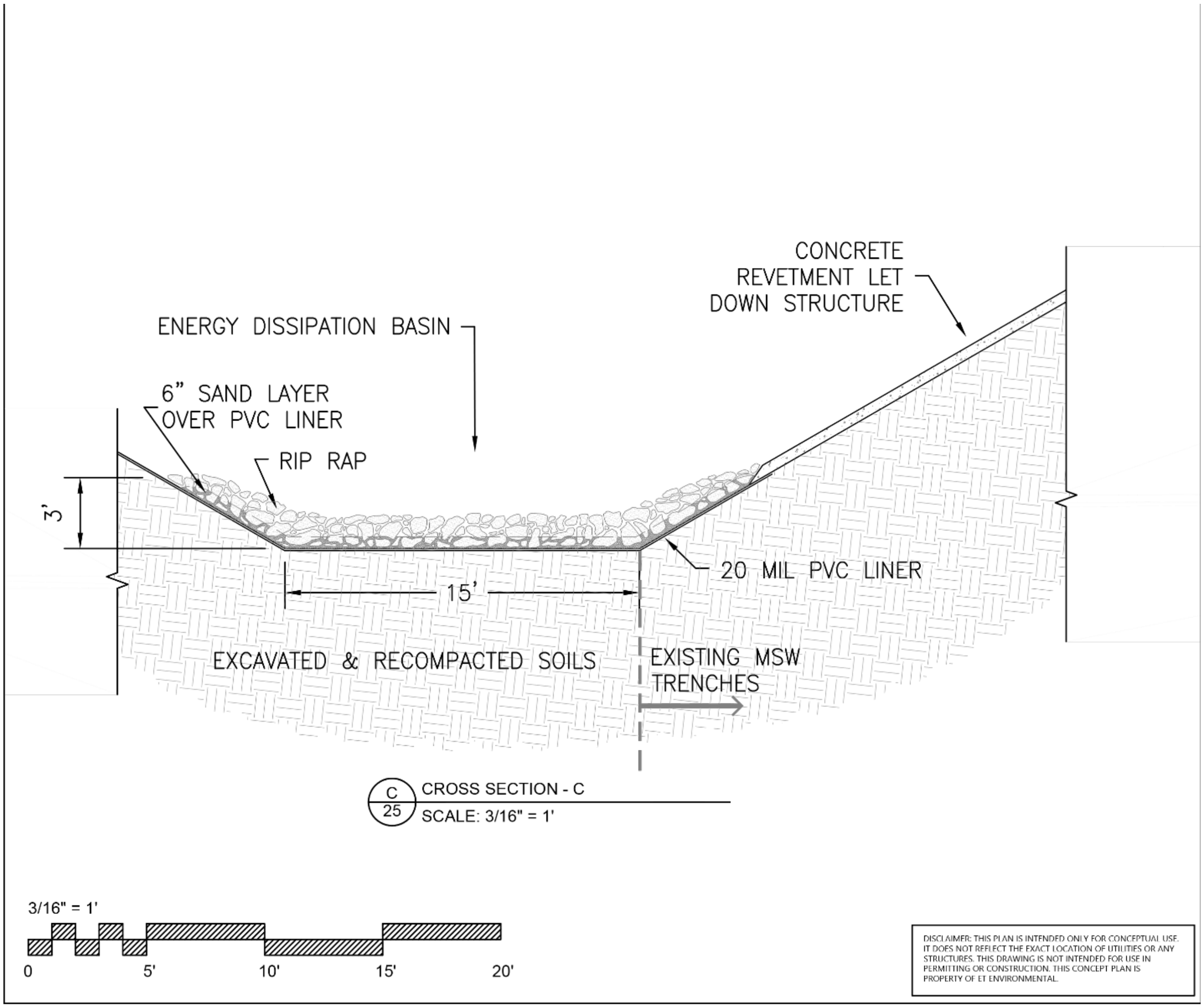


*Figure 25 – Repository Revetment (See Also Appendix A-25)*



DISCLAIMER: THIS PLAN IS INTENDED ONLY FOR CONCEPTUAL USE. IT DOES NOT REFLECT THE EXACT LOCATION OF UTILITIES OR ANY STRUCTURES. THIS DRAWING IS NOT INTENDED FOR USE IN PERMITTING OR CONSTRUCTION. THIS CONCEPT PLAN IS PROPERTY OF ET ENVIRONMENTAL.

*Figure 26 – Energy Dissipation Basins (See Also Appendix A-26)*

## 5.4 SPECIAL/SUSPECT WASTE

### 5.4.1 Contingency Plan

The numerous test pit explorations conducted on the site has confirmed that the majority of the waste deposited is MSW. A substantial fraction of the waste mass are scrap tires that will need to be separated from waste being relocated into the repository. We may encounter other less numerous non-MSW materials as the excavated proceeds.

The strategy for dealing with non-MSW materials will be to pre-position small lined, roll off containers at or near the area of waste excavation operation and to segregate those wastes in the following manner:

- Tires – for transport to Liberty Tire Recyclers
- White goods (or other large metallic items) for local scrap metal processor
- Unidentifiable or suspect materials for testing and evaluation
- Used drums and/or significant, non-leachate fluids (no free liquids will be deposited in the repository)

The Excavation will be overseen by Ninigret/ET/CARDNO professionals and a third-party observer. The third-party observer will be selected from local engineering firms with experience in solid waste and/or remediation projects. That person will be on-site during all excavation operations.

The observer's duties will be to identify items which are not characteristic to MSW and to see that those items are segregated from the waste stream destined for redeposition. The proposed segregation system will be to separate tires, white goods, and any very large mass items (i.e., sofa, engine block, etc.) into roll-off containers for alternate disposal or recycling. The observer would also oversee environmentally suspect materials (also to be segregated and tested) that could be encountered in the excavation.

The field chain of command would have the observer reporting to the field engineer and/or field superintendent regarding any concerning observations. The observer will be given the authority to intercede with the site contractor and stop work if the field management team are not present.

In any case of suspect material (i.e., a 55-gallon drum), the item will be segregated into a roll-off container and covered. The work area will be flagged, and the excavation sequence will advance forward 100 feet and resume. Areas in the trench will be examined and samples taken of suspect soil or perched groundwater for laboratory analysis. Determination of outcomes will depend on test results this area will remain "as-is" until testing data is made available. However, any free liquid associated with the discovery of suspect materials (not typical leachate) encountered would not be placed in the repository but instead would be transported off-site to the appropriate licensed disposal facility. The analytical results will be shared with DERR and a determination of risk will be made. If the material proves hazardous, provisions will be made to send the material to a RCRA TSD facility. If non-hazardous, the material will be placed in the repository.

### 5.4.2 Asbestos Containing Material Removal and Relocation

The waste in the existing cells is believed to have been placed in the landfill between 1958 and 1978. It is possible that asbestos containing materials (ACM) were disposed of at this facility during that time. The types of ACM that could have been disposed of during the timeframe would generally be expected to be associated with demolition and construction debris such as pipe insulation, floor tiles, roofing shingles and other related construction materials. Prior to the initiation of the waste excavation efforts, a specific asbestos design document will be developed which will address federal, state and local asbestos rules and regulations. This design document will be developed by a state certified asbestos project designer, and subsequently approved by the UDEQ's Division of Air Quality, establishing the means and methodologies that will be utilized to minimize potential impacts from the interaction with asbestos containing material should such material be identified during the remediation efforts.

## 5.5 MONITORING PLANS

### 5.5.1 Odor, Dust and Vector Control Plan

#### *5.5.1.1 Odor Control Plan*

The Intent of the Odor Control Plan is to control and counteract noxious odors from waste exhumation. We will employ a "Defense-in-depth" approach, using odor control components at sensitive property lines and at points of waste exposure. The methodology will be to provide perimeter control and point of excavation control.

The term "defense-in-depth" refers to a multi-layered strategy for combating odors from MSW exposure. We intend to abate odors in these ways:

1. Use odor surfactant (as needed) in the excavation and repository. This will be distributed by man-portable sprayers.
2. Area wide turbine sprayers will distribute odor masking agents at strategic locations near repository and excavation areas.
3. A perimeter odor control misting system, consisting of pole mounted misters distributing odor masking chemicals.

The field personnel will be equipped with handheld anemometers to gauge wind speed and direction so that the turbine sprayers can be properly positioned. If sustained wind speeds exceed 30 mph, work will be temporarily halted.

#### *5.5.1.2 Perimeter Control*

During the Phase I efforts, perimeter 10-foot-high misting nozzles will be utilized at appropriately spaced at locations that have been identified as possible sensitive site perimeters **(Figure 27/Appendix A-27)**. There will be a stationary pumping system with flexible supply hoses which will distribute odor control surfactant during hours of operation to those areas requiring odor control.

#### *5.5.1.3 Point of Excavation*

Mobile fogging-style pump & fan combinations will be utilized at or near active excavations. The turbine fans atomize the odor control chemicals and will be directed accordingly with excavation areas and wind direction.

#### *5.5.1.4 Wet Waste Staging*

The wet waste will be excavated from the northern part of Phase I and windrowed to dry at the edge of the trench. The wet waste will be covered with tarps for 24-48 hours and then transported to the repository for reposition.

A topical odor suppressant will be applied on exposed waste after excavation (at trench site) and reapply at the point of deposition. The proposed system can be diesel or electric powered depending on mobility needs. The odor control agents will be specially formulated for MSW characteristics by Benzaco Scientific, an experienced odor control firm serving the solid waste industry. The system (perimeter and mobile) will be operated concurrently with all active excavation operations. A conceptual diagram of Odor Control locations is shown in **Figure 27/Appendix A-27**.

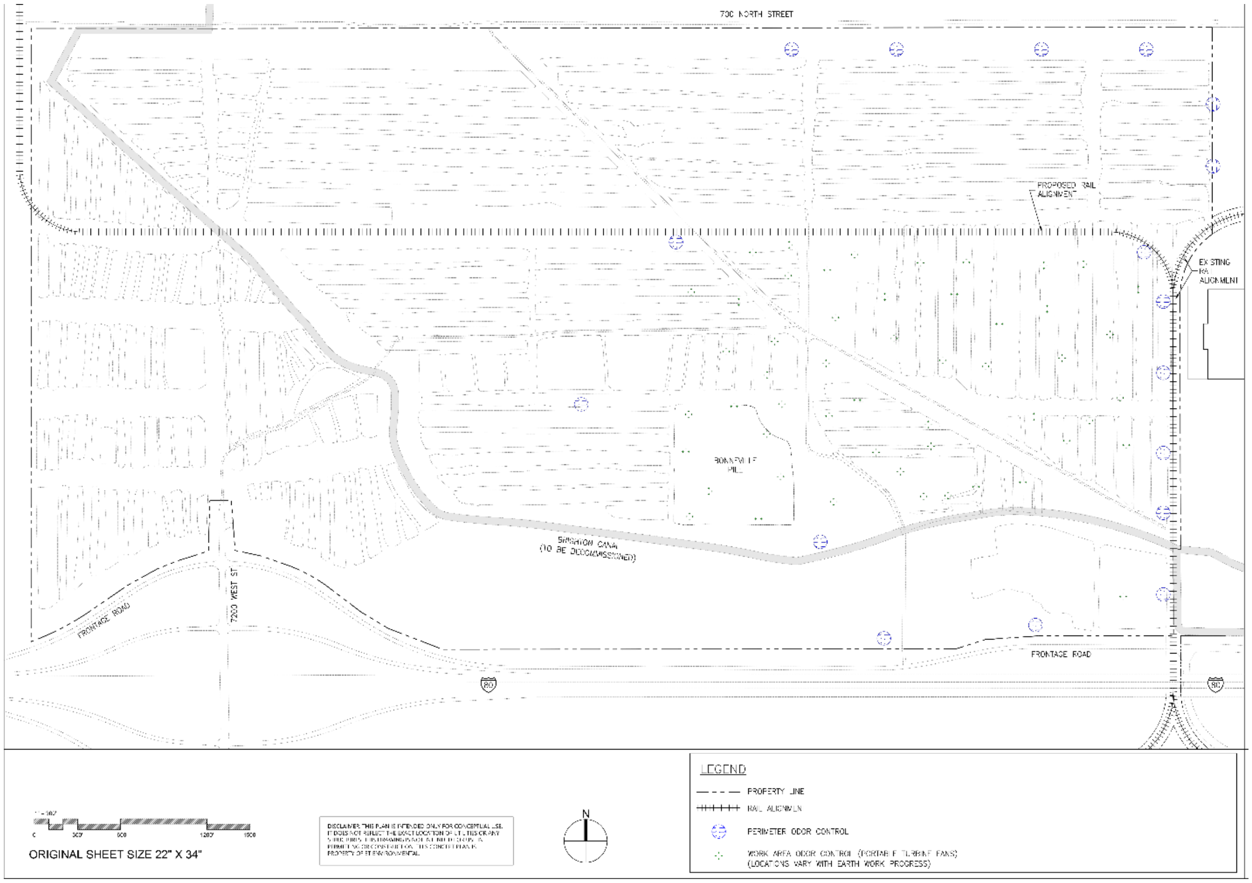


*Figure 27 – Odor Control Plan (See Also Appendix A-27)*

### *5.5.1.5 Dust Control Plan*

The project will entail significant hauling of soil/aggregate and waste materials over unpaved haul routes across the site. The excavation contractor will employ water trucks to wet down haul roads to suppress dust. The proposed haul routes are depicted in the previous **Figure 22/Appendix A-22**. The raw water source will be non-decommissioned portion of the Brighton Canal (if available), or a culinary water line tap at the 7200 West property entrance.

The collective experience with North Temple Landfill test pit explorations suggests that there is very little risk of fugitive dust emissions from the removal of buried waste. The principal concern for dust emission is the extensive haul-road traffic between excavation sites, repository, and soil stockpile areas. Haul roads will be patrolled with a water truck (water source available on-site) continuously to keep roadway surfaces damp. As noted in the odor control section, if sustained winds exceed 30 mph, work will be temporarily halted. The goal is zero visible dust in contaminated areas.

### *5.5.1.6 Vector Control Plan*

All exposed waste surfaces whether in the trench, stockpiled trench site or deposited in the repository will be covered with geosynthetic tarps to protect against vectors such as birds and scavenging animals.

### 5.5.2 Community Air Monitoring Plan

Despite the considerable degradation of the old MSW in the land fill, excavation of waste and extraction of leachate create opportunities for fugitive emissions, as compared to the current covered composition on-site.

As background, the site owner has performed a site emission scan using remote sensing technology where small, but detectable methane emissions were identified in certain locations of the landfill. The range of CH4 detected was 20 ppm to 80 ppm. The total site area where emissions were detected comprised 0.17% of the total site area, and 0.06% of the site area emitted over 60 ppm. As a point of reference, The New Source Performance Standards (NSPS) threshold for methane emissions is 500 ppm. Although the methane emissions identified in the Phase I area (in the above-mentioned site scan) were minimal, an additional aerial drone scan will be undertaken during waste removal operations as well as after the excavated trenches are backfilled.

### 5.5.3 Air/Odor/Emission Monitoring

As referenced in several sections of the plan, various types of air and vapor monitoring will be used in the active remediation phase.

- Emission monitoring at point of excavation. Using hand-held PID monitoring, site personnel will be at trench-side monitoring for off gassing of vapor/LFG emissions.
- Emission monitoring at repository. The same procedure as above will take place at the point of waste placement.
- Leachate pond/evaporation. Periodically, emissions will be monitored at the pond and evaporator.
- Odor/emission monitoring at sensitive perimeter receptors. The PID and the field olfactometer will be used together (to objectively characterize odor reading with PID readings) at both trench excavation and along the sensitive receptors at the north, east, and south property boundaries.
- Aerial drone scans to measure LFG emissions will be performed at the mid-point of the remediation and at the end when the landfill cap is complete.

The readings will be documented in the daily/weekly reports. The excavator operator and attending personnel will have PPE available if the PID readings support additional protective action.

During the site characterization phase, an aerial drone with remote sensing technology for methane detection was used to establish pre-RAP background emission data. The results were included in the 2021 Phase I SI and only one area in the SW corner of the site (beyond Phase I) has noticeable emission (80ppm). We intend to rescan the site during the excavation phase, and we will adjust the flight schedule to correspond to the excavation operation in the North part of Phase I and the reclamation of the Bonneville pile, which should approximately be at the 60-day milestone following contractor mobilization. The drone will also re-scan after the excavation efforts have been completed and the waste has been relocated in the repository.

The emission data collected in the Phase I RAP (PID, aerial drone, field olfactometry) will be analyzed to provide future vapor intrusion risk indication for the future phases of remediation. The vapor intrusion barriers would consist of gravel zones for vapor collection, overlain by HDPE membranes beneath foundation and floor slabs with active vapor collection, piping and filtration.

## 6.0 ENGINEERING CONTROLS

The remedial objectives are twofold. The first objective will be to remove the source material (MSW) from the poorly covered waste cells which trap infiltration in the waste as leachate and reconsolidate the excavated waste into a new onsite engineered waste repository. The reconsolidated waste will be placed above the underlying groundwater and will be covered with a low permeable cover system (cap) to restrict infiltration. The cover will include a gas collection layer to control potential air emissions. Details of a typical landfill gas collection wellhead and one that will be implemented in the proposed repository can be seen in the previous **Figure 15/Appendix A-15.** The second objective will be to eliminate the potential for vapor emissions entering future buildings through the potential for concentrations within the groundwater or underlying soil. This potential will be addressed by both the lowering of volatile concentration within the site groundwater through the removal of the source material and incorporating engineered barriers and collection system beneath the buildings where appropriate. These objectives will be demonstrated by the collection of groundwater monitoring data down gradient from the areas where waste is removed and from the downgradient areas of the new waste repository cell. The collection of confirmation samples from the soil remaining beneath the excavated waste cells will be collected and compared to the potential for ongoing air emissions to indoor air.

Sampling procedures for this RAP will follow prior project field work procedures and will be outlined in individual sampling and analysis plans (SAPs) with accompanying standard operating procedures (SOPs) to be submitted and reviewed prior to commencement of any field work.

### 6.1 GROUNDWATER SITEWIDE MONITORING SYSTEM

Monitoring of the groundwater will continue with the sampling of existing wells located in the Phase I area and new wells installed to assess the up and down gradient groundwater quality in relation to the new repository cell. A total of 13 groundwater monitoring wells are proposed for the Phase I area groundwater monitoring program at the Airport West VCP Site. Ongoing monitoring of the entire former NTL Site and impacted downgradient area will continue and be identified in a separate workplan to address the remedial designs for future remedial efforts on the site. Six of the wells are at existing locations within the Phase I area. An additional seven wells are to be located proximate to the repository. The wells are described as follows and are indicated on **Figure 28/Appendix A-28.**

| AREA | LOCATION | NUMBERS | NEW/EXISTING | DESCRIPTION |
|---|---|---|---|---|
| Phase I | Downgradient | 2 | 2 existing | Along the north boundary of the Phase I area |
| Phase I Repository | Upgradient | 4 | 3 new, 1 existing | Along the eastern boundary of the new repository |
| Phase I Repository | Downgradient | 4 | 4 new | Along the NW and western boundary of the new Repository |
| Upgradient Site Wells – South | Upgradient | 3 | 3 existing | Along the southern boundary |

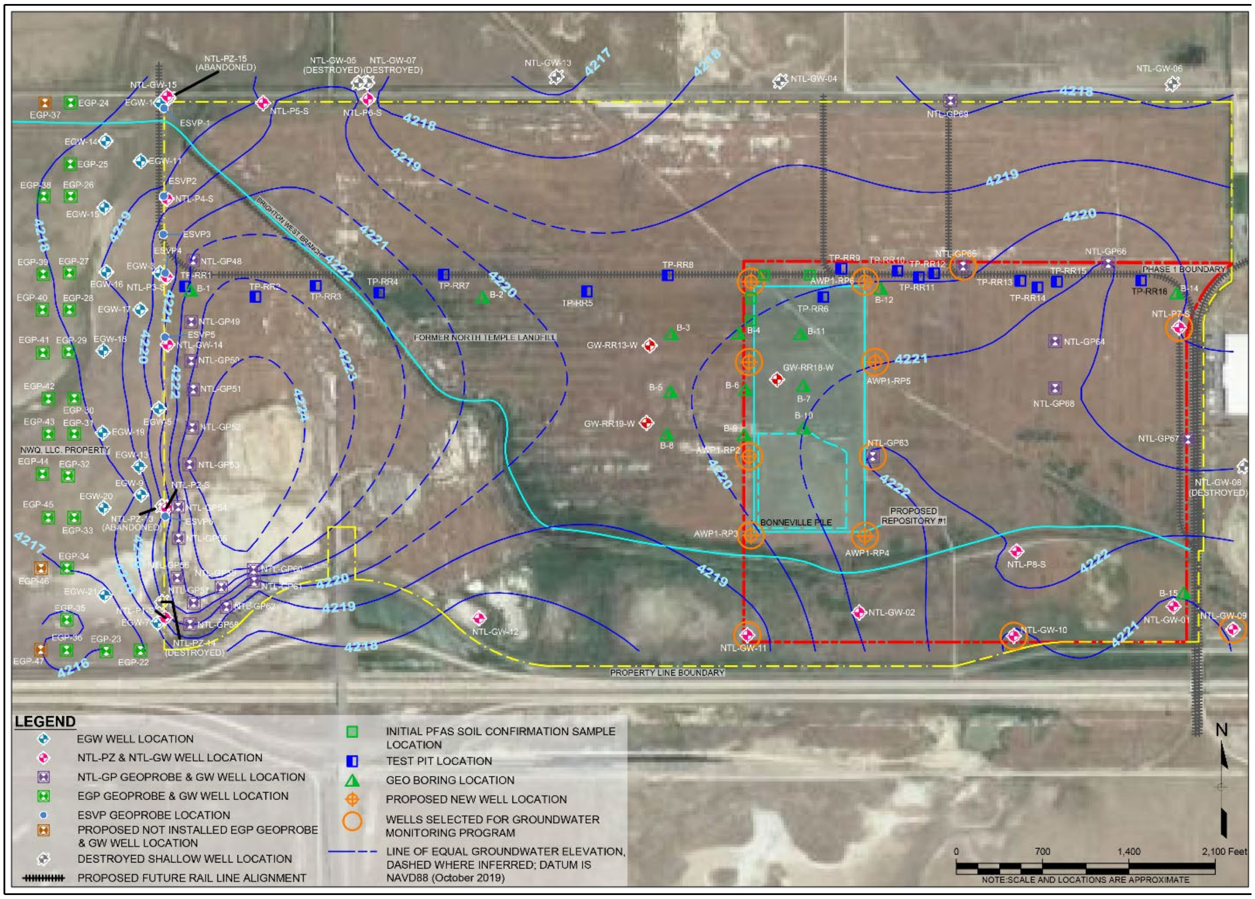


*Figure 28 – Groundwater Monitoring Program Location Map – Proposed (See Also Appendix A-28)*

### 6.1.1 Monitoring Schedule

The well network is proposed to be sampled on a 6-month schedule during the spring and fall during the Phase I Remedial Action (RA) efforts. Following the completion of the Phase I RA, a Site Management Plan (SMP) will be adopted for the Phase I area which will identify and include a program for future groundwater monitoring during the post closure period.

### 6.1.2 Analyte Testing

The parameters list for each well will include similar test method analyses for both upgradient and downgradient wells for the proposed Phase I area wells. The objectives of the Phase I groundwater monitoring are to establish a baseline concentration prior to the remedial actions to be undertaken in the Phase I area, characterize the concentrations following the waste removal from the existing waste cells, and characterize the concentrations up and downgradient of the new waste repository. Following the completion of the Phase I RA, groundwater monitoring concentrations will be evaluated for preparation of the post closure monitoring to be implemented during SMP activities.

The analytes will include the list of RCRA metals, VOCs, SVOCs, PAHs, TPHs and PFAS compounds as identified in **Table 3/Appendix A-30**, titled Groundwater Monitoring Screening Levels. The groundwater monitoring concentrations identified will be compared to the Table 3 Screening Levels (SL). The table 3 groundwater SLs are based on the most protective when comparing the risk associated with both the carcinogenic "composite" SL (dermal, inhalation and ingestion) and the non-carcinogenic "composite" SL (dermal, inhalation and ingestion) for an adult resident exposure. These levels will be based on their HQ of 1 and a carcinogenic risk at 1 in $10^{-4}$. No screening levels will be less than the MCL. For groundwater concentrations exceeding the Table 3 screening levels, further assessments will be conducted to determine which pathway(s) are contributing to the elevated risk level. For each pathway and receptor identified, appropriate mitigation will be identified in the Site Management Plan. For the volatile compounds associated with the risk to indoor air intrusion, a groundwater concentration will be established based on the VISL model for a site worker. These levels will be based on their HQ of 1 and a carcinogenic risk at 1 in $10^{-4}$

The Groundwater Monitoring Action Levels are presented in **Table 3/Appendix A-30**, titled Groundwater Monitoring Screening Levels, which includes the list of analytes and their respective levels for concentrations to "demonstrate the remedial action objectives are being met".

## 6.2 SOIL GAS SAMPLING

During the remedial actions involving the excavation of waste, the immediate areas of excavation and waste handling will be monitored for volatile concentrations emitting from the waste. These compounds and the monitoring procedures are included in the HASP. The concentration will be compared to identify the appropriate PPE and to compare to the established risk levels identified in the risk assessment for the construction worker.

Soil gas sampling will be conducted to determine the potential for indoor air concentrations resulting from the post waste removal areas. Per an approved SMP, areas where MSW was removed and backfilled, areas adjacent to the repository, and areas where special waste may have been encountered during the waste removal efforts will be monitored for the TO-15 volatile compounds, along with methane gas, and compared to the EPA VISL target sub-slab and exterior soil gas concentrations. These levels will be based on their HQ of 1 and a carcinogenic risk at 1 in $10^{-4}$.

As the waste excavation and backfill efforts proceed across the Phase I Area, soil gas testing will be undertaken in those areas that have been completed to identify the potential for soil gas impacts on future planned building development. If testing results identify exceedances, mitigation procedures will be identified and coordinated with DERR and incorporated into an SMP for that area, or alternatively, a separate sampling strategy will be implemented to allow building construction to proceed prior to site closure.

# 7.0 INSTITUTIONAL CONTROLS

## 7.1 ENVIRONMENTAL COVENANTS, EASEMENTS ORDEED RESTRICTIONS

Certain environmental easements and deed restrictions will be formulated at the conclusion of remediation efforts. Environmental easements may include provision to access monitoring wells and other site environmental improvements. Deed restrictions such as prohibitions on residential development and the use of site groundwater are expected.

## 7.2 SITE MANAGEMENT PLAN

A site management plan will be developed upon conclusion of remedial field efforts. The plan will include a description of the required controls to be implemented on the site, the intended role of each implemented control and a description of procedures to be followed for implementation of the controls (i.e., a site groundwater monitoring plan). The plan will also set forth procedures to minimize potential exposure to any remaining contamination during maintenance or redevelopment work and the reporting requirements for these controls. At the conclusion of all remedial efforts associated with Phase I, a final survey will be completed identifying the boundaries of Phase I and the final location of the completed repository.

# 8.0 FINAL ENGINEERING REPORT

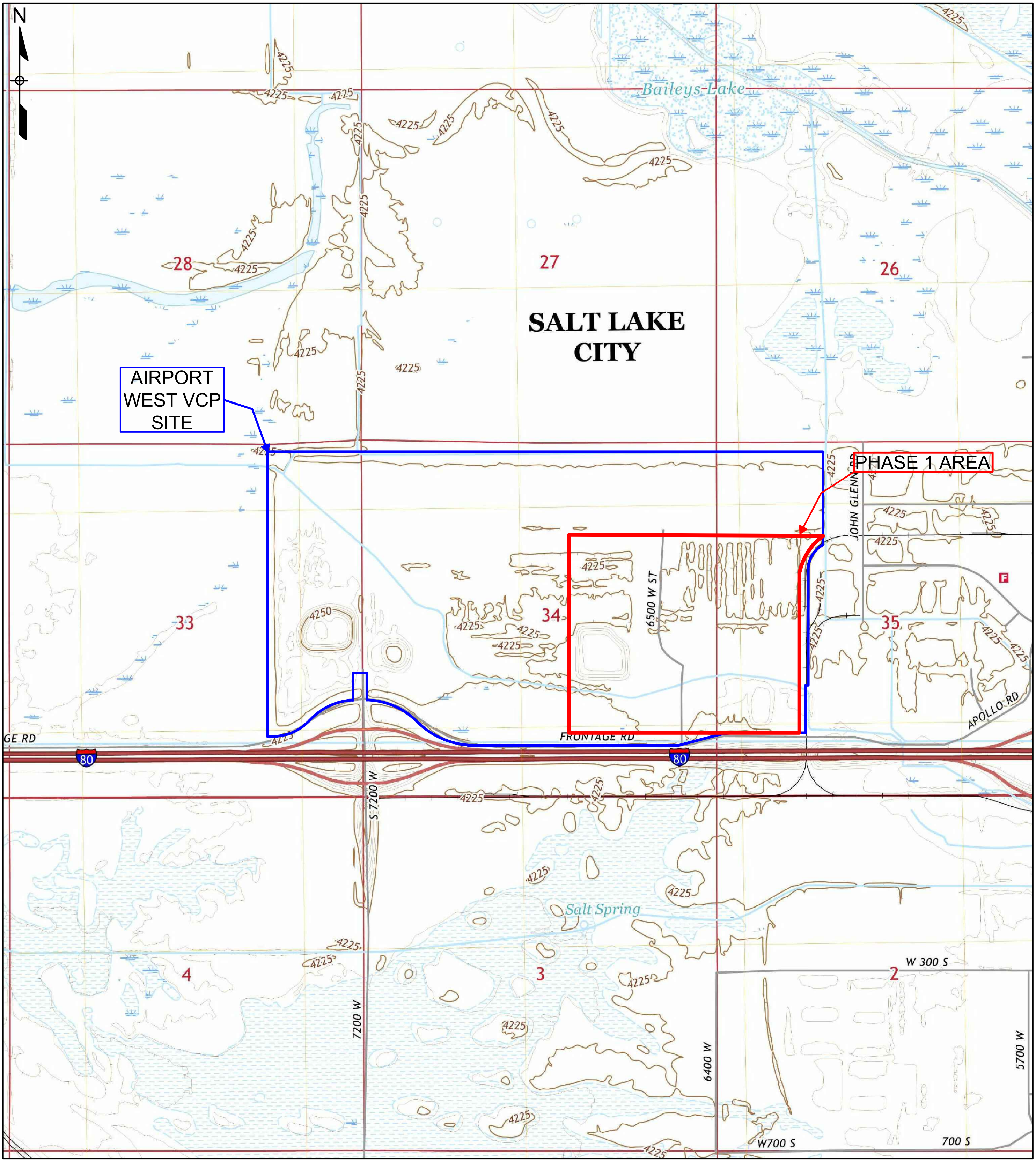
A final engineering report will be produced at the conclusion of remediation field efforts reviewing the work that has been completed and any modification or deviations from the procedures set forth in the RAP.

## 8.1 CERTIFICATIONS

Upon the successful completion of the Phase I remediation efforts and the submittal and acceptance of the Final Engineering Report, Site Management Plan and Environmental Covenant, the project sponsor will request the issuance of an administrative letter from UDEQ.

# APPENDIX A REPORT FIGURES

## A-1 Figure 1 – Site Location Map



1

**Latitude: 40° 46' 25.50" N**
**Longitude: -112° 4' 6.16" W**
**Baileys Lake, Utah, 2020, 7.5-min**

**Project No. 819AR00640.0004**

## Figure 1: Site Vicinity Map

Phase I Area Development SI
6460 West North Temple Frontage Road
Salt Lake City, Utah

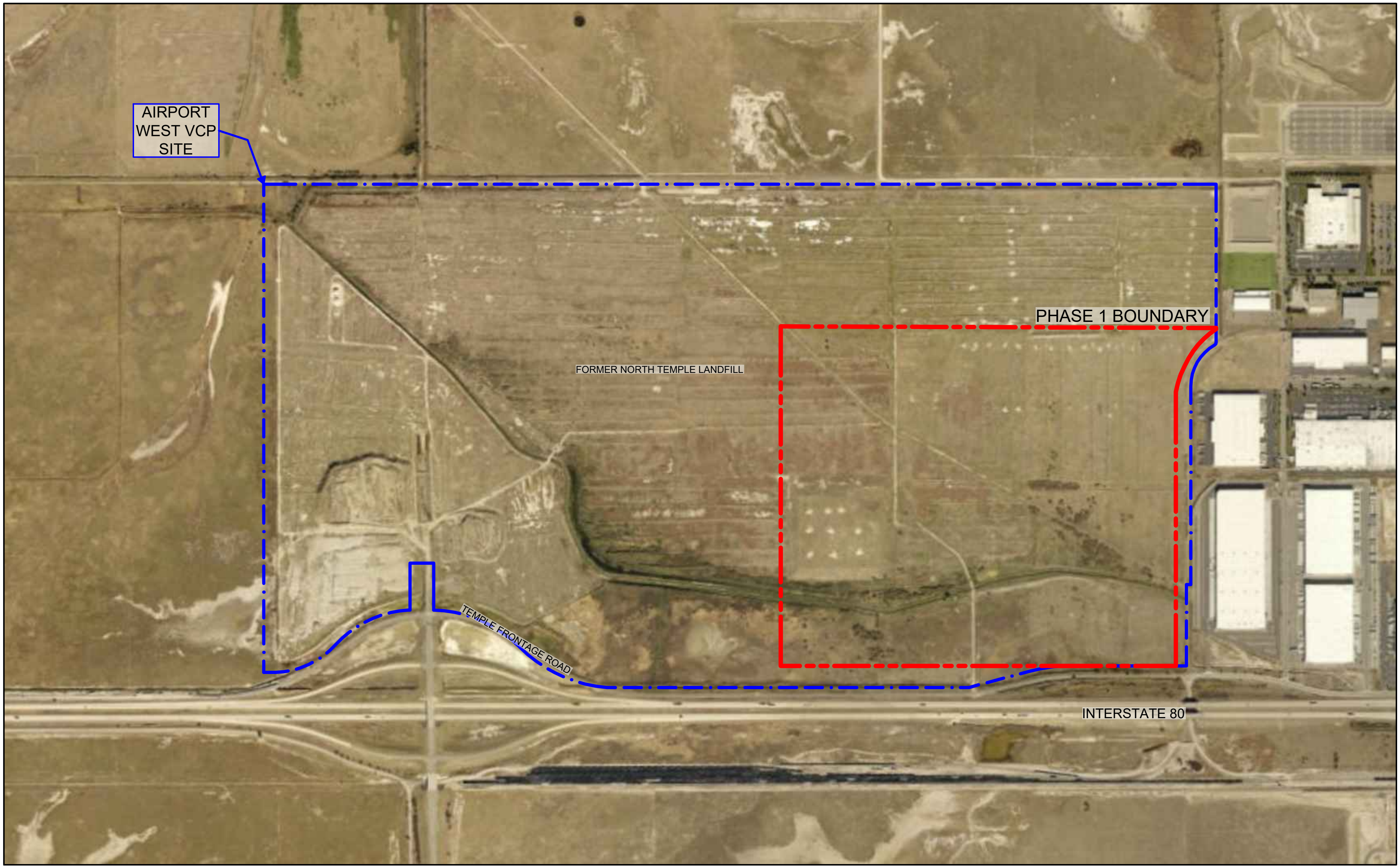
0 2,000 4,000 Feet

Cardno now Stantec

1142 WEST 2320 SOUTH, SUITE A
WEST VALLEY, UTAH 84119
P: 801-256-3800 F: 801-973-1095

Date Created: 11/9/2021 Date Revised: 11/9/2021 File Path: N:\Data-AZ\00 - Utah\Epperson\2021.09_NTL PHS1.TOPOS.dwg
Data Sources: Baileys Lake, Utah, 2020, 7.5 minute series
CAD Analyst: Justin.Patton

## A-2 Figure 2 – Phase I Boundary Map



2

**Latitude: 40° 46' 25.50" N**
**Longitude: -112° 4' 6.16" W**

**Project No. 819AR00640.0004**

# Figure 2: Site Aerial Map

Phase I Area Development SI
6460 West North Temple Frontage Road
Salt Lake City, Utah

0 1,200 2,400 Feet

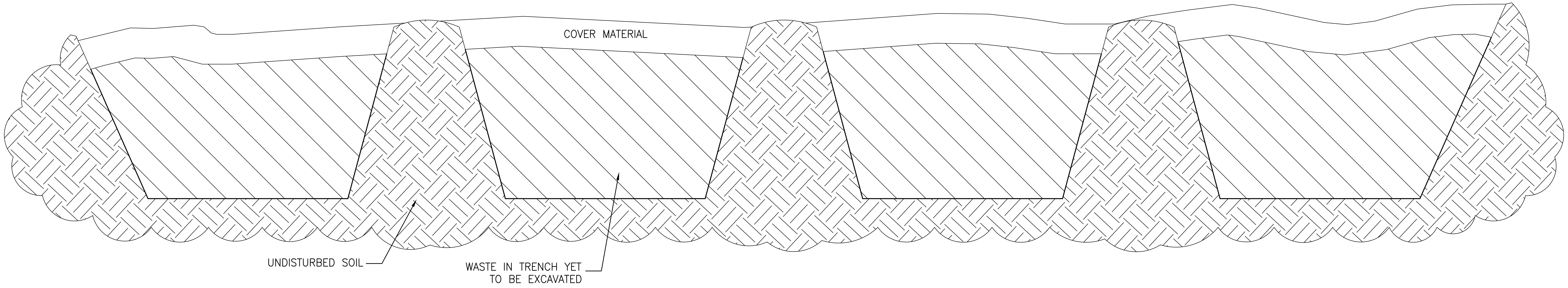
N

Cardno now Stantec
1142 WEST 2320 SOUTH, SUITE A
WEST VALLEY, UTAH 84119
P: 801-256-3800 F: 801-973-1095

Date Created: 11/13/2021 Date Revised: 11/13/2021 File Path: N:\Data-AZ\00 - Utah\Epperson\2021.09_NTL PHS1.SITE AERIAL.dwg
Data Sources: SALT LAKE COUNTY ASSESSOR, 2020

CAD Analyst: Justin.Patton

## A-3 Figure 3 – Typical Trench Cell Cross Section



# TYPICAL TRENCH CELL CROSS SECTION

NORTH TEMPLE LANDFILL REMEDIATION
SALT LAKE CITY, UT 84116

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LEGEND

N

ORIGINAL SHEET SIZE 22" X 34"

CONCEPTUAL PHASE
4-5-2022

SHEET NUMBER
A-3

05-ET1668

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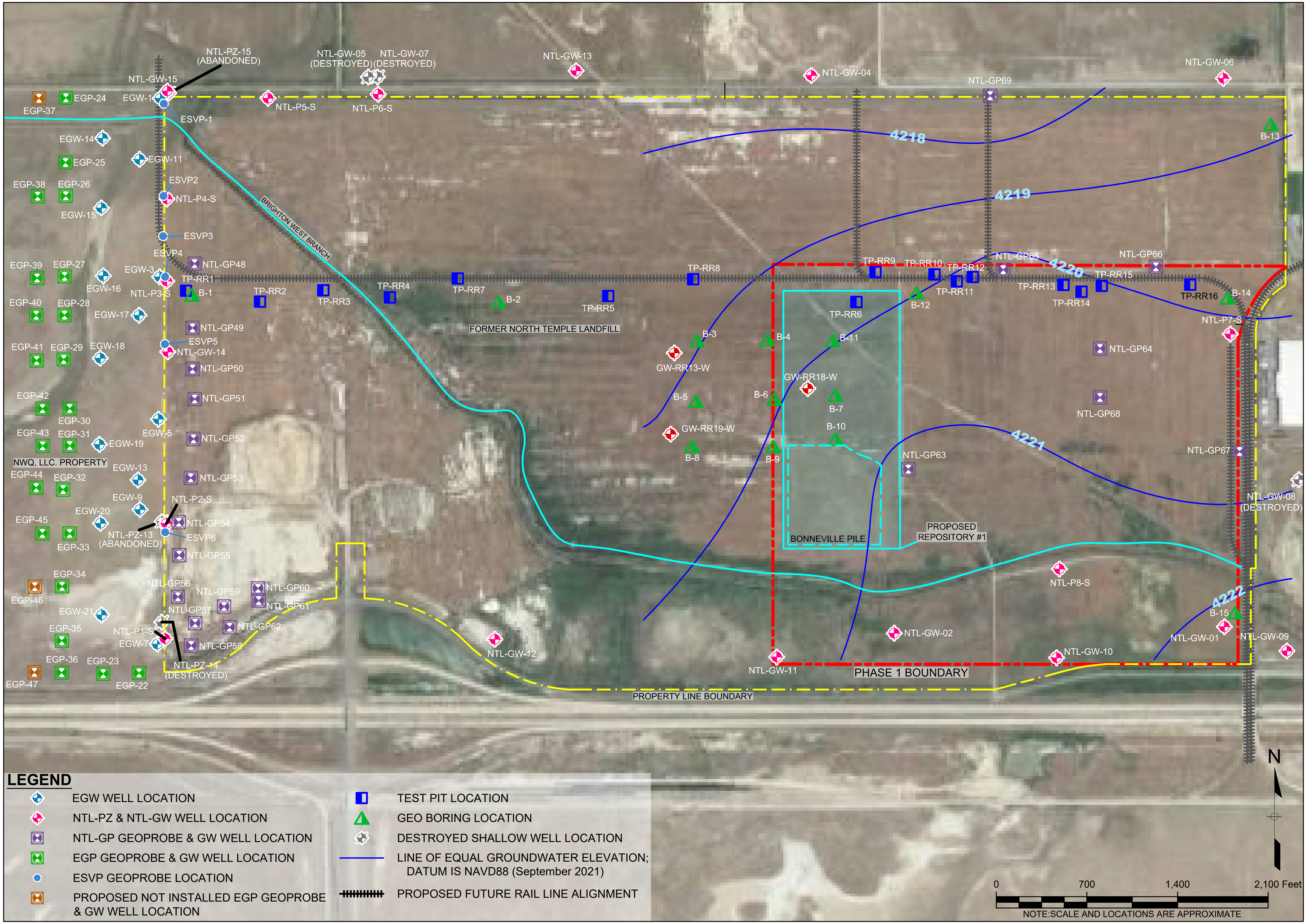
## A-4 Figure 4 – Phase I Groundwater Elevations & Testing Locations



Cardno now Stantec

1142 WEST 2320 SOUTH, SUITE A
WEST VALLEY, UTAH 84119
P: 801-256-3800 F: 801-973-1095

# Figure 4: Groundwater Elevation Map Shallow Aquifer - September 2021

## Phase I Area Development SI
## 6460 West North Temple Frontage Road
## Salt Lake City, Utah

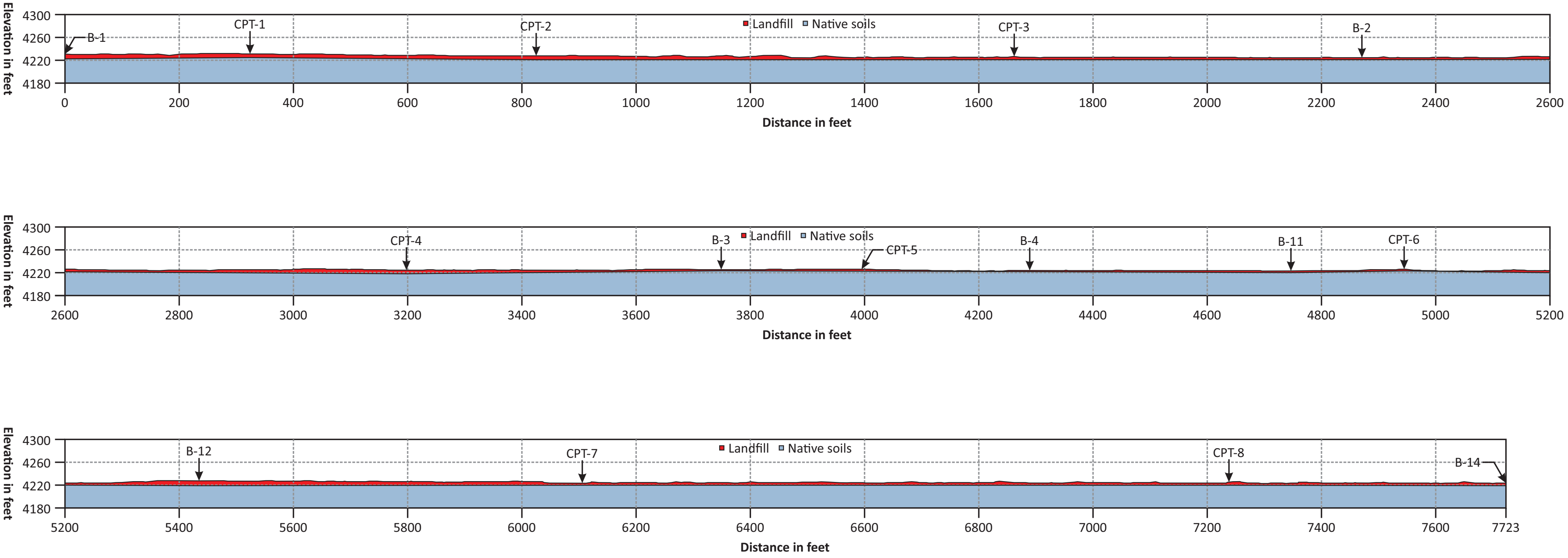
4

Latitude: 40° 46' 25.50" N
Longitude: -112° 4' 6.16" W

Project No. 819AR00640.0004

Date Created: 9/8/2016 Date Revised: 11/14/2017 File Path: N:\Data-AZ\00 - Utah\Epperson\2021.09_NTL PHS1.SHALLOW CONTOURS.dwg
Data Sources: GOOGLE MAP
CAD Analyst: Justin.Patton

## A-5 Figure 5 – CPT Cross Section



North view, west to east; scale one inch equals 175 feet (1:2,100) with no vertical exaggeration. Topographic profile from geoprocessed 2013 LiDAR bare earth DEM data. Landfill thickness estimated based on boring observations and CPT data.

CMT ENGINEERING LABORATORIES

**North Temple Landfill Redevelopment**
About 7610 West North Temple, Salt Lake City, Utah

**Cross Section**

| | |
|---|---|
| Date: | 22-Dec-2021 |
| CMT No.: | 17224 |

Figure
5

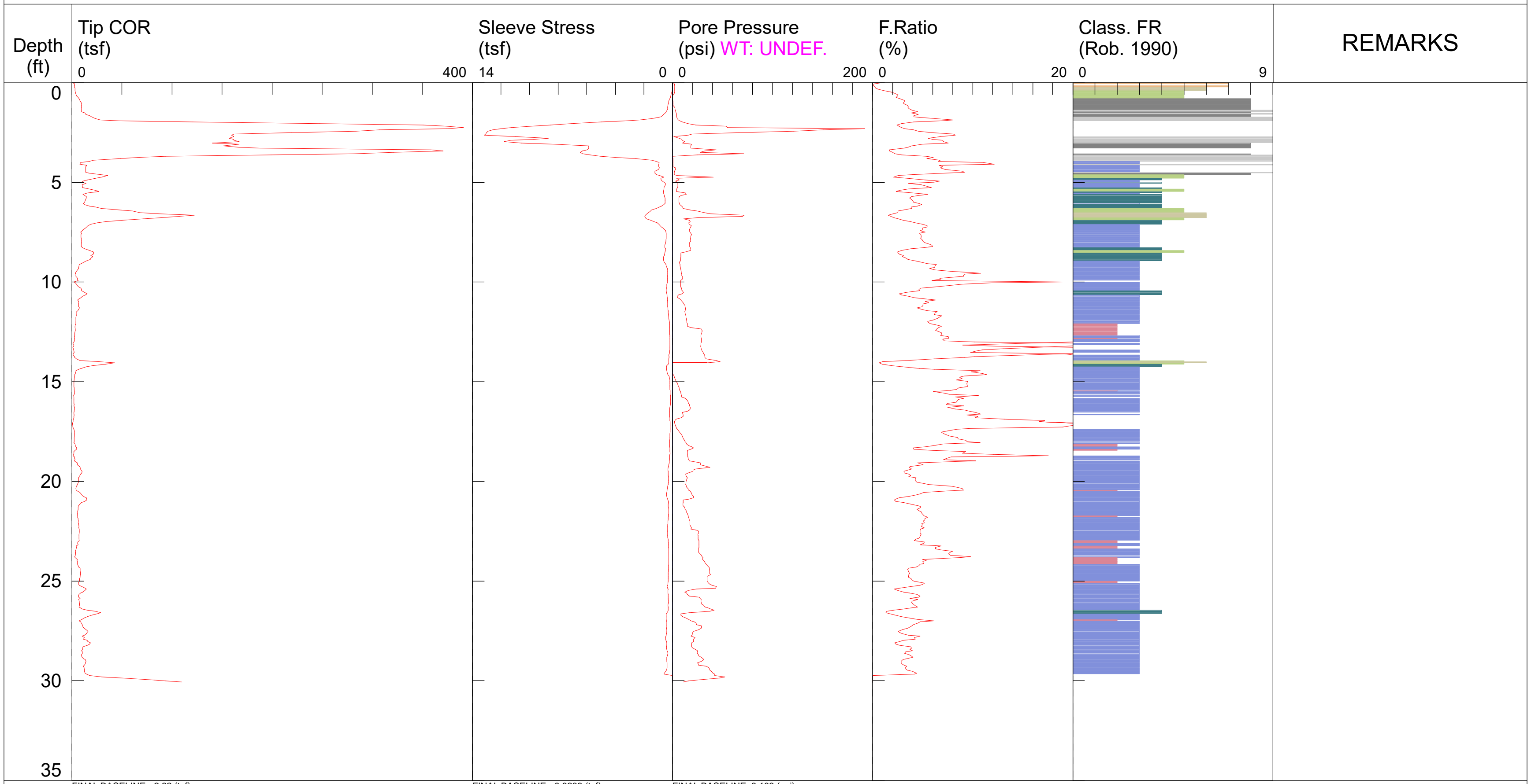
## A-6 Figure 6 – CPT Boring Logs

# SOUNDING

**ACache Corp.**
Engineering a Firm Foundation

TOTAL DEPTH: 30.067 ft
SITE: 17224 West Noth Temple, Salt Lake County UT
SOUNDING
COMPANY: VERTEK
FILENAME: CPT-2.dat

PROBE ID: 4444.190XX
TEST ID: 21-10-26-02
PROJECT: 17224 North Temple Landfill
LOCATION: CPT-2



FINAL BASELINE: -2.82 (tsf)
FINAL BASELINE: -0.0209 (tsf)
FINAL BASELINE: 0.103 (psi)

NOTES:: Example of notes

🟥 1 Sensitive, fine grained
🟪 2 Organic soils - peats
🟦 3 Clays - clay to silty clay
🟩 4 Silt mixtures - clayey silt to silty clay
🟩 5 Sand mixtures - silty sand to sandy silt
🟨 6 Sands - clean sand to silty sand
🟧 7 Gravelly sand to sand
⬛ 8 Very stiff sand to clayey sand **
⬜ 9 Very stiff, fine grained **

*SBT: Robertson 1990; **Overconsolidated or Cemented; *SBT/SPT CORRELATION: UBC-1983

# SOUNDING

**ACache Corp.**
Engineering a Firm Foundation

TOTAL DEPTH: 30.074 ft
SITE: 17224 West Noth Temple, Salt Lake County UT
SOUNDING
COMPANY: VERTEK
FILENAME: CPT-4.dat

PROBE ID: 4444.190XX
TEST ID: 21-10-26-04
PROJECT: 17224 North Temple Landfill
LOCATION: CPT-4

FINAL BASELINE: 2.55 (tsf)
FINAL BASELINE: 0.0532 (tsf)
FINAL BASELINE: 1.033 (psi)

NOTES:: Example of notes

🟥 1 Sensitive, fine grained
🟥 2 Organic soils - peats
🟦 3 Clays - clay to silty clay
🟦 4 Silt mixtures - clayey silt to silty clay
🟩 5 Sand mixtures - silty sand to sandy silt
🟨 6 Sands - clean sand to silty sand
🟧 7 Gravelly sand to sand
⬛ 8 Very stiff sand to clayey sand **
⬜ 9 Very stiff, fine grained **

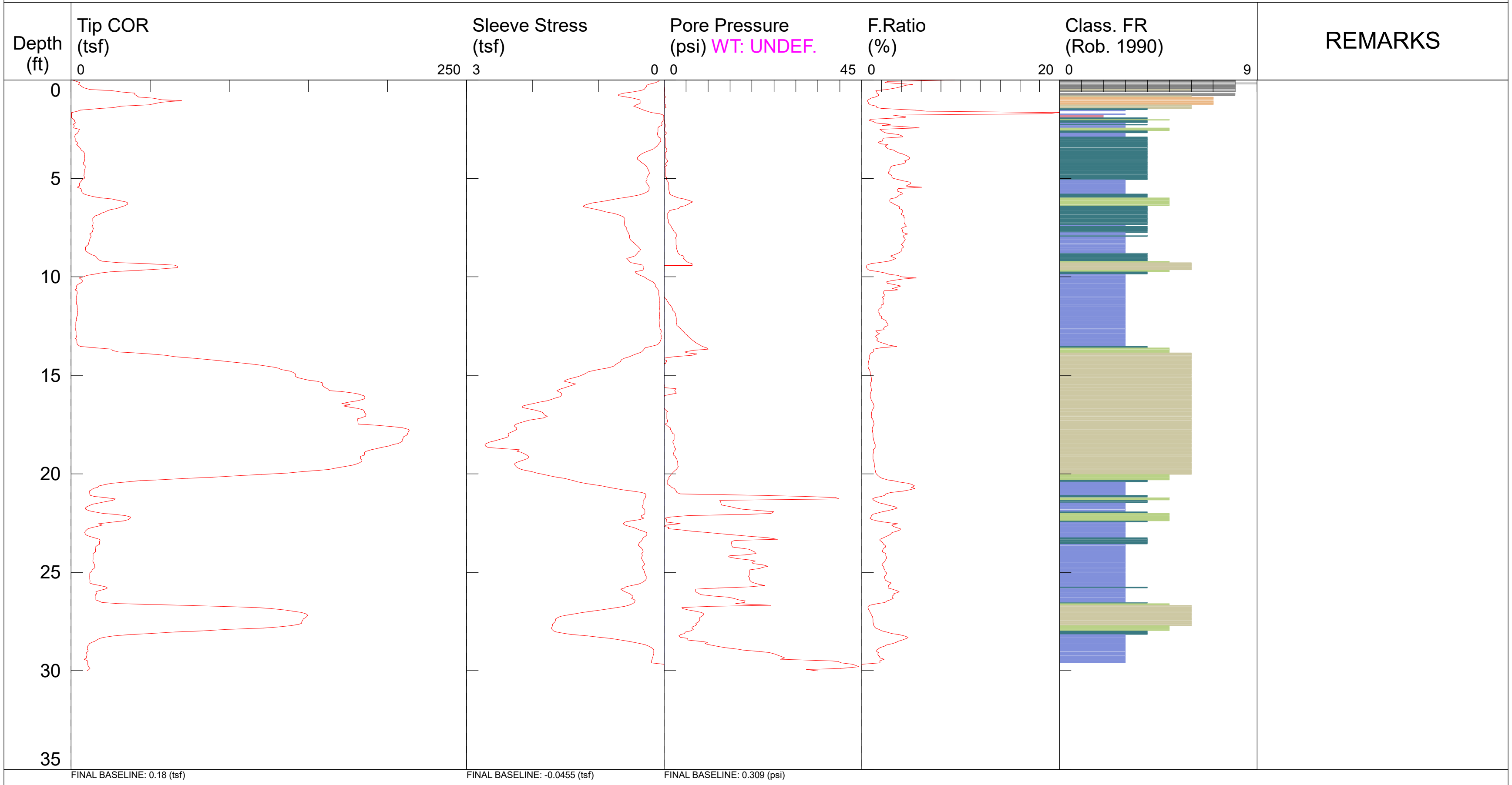
*SBT: Robertson 1990; **Overconsolidated or Cemented; *SBT/SPT CORRELATION: UBC-1983

# SOUNDING

**ACache Corp.**
Engineering a Firm Foundation

TOTAL DEPTH: 30.006 ft
SITE: 17224 West Noth Temple, Salt Lake County UT
SOUNDING
COMPANY: VERTEK
FILENAME: CPT-6.dat

PROBE ID: 4444.190XX
TEST ID: 21-10-27-01
PROJECT: 17224 North Temple Landfill
LOCATION: CPT-6



NOTES:: Example of notes

🟥 1 Sensitive, fine grained
🟥 2 Organic soils - peats
🟦 3 Clays - clay to silty clay
🟦 4 Silt mixtures - clayey silt to silty clay
🟩 5 Sand mixtures - silty sand to sandy silt
🟫 6 Sands - clean sand to silty sand
🟧 7 Gravelly sand to sand
⬛ 8 Very stiff sand to clayey sand **
⬜ 9 Very stiff, fine grained **

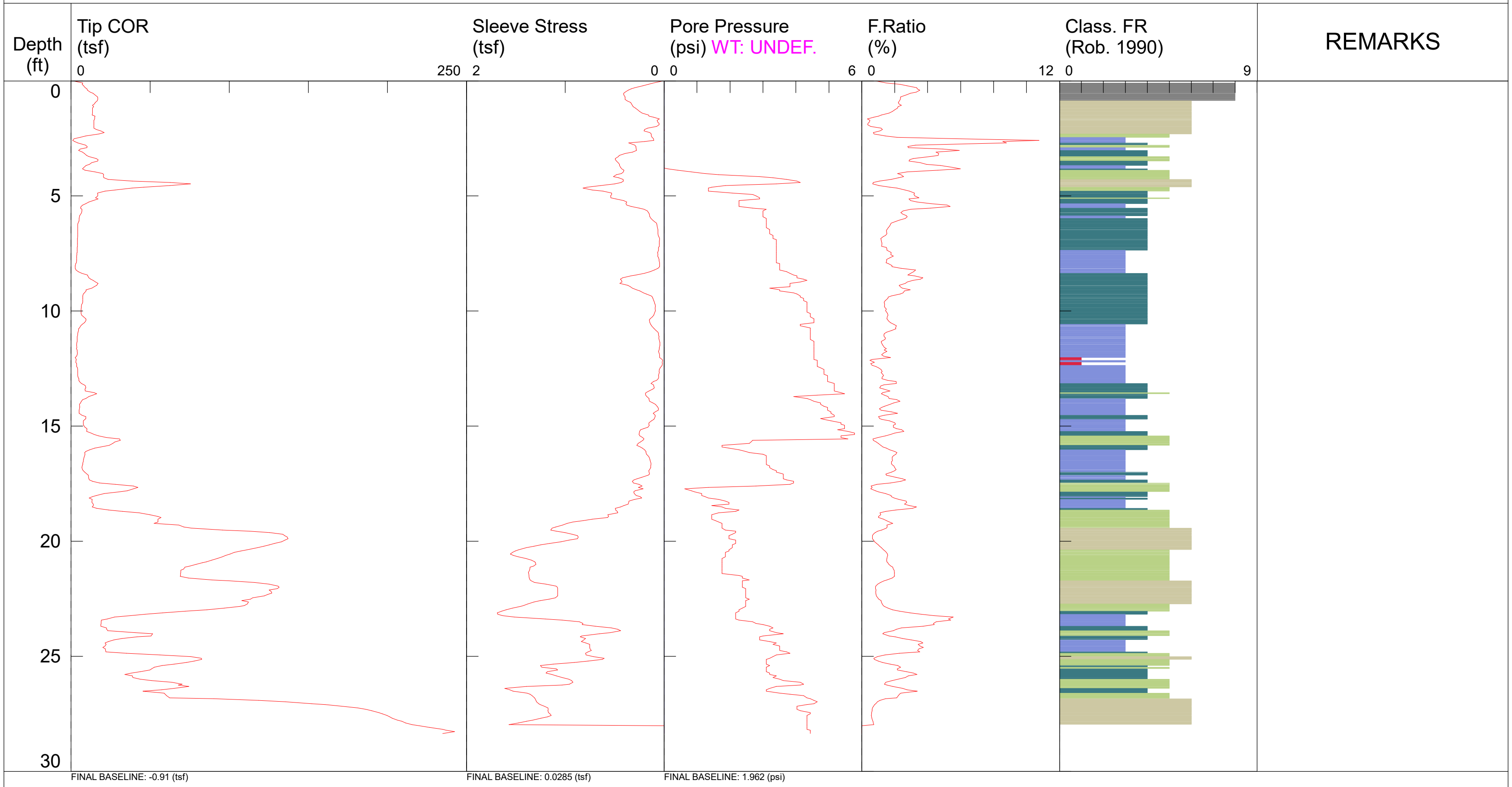
*SBT: Robertson 1990; **Overconsolidated or Cemented; *SBT/SPT CORRELATION: UBC-1983

# SOUNDING

**ACache Corp.**
Engineering a Firm Foundation

TOTAL DEPTH: 28.357 ft
SITE: 17224 West Noth Temple, Salt Lake County UT
SOUNDING
COMPANY: VERTEK
FILENAME: CPT-8.dat

PROBE ID: 4444.190XX
TEST ID: 21-10-27-03
PROJECT: 17224 North Temple Landfill
LOCATION: CPT-8



NOTES:: Example of notes

🟥 1 Sensitive, fine grained
🟪 2 Organic soils - peats
🟦 3 Clays - clay to silty clay
🟩 4 Silt mixtures - clayey silt to silty clay
🟩 5 Sand mixtures - silty sand to sandy silt
🟨 6 Sands - clean sand to silty sand
🟧 7 Gravelly sand to sand
⬛ 8 Very stiff sand to clayey sand **
⬜ 9 Very stiff, fine grained **

*SBT: Robertson 1990; **Overconsolidated or Cemented; *SBT/SPT CORRELATION: UBC-1983

## A-7 Figure 7 – CSM Model

# CONCEPTUAL SITE MODEL
# AIRPORT WEST VCP PHASE 1

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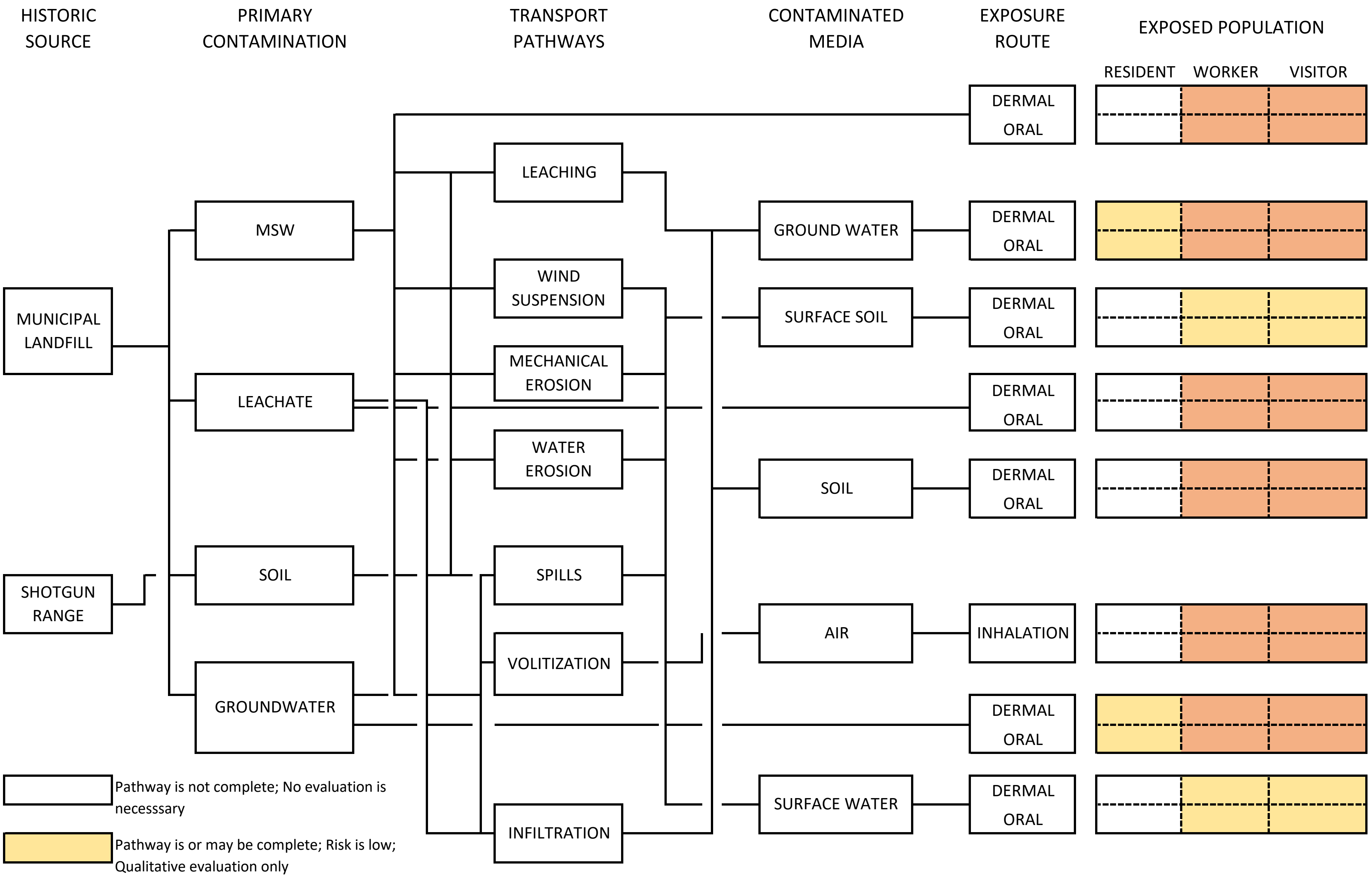


| CONTAMINATED MEDIA | EXPOSURE ROUTE | RESIDENT | WORKER | VISITOR |
|---|---|---|---|---|
| | DERMAL<br>ORAL | ☐ | 🟧 | 🟧 |
| GROUND WATER | DERMAL<br>ORAL | 🟨 | 🟧 | 🟧 |
| SURFACE SOIL | DERMAL<br>ORAL | ☐ | 🟨 | 🟨 |
| | DERMAL<br>ORAL | ☐ | 🟧 | 🟧 |
| SOIL | DERMAL<br>ORAL | ☐ | 🟧 | 🟧 |
| AIR | INHALATION | ☐ | 🟧 | 🟧 |
| | DERMAL<br>ORAL | 🟨 | 🟧 | 🟧 |
| SURFACE WATER | DERMAL<br>ORAL | ☐ | 🟨 | 🟨 |

☐ Pathway is not complete; No evaluation is necesssary

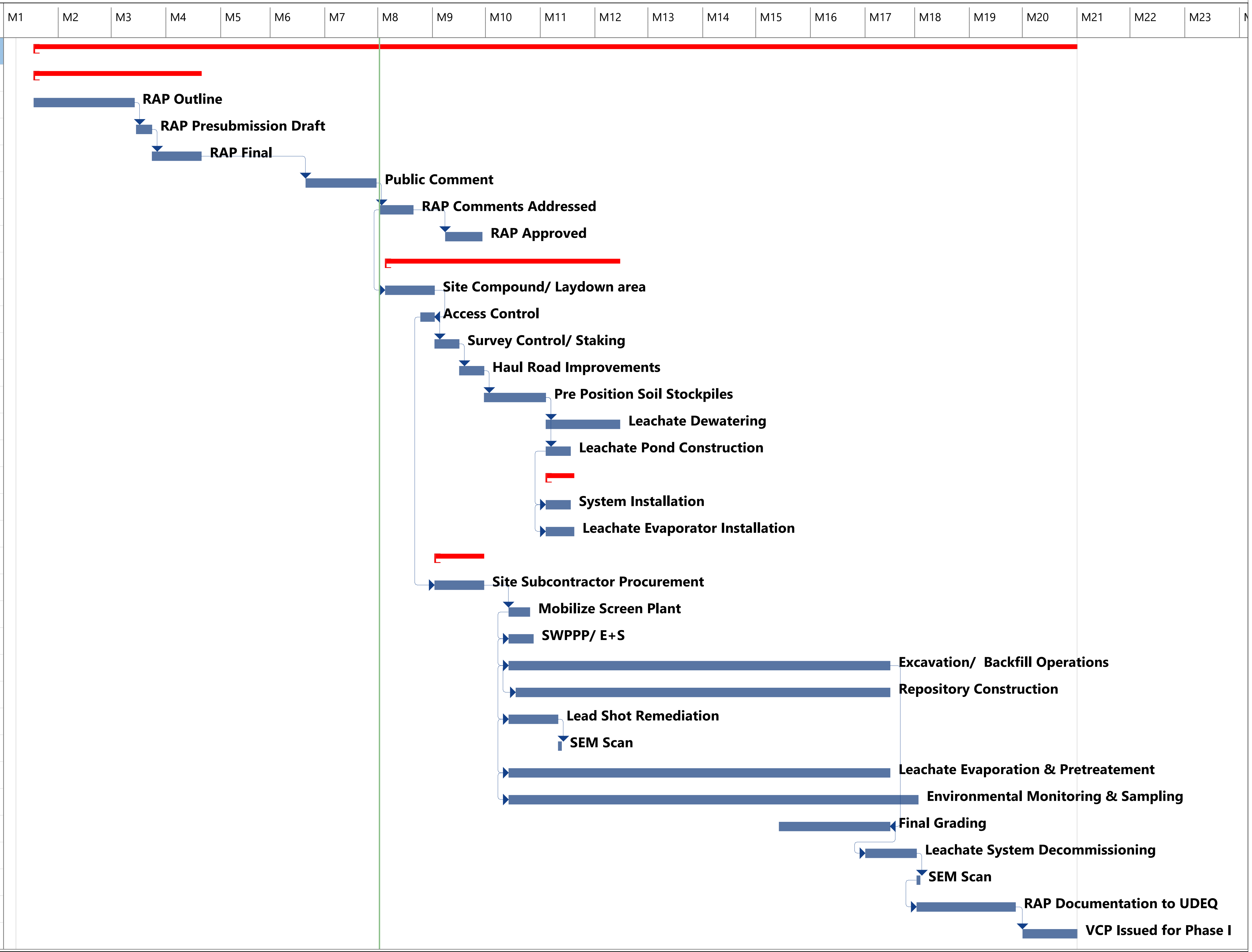
🟨 Pathway is or may be complete; Risk is low; Qualitative evaluation only

🟧 Pathway is complete and may be significant; Quantitative Evaluation

## A-8 Figure 8 – General Remediation Schedule

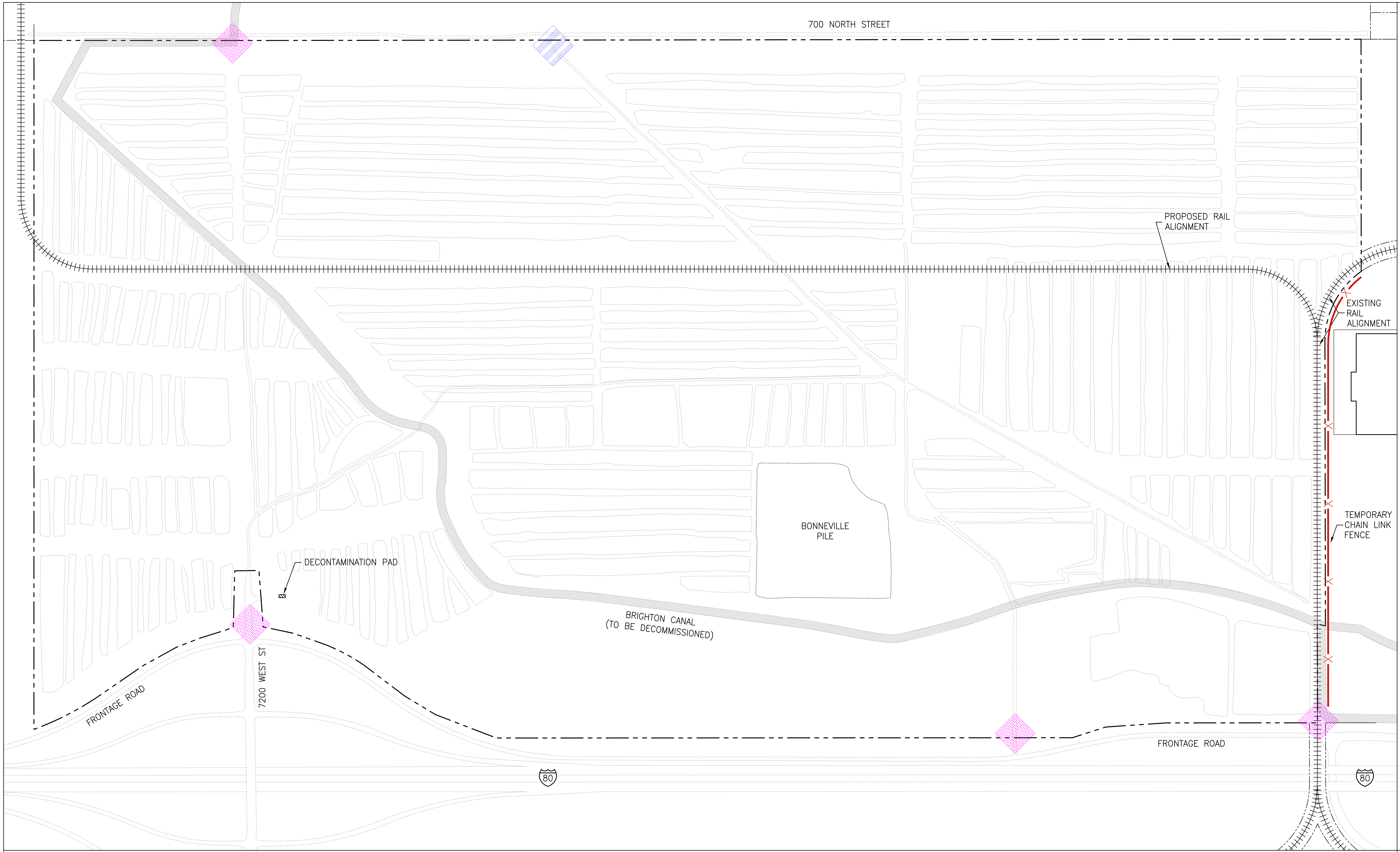
## North Temple Landfill - Phase I Remedial Action Schedule

| ID | Task Name | Duration |
|---|---|---|
| 1 | **Remedial Action Plan** | **423 days** |
| 2 | **RAP** | **69 days** |
| 3 | RAP Outline | 41 days |
| 4 | RAP Presubmission Draft | 7 days |
| 5 | RAP Final | 20 days |
| 6 | Public Comment | 30 days |
| 7 | RAP Comments Addressed | 15 days |
| 8 | RAP Approved | 15 days |
| 9 | **Pre Mobilization Tasks** | **95 days** |
| 10 | Site Compound/ Laydown area | 20 days |
| 11 | Access Control | 6 days |
| 12 | Survey Control/ Staking | 10 days |
| 13 | Haul Road Improvements | 10 days |
| 14 | Pre Position Soil Stockpiles | 25 days |
| 15 | Leachate Dewatering | 30 days |
| 16 | Leachate Pond Construction | 10 days |
| 17 | **Odor Control** | **12 days** |
| 18 | System Installation | 10 days |
| 19 | Leachate Evaporator Installati | 12 days |
| 20 | **Site Subcontractor Procurement** | **20 days** |
| 21 | Site Subcontractor Procureme | 20 days |
| 22 | Mobilize Screen Plant | 8 days |
| 23 | SWPPP/ E+S | 10 days |
| 24 | Excavation/ Backfill Operations | 154 days |
| 25 | Repository Construction | 152 days |
| 26 | Lead Shot Remediation | 20 days |
| 27 | SEM Scan | 2 days |
| 28 | Leachate Evaporation & Pretreatem | 154 days |
| 29 | Environmental Monitoring & Sampl | 166 days |
| 30 | Final Grading | 45 days |
| 31 | Leachate System Decommissioning | 21 days |
| 32 | SEM Scan | 2 days |
| 33 | RAP Documentation to UDEQ | 40 days |
| 34 | VCP Issued for Phase I | 23 days |



Mon 5/2/22 - **FIGURE A-8**

## A-9 Figure 9 – Gated Access Locations & Barriers



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# GATED ACCESS LOCATIONS & BARRIERS

NORTH TEMPLE LANDFILL REMEDIATION
SALT LAKE CITY, UT 84116

1" = 300'
0 300' 600' 1200' 1500'

ORIGINAL SHEET SIZE 22" X 34"

DISCLAIMER: THIS PLAN IS INTENDED ONLY FOR CONCEPTUAL USE. IT DOES NOT REFLECT THE EXACT LOCATION OF UTILITIES OR ANY STRUCTURES. THIS DRAWING IS NOT INTENDED FOR USE IN PERMITTING OR CONSTRUCTION. THIS CONCEPT PLAN IS PROPERTY OF ET ENVIRONMENTAL.

N

LEGEND

- — - — PROPERTY LINE
- ++++++++ RAIL ALIGNMENT
- —X— FENCE LINE
- ▨ INGRESS/EGRESS (GATED)
- ▨ BARRIER

CONCEPTUAL PHASE
4-7-2022

SHEET NUMBER
A-9
05-ET1668

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## A-10 Figure 10 – Wildlife Protection Fence

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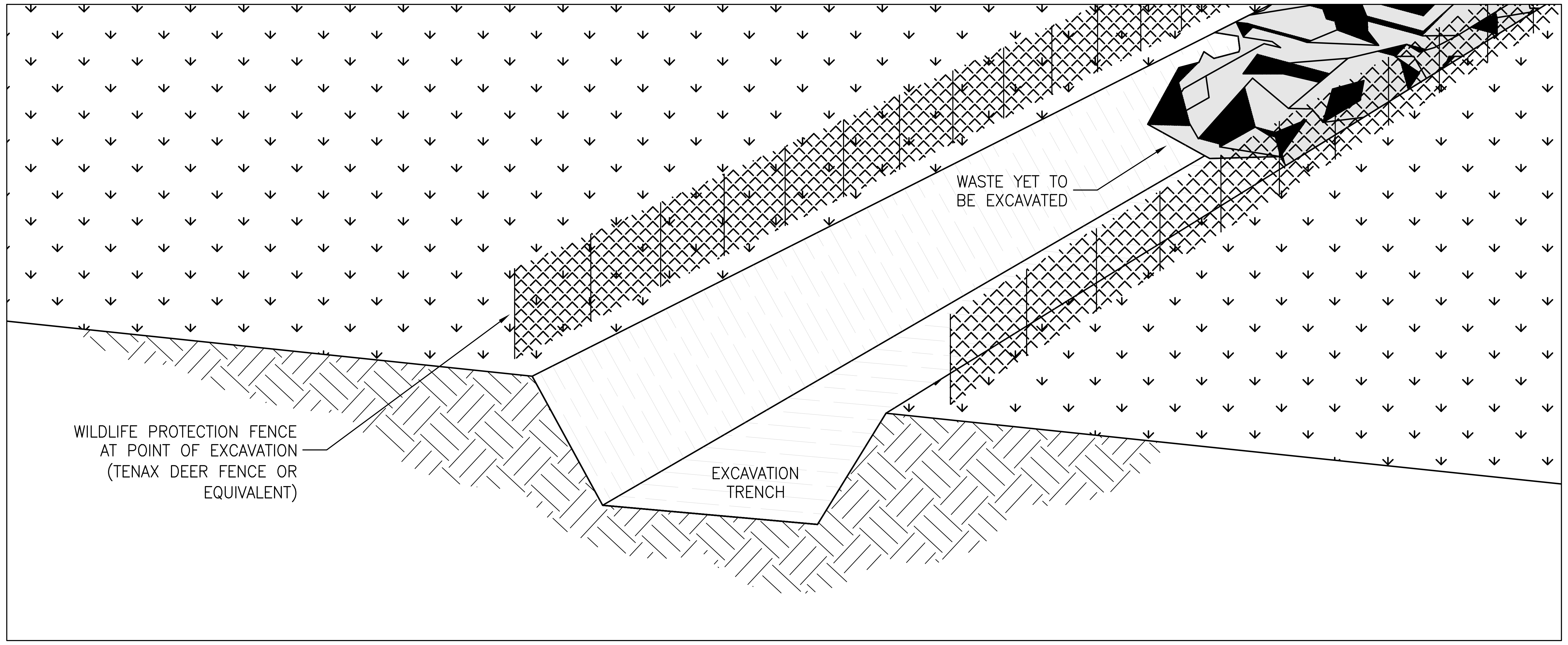

1/10 WILDLIFE PROTECTION FENCE AT POINT OF TRENCH EXCAVATION

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# WILDLIFE PROTECTION FENCE

NORTH TEMPLE LANDFILL REMEDIATION
SALT LAKE CITY, UT 84116

ORIGINAL SHEET SIZE 22" X 34"

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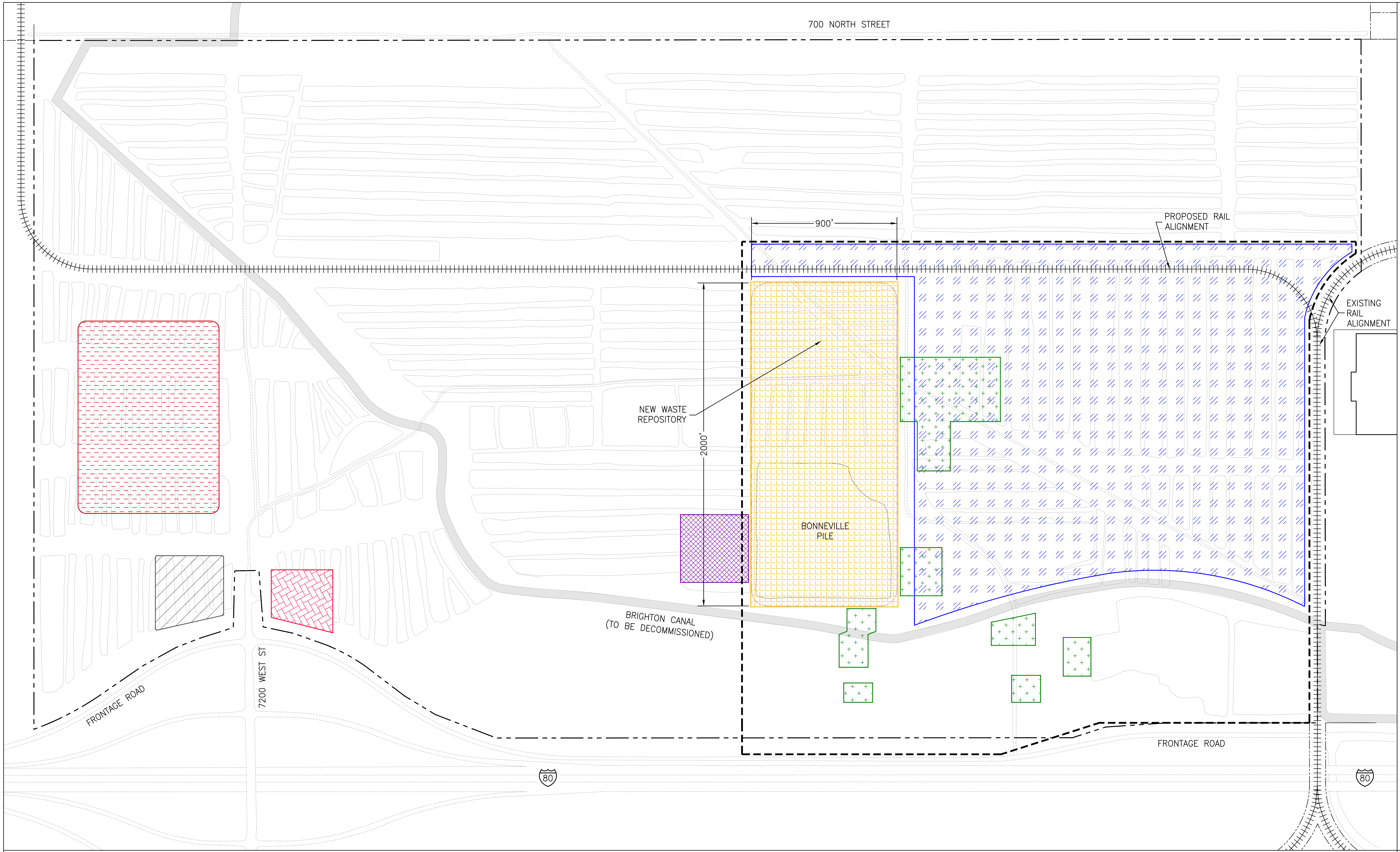
N

LEGEND

CONCEPTUAL PHASE
5-16-2022

SHEET NUMBER
A-10
05-ET1668

## A-11 Figure 11 – Site Logistics Plan



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# SITE LOGISTICS PLAN
## NORTH TEMPLE LANDFILL REMEDIATION
SALT LAKE CITY, UT 84116

CONCEPTUAL PHASE
4-7-2022

SHEET NUMBER
**A-11**
05-ET1668

## LEGEND

| | |
|---|---|
| — - — - — | PROPERTY LINE |
| ┼┼┼┼┼┼┼┼┼ | RAIL ALIGNMENT |
| — — — — | PHASE I BOUNDARY |
| ▤ | SOIL STOCKPILE (BACKFILL SOURCE) |
| ▩ | LEACHATE POND & TEMPORARY TREATMENT AREA |
| ▦ | WASTE REPOSITORY |
| ▨ | PHASE I EXCAVATION AREA |
| ▩ | EQUIP OFFICE/COMPOUND |
| ▨ | AGGREGATE PROCESSING |
| ⊞ | APPROXIMATE LEAD SCRAPE AREA (FROM PREVIOUS STUDY) |

1" = 300'
0 300' 600' 1200' 1500'

ORIGINAL SHEET SIZE 22" X 34"

DISCLAIMER: THIS PLAN IS INTENDED ONLY FOR CONCEPTUAL USE. IT DOES NOT REFLECT THE EXACT LOCATION OF UTILITIES OR ANY STRUCTURES. THIS DRAWING IS NOT INTENDED FOR USE IN PERMITTING OR CONSTRUCTION. THIS CONCEPT PLAN IS PROPERTY OF ET ENVIRONMENTAL.

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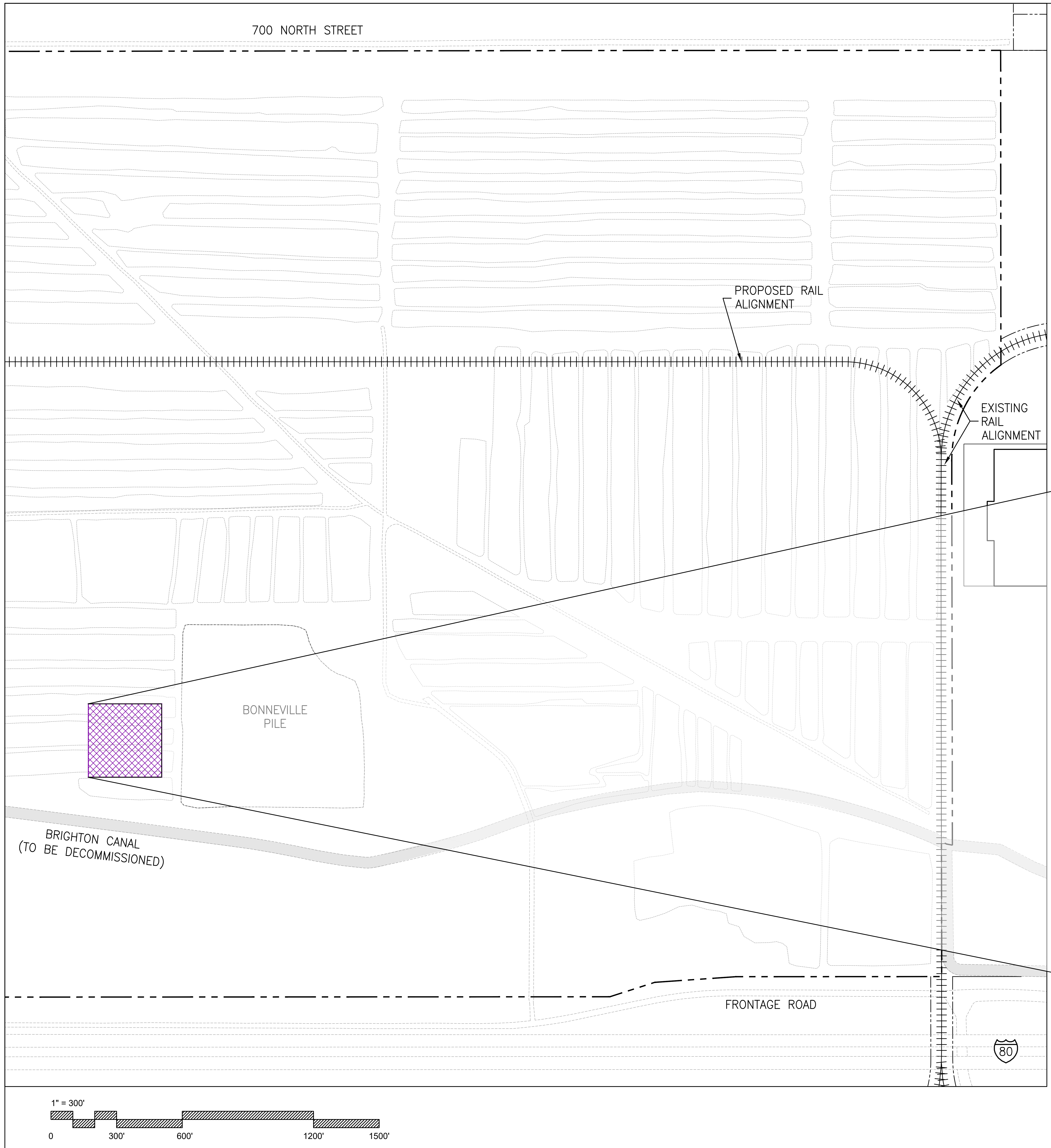
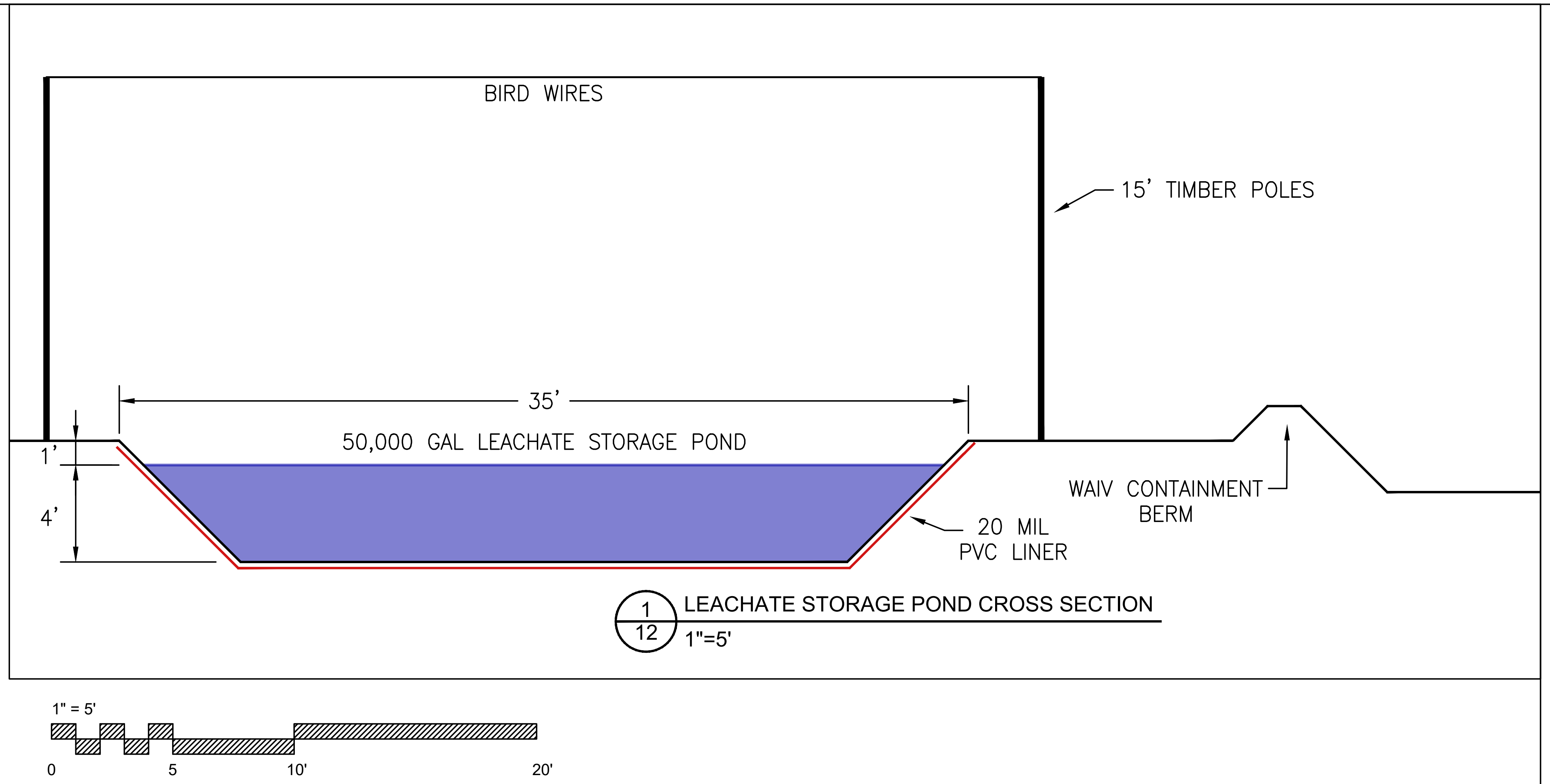
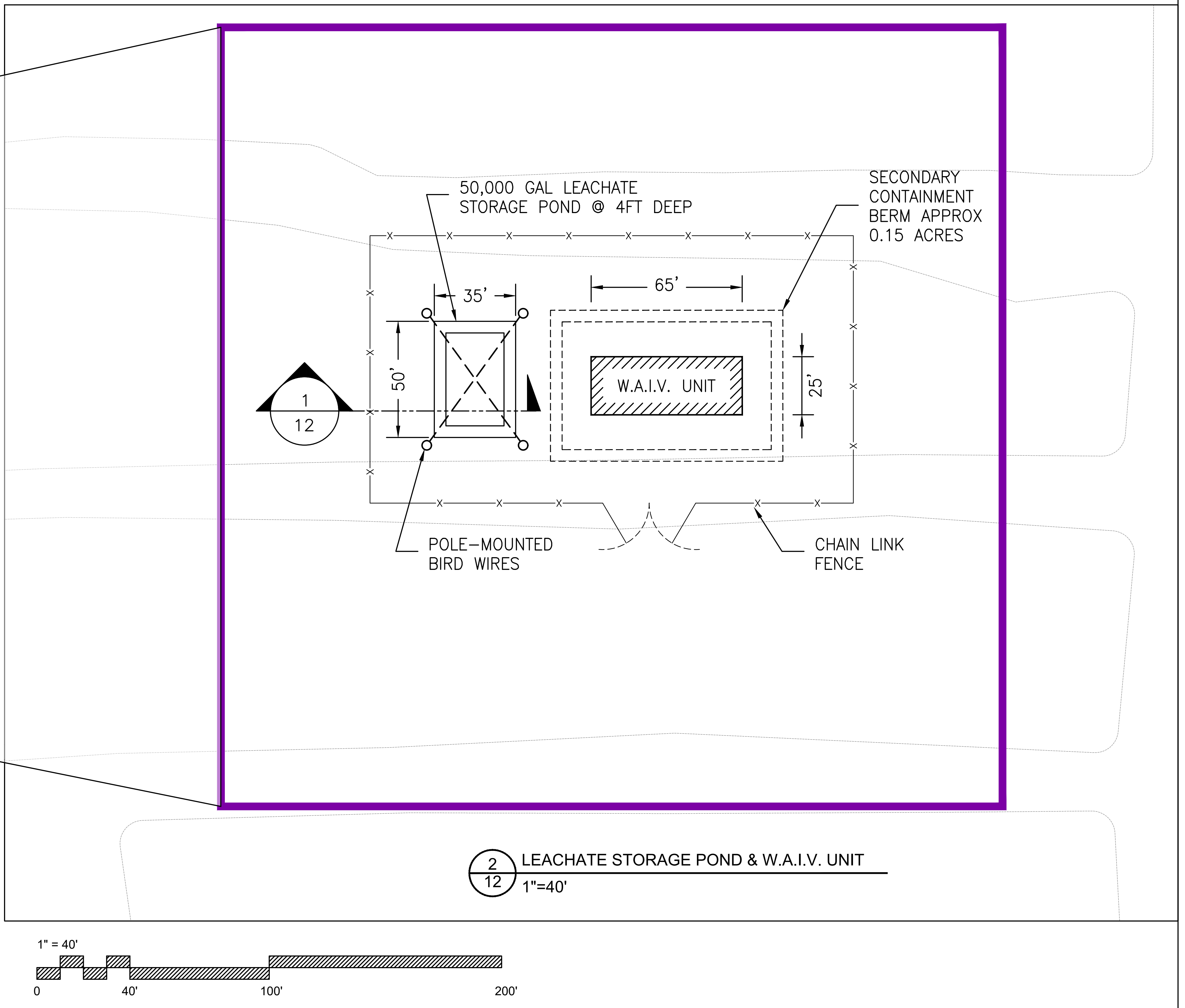
## A-12 Figure 12 – Leachate Storage Detail





1/12 LEACHATE STORAGE POND CROSS SECTION
1"=5'



2/12 LEACHATE STORAGE POND & W.A.I.V. UNIT
1"=40'

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ORIGINAL SHEET SIZE 22" X 34"

DISCLAIMER: THIS PLAN IS INTENDED ONLY FOR CONCEPTUAL USE. IT DOES NOT REFLECT THE EXACT LOCATION OF UTILITIES OR ANY STRUCTURES. THIS DRAWING IS NOT INTENDED FOR USE IN PERMITTING OR CONSTRUCTION. THIS CONCEPT PLAN IS PROPERTY OF ET ENVIRONMENTAL.

N

LEGEND

| | |
|---|---|
| — - — | PROPERTY LINE |
| ┼┼┼┼┼┼┼┼┼ | RAIL ALIGNMENT |
| ——x—— | FENCE LINE |

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# LEACHATE STORAGE DETAIL

NORTH TEMPLE LANDFILL REMEDIATION
SALT LAKE CITY, UT 84116

CONCEPTUAL PHASE
5-17-2022

SHEET NUMBER
A-12

05-ET1668

## A-13 Figure 13 – Repository Plan View

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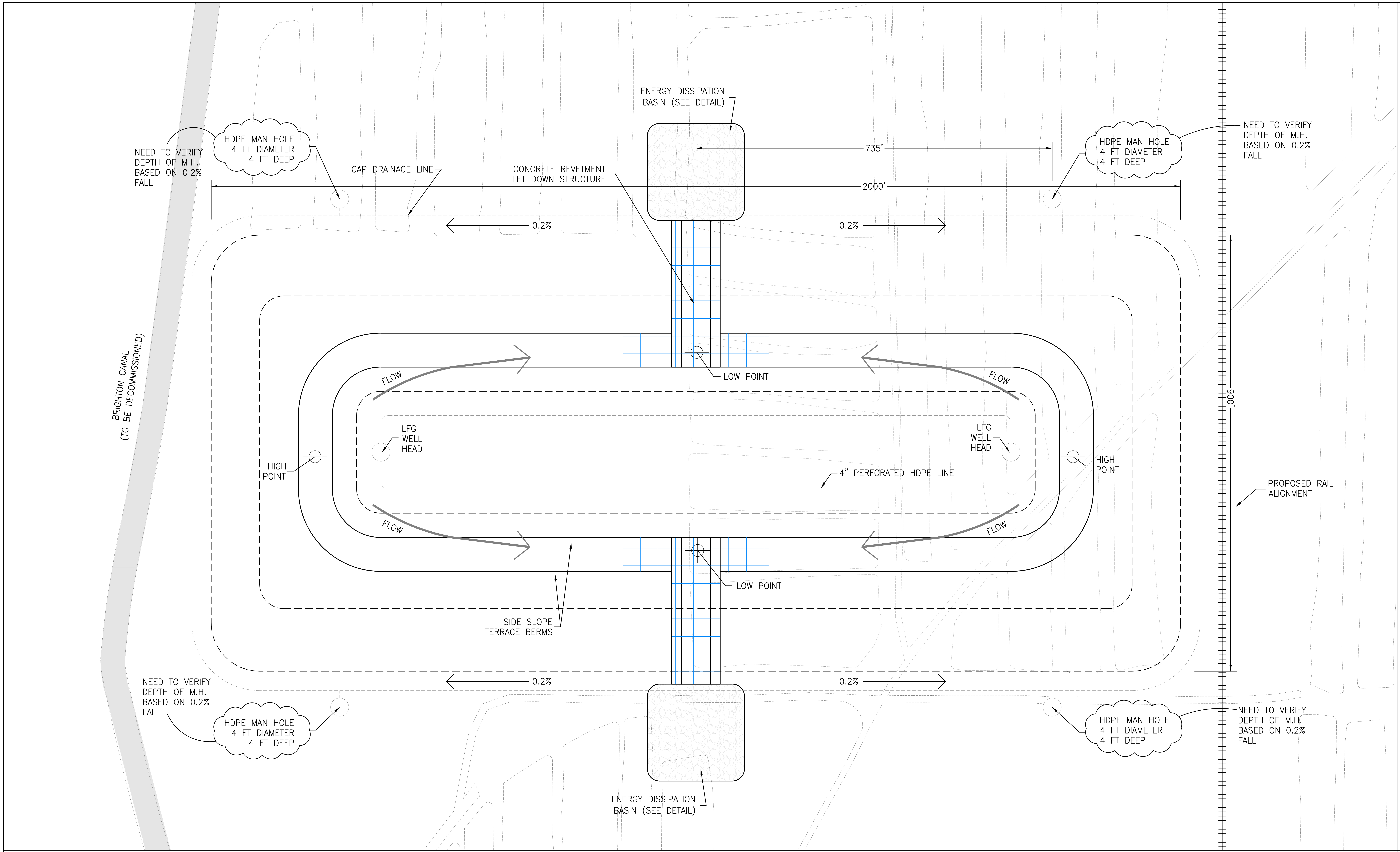

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# REPOSITORY PLAN VIEW
NORTH TEMPLE LANDFILL REMEDIATION
SALT LAKE CITY, UT 84116

1" = 100'
0 100' 200' 400'

ORIGINAL SHEET SIZE 22" X 34"

N

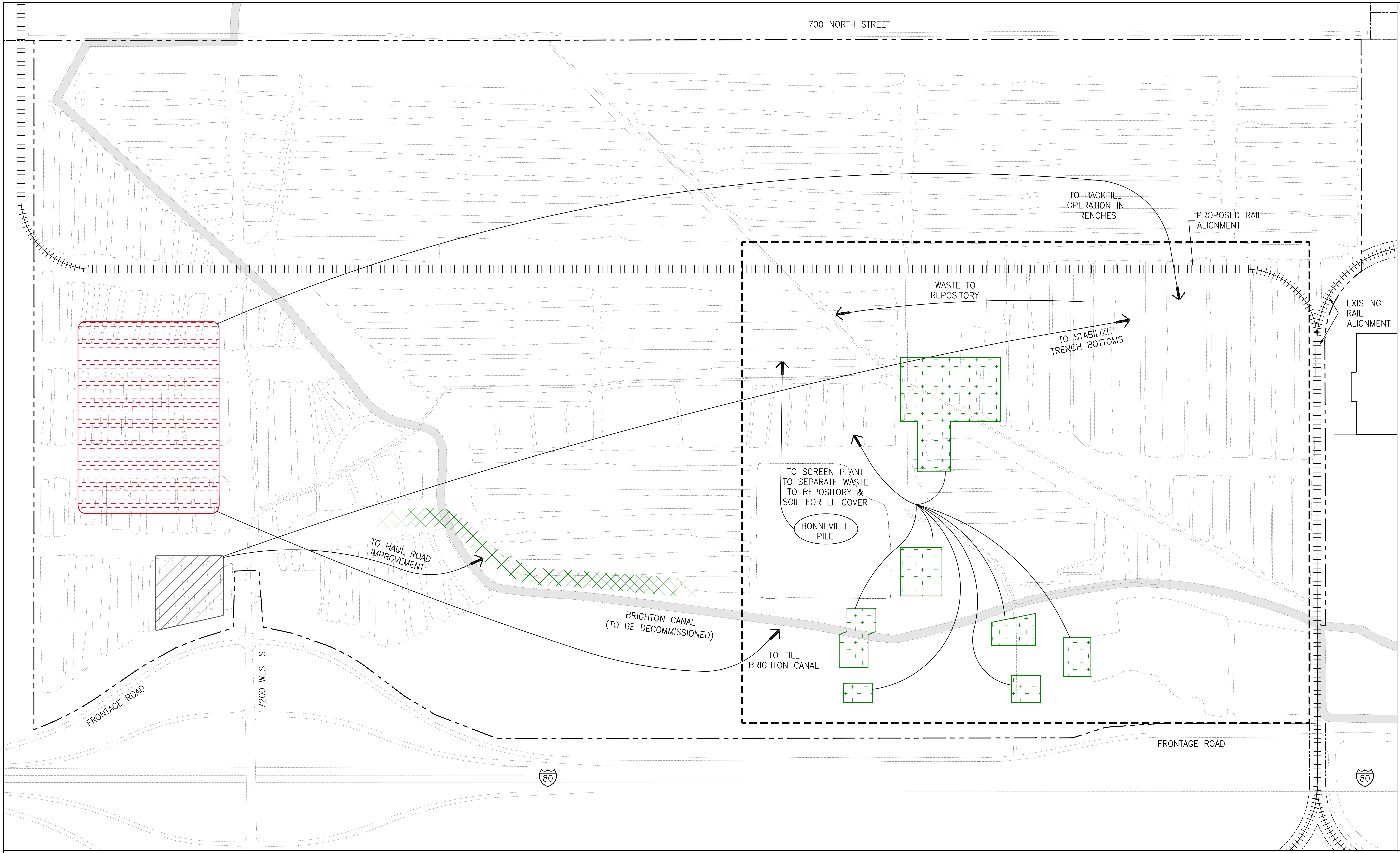
LEGEND

| | |
|---|---|
| ++++++++++ | RAIL ALIGNMENT |
| ▦ | PROPOSED CONCRETE REVETMENT |

CONCEPTUAL PHASE
4-8-2022

SHEET NUMBER
A-13
05-ET1668

## A-14 Figure 14 – Material Flow Diagram



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# MATERIAL FLOW DIAGRAM

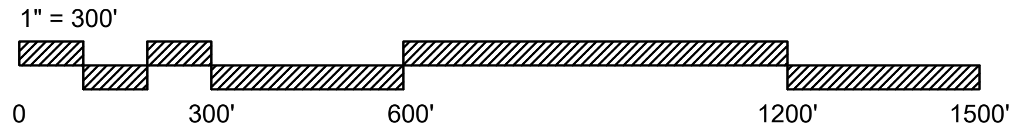
## NORTH TEMPLE LANDFILL REMEDIATION
## SALT LAKE CITY, UT 84116

CONCEPTUAL PHASE
4-7-2022

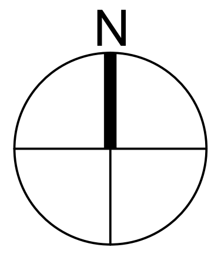
SHEET NUMBER
A-14
05-ET1668

## LEGEND

- PROPERTY LINE
- RAIL ALIGNMENT
- PHASE I BOUNDARY
- ▨ PROPOSED NEW HAULING ROUTE
- 🟥 SOIL STOCKPILE
- ▨ AGGREGATE STOCKPILE
- 🟩 LEAD SCRAPE AREA TO REPOSITORY



ORIGINAL SHEET SIZE 22" X 34"



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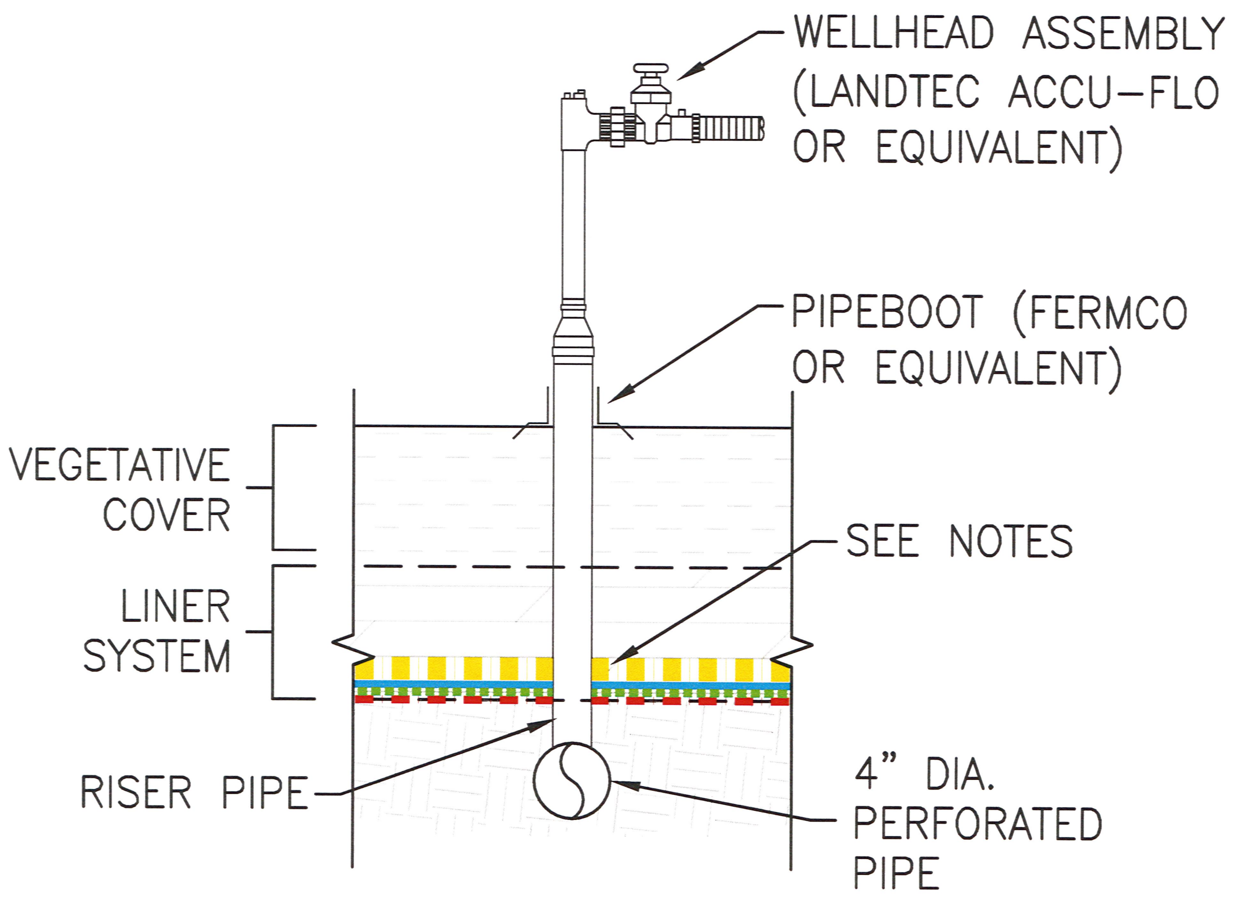
## A-15 Figure 15 – Landfill Gas Wellhead



NOTES:

RISER PENETRATIONS

- GCL – BENTONITE CLAY SEAL AROUND RISER
- LLDPE LINER – PE BOOT (FERNCO OR EQUIVALENT)
- GEO NET – PE BOOT

LEGEND:

🟨 GEO NET
🟦 40 MIL LLDPE
🟩 GCL
🟥 TOP OF 6" SOIL LAYER

SCALE: N.T.S.

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## LANDFILL GAS WELLHEAD

NORTH TEMPLE LANDFILL REMEDIATION
SALT LAKE CITY, UT 84116

DRAWN BY JJ
CHECKED BY BH
DATE 4-18-2022
REV. # CONCEPTUAL PHASE

SHEET NUMBER
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## A-16 Figure 16 – Leachate Dewatering Plan

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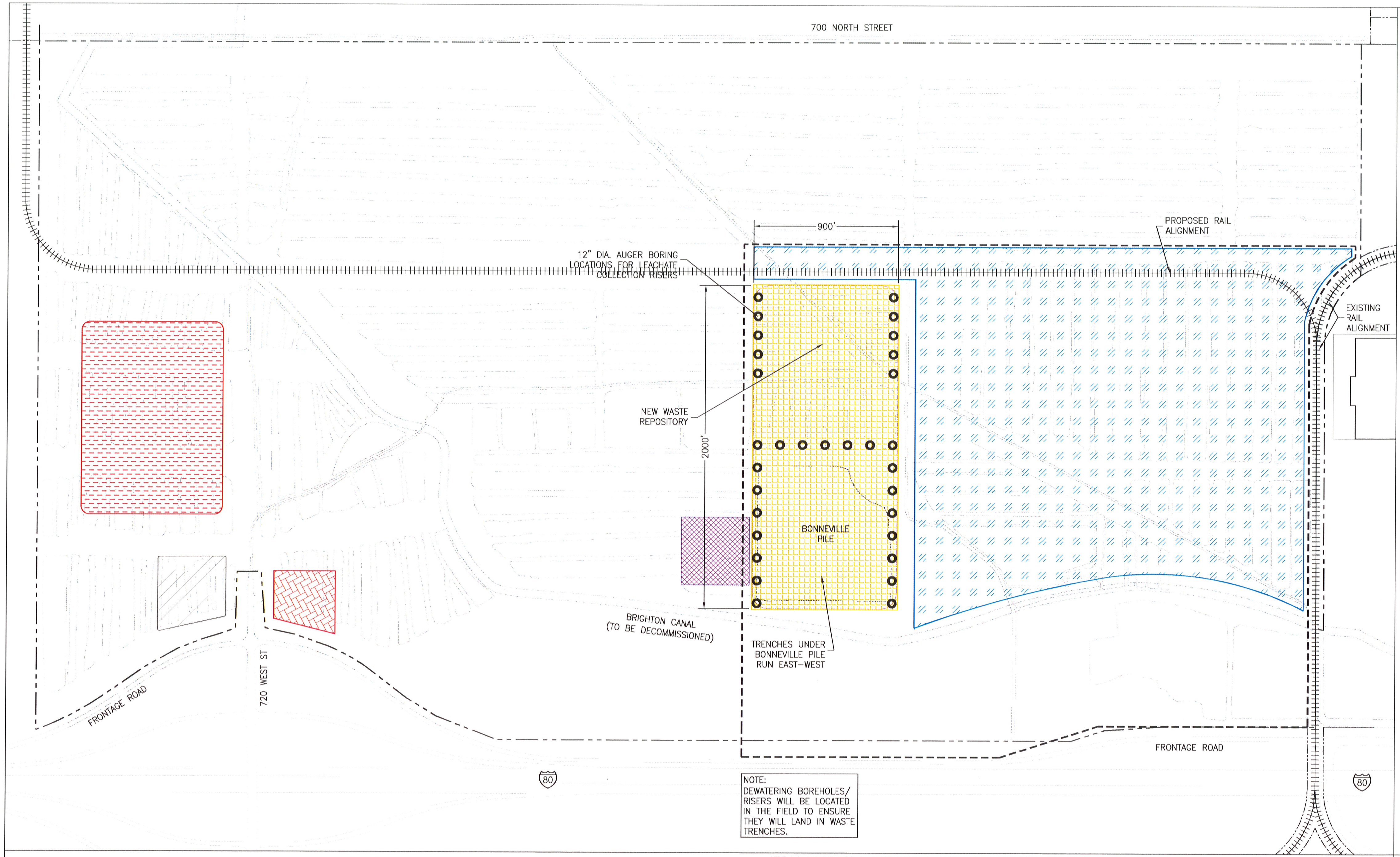
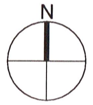


NOTE:
DEWATERING BOREHOLES/ RISERS WILL BE LOCATED IN THE FIELD TO ENSURE THEY WILL LAND IN WASTE TRENCHES.

ORIGINAL SHEET SIZE 22" X 34"



## LEGEND

| | |
|---|---|
| — - - — | PROPERTY LINE |
| ┼┼┼┼┼┼┼┼ | RAIL ALIGNMENT |
| — — — — | PHASE I BOUNDARY |
| 🟥 | SOIL STOCKPILE (BACKFILL SOURCE) |
| ▨ | LEACHATE POND & TEMPORARY TREATMENT AREA |
| 🟨 | WASTE REPOSITORY |
| 🟦 | PHASE I EXCAVATION AREA |
| ▨ | EQUIP OFFICE/COMPOUND |
| ☐ | AGGREGATE PROCESSING |
| ○ | AUGER BORING LOCATIONS |

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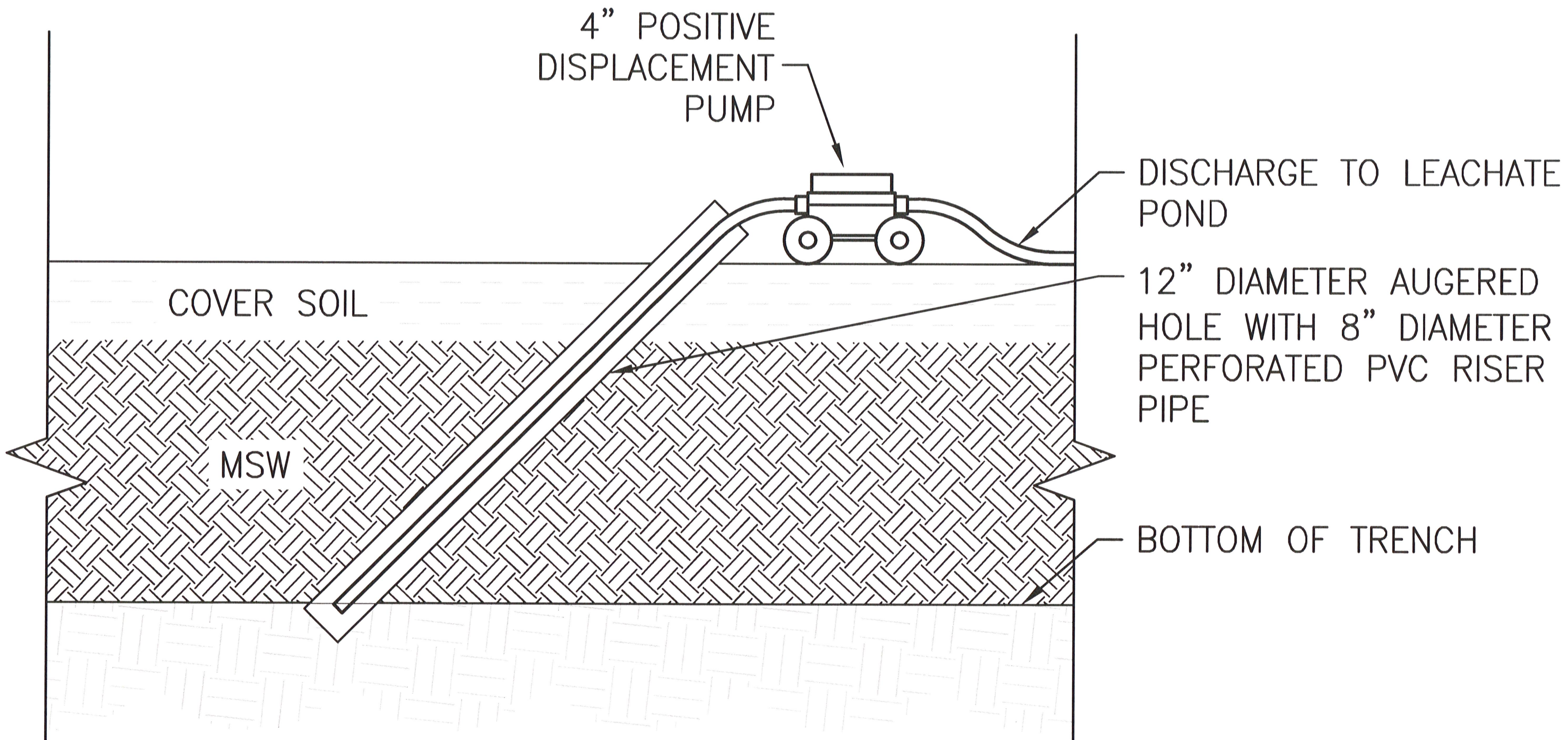
# LECHATE DEWATERING PLAN
## NORTH TEMPLE LANDFILL REMEDIATION
SALT LAKE CITY, UT 84116

CONCEPTUAL PHASE
5-5-2022

SHEET NUMBER
A-16
05-ET1668

## A-17 Figure 17 – Leachate Dewatering Detail



NOTE:
THE DEWATERING BOREHOLES WILL REACH NATIVE SOILS PRIOR TO PLACEMENT OF RISER PIPE

SCALE: N.T.S.

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## TRENCH DEWATERING DETAIL

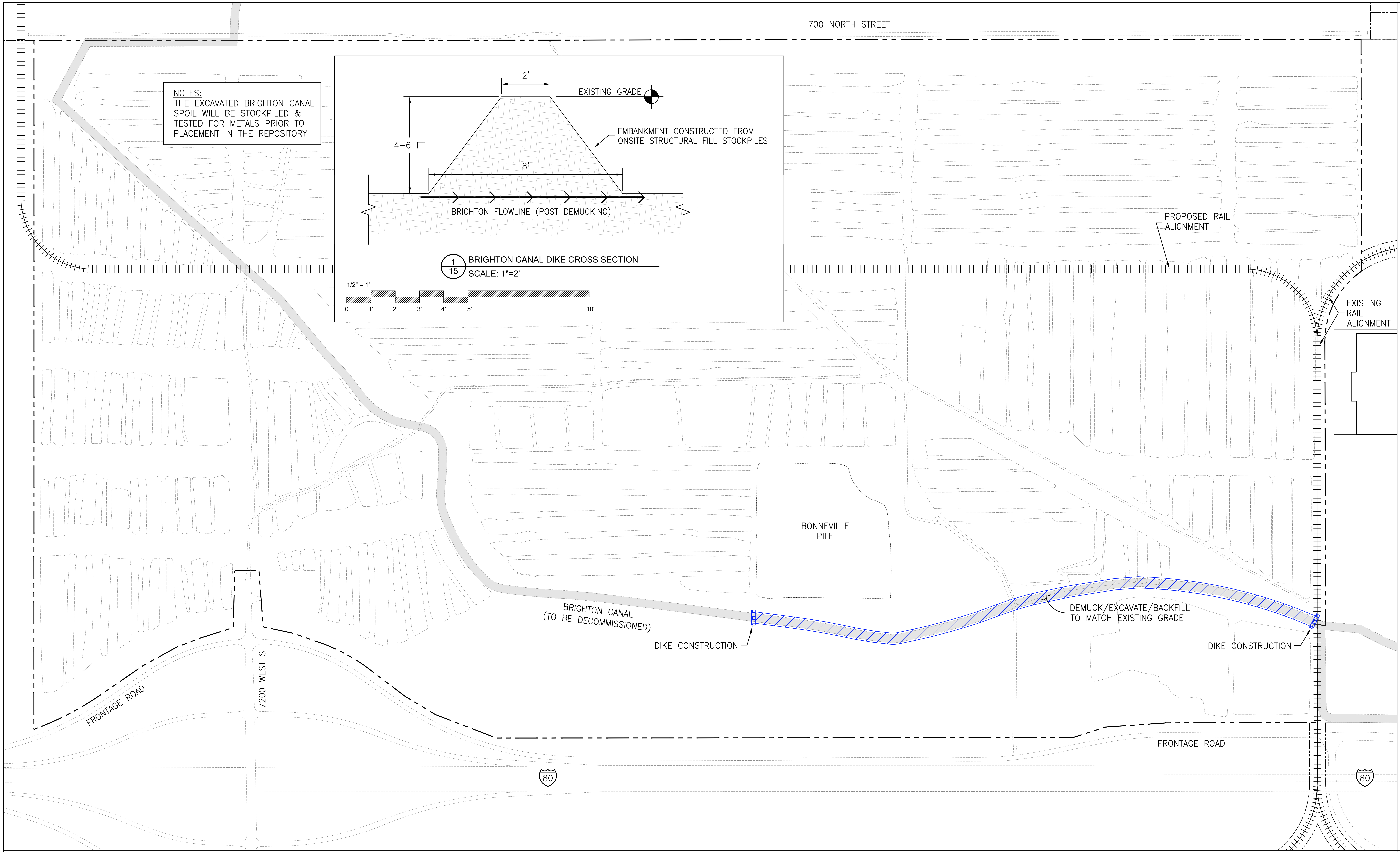
NORTH TEMPLE LANDFILL REMEDIATION
SALT LAKE CITY, UT 84116

| | |
|---|---|
| DRAWN BY | JJ |
| CHECKED BY | BH |
| DATE | 4-25-2022 |
| REV. # | CONCEPTUAL PHASE |

SHEET NUMBER
A-17
05-ET1668

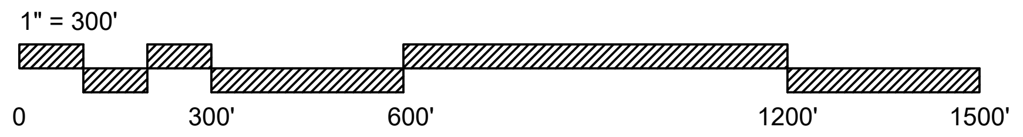
## A-18 Figure 18 – Lead Shot Removal Areas (See Figure A-11)

## A-19 Figure 19 – Brighton Canal Decommissioning

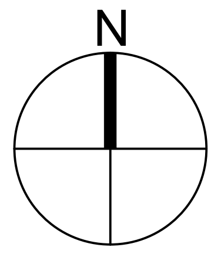


BRIGHTON CANAL DIKE CROSS SECTION
SCALE: 1"=2'

NOTES:
THE EXCAVATED BRIGHTON CANAL SPOIL WILL BE STOCKPILED & TESTED FOR METALS PRIOR TO PLACEMENT IN THE REPOSITORY



ORIGINAL SHEET SIZE 22" X 34"



LEGEND

— - — PROPERTY LINE
┼┼┼┼┼┼ RAIL ALIGNMENT
▨ BRIGHTON CANAL DECOMMISSION
┼ DIKE CONSTRUCTION

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# BRIGHTON CANAL DECOM. PHASE 1

NORTH TEMPLE LANDFILL REMEDIATION
SALT LAKE CITY, UT 84116

CONCEPTUAL PHASE
4-11-2022

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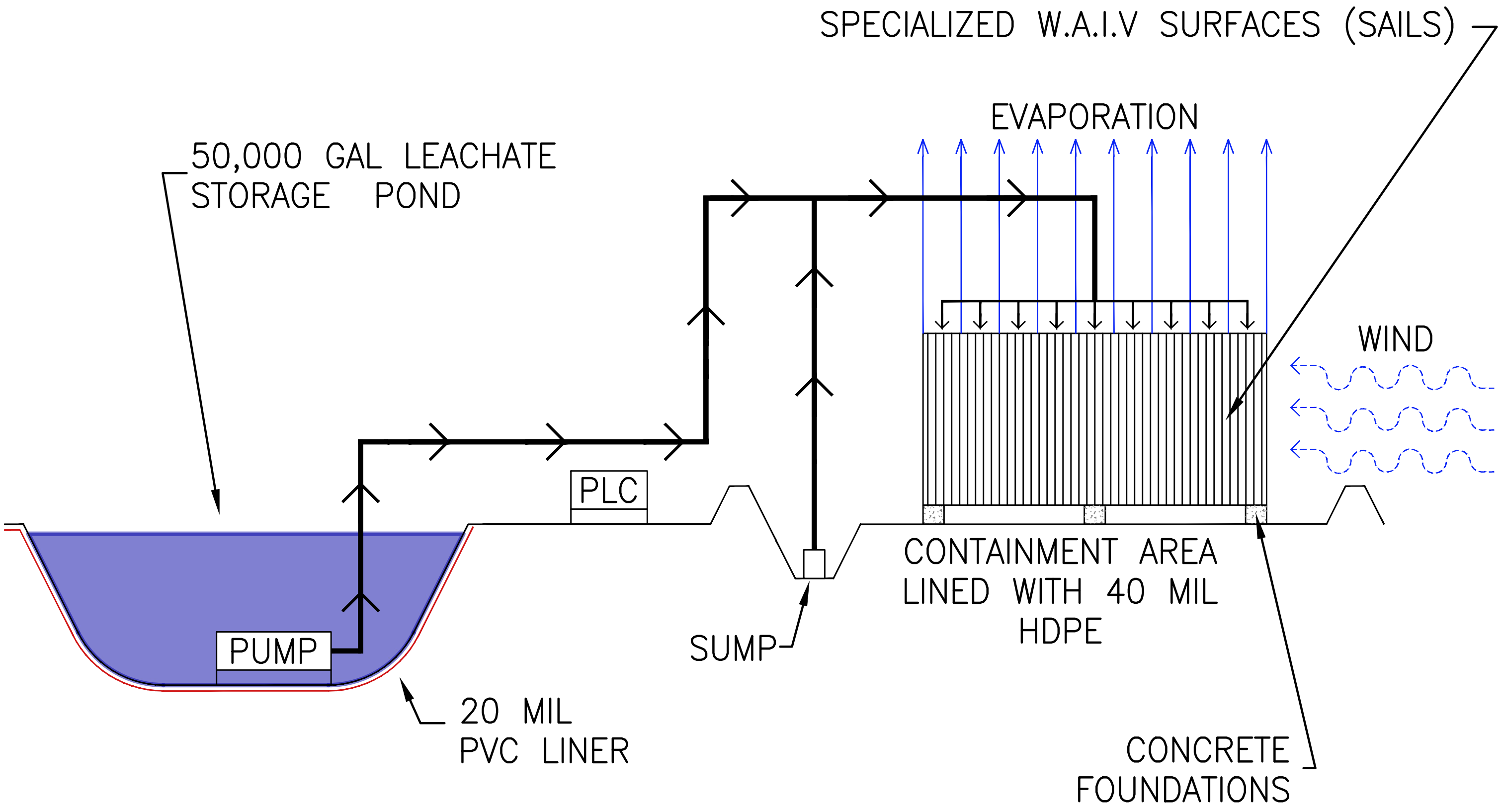
## A-20 Figure 20 – WAIV® Evaporator System



SCALE: N.T.S.

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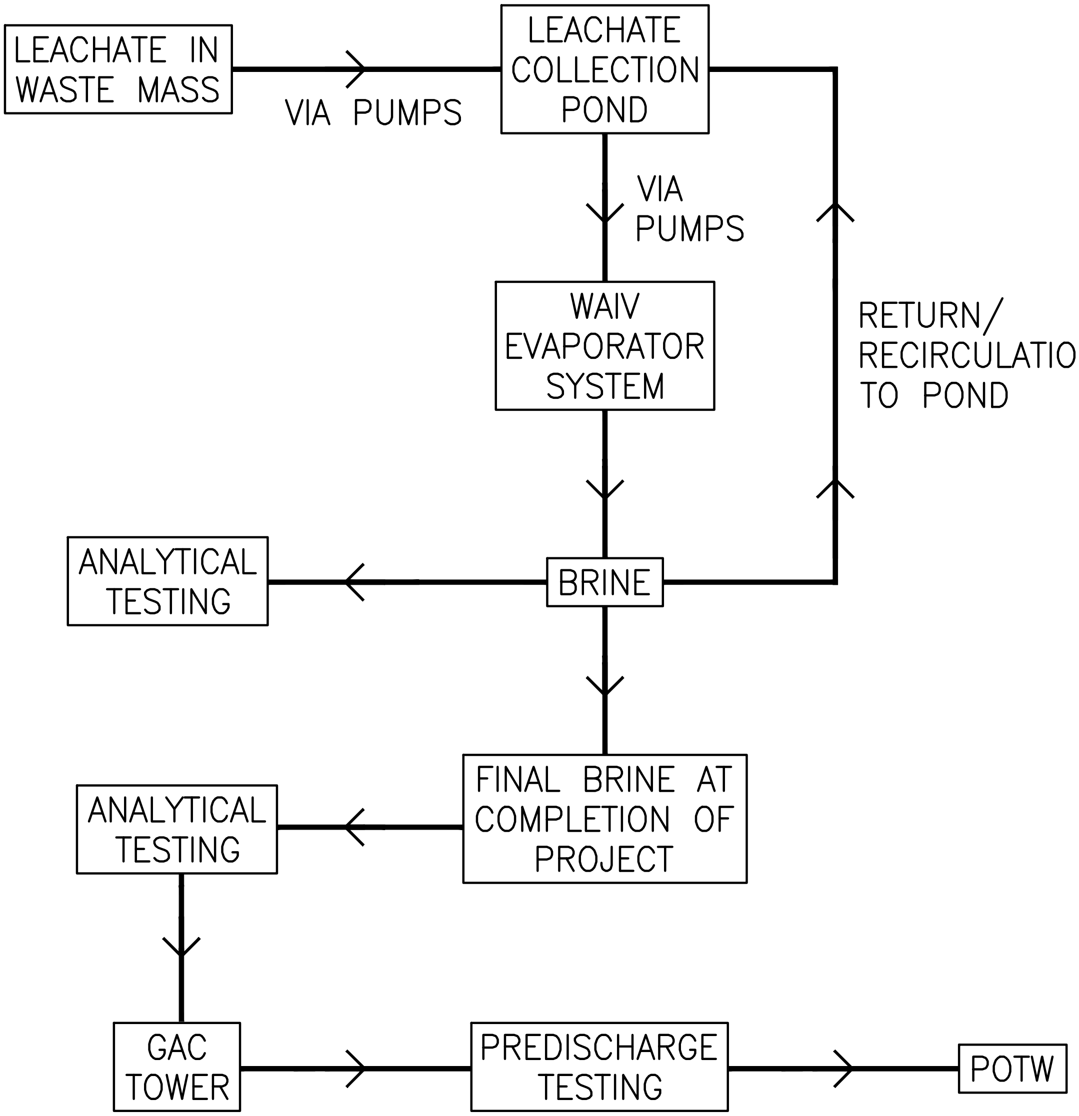
## WAIV® EVAPORATOR SYSTEM
NORTH TEMPLE LANDFILL REMEDIATION
SALT LAKE CITY, UT 84116

| | |
|---|---|
| DRAWN BY | JJ |
| CHECKED BY | BH |
| DATE | 4-5-2022 |
| REV. # | CONCEPTUAL PHASE |

SHEET NUMBER
A-20
05-ET1668

## A-21 Figure 21 – Leachate Management Process Flow Diagram



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SCALE: N.T.S.

# LEACHATE MANAGEMENT PROCESS FLOW DIAGRAM

NORTH TEMPLE LANDFILL REMEDIATION
SALT LAKE CITY, UT 84116

DRAWN BY JJ
CHECKED BY BH
DATE 4-5-2022
REV. # CONCEPTUAL PHASE

SHEET NUMBER
A-21
05-ET1668

## A-22 Figure 22 – Material Hauling Plan

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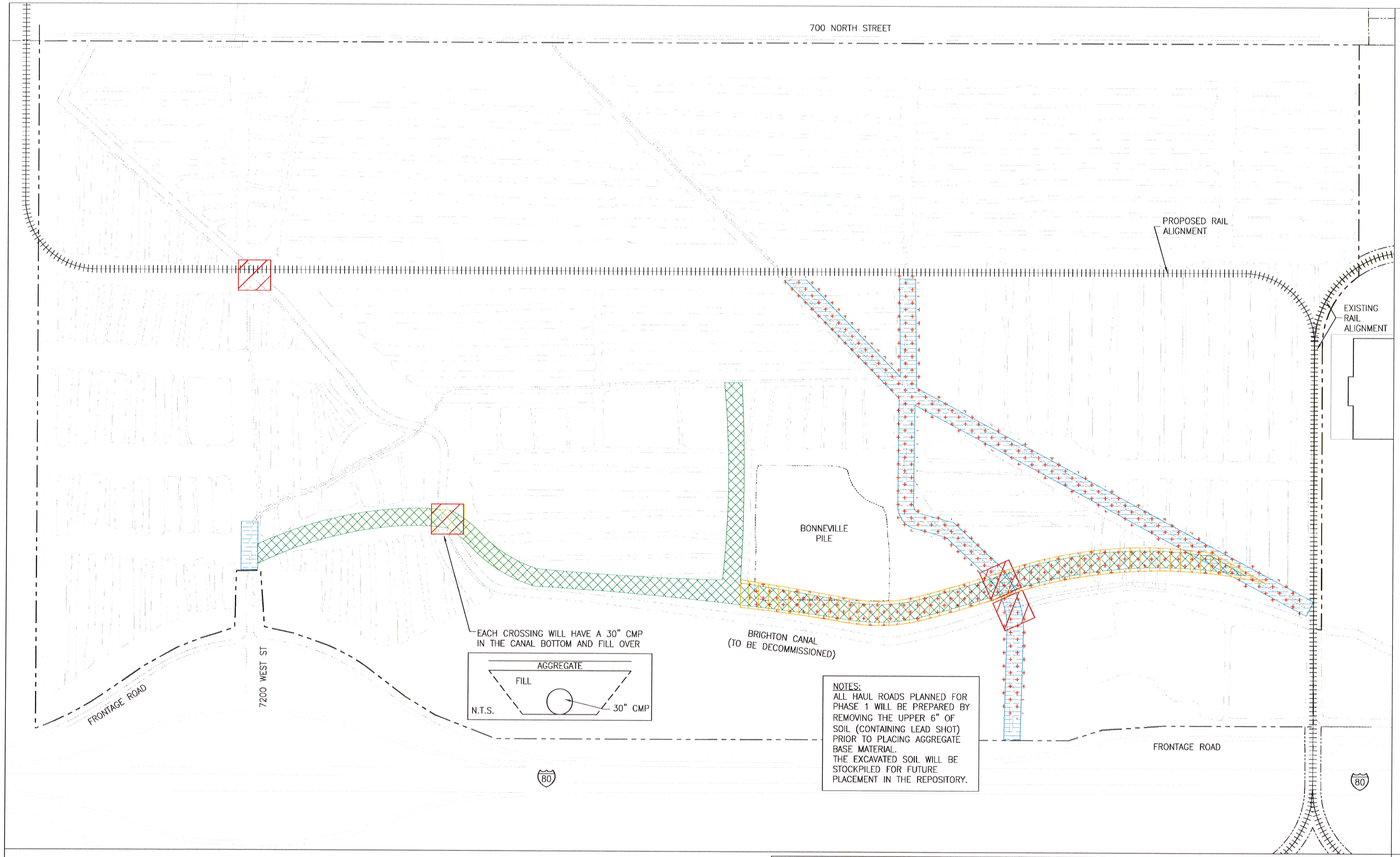

NOTES:
ALL HAUL ROADS PLANNED FOR PHASE 1 WILL BE PREPARED BY REMOVING THE UPPER 6" OF SOIL (CONTAINING LEAD SHOT) PRIOR TO PLACING AGGREGATE BASE MATERIAL.
THE EXCAVATED SOIL WILL BE STOCKPILED FOR FUTURE PLACEMENT IN THE REPOSITORY.

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# MATERIAL HAULING PLAN
## NORTH TEMPLE LANDFILL REMEDIATION
## SALT LAKE CITY, UT 84116

1" = 300'
0 300' 600' 1200' 1500'

ORIGINAL SHEET SIZE 22" X 34"

DISCLAIMER: THIS PLAN IS INTENDED ONLY FOR CONCEPTUAL USE IT DOES NOT REFLECT THE EXACT LOCATION OF UTILITIES OR ANY STRUCTURES. THIS DRAWING IS NOT INTENDED FOR USE IN PERMITTING OR CONSTRUCTION. THIS CONCEPT PLAN IS PROPERTY OF ET ENVIRONMENTAL.

N

LEGEND

| | | | |
|---|---|---|---|
| – – – – | PROPERTY LINE | ▨ | CANAL CROSSING |
| ┼┼┼┼┼┼ | RAIL ALIGNMENT | + | LEAD SCRAPE AREA TO REPOSITORY (PHASE 1 ONLY) |
| 🟩 | PROPOSED NEW HAULING ROUTE | | |
| 🟨 | PROPOSED NEW HAULING ROUTE (PHASE 1 ONLY) | | |
| 🟦 | EXISTING HAULING ROUTE OR EASEMENTS (TO BE IMPROVED) | | |

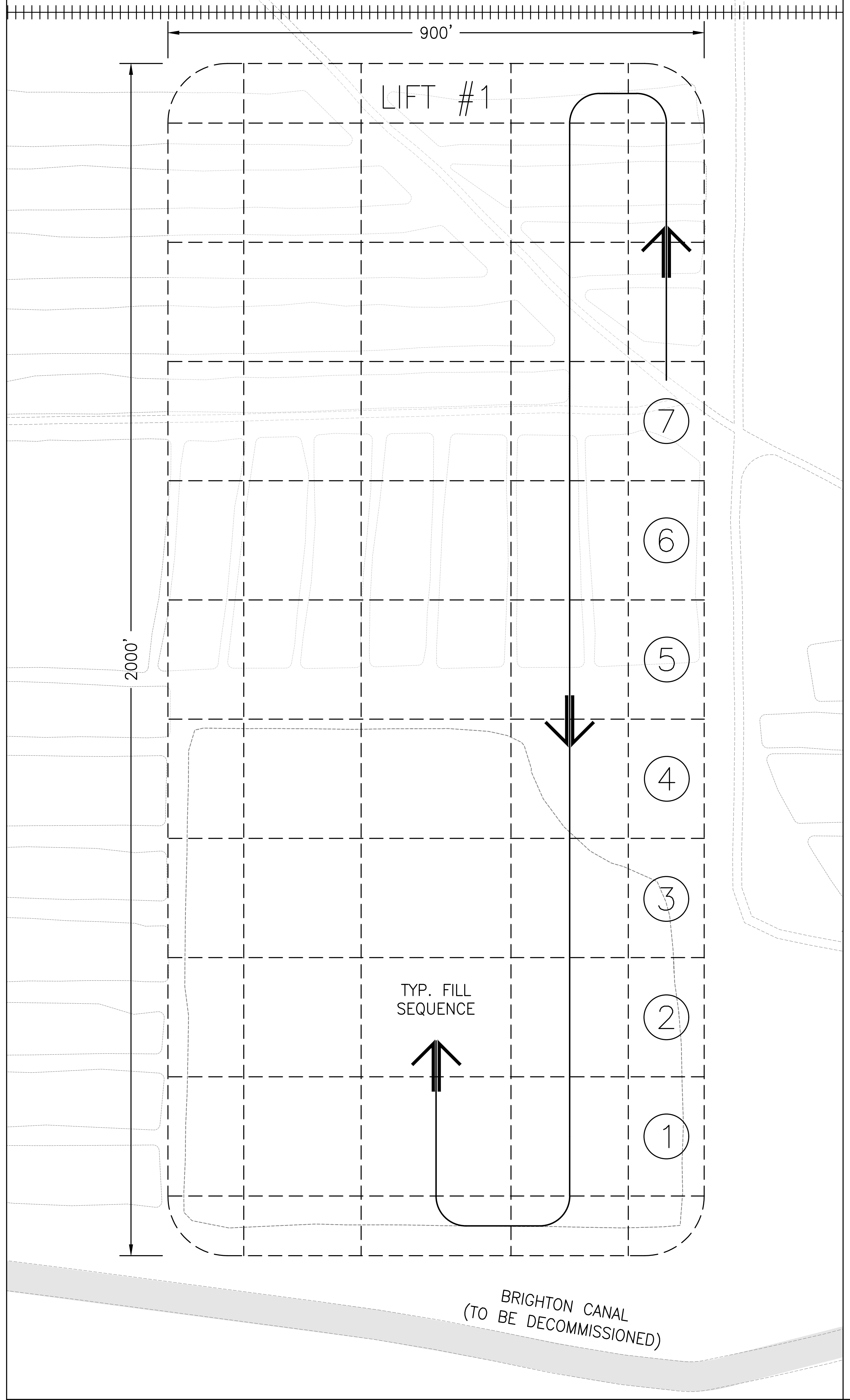
CONCEPTUAL PHASE
4-11-2022

SHEET NUMBER
A-22
05-ET1668

## A-23 Figure 23 – Repository Fill Sequence

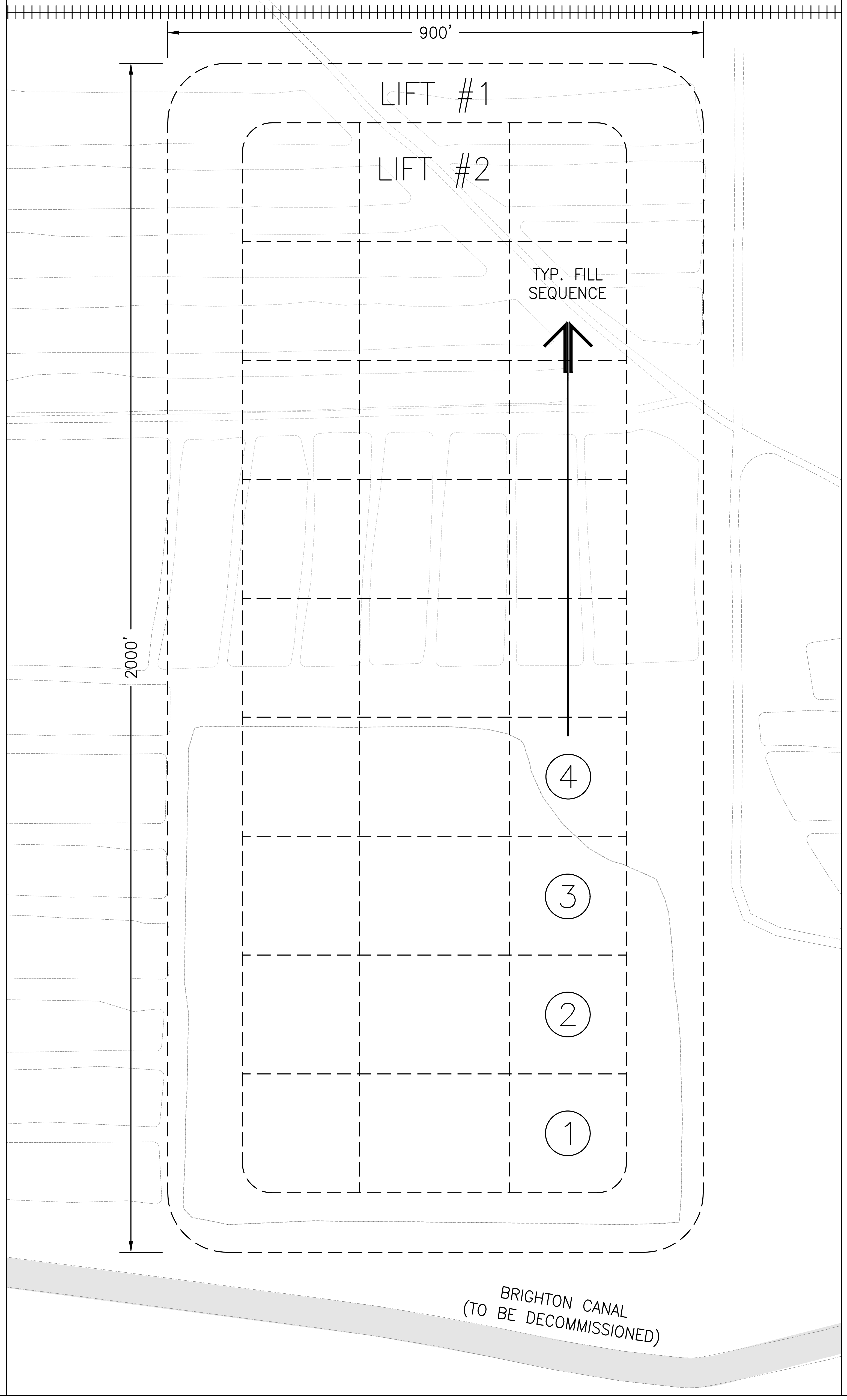
**1ST LIFT**

NOTE:
- WHEN FILLING #1, TARPS ARE USED FOR COVER
- WHEN #1 IS FILLED TO 3–4 FT DEPTH, MOVE TO #2 USING SAME TARPS AND USE SOIL LAYER (6") TO COVER #1

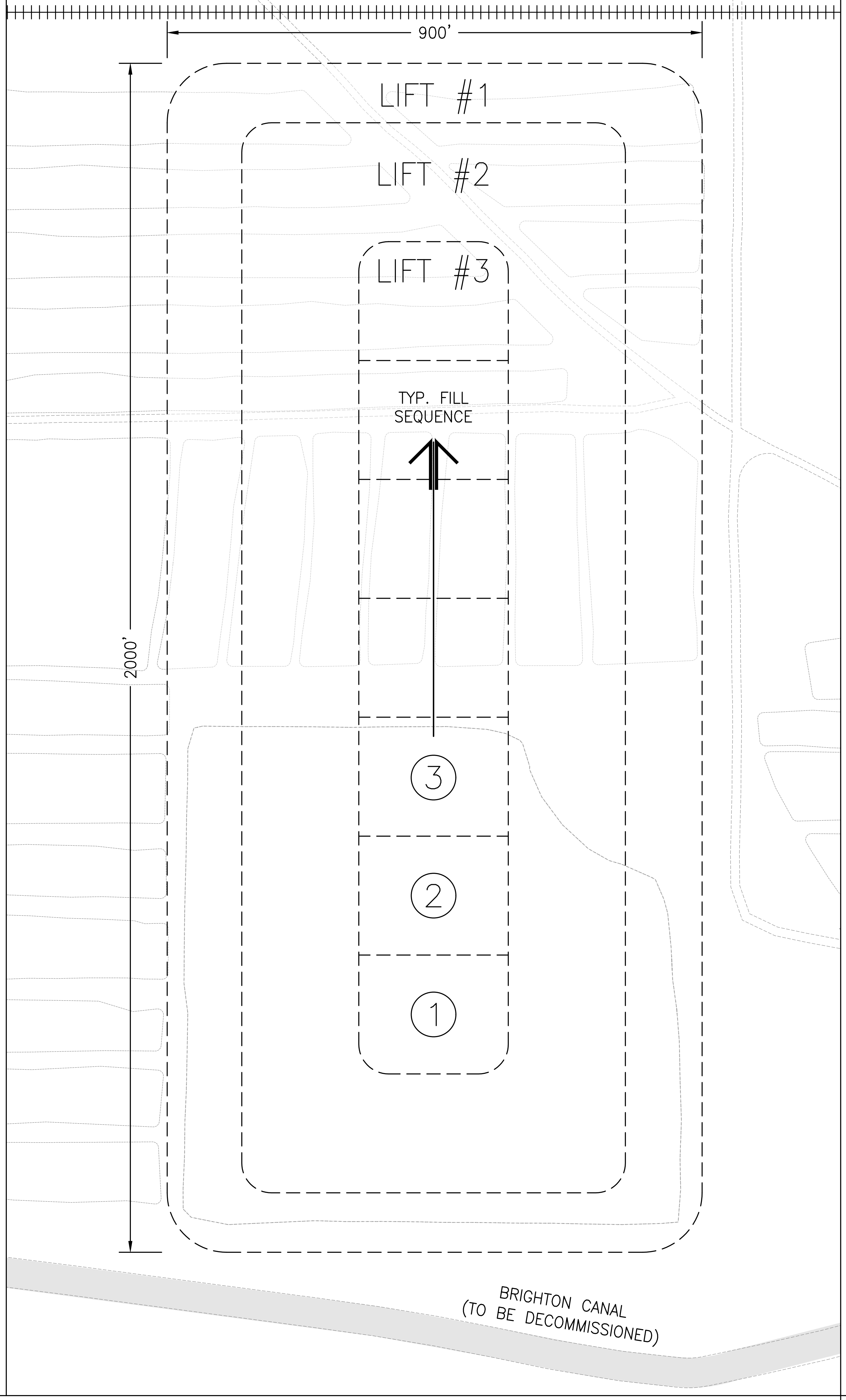


**2ND LIFT**

NOTE:
EXTERIOR SLOPE GRADING BEGINS DURING LIFT 2 AND REPEATS ON LIFT 3



**3RD LIFT**



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# REPOSITORY FILL SEQUENCE

NORTH TEMPLE LANDFILL REMEDIATION
SALT LAKE CITY, UT 84116

1" = 150'
0 150' 300' 600'

ORIGINAL SHEET SIZE 22" X 34"

N

LEGEND

┼┼┼┼┼┼┼┼┼ RAIL ALIGNMENT

CONCEPTUAL PHASE
4-5-2022

SHEET NUMBER
A-23
05-ET1668

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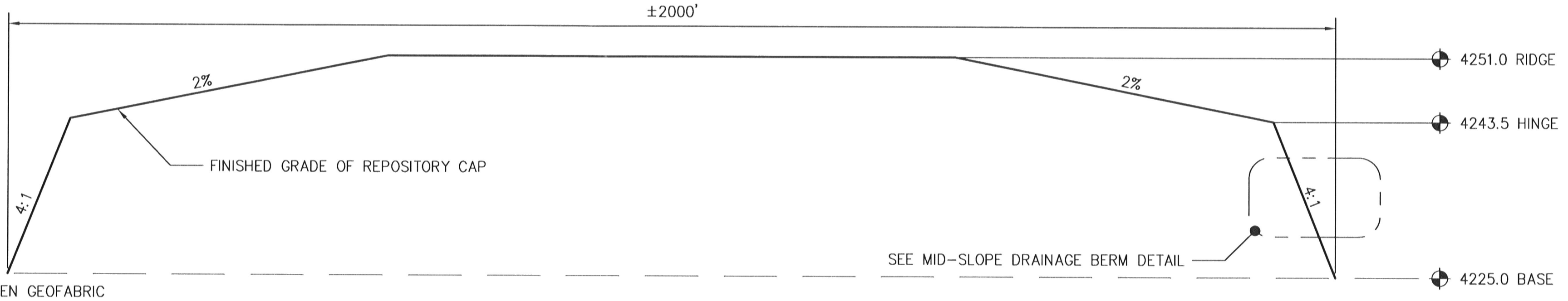
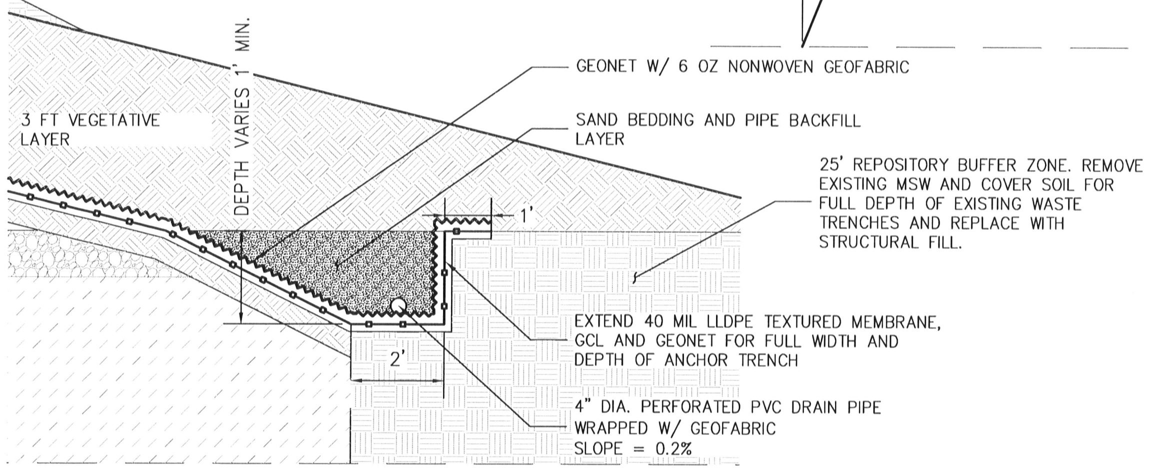
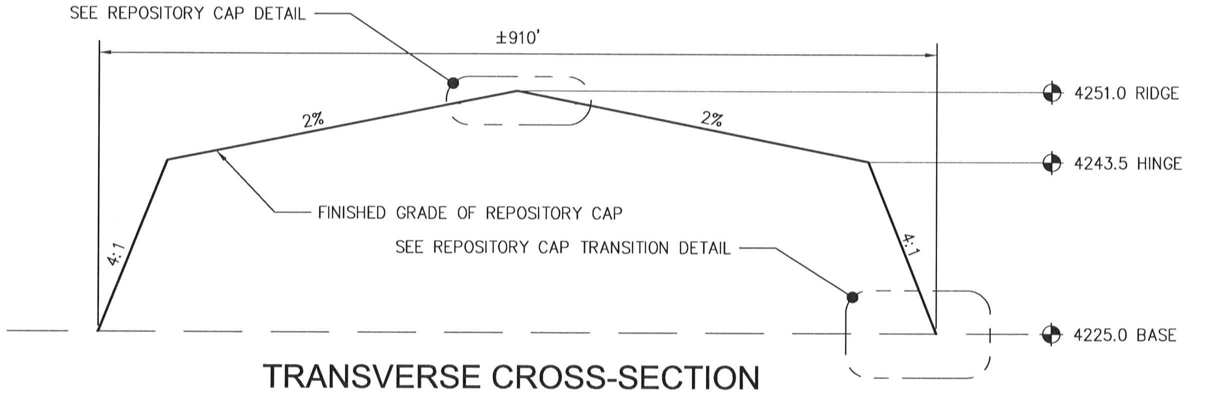
## A-24 Figure 24 – Repository Sections & Details



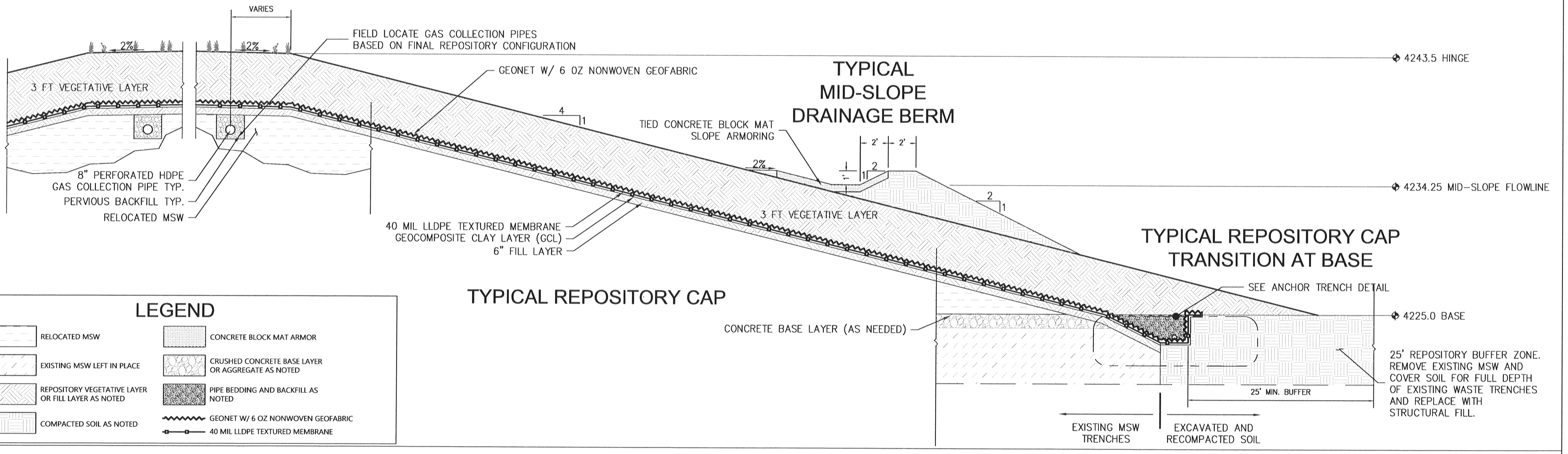
## LONGITUDINAL CROSS-SECTION



## ANCHOR TRENCH DETAIL



## TRANSVERSE CROSS-SECTION



## TYPICAL MID-SLOPE DRAINAGE BERM

## TYPICAL REPOSITORY CAP TRANSITION AT BASE

## TYPICAL REPOSITORY CAP

### LEGEND

| | | | |
|---|---|---|---|
| ▭ | RELOCATED MSW | ▦ | CONCRETE BLOCK MAT ARMOR |
| ▨ | EXISTING MSW LEFT IN PLACE | ▩ | CRUSHED CONCRETE BASE LAYER OR AGGREGATE AS NOTED |
| ▧ | REPOSITORY VEGETATIVE LAYER OR FILL LAYER AS NOTED | ■ | PIPE BEDDING AND BACKFILL AS NOTED |
| ▥ | COMPACTED SOIL AS NOTED | 〰 | GEONET W/ 6 OZ NONWOVEN GEOFABRIC |
| | | ─▫─ | 40 MIL LLDPE TEXTURED MEMBRANE |

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# NORTH TEMPLE LANDFILL

SALT LAKE CITY, UT 84116

WORKING DRAFT
4-21-2022

## REPOSITORY SECTIONS AND DETAILS

(NTS)

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ORIGINAL SHEET SIZE 22" X 34"

SHEET NUMBER
A-24
05-ET1668

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## A-25 Figure 25 – Repository Revetment

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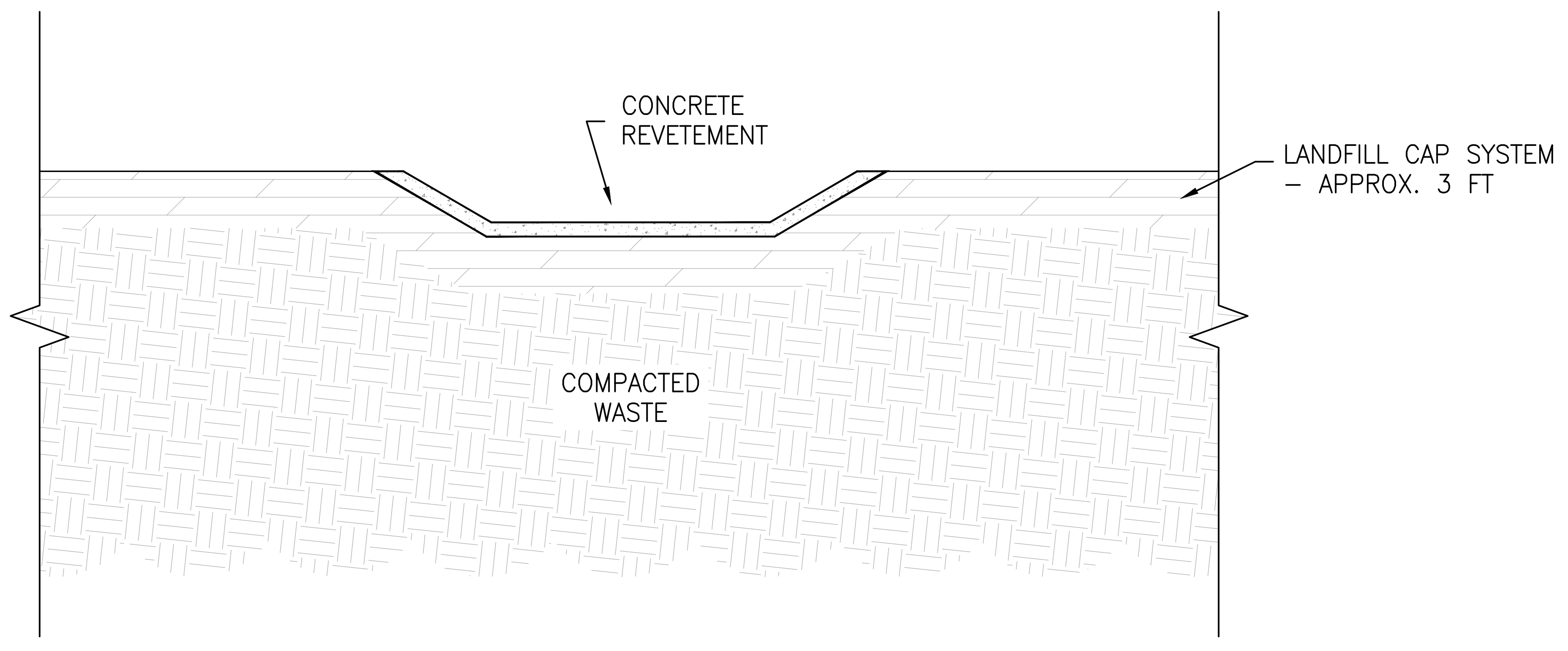
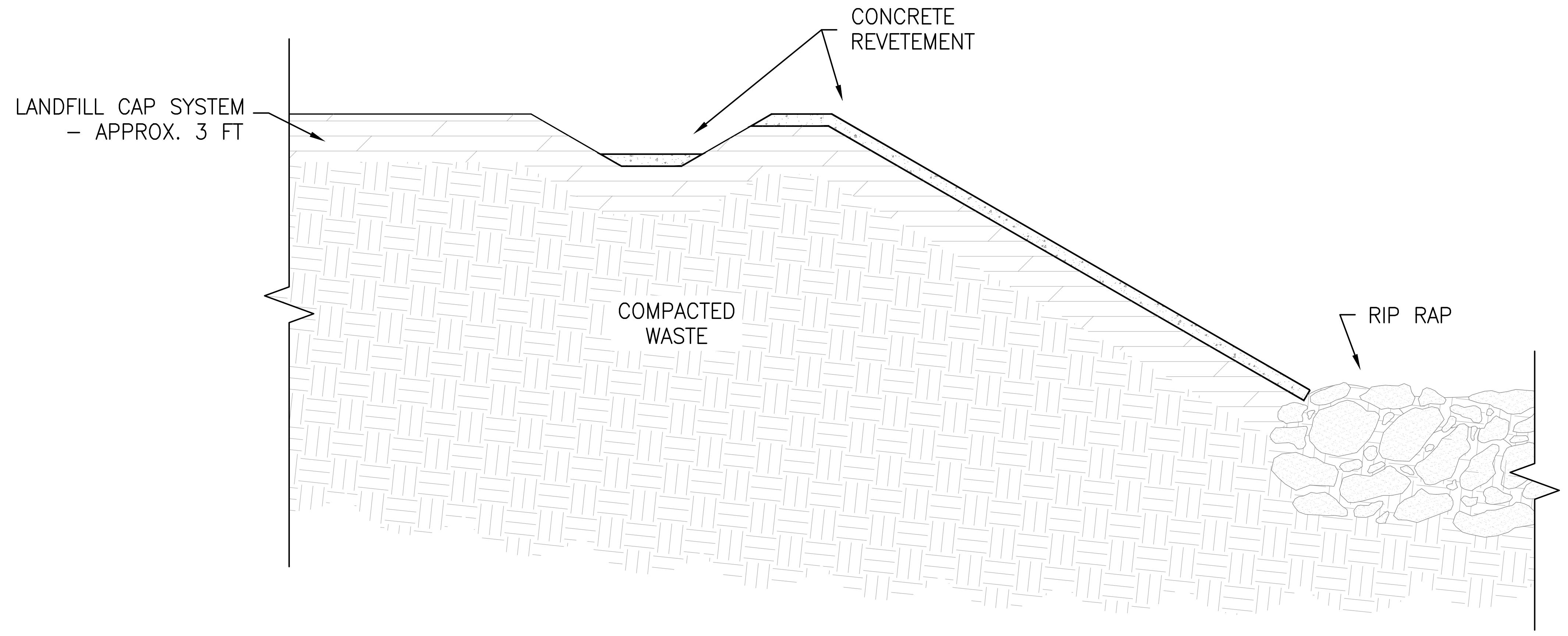
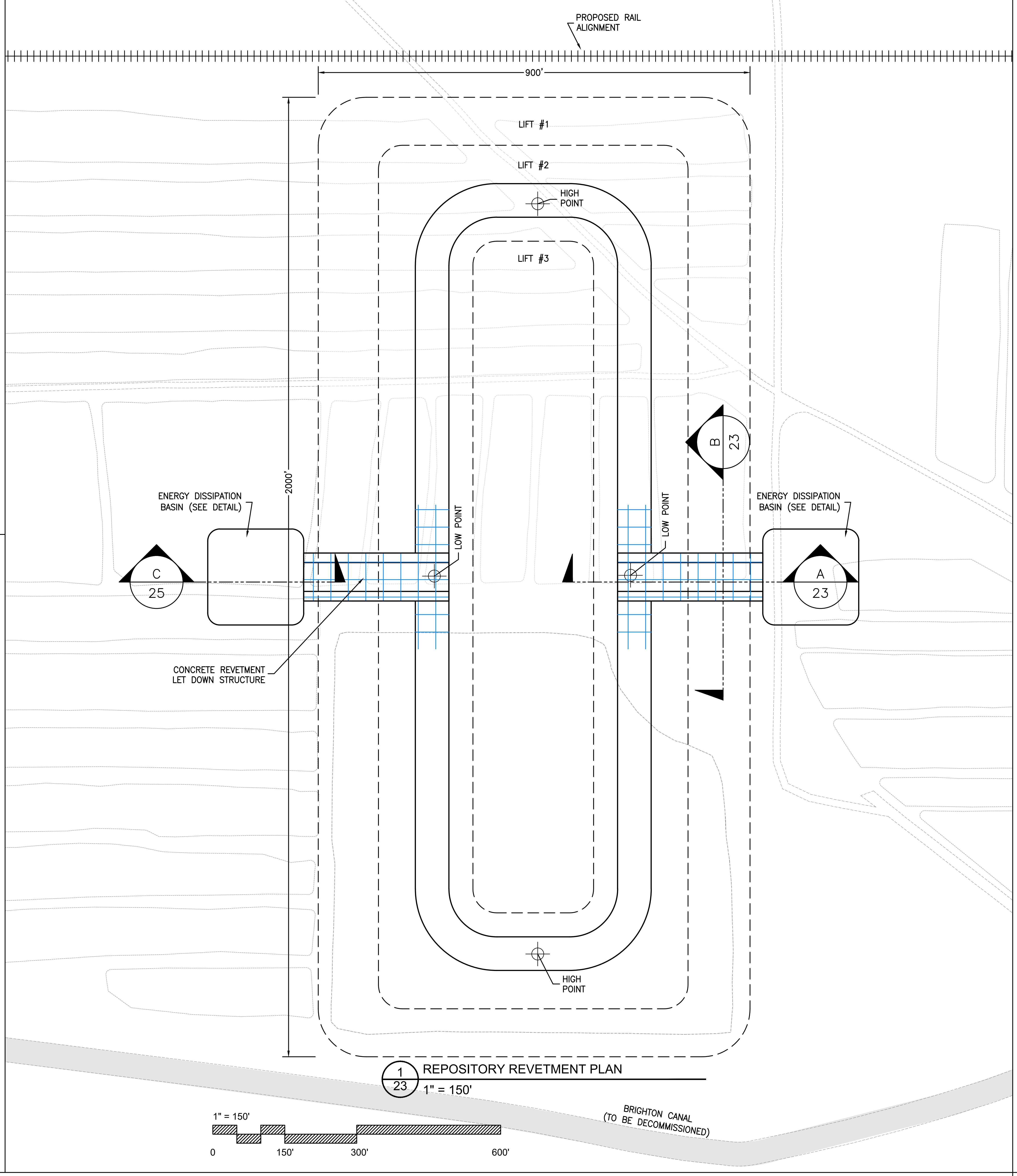


B 23 CROSS SECTION - B
N.T.S.



B 23 CROSS SECTION - A
N.T.S.



1 23 REPOSITORY REVETMENT PLAN
1" = 150'

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# REPOSITORY REVETMENT

## NORTH TEMPLE LANDFILL REMEDIATION
## SALT LAKE CITY, UT 84116

ORIGINAL SHEET SIZE 22" X 34"

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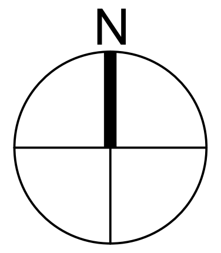


LEGEND

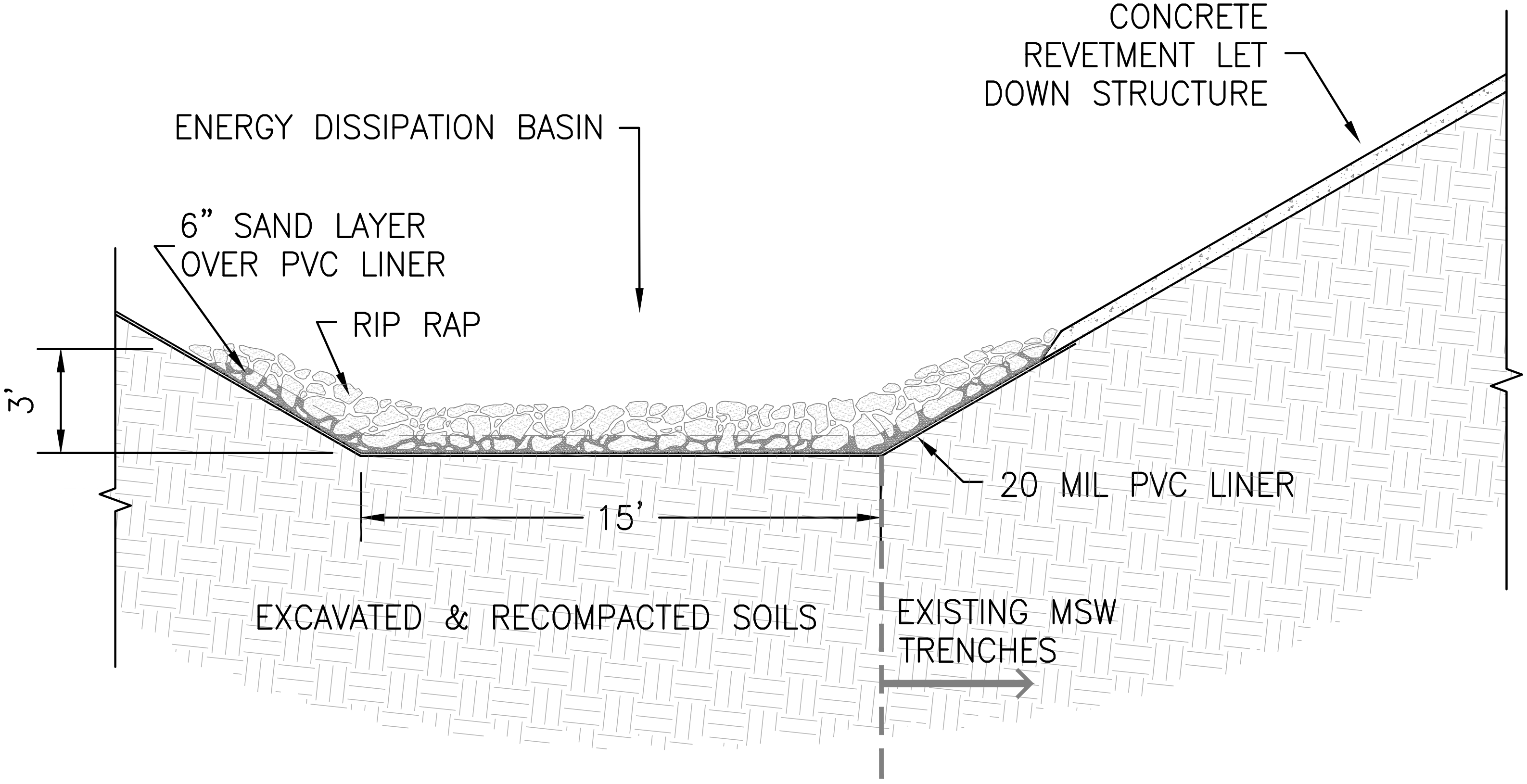
┼┼┼┼┼┼┼┼ RAIL ALIGNMENT

▦ PROPOSED CONCRETE REVETMENT

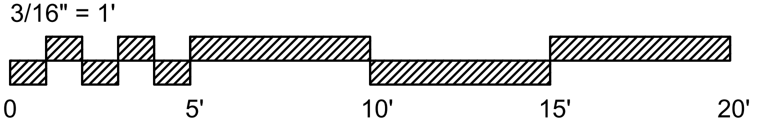
CONCEPTUAL PHASE
4-8-2022

SHEET NUMBER
A-25
05-ET1668

## A-26 Figure 26 – Energy Dissipation Basins



C
25
CROSS SECTION - C
SCALE: 3/16" = 1'



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## REPOSITORY ENERGY DISSP. BASIN

NORTH TEMPLE LANDFILL REMEDIATION
SALT LAKE CITY, UT 84116

DRAWN BY JJ
CHECKED BY BH
DATE 5-2-2022
REV. # CONCEPTUAL PHASE

SHEET NUMBER
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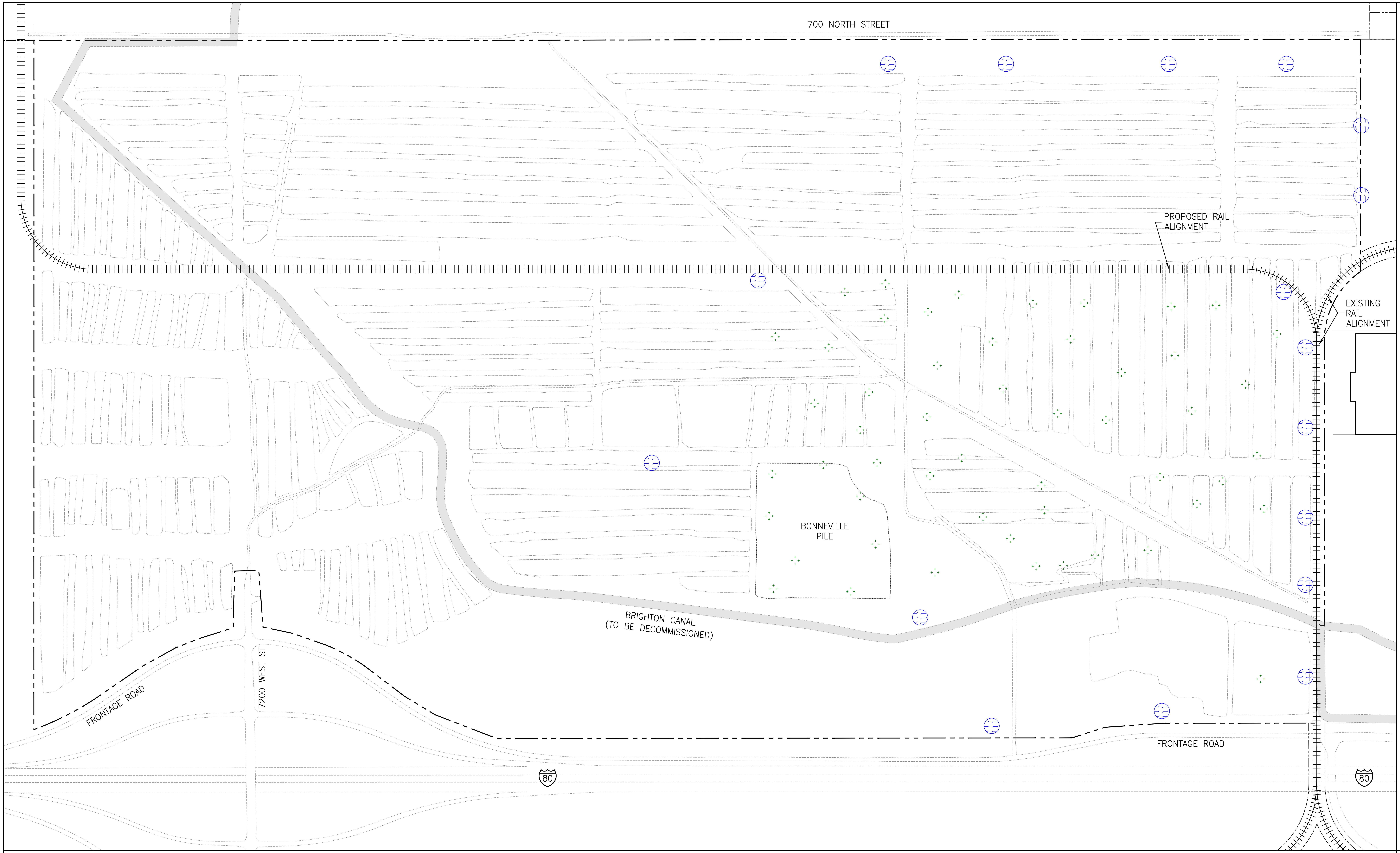
05-ET1668

## A-27 Figure 27 – Odor Control Plan



# ODOR CONTROL PLAN

NORTH TEMPLE LANDFILL REMEDIATION
SALT LAKE CITY, UT 84116

CONCEPTUAL PHASE
4-5-2022

SHEET NUMBER
A-27
05-ET1668

LEGEND

- – – – PROPERTY LINE
- ┼┼┼┼┼┼┼┼ RAIL ALIGNMENT
- ⊜ PERIMETER ODOR CONTROL
- ⁘ WORK AREA ODOR CONTROL (PORTABLE TURBINE FANS) (LOCATIONS VARY WITH EARTH WORK PROGRESS)

1" = 300'
0 300' 600' 1200' 1500'

ORIGINAL SHEET SIZE 22" X 34"

N

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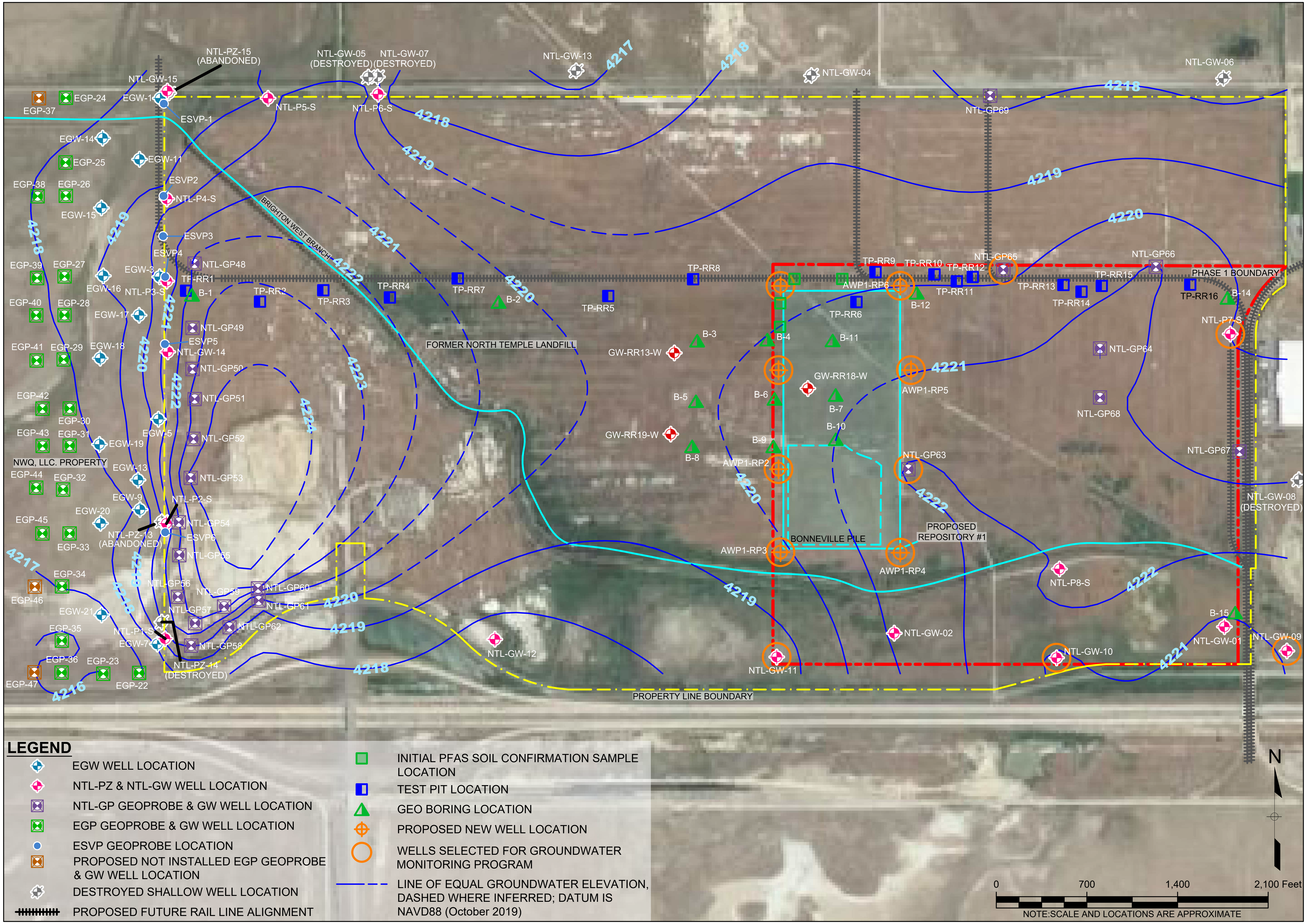
## A-28 Figure 28 – Groundwater Monitoring Program Location Map



CAD Analyst: Justin Patton

Cardno now Stantec

1142 WEST 2320 SOUTH, SUITE A
WEST VALLEY, UTAH 84119
P: 801-256-3800 F: 801-973-1095

# Figure 28: Groundwater Monitoring Program Well Location Map - Proposed Shallow Aquifer - October 2019

## Phase I Area Development SI
## 7200 West North Temple Frontage Road
## Salt Lake City, Utah

28

Latitude: 40° 46' 25.50" N
Longitude: -112° 4' 6.16" W

Project No. 819AR00640.0004

Date Created: 9/8/2016 Date Revised: 11/14/2017 File Path: N:\Data-AZ\00 - Utah\Epperson\2022.06_Phase I Area.Fig 28 Prop Wells & Shallow Contours-2019-10.dwg
Data Sources: GOOGLE MAP

## A-29 Table 2 – Soil Confirmation Screening Levels

# TABLE 2
# SOIL CONFIRMATION
# SCREENING LEVELS - VOC
# PHASE 1 AREA
# AIRPORT WEST VCP
# JULY 2022

| Matrix | TestCode | Units | Analyte | CAS | Action Level |
|---|---|---|---|---|---|
| Soil | 8260D-S | mg/kg-dry | Acetone | 67-64-1 | 1050000 |
| | | | Benzene | 71-43-2 | 423 |
| | | | Bromobenzene | 108-86-1 | 1780 |
| | | | Bromochloromethane | 74-97-5 | 628 |
| | | | Bromodichloromethane | 75-27-4 | 128 |
| | | | Bromoform | 75-25-2 | 8570 |
| | | | Bromomethane | 74-83-9 | 30.1 |
| | | | Butylbenzene, n- | 104-51-8 | 58400 |
| | | | Butylbenzene, sec- | 135-98-8 | 117000 |
| | | | Butylbenzene, tert- | 98-06-6 | 117000 |
| | | | Carbon disulfide | 75-15-0 | 3470 |
| | | | Carbon tetrachloride | 56-23-5 | 287 |
| | | | Chlorobenzene | 108-90-7 | 1330 |
| | | | Chloroethane | 75-00-3 | 22700 |
| | | | Chloroform | 67-66-3 | 138 |
| | | | Chloromethane | 74-87-3 | 463 |
| | | | Chlorotoluene, o- | 95-49-8 | 23400 |
| | | | Chlorotoluene, p- | 106-43-4 | 23400 |
| | | | cis-1,2-Dichloroethene | 156-59-2 | 2340 |
| | | | cis-1,3-Dichloropropene | 10061-01-5 | 309 |
| | | | Cyclohexane | 110-82-7 | 27400 |
| | | | Dibromo-3-chloropropane, 1,2- | 96-12-8 | 6.43 |
| | | | Dibromobenzene, 1,4- | 106-37-6 | 11700 |
| | | | Dibromochloromethane | 124-48-1 | 3890 |
| | | | Dibromoethane, 1,2- | 106-93-4 | 15.9 |
| | | | Dibromomethane (Methylene Bromide) | 74-95-3 | 98.9 |
| | | | Dichloro-2-butene, trans-1,4- | 110-57-6 | 3.25 |
| | | | Dichlorobenzene, 1,2- | 95-50-1 | 9330 |
| | | | Dichlorobenzene, 1,4- | 106-46-7 | 1140 |
| | | | Dichlorodifluoromethane | 75-71-8 | 368 |
| | | | Dichloroethane, 1,1- | 75-34-3 | 1550 |
| | | | Dichloroethane. 1,2- | 107-06-2 | 137 |
| | | | Dichloroethene, 1,1- | 75-35-4 | 995 |
| | | | Dichloropropane, 1,2- | 78-87-5 | 66.3 |
| | | | Dichloropropane, 1,3- | 142-28-9 | 23400 |
| | | | Dichloropropene, 1,3- | 542-75-6 | 309 |
| | | | Dioxane, 1,4- | 123-91-1 | 2450 |
| | | | Ethylbenzene | 100-41-4 | 2540 |
| | | | Hexanone, 2- | 591-78-6 | 1340 |
| | | | Isopropylbenzene | 98-82-8 | 9950 |
| | | | Methyl Acetate | 79-20-9 | 1170000 |
| | | | Methyl Ethyl Ketone (2-Butanone) | 78-93-3 | 193000 |
| | | | Methyl tert-butyl ether | 1634-04-4 | 20500 |
| | | | Methyl-2-pentanone, 4- | 108-10-1 | 139000 |
| | | | Methylcyclohexane | 108-87-2 | NE |
| | | | Methylene chloride | 75-09-2 | 3160 |
| | | | Naphthalene | 91-20-3 | 585 |
| | | | Propyl benzene | 103-65-1 | 24300 |
| | | | Styrene | 100-42-5 | 34800 |
| | | | Tetrachloroethane, 1,1,1,2- | 630-20-6 | 875 |
| | | | Tetrachloroethane, 1,1,2,2- | 79-34-5 | 267 |
| | | | Tetrachloroethene | 127-18-4 | 389 |
| | | | Toluene | 108-88-3 | 46800 |
| | | | trans-1,2-Dichloroethene | 156-60-5 | 302 |
| | | | trans-1,3-Dichloropropene | 10061-02-6 | 309 |
| | | | Trichloro-1,2,2-trifluoroethane, 1,1,2- | 76-13-1 | 28100 |
| | | | Trichlorobenzene, 1,2,3- | 87-61-6 | 934 |
| | | | Trichlorobenzene, 1,2,4- | 120-82-1 | 256 |
| | | | Trichloroethane, 1,1,1- | 71-55-6 | 35600 |
| | | | Trichloroethane, 1,1,2- | 79-00-5 | 6.31 |
| | | | Trichloroethene | 79-01-6 | 18.7 |
| | | | Trichlorofluoromethane | 75-69-4 | 350000 |
| | | | Trimethylbenzene, 1,2,4- | 95-63-6 | 1770 |
| | | | Trimethylbenzene, 1,3,5- | 108-67-8 | 1510 |
| | | | Trimethylpentene, 2,4,4- | 25167-70-8 | 11700 |
| | | | Vinyl chloride | 75-01-4 | 168 |
| | | | Xylene, m- | 108-38-3 | 2370 |
| | | | Xylene, p- | 106-42-3 | 2420 |
| | | | Xylenes | 1330-20-7 | 2490 |

# TABLE 2
# SOIL CONFIRMATION
# SCREENING LEVELS - SVOC
# PHASE I AREA
# AIRPORT WEST VCP
# JULY 2022

| Matrix | TestCode | Units | Analyte | CAS | Action Level |
|---|---|---|---|---|---|
| Soil | 8270E-S | mg/kg-dry | Acetophenone | 98-86-2 | 117000 |
| | | | Atrazine | 1912-24-9 | 999 |
| | | | Biphenyl, 1,1´- | 92-52-4 | 200 |
| | | | Bis(2-chloroethoxy)methane | 111-91-1 | 2460 |
| | | | Bis(2-chloroethyl) ether | 111-44-4 | 103 |
| | | | Bis(2-ethylhexyl) phthalate | 117-81-7 | 16400 |
| | | | Butyl benzyl phthalate | 85-68-7 | 121000 |
| | | | Caprolactam | 105-60-2 | 398000 |
| | | | Chloro-3-methylphenol, 4- | 59-50-7 | 82100 |
| | | | Chloroaniline, 4- | 106-47-8 | 410 |
| | | | Chloronaphthalene, 2- | 91-58-7 | 60300 |
| | | | Chlorophenol, 2- | 95-57-8 | 5840 |
| | | | Dibenzofuran | 132-64-9 | 1170 |
| | | | Dichlorobenzidine, 3,3´- | 91-94-1 | 511 |
| | | | Dichlorophenol, 2,4- | 120-83-2 | 2460 |
| | | | Diethyl phthalate | 84-66-2 | 657000 |
| | | | Dimethylphenol, 2,4- | 105-67-9 | 16400 |
| | | | Di-n-butyl phthalate | 84-74-2 | 82100 |
| | | | Dinitro-2-methylphenol, 4,6- | 534-52-1 | 65.7 |
| | | | Dinitrophenol, 2,4- | 51-28-5 | 1640 |
| | | | Dinitrotoluene, 2,4- | 121-14-2 | 737 |
| | | | Dinitrotoluene, 2,6- | 606-20-2 | 154 |
| | | | Di-n-octyl phthalate | 117-84-0 | 8210 |
| | | | Hexachlorobenzene | 118-74-1 | 11.7 |
| | | | Hexachlorobutadiene | 87-68-3 | 526 |
| | | | Hexachlorocyclopentadiene | 77-47-4 | 7.45 |
| | | | Hexachloroethane | 67-72-1 | 460 |
| | | | Isophorone | 78-59-1 | 164000 |
| | | | Methylphenol, 2- | 95-48-7 | 41000 |
| | | | Methylphenol, 3&4- | (blank) | 821 |
| | | | Nitroaniline, 2- | 88-74-4 | 7990 |
| | | | Nitroaniline, 4- | 100-01-6 | 3280 |
| | | | Nitrobenzene | 98-95-3 | 1290 |
| | | | N-Nitrosodi-n-propylamine | 621-64-7 | 32.8 |
| | | | N-Nitrosodiphenylamine | 86-30-6 | 46900 |
| | | | Oxybis(1-chloropropane), 2,2´- | 108-60-1 | 46700 |
| | | | Pentachlorophenol | 87-86-5 | 397 |
| | | | Phenol | 108-95-2 | 246000 |
| | | | Tetrachlorobenzene, 1,2,4,5- | 95-94-3 | 35 |
| | | | Tetrachlorophenol, 2,3,4,6- | 58-90-2 | 24600 |
| | | | Trichlorophenol, 2,4,5- | 95-95-4 | 82100 |
| | | | Trichlorophenol, 2,4,6- | 88-06-2 | 821 |

# TABLE 2
# SOIL CONFIRMATION
# SCREENING LEVELS - RCRA METALS
# PHASE 1 AREA
# AIRPORT WEST VCP
# JULY 2022

| Matrix | TestCode | Units | Analyte | CAS | Acton Level |
|---|---|---|---|---|---|
| Soil | 6020B-S | mg/kg-dry | Arsenic | 7440-38-2 | 300 |
| | | | Barium | 7440-39-3 | 217000 |
| | | | Cadmium | 7440-43-9 | 99.7 |
| | | | Lead | 7439-92-1 | 800 |
| | | | Selenium | 7782-49-2 | 5840 |
| | | | Silver | 7440-22-4 | 5840 |
| | **3060A/7196A** | | Chrom VI | 18540-29-9 | 633 |
| | **HG-S-7471B** | | Mercury | 7439-97-6 | 45.6 |

# TABLE 2
# SOIL CONFIRMATION
# SCREENING LEVELS - TPH/PAH
# PHASE I AREA
# AIRPORT WEST VCP
# JULY 2022

| Matrix | Units | Type | TestCode | Analyte | CAS | Action Level |
|---|---|---|---|---|---|---|
| Soil | mg/kg-dry | **PAH** | 8270 | Acenaphthene | 83-32-9 | 45200 |
| | | | | Anthracene | 120-12-7 | 226000 |
| | | | | Benz[a]anthracene | 56-55-3 | 2060 |
| | | | | Benzo(e)pyrene | 192-97-2 | 73.4 |
| | | | | Benzo(j)fluoranthene | 205-82-3 | 176 |
| | | | | Benzo[a]pyrene | 50-32-8 | 211 |
| | | | | Benzo[b]fluoranthene | 205-99-2 | 2110 |
| | | | | Benzo[k]fluoranthene | 207-08-9 | 21110 |
| | | | | Chloronaphthalene, Beta- | 91-58-7 | 60300 |
| | | | | Chrysene | 218-01-9 | 211000 |
| | | | | Dibenz[a,h]anthracene | 53-70-3 | 211 |
| | | | | Dibenzo(a,e)pyrene | 192-65-4 | 17.6 |
| | | | | Dimethylbenz(a)anthracene, 7,12- | 57-97-6 | 0.844 |
| | | | | Fluoranthene | 206-44-0 | 30100 |
| | | | | Fluorene | 86-73-7 | 30100 |
| | | | | Indeno[1,2,3-cd]pyrene | 193-39-5 | 2110 |
| | | | | Methylnaphthalene, 1- | 90-12-0 | 7270 |
| | | | | Methylnaphthalene, 2- | 91-57-6 | 3010 |
| | | | | Naphthalene | 91-20-3 | 585 |
| | | | | Nitropyrene, 4- | 57835-92-4 | 176 |
| | | | | Pyrene | 129-00-0 | 22600 |
| | | **TPH-GRO** | 8260 | Benzene | 71-43-2 | 423 |
| | | | | Ethylbenzene | 100-41-4 | 2540 |
| | | | | Methyl tert-Butyl Ether (MTBE) | 1634-04-4 | 20500 |
| | | | | Naphthalene | 91-20-3 | 585 |
| | | | | Toluene | 108-88-3 | 46800 |
| | | | | Xylenes, total | 1330-20-7 | 2490 |
| | | | 8260 TPH Fractionation | Total Petroleum Hydrocarbons (Aliphatic Low) | NA | 2180 |
| | | | | Total Petroleum Hydrocarbons (Aliphatic Medium) | | 440 |
| | | **TPH-DRO** | 8270 TPH Fractionation | Total Petroleum Hydrocarbons (Aliphatic High) | | 3500000 |
| | | | | Total Petroleum Hydrocarbons (Aromatic High) | | 30100 |
| | | | | Total Petroleum Hydrocarbons (Aromatic Low) | | 423 |
| | | | | Total Petroleum Hydrocarbons (Aromatic Medium) | | 561 |

# TABLE 2
# SOIL CONFIRMATION
# SCREENING LEVELS - PFAS
# PHASE I AREA
# AIRPORT WEST VCP
# JULY 2022

| Matrix | TestCode | Units | Analyte | CAS | Action Level |
|---|---|---|---|---|---|
| Soil | 537 (modified) | mg/Kg | Hexafluoropropylene oxide dimer acid (HFPO-DA) | 13252-13-6 | 3.5 |
| | | | Perfluorobutanesulfonic acid (PFBS) | 375-73-5 | 246 |
| | | | Perfluorohexanesulfonate acid (PFHxS) | 355-46-4 | 16.4 |
| | | | Perfluorononanoic acid (PFNA) | 375-95-1 | 2.46 |
| | | | Perfluorooctanesulfonic acid (PFOS) | 1763-23-1 | 1.64 |
| | | | Perfluorooctanoic acid (PFOA) | 335-67-1 | 2.46 |

## A-30 Table 3 – Groundwater Monitoring Screening Levels

# TABLE 3
# GW MONITORING
# SCREENING LEVELS - VOC
# PHASE 1 AREA
# AIRPORT WEST VCP
# JULY 2022

| matrix | TestCode | Units | Analyte | CAS | Screening Level |
|---|---|---|---|---|---|
| Groundwater | 8260D-W | µg/L | Acetone | 67-64-1 | 29900 |
| | | | Benzene | 71-43-2 | 40.7 |
| | | | Bromobenzene | 108-86-1 | 77.2 |
| | | | Bromochloromethane | 74-97-5 | 83.4 |
| | | | Bromodichloromethane | 75-27-4 | 80 |
| | | | Bromoform | 75-25-2 | 329 |
| | | | Bromomethane | 74-83-9 | 8.48 |
| | | | Butylbenzene, n- | 104-51-8 | 1670 |
| | | | Butylbenzene, sec- | 135-98-8 | 3340 |
| | | | Butylbenzene, tert- | 98-06-6 | 1080 |
| | | | Carbon Disulfide | 75-15-0 | 982 |
| | | | Carbon Tetrachloride | 56-23-5 | 45.5 |
| | | | Chlorobenzene | 108-90-7 | 100 |
| | | | Chloroform | 67-66-3 | 80 |
| | | | Chloromethane | 74-87-3 | 188 |
| | | | Chlorotoluene, o- | 95-49-8 | 377 |
| | | | Chlorotoluene, p- | 106-43-4 | 400 |
| | | | Cyclohexane | 110-82-7 | 12500 |
| | | | Dibromo-3-chloropropane, 1,2- | 96-12-8 | 0.2 |
| | | | Dibromobenzene, 1,4- | 106-37-6 | 209 |
| | | | Dibromochloromethane | 124-48-1 | 87.1 |
| | | | Dibromoethane, 1,2- | 106-93-4 | 0.747 |
| | | | Dibromomethane (Methylene Bromide) | 74-95-3 | 8.34 |
| | | | Dichloro-2-butene, trans-1,4- | 110-57-6 | 0.134 |
| | | | Dichlorobenzene, 1,2- | 95-50-1 | 600 |
| | | | Dichlorobenzene, 1,4- | 106-46-7 | 75 |
| | | | Dichlorodifluoromethane | 75-71-8 | 202 |
| | | | Dichloroethane, 1,1- | 75-34-3 | 275 |
| | | | Dichloroethane, 1,2- | 107-06-2 | 13.6 |
| | | | Dichloroethylene, cis-1,2- | 156-59-2 | 70 |
| | | | Dichloroethylene, trans-1,2- | 156-60-5 | 100 |
| | | | Dichloropropane, 1,2- | 78-87-5 | 8.29 |
| | | | Dichloropropane, 1,3- | 142-28-9 | 609 |
| | | | Dichloropropene, 1,3- | 542-75-6 | 39.9 |
| | | | Dioxane, 1,4- | 123-91-1 | 45.9 |
| | | | Ethylbenzene | 100-41-4 | 700 |
| | | | Hexanone, 2- | 591-78-6 | 45 |
| | | | Methyl Acetate | 79-20-9 | 33100 |
| | | | Methyl Ethyl Ketone (2-Butanone) | 78-93-3 | 6840 |
| | | | Methyl Isobutyl Ketone (4-methyl-2-pentanone) | 108-10-1 | 6260 |
| | | | Methyl tert-Butyl Ether (MTBE) | 1634-04-4 | 1430 |
| | | | Methylene Chloride | 75-09-2 | 167 |
| | | | Naphthalene | 91-20-3 | 6.16 |
| | | | Propyl benzene | 103-65-1 | 876 |
| | | | Styrene | 100-42-5 | 1440 |
| | | | Tetrachloroethane, 1,1,1,2- | 630-20-6 | 57.4 |
| | | | Tetrachloroethane, 1,1,2,2- | 79-34-5 | 7.57 |
| | | | Toluene | 108-88-3 | 1680 |
| | | | Trichloro-1,2,2-trifluoroethane, 1,1,2- | 76-13-1 | 10300 |
| | | | Trichlorobenzene, 1,2,3- | 87-61-6 | 11.1 |
| | | | Trichlorobenzene, 1,2,4- | 120-82-1 | 70 |
| | | | Trichloroethane, 1,1,1- | 71-55-6 | 8810 |
| | | | Trichloroethane, 1,1,2- | 79-00-5 | 5 |
| | | | Trichloroethylene | 79-01-6 | 5 |
| | | | Trichlorofluoromethane | 75-69-4 | 8460 |
| | | | Trimethylbenzene, 1,2,4- | 95-63-6 | 69.9 |
| | | | Trimethylbenzene, 1,3,5- | 108-67-8 | 74.7 |
| | | | Trimethylpentene, 2,4,4- | 25167-70-8 | 58 |
| | | | Vinyl Chloride | 75-01-4 | 2 |
| | | | Xylene, m- | 108-38-3 | 198 |
| | | | Xylene, p- | 106-42-3 | 199 |
| | | | Xylenes | 1330-20-7 | 10000 |
| | | | Chloroethane | 75-00-3 | 8340 |
| | | | Dichloroethene, 1,1- | 75-35-4 | 325 |
| | | | Isopropylbenzene | 98-82-8 | 542 |
| | | | Tetrachloroethene | 127-18-4 | 50.3 |

# TABLE 3
# GW MONITORING
# SCREENING LEVELS - SVOC
# PHASE 1 AREA
# AIRPORT WEST VCP
# JULY 2022

| Matrix | Test Code | Units | Analyte | CAS | Screening Levels |
|---|---|---|---|---|---|
| Groundwater | 8270E-W | ug/L | Acenaphthene | 83-32-9 | 841 |
| | | | Acetophenone | 98-86-2 | 3180 |
| | | | Anthracene | 120-12-7 | 2740 |
| | | | Atrazine | 1912-24-9 | 30.2 |
| | | | Benz(a)anthracene | 56-55-3 | 2.98 |
| | | | Benzaldehyde | 100-52-7 | 1860 |
| | | | Benzo(a)pyrene | 50-32-8 | 2.51 |
| | | | Benzo(b)fluoranthene | 205-99-2 | 25.1 |
| | | | Benzo(k)fluoranthene | 207-08-9 | 251 |
| | | | Biphenyl 1,1´- | 92-52-4 | 0.834 |
| | | | Bis(2-chloroethoxy)methane | 111-91-1 | 97.9 |
| | | | Bis(2-chloroethyl) ether | 111-44-4 | 1.37 |
| | | | Bis(2-ethylhexyl) phthalate | 117-81-7 | 556 |
| | | | Butyl benzyl phthalate | 85-68-7 | 1630 |
| | | | Caprolactam | 105-60-2 | 16500 |
| | | | Chloro-3-methylphenol 4- | 59-50-7 | 2340 |
| | | | Chloroaniline 4- | 106-47-8 | 15.6 |
| | | | Chloronaphthalene 2- | 91-58-7 | 1180 |
| | | | Chlorophenol 2- | 95-57-8 | 151 |
| | | | Chrysene | 218-01-9 | 2510 |
| | | | Dibenz(a,h)anthracene | 53-70-3 | 2.51 |
| | | | Dibenzofuran | 132-64-9 | 12.3 |
| | | | Dichlorobenzidine 3,3´- | 91-94-1 | 12.5 |
| | | | Dichlorophenol 2,4- | 120-83-2 | 74.2 |
| | | | Diethyl phthalate | 84-66-2 | 24500 |
| | | | Dimethylphenol 2,4- | 105-67-9 | 584 |
| | | | Di-n-butyl phthalate | 84-74-2 | 1420 |
| | | | Dinitro-2-methylphenol 4,6- | 534-52-1 | 2.5 |
| | | | Dinitrophenol 2,4- | 51-28-5 | 64.4 |
| | | | Dinitrotoluene 2,4- | 121-14-2 | 23.7 |
| | | | Dinitrotoluene 2,6- | 606-20-2 | 4.85 |
| | | | Di-n-octyl phthalate | 117-84-0 | 334 |
| | | | Fluoranthene | 206-44-0 | 1330 |
| | | | Fluorene | 86-73-7 | 459 |
| | | | Hexachlorobenzene | 118-74-1 | 0.334 |
| | | | Hexachlorobutadiene | 87-68-3 | 10 |
| | | | Hexachlorocyclopentadiene | 77-47-4 | 0.414 |
| | | | Hexachloroethane | 67-72-1 | 9.32 |
| | | | Indeno(1,2,3-cd)pyrene | 193-39-5 | 25.1 |
| | | | Isophorone | 78-59-1 | 6350 |
| | | | Methylnaphthalene 2- | 91-57-6 | 56.5 |
| | | | Methylphenol 2- | 95-48-7 | 1530 |
| | | | Methylphenol 3&4- (Cresol,p-) | 106-44-5 | 612 |
| | | | Naphthalene | 91-20-3 | 6.16 |
| | | | Nitroaniline 2- | 88-74-4 | 313 |
| | | | Nitroaniline 4- | 100-01-6 | 129 |
| | | | Nitrobenzene | 98-95-3 | 14 |
| | | | N-Nitrosodiphenylamine | 86-30-6 | 1220 |
| | | | N-nitrosodipropylamine | 62-75-9 | 0.0112 |
| | | | Oxybis(1-chloropropane) 2,2´- | 108-60-1 | 1170 |
| | | | Pentachlorophenol | 87-86-5 | 4.13 |
| | | | Phenol | 108-95-2 | 9560 |
| | | | Pyrene | 129-00-0 | 186 |
| | | | Tetrachlorobenzene 1,2,4,5- | 95-94-3 | 0.264 |
| | | | Tetrachlorophenol 2,3,4,6- | 58-90-2 | 372 |
| | | | Trichlorophenol 2,4,5- | 95-95-4 | 1890 |
| | | | Trichlorophenol 2,4,6- | 88-06-2 | 19.2 |

# TABLE 3
# GW MONITORING
# SCREENING LEVELS - RCRA METALS
# PHASE 1 AREA
# AIRPORT WEST VCP
# JULY 2022

| Matrix | Units | Test Code | Chemical | CAS | Screening Levels |
|---|---|---|---|---|---|
| Groundwater | mg/L | 6020B-W | Arsenic | 7440-38-2 | 0.01 |
| | | | Barium | 7440-39-3 | 6.18 |
| | | | Cadmium | 7440-43-9 | 0.005 |
| | | | Lead | 7439-92-1 | 0.015 |
| | | | Selenium | 7782-49-2 | 0.166 |
| | | | Silver | 7440-22-4 | 0.154 |
| | | | Chromium(III) | 16065-83-1 | 35 |
| | | 7196A | Chromium(VI) | 18540-29-9 | 0.0035 |
| | | 7471B | Mercury | 7439-97-6 | 0.002 |

# TABLE 3
# GW MONITORING
# SCREENING LEVELS - TPH/PAH
# PHASE I AREA
# AIRPORT WEST VCP
# JULY 2022

| Matrix | Units | TYPE | TestCode | Analyte | CAS | Screening Level |
|---|---|---|---|---|---|---|
| Groundwater | (ug/L) | **PAH** | **8270** | Acenaphthene | 83-32-9 | 841 |
| | | | | Anthracene | 120-12-7 | 2740 |
| | | | | Benz[a]anthracene | 56-55-3 | 2.98 |
| | | | | Benzo(e)pyrene | 192-97-2 | 3 |
| | | | | Benzo(j)fluoranthene | 205-82-3 | 6.49 |
| | | | | Benzo[a]pyrene | 50-32-8 | 2.51 |
| | | | | Benzo[b]fluoranthene | 205-99-2 | 25.1 |
| | | | | Benzo[k]fluoranthene | 207-08-9 | 251 |
| | | | | Chloronaphthalene, Beta- | 91-58-7 | 1180 |
| | | | | Chrysene | 218-01-9 | 2510 |
| | | | | Dibenz[a,h]anthracene | 53-70-3 | 2.51 |
| | | | | Dibenzo(a,e)pyrene | 192-65-4 | 0.649 |
| | | | | Dimethylbenz(a)anthracene, 7,12- | 57-97-6 | 0.01 |
| | | | | Fluoranthene | 206-44-0 | 1330 |
| | | | | Fluorene | 86-73-7 | 459 |
| | | | | Indeno[1,2,3-cd]pyrene | 193-39-5 | 25.1 |
| | | | | Methylnaphthalene, 1- | 90-12-0 | 114 |
| | | | | Methylnaphthalene, 2- | 91-57-6 | 56.5 |
| | | | | Naphthalene | 91-20-3 | 6.16 |
| | | | | Nitropyrene, 4- | 57835-92-4 | 1.9 |
| | | | | Pyrene | 129-00-0 | 186 |
| | | **TPH-DRO** | **8270 TPH Fractionation** | Total Petroleum Hydrocarbons (Aliphatic High) | NA | 100000 |
| | | | | Total Petroleum Hydrocarbons (Aromatic High) | NA | 1330 |
| | | | | Total Petroleum Hydrocarbons (Aromatic Low) | NA | 40.7 |
| | | | | Total Petroleum Hydrocarbons (Aromatic Medium) | NA | 5.73 |
| | | **TPH-GRO** | **8260 TPH Fractionation** | Total Petroleum Hydrocarbons (Aliphatic Low) | NA | 1250 |
| | | | | Total Petroleum Hydrocarbons (Aliphatic Medium) | NA | 128 |
| | | | **8260** | Benzene | 71-43-2 | 40.7 |
| | | | | Ethylbenzene | 100-41-4 | 700 |
| | | | | Methyl tert-Butyl Ether (MTBE) | 1634-04-4 | 1430 |
| | | | | Naphthalene | 91-20-3 | 6.16 |
| | | | | Toluene | 108-88-3 | 1680 |
| | | | | Xylenes | 1330-20-7 | 10000 |

# TABLE 3
# GW MONITORING
# SCREENING LEVELS - PFAS
# PHASE I AREA
# AIRPORT WEST VCP
# JULY 2022

| Matrix | Test Code | Units | Analyte | CAS Number | Screening Level |
|---|---|---|---|---|---|
| **GW** | **537 (modified)** | **µg/L** | **Hexafluoropropylene oxide dimer acid (HFPO-DA)** | **13252-13-6** | **0.1** |
| | | | **Perfluorobutanesulfonic acid (PFBS)** | **375-73-5** | **10** |
| | | | **Perfluorohexanesulfonic acid (PFHxS)** | **355-46-4** | **0.654** |
| | | | **Perfluorononanoic acid (PFNA)** | **375-95-1** | **0.0978** |
| | | | **Perfluorooctanesulfonic acid (PFOS)** | **1763-23-1** | **0.0667** |
| | | | **Perfluorooctanoic acid (PFOA)** | **335-67-1** | **0.1** |

# APPENDIX B – Risk Assessment Report

Airport West VCP #C092

# APPENDIX

# B

## RISK ASSESSMENT

# Appendix B
# Risk Assessment

## 2022 Phase 1 Area RAP Update
## to the 2015 Risk Assessment

July, 2022

# 2022 UPDATED RISK ASSESSMENT

## PHASE I AREA RAP

Assumptions

The 2018 Risk Assessment (RA) was conducted on the Cardno 2015 characterization data. The updated 2022 RA utilized the 2018 RA. The highest concentration of a chemical detected during the 2021 Phase I SI was used in this risk assessment. Only when a chemical was detected by the 2019 ESI, but not in the 2021 Phase I SI, was the 2019 data utilized. The updated Table 3-1 identified the groundwater concentrations used from the 2016 RA and the updated concentration from the 2021 Phase I area SI. There were chemicals which were detected at higher concentrations in the 2019 ESI. The lower concentrations in the 2021 Phase I SI could have resulted from degradation/dispersion over the years between the two investigations. However, it is also possible that the greater number of sampling rounds/locations encompassed by the 2019 ESI uncovered higher concentrations that are representative of current conditions.

The RA evaluated the vapor intrusion risk resulting from the underlying groundwater. No concentrations were identified which exceeded the carcinogenic risk levels for 1 x $10^{-6}$ or chronic hazard quotient of 1.

For the 2021 RA constituents exceeding their PSL were use to updated the RA. Risk evaluations were done for the construction worker exposed to Groundwater, both oral ingestion and dermal contact. No concentrations were identified which exceeded the carcinogenic risk levels for 1 x $10^{-6}$ or chronic hazard quotient of 1.

# TABLE 3-1
## Comparison of Groundwater Concentrations to Vapor Intrusion Screening Levels
## Groundwater Concentration to Indoor Air Concentration (GWC-IAC) Calculator Version 3.45, November 2015 RSLs

| Parameter | Symbol | Value | Instructions |
|---|---|---|---|
| Exposure Scenario | Scenario | Commercial | Select residential or commercial scenario from pull down list |
| Target Risk for Carcinogens | TCR | 1.00E-06 | Enter target risk for carcinogens (for comparison to the calculated VI carcinogenic risk in column F) |
| Target Hazard Quotient for Non-Carcinogens | THQ | 1 | Enter target hazard quotient for non-carcinogens (for comparison to the calculated VI hazard in column G) |
| Average Groundwater Temperature (°C) | Tgw | 10 | Enter average of the stabilized groundwater temperature to correct Henry's Law Constant for groundwater target concentrations |

| CAS | Chemical Name | Site Groundwater Concentration Cgw (ug/L) | Calculated Indoor Air Concentration Cia (ug/m$^3$) | VI Carcinogenic Risk CR | VI Hazard HQ | Inhalation Unit Risk IUR (ug/m$^3$)$^{-1}$ | IUR Source* | Reference Concentration RfC (mg/m$^3$) | RFC Source* |
|---|---|---|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | 1.8E+01 | 1.34E-02 | No IUR | 9.9E-08 | | | 3.10E+01 | A |
| 309-00-2 | Aldrin | 5.5E-02 | 1.96E-05 | 7.8E-09 | No RfC | 4.90E-03 | I | | |
| 71-43-2 | Benzene | 8.4E+00 | 9.24E-01 | 5.9E-07 | 7.0E-03 | 7.80E-06 | I | 3.00E-02 | I |
| 75-15-0 | Carbon Disulfide | 1.1E+00 | 3.63E-01 | No IUR | 1.2E-04 | | | 7.00E-01 | I |
| 12789-03-6 | Chlordane | 3.3E-02 | 2.03E-05 | 1.7E-10 | 6.6E-06 | 1.00E-04 | I | 7.00E-04 | I |
| 108-90-7 | Chlorobenzene | 8.0E+00 | 4.23E-01 | No IUR | 1.9E-03 | | | 5.00E-02 | P |
| 67-66-3 | Chloroform | 5.0E-01 | 3.82E-02 | 7.2E-08 | 8.9E-05 | 2.30E-05 | I | 9.80E-02 | A |
| 74-87-3 | Chloromethane | 7.8E+00 | 1.83E+00 | No IUR | 4.6E-03 | | | 9.00E-02 | I |
| 98-82-8 | Cumene | 2.1E+00 | 3.22E-01 | No IUR | 1.8E-04 | | | 4.00E-01 | I |
| 110-82-7 | Cyclohexane | 1.5E+00 | 4.45E+00 | No IUR | 1.7E-04 | | | 6.00E+00 | I |
| 72-55-9 | DDE, p,p'- | 2.1E-02 | 6.10E-06 | 4.8E-11 | No RfC | 9.70E-05 | CA | | |
| 95-50-1 | Dichlorobenzene, 1,2- | 6.2E+00 | 1.70E-01 | No IUR | 1.9E-04 | | | 2.00E-01 | H |
| 106-46-7 | Dichlorobenzene, 1,4- | 5.8E+00 | 2.09E-01 | 1.9E-07 | 6.0E-05 | 1.10E-05 | CA | 8.00E-01 | I |
| 75-71-8 | Dichlorodifluoromethane | 6.9E+01 | 4.59E+02 | No IUR | **1.0E+00** | | | 1.00E-01 | X |
| 75-34-3 | Dichloroethane, 1,1- | 3.9E+01 | 4.64E+00 | 6.0E-07 | No RfC | 1.60E-06 | CA | | |
| 107-06-2 | Dichloroethane, 1,2- | 3.7E-01 | 8.33E-03 | 1.8E-08 | 2.7E-04 | 2.60E-05 | I | 7.00E-03 | P |
| 75-35-4 | Dichloroethylene, 1,1- | 9.1E+00 | 5.48E+00 | No IUR | 6.3E-03 | | | 2.00E-01 | I |
| 123-91-1 | Dioxane, 1,4- | 3.0E+02 | 2.41E-02 | 9.8E-09 | 1.8E-04 | 5.00E-06 | I | 3.00E-02 | I |
| 75-00-3 | Ethyl Chloride (Chloroethane) | 3.0E+01 | 8.08E+00 | No IUR | 1.8E-04 | | | 1.00E+01 | I |
| 100-41-4 | Ethylbenzene | 5.9E+00 | 7.66E-01 | 1.6E-07 | 1.7E-04 | 2.50E-06 | CA | 1.00E+00 | I |
| 76-44-8 | Heptachlor | 1.1E-01 | 2.89E-04 | 3.1E-08 | No RfC | 1.30E-03 | I | | |
| 1024-57-3 | Heptachlor Epoxide | 7.0E-02 | 9.10E-06 | 1.9E-09 | No RfC | 2.60E-03 | I | | |
| 1634-04-4 | Methyl tert-Butyl Ether (MTBE) | 6.9E-01 | 8.62E-03 | 1.8E-10 | 6.6E-07 | 2.60E-07 | CA | 3.00E+00 | I |
| 75-09-2 | Methylene Chloride | 6.4E+00 | 4.53E-01 | 3.7E-10 | 1.7E-04 | 1.00E-08 | I | 6.00E-01 | I |
| 91-20-3 | Naphthalene | 5.6E-01 | 3.17E-03 | 8.8E-09 | 2.4E-04 | 3.40E-05 | CA | 3.00E-03 | I |
| 62-75-9 | Nitrosodimethylamine, N- | 9.0E+00 | 6.70E-04 | 7.6E-07 | 3.8E-03 | 1.40E-02 | I | 4.00E-05 | X |
| 103-65-1 | Propyl benzene | 1.7E+00 | 2.64E-01 | No IUR | 6.0E-05 | | | 1.00E+00 | X |
| 1746-01-6 | TCDD, 2,3,7,8- | 7.9E-08 | 1.61E-10 | 5.0E-10 | 9.2E-07 | 3.80E+01 | CA | 4.00E-08 | CA |
| 109-99-9 | Tetrahydrofuran | 3.2E+02 | 4.63E-01 | No IUR | 5.3E-05 | | | 2.00E+00 | I |
| 108-88-3 | Toluene | 4.7E+00 | 5.59E-01 | No IUR | 2.6E-05 | | | 5.00E+00 | I |
| 120-82-1 | Trichlorobenzene, 1,2,4- | 2.0E-01 | 3.55E-03 | No IUR | 4.1E-04 | | | 2.00E-03 | P |
| 71-55-6 | Trichloroethane, 1,1,1- | 1.2E+00 | 4.17E-01 | No IUR | 1.9E-05 | | | 5.00E+00 | I |
| 79-01-6 | Trichloroethylene | 1.2E+00 | 2.23E-01 | 7.4E-08 | 2.5E-02 | see note | I | 2.00E-03 | I |
| 95-63-6 | Trimethylbenzene, 1,2,4- | 7.7E-01 | 6.81E-02 | No IUR | 2.6E-04 | | | 6.00E-02 | I |
| 75-01-4 | Vinyl Chloride | 3.3E+00 | 2.39E+00 | 8.6E-07 | 5.5E-03 | 4.40E-06 | I | 1.00E-01 | I |
| 108-38-3 | Xylene, m- | 1.1E+01 | 1.31E+00 | No IUR | 3.0E-03 | | | 1.00E-01 | S |
| 95-47-6 | Xylene, o- | 1.2E+01 | 9.80E-01 | No IUR | 2.2E-03 | | | 1.00E-01 | S |
| 1330-20-7 | Xylenes | 1.7E+01 | 1.80E+00 | No IUR | 4.1E-03 | | | 1.00E-01 | I |

**Notes:**

(1) **Inhalation Pathway Exposure Parameters (RME):**

| Exposure Scenario | Units | Residential Symbol | Residential Value | Commercial Symbol | Commercial Value | Selected (based Value |
|---|---|---|---|---|---|---|
| Averaging time for carcinogens | (yrs) | ATc_R_GW | 70 | ATc_C_GW | 70 | 70 |
| Averaging time for non-carcinogens | (yrs) | ATnc_R_GW | 26 | ATnc_C_GW | 25 | 25 |
| Exposure duration | (yrs) | ED_R_GW | 26 | ED_C_GW | 25 | 25 |
| Exposure frequency | (days/yr) | EF_R_GW | 350 | EF_C_GW | 250 | 250 |
| Exposure time | (hr/day) | ET_R_GW | 24 | ET_C_GW | 8 | 8 |

(2) **Generic Attenuation Factors:**

| Source Medium of Vapors | | Residential Symbol | Residential Value | Commercial Symbol | Commercial Value | Selected (based Value |
|---|---|---|---|---|---|---|
| Groundwater | ( - ) | AFgw_R_GW | 0.001 | AFgw_C_GW | 0.001 | 0.001 |
| Sub-Slab and Exterior Soil Gas | ( - ) | AFss_R_GW | 0.03 | AFss_C_GW | 0.03 | 0.03 |

(3) **Formulas**

Cia, target = MIN( Cia,c; Cia,nc)
Cia,c (ug/m3) = TCR x ATc x (365 days/yr) x (24 hrs/day) / (ED x EF x ET x IUR)
Cia,nc (ug/m3) = THQ x ATnc x (365 days/yr) x (24 hrs/day) x RfC x (1000 ug/mg) / (ED x EF x ET)

**Notation:**

I = IRIS: EPA Integrated Risk Information System (IRIS). Available online at: http://www.epa.gov/iris/subst/index.html
P = PPRTV. EPA Provisional Peer Reviewed Toxicity Values (PPRTVs). Available online at: http://hhpprtv.ornl.gov/pprtv.shtml
A = Agency for Toxic Substances and Disease Registry (ATSDR) Minimum Risk Levels (MRLs). Available online at: http://www.atsdr.cdc.gov/mrls/index.html
CA = California Environmental Protection Agency/Office of Environmental Health Hazard Assessment assessments. Available online at: http://www.oehha.ca.gov/risk/ChemicalDB/index.asp
H = HEAST. EPA Superfund Health Effects Assessment Summary Tables (HEAST) database. Available online at: http://epa-heast.ornl.gov/heast.shtml
S = See RSL User Guide, Section 5
X = PPRTV Appendix
Yellow highlighting indicates 2016 site-specific parameters.
Orange highlighting indicates 2021 site-specific parameters.
Blue highlighting indicates exposure factors that are based on Risk Assessment Guidance for Superfund (RAGS) or EPA vapor intrusion guidance, which generally should not be changed.
Pink highlighting indicates VI carcinogenic risk greater than the target risk for carcinogens (TCR) or VI Hazard greater than or equal to the target hazard quotient for non-carcinogens (THQ).

# TABLE 5-2
# SITE WORKER
# VAPOR INTRUSION RISKS

| Compound | Cancer Risk | Hazard Quotient |
|---|---|---|
| Benzene | | |
| 1,4-Dichlorobenzene | | |
| 1,1-Dichloroethane | 2.9E-08 | NA |
| Dichlorodifluoromethane | | |
| Ethylbenzene | | |
| Vinyl Chloride | 1.8E-08 | 0.0001 |
| N-Nitrosodimethylamine | | |
| **Total:** | 5E-08 | 1E-04 |

# TABLE 5-3
## EXPOSURE DOSES AND RISK CALCULATIONS FOR A CONSTRUCTION WORKER IN CONTACT WITH GROUNDWATER

| Constituent | Cgw (µg/l) | Oral Dose (mg/kg/day) | Dermal Dose (mg/kg/day) | Toxicity Values Oral | Toxicity Values Dermal | Oral Calculated Risk/HI | Dermal Calculated Risk/HI | Total Calculated Risk/HI |
|---|---|---|---|---|---|---|---|---|
| **CANCER EFFECTS** | | | | | | | | |
| | | | | *CSFo* | *CSFd* | | | |
| **Volatile Organic Compounds** | | | | | | | | |
| 1,1-Dichloroethane | 39.3 | 2.4E-08 | 2.2E-07 | 0.0057 | 0.0057 | 1.4E-10 | 1.2E-09 | 1.4E-09 |
| 1,4-Dioxane | 298 | 1.8E-07 | 7.6E-08 | 0.1 | 0.1 | 1.8E-08 | 7.6E-09 | 2.6E-08 |
| Methylene chloride | 6.4 | 3.9E-09 | 1.7E-08 | 0.002 | 0.002 | 7.8E-12 | 3.4E-11 | 4.2E-11 |
| Vinyl chloride | 3.29 | 2.0E-09 | 1.9E-08 | 0.72 | 0.72 | 1.4E-09 | 1.3E-08 | 1.5E-08 |
| **Metals** | | | | | | | | |
| Arsenic | 0.875 | 5.4E-10 | 4.1E-10 | 1.5 | 1.5 | 8.0E-10 | 6.1E-10 | 1.4E-09 |
| Cadmium | 0.0156 | 9.5E-12 | 7.3E-12 | NA | NA | NC | NC | 0.0E+00 |
| | | | | | **Total:** | **2E-08** | **2E-08** | **4E-08** |
| **NON-CANCER EFFECTS** | | | | | | | | |
| | | | | *RfDo* | *RfDd* | | | |
| **VOCs** | | | | | | | | |
| 1,1-Dichloroethane | 39.3 | 1.7E-06 | 1.5E-05 | 0.2 | 0.2 | 8.4E-06 | 7.6E-05 | 8.4E-05 |
| 1,4-Dioxane | 298 | 1.3E-05 | 5.3E-06 | 0.03 | 0.03 | 4.3E-04 | 1.8E-04 | 6.0E-04 |
| Methylene chloride | 6.4 | 2.7E-07 | 1.2E-06 | 0.006 | 0.006 | 4.6E-05 | 2.0E-04 | 2.5E-04 |
| Vinyl chloride | 3.29 | 1.4E-07 | 1.3E-06 | 0.003 | 0.003 | 4.7E-05 | 4.4E-04 | 4.8E-04 |
| **Metals** | | | | | | | | |
| Arsenic | 0.875 | 3.7E-08 | 2.9E-08 | 0.0003 | 0.0003 | 1.2E-04 | 9.5E-05 | 2.2E-04 |
| Cadmium | 0.0156 | 6.7E-10 | 5.1E-10 | 0.001 | 0.000025 | 6.7E-07 | 2.0E-05 | 2.1E-05 |
| | | | | | **Total:** | **7E-04** | **1E-03** | **2E-03** |

| | |
|---|---|
| Cgw | Groundwater concentration |
| CSFd | Cancer slope factor - dermal |
| CSFo | Cancer slope factor - oral |
| ExC | Exposure concentration |
| HI | Hazard index |
| NA | Not available |
| NC | Not calculated |
| NV | Not volatile |
| RfC | Reference concentration |
| RfDd | Reference dose - dermal |
| RfDo | Reference dose - oral |
| URF | Unit risk factor |

# TABLE 5-4
# CONSTRUCTION WORKER
# BLOOD-LEAD LEVELS

| Parameter | Units | Value |
|---|---|---|
| Maximum Lead Concentration in Groundwater | µg/l | 6.98 |
| Baseline Blood-Lead Concentration | µg/dl | 1.0 |
| Biokinetic Slope Factor | µg/dl per µg/l | 0.4 |
| Groundwater Ingestion Rate | l/day | 0.005 |
| Absorption Factor from Groundwater | unitless | 0.2 |
| Exposure Frequency | days/year | 219 |
| Averaging Time | days/year | 365 |
| Blood-Lead Concentration With Exposure | µg/dl | 1.002 |
| Geometric Standard Deviation | unitless | 1.8 |
| Fetal-to-Maternal Blood-Lead Ratio | unitless | 0.9 |
| Fetal Blood-Lead Level, 95th percentile | µg/dl | 2.4 |

SCREENING LEVEL RISK CALCULATIONS FOR VAPOR INTRUSION OF COMPOUNDS IN GROUNDWATER:  1,1-DICHLOROETHANE

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

| Indoor exposure groundwater conc., carcinogen (μg/L) | Indoor exposure groundwater conc., noncarcinogen (μg/L) | Risk-based indoor exposure groundwater conc., (μg/L) | Pure component water solubility, S (μg/L) | Final indoor exposure groundwater conc., (μg/L) |
|---|---|---|---|---|
| NA | NA | NA | 5.06E+06 | NA |

INCREMENTAL RISK CALCULATIONS:

| Incremental risk from vapor intrusion to indoor air, carcinogen (unitless) | Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless) |
|---|---|
| 2.9E-08 | NA |

Hazard quotient and cancer risk have been divided by 3 to account for a worker exposure time of 8 hours per day.

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

## SCREENING LEVEL RISK CALCULATIONS FOR VAPOR INTRUSION OF COMPOUNDS IN GROUNDWATER:  VINYL CHLORIDE

### RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

| Indoor exposure groundwater conc., carcinogen (μg/L) | Indoor exposure groundwater conc., noncarcinogen (μg/L) | Risk-based indoor exposure groundwater conc., (μg/L) | Pure component water solubility, S (μg/L) | Final indoor exposure groundwater conc., (μg/L) |
|---|---|---|---|---|
| NA | NA | NA | 8.80E+06 | NA |

### INCREMENTAL RISK CALCULATIONS:

| Incremental risk from vapor intrusion to indoor air, carcinogen (unitless) | Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless) |
|---|---|
| 1.8E-08 | 1.1E-04 |

Hazard quotient and cancer risk have been divided by 3 to account for a worker exposure time of 8 hours per day.

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL
DOWN
TO "END"

END

# GROUNDWATER RISK EVALUATION

## NORTH TEMPLE LANDFILL

**7610 West North Temple Frontage Road**
**Salt Lake City, Utah**

**Prepared By**

**Steven L Glaser, Environmental Consulting LLC**
**2052 E. Arbor Lane**
**Holladay, Utah 84117**

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# ACRONYMNS

| | |
|---|---|
| $AF_{GW}$ | absorption factor for groundwater |
| ALM | Adult Lead Model |
| AT | averaging time |
| ATSDR | Agency for Toxic Substances and Disease Registry |
| | |
| BKSF | biokinetic slope factor |
| BW | body weight |
| | |
| CDI | chronic daily intake |
| CDM | Camp, Dresser, & McKee |
| $C_w$ | chemical concentration in groundwater |
| | |
| $DA_{event}$ | Absorbed dose per event |
| DCE | dichloroethene |
| DSHW | Division of Solid and Hazardous Waste |
| | |
| EC | exposure concentration |
| ED | exposure duration |
| EF | exposure frequency |
| EPA | Environmental Protection Agency |
| ERM | Environmental Resources Management |
| EvF | event frequency |
| | |
| GSD | geometric standard deviation |
| | |
| HI | hazard index |
| HQ | hazard quotient |
| | |
| $IR_{gw}$ | groundwater ingestion rate |
| IRIS | Integrated Risk Information System |
| | |
| LDC | lifetime daily concentration |
| LDI | lifetime daily intake |
| LOAEL | lowest-observed-adverse-effect level |
| | |
| MCL | maximum contaminant level |
| MRL | minimal risk level |
| | |
| NOAEL | no-observed-adverse-effect level |
| NTL | North Temple Landfill |
| | |
| OEHHA | California Office of Environmental Health Hazard Assessment |

## ACRONYMNS (continued)

| | |
|---|---|
| $PbB_{adult,\ central}$ | average blood-lead concentration in an exposed adult worker |
| $PbB_{fetal,\ 0.95}$ | 95th percentile blood-lead concentration in the fetus of an exposed adult |
| $PbB_{GW}$ | lead concentration in groundwater |
| $PbB_{worker,\ 0}$ | average blood-lead concentration in an unexposed adult worker |
| PPRTV | Provisional Peer-Reviewed Toxicity Value |
| RfC | reference concentration |
| RfD | reference dose |
| $R_{fetal/maternal}$ | ratio of blood lead concentration in a fetus compared to the mother |
| RMEC | Rocky Mountain Environmental Consulting |
| RSL | Regional Screening Level |
| $SA_w$ | skin surface area exposed to groundwater |
| SF | slope factor |
| TCDD | tetrachlorodibenzo-p-dioxin |
| TEF | toxicity equivalency factors |
| URF | unit risk factor |
| VISL | vapor intrusion screening level |

# EXECUTIVE SUMMARY

The North Temple Landfill (NTL) is west of downtown Salt Lake City, immediately north of Interstate 80 between 5600 West and 7200 West. The NTL is a 782-acre closed municipal landfill that was operated by Salt Lake City Corporation from 1959 until 1979. The property is being considered for commercial development. However, subsurface contamination has been identified on this property.

This document evaluates risks that could be present as a result of exposure to chemicals in groundwater. The purpose is to provide a framework for evaluating the types of development that are suitable for this property. This risk assessment is thus intended to be a platform for discussion. It is not intended to satisfy the regulatory requirements of programs such as Utah Administrative Code Rule 315-101 or Utah's Voluntary Cleanup Program.

While contamination has been identified in soil samples, this document does not evaluate their associated risk implications. In general, due to the nature of how a landfill accepts waste, soil samples only identify what was in the soil at that location. It is not appropriate to extrapolate from a soil sample to what is present in the surrounding area. As such, any development on the landfill property will need to be conducted in a manner that is compatible with potentially contaminated underlying soil.

Three receptors were evaluated. These are a municipal user of tap water, a site worker exposed via vapor intrusion, and a construction worker that comes in contact with groundwater during the course of site excavation. For the construction worker, potential exposure pathways are dermal contact with groundwater and incidental ingestion of groundwater.

For a municipal user of tap water, groundwater concentrations were compared to maximum contaminant levels (MCLs), which are drinking water standards. For chemicals without MCLs, groundwater concentrations were compared to U.S. Environmental Protection Agency (EPA) residential Regional Screening Levels (RSLs). The RSLs incorporate the range of uses of tap water, including drinking, bathing, cooking, laundry, etc.

Several chemicals had groundwater concentrations above their MCLs/RSLs. The compounds 1,1-dichloroethane, 1,4-dioxane, and N-nitrosodimethylamine exceeded these benchmarks by over two orders of magnitude. Using the groundwater as a source of tap water would be accompanied by significant risks.

However, the shallow groundwater is unlikely to be used for this purpose, as the aquifer has a low yield. It is worth noting that the potential for a municipal well is unaffected by the type of development that occurs on the property.

For a site worker exposed to groundwater via vapor intrusion, the cancer risk was $2 \times 10^{-6}$ and the hazard index was 0.02. While the cancer risk exceeds $1 \times 10^{-6}$, no individual compound has a risk above this benchmark. The area where groundwater exceeds the $1 \times 10^{-6}$ cancer benchmark is confined to a single monitoring well (NTL-PZ-13). Furthermore, the uncertainties associated with this calculation make it likely that the actual cancer risk is less than $1 \times 10^{-6}$ even at this location. The risk estimates are based on a building that resembles a small, tight house, whereas a larger building with air mixing that is typical of a business will reduce indoor air concentrations, and their associated risk, substantially.

For a construction worker exposed to groundwater via dermal contact and incidental ingestion, the calculated cancer risk was 4 x $10^{-6}$ and the hazard index was 0.5. As with the site worker, no individual chemical had a cancer risk in excess of 1 x $10^{-6}$. And as with the site worker, the uncertainties associated with the risk estimates make it unlikely that the actual cancer risk exceeds 1 x $10^{-6}$.

The risk calculations assume that workers come in contact with groundwater that is exposed during a 1-year construction project. That is only plausible if the same workers prepare the foundation on a series of buildings. However, in this instance, the average groundwater concentrations that workers encounter cannot plausibly be that assumed by the calculations; name, the maximum chemical concentrations detected in groundwater. For example, the two compounds with the highest cancer risks were pentachlorophenol and aldrin, and they were detected in less than 3 percent of the groundwater samples.

In summary, calculated groundwater risks associated with the NTL for site and construction workers exceed the 1 x $10^{-6}$ cancer risk benchmark. However, no individual chemical has a risk above this benchmark, the cumulative risk exceeds the benchmark by only a small amount, and the conservativeness of the calculations make it probable that the true cumulative risk is below this benchmark. The groundwater is not appropriate for use of tap water, although the nature of the aquifer is such that such a use is unlikely.

# 1.0 INTRODUCTION

The North Temple Landfill (NTL) is between downtown Salt Lake City and the Great Salt Lake, along Interstate 80 on the north frontage road between 5600 West and 7200 West, within the northwest portion of Salt Lake City, Utah (Figure 1-1). The NTL is approximately 782 acres in area. The NTL is a closed municipal landfill that was operated by Salt Lake City Corporation from 1959 until 1979.

The Ninigret Corporation is considering commercial development such as warehouses and office complexes over parts of the landfill, consolidating the landfill waste in other portions. Additional development would be conducted in the immediate vicinity, including potentially downgradient of the landfill.

This document evaluates risks that could be present as a result of exposure to chemicals that are in groundwater. The purpose is to provide a framework for evaluating the types of development are suitable for this property given the contamination that is present. This risk assessment is thus intended to be a platform for discussion between Ninigret and various government agencies and other interested parties. It is not intended to satisfy the regulatory requirements of programs such as Utah Administrative Code Rule 315-101 or Utah's Voluntary Cleanup Program.

This risk assessment is focused on chemicals that have been found in site groundwater. While contamination has been identified in soil samples, these data are not sufficient to evaluate soil-related risks. In general, due to the nature of how a landfill accepts waste, it is not appropriate to extrapolate from soil sample results to infer what is present in the surrounding area. As such, any development on the landfill property will need to be conducted in a manner that is compatible with potentially contaminated underlying soil.

## 1.1 SITE GROUNDWATER

The following discussion of groundwater conditions is taken from the *Subsurface Investigation Report*, prepared by Cardno (Cardno, 2016). Summaries of the local hydrogeology have characterized the groundwater beneath the landfill complex as consisting of two distinct units: a shallow, unconfined aquifer, generally called the shallow aquifer, and a confined artesian aquifer commonly referred to as the principal aquifer. The shallow aquifer overlies a bed of low permeable material, which confines the water in the principal aquifer. The shallow aquifer is comprised of clay, silt and fine sand, and exhibits relatively low permeability. The thickness of the shallow aquifer is somewhat variable but its maximum thickness is estimated at 50 feet

(URS, 1994). The shallow aquifer receives recharge via upward flow from the principal aquifer and infiltration from local precipitation. Investigations of potential groundwater contamination have focused on the shallow aquifer.

There are no municipal wells located within a four-mile radius of the NTL site. The general direction of groundwater flow is to the north-northwest. The quality of the water in the shallow aquifer is poor. Utilization of the shallow aquifer is limited due to its clayey nature and poor yield. The depth to the groundwater as measured in monitoring wells during the past 20 years at the NTL site has ranged from 4 to 11 feet bgs (Utah DSHW, 1987, and ERM, 2012) depending on seasonal groundwater fluctuations. Generally, the depth to groundwater in NTL wells range from 5 to 11 feet bgs in the late summer and fall months (August through October) and from 4 to 7 feet bgs during late spring months associated with spring runoff (May through early June).

## 1.2 GROUNDWATER INVESTIGATIONS

Numerous groundwater investigations have been conducted since the late 1980s. This risk assessment focuses on the most recent of these investigations, as they better reflect current site conditions.

Environmental Resources Management (ERM) conducted four groundwater monitoring events between 2009 and 2012 (ERM, 2012). Their reporting also included a 2008 monitoring event conducted by Camp Dresser & McKee (CDM) (CDM, 2008). Twelve monitoring wells/piezometers were sampled during this time. The monitoring wells/piezometers were located around the entire perimeter of the landfill. The location of these wells is shown in Figure 1-2.

Cardno sampled 15 wells/piezometers along the western perimeter of the landfill in 2015 (Cardno, 2016). The western perimeter is where the prior CDM and ERM monitoring events had identified the greatest groundwater contamination. The location of the wells included in the Cardno investigation is shown in Figure 1-3.

Rocky Mountain Environmental Consulting (RMEC) conducted a groundwater investigation in 2016 to evaluate the feasibility of a utility corridor north of the landfill (RMEC, 2016). They installed 10 wells, including five along the northern perimeter of the landfill, and five additional wells further north along an alternate route for the corridor. These wells are shown in Figure 1-4.

## 1.3 RISK ASSESSMENT ORGANIZATION

This risk assessment consists of a human health and ecological risk assessment. This document includes the following sections:

- Data Evaluation
- Exposure Assessment
- Toxicity Assessment
- Risk Characterization
- Summary and Conclusions

The Data Evaluation (Section 2) describes the data employed in the risk assessment and provides a statistical summary. The Exposure Assessment (Section 3) identifies potential receptors, and describes potential current and future pathways by which exposure could occur. The methods by which exposure is quantified are also described. The Toxicity Assessment (Section 4) describes the framework by which toxicity is evaluated in this risk assessment. The Risk Characterization (Section 5) estimates the potential for an adverse health effect under the conditions of exposure defined in Section 3. This section also includes an uncertainty analysis. The Summary and Conclusions (Section 6) reviews both the quantitative and qualitative information in the Risk Characterization to make a determination about conditions where significant groundwater risks could exist, and where risks would be low.

## 2.0 DATA EVALUATION

This section describes the data used in this risk assessment. Risks for a chemical are based on its recent maximum detected concentration. The Cardno (2016) data from 2015 have been used in this risk assessment, as these data reflect current conditions. Furthermore, this monitoring event was a high density investigation on the west side of the landfill where (as observed above) the highest chemical concentrations had previously been detected. The Cardno data are presented in Table 2-1.

The RMEC (2016) data from 2016 are sufficiently recent to be suitable. However, the concentrations detected were quite low, and were not the maximum for any compound. This is due to the fact that RMEC did not sample on the west side of the landfill where the highest concentrations of chemicals have been found in groundwater. Consequently, the RMEC data have not been utilized in this risk assessment.

The ERM (2012) data, while older (encompassing monitoring events conducted from 2008 through 2012), provide good coverage for all parts of the site. These data have been used for chemicals that were not detected in the Cardno (2016) study. These data have been considered because of the possibility that chemicals were disposed of in a portion of the landfill where they would be unlikely to migrate across the western boundary. Furthermore, where concentrations from the ERM study exceeded those from Cardno for a given chemical, they are considered in the Uncertainty Analysis. Other older sampling events are considered no longer representative of current conditions, and have not been used in this risk assessment. The ERM data are presented in Table 2-2. Tables 2-3 and 2-4 show the frequency of detection and maximum detected concentration of the various chemicals detected in the Cardno and ERM datasets, respectively.

While metals have been detected and in certain instances likely reflect background conditions, all of the data have been used in the risk calculations. The potential effect of background conditions has been considered in the Uncertainty Analysis.

It should be noted that average (rather than maximum) concentrations are typically used in a risk assessment, as one's exposure relates to the average concentration. However, the maximum concentration is suitable for providing perspective, and is an appropriate statistic given that this document is designed to facilitate discussion. Furthermore, the property is quite large, with the western boundary being about 5/8th of a mile long. As such, each well already represents a relatively large area, consistent with an individual's exposure.

# 3.0 EXPOSURE ASSESSMENT

The exposure assessment identifies the people (known as receptors) who could come in contact with site constituents, describes the ways in which the contact could occur (known as exposure pathways), and reviews the assumptions used to calculate the amount of contact the receptors could have.

## 3.1 RECEPTOR IDENTIFICATION

The NTL is in an undeveloped area. It is bordered on the east by the Salt Lake International Center, which is a business park primarily comprised of offices and warehouses. Other land surrounding the landfill is undeveloped. No houses were identified within four miles of the landfill property.

Future land use in the general area may change. A prison is slated for construction approximately 2 1/2 miles northwest of the landfill, and this project would require new infrastructure in the area. Additional development could potentially follow.

People who could come in contact with groundwater include construction workers, and once development is completed, site workers (via vapor intrusion, as discussed further below). The expectation is that the area surrounding the former landfill will continue to be non-residential, but hypothetical future residents are considered in this risk assessment.

People could be exposed to chemicals detected in the shallow aquifer if they were to drink or otherwise use impacted groundwater. This situation could apply to people who are living or working on top of the landfill, or if they are some distance away. For example, if a municipal well were to pump the groundwater in the vicinity of the former landfill, people a substantial distance away could come in contact with groundwater beneath the landfill. The potential for such usage is extremely low. However, consideration of the risks associated with the use of groundwater for municipal purposes will contribute to the discussion of what land uses may be acceptable, and residential use of groundwater is considered in this document.

The Brighton Canal crosses the landfill, and the North Point Drain borders the landfill on the north. Commercial development of the landfill property or in the immediate surrounding area will not affect any exposure pathways associated with these canals. They are not further considered in this document.

## 3.2 EXPOSURE PATHWAYS

### 3.2.1. Pathways Associated with Site Workers

Following redevelopment of the property, site workers could be exposed to constituents in groundwater via vapor intrusion. Vapor intrusion is a process whereby volatile compounds migrate upwards from the water table through the soil column and into a building where they can be inhaled. This exposure pathway only applies to volatile chemicals.

### 3.2.2. Pathways Associated with Construction Workers

Construction workers could contact chemicals in shallow groundwater if the water table is exposed during construction. Groundwater exposure pathways would consist of incidental ingestion and dermal contact. Dermal contact with groundwater would occur if groundwater infiltrated into a trench where workers were present. Incidental ingestion could occur if groundwater were to get on the hands of a worker, followed by eating or smoking.

### 3.2.3. Pathways Associated with Municipal Use of Groundwater

If a municipal well was hypothetically installed in the shallow aquifer, the water would be utilized for drinking, cooking, bathing, and laundry. Exposure pathways would therefore include ingestion, dermal contact, and inhalation of volatilized compounds.

## 3.3 QUANTIFICATION OF EXPOSURE

### 3.3.1. Site Workers

Different approaches have been used to quantify exposure (and risk) for each of the receptors. For site workers exposed via vapor intrusion, groundwater concentrations have been compared to the U.S. Environmental Protection Agency's (EPA's) Vapor Intrusion Screening Levels (VISLs) (EPA, 2014). This comparison is provided in Table 3-1.

The VISLs conservatively assume that a compound's concentration in indoor air is three percent of that in the vapor immediately above the capillary zone. This percentage was determined by examining the relationship between indoor air and groundwater concentrations at a large number of sites.

For compounds where the maximum concentration is at least one-tenth the VISL, the compound has been evaluated via EPA's implementation of the Johnson and Ettinger model (EPA, 2004a). These compounds are benzene, 1,4-dichlorobenzene, dichlorodifluoromethane, 1,1-dichloroethane, ethylbenzene, N-nitrosodimethylamine, and vinyl chloride.

The Johnson and Ettinger model evaluates the partitioning of compounds between groundwater and interstitial air immediately above the capillary zone. It then models the transport of these compounds upward through soil and into a building. The model permits use of site-specific soil conditions.

It was assumed that workers were present in a building eight hours per day, 250 days per year for 25 years. These values are EPA default exposure assumptions for indoor workers (EPA, 2014b). A more detailed description of the application of the Johnson and Ettinger model as well of the model outputs is provided in Appendix A.

### 3.3.2. Construction Workers

Construction workers were assumed to be exposed to chemicals in groundwater that is uncovered during the construction process. The following equations were used:

$$\text{Groundwater Ingestion Intake (mg/kg-day)} = \frac{C_w \text{ x } IR_{gw} \text{ x EF x ED}}{\text{BW x AT}}$$

where:

$C_w$ = Average concentration in water (mg/l)

$IR_{gw}$ = Groundwater ingestion rate (l of water/day)

EF = Exposure frequency (days/year)

ED = Exposure duration (years)

BW = Body weight (kg)

AT = Averaging time (period over which exposure is averaged - days).

Exposure from dermal contact with groundwater was calculated as follows:

$$\text{Groundwater Dermal Intake (mg/kg-day)} = \frac{DA_{event} \text{ x } EvF \text{ x } ED \text{ x } EF \text{ x } SA_{w}}{BW \text{ x } AT}$$

where:

$DA_{event}$ = Absorbed dose per event (mg/cm$^2$-event)

$SA_w$ = Skin surface area available for contact with groundwater (cm$^2$)

EvF = Event frequency (events/day)

EF = Exposure frequency (days/year)

ED = Exposure duration (years)

BW = Body weight (kg)

AT = Averaging time (period over which exposure is averaged–days).

The parameter $DA_{event}$ is a calculated value, and this calculation is provided in Appendix B.

The exposure parameters for these equations are presented in Table 3-2. Some of the parameters are default values developed by EPA's Superfund program. The other parameters were determined as follows.

It was assumed that construction workers could be exposed to groundwater if the water table was exposed during an excavation, either associated with the installation of or repairs to utility lines, or while excavating a building foundation. To evaluate the amount of dermal exposure a construction worker would receive, it was assumed that there would be water contact for one hour per day, and the feet and hands would come in contact with groundwater.

A 5-ml/hour ingestion rate was assumed for incidental ingestion of groundwater by construction workers. The EPA (1989) recommends a 50-ml/hour ingestion rate for swimmers in recreational scenarios. Recognizing that accidental splashing or hand-to-face contact could occur while working, one-tenth the ingestion rate of a swimmer was assumed to be appropriate for a construction worker.

### 3.3.3. Municipal Use of Shallow Groundwater

If the shallow groundwater was hypothetically used for municipal purposes, exposure would be via ingestion, dermal contact, and inhalation of volatiles. Groundwater concentrations were compared to primary maximum contaminant levels (MCLs) when these benchmarks have been established for the chemical under consideration. MCLs are promulgated drinking water standards.

EPA's Regional Screening Level (RSL) tables consider all appropriate exposure pathways, and use EPA default assumptions to evaluate exposure and risk. For chemicals without MCLs, groundwater concentrations have been compared to the risk-based concentration in the RSL tables (EPA, 2017).

### 3.3.4. Lead-Specific Considerations

The quantification of lead exposure differs from other constituents. Cause-and-effect relationships in humans have been correlated with blood concentrations of lead. Therefore, the preferred risk assessment approach for lead is the estimation of human blood lead concentrations associated with a particular set of exposure conditions, as opposed to calculating the dose taken into the body (as is done for other chemicals).

Lead is not volatile, and thus exposure pathways between site workers and groundwater via vapor intrusion is incomplete. For municipal use of tap water, lead concentrations can be compared to an EPA action level of 15 µg/l. However, separate equations are necessary for evaluating construction worker exposure to lead.

Exposure of construction workers to lead in groundwater and subsequent blood lead concentrations was estimated by use of the Adult Lead Model (ALM) developed by the EPA Technical Work Group for Lead (EPA, 2003a; 2009). The Work Group recommended that adult lead exposure be evaluated by calculating a blood lead level in a pregnant adult, followed by calculating the resulting blood lead level in a fetus. The model put forth by the Work Group conservatively evaluates the upper end of the distribution of possible blood lead concentrations.

The following equation was used to estimate typical blood lead levels in a worker as a result of exposure to lead in groundwater:

$$PbB_{adult,\ central} = PbB_{worker,\ 0} + \frac{PbGW \times BKSF \times IR_{GW} \times AF_{GW} \times EF}{AT}$$

where:

$PbB_{adult, central}$ = Central estimate of blood-lead concentration in adults that have site exposure (µg/dl)

$PbB_{worker, 0}$ = Typical blood-lead concentration in adults in the absence of site exposure (µg/dl)

PbGW = Arithmetic mean lead concentration in groundwater (µg/l)

BKSF = Biokinetic slope factor relating the increase in the adult blood lead level to the average daily lead uptake under quasi steady-state conditions (µg-lead/dl-blood per µg-lead/day)

$IR_{GW}$ = Groundwater ingestion rate (l/day)

$AF_{GW}$ = Absolute gastrointestinal absorption fraction for ingested lead from groundwater (unitless)

EF = Exposure frequency (days/year)

AT = Averaging time (days/year)

The following equation was used to estimate the 95th percentile blood lead concentration in a fetus from the average estimated adult blood lead concentration, assuming that blood lead levels are distributed lognormally:

$$PbB_{fetal,0.95} = PbB_{adult,\, central} \text{ x } GSD_{t,\, adult}^{1.645} \text{ x } R_{fetal,\, maternal}$$

where:

$PbB_{fetal, 0.95}$ = 95th percentile blood-lead concentration among fetuses born to women exposed to site media (µg/dl)

$PbB_{adult, central}$ = Central estimate of blood lead concentration in adults that have site exposure (µg/dl)

$GSD_{t,adult}^{1.645}$ = Estimated value of the individual geometric standard deviation (unitless). The exponent, 1.645, is the value of the standard normal deviate used to calculate the 95th percentile from a lognormal distribution.

$R_{fetal/maternal}$ = Ratio between fetal blood lead concentration at birth to the maternal blood lead concentration (unitless).

The parameters utilized in the ALM model are presented in Table 3-3.

# 4.0 TOXICITY ASSESSMENT

The risks associated with exposure to the constituents detected at a site are a function of the inherent toxicity of each chemical, as well as the exposure dose or concentration. This section provides an overview of how toxicity is quantified in this risk assessment.

Evaluation of the toxic potential of a chemical involves the examination of available data that relate observed toxic effects to doses. Generally, there are two categories of information that are considered:

- Information on the non-cancer effects of chemicals
- Information on the potential for chemicals to initiate or promote cancers

These two categories are elaborated upon in the following sections.

## 4.1 NON-CARCINOGENIC EFFECTS

The assessment of non-carcinogenic effects is complex. There is a broad interaction of time scales (acute, sub-chronic, and chronic) and routes of exposure (ingestion, inhalation, dermal) with varying kinds of effects. A single chemical may elicit several adverse non-carcinogenic effects depending on the dose, exposure route, and duration of exposure.

For many non-carcinogenic effects, protective mechanisms must be overcome before the effect is manifested. Therefore, a finite dose (threshold) below which adverse effects will not occur is believed to exist for non-carcinogens. Many toxicological studies focus on identifying where this threshold occurs.

For a given chemical, the dose that elicits no effect when evaluating the most sensitive response (the adverse effect that occurs at the lowest dose) in the most sensitive species is used to establish an acceptable dose (toxicity value) for non-carcinogenic effects. This dose can be related to an oral reference dose (RfD). A chronic RfD is an estimate of a daily exposure level (with uncertainty spanning perhaps an order of magnitude) for which people, including sensitive individuals, do not have an appreciable risk of suffering significant adverse health effects. Exposure above an RfD could possibly cause health effects.

The primary source of RfDs is the Integrated Risk Information System (IRIS), which is an electronic database for selected compounds that was established and maintained by EPA. This database is based on a compendium of available toxicological data, containing both United States and international studies, and peer-reviewed and non-peer reviewed research. The EPA uses this compendium to derive toxicity values for chemicals in the database. The database identifies a critical effect, which is the health endpoint upon which the RfD is based. Uncertainty (safety) factors are used as a divisor to the dose associated with the critical effect, which is usually a no-observed-adverse-effect level (NOAEL) or a lowest-observed-adverse-effect level (LOAEL). Most uncertainty factors are standardized and include:

- 10-fold factor for extrapolation from animals to humans
- 10-fold factor for variability in the human population
- 10-fold factor for use of a less than chronic study
- 1 to 10-fold factor for extrapolation from a LOAEL.

The use of 10-fold uncertainty factors is traditional. However, there are situations where data support the application of smaller uncertainty factors. There is on-going research directed at the use of physiologically based pharmacokinetic modeling for interspecies extrapolation. However, at this time, no specific guidance is provided on the use of this method for developing better extrapolation (from animal to human, and administered versus absorbed) values for application.

Other factors may further modify the RfD, such as epidemiological evidence or the absence of information on certain types of effects (e.g., reproductive effects). The IRIS database also provides a rating of confidence in the RfD, which refers to a qualitative judgment with regard to the quality of the critical study, the supporting database, and the dose developed.

## 4.2 CARCINOGENIC EFFECTS

Studies of carcinogenicity tend to focus on identifying the slope of the linear portion of a curve of dose versus response. A plausible upper-bound value of the slope is called the cancer slope factor (SF). The product of the SF and the exposure dose is an estimate of the risk of developing cancer.

Identification of chemicals as potential human carcinogens is based on a EPA weight-of-evidence classification scheme in which chemicals are systematically evaluated for their ability to cause cancer in humans. The EPA classification scheme (EPA, 2005) contains five classes based on the weight of available evidence, as follows:

- Carcinogenic to Humans
- Likely to Be Carcinogenic to Humans
- Suggestive Evidence of Carcinogenic Potential
- Inadequate Information to Assess Carcinogenic Potential
- Not Likely to Be Carcinogenic to Humans

This classification scheme replaced one developed in 1986 (EPA, 1986). However, there are chemicals for which EPA has not re-evaluated carcinogenic potential since the new classification scheme was developed. The 1986 classification scheme was as follows:

| | |
|---|---|
| A | Known human carcinogen |
| B1 | Probable human carcinogen – limited evidence in humans |
| B2 | Probable human carcinogen – sufficient evidence in animals and inadequate data in humans |
| C | Possible human carcinogen – limited evidence in animals |
| D | Inadequate evidence to classify |
| E | Evidence of non-carcinogenicity |

## 4.3 TOXICITY VALUES

The toxicity values used in this risk assessment are summarized in Table 4-1. The preferred source of toxicity values is IRIS (EPA, 2003b). In accordance with an EPA memorandum, when toxicity values are not available on IRIS, EPA’s Provisional Peer-Reviewed Toxicity Values (PPRTV) database is to be used as a source of toxicity values (EPA, 2003b). When values are neither available on IRIS nor the PPRTV database, comparable State-promulgated values, and non peer-reviewed values such as minimal risk levels (MRLs) established by the Agency for Toxic Substances and Disease Registry (ATSDR) may be consulted.

Because toxicity values for dermal exposure are not published by the EPA, adjustments have been made to oral toxicity values (both RfDs and SFs) for dermal use as per EPA guidance (EPA, 1989). These adjustments involved the application of oral absorption efficiency values obtained from EPA’s dermal guidance (EPA, 2004b). Dermal RfDs and SFs were derived as follows:

Dermal RfD = Oral RfD x Oral Absorption Efficiency

Dermal SF = Oral SF/Oral Absorption Efficiency

Consistent with EPA (2004b) guidance, the adjustment with the oral absorption efficiency was only done when this value is less than 50 percent.

The EPA establishes inhalation toxicity values in the form of reference concentrations (RfCs) and unit risk factors (URFs) for non-carcinogenic and carcinogenic endpoints, respectively, instead of RfDs and SFs. The RfC (in units of $\mu g/m^3$) is analogous to the RfD, with the exception that it is concentration- rather than dose-based. The URF is the upper-bound lifetime excess cancer risk estimated to result from continuous exposure to a concentration of 1 $\mu g/m^3$. The RfCs and URFs are embedded in EPA's calculation of the residential RSLs; they are not directly used in any calculations in this risk assessment.

Cancer slope factors and unit risk factors for chlorinated dioxins and furans are based on those for 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). The California Office of Environmental Health Hazard Assessment (OEHHA) has established an oral slope factor of 130,000 $(mg/kg\text{-}day)^{-1}$ and a unit risk factor of 38 $(\mu g/m^3)^{-1}$ for this compound. The cancer toxicity values for other chlorinated dioxins/furans are a fraction of these OEHHA values. The fractions used in this risk assessment have been established by the World Health Organization, as presented in Table 4-2 (Van den Berg et al., 2006). These fractions are known as Toxicity Equivalency Factors (TEFs). The slope/unit risk factor for a specific dioxin congener is the product of the slope/unit risk factor for 2,3,7,8-TCDD and the congener's TEF. It should be noted that the TEFs are only applicable to the carcinogenic toxicity values. The TEFs are not applicable to 2,3,7,8-TCDD's RfD and URF.

## 4.4 LEAD-SPECIFIC CONSIDERATIONS

EPA has not developed traditional RfD toxicity criteria for lead. The primary reason is that a threshold for toxic effects in mammals has not been established. Rather, cause-and-effect relationships in humans have been correlated with blood concentrations of lead. Therefore, as discussed in Section 3.3.4., the preferred risk assessment approach for lead involves estimation of human blood-lead concentrations associated with the exposure scenario being evaluated.

EPA applies a blood level of 10 µg/dl as a basis for risk-based decision-making (EPA, 1994). For adult exposure, the target population for the modeling is fertile, adult women, with the objective of protecting a developing fetus, a more sensitive endpoint than direct effects on adults. The benchmark utilized by the EPA Adult Lead Model is that the 95th percentile of the modeled fetal blood-lead concentration be less than 10 µg/dl (EPA, 2003a).

# 5.0 RISK CHARACTERIZATION

This section characterizes the risks to human health based on the exposure and toxicity assessments described previously. This section begins with a discussion of the methodology, followed by an assessment of risk for each exposure pathway. Risk assessment uncertainties are discussed in Section 5.3.

## 5.1 METHODOLOGY

### 5.1.1. Carcinogenic Risks

For carcinogens, risk estimates represent the incremental probability that an individual will develop cancer over a lifetime as a result of exposure to a particular carcinogen or a set of carcinogens (EPA, 1989). These risks are calculated as follows:

$$\text{Excess Lifetime Cancer Risk} = \text{LDI} \times \text{SF}$$

where:

LDI = Lifetime Daily Intake (mg/kg-day)

SF = Slope Factor $(\text{mg/kg-day})^{-1}$

Note that this risk is an estimate of the additional cancer risk posed by exposure to site constituents. It does not include the much larger probability of cancer from all other causes.

For inhalation exposure pathways, the cancer risk is calculated by multiplying the exposure concentration, averaged over a lifetime, by the unit risk factor:

$$\text{Excess Lifetime Cancer Risk} = \text{LDC} \times \text{URF}$$

where:

LDC = Lifetime Daily Concentration ($\mu g/m^3$)

URF = Unit Risk Factor $(\mu g/m^3)^{-1}$

A carcinogenic risk is expressed as a probability, such as one additional cancer in an exposed population of one million (which is also expressed as $1 \times 10^{-6}$). The lifetime daily intake is the exposure dose averaged over a 70-year lifetime. This is in keeping with the concept that there are no threshold doses for carcinogens. Risks below 1 x $10^{-6}$ are considered *de minimis*. Cancer risks between 1 x $10^{-4}$ and 1 x $10^{-6}$ are potentially acceptable, while risks greater than 1 x $10^{-4}$ are considered to be unacceptable.

For a given pathway, an individual may be exposed to more than one chemical. To estimate the overall carcinogenic risk potential for each exposure pathway, risks are summed for each chemical within the pathway. Risks across pathways are then summed to obtain a total estimated cancer risk.

### 5.1.2 Non-Carcinogenic Risks

The potential for individuals to experience effects other than cancer is evaluated by comparing an exposure dose to an RfD. This comparison takes the form of a ratio termed the hazard quotient (HQ), which is calculated by dividing the chronic daily intake by the RfD:

$$\text{Hazard Quotient} = \frac{\text{CDI}}{\text{RfD}}$$

where:

CDI = Chronic Daily Intake (mg/kg-day)

RfD = Reference Dose (mg/kg-day)

For inhalation pathways, the hazard quotient is calculated by dividing the exposure concentration by the reference concentration:

$$\text{Hazard Quotient} = \frac{\text{EC}}{\text{RfC}}$$

where:

EC = Exposure Concentration (mg/$m^3$)

RfC = Reference Concentration (mg/$m^3$)

If the hazard quotient is less than or equal to 1, no adverse health effects are expected. If the hazard quotient is greater than 1, then adverse health risks are considered possible.

To estimate the overall non-carcinogenic potential for health effects, HQs were summed within pathways to give a hazard index (HI). The total hazard index was then obtained by summing the HIs from each applicable exposure route.

## 5.2 RISK CALCULATION RESULTS

### 5.2.1. Municipal Use of Shallow Groundwater`

Groundwater concentrations are compared to MCLs in Table 5-1. In the absence of such values, groundwater concentrations are compared to tap water RSLs. The MCL/RSL benchmarks are exceeded for several chemicals. These include benzene, 1,1-dichloroethane (DCA), 1,1-dichloroethene (DCE), 1,4-dioxane, vinyl chloride, benzaldehyde, bis(2-ethylhexyl)phthalate, naphthalene, N-nitrosodimethylamine, pentachlorophenol, aldrin, beta-BHC, arsenic, and barium.

An inspection of Table 5-1 shows that the exceedances of the greatest magnitude were for 1,1-DCA, 1,4-dioxane, and N-nitrosodimethylamine. These chemicals exceeded their benchmarks by over two orders of magnitude. An inspection of Tables 2-1 and 2-2 show that arsenic and 1,4-dioxane exceeded their MCLs/RSLs most frequently. The number of chemicals exceeding MCLs/RSLs and the magnitude and/or frequency of some of these exceedances results in a conclusion that the shallow groundwater immediately downgradient of the NTL is not suitable for municipal purposes.

### 5.2.2. Site Worker Exposure Via Vapor Intrusion

Groundwater concentrations of benzene, 1,4-dichlorobenzene, dichlorodifluoromethane, 1,1-DCA, ethylbenzene, N-nitrosodimethylamine, and vinyl chloride were at least one-tenth of EPA's VISLs (Table 3-1). Further analysis has been performed regarding the potential of these compounds to create a health hazard to site workers via vapor intrusion. The Johnson and Ettinger model has been used to calculate risks for these compounds using site-specific geology. The output spreadsheets for the Johnson and Ettinger model are in Appendix A.

The total cancer risk was $2 \times 10^{-6}$, while the hazard index was 0.02 (Table 5-2). However, no compound had a cancer risk above $1 \times 10^{-6}$. The highest cancer risks were $8 \times 10^{-7}$ for 1,1-DCA, $7 \times 10^{-7}$ for N-nitrosodimethylamine, and $5 \times 10^{-7}$ for vinyl chloride.

An inspection of Tables 2-1 and 2-2 shows that PZ-13 is the location where risks would be highest. To the extent that the total risk exceeds 1 x $10^{-6}$, the vapor intrusion pathway warrants attention. However, the fact that the total risk is only slightly above this benchmark combined with the fact that no individual compound exceeds this level indicates that the overall level of concern is low.

### 5.2.3. Construction Worker Contact with Groundwater

For a construction worker in contact with groundwater, the total cancer risk was 4 x $10^{-6}$ and the total hazard index was 0.5 (Table 5-3). Two compounds (pentachlorophenol and aldrin) had cancer risks equal to 1 x $10^{-6}$, but none exceeded this benchmark. The rest of the total cancer was derived from several chemicals with risks in the $10^{-7}$ range (1,4-dioxane, vinyl chloride, bis(2-ethylhexyl)phthalate, N-nitrosodimethylamine, heptachlor, and arsenic). Dermal exposure accounted for over 80 percent of the total cancer risk estimate.

As with site worker exposure to vapor intrusion, the level of concern is diminished by the fact that there is no single chemical with a cancer risk above 1 x $10^{-6}$. For the construction worker, this conclusion is emphasized by the fact that many of these chemicals have rarely been detected. For the two compounds with the highest risks, pentachlorophenol was detected in 1 out 55 samples and aldrin was detected in 2 out of 62 samples in the ERM data set (Table 2-4). Furthermore, neither of these compounds were detected in the more recent Cardno sampling effort. Bis(2-ethylhexyl)phthalate, N-nitrosodimethylamine, and heptachlor were detected similarly infrequently. The total risk from the chemicals that were detected with greater frequency (1,4-dioxane, vinyl chloride, and arsenic) is only 1 x $10^{-6}$.

Blood-lead levels for the fetus of a pregnant construction worker are calculated in Table 5-4. The 95 percentile level is 2.4 μg/dl, which is well less than the benchmark of 10 μg/dl. No adverse effects are anticipated as a result of the presence of lead in groundwater.

## 5.3 UNCERTAINTY ANALYSIS

The primary uncertainty with the municipal use of shallow groundwater is that it is highly unlikely that the shallow groundwater in the vicinity of the NTL would ever be used for such a purpose. Groundwater concentrations exceed RSLs by a sufficient margin (by over a factor of 1,000 in some instances) that there is a high degree of certainty in the conclusion that there could be adverse health effects from such use if it were to occur.

When evaluating vapor intrusion risks that would be associated with an indoor site worker, it was assumed that the worker would be present for 25 years. This is the 95th percentile for how long workers stay a job (EPA, 2014). Most workers change jobs more frequently. In 2016, the median time a person had been with their current employer was 4.2 years (U.S. Bureau of Labor Statistics (BLS), 2016).

Modeling was used to estimate indoor air exposure concentrations. The indoor air modeling made use of EPA's implementation of the Johnson and Ettinger model (EPA, 2004a). Using this model requires assumptions regarding building size, soil-building pressure differential, the floor-wall seam crack width, the vapor flow rate into the building, and the indoor air exchange rate. EPA and model default values were used for these parameters.

EPA has designed these defaults to be conservative but within the range of possible values. Taken as a whole, these assumptions are likely to overestimate total risk. For example, the air exchange rate of one change per four hours is typical of winter conditions in areas of the country with a cold climate, and that will be more conservative than data averaged over an entire year (EPA, 2004a). It is also based on residential data, and will overestimate indoor air concentrations for facilities such as warehouses. Also, a small building of about 1,100 square feet is assumed; larger ones typical of office complexes and warehouses allow for greater mixing with outdoor air. When these uncertainties are juxtaposed with risk estimates that slightly exceed $1 \times 10^{-6}$ (and are less than this value for all individual compounds), the conclusion is that there is no significant vapor intrusion risk.

Construction worker risk estimates required assumptions regarding the amount of contact workers will have with groundwater. Highly conservative assumptions were made, including that such contact would occur daily over the course of a year-long construction project (this assumption was made to match up with the EPA standard default assumption for construction worker exposure duration (EPA, 2002)). Obviously, much of any construction project takes place above ground with no contact with groundwater. This assumption can only be at all plausible if it is assumed that several buildings are constructed in this area, and one group of workers goes from building site to building site, excavating and installing each of these foundations.

However, if a worker is at multiple construction sites, they will be in contact with groundwater over a much larger area. The assumption that a worker is in contact with maximum detected groundwater concentrations is no longer tenable. Given that several of the compounds (including aldrin and pentachlorophenol, the two with the highest risks) have been detected in less than two percent of the samples, risks would be substantially lower than estimated. In other words, one can assume a construction worker is in contact with the highest concentrations in groundwater or have contact over the course of a year, but not both. For perspective, the total construction worker cancer risk (based on maximum groundwater concentrations) would equal $1 \times 10^{-6}$ if the exposure duration was about 2.5 months.

The assumption of maximum recent groundwater concentrations was made for simplicity. Even for chemicals detected frequently, the highest concentrations are one to two orders of magnitude higher than those found in any other wells. The only exception is 1,4-dioxane, and by itself it does not significantly contribute to site or construction worker risks. Thus, the use of the maximum detected concentration substantially overestimates site risks.

The highest concentration of a chemical detected during the Cardno investigation was used in this risk assessment. Only when a chemical was detected by the ERM investigation but not in the Cardno investigation was the ERM data utilized. There are many chemicals which were detected at higher concentrations in the ERM investigation. The lower concentrations in the Cardno investigation could have resulted from degradation/dispersion over the years between the two investigations. However, it is also possible that the greater number of sampling rounds/locations encompassed by the ERM investigation uncovered higher concentrations that are representative of current conditions.

The most significant discrepancy is for methylene chloride at PZ-13. In three of the five sampling rounds, ERM detected methylene chloride concentrations between 1,090 and 1,700 µg/l. In the other two sampling rounds, as well as the Cardno sampling round, methylene chloride was either non-detect or detected at a concentration about three orders of magnitude lower. A concentration of 1.39 µg/l was used in this risk assessment.

If a methylene chloride concentration of 1,700 µg/l had been used, it would have exceeded the tap water RSL (Table 5-1). However, it still would have not passed the VISL screen with a cancer risk of less than $1 \times 10^{-7}$ and a hazard quotient less than 0.1. For the construction worker, the cancer risk would have been $1 \times 10^{-8}$ and the hazard index would have been 0.07.

No other chemical exceeded its Cardno maximum concentration by more than a factor of 5. For most chemicals the change was small or the Cardno maximum exceeded the ERM maximum. For the chemicals evaluated in the Johnson and Ettinger model for vapor intrusion, if the ERM maximum concentration was used whenever it was higher than the Cardno maximum, the cancer risk would increase from 2.0 to 2.1 x $10^{-6}$. For the construction worker, the cancer risk would increase from 4.5 to 4.7 x $10^{-6}$, and the hazard index would increase from 0.5 to 0.6. Thus, there would be essentially no risk implications for site and construction workers. The use of the maximum Cardno concentration, and its being much higher than its concentration in any other well for most chemicals, is a much more significant uncertainty.

Some of the chemicals detected in groundwater may not be related to the landfill operations. Some (and potentially all) of the metal concentrations detected will be naturally occurring. However, only arsenic and barium were associated with risks and/or above benchmarks for one or more receptors. The maximum concentrations of 359 and 3,060 μg/l of these metals, respectively, are higher than the normal range that is present in Salt Lake Valley groundwater. It is unlikely that these are naturally occurring concentrations at this site.

Another landfill used to be located to the east of the NTL. Chemicals could have migrated from this landfill under the NTL. However, an inspection of the data in Table 2-2 shows that only minor contamination has been detected in the wells on the eastern portion of the property and the area to the east (NTL-GW-02, NTL-GW-03, NTL-GW-04, NTL-GW-06, NTL-GW-08, and NTL-GW-09). To the extent that this second landfill is affecting groundwater quality beneath the NTL, it is much less than that which originated in the NTL itself.

# 6.0 SUMMARY AND CONCLUSIONS

This section reviews the results of this risk assessment and draws conclusions that will be useful in determining what types of development are appropriate given the environmental conditions. The conclusions are based on the quantitative risk results, but also on qualitative information, including information in the Uncertainty Analysis.

Three receptors were evaluated in this risk assessment of groundwater at the NTL. These are a municipal user of tap water, a site worker exposed via vapor intrusion, and a construction worker that comes in contact with groundwater during the course of site excavation. For the construction worker, potential exposure pathways are dermal contact with groundwater and incidental ingestion. The receptors were chosen based on potential commercial development of the property.

For a municipal user of tap water, groundwater concentrations were compared to MCLs and EPA residential RSLs. Several chemicals exceeded their MCLs/RSLs. 1,1-DCA, 1,4-dioxane, and N-nitrosodimethylamine exceeded these benchmarks by over two orders of magnitude. Using the groundwater as a source of tap water would be accompanied by significant risks.

However, the shallow groundwater is unlikely to be used for this purpose. The aquifer is tight, consisting of clay, silt, and fine sand, and would have a low yield. The nearest residence is over four miles distant, making even a private well unlikely. It is worth noting that the potential for a municipal well is unaffected by the type of development that occurs on the property.

For a site worker exposed to groundwater via vapor intrusion, the cancer risk was $2 \times 10^{-6}$ and the hazard index was 0.02. While the cancer risk exceeds $1 \times 10^{-6}$, no individual compound exceeds this benchmark.

The uncertainties associated with this evaluation make it likely that the actual cancer risk is less than $1 \times 10^{-6}$. The air exchange rate embedded in the vapor intrusion modeling of 0.25 $hr^{-1}$ is representative of homes in winter in a cold climate. The modeling also assumes a small house of approximately 1,100 square feet. Using air exchange rates that are more representative of average conditions and typical building sizes (especially for businesses) would bring the calculated risk to $1 \times 10^{-6}$ or lower. It should also be noted that the only area where groundwater concentrations are high enough to yield a calculated risk above $1 \times 10^{-6}$, even with the conservative embedded model assumptions, is in the vicinity of NTL-PZ-13.

For a construction worker exposed to groundwater via dermal contact and incidental ingestion, the calculated cancer risk was 4 x $10^{-6}$ and the hazard index was 0.5. As with the site worker, no individual chemical had a cancer risk in excess of 1 x $10^{-6}$.

The uncertainties associated with construction worker risks make it likely that the true cancer risk does not exceed the 1 x $10^{-6}$ benchmark. A key uncertainty is the exposure duration of 1 year. While a construction project is likely to last this long, the amount of time that an excavation is open to groundwater is much less. If groundwater is available for contact 2.5 months or less, the cancer risk will not exceed 1 x $10^{-6}$. A construction worker could have a longer exposure duration if they worked on several buildings in the area, performing the excavation or other tasks with exposed groundwater at each of these. However, in this instance another assumption would no longer be appropriate; namely, that a worker would typically come in contact with the maximum detected concentration of the various chemicals in groundwater. This is particularly salient given that several of the chemicals that contributed most to the cancer risk were detected in only two to five percent of the samples. While the worker might be exposed to groundwater with the maximum concentrations at one building, concentrations would be lower or non-detect at the next. Risks would be proportional to the average groundwater concentrations at all of the building locations.

In summary, calculated groundwater risks associated with the NTL for site and construction workers exceed the 1 x $10^{-6}$ cancer risk benchmark. However, no individual chemical has a risk above this benchmark, the cumulative risk exceeds the benchmark by only a small amount, and the conservativeness of the calculations make it probable that the true cumulative risk is below this benchmark. The groundwater is not appropriate for use of tap water, although the nature of the aquifer is such that such a use is unlikely.

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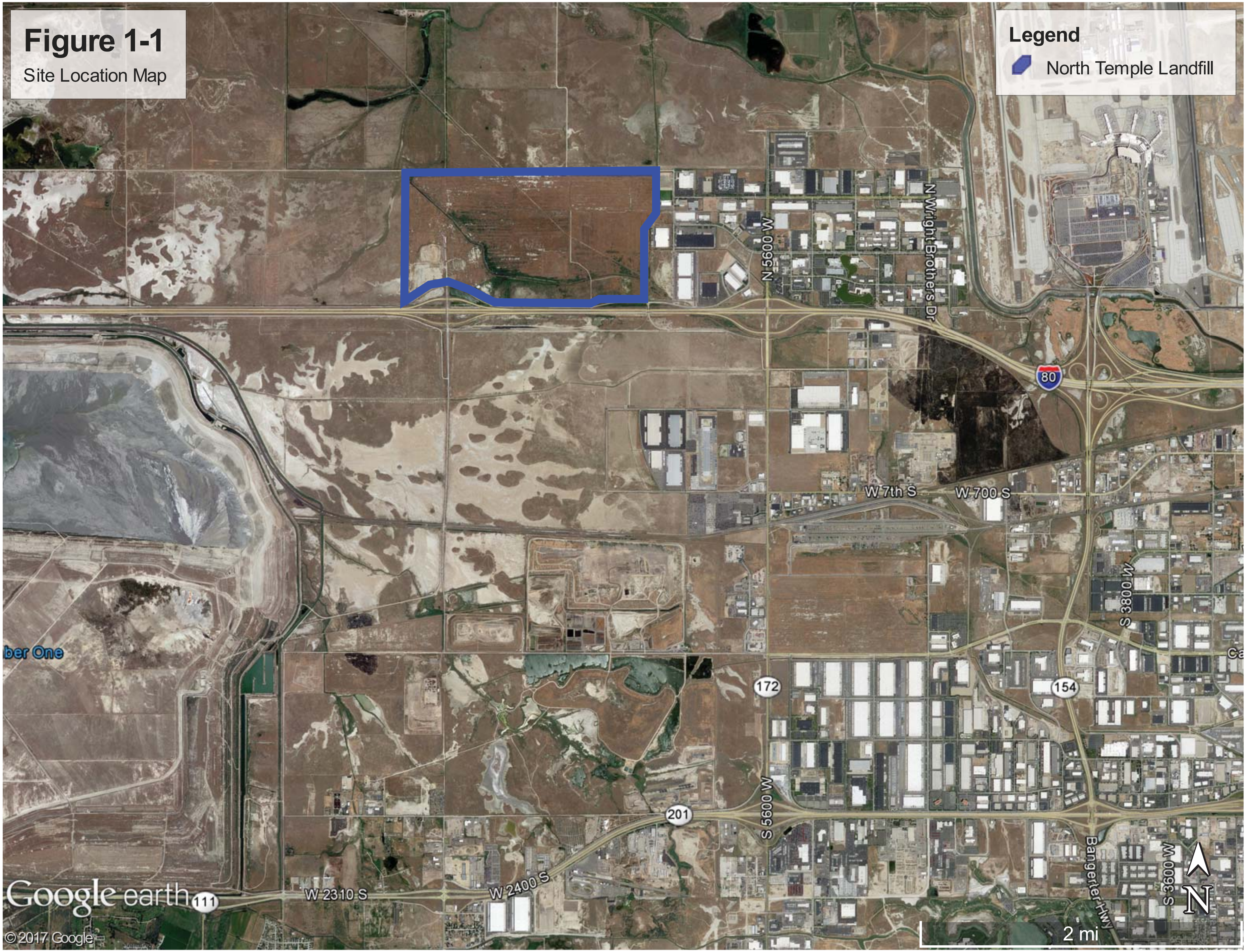
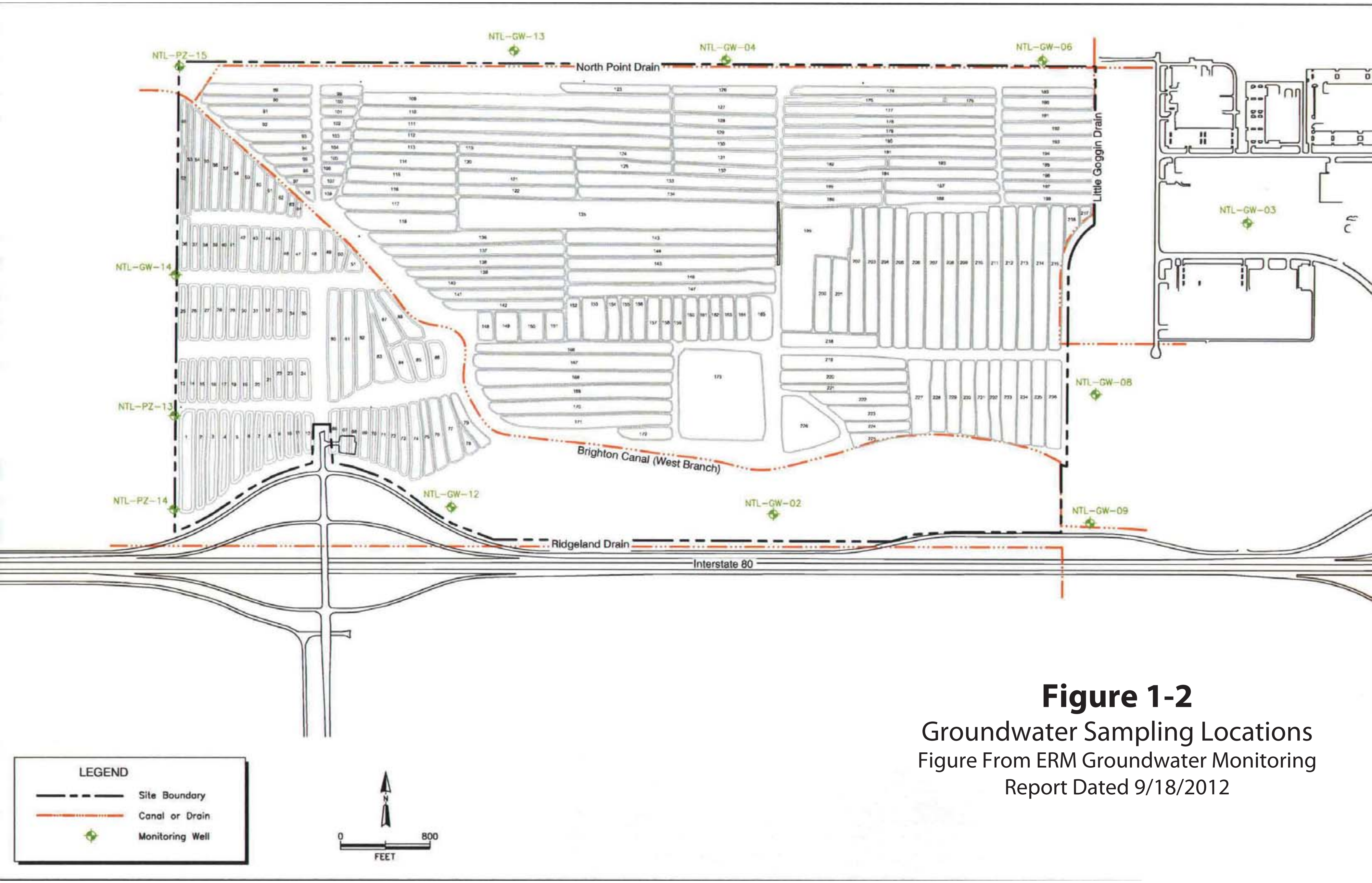
# FIGURES

**Figure 1-1**

Site Location Map

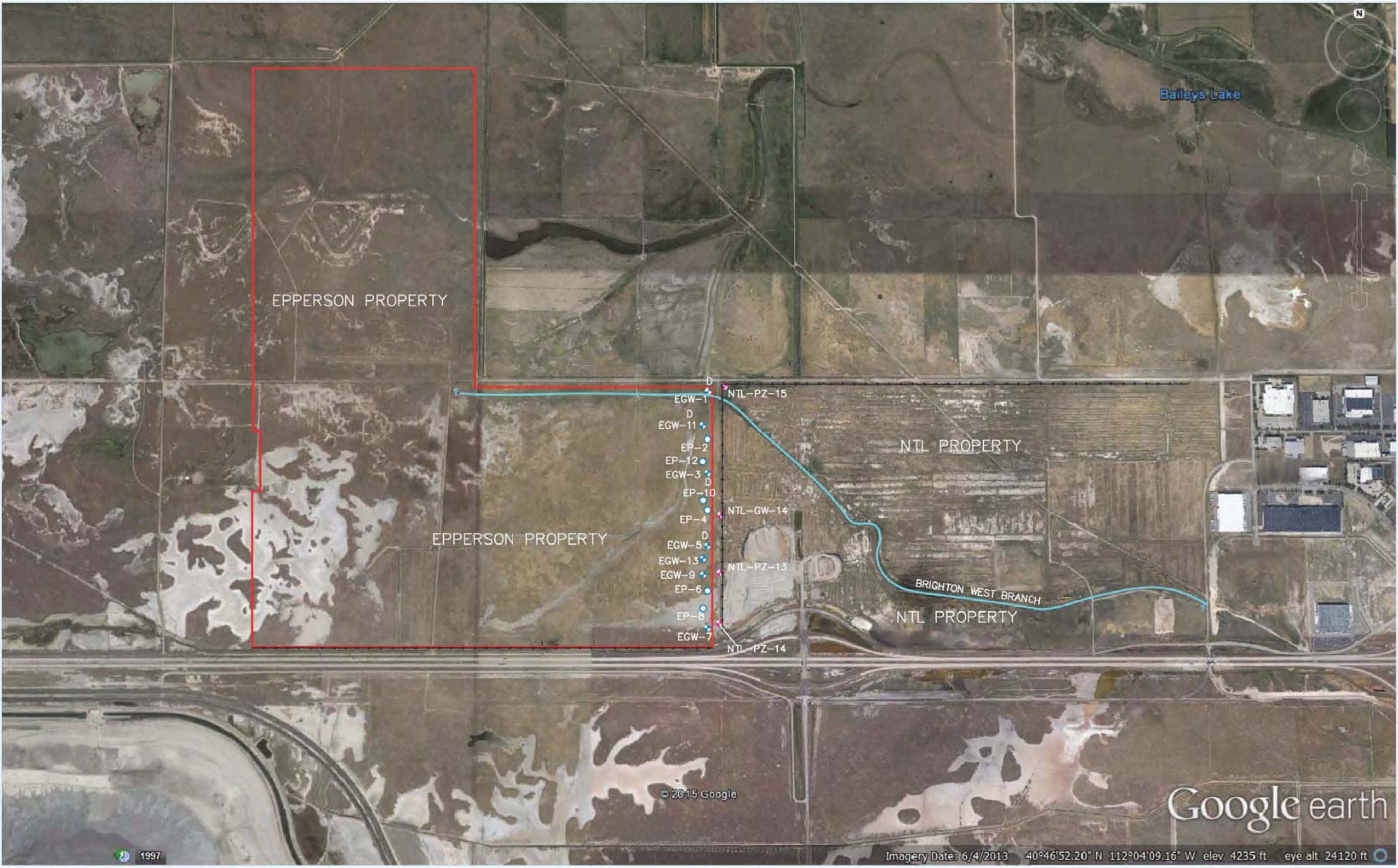




# Figure 1-2

Groundwater Sampling Locations

Figure From ERM Groundwater Monitoring
Report Dated 9/18/2012



LEGEND

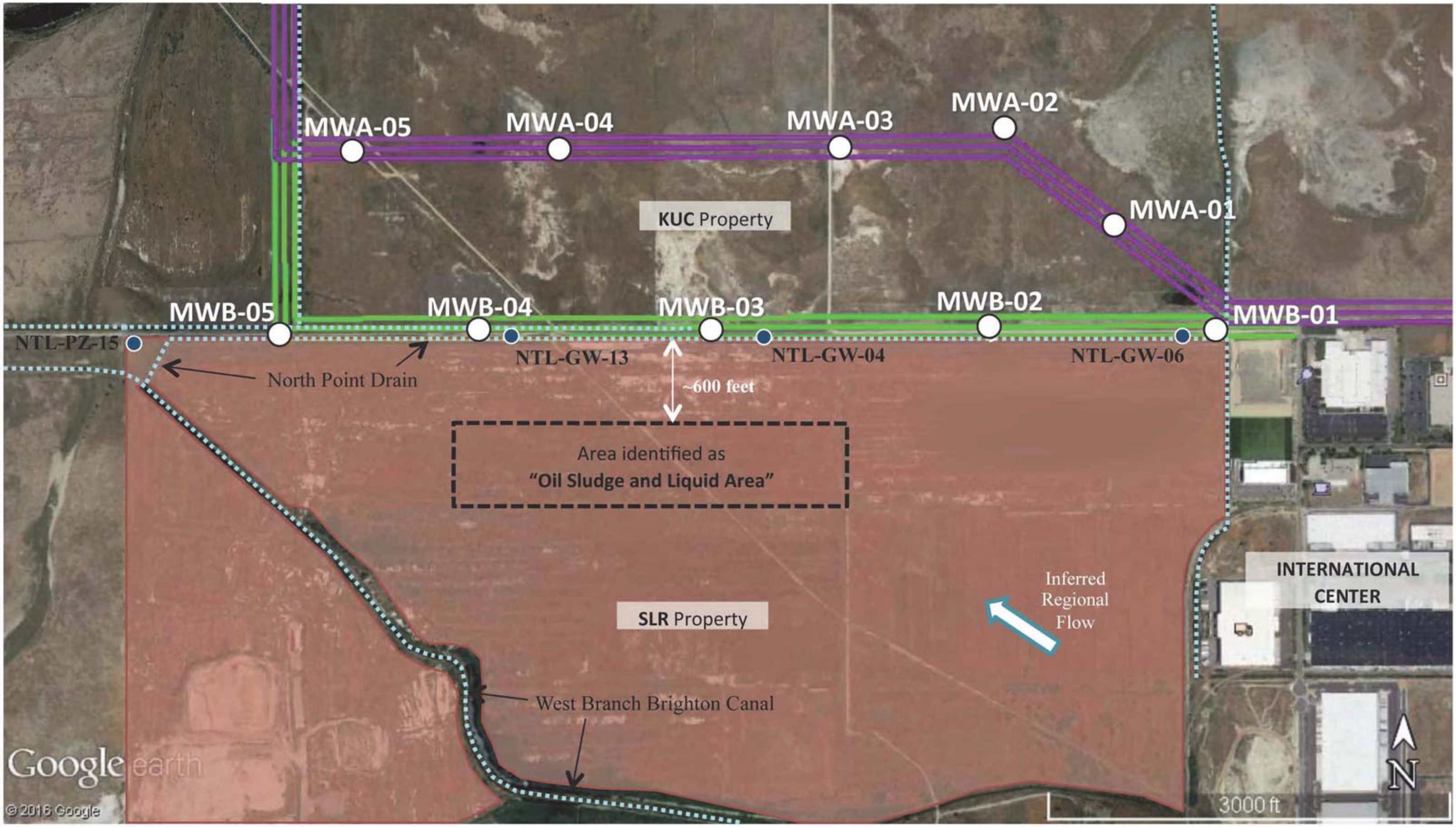
- EGW WELL LOCATION
- NTL-GW & NTL-PZ WELL LOCATION
- ○ PROBE (5) TEMPORARY WELL LOCATION
- D = DIOXIN SAMPLE LOCATION

**Figure 1-3**

CARDNO Groundwater Sampling Locations

Figure From Cardno Subsurface Investigation Report - Final

Dated 6/1/2016



*MARKINGS NOT TO SCALE. FOR GENERAL LOCATION PURPOSES ONLY.

**Key**

| | | | |
|---|---|---|---|
| 🟥 | NTL Boundary | ○ | RMEC GW Wells |
| ☰ | "A" Corridor ROW | ● | Previous GW Wells |
| ☰ | "B" Corridor ROW | ⇦ | GW Direction |
| ┈ | Ditches/Canals | | |

**Figure 1-4**
RMEC Groundwater Sampling Locations
Figure From RMEC Utility Corridor Testing Letter Dated 10/31/2016

# TABLES

## TABLE 2-1

## GROUNDWATER CONCENTRATIONS FROM 2016 CARDNO INVESTIGATION
(Page 1 of 4)

| Monitoring Location: | | EP-2 | EP-12 | EP-4 | EP-4 Dup | EP-4 | EP-4 Dup | EP-6 | EP-8 | EP-10 | EGW-1 | EGW-3 | EGW-5 | EGW-7 | EGW-9 | EGW-11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Chemical** | | | | | | | | | | | | | | | | |
| **Volatile Organic Compounds** | | | | | | | | | | | | | | | | |
| Acetone | (µg/l) | 4.41 | <10.0 | 10.3 | 3.73 | NA | NA | 2.73 | <10.0 | 3.49 | <10.0 | <10.0 | 5.28 | 7.58 | 4.39 | <10.0 |
| Benzene | (µg/l) | 1.34 | 6.64 | 8.35 | 8.42 | NA | NA | 3.76 | <2.00 | 1.88 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 |
| Carbon disulfide | (µg/l) | <2.00 | <2.00 | <2.00 | <2.00 | NA | NA | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 |
| Chlorobenzene | (µg/l) | 1.89 | 7.99 | 0.92 | <2.00 | NA | NA | <2.00 | <2.00 | 0.87 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 |
| Chloroethane | (µg/l) | <2.00 | <2.00 | <2.00 | 2.16 | NA | NA | 4.43 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 |
| Chloromethane | (µg/l) | 1.75 | 7.77 | <3.00 | 3.8 | NA | NA | 0.55 | <3.00 | 0.71 | 0.58 | 1.29 | 0.64 | 0.67 | 0.85 | 0.64 |
| Cyclohexane | (µg/l) | <2.00 | 1.48 | <2.00 | <2.00 | NA | NA | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 |
| 1,2-Dichlorobenzene | (µg/l) | 0.79 | 6.15 | 0.83 | 0.86 | NA | NA | 0.75 | <2.00 | 0.59 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 |
| 1,3-Dichlorobenzene | (µg/l) | <2.00 | 0.27 | <2.00 | <2.00 | NA | NA | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 |
| 1,4-Dichlorobenzene | (µg/l) | <10.0 | <10.0 | 4.11 | 5.8 | NA | NA | <10.0 | <10.0 | <10.0 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 |
| 1,1-Dichloroethane | (µg/l) | 30.6 | 27.3 | 0.91 | 3.13 | NA | NA | 6.32 | <2.00 | 7.48 | 1.18 | 5.82 | <2.00 | <2.00 | 1.82 | <2.00 |
| 1,2-Dichloroethane | (µg/l) | <2.00 | <2.00 | 0.37 | <2.00 | NA | NA | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 |
| 1,1-Dichloroethene | (µg/l) | <2.00 | 0.78 | <2.00 | <2.00 | NA | NA | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 |
| cis-1,2-Dichloroethene | (µg/l) | 1.66 | 13.1 | 0.33 | 0.34 | NA | NA | 0.47 | <2.00 | 0.55 | 2.73 | <2.00 | <2.00 | <2.00 | <2.00 | 0.43 |
| trans-1,2-Dichloroethene | (µg/l) | 0.6 | 0.86 | <2.00 | <2.00 | NA | NA | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 |
| 1,4-Dioxane | (µg/l) | 236 | 172 | 904 | 1080 | NA | NA | 1150 | 47.5 | 806 | <50.0 | 43.9 | 25 | 70.7 | 292 | <50.0 |
| Ethylbenzene | (µg/l) | <2.00 | <2.00 | 1.32 | 1.5 | NA | NA | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 |
| Ethyl ether | (µg/l) | 37.1 | 38 | 41.6 | 38.4 | NA | NA | 41.1 | <10.0 | 40 | <10.0 | 1.79 | 1.84 | <10.0 | 2.49 | <10.0 |
| Isopropylbenzene | (µg/l) | <2.00 | 1 | 1.65 | 1.96 | NA | NA | 0.85 | <2.00 | 2.12 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 |
| Methylcyclohexane | (µg/l) | <2.00 | 1.61 | <2.00 | <2.00 | NA | NA | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 |
| Methylene chloride | (µg/l) | <2.00 | <2.00 | <2.00 | <2.00 | NA | NA | 0.4 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 |
| Methyl tert-butyl ether | (µg/l) | <2.00 | 0.69 | <2.00 | <2.00 | NA | NA | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 |
| Tetrahydrofuran | (µg/l) | 17.4 | 30.9 | 149 | 126 | NA | NA | 320 | <2.00 | 116 | <2.00 | 6.97 | 13.3 | 16.2 | 19.7 | <2.00 |
| Toluene | (µg/l) | 0.2 | 0.43 | 0.27 | 0.26 | NA | NA | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 |
| 1,2,4-Trichlorobenzene | (µg/l) | 0.2 | <2.00 | <2.00 | <2.00 | NA | NA | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 |
| 1,1,1-Trichloroethane | (µg/l) | <2.00 | <2.00 | <2.00 | <2.00 | NA | NA | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 |
| Trichloroethene | (µg/l) | <2.00 | <2.00 | <2.00 | <2.00 | NA | NA | <2.00 | <2.00 | <2.00 | 1.14 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 |
| Vinyl chloride | (µg/l) | 2.35 | 7.98 | <1.00 | <1.00 | NA | NA | <1.00 | <1.00 | <1.00 | 2.04 | <1.00 | <1.00 | <1.00 | <1.00 | <1.00 |
| Xylenes, Total | (µg/l) | <2.00 | 0.95 | <2.00 | <2.00 | NA | NA | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 |
| **Semivolatile Organic Compounds** | | | | | | | | | | | | | | | | |
| Benzaldehyde | (µg/l) | <10.0 | <10.0 | 58.7 | <10.0 | NA | NA | <10.0 | <10.0 | <10.0 | <10.0 | <10.5 | <10.5 | <10.0 | <11.1 | <10.5 |
| Bis-(2-ethylhexyl)phthalate | (µg/l) | 3.21 | <10.0 | 6.76 | <10.0 | NA | NA | 5.74 | <10.0 | <10.0 | <10.0 | <10.5 | <10.5 | <10.0 | <11.1 | <10.5 |
| 4-Chloro-3-methylphenol | (µg/l) | <10.0 | <10.0 | 15.6 | <10.0 | NA | NA | <10.0 | <10.0 | 5.43 | <10.0 | <10.5 | <10.5 | <10.0 | <11.1 | <10.5 |
| Diphenylamine | (µg/l) | <10.0 | <10.0 | 4.98 | <10.0 | NA | NA | <10.0 | <10.0 | <10.0 | NA | NA | NA | NA | NA | NA |
| N-Nitrosodiphenylamine | (µg/l) | <10.0 | <10.0 | 4.74 | <10.0 | NA | NA | <10.0 | <10.0 | <10.0 | <10.0 | <10.5 | <10.5 | <10.0 | <11.1 | <10.5 |

# TABLE 2-1

## GROUNDWATER CONCENTRATIONS FROM 2016 CARDNO INVESTIGATION
## (Page 2 of 4)

| **Monitoring Location:** | | EGW-13 | EGW-13 Dup | NTL-PZ-13 | NTL-PZ-14 | NTL-GW-14 | NTL-PZ-15 |
|---|---|---|---|---|---|---|---|
| **Chemical** | | | | | | | |
| **Volatile Organic Compounds** | | | | | | | |
| Acetone | (µg/l) | <10.0 | <10.0 | 5.17 | 17.7 | 18.4 | <10.0 |
| Benzene | (µg/l) | <2.00 | <2.00 | 2.13 | 0.65 | 2.44 | <2.00 |
| Carbon disulfide | (µg/l) | <2.00 | <2.00 | 1.12 | <2.00 | <2.00 | <2.00 |
| Chlorobenzene | (µg/l) | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 |
| Chloroethane | (µg/l) | <2.00 | <2.00 | 30.2 | <2.00 | <2.00 | <2.00 |
| Chloromethane | (µg/l) | 0.65 | 0.57 | <3.00 | <3.00 | <3.00 | <3.00 |
| Cyclohexane | (µg/l) | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 |
| 1,2-Dichlorobenzene | (µg/l) | <2.00 | <2.00 | <2.00 | <2.00 | 0.27 | <2.00 |
| 1,3-Dichlorobenzene | (µg/l) | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 |
| 1,4-Dichlorobenzene | (µg/l) | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 |
| 1,1-Dichloroethane | (µg/l) | 0.32 | 0.37 | 1020 | 0.52 | <2.00 | 2.45 |
| 1,2-Dichloroethane | (µg/l) | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 |
| 1,1-Dichloroethene | (µg/l) | <2.00 | <2.00 | 9.1 | <2.00 | <2.00 | 0.48 |
| cis-1,2-Dichloroethene | (µg/l) | <2.00 | <2.00 | 43.7 | <2.00 | <2.00 | 1.93 |
| trans-1,2-Dichloroethene | (µg/l) | <2.00 | <2.00 | 2.39 | <2.00 | <2.00 | <2.00 |
| 1,4-Dioxane | (µg/l) | 114 | 134 | 2080 | 521 | 796 | <50.0 |
| Ethylbenzene | (µg/l) | <2.00 | <2.00 | 5.9 | <2.00 | <2.00 | <2.00 |
| Ethyl ether | (µg/l) | 5.8 | 6.41 | 15.5 | 5.56 | 17.9 | <10.0 |
| Isopropylbenzene | (µg/l) | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 |
| Methylcyclohexane | (µg/l) | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 |
| Methylene chloride | (µg/l) | <2.00 | <2.00 | 1.39 | <2.00 | <2.00 | <2.00 |
| Methyl tert-butyl ether | (µg/l) | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 |
| Tetrahydrofuran | (µg/l) | 11.3 | 13.1 | 60.5 | 108 | 96.2 | <2.00 |
| Toluene | (µg/l) | <2.00 | <2.00 | 4.67 | <2.00 | <2.00 | <2.00 |
| 1,2,4-Trichlorobenzene | (µg/l) | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 | <2.00 |
| 1,1,1-Trichloroethane | (µg/l) | <2.00 | <2.00 | 1.2 | <2.00 | <2.00 | <2.00 |
| Trichloroethene | (µg/l) | <2.00 | <2.00 | 1.19 | <2.00 | <2.00 | <2.00 |
| Vinyl chloride | (µg/l) | <1.00 | <1.00 | 91.8 | <1.00 | <1.00 | 2.76 |
| Xylenes, Total | (µg/l) | <2.00 | <2.00 | 16.6 | <2.00 | <2.00 | <2.00 |
| **Semivolatile Organic Compounds** | | | | | | | |
| Benzaldehyde | (µg/l) | <11.8 | <11.1 | <11.8 | <10.5 | <10.0 | <10.5 |
| Bis-(2-ethylhexyl)phthalate | (µg/l) | <11.8 | <11.1 | <11.8 | <10.5 | <10.0 | <10.5 |
| 4-Chloro-3-methylphenol | (µg/l) | <11.8 | <11.1 | <11.8 | <10.5 | <10.0 | <10.5 |
| Diphenylamine | (µg/l) | NA | NA | NA | NA | NA | NA |
| N-Nitrosodiphenylamine | (µg/l) | <11.8 | <11.1 | <11.8 | <10.5 | <10.0 | <10.5 |

## TABLE 2-1

## GROUNDWATER CONCENTRATIONS FROM 2016 CARDNO INVESTIGATION
(Page 3 of 4)

| Monitoring Location: | | EP-2 | EP-12 | EP-4 | EP-4 Dup | EP-4 | EP-4 Dup | EP-6 | EP-8 | EP-10 | EGW-1 | EGW-3 | EGW-5 | EGW-7 | EGW-9 | EGW-11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Pesticides** | | | | | | | | | | | | | | | | |
| beta-BHC | (µg/l) | <0.0200 | <0.0200 | <0.0200 | 0.361 | NA | NA | <0.0200 | <0.0200 | <0.0200 | <0.0200 | <0.0222 | <0.0200 | <0.0229 | <0.0211 | <0.0222 |
| alpha-Chlordane | (µg/l) | <0.0200 | <0.0200 | <0.0200 | <0.0200 | NA | NA | 0.0236 | <0.0200 | <0.0200 | <0.0200 | <0.0222 | <0.0200 | <0.0229 | <0.0211 | <0.0222 |
| gamma-Chlordane | (µg/l) | <0.0200 | <0.0200 | <0.0200 | <0.0200 | NA | NA | <0.0200 | <0.0200 | <0.0200 | <0.0200 | <0.0222 | <0.0200 | <0.0229 | <0.0211 | <0.0222 |
| 4,4´-DDD | (µg/l) | <0.0200 | <0.0200 | <0.0200 | <0.0200 | NA | NA | <0.0200 | <0.0200 | <0.0200 | <0.0200 | <0.0222 | <0.0200 | <0.0229 | <0.0211 | <0.0222 |
| 4,4´-DDE | (µg/l) | <0.0200 | <0.0200 | <0.0200 | <0.0200 | NA | NA | 0.021 | <0.0200 | <0.0200 | <0.0200 | <0.0222 | <0.0200 | <0.0229 | <0.0211 | <0.0222 |
| Methoxychlor | (µg/l) | <0.0200 | <0.0200 | <0.0200 | <0.0200 | NA | NA | <0.0200 | <0.0200 | 0.0505 | <0.0200 | <0.0222 | <0.0200 | <0.0229 | <0.0211 | <0.0222 |
| **Metals** | | | | | | | | | | | | | | | | |
| Arsenic | (µg/l) | 205 | 359 | 282 | 290 | 277 | 299 | 132 | 13 | 85.8 | 65.2 | 2 | 124 | 5.81 | 33 | 12.2 |
| Barium | (µg/l) | 157 | 225 | 2950 | 2970 | 2900 | 3000 | 162 | 37.3 | 204 | 43.3 | 385 | 363 | 371 | 81.9 | 58.1 |
| Chromium | (µg/l) | 1.19 | 1.43 | 4.53 | 4.4 | <10 | <10 | 4.55 | <10 | 3.37 | <2 | <2 | 2.56 | 1.02 | 1.63 | <2 |
| Lead | (µg/l) | <2 | 0.883 | 0.531 | 0.455 | <10 | <10 | 1.27 | <10 | 0.555 | <2 | <2 | 1.05 | <2 | 0.576 | <2 |
| Selenium | (µg/l) | 0.584 | 0.436 | 0.815 | <10 | <10 | 0.655 | 2.6 | 3.52 | 1.02 | <2 | 0.296 | 0.626 | 0.319 | 3.12 | 0.643 |
| Silver | (µg/l) | 0.114 | 0.0466 | <2 | <10 | <10 | 0.0551 | 0.11 | 2.04 | 0.1 | 0.0489 | 0.131 | 0.106 | <2 | 0.153 | 0.049 |
| Mercury | (µg/l) | 0.155 | 0.243 | 0.0617 | <0.15 | NA | NA | 0.085 | 0.0983 | 0.168 | <0.15 | <0.15 | 0.055 | <0.15 | 0.0117 | <0.15 |
| **Dioxins/Furans** | | | | | | | | | | | | | | | | |
| 1,2,3,7,8-PeCDF | pg/l | NA | NA | NA | NA | NA | NA | NA | NA | NA | <0.38 | <0.34 | <0.41 | NA | NA | 0.64 |
| Total PeCDF | pg/l | NA | NA | NA | NA | NA | NA | NA | NA | NA | <0.36 | <0.29 | <0.46 | NA | NA | 0.64 |
| 1,2,3,6,7,8-HxCDF | pg/l | NA | NA | NA | NA | NA | NA | NA | NA | NA | <0.35 | <0.43 | <0.31 | NA | NA | 0.43 |
| Total HxCDF | pg/l | NA | NA | NA | NA | NA | NA | NA | NA | NA | <0.33 | <0.42 | <0.33 | NA | NA | 0.43 |
| 1,2,3,4,6,7,8-HpCDD | pg/l | NA | NA | NA | NA | NA | NA | NA | NA | NA | <0.85 | 1.2 | 0.94 EMPC | NA | NA | 1.1 |
| Total HpCDD | pg/l | NA | NA | NA | NA | NA | NA | NA | NA | NA | <0.85 | 2.5 | 1.5 | NA | NA | 2.5 |
| OCDF | pg/l | NA | NA | NA | NA | NA | NA | NA | NA | NA | <0.96 | <1.6 | 12 | NA | NA | 1 |
| OCDD | pg/l | NA | NA | NA | NA | NA | NA | NA | NA | NA | 3.5 EMPC | 3.7 | 2.8 EMPC | NA | NA | 4.6 |

| | |
|---|---|
| EMPC | estimated maximum possible concentration (no definitive determination that the analyte is the compound detected) |
| HpCDD | heptachlorodibenzodioxin |
| HxCDF | hexachlorodibenzofuran |
| NA | not analyzed |
| OCDD | octafluorodibenzodioxin |
| OCDF | octafluorodibenozofuran |
| PeCDF | pentachlorodibenzofuran |

# TABLE 2-1

## GROUNDWATER CONCENTRATIONS FROM 2016 CARDNO INVESTIGATION
## (Page 4 of 4)

| | **Monitoring Location:** | EGW-13 | EGW-13 Dup | NTL-PZ-13 | NTL-PZ-14 | NTL-GW-14 | NTL-PZ-15 |
|---|---|---|---|---|---|---|---|
| **Pesticides** | | | | | | | |
| beta-BHC | (µg/l) | <0.0211 | <0.0222 | <0.0235 | <0.0222 | <0.0211 | <0.0211 |
| alpha-Chlordane | (µg/l) | <0.0211 | <0.0222 | <0.0235 | <0.0222 | <0.0211 | <0.0211 |
| gamma-Chlordane | (µg/l) | 0.00948 | 0.00859 | <0.0235 | <0.0222 | <0.0211 | <0.0211 |
| 4,4´-DDD | (µg/l) | <0.0211 | 0.0137 | <0.0235 | <0.0222 | <0.0211 | <0.0211 |
| 4,4´-DDE | (µg/l) | <0.0211 | <0.0222 | <0.0235 | <0.0222 | <0.0211 | <0.0211 |
| Methoxychlor | (µg/l) | <0.0211 | <0.0222 | <0.0235 | <0.0222 | <0.0211 | <0.0211 |
| **Metals** | | | | | | | |
| Arsenic | (µg/l) | 81.6 | 84 | 11 | 22.6 | 313 | 54 |
| Barium | (µg/l) | 279 | 296 | 157 | 213 | 3060 | 44.9 |
| Chromium | (µg/l) | 1.51 | 1.61 | <2 | 1.82 | 4.55 | <2 |
| Lead | (µg/l) | <2 | <2 | <2 | <2 | 6.98 | <2 |
| Selenium | (µg/l) | 5.88 | 5.81 | 0.36 | 0.398 | 0.976 | <2 |
| Silver | (µg/l) | 0.0802 | 0.0921 | 0.064 | <2 | <2 | <2 |
| Mercury | (µg/l) | 0.0133 | 0.0117 | <0.15 | <0.15 | 0.01 | <0.15 |
| **Dioxins/Furans** | | | | | | | |
| 1,2,3,7,8-PeCDF | pg/l | NA | NA | NA | NA | NA | NA |
| Total PeCDF | pg/l | NA | NA | NA | NA | NA | NA |
| 1,2,3,6,7,8-HxCDF | pg/l | NA | NA | NA | NA | NA | NA |
| Total HxCDF | pg/l | NA | NA | NA | NA | NA | NA |
| 1,2,3,4,6,7,8-HpCDD | pg/l | NA | NA | NA | NA | NA | NA |
| Total HpCDD | pg/l | NA | NA | NA | NA | NA | NA |
| OCDF | pg/l | NA | NA | NA | NA | NA | NA |
| OCDD | pg/l | NA | NA | NA | NA | NA | NA |

| | |
|---|---|
| EMPC | estimated maximum possible concentration (no definitive determination that the analyte is the compound detected) |
| HpCDD | heptachlorodibenzodioxin |
| HxCDF | hexachlorodibenzofuran |
| NA | not analyzed |
| OCDD | octafluorodibenzodioxin |
| OCDF | octafluorodibenozofuran |
| PeCDF | pentachlorodibenzofuran |

## TABLE 2-2

## GROUNDWATER CONCENTRATIONS FROM 2008-2012 CDM AND ERM INVESTIGATIONS
(Page 1 of 8)

| **Monitoring Well:** | **NTL-GW-02** | | | | | | **NTL-GW-03** | | | | | **NTL-GW-04** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date Sampled:** | **23-Oct-08** | **10-Aug-09** | **8/10/09 (DUP)** | **22-Oct-09** | **21-Jan-10** | **7-May-12** | **27-Oct-08** | **6-Aug-09** | **20-Oct-09** | **20-Jan-10** | **8-May-12** | **27-Oct-08** | **6-Aug-09** | **21-Oct-09** | **22-Jan-10** | **8-May-12** |
| **Chemical** | | | | | | | | | | | | | | | | |
| **Volatile Organic Compounds** | | | | | | | | | | | | | | | | |
| Acetone | <10 | <10 | NA | <10 | <10 | <1.9 | <10 | <10 | <10 | <10 | <1.9 | <10 | <10 | <10 | <10 | <1.9 |
| Benzene | <2 | <0.40 | ND | <0.40 | <0.21 | <0.30 | <2 | <0.40 | <0.40 | <0.21 | <0.30 | <2 | <0.40 | <0.40 | <0.21 | <0.30 |
| n-Butylbenzene | NA | <0.28 | ND | <0.28 | <0.24 | <0.30 | NA | <0.28 | <0.28 | <0.24 | <0.30 | NA | <0.28 | <0.28 | <0.24 | <0.30 |
| sec-Butylbenzene | NA | <0.25 | ND | <0.25 | <0.23 | <0.30 | NA | <0.25 | <0.25 | <0.23 | <0.30 | NA | <0.25 | <0.25 | <0.23 | <0.30 |
| tert-Butylbenzene | NA | <0.32 | NA | <0.32 | <0.24 | <0.30 | NA | <0.32 | <0.32 | <0.24 | <0.30 | NA | <0.32 | <0.32 | <0.24 | <0.30 |
| Carbon disulfide | <2 | <0.40 | ND | <0.40 | <0.40 | <0.30 | <2 | <0.40 | <0.40 | <0.40 | <0.30 | <2 | <0.40 | <0.40 | <0.40 | <0.30 |
| Chlorobenzene | <2 | <0.22 | ND | <0.22 | <0.20 | <0.30 | <2 | <0.22 | <0.22 | <0.20 | <0.30 | <2 | <0.22 | <0.22 | <0.20 | <0.30 |
| Chloroethane | <2 | <0.48 | ND | <0.48 | <0.51 | <0.30 | <2 | <0.48 | <0.48 | <0.51 | <0.30 | <2 | <0.48 | <0.48 | <0.51 | <0.30 |
| Chloroform | <2 | <0.28 | ND | <0.28 | <0.25 | <0.30 | <2 | <0.28 | <0.28 | <0.25 | <0.30 | <2 | <0.28 | <0.28 | <0.25 | <0.30 |
| Chloromethane | <3 | <0.61 | ND | <0.61 | <0.50 | <0.30 | <3 | <0.61 | <0.61 | <0.50 | <0.30 | <3 | <0.61 | <0.61 | <0.50 | **1.8** |
| Cyclohexane | NA | NA | NA | NA | NA | <0.30 | NA | NA | NA | NA | <0.30 | NA | NA | NA | NA | <0.30 |
| 1,2-Dichlorobenzene | <11 | <0.20 | ND | <0.20 | <0.26 | <0.30 | <11 | <0.20 | <0.20 | <0.26 | <0.30 | <11 | <0.20 | <0.20 | <0.26 | <0.30 |
| 1,3-Dichlorobenzene | <11 | <0.23 | ND | <0.23 | <0.29 | <0.30 | <11 | <0.23 | <0.23 | <0.29 | <0.30 | <11 | <0.23 | <0.23 | <0.29 | <0.30 |
| 1,4-Dichlorobenzene | <11 | <0.22 | ND | <0.22 | <0.22 | <0.30 | <11 | <0.22 | <0.22 | <0.22 | <0.30 | <11 | <0.22 | <0.22 | <0.22 | <0.30 |
| Dichlorodifluoromethane | <2 | <1.0 | ND | <1.0 | <0.67 | <0.30 | <2 | <1.0 | <1.0 | <0.67 | <0.30 | <2 | <1.0 | <1.0 | <0.67 | <0.30 |
| 1,1-Dichloroethane | NA | <0.24 | ND | <0.24 | <0.22 | <0.30 | <2 | <0.24 | <0.24 | <0.22 | <0.30 | <2 | <0.24 | <0.24 | <0.22 | <0.30 |
| 1,2-Dichloroethane | <2 | <0.34 | ND | <0.34 | <0.33 | <0.30 | <2 | <0.34 | <0.34 | <0.33 | <0.30 | <2 | <0.34 | <0.34 | <0.33 | <0.30 |
| 1,1-Dichloroethylene | <2 | <0.54 | ND | <0.54 | <0.29 | <0.30 | <2 | <0.54 | <0.54 | <0.29 | <0.30 | <2 | <0.54 | <0.54 | <0.29 | <0.30 |
| cis-1,2-Dichloroethylene | <2 | <0.20 | ND | <0.20 | <0.32 | <0.30 | <2 | <0.20 | <0.20 | <0.32 | <0.30 | <2 | <0.20 | <0.20 | <0.32 | <0.30 |
| trans-1,2-Dichloroethylene | <2 | <0.45 | ND | <0.45 | <0.34 | <0.30 | <2 | <0.45 | <0.45 | <0.34 | <0.30 | <2 | <0.45 | <0.45 | <0.34 | <0.30 |
| Ethylbenzene | <2 | <0.43 | ND | <0.43 | <0.20 | <0.30 | <2 | <0.43 | <0.43 | <0.20 | <0.30 | <2 | <0.43 | <0.43 | <0.20 | <0.30 |
| Ethyl ether | NA | NA | NA | NA | NA | <0.30 | NA | NA | NA | NA | <0.30 | NA | NA | NA | NA | <0.30 |
| Isopropylbenzene | <2 | <0.20 | ND | <0.20 | <0.20 | <0.30 | <2 | <0.20 | <0.20 | <0.20 | <0.30 | <2 | <0.20 | <0.20 | <0.20 | <0.30 |
| p-Isopropyltoluene | NA | <0.32 | ND | <0.32 | <0.21 | <0.30 | NA | <0.32 | <0.32 | <0.21 | <0.30 | NA | <0.32 | <0.32 | <0.21 | <0.30 |
| Methylene chloride | <2 | <1.0 | ND | <1.0 | <2.0 | <0.30 | <2 | <1.0 | <1.0 | <2.0 | <0.30 | <2 | <1.0 | <1.0 | <2.0 | <0.30 |
| Methyl tert butyl ether | <2 | <0.26 | ND | <0.26 | <0.25 | <0.30 | <2 | <0.26 | <0.26 | <0.25 | <0.30 | <2 | <0.26 | <0.26 | <0.25 | <0.30 |
| n-Propylbenzene | NA | <0.25 | ND | <0.25 | <0.20 | <0.30 | NA | <0.25 | <0.25 | <0.20 | <0.30 | NA | <0.25 | <0.25 | <0.20 | <0.30 |
| Tetrahydrofuran | NA | NA | NA | NA | NA | <1.7 | NA | NA | NA | NA | <1.7 | NA | NA | NA | NA | <1.7 |
| Toluene | <2 | <0.35 | ND | <0.35 | <0.20 | <0.30 | <2 | <0.35 | <0.35 | <0.20 | <0.30 | <2 | <0.35 | <0.35 | <0.20 | <0.30 |
| 1,1,1-Trichloroethane | <2 | <0.33 | ND | <0.33 | <0.22 | <0.30 | <2 | <0.33 | <0.33 | <0.22 | <0.30 | <2 | <0.33 | <0.33 | <0.22 | <0.30 |
| Trichloroethylene | <2 | <0.32 | ND | <0.32 | <0.24 | <0.30 | <2 | <0.32 | <0.32 | <0.24 | <0.30 | <2 | <0.32 | <0.32 | <0.24 | <0.30 |
| 1,2,4-Trimethylbenzene | NA | <0.22 | ND | <0.22 | <0.22 | <0.30 | NA | <0.22 | <0.22 | <0.22 | <0.30 | NA | <0.22 | <0.22 | <0.22 | <0.30 |
| Vinyl chloride | <1 | <0.30 | ND | <0.30 | <0.28 | <0.30 | <1 | <0.30 | <0.30 | <0.28 | <0.30 | <1 | <0.30 | <0.30 | <0.28 | <0.30 |
| m,p-Xylene | <2 | <0.78 | ND | <0.78 | <0.34 | <0.30 | <2 | <0.78 | <0.78 | <0.34 | <0.30 | <2 | <0.78 | <0.78 | <0.34 | <0.30 |
| o-Xylene | <2 | <0.37 | ND | <0.37 | <0.20 | <0.30 | <2 | <0.37 | <0.37 | <0.20 | <0.30 | <2 | <0.37 | <0.37 | <0.20 | <0.30 |
| Xylene Total | <2 | ND | ND | NA | NA | NA | <2 | ND | NA | NA | NA | <2 | ND | NA | NA | NA |
| **Semi-Volatile Organic Compounds** | | | | | | | | | | | | | | | | |
| Aniline | <11 | <0.97 | ND | <0.96 | <1.0 | NA | <11 | <0.95 | <0.95 | <0.97 | NA | <11 | <0.95 | <0.95 | <0.95 | NA |
| Benzoic Acid | <11 | <9.7 | ND | <9.6 | <10 | <8.0 | <11 | <9.5 | <9.5 | <9.7 | <7.4 | <11 | <9.5 | <9.5 | <9.5 | <7.4 |
| bis(2-Ethylhexyl)phthalate | <11 | <1.9 | ND | <1.9 | <2.0 | <1.6 | <11 | **6.2** | <1.9 | <1.9 | <1.5 | <11 | <1.9 | <1.9 | <1.9 | <1.5 |
| 3&4-Methylphenol* | <11 | <0.97 | ND | <0.96 | <1.6 | <1.6 | <11 | <0.95 | <0.95 | <1.6 | <1.5 | <11 | <0.95 | <0.95 | <1.5 | <1.5 |
| Naphthalene | <2 | <0.97 | ND | <0.96 | <1.0 | <0.30 | <2 | <0.95 | <0.95 | <0.97 | <0.30 | <2 | <0.95 | <0.95 | <0.95 | <0.30 |
| N-Nitrosodimethylamine | <11 | <1.7 | ND | <1.6 | <2.2 | <1.6 | <11 | <1.6 | <1.6 | <2.1 | <1.5 | <11 | <1.6 | <1.6 | <2.1 | <1.5 |
| N-Nitrosodiphenylamine | NA | <1.9 | NA | <1.9 | <1.0 | NA | NA | <1.9 | <1.9 | <0.97 | NA | NA | <1.9 | <1.9 | <0.95 | NA |
| Pentachlorophenol | NA | <9.7 | ND | <9.6 | <10 | NA | NA | <9.5 | <9.5 | <9.7 | NA | NA | <9.5 | <9.5 | <9.5 | NA |

# TABLE 2-2

## GROUNDWATER CONCENTRATIONS FROM 2008-2012 CDM AND ERM INVESTIGATIONS
## (Page 2 of 8)

| **Monitoring Well:** | **NTL-GW-02** | | | | | | **NTL-GW-03** | | | | | **NTL-GW-04** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date Sampled:** | **23-Oct-08** | **10-Aug-09** | **8/10/09 (DUP)** | **22-Oct-09** | **21-Jan-10** | **7-May-12** | **27-Oct-08** | **6-Aug-09** | **20-Oct-09** | **20-Jan-10** | **8-May-12** | **27-Oct-08** | **6-Aug-09** | **21-Oct-09** | **22-Jan-10** | **8-May-12** |
| **Chemical** | | | | | | | | | | | | | | | | |
| **Pesticides** | | | | | | | | | | | | | | | | |
| Aldrin | <0.020 | <0.0095 | NA | <0.0096 | <0.015 | <0.0061 | <0.021 | <0.0095 | <0.0096 | <0.015 | <0.0061 | <0.020 | <0.0096 | <0.0096 | <0.015 | <0.0061 |
| beta-BHC | <0.020 | <0.0095 | NA | <0.0096 | <0.0096 | <0.0071 | <0.021 | <0.0095 | <0.0096 | <0.0095 | <0.0071 | <0.020 | <0.0096 | <0.0096 | <0.0095 | <0.0071 |
| delta-BHC | <0.020 | <0.018 | NA | <0.018 | <0.0096 | <0.0063 | <0.021 | <0.018 | <0.018 | <0.0095 | <0.0063 | <0.020 | <0.018 | <0.018 | <0.0095 | <0.0063 |
| gamma-BHC (Lindane) | <0.020 | <0.0095 | NA | <0.0096 | <0.0096 | <0.0075 | <0.021 | <0.0095 | <0.0096 | <0.0095 | <0.0075 | <0.020 | <0.0096 | <0.0096 | <0.0095 | <0.0075 |
| alpha-Chlordane | <0.020 | <0.0095 | ND | <0.0096 | **0.013 J** | <0.0085 | <0.021 | <0.0095 | <0.0096 | <0.0095 | <0.0085 | <0.020 | <0.0096 | <0.0096 | <0.0095 | <0.0085 |
| gamma-Chlordane | <0.020 | <0.0095 | ND | <0.0096 | **0.022 J** | <0.0082 | <0.021 | <0.0095 | <0.0096 | <0.0095 | <0.0082 | <0.020 | <0.0096 | <0.0096 | <0.0095 | <0.0082 |
| 4,4'-DDD | <0.020 | <0.021 | NA | <0.021 | <0.019 | <0.0080 | <0.021 | <0.021 | <0.021 | <0.019 | <0.0080 | <0.020 | <0.021 | <0.021 | <0.019 | <0.0080 |
| 4,4'-DDE | <0.020 | <0.021 | NA | <0.021 | <0.019 | <0.0085 | <0.021 | <0.021 | <0.021 | <0.019 | <0.0085 | <0.020 | <0.021 | <0.021 | <0.019 | <0.0085 |
| 4,4'-DDT | <0.020 | <0.019 | NA | <0.019 | <0.019 | <0.0062 | <0.021 | <0.019 | <0.019 | <0.019 | <0.0062 | <0.020 | <0.019 | <0.019 | <0.019 | <0.0062 |
| Endosulfan-I | <0.020 | <0.0095 | ND | <0.0096 | <0.0096 | <0.018 | <0.021 | <0.0095 | <0.0096 | <0.0095 | <0.018 | <0.020 | <0.0096 | <0.0096 | <0.0095 | <0.018 |
| Endrin | <0.020 | <0.019 | NA | <0.019 | <0.019 | <0.0072 | <0.021 | <0.019 | <0.019 | <0.019 | <0.0072 | <0.020 | <0.019 | <0.019 | <0.019 | <0.0072 |
| Heptachlor | <0.020 | <0.0095 | NA | <0.0096 | <0.013 | <0.0081 | <0.021 | <0.0095 | <0.0096 | <0.013 | <0.0081 | <0.020 | <0.0096 | <0.0096 | <0.013 | <0.0081 |
| Heptachlor epoxide | <0.020 | <0.0095 | ND | <0.0096 | <0.0096 | <0.0076 | <0.021 | <0.0095 | <0.0096 | <0.0095 | <0.0076 | <0.020 | <0.0096 | <0.0096 | <0.0095 | <0.0076 |
| **Metals** | | | | | | | | | | | | | | | | |
| Arsenic | **3.6** | **3.6** | **8.7** | **5.1** | **2.9** | **3.66** | **65** | **57.4** | **58.2** | **53.8** | **58.2** | **5.9** | <10 | **5.7** | **5.2** | **5.32 J** |
| Barium | **29** | **40.5** | **41.3** | **36.5** | **39.5** | **36.6** | **120** | **109** | **104** | **104** | **97** | **50** | **44.8** | **49.2** | **43.6** | **46.5** |
| Cadmium | **0.21** | <2.0 | ND | <2.0 | <1.0 | <1.5 | **0.27** | <2.0 | <2.0 | <1.0 | <1.50 | <0.18 | <2.0 | <2.0 | <1.0 | <1.50 |
| Chromium | <10 | <10 | ND | <10 | <10 | <3.0 | <10 | <10 | <10 | <10 | <3.0 | **10** | <10 | <10 | <10 | <3.00 |
| Lead | <1.0 | <1.0 | ND | <1.0 | <1.0 | <3.0 | <1.0 | <1.0 | <1.0 | <1.0 | **3.20 J** | <1.0 | <1.0 | <1.0 | <1.0 | **3.26 J** |
| Selenium | <0.8 | <10 | ND | <10 | <2.0 | <6.0 | <0.8 | <10 | <10 | <2.0 | <6.0 | <0.8 | <50 | <10 | <5.0 | <6.00 |

All results in micrograms
per liter (µg/L)
Bold indicates a detection above
laboratory reporting limits

B analyte found in
associated blank
E value exceeds
calibration range
J estimated value
NA not analyzed
ND not detected
* May 2012 samples were
only analyzed for
4-methylphenol

## TABLE 2-2

## GROUNDWATER CONCENTRATIONS FROM 2008-2012 CDM AND ERM INVESTIGATIONS
(Page 3 of 8)

| **Monitoring Well:** | **NTL-GW-06** | | | | | **NTL-GW-08** | | | | | **NTL-GW-09** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date Sampled:** | **27-Oct-08** | **6-Aug-09** | **21-Oct-09** | **22-Jan-10** | **9-May-12** | **27-Oct-08** | **10-Aug-09** | **22-Oct-09** | **21-Jan-10** | **8-May-12** | **23-Oct-08** | **10-Aug-09** | **21-Oct-09** | **21-Jan-10** | **7-May-12** |
| **Chemical** | | | | | | | | | | | | | | | |
| **Volatile Organic Compounds** | | | | | | | | | | | | | | | |
| Acetone | <10 | <10 | <10 | <10 | <1.9 | <10 | <10 | <10 | <10 | <1.9 | <10 | <10 | <10 | <10 | **3.3 B** |
| Benzene | <2 | <0.40 | <0.40 | <0.21 | <0.30 | <2 | <0.40 | <0.40 | <0.21 | <0.30 | <2 | <0.40 | <0.40 | <0.21 | <0.30 |
| n-Butylbenzene | NA | <0.28 | <0.28 | <0.24 | <0.30 | NA | <0.28 | <0.28 | <0.24 | <0.30 | NA | <0.28 | <0.28 | <0.24 | <0.30 |
| sec-Butylbenzene | NA | <0.25 | <0.25 | <0.23 | <0.30 | NA | <0.25 | <0.25 | <0.23 | <0.30 | NA | <0.25 | <0.25 | <0.23 | <0.30 |
| tert-Butylbenzene | NA | <0.32 | <0.32 | <0.24 | <0.30 | NA | <0.32 | <0.32 | <0.24 | <0.30 | NA | <0.32 | <0.32 | <0.24 | <0.30 |
| Carbon disulfide | <2 | <0.40 | <0.40 | <0.40 | <0.30 | <2 | <0.40 | <0.40 | <0.40 | <0.30 | <2 | <0.40 | <0.40 | <0.40 | <0.30 |
| Chlorobenzene | <2 | <0.22 | <0.22 | <0.20 | <0.30 | <2 | <0.22 | <0.22 | <0.20 | <0.30 | <2 | <0.22 | <0.22 | <0.20 | <0.30 |
| Chloroethane | <2 | <0.48 | <0.48 | <0.51 | <0.30 | <2 | <0.48 | <0.48 | <0.51 | <0.30 | <2 | <0.48 | <0.48 | <0.51 | <0.30 |
| Chloroform | <2 | <0.28 | <0.28 | <0.25 | <0.30 | <2 | <0.28 | <0.28 | <0.25 | <0.30 | <2 | <0.28 | <0.28 | <0.25 | <0.30 |
| Chloromethane | <3 | <0.61 | <0.61 | <0.50 | <0.30 | <3 | <0.61 | <0.61 | <0.50 | <0.30 | <3 | <0.61 | <0.61 | <0.50 | <0.30 |
| Cyclohexane | NA | NA | NA | NA | <0.30 | NA | NA | NA | NA | <0.30 | NA | NA | NA | NA | <0.30 |
| 1,2-Dichlorobenzene | <10 | <0.20 | <0.20 | <0.26 | <0.30 | <11 | <0.20 | <0.20 | <0.26 | <0.30 | <11 | <0.20 | <0.20 | <0.26 | <0.30 |
| 1,3-Dichlorobenzene | <10 | <0.23 | <0.23 | <0.29 | <0.30 | <11 | <0.23 | <0.23 | <0.29 | <0.30 | <11 | <0.23 | <0.23 | <0.29 | <0.30 |
| 1,4-Dichlorobenzene | <10 | <0.22 | <0.22 | <0.22 | <0.30 | <11 | <0.22 | <0.22 | <0.22 | <0.30 | <11 | <0.22 | <0.22 | <0.22 | <0.30 |
| Dichlorodifluoromethane | <2 | **1.2 J** | <1.0 | <0.67 | **2.2** | <2 | <1.0 | <1.0 | <0.67 | <0.30 | <2 | <1.0 | <1.0 | <0.67 | <0.30 |
| 1,1-Dichloroethane | <2 | **1.1** | **1.1** | <0.22 | **0.32 J** | <2 | <0.24 | <0.24 | <0.22 | <0.30 | <2 | <0.24 | <0.24 | <0.22 | <0.30 |
| 1,2-Dichloroethane | <2 | <0.34 | <0.34 | <0.33 | <0.30 | <2 | <0.34 | <0.34 | <0.33 | <0.30 | <2 | <0.34 | <0.34 | <0.33 | <0.30 |
| 1,1-Dichloroethylene | <2 | <0.54 | <0.54 | <0.29 | <0.30 | <2 | <0.54 | <0.54 | <0.29 | <0.30 | <2 | <0.54 | <0.54 | <0.29 | <0.30 |
| cis-1,2-Dichloroethylene | <2 | <0.20 | <0.20 | <0.32 | <0.30 | <2 | <0.20 | <0.20 | <0.32 | <0.30 | <2 | <0.20 | <0.20 | <0.32 | <0.30 |
| trans-1,2-Dichloroethylene | <2 | <0.45 | <0.45 | <0.34 | <0.30 | <2 | <0.45 | <0.45 | <0.34 | <0.30 | <2 | <0.45 | <0.45 | <0.34 | <0.30 |
| Ethylbenzene | <2 | <0.43 | <0.43 | <0.20 | <0.30 | <2 | <0.43 | <0.43 | <0.20 | <0.30 | <2 | <0.43 | <0.43 | <0.20 | <0.30 |
| Ethyl ether | NA | NA | NA | NA | **2.4** | NA | NA | NA | NA | <0.30 | NA | NA | NA | NA | <0.30 |
| Isopropylbenzene | <2 | <0.20 | <0.20 | <0.20 | <0.30 | <2 | <0.20 | <0.20 | <0.20 | <0.30 | <2 | <0.20 | <0.20 | <0.20 | <0.30 |
| p-Isopropyltoluene | NA | <0.32 | <0.32 | <0.21 | <0.30 | NA | <0.32 | <0.32 | <0.21 | <0.30 | NA | <0.32 | <0.32 | <0.21 | <0.30 |
| Methylene chloride | <2 | <1.0 | <1.0 | <2.0 | <0.30 | <2 | **2.8 J** | <1.0 | <2.0 | <0.30 | <2 | **3.2 J** | <1.0 | <2.0 | **6.7 B** |
| Methyl tert butyl ether | <2 | <0.26 | <0.26 | <0.25 | <0.30 | <2 | <0.26 | <0.26 | <0.25 | <0.30 | <2 | <0.26 | <0.26 | <0.25 | <0.30 |
| n-Propylbenzene | NA | <0.25 | <0.25 | <0.20 | <0.30 | NA | <0.25 | <0.25 | <0.20 | <0.30 | NA | <0.25 | <0.25 | <0.20 | <0.30 |
| Tetrahydrofuran | NA | NA | NA | NA | **5.6** | NA | NA | NA | NA | <1.7 | NA | NA | NA | NA | <1.7 |
| Toluene | <2 | <0.35 | <0.35 | <0.20 | <0.30 | <2 | <0.35 | <0.35 | <0.20 | <0.30 | <2 | <0.35 | <0.35 | <0.20 | <0.30 |
| 1,1,1-Trichloroethane | <2 | <0.33 | <0.33 | <0.22 | <0.30 | <2 | <0.33 | <0.33 | <0.22 | <0.30 | <2 | <0.33 | <0.33 | <0.22 | <0.30 |
| Trichloroethylene | <2 | <0.32 | <0.32 | <0.24 | <0.30 | <2 | <0.32 | <0.32 | <0.24 | <0.30 | <2 | <0.32 | <0.32 | <0.24 | <0.30 |
| 1,2,4-Trimethylbenzene | NA | <0.22 | <0.22 | <0.22 | <0.30 | NA | <0.22 | <0.22 | <0.22 | <0.30 | NA | <0.22 | <0.22 | <0.22 | <0.30 |
| Vinyl chloride | <1 | **1.6** | **1.9** | <0.28 | **0.53 J** | <1 | <0.30 | <0.30 | <0.28 | <0.30 | <1 | <0.30 | <0.30 | <0.28 | <0.30 |
| m,p-Xylene | <2 | <0.78 | <0.78 | <0.34 | <0.30 | <2 | <0.78 | <0.78 | <0.34 | <0.30 | <2 | <0.78 | <0.78 | <0.34 | <0.30 |
| o-Xylene | <2 | <0.37 | <0.37 | <0.20 | <0.30 | <2 | <0.37 | <0.37 | <0.20 | <0.30 | <2 | <0.37 | <0.37 | <0.20 | <0.30 |
| Xylene Total | <2 | ND | NA | NA | NA | <2 | ND | NA | NA | NA | <2 | ND | NA | NA | NA |
| **Semi-Volatile Organic Compo** | | | | | | | | | | | | | | | |
| Aniline | <10 | <0.95 | <0.96 | <0.95 | NA | <11 | <0.96 | <0.96 | <0.98 | NA | <11 | <0.95 | <0.95 | <0.97 | NA |
| Benzoic Acid | <10 | <9.5 | <9.6 | <9.5 | <7.4 | <11 | <9.6 | <9.6 | <9.8 | <7.4 | <11 | <9.5 | <9.5 | <9.7 | <7.4 |
| bis(2-Ethylhexyl)phthalate | <10 | <1.9 | <1.9 | <1.9 | <1.5 | <11 | <1.9 | <1.9 | <2.0 | <1.5 | <11 | <1.9 | <1.9 | <1.9 | <1.5 |
| 3&4-Methylphenol* | <10 | <0.95 | <0.96 | <1.5 | <2.1 | <11 | <0.96 | <0.96 | <1.6 | <1.5 | <11 | <0.95 | <0.95 | <1.6 | <1.5 |
| Naphthalene | <2 | <0.95 | <0.96 | <0.95 | <0.30 | <2 | <0.96 | <0.96 | <0.98 | <0.30 | <2 | <0.95 | <0.95 | <0.97 | <0.30 |
| N-Nitrosodimethylamine | <10 | <1.6 | <1.6 | <2.1 | <1.5 | <11 | <1.6 | <1.6 | <2.2 | <1.5 | <11 | <1.6 | <1.6 | <2.1 | <1.5 |
| N-Nitrosodiphenylamine | NA | <1.9 | <1.9 | <0.95 | NA | NA | <1.9 | <1.9 | <0.98 | NA | NA | <1.9 | <1.9 | <0.97 | NA |
| Pentachlorophenol | <10 | <9.5 | <9.6 | <9.5 | NA | NA | <9.6 | <9.6 | <9.8 | NA | NA | <9.5 | <9.5 | <9.7 | NA |

## TABLE 2-2

## GROUNDWATER CONCENTRATIONS FROM 2008-2012 CDM AND ERM INVESTIGATIONS
(Page 4 of 8)

| **Monitoring Well:** | **NTL-GW-06** | | | | | **NTL-GW-08** | | | | | **NTL-GW-09** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date Sampled:** | **27-Oct-08** | **6-Aug-09** | **21-Oct-09** | **22-Jan-10** | **9-May-12** | **27-Oct-08** | **10-Aug-09** | **22-Oct-09** | **21-Jan-10** | **8-May-12** | **23-Oct-08** | **10-Aug-09** | **21-Oct-09** | **21-Jan-10** | **7-May-12** |
| **Chemical** | | | | | | | | | | | | | | | |
| **Pesticides** | | | | | | | | | | | | | | | |
| Aldrin | <0.021 | <0.0096 | <0.0096 | <0.015 | <0.0061 | <0.020 | <0.0096 | <0.0096 | <0.015 | <0.0061 | <0.022 | <0.0095 | <0.0095 | <0.015 | <0.0061 |
| beta-BHC | <0.021 | <0.0096 | <0.0096 | <0.0096 | <0.0071 | <0.020 | <0.0096 | <0.0096 | <0.0096 | <0.0071 | <0.022 | <0.0095 | <0.0095 | <0.0095 | <0.0071 |
| delta-BHC | <0.021 | <0.018 | <0.018 | <0.0096 | <0.0063 | <0.020 | <0.018 | <0.018 | <0.0096 | <0.0063 | <0.022 | <0.018 | <0.018 | <0.0095 | <0.0063 |
| gamma-BHC (Lindane) | <0.021 | <0.0096 | <0.0096 | <0.0096 | <0.0075 | <0.020 | <0.0096 | <0.0096 | <0.0096 | <0.0075 | <0.022 | <0.0095 | <0.0095 | <0.0095 | <0.0075 |
| alpha-Chlordane | <0.021 | <0.0096 | <0.0096 | <0.0096 | <0.0085 | <0.020 | <0.0096 | <0.0096 | <0.0096 | <0.0085 | <0.022 | <0.0095 | <0.0095 | <0.0095 | <0.0085 |
| gamma-Chlordane | <0.021 | <0.0096 | <0.0096 | <0.0096 | <0.0082 | <0.020 | <0.0096 | <0.0096 | <0.0096 | <0.0082 | <0.022 | <0.0095 | <0.0095 | <0.0095 | <0.0082 |
| 4,4'-DDD | <0.021 | <0.021 | <0.021 | <0.019 | <0.0080 | <0.020 | <0.021 | <0.021 | <0.019 | <0.0080 | <0.022 | <0.021 | <0.021 | <0.019 | <0.0080 |
| 4,4'-DDE | <0.021 | <0.021 | <0.021 | <0.019 | <0.0085 | <0.020 | <0.021 | <0.021 | <0.019 | <0.0085 | <0.022 | <0.021 | <0.021 | <0.019 | <0.0085 |
| 4,4'-DDT | <0.021 | <0.019 | <0.019 | <0.019 | <0.0062 | <0.020 | <0.019 | <0.019 | <0.019 | <0.0062 | <0.022 | <0.019 | <0.019 | <0.019 | <0.0062 |
| Endosulfan-I | <0.021 | <0.0096 | <0.0096 | <0.0096 | <0.018 | <0.020 | <0.0096 | <0.0096 | <0.0096 | <0.018 | <0.022 | <0.0095 | <0.0095 | <0.0095 | <0.018 |
| Endrin | <0.021 | <0.019 | <0.019 | <0.019 | <0.0072 | <0.020 | <0.019 | <0.019 | <0.019 | <0.0072 | <0.022 | <0.019 | <0.019 | <0.019 | <0.0072 |
| Heptachlor | <0.021 | <0.0096 | <0.0096 | <0.013 | <0.0081 | <0.020 | <0.0096 | <0.0096 | <0.013 | <0.0081 | <0.022 | <0.0095 | <0.0095 | <0.013 | <0.0081 |
| Heptachlor epoxide | <0.021 | <0.0096 | <0.0096 | <0.0096 | <0.0076 | <0.020 | <0.0096 | <0.0096 | <0.0096 | <0.0076 | <0.022 | <0.0095 | <0.0095 | <0.0095 | <0.0076 |
| **Metals** | | | | | | | | | | | | | | | |
| Arsenic | **32** | **20.2** | **25.9** | **23.3** | **34.5** | **4.2** | **9.1** | **8.7** | **8.3** | **3.69 J** | **5.2** | **3.9** | **3.5** | **2.6** | **5.05** |
| Barium | **470** | **1070** | **732** | **284** | **274** | **48** | **31.5** | **30.7** | **24.5** | **40.3** | **28** | **35.4** | **29.8** | **25.7** | **29.6** |
| Cadmium | <0.18 | <2.0 | <2.0 | <2.5 | <1.50 | **0.30** | <2.0 | <2.0 | <1.0 | <1.50 | <0.18 | <2.0 | <2.0 | <1.0 | <1.5 |
| Chromium | <10 | <10 | <10 | <10 | <3.0 | <10 | <10 | <10 | <10 | <3.00 | <10 | <10 | <10 | <10 | <3.0 |
| Lead | <1.0 | <1.0 | <1.0 | <1.0 | <3.0 | <1.0 | <1.0 | <1.0 | <1.0 | <3.00 | <1.0 | <1.0 | <1.0 | <1.0 | <3.0 |
| Selenium | <0.8 | <10 | <10 | <5.0 | <6.0 | **3** | <10 | <10 | <2.0 | <6.00 | <0.8 | <10 | <10 | <2.0 | <6.0 |

All results in micrograms
per liter (µg/L)

Bold indicates a detection above
laboratory reporting limits

B analyte found in associated blank
E value exceeds calibration range
J estimated value
NA not analyzed
ND not detected
* May 2012 samples were only analyzed for 4-methylphenol

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## TABLE 2-2

## GROUNDWATER CONCENTRATIONS FROM 2008-2012 CDM AND ERM INVESTIGATIONS
(Page 5 of 8)

| Monitoring Well: | NTL-GW-12 | | | | | NTL-GW-13 | | | | | NTL-GW-14 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date Sampled:** | **23-Oct-08** | **10-Aug-09** | **22-Oct-09** | **21-Jan-10** | **7-May-12** | **18-Nov-08** | **6-Aug-09** | **20-Oct-09** | **22-Jan-10** | **8-May-12** | **19-Nov-08** | **10-Aug-09** | **20-Oct-09** | **22-Jan-10** | **8-May-12** |
| **Chemical** | | | | | | | | | | | | | | | |
| **Volatile Organic Compounds** | | | | | | | | | | | | | | | |
| Acetone | <10 | <10 | <10 | <10 | **4.9 JB** | <10 | <10 | <10 | <10 | <1.9 | <10 | <10 | <10 | <10 | **6.2 B** |
| Benzene | <2 | <0.40 | <0.40 | <0.21 | <0.30 | <2 | <0.40 | <0.40 | <0.21 | <0.30 | **11** | **12.4** | **12.2** | **10.9** | **8.6** |
| n-Butylbenzene | NA | <0.28 | <0.28 | <0.24 | <0.30 | NA | <0.28 | <0.28 | <0.24 | <0.30 | NA | **0.38 J** | <0.28 | **0.37 J** | <0.30 |
| sec-Butylbenzene | NA | <0.25 | <0.25 | <0.23 | <0.30 | NA | <0.25 | <0.25 | <0.23 | <0.30 | NA | **0.26 J** | **0.32 J** | **0.24 J** | <0.30 |
| tert-Butylbenzene | NA | <0.32 | <0.32 | <0.24 | <0.30 | NA | <0.32 | <0.32 | <0.24 | <0.30 | NA | <0.32 | <0.32 | 0.24 J | <0.30 |
| Carbon disulfide | <2 | <0.40 | <0.40 | <0.40 | <0.30 | <2 | <0.40 | <0.40 | <0.40 | <0.30 | <2 | <0.40 | <0.40 | <0.40 | <0.30 |
| Chlorobenzene | <2 | <0.22 | <0.22 | <0.20 | <0.30 | <2 | <0.22 | <0.22 | <0.20 | <0.30 | <2 | **0.97 J** | **0.90 J** | **0.90 J** | **0.8 J** |
| Chloroethane | <2 | <0.48 | <0.48 | <0.51 | <0.30 | <2 | <0.48 | <0.48 | <0.51 | <0.30 | **5.2** | **4.6** | **4.7** | **5.5** | **7.5** |
| Chloroform | <2 | <0.28 | <0.28 | <0.25 | <0.30 | <2 | <0.28 | <0.28 | <0.25 | <0.30 | <2 | <0.28 | <0.28 | <0.25 | <0.30 |
| Chloromethane | <3 | <0.61 | <0.61 | <0.50 | <0.30 | <3 | <0.61 | <0.61 | <0.50 | <0.30 | <3 | <0.61 | <0.61 | <0.50 | <0.30 |
| Cyclohexane | NA | NA | NA | NA | <0.30 | NA | NA | NA | NA | <0.30 | NA | NA | NA | NA | **0.59 J** |
| 1,2-Dichlorobenzene | <11 | <0.20 | <0.20 | <0.26 | <0.30 | <10 | <0.20 | <0.20 | <0.26 | <0.30 | <10 | **0.72 J** | **0.75 J** | **0.59 J** | **0.68 J** |
| 1,3-Dichlorobenzene | <11 | <0.23 | <0.23 | <0.29 | <0.30 | <10 | <0.23 | <0.23 | <0.29 | <0.30 | <10 | **1.5** | **1.3** | **1.3** | **0.89 J** |
| 1,4-Dichlorobenzene | <11 | <0.22 | <0.22 | <0.22 | <0.30 | <10 | <0.22 | <0.22 | <0.22 | <0.30 | <11 | **6.5** | **6.2** | **5.7** | **2.9** |
| Dichlorodifluoromethane | <2 | <1.0 | <1.0 | <0.67 | <0.30 | <2 | <1.0 | <1.0 | <0.67 | <0.30 | <2 | <1.0 | <1.0 | <0.67 | **1.2** |
| 1,1-Dichloroethane | <2 | <0.24 | <0.24 | <0.22 | <0.30 | <2 | <0.24 | <0.24 | <0.22 | <0.30 | **3.9** | **3.5** | **3.4** | **3.7** | **1.8** |
| 1,2-Dichloroethane | <2 | <0.34 | <0.34 | <0.33 | <0.30 | <2 | <0.34 | <0.34 | <0.33 | <0.30 | <2 | **0.62 J** | <0.34 | <0.33 | <0.30 |
| 1,1-Dichloroethylene | <2 | <0.54 | <0.54 | <0.29 | <0.30 | <2 | <0.54 | <0.54 | <0.29 | <0.30 | <2 | <0.54 | <0.54 | <0.29 | <0.30 |
| cis-1,2-Dichloroethylene | <2 | <0.20 | <0.20 | <0.32 | <0.30 | <2 | <0.20 | <0.20 | <0.32 | <0.30 | <2 | **0.48 J** | **0.53 J** | **0.44 J** | **0.34 J** |
| trans-1,2-Dichloroethylene | <2 | <0.45 | <0.45 | <0.34 | <0.30 | <2 | <0.45 | <0.45 | <0.34 | <0.30 | <2 | <0.45 | <0.45 | **0.36 J** | <0.30 |
| Ethylbenzene | <2 | <0.43 | <0.43 | <0.20 | <0.30 | <2 | <0.43 | <0.43 | <0.20 | <0.30 | **2.6** | **4.1** | **4.1** | **2.6** | **3.1** |
| Ethyl ether | NA | NA | NA | NA | <0.30 | NA | NA | NA | NA | <0.30 | NA | NA | NA | NA | **46** |
| Isopropylbenzene | <2 | <0.20 | <0.20 | <0.20 | <0.30 | <2 | <0.20 | <0.20 | <0.20 | <0.30 | **2.3** | **2.1** | **2.6** | **1.9** | **1.9** |
| p-Isopropyltoluene | NA | <0.32 | <0.32 | <0.21 | <0.30 | NA | <0.32 | <0.32 | <0.21 | <0.30 | NA | <0.32 | <0.32 | <0.21 | <0.30 |
| Methylene chloride | <2 | <1.0 | <1.0 | <2.0 | **6 B** | <2 | <1.0 | <1.0 | <2.0 | **2.2 B** | <2 | **1.9 J** | <1.0 | <2.0 | <0.30 |
| Methyl tert butyl ether | <2 | <0.26 | <0.26 | <0.25 | <0.30 | <2 | <0.26 | <0.26 | <0.25 | <0.30 | <2 | **0.97 J** | **1.1** | **0.99 J** | **1.1** |
| n-Propylbenzene | NA | <0.25 | <0.25 | <0.20 | <0.30 | NA | <0.25 | <0.25 | <0.20 | <0.30 | NA | **1.7** | **1.7** | **1.5** | **1.5** |
| Tetrahydrofuran | NA | NA | NA | NA | <1.7 | NA | NA | NA | NA | <1.7 | NA | NA | NA | NA | **200** |
| Toluene | <2 | <0.35 | <0.35 | <0.20 | <0.30 | <2 | <0.35 | <0.35 | <0.20 | <0.30 | <2 | **0.44 J** | **0.43 J** | **0.24 J** | **0.79 J** |
| 1,1,1-Trichloroethane | <2 | <0.33 | <0.33 | <0.22 | <0.30 | <2 | <0.33 | <0.33 | <0.22 | <0.30 | <2 | <0.33 | <0.33 | <0.22 | <0.30 |
| Trichloroethylene | <2 | <0.32 | <0.32 | <0.24 | <0.30 | <2 | <0.32 | <0.32 | <0.24 | <0.30 | <2 | <0.32 | <0.32 | <0.24 | <0.30 |
| 1,2,4-Trimethylbenzene | NA | <0.22 | <0.22 | <0.22 | <0.30 | NA | <0.22 | <0.22 | <0.22 | <0.30 | NA | <0.22 | <0.22 | <0.22 | <0.30 |
| Vinyl chloride | <1 | <0.30 | <0.30 | <0.28 | <0.30 | <1 | <0.30 | <0.30 | <0.28 | <0.30 | **1.4** | **1.1** | **1.0** | **1.1** | **0.66 J** |
| m,p-Xylene | <2 | <0.78 | <0.78 | <0.34 | <0.30 | <2 | <0.78 | <0.78 | <0.34 | <0.30 | <2 | <0.78 | <0.78 | <0.34 | **0.98 J** |
| o-Xylene | <2 | <0.37 | <0.37 | <0.20 | <0.30 | <2 | <0.37 | <0.37 | <0.20 | <0.30 | <2 | <0.37 | <0.37 | <0.20 | **0.75 J** |
| Xylene Total | <2 | ND | NA | NA | NA | <2 | ND | NA | NA | NA | <2 | ND | NA | NA | NA |
| **Semi-Volatile Organic Compo** | | | | | | | | | | | | | | | |
| Aniline | <11 | <0.96 | <0.96 | <1.0 | NA | <10 | <0.95 | <0.96 | <0.96 | NA | <11 | **1.3 J** | <0.96 | <0.96 | NA |
| Benzoic Acid | <11 | <9.6 | <9.6 | <10 | <7.4 | <10 | <9.5 | <9.6 | **43.7** | <7.4 | <11 | <9.5 | <9.6 | <9.6 | <7.4 |
| bis(2-Ethylhexyl)phthalate | <11 | <1.9 | <1.9 | <2.0 | <1.5 | <10 | <1.9 | <1.9 | <1.9 | <1.5 | <11 | <1.9 | <1.9 | <1.9 | <1.5 |
| 3&4-Methylphenol* | <11 | <0.96 | <0.96 | <1.6 | <1.5 | <10 | <0.95 | <0.96 | <1.5 | <1.5 | <11 | <0.95 | <0.96 | <1.5 | <1.5 |
| Naphthalene | <2 | <0.96 | <0.96 | <1.0 | <0.30 | <2 | <0.95 | <0.96 | <0.96 | <0.30 | <2 | <0.95 | <0.96 | <0.96 | **0.56 J** |
| N-Nitrosodimethylamine | <11 | <1.6 | <1.6 | <2.2 | <1.5 | <10 | <1.6 | <1.6 | <2.1 | <1.5 | <11 | <1.6 | <1.6 | <2.1 | **9** |
| N-Nitrosodiphenylamine | NA | <1.9 | <1.9 | <1.0 | NA | NA | <1.9 | <1.9 | <0.96 | NA | NA | 12.8 | 12.6 | 8.9 | NA |
| Pentachlorophenol | NA | <9.6 | <9.6 | <10 | NA | <10 | <9.5 | <9.6 | <9.6 | NA | NA | <9.5 | <9.6 | <9.6 | NA |

## TABLE 2-2

## GROUNDWATER CONCENTRATIONS FROM 2008-2012 CDM AND ERM INVESTIGATIONS
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| **Monitoring Well:** | **NTL-GW-12** | | | | | **NTL-GW-13** | | | | | **NTL-GW-14** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date Sampled:** | **23-Oct-08** | **10-Aug-09** | **22-Oct-09** | **21-Jan-10** | **7-May-12** | **18-Nov-08** | **6-Aug-09** | **20-Oct-09** | **22-Jan-10** | **8-May-12** | **19-Nov-08** | **10-Aug-09** | **20-Oct-09** | **22-Jan-10** | **8-May-12** |
| **Chemical** | | | | | | | | | | | | | | | |
| **Pesticides** | | | | | | | | | | | | | | | |
| Aldrin | <0.021 | <0.0095 | <0.0095 | <0.015 | <0.0061 | <0.020 | <0.0096 | <0.0096 | <0.015 | <0.0061 | <0.020 | <0.0095 | <0.0095 | <0.015 | **0.055** |
| beta-BHC | <0.021 | <0.0095 | <0.0095 | <0.0096 | <0.0071 | <0.020 | <0.0096 | <0.0096 | <0.0095 | <0.0071 | <0.020 | <0.0095 | <0.0095 | <0.0095 | **0.2** |
| delta-BHC | <0.021 | <0.018 | <0.018 | <0.0096 | <0.0063 | <0.020 | <0.018 | <0.018 | <0.0095 | <0.0063 | <0.020 | <0.018 | <0.018 | <0.0095 | **0.032** |
| gamma-BHC (Lindane) | <0.021 | <0.0095 | <0.0095 | <0.0096 | <0.0075 | <0.020 | <0.0096 | <0.0096 | <0.0095 | <0.0075 | <0.020 | <0.0095 | <0.0095 | <0.0095 | **0.024** |
| alpha-Chlordane | <0.021 | <0.0095 | <0.0095 | <0.0096 | <0.0085 | <0.020 | <0.0096 | <0.0096 | <0.0095 | <0.0085 | <0.020 | <0.0095 | <0.0095 | <0.0095 | **0.02** |
| gamma-Chlordane | <0.021 | <0.0095 | <0.0095 | <0.0096 | <0.0082 | <0.020 | <0.0096 | <0.0096 | <0.0095 | <0.0082 | <0.020 | <0.0095 | <0.0095 | <0.0095 | <0.0082 |
| 4,4'-DDD | <0.021 | <0.021 | <0.021 | <0.019 | <0.0080 | <0.020 | <0.021 | <0.021 | <0.019 | <0.0080 | <0.020 | <0.021 | <0.021 | <0.019 | **0.010 J** |
| 4,4'-DDE | <0.021 | <0.021 | <0.021 | <0.019 | <0.0085 | <0.020 | <0.021 | <0.021 | <0.019 | <0.0085 | <0.020 | <0.021 | <0.021 | <0.019 | <0.0085 |
| 4,4'-DDT | <0.021 | <0.019 | <0.019 | <0.019 | <0.0062 | <0.020 | <0.019 | <0.019 | <0.019 | <0.0062 | <0.020 | <0.019 | <0.019 | <0.019 | **0.011 J** |
| Endosulfan-I | <0.021 | <0.0095 | <0.0095 | <0.0096 | <0.018 | <0.020 | <0.0096 | <0.0096 | <0.0095 | <0.018 | <0.020 | <0.0095 | **0.019 J** | **0.014 J** | <0.018 |
| Endrin | <0.021 | <0.019 | <0.019 | <0.019 | <0.0072 | <0.020 | <0.019 | <0.019 | <0.019 | <0.0072 | <0.020 | <0.019 | 0.019 J | <0.019 | <0.0072 |
| Heptachlor | <0.021 | <0.0095 | <0.0095 | <0.013 | <0.0081 | <0.020 | <0.0096 | <0.0096 | <0.013 | <0.0081 | <0.020 | <0.0095 | <0.0095 | <0.013 | <0.0081 |
| Heptachlor epoxide | <0.021 | <0.0095 | <0.0095 | <0.0096 | <0.0076 | <0.020 | <0.0096 | <0.0096 | <0.0095 | <0.0076 | **0.027** | <0.0095 | <0.0095 | <0.0095 | **0.04** |
| **Metals** | | | | | | | | | | | | | | | |
| Arsenic | **5.4** | **12.3** | **9.5** | **7.3** | **7.31 J** | **11** | **7.0** | **17.6** | **11.1** | **15.2** | **150** | **152** | **112** | **103** | **113** |
| Barium | **28** | **32.6** | **25.2** | **23.0** | **24.4** | **230** | **124** | **133** | **212** | **153** | **2500** | **2790** | **2820** | **2580** | **3,230** |
| Cadmium | <0.18 | <2.0 | <2.0 | <1.0 | <1.5 | **0.35** | <2.0 | <2.0 | <1.0 | <1.50 | <0.18 | <2.0 | <2.0 | <1.0 | <1.50 |
| Chromium | **12** | <20 | <20 | <20 | <3.0 | **13** | <10 | <10 | <10 | <3.0 | **14** | <10 | <10 | <10 | **7.78 J** |
| Lead | <1.0 | <1.0 | <1.0 | <1.0 | <3.0 | <0.40 | <1.0 | <1.0 | <1.0 | **3.67 J** | **1.2** | <1.0 | <1.0 | <1.0 | **8.52 J** |
| Selenium | **0.83** | **22.0** | **17.2** | <20 | <6.0 | <0.42 | <50 | <10 | <2.0 | <6.0 | **4.2** | **19.3** | **19.9** | <20 | <6.0 |

All results in micrograms
per liter (μg/L)

Bold indicates a detection above
laboratory reporting limits

| | |
|---|---|
| B | analyte found in associated blank |
| E | value exceeds calibration range |
| J | estimated value |
| NA | not analyzed |
| ND | not detected |
| * | May 2012 samples were only analyzed for 4-methylphenol |

# TABLE 2-2

## GROUNDWATER CONCENTRATIONS FROM 2008-2012 CDM AND ERM INVESTIGATIONS
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| **Monitoring Well:** | **NTL-PZ-13** | | | | | **NTL-PZ-14** | | | | | **NTL-PZ-15** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date Sampled:** | **20-Nov-08** | **10-Aug-09** | **20-Oct-09** | **22-Jan-10** | **7-May-12** | **19-Nov-08** | **10-Aug-09** | **20-Oct-09** | **21-Jan-10** | **7-May-12** | **20-Nov-08** | **10-Aug-09** | **20-Oct-09** | **22-Jan-10** | |
| **Chemical** | | | | | | | | | | | | | | | |
| **Volatile Organic Compounds** | | | | | | | | | | | | | | | |
| Acetone | <10 | <10 | <100 | <200 | **4.8 B** | <20 | 13.0 J | <10 | <10 | **9.4 B** | <10 | <10 | <10 | <10 | <1.9 |
| Benzene | <2 | **2.0** | <4.0 | <4.2 | **1.5** | <20 | **1.4** | **0.82 J** | **0.84 J** | <0.30 | <2 | **0.69 J** | **0.70 J** | **0.49 J** | **0.41** |
| n-Butylbenzene | NA | <0.28 | <2.8 | <4.8 | <0.30 | NA | <0.28 | <0.28 | <0.24 | <0.30 | NA | <0.28 | <0.28 | <0.24 | <0.30 |
| sec-Butylbenzene | NA | <0.25 | <2.5 | <4.6 | <0.30 | NA | <0.25 | <0.25 | <0.23 | <0.30 | NA | <0.25 | **0.36 J** | <0.23 | <0.30 |
| tert-Butylbenzene | NA | <0.32 | <3.2 | <4.8 | <0.30 | NA | <0.32 | <0.32 | <0.24 | <0.30 | NA | <0.32 | <0.32 | <0.24 | <0.30 |
| Carbon disulfide | <2 | **2.8** | <4.0 | <8.0 | <0.30 | <2 | <0.40 | <0.40 | <0.40 | <0.30 | <2 | <0.40 | <0.40 | <0.40 | <0.30 |
| Chlorobenzene | <2 | <0.22 | <2.2 | <4.0 | <0.30 | <20 | **0.22 J** | <0.22 | <0.20 | <0.30 | <2 | <0.22 | <0.22 | <0.20 | <0.30 |
| Chloroethane | **53** | **7.7** | **37.4** | **12.5 J** | **13** | <20 | **1.0 J** | <0.48 | <0.51 | <0.30 | **3.5** | <0.48 | <0.48 | <0.51 | <0.30 |
| Chloroform | <2 | <0.28 | <2.8 | **9.9 J** | <0.30 | <20 | <0.28 | <0.28 | <0.25 | <0.30 | <2 | <0.28 | <0.28 | <0.25 | <0.30 |
| Chloromethane | <3 | <0.61 | <6.1 | <10 | **3.0** | <3 | <0.61 | <0.61 | <0.50 | <0.30 | <3 | <0.61 | <0.61 | <0.50 | **4.0** |
| Cyclohexane | NA | NA | NA | NA | <0.60 | NA | NA | NA | NA | <0.30 | NA | NA | NA | NA | **0.74 J** |
| 1,2-Dichlorobenzene | <10 | <0.20 | <2.0 | <5.2 | <0.30 | <11 | <0.20 | <0.20 | <0.26 | <0.30 | <10 | <0.20 | **0.24 J** | <0.26 | <0.30 |
| 1,3-Dichlorobenzene | <10 | <0.23 | <2.3 | <5.8 | <0.30 | <11 | <0.23 | <0.23 | <0.29 | <0.30 | <10 | <0.23 | <0.23 | <0.29 | <0.30 |
| 1,4-Dichlorobenzene | <10 | **0.26 J** | <2.2 | <4.4 | <0.30 | <10 | **1.1** | **0.76 J** | **0.74 J** | <0.30 | <10 | <0.22 | <0.22 | <0.22 | <0.30 |
| Dichlorodifluoromethane | <2 | <1.0 | <10 | <13 | <0.30 | <20 | <1.0 | <1.0 | <0.67 | <0.30 | <2 | <1.0 | **69.3** | <0.67 | <0.30 |
| 1,1-Dichloroethane | **990** | **1070** | **877** | **689** | <0.30 | <20 | **20** | <0.24 | <0.22 | <0.30 | **130** | **9.3** | **8.7** | **8.9** | **3.6** |
| 1,2-Dichloroethane | <2 | <0.34 | <3.4 | <6.6 | <0.30 | <20 | <0.34 | <0.34 | <0.33 | <0.30 | <2 | <0.34 | <0.34 | <0.33 | <0.30 |
| 1,1-Dichloroethylene | **14** | **16.7** | **7.0 J** | **9.5 J** | **7.2** | <20 | <0.54 | <0.54 | <0.29 | <0.30 | <2 | **2.1** | **2.3** | **2.3** | **1.0** |
| cis-1,2-Dichloroethylene | **76** | **97** | **43.1** | **40.6** | **29** | <20 | **0.97 J** | <0.20 | <0.32 | <0.30 | **5.1** | **9.2** | **9.8** | **8.7** | **3.3** |
| trans-1,2-Dichloroethylene | <2 | **2.2** | <4.5 | <6.8 | **1.8** | <20 | <0.45 | <0.45 | <0.34 | <0.30 | <2 | <0.45 | <0.45 | <0.34 | <0.30 |
| Ethylbenzene | <2 | **7.2** | **5.0 J** | <4.0 | **5.0** | <20 | <0.43 | <0.43 | <0.20 | <0.30 | <2 | <0.43 | <0.43 | <0.20 | <0.30 |
| Ethyl ether | NA | NA | NA | NA | **12** | NA | NA | NA | NA | **3.2** | NA | NA | NA | NA | <0.30 |
| Isopropylbenzene | <2 | <0.20 | <2.0 | <4.0 | <0.30 | <20 | **0.55 J** | **0.65 J** | **0.31 J** | <0.30 | <2 | <0.20 | <0.20 | <0.20 | <0.30 |
| p-Isopropyltoluene | NA | <0.32 | <3.2 | 4.2 | <0.30 | NA | <0.32 | <0.32 | <0.21 | <0.30 | NA | <0.32 | <0.32 | <0.21 | <0.30 |
| Methylene chloride | **1200** | <1.0 | **1090 E** | **1700** | <0.30 | <20 | **7.9** | <1.0 | <2.0 | <0.30 | <2 | **1.9 J** | <1.0 | <2.0 | <0.30 |
| Methyl tert butyl ether | <2 | <0.26 | <2.6 | <5.0 | <0.30 | <20 | <0.26 | <0.26 | <0.25 | <0.30 | <2 | <0.26 | <0.26 | <0.25 | <0.30 |
| n-Propylbenzene | NA | <0.25 | <2.5 | <4.0 | <0.30 | NA | <0.25 | <0.25 | <0.20 | <0.30 | NA | <0.25 | <0.25 | <0.20 | <0.30 |
| Tetrahydrofuran | NA | NA | NA | NA | **49** | NA | NA | NA | NA | **100** | NA | NA | NA | NA | <1.7 |
| Toluene | **10** | **14.6** | **6.9 J** | **4.1 J** | **1.9 J** | <20 | **0.89 J** | <0.35 | <0.20 | <0.30 | <2 | <0.35 | <0.35 | <0.20 | <0.30 |
| 1,1,1-Trichloroethane | <2 | **0.39 J** | <3.3 | <4.4 | **1.3** | <20 | <0.33 | <0.33 | <0.22 | <0.30 | <2 | <0.33 | <0.33 | <0.22 | <0.30 |
| Trichloroethylene | <2 | **2.4** | <3.2 | <4.8 | **1.0** | <20 | <0.32 | <0.32 | <0.24 | <0.30 | <2 | **2.1** | **2.3** | **2.1** | **0.6** |
| 1,2,4-Trimethylbenzene | NA | **0.77 J** | <2.2 | <4.4 | **0.74 J** | NA | <0.22 | <0.22 | <0.22 | <0.30 | NA | <0.22 | <0.22 | <0.22 | <0.30 |
| Vinyl chloride | **43** | **56.1** | **19.2** | **40.2** | **59** | <10 | **0.30 J** | <0.30 | <0.28 | <0.30 | **5.9** | **11.7** | **10.3** | **13.3** | **3.1** |
| m,p-Xylene | <2 | **11.2** | <7.8 | <6.8 | **6.1** | <20 | <0.78 | <0.78 | <0.34 | <0.30 | <2 | <0.78 | <0.78 | <0.34 | <0.30 |
| o-Xylene | **5.7** | **11.6** | **7.6 J** | **4.2 J** | **9.5** | <20 | **0.49 J** | <0.37 | <0.20 | <0.30 | <2 | <0.37 | <0.37 | <0.20 | <0.30 |
| Xylene Total | **0.0057** | ND | NA | NA | NA | <20 | ND | NA | NA | NA | <2 | ND | NA | NA | NA |
| **Semi-Volatile Organic Compo** | | | | | | | | | | | | | | | |
| Aniline | <10 | <1.0 | <0.95 | <0.97 | NA | <10 | <0.97 | <0.96 | <0.98 | NA | <10 | <0.96 | <0.96 | <0.97 | NA |
| Benzoic Acid | <10 | <10 | <9.5 | <9.7 | <7.4 | <10 | <9.7 | <9.6 | <9.8 | <7.4 | <10 | <9.6 | <9.6 | <9.7 | <7.4 |
| bis(2-Ethylhexyl)phthalate | <10 | <2.0 | <1.9 | <1.9 | <1.5 | <10 | <1.9 | <1.9 | <2.0 | <1.5 | <10 | <1.9 | <1.9 | <1.9 | <1.5 |
| 3&4-Methylphenol* | <10 | **1.4 J** | **0.95 J** | <1.6 | <1.5 | <10 | <0.97 | <0.96 | <1.6 | <1.5 | <10 | <0.96 | <0.96 | <1.6 | <1.7 |
| Naphthalene | <2 | <1.0 | <0.95 | <0.97 | <0.30 | <20 | <0.97 | **0.96** | <0.98 | <0.30 | <2 | <0.96 | <0.96 | <0.97 | <0.30 |
| N-Nitrosodimethylamine | <10 | <1.7 | <1.6 | <2.1 | <1.5 | <10 | <1.7 | <1.6 | <2.2 | <1.5 | <10 | <1.6 | <1.6 | <2.1 | <1.5 |
| N-Nitrosodiphenylamine | NA | <2.0 | <1.9 | <0.97 | NA | NA | <1.9 | <1.9 | <0.98 | NA | NA | <1.9 | <1.9 | <0.97 | NA |
| Pentachlorophenol | <10 | <10 | <9.5 | 9.7 | NA | <10 | <9.7 | <9.6 | <9.8 | NA | <10 | <9.6 | <9.6 | <9.7 | NA |

## TABLE 2-2

## GROUNDWATER CONCENTRATIONS FROM 2008-2012 CDM AND ERM INVESTIGATIONS
(Page 8 of 8)

| **Monitoring Well:** | **NTL-PZ-13** | | | | | **NTL-PZ-14** | | | | | **NTL-PZ-15** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date Sampled:** | **20-Nov-08** | **10-Aug-09** | **20-Oct-09** | **22-Jan-10** | **7-May-12** | **19-Nov-08** | **10-Aug-09** | **20-Oct-09** | **21-Jan-10** | **7-May-12** | **20-Nov-08** | **10-Aug-09** | **20-Oct-09** | **22-Jan-10** | |
| **Chemical** | | | | | | | | | | | | | | | |
| **Pesticides** | | | | | | | | | | | | | | | |
| Aldrin | <0.020 | <0.010 | <0.0096 | <0.015 | <0.0061 | <0.020 | <0.0095 | <0.0096 | <0.015 | <0.0061 | <0.020 | <0.0096 | <0.0095 | <0.015 | <0.0061 |
| beta-BHC | <0.020 | <0.010 | <0.0096 | <0.0095 | **0.097** | <0.020 | <0.0095 | <0.0096 | <0.0096 | <0.0071 | <0.020 | <0.0096 | <0.0095 | <0.0095 | <0.0071 |
| delta-BHC | <0.020 | <0.019 | <0.018 | <0.0095 | **0.04** | <0.020 | <0.018 | <0.018 | <0.0096 | **0.021** | <0.020 | <0.018 | <0.018 | <0.0095 | <0.0063 |
| gamma-BHC (Lindane) | <0.020 | <0.010 | <0.0096 | <0.0095 | **0.2** | <0.020 | <0.0095 | <0.0096 | <0.0096 | <0.0075 | <0.020 | <0.0096 | <0.0095 | <0.0095 | <0.0075 |
| alpha-Chlordane | <0.020 | <0.010 | <0.0096 | <0.0095 | **0.038** | <0.020 | <0.0095 | <0.0096 | <0.0096 | <0.0085 | <0.020 | <0.0096 | <0.0095 | <0.0095 | <0.0085 |
| gamma-Chlordane | <0.020 | <0.010 | <0.0096 | <0.0095 | **0.039** | <0.020 | <0.0095 | <0.0096 | <0.0096 | <0.0082 | <0.020 | <0.0096 | <0.0095 | <0.0095 | <0.0082 |
| 4,4'-DDD | <0.020 | <0.022 | <0.021 | <0.019 | **0.036** | <0.020 | <0.021 | <0.021 | <0.019 | <0.0080 | <0.020 | <0.021 | <0.021 | <0.019 | <0.0080 |
| 4,4'-DDE | <0.020 | <0.022 | <0.021 | <0.019 | **0.037** | <0.020 | <0.021 | <0.021 | <0.019 | <0.0085 | <0.020 | <0.021 | <0.021 | <0.019 | <0.0085 |
| 4,4'-DDT | <0.020 | <0.020 | <0.019 | <0.019 | <0.0062 | <0.020 | <0.019 | <0.019 | <0.019 | <0.0062 | <0.020 | <0.019 | <0.019 | <0.019 | <0.0062 |
| Endosulfan-I | <0.020 | <0.010 | <0.0096 | <0.0095 | **0.11** | <0.020 | <0.0095 | <0.0096 | <0.0096 | <0.018 | <0.020 | <0.0096 | <0.0095 | <0.0095 | <0.018 |
| Endrin | <0.020 | <0.020 | <0.019 | <0.019 | **0.013 J** | <0.020 | <0.019 | <0.019 | <0.019 | <0.0072 | <0.020 | <0.019 | <0.019 | <0.019 | <0.0072 |
| Heptachlor | <0.020 | <0.010 | <0.0096 | <0.013 | **0.11** | <0.020 | <0.0095 | <0.0096 | <0.013 | <0.0081 | <0.020 | <0.0096 | <0.0095 | <0.013 | <0.0081 |
| Heptachlor epoxide | <0.020 | <0.010 | <0.0096 | <0.0095 | **0.07** | <0.020 | <0.0095 | <0.0096 | <0.0096 | <0.0076 | <0.020 | <0.0096 | <0.0095 | <0.0095 | <0.0076 |
| **Metals** | | | | | | | | | | | | | | | |
| Arsenic | **22** | **20.5** | **26.1** | **8.4** | **17.9** | **6** | **9.3** | **8.2** | **7.1** | **4.58 J** | **27** | **27.7** | **26.2** | **25.5** | **55.1** |
| Barium | **870** | **250** | **256** | **179** | **141** | **210** | **208** | **180** | **170** | **171** | **57** | **55.8** | **60.4** | **48.9** | **33** |
| Cadmium | **0.2** | <2.0 | <2.0 | <1.0 | <1.50 | <0.18 | <2.0 | <2.0 | <1.0 | <1.50 | <0.18 | <2.0 | <2.0 | <2.5 | <1.50 |
| Chromium | **14** | <10 | <10 | <10 | <3.00 | **0.025** | <10 | <10 | <10 | <3.0 | <10 | <10 | <10 | <10 | <3.0 |
| Lead | <0.4 | <1.0 | <1.0 | <1.0 | **4.63 J** | <0.4 | <1.0 | <1.0 | <1.0 | **4.50 J** | <0.4 | <1.0 | <1.0 | <1.0 | **3.33 J** |
| Selenium | **2.4** | <10 | <10 | <2.0 | <6.00 | **3.3** | **13.1** | **10.9** | **4.4** | <6.0 | <0.8 | <10 | <10 | <5.0 | <6.0 |

All results in micrograms per liter (µg/L)

Bold indicates a detection above laboratory reporting limits

| | |
|---|---|
| B | analyte found in associated blank |
| E | value exceeds calibration range |
| J | estimated value |
| NA | not analyzed |
| ND | not detected |
| * | May 2012 samples were only analyzed for 4-methylphenol |

# TABLE 2-3

# STATISTICS FOR CARDNO GROUNDWATER DATA
## (Page 1 of 2)

| Chemical | | Number of Detections | Number of Samples | Maximum Concentration |
|---|---|---|---|---|
| **Volatile Organic Compounds** | | | | |
| Acetone | (μg/l) | 11 | 19 | 18.4 |
| Benzene | (μg/l) | 9 | 19 | 8.42 |
| Carbon disulfide | (μg/l) | 1 | 19 | 1.12 |
| Chlorobenzene | (μg/l) | 4 | 19 | 7.99 |
| Chloroethane | (μg/l) | 3 | 19 | 30.2 |
| Chloromethane | (μg/l) | 13 | 19 | 7.77 |
| Cyclohexane | (μg/l) | 1 | 19 | 1.48 |
| 1,2-Dichlorobenzene | (μg/l) | 7 | 19 | 6.15 |
| 1,3-Dichlorobenzene | (μg/l) | 1 | 19 | 0.27 |
| 1,4-Dichlorobenzene | (μg/l) | 2 | 19 | 5.8 |
| 1,1-Dichloroethane | (μg/l) | 14 | 19 | 1020 |
| 1,2-Dichloroethane | (μg/l) | 1 | 19 | 0.37 |
| 1,1-Dichloroethene | (μg/l) | 3 | 19 | 9.1 |
| cis-1,2-Dichloroethene | (μg/l) | 10 | 19 | 43.7 |
| trans-1,2-Dichloroethene | (μg/l) | 3 | 19 | 2.39 |
| 1,4-Dioxane | (μg/l) | 16 | 19 | 2080 |
| Ethylbenzene | (μg/l) | 3 | 19 | 5.9 |
| Ethyl ether | (μg/l) | 14 | 19 | 41.6 |
| Isopropylbenzene | (μg/l) | 5 | 19 | 2.12 |
| Methylcyclohexane | (μg/l) | 1 | 19 | 1.61 |
| Methylene chloride | (μg/l) | 2 | 19 | 1.39 |
| Methyl tert-butyl ether | (μg/l) | 1 | 19 | 0.69 |
| Tetrahydrofuran | (μg/l) | 15 | 19 | 320 |
| Toluene | (μg/l) | 5 | 19 | 4.67 |
| 1,2,4-Trichlorobenzene | (μg/l) | 1 | 19 | 0.2 |
| 1,1,1-Trichloroethane | (μg/l) | 1 | 19 | 1.2 |
| Trichloroethene | (μg/l) | 2 | 19 | 1.19 |
| Vinyl chloride | (μg/l) | 5 | 19 | 91.8 |
| Xylenes, Total | (μg/l) | 2 | 19 | 16.6 |
| **Semivolatile Organic Compounds** | | | | |
| Benzaldehyde | (μg/l) | 1 | 19 | 58.7 |
| Bis-(2-ethylhexyl)phthalate | (μg/l) | 3 | 19 | 6.76 |
| 4-Chloro-3-methylphenol | (μg/l) | 2 | 19 | 15.6 |
| Diphenylamine | (μg/l) | 1 | 7 | 4.98 |
| N-Nitrosodiphenylamine | (μg/l) | 1 | 19 | 4.74 |

# TABLE 2-3

## STATISTICS FOR CARDNO GROUNDWATER DATA
## (Page 2 of 2)

| Chemical | | Number of Detections | Number of Samples | Maximum Concentration |
|---|---|---|---|---|
| **Pesticides** | | | | |
| beta-BHC | (μg/l) | 1 | 19 | 0.361 |
| alpha-Chlordane | (μg/l) | 1 | 19 | 0.0236 |
| gamma-Chlordane | (μg/l) | 2 | 19 | 0.00948 |
| 4,4´-DDD | (μg/l) | 1 | 19 | 0.0137 |
| 4,4´-DDE | (μg/l) | 1 | 19 | 0.021 |
| Methoxychlor | (μg/l) | 1 | 19 | 0.0505 |
| **Metals** | | | | |
| Arsenic | (μg/l) | 21 | 21 | 359 |
| Barium | (μg/l) | 21 | 21 | 3060 |
| Chromium | (μg/l) | 13 | 21 | 4.55 |
| Lead | (μg/l) | 8 | 21 | 6.98 |
| Selenium | (μg/l) | 17 | 21 | 5.88 |
| Silver | (μg/l) | 14 | 21 | 2.04 |
| Mercury | (μg/l) | 11 | 19 | 0.243 |
| **Dioxins/Furans** | | | | |
| 1,2,3,7,8-PeCDF | pg/l | 1 | 4 | 0.64 |
| 1,2,3,6,7,8-HxCDF | pg/l | 1 | 4 | 0.43 |
| 1,2,3,4,6,7,8-HpCDD | pg/l | 3 | 4 | 1.2 |
| OCDF | pg/l | 2 | 4 | 12 |
| OCDD | pg/l | 4 | 4 | 4.6 |

| | |
|---|---|
| HpCDD | heptachlorodibenzodioxin |
| HxCDF | hexachlorodibenzofuran |
| NA | not analyzed |
| OCDD | octafluorodibenzodioxin |
| OCDF | octafluorodibenozofuran |
| PeCDF | pentachlorodibenzofuran |

## TABLE 2-4

## STATISTICS FOR ERM GROUNDWATER DATA
(Page 1 of 2)

| Chemical | Number of Detections | Number of Samples | Maximum Detected Concentration (μg/l) |
|---|---|---|---|
| **Volatile Organic Compounds** | | | |
| Acetone | 6 | 62 | 13 |
| Benzene | 15 | 62 | 12.4 |
| n-Butylbenzene | 3 | 50 | 0.38 |
| sec-Butylbenzene | 4 | 50 | 0.36 |
| tert-Butylbenzene | 1 | 62 | 0.24 |
| Carbon disulfide | 1 | 62 | 2.8 |
| Chlorobenzene | 6 | 62 | 0.97 |
| Chloroethane | 13 | 62 | 53 |
| Chloroform | 1 | 62 | 9.9 |
| Chloromethane | 4 | 62 | 4.0 |
| Cyclohexane | 2 | 13 | 0.74 |
| 1,2-Dichlorobenzene | 6 | 62 | 0.75 |
| 1,3-Dichlorobenzene | 5 | 62 | 1.5 |
| 1,4-Dichlorobenzene | 9 | 62 | 6.5 |
| Dichlorodifluoromethane | 4 | 62 | 69.3 |
| 1,1-Dichloroethane | 19 | 62 | 1070 |
| 1,2-Dichloroethane | 1 | 62 | 0.62 |
| 1,1-Dichloroethylene | 9 | 62 | 16.7 |
| cis-1,2-Dichloroethylene | 16 | 62 | 97 |
| trans-1,2-Dichloroethylene | 3 | 62 | 2.2 |
| Ethylbenzene | 9 | 62 | 7.2 |
| Ethyl ether | 4 | 13 | 46 |
| Isopropylbenzene | 9 | 62 | 2.6 |
| p-Isopropyltoluene | 1 | 50 | 4.2 |
| Methylene chloride | 11 | 62 | 1700 |
| Methyl tert butyl ether | 5 | 62 | 1.1 |
| n-Propylbenzene | 5 | 50 | 1.7 |
| Tetrahydrofuran | 4 | 13 | 200 |
| Toluene | 11 | 62 | 14.6 |
| 1,1,1-Trichloroethane | 2 | 62 | 1.3 |
| Trichloroethylene | 6 | 62 | 2.4 |
| 1,2,4-Trimethylbenzene | 2 | 50 | 0.77 |
| Vinyl chloride | 20 | 62 | 59 |
| m,p-Xylene | 3 | 62 | 11.2 |
| o-Xylene | 7 | 62 | 11.6 |
| Xylene Total | 1 | 62 | 0.0057 |

# TABLE 2-4

## STATISTICS FOR ERM GROUNDWATER DATA
## (Page 2 of 2)

| Chemical | Number of Detections | Number of Samples | Maximum Detected Concentration (μg/l) |
|---|---|---|---|
| **Semi-Volatile Organic Compounds** | | | |
| Aniline | 2 | 50 | 1.3 |
| Benzoic Acid | 1 | 62 | 43.7 |
| bis(2-Ethylhexyl)phthalate | 1 | 62 | 6.2 |
| 3&4-Methylphenol | 2 | 62 | 1.4 |
| Naphthalene | 2 | 60 | 0.96 |
| N-Nitrosodimethylamine | 2 | 62 | 9 |
| N-Nitrosodiphenylamine | 3 | 50 | 12.8 |
| Pentachlorophenol | 1 | 55 | 9.7 |
| **Pesticides** | | | |
| Aldrin | 2 | 62 | 0.055 |
| beta-BHC | 2 | 62 | 0.2 |
| delta-BHC | 3 | 62 | 0.04 |
| gamma-BHC (Lindane) | 2 | 62 | 0.2 |
| alpha-Chlordane | 3 | 62 | 0.038 |
| gamma-Chlordane | 2 | 62 | 0.039 |
| 4,4'-DDD | 2 | 62 | 0.036 |
| 4,4'-DDE | 1 | 62 | 0.037 |
| 4,4'-DDT | 1 | 62 | 0.011 |
| Endosulfan-I | 3 | 62 | 0.11 |
| Endrin | 2 | 62 | 0.019 |
| Heptachlor | 1 | 62 | 0.11 |
| Heptachlor epoxide | 4 | 62 | 0.07 |
| **Metals** | | | |
| Arsenic | 61 | 62 | 152 |
| Barium | 62 | 62 | 3230 |
| Cadmium | 5 | 62 | 0.35 |
| Chromium | 7 | 62 | 14 |
| Lead | 8 | 62 | 8.52 |
| Selenium | 13 | 62 | 22 |

## TABLE 3-1
## Comparison of Groundwater Concentrations to Vapor Intrusion Screening Levels
## Groundwater Concentration to Indoor Air Concentration (GWC-IAC) Calculator Version 3.45, November 2015 RSLs

| Parameter | Symbol | Value | Instructions |
|---|---|---|---|
| Exposure Scenario | Scenario | Commercial | Select residential or commercial scenario from pull down list |
| Target Risk for Carcinogens | TCR | 1.00E-06 | Enter target risk for carcinogens (for comparison to the calculated VI carcinogenic risk in column F) |
| Target Hazard Quotient for Non-Carcinogens | THQ | 1 | Enter target hazard quotient for non-carcinogens (for comparison to the calculated VI hazard in column G) |
| Average Groundwater Temperature ($^oC$) | Tgw | 10 | Enter average of the stabilized groundwater temperature to correct Henry's Law Constant for groundwater target concentrations |

| CAS | Chemical Name | Site Groundwater Concentration Cgw (ug/L) | Calculated Indoor Air Concentration Cia (ug/m$^3$) | VI Carcinogenic Risk CR | VI Hazard HQ | Inhalation Unit Risk IUR (ug/m$^3$)$^{-1}$ | IUR Source* | Reference Concentration RfC (mg/m$^3$) | RFC Source* |
|---|---|---|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | 1.8E+01 | 1.34E-02 | No IUR | 9.9E-08 | | | 3.10E+01 | A |
| 309-00-2 | Aldrin | 5.5E-02 | 1.96E-05 | 7.8E-09 | No RfC | 4.90E-03 | I | | |
| 71-43-2 | Benzene | 8.4E+00 | 9.24E-01 | 5.9E-07 | 7.0E-03 | 7.80E-06 | I | 3.00E-02 | I |
| 75-15-0 | Carbon Disulfide | 1.1E+00 | 3.63E-01 | No IUR | 1.2E-04 | | | 7.00E-01 | I |
| 12789-03-6 | Chlordane | 3.3E-02 | 2.03E-05 | 1.7E-10 | 6.6E-06 | 1.00E-04 | I | 7.00E-04 | I |
| 108-90-7 | Chlorobenzene | 8.0E+00 | 4.23E-01 | No IUR | 1.9E-03 | | | 5.00E-02 | P |
| 67-66-3 | Chloroform | 5.0E-01 | 3.82E-02 | 7.2E-08 | 8.9E-05 | 2.30E-05 | I | 9.80E-02 | A |
| 74-87-3 | Chloromethane | 7.8E+00 | 1.83E+00 | No IUR | 4.6E-03 | | | 9.00E-02 | I |
| 98-82-8 | Cumene | 2.1E+00 | 3.22E-01 | No IUR | 1.8E-04 | | | 4.00E-01 | I |
| 110-82-7 | Cyclohexane | 1.5E+00 | 4.45E+00 | No IUR | 1.7E-04 | | | 6.00E+00 | I |
| 72-55-9 | DDE, p,p'- | 2.1E-02 | 6.10E-06 | 4.8E-11 | No RfC | 9.70E-05 | CA | | |
| 95-50-1 | Dichlorobenzene, 1,2- | 6.2E+00 | 1.70E-01 | No IUR | 1.9E-04 | | | 2.00E-01 | H |
| 106-46-7 | Dichlorobenzene, 1,4- | 5.8E+00 | 2.09E-01 | 1.9E-07 | 6.0E-05 | 1.10E-05 | CA | 8.00E-01 | I |
| 75-71-8 | Dichlorodifluoromethane | 6.9E+01 | 4.59E+02 | No IUR | **1.0E+00** | | | 1.00E-01 | X |
| 75-34-3 | Dichloroethane, 1,1- | 1.0E+03 | 1.20E+02 | **1.6E-05** | No RfC | 1.60E-06 | CA | | |
| 107-06-2 | Dichloroethane, 1,2- | 3.7E-01 | 8.33E-03 | 1.8E-08 | 2.7E-04 | 2.60E-05 | I | 7.00E-03 | P |
| 75-35-4 | Dichloroethylene, 1,1- | 9.1E+00 | 5.48E+00 | No IUR | 6.3E-03 | | | 2.00E-01 | I |
| 123-91-1 | Dioxane, 1,4- | 2.1E+03 | 1.68E-01 | 6.9E-08 | 1.3E-03 | 5.00E-06 | I | 3.00E-02 | I |
| 75-00-3 | Ethyl Chloride (Chloroethane) | 3.0E+01 | 8.08E+00 | No IUR | 1.8E-04 | | | 1.00E+01 | I |
| 100-41-4 | Ethylbenzene | 5.9E+00 | 7.66E-01 | 1.6E-07 | 1.7E-04 | 2.50E-06 | CA | 1.00E+00 | I |
| 76-44-8 | Heptachlor | 1.1E-01 | 2.89E-04 | 3.1E-08 | No RfC | 1.30E-03 | I | | |
| 1024-57-3 | Heptachlor Epoxide | 7.0E-02 | 9.10E-06 | 1.9E-09 | No RfC | 2.60E-03 | I | | |
| 1634-04-4 | Methyl tert-Butyl Ether (MTBE) | 6.9E-01 | 8.62E-03 | 1.8E-10 | 6.6E-07 | 2.60E-07 | CA | 3.00E+00 | I |
| 75-09-2 | Methylene Chloride | 1.4E+00 | 9.84E-02 | 8.0E-11 | 3.7E-05 | 1.00E-08 | I | 6.00E-01 | I |
| 91-20-3 | Naphthalene | 5.6E-01 | 3.17E-03 | 8.8E-09 | 2.4E-04 | 3.40E-05 | CA | 3.00E-03 | I |
| 62-75-9 | Nitrosodimethylamine, N- | 9.0E+00 | 6.70E-04 | 7.6E-07 | 3.8E-03 | 1.40E-02 | I | 4.00E-05 | X |
| 103-65-1 | Propyl benzene | 1.7E+00 | 2.64E-01 | No IUR | 6.0E-05 | | | 1.00E+00 | X |
| 1746-01-6 | TCDD, 2,3,7,8- | 7.9E-08 | 1.61E-10 | 5.0E-10 | 9.2E-07 | 3.80E+01 | CA | 4.00E-08 | CA |
| 109-99-9 | Tetrahydrofuran | 3.2E+02 | 4.63E-01 | No IUR | 5.3E-05 | | | 2.00E+00 | I |
| 108-88-3 | Toluene | 4.7E+00 | 5.59E-01 | No IUR | 2.6E-05 | | | 5.00E+00 | I |
| 120-82-1 | Trichlorobenzene, 1,2,4- | 2.0E-01 | 3.55E-03 | No IUR | 4.1E-04 | | | 2.00E-03 | P |
| 71-55-6 | Trichloroethane, 1,1,1- | 1.2E+00 | 4.17E-01 | No IUR | 1.9E-05 | | | 5.00E+00 | I |
| 79-01-6 | Trichloroethylene | 1.2E+00 | 2.23E-01 | 7.4E-08 | 2.5E-02 | see note | I | 2.00E-03 | I |
| 95-63-6 | Trimethylbenzene, 1,2,4- | 7.7E-01 | 6.81E-02 | No IUR | 2.6E-04 | | | 6.00E-02 | I |
| 75-01-4 | Vinyl Chloride | 9.2E+01 | 6.67E+01 | **2.4E-05** | 1.5E-01 | 4.40E-06 | I | 1.00E-01 | I |
| 108-38-3 | Xylene, m- | 1.1E+01 | 1.31E+00 | No IUR | 3.0E-03 | | | 1.00E-01 | S |
| 95-47-6 | Xylene, o- | 1.2E+01 | 9.80E-01 | No IUR | 2.2E-03 | | | 1.00E-01 | S |
| 1330-20-7 | Xylenes | 1.7E+01 | 1.80E+00 | No IUR | 4.1E-03 | | | 1.00E-01 | I |

**Notes:**

(1) **Inhalation Pathway Exposure Parameters (RME):**

| Exposure Scenario | Units | Residential Symbol | Residential Value | Commercial Symbol | Commercial Value | Selected (based Value |
|---|---|---|---|---|---|---|
| Averaging time for carcinogens | (yrs) | ATc_R_GW | 70 | ATc_C_GW | 70 | 70 |
| Averaging time for non-carcinogens | (yrs) | ATnc_R_GW | 26 | ATnc_C_GW | 25 | 25 |
| Exposure duration | (yrs) | ED_R_GW | 26 | ED_C_GW | 25 | 25 |
| Exposure frequency | (days/yr) | EF_R_GW | 350 | EF_C_GW | 250 | 250 |
| Exposure time | (hr/day) | ET_R_GW | 24 | ET_C_GW | 8 | 8 |

**TABLE 3-1**
**Comparison of Groundwater Concentrations to Vapor Intrusion Screening Levels**
**Groundwater Concentration to Indoor Air Concentration (GWC-IAC) Calculator Version 3.45, November 2015 RSLs**

| **Parameter** | **Symbol** | **Value** | **Instructions** |
|---|---|---|---|
| Exposure Scenario | Scenario | Commercial | Select residential or commercial scenario from pull down list |
| Target Risk for Carcinogens | TCR | 1.00E-06 | Enter target risk for carcinogens (for comparison to the calculated VI carcinogenic risk in column F) |
| Target Hazard Quotient for Non-Carcinogens | THQ | 1 | Enter target hazard quotient for non-carcinogens (for comparison to the calculated VI hazard in column G) |
| Average Groundwater Temperature ($^{o}$C) | Tgw | 10 | Enter average of the stabilized groundwater temperature to correct Henry's Law Constant for groundwater target concentrations |

| **CAS** | **Chemical Name** | **Site Groundwater Concentration** Cgw (ug/L) | **Calculated Indoor Air Concentration** Cia (ug/m$^3$) | **VI Carcinogenic Risk** CR | **VI Hazard** HQ | **Inhalation Unit Risk** IUR (ug/m$^3$)$^{-1}$ | **IUR Source*** | **Reference Concentration** RfC (mg/m$^3$) | **RFC Source*** |
|---|---|---|---|---|---|---|---|---|---|

(2) **Generic Attenuation Factors:**

| **Source Medium of Vapors** | | **Residential Symbol** | **Residential Value** | **Commercial Symbol** | **Commercial Value** | **Selected (based Value** |
|---|---|---|---|---|---|---|
| Groundwater | ( - ) | AFgw_R_GW | 0.001 | AFgw_C_GW | 0.001 | 0.001 |
| Sub-Slab and Exterior Soil Gas | ( - ) | AFss_R_GW | 0.03 | AFss_C_GW | 0.03 | 0.03 |

(3) **Formulas**

Cia, target = MIN( Cia,c; Cia,nc)
Cia,c (ug/m3) = TCR x ATc x (365 days/yr) x (24 hrs/day) / (ED x EF x ET x IUR)
Cia,nc (ug/m3) = THQ x ATnc x (365 days/yr) x (24 hrs/day) x RfC x (1000 ug/mg) / (ED x EF x ET)

**Notation:**

I = IRIS: EPA Integrated Risk Information System (IRIS). Available online at: http://www.epa.gov/iris/subst/index.html
P = PPRTV. EPA Provisional Peer Reviewed Toxicity Values (PPRTVs). Available online at: http://hhpprtv.ornl.gov/pprtv.shtml
A = Agency for Toxic Substances and Disease Registry (ATSDR) Minimum Risk Levels (MRLs). Available online at: http://www.atsdr.cdc.gov/mrls/index.html
CA = California Environmental Protection Agency/Office of Environmental Health Hazard Assessment assessments. Available online at: http://www.oehha.ca.gov/risk/ChemicalDB/index.asp
H = HEAST. EPA Superfund Health Effects Assessment Summary Tables (HEAST) database. Available online at: http://epa-heast.ornl.gov/heast.shtml
S = See RSL User Guide, Section 5
X = PPRTV Appendix

Yellow highlighting indicates site-specific parameters that may be edited by the user.

Blue highlighting indicates exposure factors that are based on Risk Assessment Guidance for Superfund (RAGS) or EPA vapor intrusion guidance, which generally should not be changed.

Pink highlighting indicates VI carcinogenic risk greater than the target risk for carcinogens (TCR) or VI Hazard greater than or equal to the target hazard quotient for non-carcinogens (THQ).

# TABLE 3-2

# EXPOSURE PARAMETERS

| Parameter | Units | Value | Rationale |
|---|---|---|---|
| *General* | | | |
| Exposure Frequency, Construction Workers | days/year | 250 | EPA, 2002 |
| Exposure Duration, Construction Workers | years | 1 | EPA, 2002 |
| Body Weight, Construction Workers | kg | 80 | EPA, 2014 |
| Averaging Time, Non-Carcinogenic, Construction Worke | days | 365 | Number of days over the duration of exposure |
| Averaging Time, Carcinogenic | days | 25550 | EPA, 2014 |
| Exposure Time, Construction Workers | hours | 1 | Site-specific value; see text |
| *Groundwater Ingestion* | | | |
| Groundwater Ingestion Rate, Construction Workers | liters/hour | 0.005 | Site-specific value; see text |
| *Groundwater Dermal* | | | |
| Skin Surface Area, Construction Workers | $cm^2$ | 3810 | EPA, 2004 for hands and feet |

# TABLE 3-3

## BLOOD-LEAD EXPOSURE PARAMETERS

| Parameter | Units | Value | Rationale |
|---|---|---|---|
| Blood-Lead Concentration With Exposure | µg/dl | NA | Calculated value |
| Baseline Blood-Lead Concentration | µg/dl | 1.0 | EPA, 2009 |
| Biokinetic Slope Factor | µg/dl per µg/l | 0.4 | EPA, 2003 |
| Groundwater Ingestion Rate | l/day | 0.005 | Site-specific value; see text |
| Absorption Factor from Groundwater | unitless | 0.2 | alue from EPA, 2003 using only the absorption factor for soluble lea |
| Exposure Frequency | days/year | 219 | EPA, 2003 |
| Averaging Time | days/year | 365 | Number of days over the duration of exposure |
| Geometric Standard Deviation | unitless | 1.8 | EPA, 2009 |
| Fetal-to-Maternal Blood-Lead Ratio | unitless | 0.9 | EPA, 2003 |

## TABLE 4-1

## TOXICITY VALUES
(Page 1 of 4)

| | Oral Reference Dose (mg/kg-day) | Source | Dermal Reference Dose (mg/kg-day) | Inhalation Reference Concentration (mg/m$^3$) | Source | Oral Slope Factor (mg/kg-day)$^{-1}$ | Source | Dermal Slope Factor (mg/kg-day)$^{-1}$ | Inhalation Unit Risk Factor (μg/m$^3$)$^{-1}$ | Source | Cancer Classification | Source | GI Absorption (fraction) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Volatile Organic Compounds** | | | | | | | | | | | | | |
| Acetone | 0.9 | I | 0.9 | 31 | M | NC | | NC | NC | | IN | H | 1 |
| Benzene | 0.004 | I | 0.004 | 0.03 | I | 0.055 | I | 0.055 | 0.0000078 | I | CaH | I | 1 |
| n-Butylbenzene | 0.05 | P | 0.05 | | M | NC | | NC | NC | | IN | P | 1 |
| sec-Butylbenzene | 0.1 | X | 0.1 | | M | NC | | NC | NC | | IN | P | 1 |
| tert-Butylbenzene | 0.1 | X | 0.1 | | M | NC | | NC | NC | | IN | P | 1 |
| Carbon disulfide | 0.1 | I | 0.1 | 0.7 | I | NC | | NC | NC | | NA | | 1 |
| Chlorobenzene | 0.02 | I | 0.02 | 0.05 | P | NC | | NC | NC | | D | I | 1 |
| Chloroethane | NA | | NA | 10 | I | NC | | NC | NC | | LI | P | 1 |
| Chloroform | 0.01 | I | 0.01 | 0.098 | M | 0.031 | Ca | 0.031 | 0.000023 | I | LI | I | 1 |
| Chloromethane | NA | | NA | 0.09 | I | NC | | NC | NC | | IN | I | 1 |
| Cyclohexane | NA | | NA | 6 | I | NC | | NC | NC | | IN | I | 1 |
| 1,2-Dichlorobenzene | 0.09 | I | 0.09 | 0.2 | H | NC | | NC | NC | | D | I | 1 |
| 1,3-Dichlorobenzene | NA | | NA | NA | | NC | | NC | NC | | D | I | 1 |
| 1,4-Dichlorobenzene | 0.07 | M | 0.07 | 0.8 | I | 0.0054 | Ca | 0.0054 | 0.000011 | Ca | NA | | 1 |
| 1,1-Dichloroethane | 0.2 | P | 0.2 | NA | | 0.0057 | Ca | 0.0057 | 0.0000016 | Ca | C | I | 1 |
| 1,2-Dichloroethane | 0.006 | P2 | 0.006 | 0.007 | P | 0.091 | I | 0.091 | 0.000026 | I | B2 | I | 1 |
| 1,1-Dichloroethene | 0.05 | I | 0.05 | 0.2 | I | | | | | | IN/S | I | 1 |
| cis-1,2-Dichloroethene | 0.002 | I | 0.002 | NA | | NC | | NC | NC | | IN | I | 1 |
| trans-1,2-Dichloroethene | 0.02 | I | 0.02 | NA | | NC | | NC | NC | | IN | I | 1 |
| Dichlorodifluoromethane | 0.2 | I | 0.2 | 0.1 | M | NC | | NC | NC | | IN | P | 1 |
| 1,4-Dioxane | 0.03 | I | 0.03 | 0.03 | I | 0.1 | I | 0.1 | 0.000005 | I | LI | I | 1 |
| Ethylbenzene | 0.1 | I | 0.1 | 1 | I | 0.011 | Ca | 0.011 | 0.0000025 | Ca | D | I | 1 |
| Ethyl ether | 0.2 | I | 0.2 | NA | | NC | | NC | NC | | IN | P | 1 |
| Isopropylbenzene | 0.1 | I | 0.1 | 0.4 | I | NC | | NC | NC | | IN | I | 1 |
| Isopropyltoluene | NA | | NA | NA | | NC | | NC | NC | | NA | | 1 |
| Methylcyclohexane | NA | | NA | NA | | NC | | NC | NC | | IN | P | 1 |
| Methylene chloride | 0.006 | I | 0.006 | 0.6 | I | 0.002 | I | 0.002 | 1E-08 | I | LI | I | 1 |
| MTBE | NA | | NA | 3 | I | 0.0018 | Ca | 0.0018 | 2.6E-07 | Ca | NA | | 1 |
| n-Propylbenzene | 0.1 | X | 0.1 | 1 | M | NC | | NC | NC | | IN | P | 1 |
| Tetrahydrofuran | 0.9 | I | 0.9 | 2 | I | NC | | NC | NC | | S | I | 1 |

## TABLE 4-1

## TOXICITY VALUES
(Page 2 of 4)

| | Oral Reference Dose (mg/kg-day) | Source | Dermal Reference Dose (mg/kg-day) | Inhalation Reference Concentration ($mg/m^3$) | Source | Oral Slope Factor $(mg/kg\text{-}day)^{-1}$ | Source | Dermal Slope Factor $(mg/kg\text{-}day)^{-1}$ | Inhalation Unit Risk Factor $(\mu g/m^3)^{-1}$ | Source | Cancer Classification | Source | GI Absorption (fraction) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Toluene | 0.08 | I | 0.08 | 5 | I | NC | | NC | NC | | IN | I | 1 |
| 1,2,4-Trichlorobenzene | 0.01 | I | 0.01 | 0.002 | P | 0.029 | P | 0.029 | NA | | LI | P | 1 |
| 1,1,1-Trichloroethane | 2 | I | 2 | 5 | I | NC | | NC | NC | | IN | I | 1 |
| Trichloroethene | 0.0005 | I | 0.0005 | 0.002 | I | 0.046 | I | 0.046 | 0.0000041 | I | CaH | I | 1 |
| 1,2,4-Trimethylbenzene | 0.01 | I | 0.01 | 0.06 | I | NC | | NC | NC | | IN | I | 1 |
| Vinyl chloride | 0.003 | I | 0.003 | 0.1 | I | 0.72 | I | 0.72 | 0.0000044 | I | CaH | I | 1 |
| m,p-Xylene | 0.2 | X3 | 0.2 | 0.1 | M | NC | | NC | NC | | IN | I | 1 |
| o-Xylene | 0.2 | X3 | 0.2 | 0.1 | M | NC | | NC | NC | | IN | I | 1 |
| Xylenes, Total | 0.2 | I | 0.2 | 0.1 | I | NC | | NC | NC | | IN | I | 1 |
| **Semi-Volatile Organic Compounds** | | | | | | | | | | | | | |
| Aniline | 0.007 | P | 0.007 | 0.001 | M | 0.0057 | I | 0.0057 | 0.0000016 | Ca | B2 | I | 1 |
| Benzaldehyde | 0.1 | I | 0.1 | NA | | 0.004 | P | 0.004 | NA | | S/NI | P | 1 |
| Benzoic Acid | 4 | I | 4 | | M | NC | | NC | NC | | D | I | 1 |
| Bis-(2-ethylhexyl)phthalate | 0.02 | I | 0.02 | NA | | 0.014 | I | 0.014 | 0.0000024 | Ca | B2 | I | 1 |
| 4-Chloro-3-methylphenol | 0.1 | M | 0.1 | NA | | NC | | NC | NC | | NA | | 1 |
| Diphenylamine | 0.1 | O | 0.1 | NA | | NC | | NC | NC | | NA | | 1 |
| 3- and 4-Methylphenol | 0.05 | I | 0.05 | 0.6 | M | NC | | NC | NC | | C | I | 1 |
| Naphthalene | 0.02 | I | 0.02 | 0.003 | M | NC | | NC | 0.000034 | Ca | NI | I | 1 |
| N-Nitrosodiphenylamine | NA | | NA | NA | | 0.0049 | I | 0.0049 | 0.0000026 | Ca | B2 | I | 1 |
| N-Nitrosodimethylamine | 0.000008 | P | 0.000008 | 0.00004 | M | 51 | I | 51 | 0.014 | I | B2 | I | 1 |
| Pentachlorophenol | 0.005 | I | 0.005 | | M | 0.4 | I | 0.4 | 0.0000051 | Ca | LI | I | 1 |
| **Pesticides** | | | | | | | | | | | | | |
| Aldrin | 0.00003 | I | 0.00003 | | M | 17 | I | 17 | 0.0049 | I | B2 | I | 1 |
| beta-BHC | NA | | NA | NA | | 1.8 | I | 1.8 | 0.00053 | I | C | I | 1 |
| gamma-BHC | 0.0003 | I | 0.0003 | | M | 1.1 | Ca | 1.1 | 0.00031 | Ca | NA | | 1 |
| alpha-Chlordane | 0.0005 | I | 0.0005 | 0.0007 | I | 0.35 | I | 0.35 | 0.0001 | I | B2 | I | 1 |
| gamma-Chlordane | 0.0005 | I | 0.0005 | 0.0007 | I | 0.35 | I | 0.35 | 0.0001 | I | B2 | I | 1 |
| 4,4´-DDD | NA | | NA | NA | | 0.24 | I | 0.24 | 0.000069 | Ca | B2 | I | 1 |
| 4,4´-DDE | NA | | NA | NA | | 0.34 | I | 0.34 | 0.000097 | Ca | B2 | I | 1 |

## TABLE 4-1

## TOXICITY VALUES
(Page 3 of 4)

| | Oral Reference Dose (mg/kg-day) | Source | Dermal Reference Dose (mg/kg-day) | Inhalation Reference Concentration (mg/m$^3$) | Source | Oral Slope Factor (mg/kg-day)$^{-1}$ | Source | Dermal Slope Factor (mg/kg-day)$^{-1}$ | Inhalation Unit Risk Factor (μg/m$^3$)$^{-1}$ | Source | Cancer Classification | Source | GI Absorption (fraction) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4,4'-DDT | 0.0005 | I | 0.0005 | | M | 0.34 | I | 0.34 | 0.000097 | I | B2 | I | 1 |
| Endosulfan I | 0.006 | I | 0.006 | | M | NC | | NC | NC | | IN | P | 1 |
| Endrin | 0.0003 | I | 0.0003 | | M | NC | | NC | NC | | D | I | 1 |
| Heptachlor | 0.0005 | I | 0.0005 | | M | 4.5 | I | 4.5 | 0.0013 | I | B2 | I | 1 |
| Heptachlor Epoxide | 0.000013 | I | 0.000013 | | M | 9.1 | I | 9.1 | 0.0026 | I | B2 | I | 1 |
| Methoxychlor | 0.005 | I | 0.005 | NA | | NC | | NC | NC | | D | I | 1 |
| **Metals** | | | | | | | | | | | | | |
| Arsenic | 0.0003 | I | 0.0003 | 0.000015 | C | 1.5 | I | 1.5 | 0.0043 | | A | I | 1 |
| Barium | 0.2 | I | 0.014 | 0.0005 | H | NC | | NC | NC | | NL/IN | I | 0.07 |
| Cadmium | 0.001 | I | 0.000025 | 0.00001 | M | NC | | NC | NC | | B1 | I | 0.025 |
| Chromium | 0.003 | I | 0.000075 | 0.0001 | I | 0.5 | Ca | 20 | 0.084 | | IN/CaH | I | 0.025 |
| Lead | NA | | NA | NA | | NA | | NA | | | B2 | I | 1 |
| Selenium | 0.005 | I | 0.005 | 0.02 | C | NC | | NC | NC | | D | I | 1 |
| Silver | 0.005 | I | 0.0002 | NA | | NC | | NC | NC | | D | I | 0.04 |
| Mercury | 0.0003 | I | 0.000021 | 0.0003 | Hg | NC | | NC | NC | | C | I | 0.07 |
| **Dioxins/Furans** | | | | | | | | | | | | | |
| 1,2,3,7,8-PeCDF | NA | | NA | NA | | 3900 | | 3900 | 1.14 | | NA | | 1 |
| 1,2,3,6,7,8-HxCDF | NA | | NA | NA | | 13000 | | 13000 | 3.8 | | NA | | 1 |
| 1,2,3,4,6,7,8-HpCDD | NA | | NA | NA | | 1300 | | 1300 | 0.38 | | NA | | 1 |
| OCDF | NA | | NA | NA | | 39 | | 39 | 0.0114 | | NA | | 1 |
| OCDD | NA | | NA | NA | | 39 | | 39 | 0.0114 | | NA | | 1 |

| | |
|---|---|
| B1 | Probable human carcinogen based on limited evidence in humans |
| B2 | Probable human carcinogen based on sufficient evidence in animals and inadequate data in humans |
| C | Possible human carcinogen based on limited evidence in animals |
| Ca | Value from California Office of Health Hazard Assessment |
| CaH | Carcinogenic to humans |
| D | Inadequate data to classify with respect to carcinogenicity |
| IRIS | Integrated Risk Information System database (https://www.epa.gov/iris) |
| LI | Likely human carcinogen |
| M | Minimal risk level from the Agency for Toxic Substances and Disease Registry |
| NA | Not available |
| NC | Not available or no value as not carcinogenic |
| O | Office of Pesticide Programs |
| OCDD | Octachlorodibenzo-p-dioxin |

## TABLE 4-1

## TOXICITY VALUES
(Page 4 of 4)

| | Oral Reference Dose (mg/kg-day) | Source | Dermal Reference Dose (mg/kg-day) | Inhalation Reference Concentration ($mg/m^3$) | Source | Oral Slope Factor $(mg/kg\text{-}day)^{-1}$ | Source | Dermal Slope Factor $(mg/kg\text{-}day)^{-1}$ | Inhalation Unit Risk Factor $(\mu g/m^3)^{-1}$ | Source | Cancer Classification | Source | GI Absorption (fraction) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | |
|---|---|
| H | Health Effects Assessment Summary Tables (EPA, 1997) |
| Hg | IRIS value for elemental mercury |
| HpCDD | Heptachlorodibenzo-p-dioxin |
| HxCDF | Hexachlorodibenzofuran |
| I | Integrated Risk Information System (IRIS) database (https://www.epa.gov/iris) |
| IN | Insufficient evidence to classify carcinogenicity |
| IN/CaH | Insufficient evidence to classify carcinogenicity by oral exposure; carcinogenic to humans by inhalation exposure |
| IN/S | Insufficient evidence to classify carcinogenicity by oral exposure; suggestive evidence of carcinogenicity by inhalation exposure |
| OCDF | Octachlorodibenzofuran |
| P | Preliminary Peer-Reviewed Toxicity Value (https://hhpprtv.ornl.gov/) |
| PeCDF | Pentachlorodibenzofuran |
| S | Suggestive evidence of carcinogenicity in humans |
| S/IN | Suggestive evidence of carcinogenicity by oral exposure; insufficient evidence to classify carcinogenicity by inhalation exposure |
| X | Appendix to Preliminary Peer-Reviewed Toxicity Value (hhpprtv.ornl.gov/) |
| X3 | IRIS value based on a mixture of meta-, para-, and ortho-xylenes |

## TABLE 4-2

## TOXICITY EQUIVALENCY FACTORS

| Congener | Toxicity Equivalency Factor |
|---|---|
| 1,2,3,7,8-PeCDF | 0.03 |
| 1,2,3,6,7,8-HxCDF | 0.1 |
| 1,2,3,4,6,7,8-HpCDD | 0.01 |
| OCDF | 0.0003 |
| OCDD | 0.0003 |

Source:  Van den Berg et al., 2005

| | |
|---|---|
| HpCDD | Heptachlorodibenzo-p-dioxin |
| HxCDF | Hexachlorodibenzofuran |
| OCDD | Octachlorodibenzo-p-dioxin |
| OCDF | Octachlorodibenzofuran |
| PeCDF | Pentachlorodibenzofuran |

## TABLE 5-1

## COMPARISON OF GROUNDWATER CONCENTRATIONS TO EPA BENCHMARKS
(Page 1 of 3)

| Chemical | Concentration (μg/l) | Maximum Contaminant Level (μg/l) | EPA Residential Screening Level (μg/l) | Above MCL/RSL?[(a)] |
|---|---|---|---|---|
| **Volatile Organic Compounds** | | | | |
| Acetone | 18.4 | | 14000 | No |
| Benzene | 8.42 | 5 | 0.46 | **Yes** |
| n-Butylbenzene | 0.38 | | 1000 | No |
| sec-Butylbenzene | 0.36 | | 2000 | No |
| tert-Butylbenzene | 0.24 | | 690 | No |
| Carbon disulfide | 1.12 | | 810 | No |
| Chlorobenzene | 7.99 | 100 | 78 | No |
| Chloroethane | 30.2 | | 21000 | No |
| Chloroform | 0.5 | 80 | 0.22 | No |
| Chloromethane | 7.77 | | 190 | No |
| Cyclohexane | 1.48 | | 13000 | No |
| 1,2-Dichlorobenzene | 6.15 | 600 | 300 | No |
| 1,3-Dichlorobenzene | 0.27 | NA | NA | No |
| 1,4-Dichlorobenzene | 5.8 | 75 | 0.48 | No |
| 1,1-Dichloroethane | 1020 | | 2.8 | **Yes** |
| 1,2-Dichloroethane | 0.37 | 5 | 0.17 | No |
| 1,1-Dichloroethene | 9.1 | 7 | 280 | **Yes** |
| cis-1,2-Dichloroethene | 43.7 | 70 | 36 | No |
| trans-1,2-Dichloroethene | 2.39 | 100 | 360 | No |
| Dichlorodifluoromethane | 69.3 | | 200 | No |
| 1,4-Dioxane | 2080 | | 0.46 | **Yes** |
| Ethylbenzene | 5.9 | 700 | 1.5 | No |
| Ethyl ether | 41.6 | | 3900 | No |
| Isopropylbenzene | 2.12 | | 450 | No |
| Isopropyltoluene | 4.2 | NA | NA | No |
| Methylcyclohexane | 1.61 | NA | NA | No |
| Methylene chloride | 1.39 | 5 | 11 | No |
| MTBE | 0.69 | | 14 | No |
| n-Propylbenzene | 1.70 | | 660 | No |
| Tetrahydrofuran | 320 | | 3400 | No |
| Toluene | 4.67 | 1000 | 1100 | No |
| 1,2,4-Trichlorobenzene | 0.2 | 70 | 1.2 | No |
| 1,1,1-Trichloroethane | 1.2 | 200 | 8000 | No |
| Trichloroethene | 1.19 | 5 | 0.49 | No |
| 1,2,4-Trimethylbenzene | 0.77 | | 56 | No |
| Vinyl chloride | 91.8 | 2 | 0.019 | **Yes** |
| m,p-Xylenes | 11.2 | | 190 | No |
| o-Xylene | 11.6 | | 190 | No |
| Xylenes, Total | 16.6 | 10000 | 190 | No |

## TABLE 5-1

## COMPARISON OF GROUNDWATER CONCENTRATIONS TO EPA BENCHMARKS
(Page 2 of 3)

| Chemical | Concentration (μg/l) | Maximum Contaminant Level (μg/l) | EPA Residential Screening Level (μg/l) | Above MCL/RSL?[(a)] |
|---|---|---|---|---|
| **Semi-Volatile Organic Compounds** | | | | |
| Aniline | 1.30 | | 13 | No |
| Benzaldehyde | 58.7 | | 19 | **Yes** |
| Benzoic Acid | 43.7 | | 75000 | No |
| Bis-(2-ethylhexyl)phthalate | 6.76 | 6 | 5.6 | **Yes** |
| 4-Chloro-3-methylphenol | 15.6 | | 1400 | No |
| Diphenylamine | 4.98 | | 1300 | No |
| 3- and 4-Methylphenol | 1.4 | | 930 | No |
| Naphthalene | 0.56 | | 0.17 | **Yes** |
| N-Nitrosodiphenylamine | 4.74 | | 12 | No |
| N-Nitrosodimethylamine | 9.00 | | 0.00011 | **Yes** |
| Pentachlorophenol | 9.70 | 1 | 0.041 | **Yes** |
| **Pesticides** | | | | |
| Aldrin | 0.055 | | 0.00092 | **Yes** |
| beta-BHC | 0.361 | | 0.025 | **Yes** |
| gamma-BHC | 0.2 | 0.2 | 0.042 | No |
| alpha-Chlordane | 0.0236 | 2 | 0.02 | No |
| gamma-Chlordane | 0.00948 | 2 | 0.02 | No |
| 4,4´-DDD | 0.0137 | | 0.032 | No |
| 4,4´-DDE | 0.021 | | 0.046 | No |
| 4,4'-DDT | 0.011 | | 0.23 | No |
| Endosulfan I | 0.11 | | 100 | No |
| Endrin | 0.019 | 2 | 2.3 | No |
| Heptachlor | 0.11 | 0.4 | 0.0014 | No |
| Heptachlor Epoxide | 0.07 | 0.2 | 0.0014 | No |
| Methoxychlor | 0.0505 | 40 | 37 | No |
| **Metals** | | | | |
| Arsenic | 359 | 10 | 0.052 | **Yes** |
| Barium | 3060 | 2000 | 3800 | **Yes** |
| Cadmium | 0.35 | 5.0 | 9.2 | No |
| Chromium | 4.55 | 100 | 0.035 | No |
| Lead | 6.98 | 15 | 15 | No |
| Selenium | 5.88 | 50 | 100 | No |
| Silver | 2.04 | | 94 | No |
| Mercury | 0.243 | 2.0 | 5.7 | No |

## TABLE 5-1

## COMPARISON OF GROUNDWATER CONCENTRATIONS TO EPA BENCHMARKS
(Page 3 of 3)

| Chemical | Concentration (μg/l) | Maximum Contaminant Level (μg/l) | EPA Residential Screening Level (μg/l) | Above MCL/RSL?[(a)] |
|---|---|---|---|---|
| **Dioxins/Furans** | | | | |
| 1,2,3,7,8-PeCDF | 6.4E-07 | 0.0010 | 4.0E-06 | No |
| 1,2,3,6,7,8-HxCDF | 4.3E-07 | 0.0003 | 1.2E-06 | No |
| 1,2,3,4,6,7,8-HpCDD | 1.2E-06 | 0.0030 | 1.2E-05 | No |
| OCDF | 1.2E-05 | 0.10 | 4.0E-04 | No |
| OCDD | 4.6E-06 | 0.10 | 4.0E-04 | No |

(a) Groundwater concentration compared to MCL when available. Comparison made RSL only when MCL not established.

| | |
|---|---|
| EPA | U.S. Environmental Protection Agency |
| HpCDD | heptachlorodibenzo-p-dioxin |
| HxCDF | hexachlorodibenzofuran |
| MCL | maximum contaminant level |
| OCDD | octachlorodibenzo-p-dioxin |
| OCDF | octachlorodibenzofuran |
| PeCDF | pentachlorodibenzofuran |
| RSL | EPA Regional Screening Level (EPA, 2017) |

# TABLE 5-2

## SITE WORKER VAPOR INTRUSION RISKS

| Compound | Cancer Risk | Hazard Quotient |
|---|---|---|
| Benzene | 2.9E-08 | 0.00035 |
| 1,4-Dichlorobenzene | 1.9E-08 | 5.9E-06 |
| 1,1-Dichloroethane | 7.5E-07 | NA |
| Dichlorodifluoromethane | NA | 0.0095 |
| Ethylbenzene | 5.6E-09 | 6.2E-06 |
| Vinyl Chloride | 4.9E-07 | 0.0031 |
| N-Nitrosodimethylamine | 7.3E-07 | 0.0037 |
| **Total:** | 2E-06 | 2E-02 |

## TABLE 5-3

## EXPOSURE DOSES AND RISK CALCULATIONS FOR A CONSTRUCTION WORKER IN CONTACT WITH GROUNDWATER
(Page 1 of 4)

| Constituent | Cgw (µg/l) | Oral Dose (mg/kg/day) | Dermal Dose (mg/kg/day) | Toxicity Values | | Oral Calculated Risk/HI | Dermal Calculated Risk/HI | Total Calculated Risk/HI |
|---|---|---|---|---|---|---|---|---|
| | | | | Oral | Dermal | | | |
| **CANCER EFFECTS** | | | | | | | | |
| | | | | *CSFo* | *CSFd* | | | |
| **Volatile Organic Compounds** | | | | | | | | |
| Benzene | 8.42 | 5.1E-09 | 9.1E-08 | 0.055 | 0.055 | 2.8E-10 | 5.0E-09 | 5.3E-09 |
| Chloroform | 0.5 | 3.1E-10 | 3.1E-09 | 0.031 | 0.031 | 9.5E-12 | 9.5E-11 | 1.0E-10 |
| 1,4-Dichlorobenzene | 5.8 | 3.5E-09 | 2.8E-07 | 0.0054 | 0.0054 | 1.9E-11 | 1.5E-09 | 1.5E-09 |
| 1,1-Dichloroethane | 1020 | 6.2E-07 | 5.6E-06 | 0.0057 | 0.0057 | 3.6E-09 | 3.2E-08 | 3.6E-08 |
| 1,2-Dichloroethane | 0.37 | 2.3E-10 | 1.3E-09 | 0.091 | 0.091 | 2.1E-11 | 1.2E-10 | 1.4E-10 |
| 1,4-Dioxane | 2080 | 1.3E-06 | 5.3E-07 | 0.1 | 0.1 | 1.3E-07 | 5.3E-08 | 1.8E-07 |
| Ethylbenzene | 5.9 | 3.6E-09 | 2.5E-07 | 0.011 | 0.011 | 4.0E-11 | 2.7E-09 | 2.8E-09 |
| Methylene chloride | 1.39 | 8.5E-10 | 3.7E-09 | 0.002 | 0.002 | 1.7E-12 | 7.4E-12 | 9.1E-12 |
| MTBE | 0.69 | 4.2E-10 | 1.1E-09 | 0.0018 | 0.0018 | 7.6E-13 | 2.0E-12 | 2.8E-12 |
| 1,2,4-Trichlorobenzene | 0.2 | 1.2E-10 | 1.9E-08 | 0.029 | 0.029 | 3.5E-12 | 5.5E-10 | 5.5E-10 |
| Trichloroethene | 1.19 | 7.3E-10 | 1.3E-08 | 0.046 | 0.046 | 3.3E-11 | 6.2E-10 | 6.5E-10 |
| Vinyl chloride | 91.8 | 5.6E-08 | 5.2E-07 | 0.72 | 0.72 | 4.0E-08 | 3.8E-07 | 4.2E-07 |
| **Semi-Volatile Organic Compounds** | | | | | | | | |
| Aniline | 1.3 | 8.0E-10 | 1.9E-09 | 0.0057 | 0.0057 | 4.5E-12 | 1.1E-11 | 1.5E-11 |
| Benzaldehyde | 58.7 | 3.6E-08 | 1.9E-07 | 0.004 | 0.004 | 1.4E-10 | 7.6E-10 | 9.1E-10 |
| Bis-(2-ethylhexyl)phthalate | 6.76 | 4.1E-09 | 1.6E-05 | 0.014 | 0.014 | 5.8E-11 | 2.2E-07 | 2.2E-07 |
| Naphthalene | 0.56 | 3.4E-10 | 2.5E-08 | NA | NA | NC | NC | 0.0E+00 |
| N-Nitrosodiphenylamine | 4.74 | 2.9E-09 | 1.0E-07 | 0.0049 | 0.0049 | 1.4E-11 | 5.1E-10 | 5.2E-10 |
| N-Nitrosodimethylamine | 9 | 5.5E-09 | 1.6E-09 | 51 | 51 | 2.8E-07 | 8.3E-08 | 3.6E-07 |
| Pentachlorophenol | 9.7 | 5.9E-09 | 2.9E-06 | 0.4 | 0.4 | 2.4E-09 | 1.1E-06 | 1.1E-06 |
| **Pesticides** | | | | | | | | |
| Aldrin | 0.055 | 3.4E-11 | 5.7E-08 | 17 | 17 | 5.7E-10 | 9.6E-07 | 9.6E-07 |
| beta-BHC | 0.361 | 2.2E-10 | 2.0E-08 | 1.8 | 1.8 | 4.0E-10 | 3.6E-08 | 3.7E-08 |
| gamma-BHC | 0.2 | 1.2E-10 | 1.1E-08 | 1.1 | 1.1 | 1.3E-10 | 1.2E-08 | 1.2E-08 |
| alpha-Chlordane | 0.0236 | 1.4E-11 | 1.0E-08 | 0.35 | 0.35 | 5.1E-12 | 3.6E-09 | 3.6E-09 |
| gamma-Chlordane | 0.00948 | 5.8E-12 | 4.2E-09 | 0.35 | 0.35 | 2.0E-12 | 1.5E-09 | 1.5E-09 |
| 4,4´-DDD | 0.0137 | 8.4E-12 | 9.0E-09 | 0.24 | 0.24 | 2.0E-12 | 2.2E-09 | 2.2E-09 |
| 4,4´-DDE | 0.021 | 1.3E-11 | 3.0E-08 | 0.34 | 0.34 | 4.4E-12 | 1.0E-08 | 1.0E-08 |
| 4,4'-DDT | 0.011 | 6.7E-12 | 2.0E-08 | 0.34 | 0.34 | 2.3E-12 | 6.8E-09 | 6.8E-09 |
| Heptachlor | 0.11 | 6.7E-11 | 6.6E-08 | 4.5 | 4.5 | 3.0E-10 | 3.0E-07 | 3.0E-07 |
| Heptachlor Epoxide | 0.07 | 4.3E-11 | 7.5E-09 | 9.1 | 9.1 | 3.9E-10 | 6.8E-08 | 6.9E-08 |
| **Dioxins/Furans** | | | | | | | | |
| 1,2,3,7,8-PeCDF | 0.00000064 | 3.9E-16 | 7.4E-13 | 3900 | 3900 | 1.5E-12 | 2.9E-09 | 2.9E-09 |
| 1,2,3,6,7,8-HxCDF | 0.00000043 | 2.6E-16 | 5.3E-13 | 13000 | 13000 | 3.4E-12 | 6.9E-09 | 6.9E-09 |
| 1,2,3,4,6,7,8-HpCDD | 0.0000012 | 7.3E-16 | 2.0E-12 | 1300 | 1300 | 9.5E-13 | 2.5E-09 | 2.5E-09 |
| OCDF | 0.000012 | 7.3E-15 | 1.7E-11 | 39 | 39 | 2.9E-13 | 6.7E-10 | 6.7E-10 |
| OCDD | 0.0000046 | 2.8E-15 | 4.0E-12 | 39 | 39 | 1.1E-13 | 1.6E-10 | 1.6E-10 |
| **Metals** | | | | | | | | |
| Arsenic | 359 | 2.2E-07 | 1.7E-07 | 1.5 | 1.5 | 3.3E-07 | 2.5E-07 | 5.8E-07 |
| Cadmium | 0.35 | 2.1E-10 | 1.6E-10 | NA | NA | NC | NC | 0.0E+00 |
| Chromium | 4.55 | 2.8E-09 | 4.2E-09 | 0.5 | 20 | 1.4E-09 | 8.5E-08 | 8.6E-08 |
| Lead | 6.98 | 4.3E-09 | 3.3E-10 | NA | NA | NC | NC | 0.0E+00 |
| | | | | | **Total:** | **8E-07** | **4E-06** | **4E-06** |

## TABLE 5-3

## EXPOSURE DOSES AND RISK CALCULATIONS FOR A CONSTRUCTION WORKER IN CONTACT WITH GROUNDWATER
(Page 2 of 4)

| **Constituent** | **Cgw (μg/l)** | **Oral Dose (mg/kg/day)** | **Dermal Dose (mg/kg/day)** | **Toxicity Values** | | **Oral Calculated Risk/HI** | **Dermal Calculated Risk/HI** | **Total Calculated Risk/HI** |
|---|---|---|---|---|---|---|---|---|
| | | | | **Oral** | **Dermal** | | | |
| **NON-CANCER EFFECTS** | | | | | | | | |
| | | | | *RfDo* | *RfDd* | | | |
| **VOCs** | | | | | | | | |
| Acetone | 18.4 | 7.9E-07 | 4.4E-07 | 0.9 | 0.9 | 8.8E-07 | 4.9E-07 | 1.4E-06 |
| Benzene | 8.42 | 3.6E-07 | 6.4E-06 | 0.004 | 0.004 | 0.00009 | 0.0016 | 0.0017 |
| n-Butylbenzene | 0.38 | 1.6E-08 | 5.9E-06 | 0.05 | 0.05 | 3.3E-07 | 0.00012 | 0.00012 |
| sec-Butylbenzene | 0.36 | 1.5E-08 | 7.5E-06 | 0.1 | 0.1 | 1.5E-07 | 0.00008 | 0.00008 |
| tert-Butylbenzene | 0.24 | 1.0E-08 | 2.5E-06 | 0.1 | 0.1 | 1.0E-07 | 0.00002 | 0.00002 |
| Carbon disulfide | 1.12 | 4.8E-08 | 6.4E-07 | 0.1 | 0.1 | 4.8E-07 | 6.4E-06 | 6.9E-06 |
| Chlorobenzene | 7.99 | 3.4E-07 | 1.4E-05 | 0.02 | 0.02 | 0.00002 | 0.00068 | 0.00070 |
| Chloroethane | 30.2 | 1.3E-06 | 8.8E-06 | NA | NA | NC | NC | 0.0E+00 |
| Chloroform | 0.5 | 2.1E-08 | 2.2E-07 | 0.01 | 0.01 | 2.1E-06 | 0.00002 | 0.00002 |
| Chloromethane | 7.77 | 3.3E-07 | 1.2E-06 | NA | NA | NC | NC | 0.0E+00 |
| Cyclohexane | 1.48 | 6.3E-08 | 7.7E-06 | NA | NA | NC | NC | 0.0E+00 |
| 1,2-Dichlorobenzene | 6.15 | 2.6E-07 | 2.1E-05 | 0.09 | 0.09 | 2.9E-06 | 0.00023 | 0.00023 |
| 1,3-Dichlorobenzene | 0.27 | 1.2E-08 | 0.0E+00 | NA | NA | NC | NC | 0.0E+00 |
| 1,4-Dichlorobenzene | 5.8 | 2.5E-07 | 2.0E-05 | 0.07 | 0.07 | 3.5E-06 | 0.00028 | 0.00029 |
| 1,1-Dichloroethane | 1020 | 4.4E-05 | 3.9E-04 | 0.2 | 0.2 | 0.00022 | 0.0020 | 0.0022 |
| 1,2-Dichloroethane | 0.37 | 1.6E-08 | 8.9E-08 | 0.006 | 0.006 | 2.6E-06 | 0.00001 | 0.00002 |
| 1,1-Dichloroethene | 9.1 | 3.9E-07 | 6.0E-06 | 0.05 | 0.05 | 7.8E-06 | 0.00012 | 0.00013 |
| cis-1,2-Dichloroethene | 43.7 | 1.9E-06 | 2.7E-05 | 0.002 | 0.002 | 0.00094 | 0.014 | 0.014 |
| trans-1,2-Dichloroethene | 2.39 | 1.0E-07 | 1.5E-06 | 0.02 | 0.02 | 5.1E-06 | 0.00007 | 0.00008 |
| Dichlorodifluoromethane | 69.3 | 3.0E-06 | 4.0E-05 | 0.2 | 0.2 | 0.00001 | 2.0E-04 | 2.1E-04 |
| 1,4-Dioxane | 2080 | 8.9E-05 | 3.7E-05 | 0.03 | 0.03 | 0.0030 | 0.0012 | 0.0042 |
| Ethylbenzene | 5.9 | 2.5E-07 | 1.7E-05 | 0.1 | 0.1 | 2.5E-06 | 0.00017 | 0.00018 |
| Ethyl ether | 41.6 | 1.8E-06 | 4.9E-06 | 0.2 | 0.2 | 8.9E-06 | 0.00002 | 0.00003 |
| Isopropylbenzene | 2.12 | 9.1E-08 | 1.2E-05 | 0.1 | 0.1 | 9.1E-07 | 0.00012 | 0.00012 |
| Isopropyltoluene | #N/A | #N/A | #N/A | NA | NA | NC | NC | 0.0E+00 |
| Methylcyclohexane | 1.61 | 6.9E-08 | 0.0E+00 | NA | NA | NC | NC | 0.0E+00 |
| Methylene chloride | 1.39 | 6.0E-08 | 2.6E-07 | 0.006 | 0.006 | 9.9E-06 | 0.00004 | 0.00005 |
| MTBE | 0.69 | 3.0E-08 | 7.8E-08 | NA | NA | NC | NC | 0.0E+00 |
| n-Propylbenzene | 1.7 | 7.3E-08 | 1.0E-05 | 0.1 | 0.1 | 7.3E-07 | 0.00010 | 0.00010 |
| Tetrahydrofuran | 320 | 1.4E-05 | 2.0E-05 | 0.9 | 0.9 | 0.00002 | 0.00002 | 0.00004 |
| Toluene | 4.67 | 2.0E-07 | 7.9E-06 | 0.08 | 0.08 | 2.5E-06 | 0.00010 | 0.00010 |
| 1,2,4-Trichlorobenzene | 0.2 | 8.6E-09 | 1.3E-06 | 0.01 | 0.01 | 8.6E-07 | 0.00013 | 0.00013 |
| 1,1,1-Trichloroethane | 1.2 | 5.1E-08 | 1.0E-06 | 2 | 2 | 2.6E-08 | 5.2E-07 | 5.5E-07 |
| Trichloroethene | 1.19 | 5.1E-08 | 9.4E-07 | 0.0005 | 0.0005 | 0.00010 | 0.0019 | 0.0020 |
| 1,2,4-Trimethylbenzene | 0.77 | 3.3E-08 | 4.2E-06 | 0.01 | 0.01 | 3.3E-06 | 0.00042 | 0.00042 |
| Vinyl chloride | 91.8 | 3.9E-06 | 3.7E-05 | 0.003 | 0.003 | 0.0013 | 0.012 | 0.014 |
| m,p-Xylenes | #N/A | #N/A | #N/A | 0.2 | 0.2 | NC | NC | 0.0E+00 |
| o-Xylene | 11.6 | 5.0E-07 | 3.2E-05 | 0.2 | 0.2 | 2.5E-06 | 0.00016 | 0.00016 |
| Xylenes, Total | 16.6 | 7.1E-07 | 4.9E-05 | 0.2 | 0.2 | 3.6E-06 | 0.00025 | 0.00025 |

## TABLE 5-3

## EXPOSURE DOSES AND RISK CALCULATIONS FOR A CONSTRUCTION WORKER IN CONTACT WITH GROUNDWATER
**(Page 3 of 4)**

| Constituent | Cgw (µg/l) | Oral Dose (mg/kg/day) | Dermal Dose (mg/kg/day) | Toxicity Values | | Oral Calculated Risk/HI | Dermal Calculated Risk/HI | Total Calculated Risk/HI |
|---|---|---|---|---|---|---|---|---|
| | | | | Oral | Dermal | | | |
| **SVOCs** | | | | | | | | |
| Aniline | 1.3 | 5.6E-08 | 1.3E-07 | 0.007 | 0.007 | 8.0E-06 | 0.00002 | 0.00003 |
| Benzaldehyde | 58.7 | 2.5E-06 | 1.3E-05 | 0.1 | 0.1 | 0.00003 | 0.00013 | 0.00016 |
| Benzoic Acid | 43.7 | 1.9E-06 | 1.6E-05 | 4 | 4 | 4.7E-07 | 4.0E-06 | 4.4E-06 |
| Bis-(2-ethylhexyl)phthalate | 6.76 | 2.9E-07 | 1.1E-03 | 0.02 | 0.02 | 0.00001 | 0.055 | 0.055 |
| 4-Chloro-3-methylphenol | 15.6 | 6.7E-07 | 3.3E-05 | 0.1 | 0.1 | 6.7E-06 | 0.00033 | 0.00033 |
| Diphenylamine | 4.98 | 2.1E-07 | 1.6E-05 | 0.1 | 0.1 | 2.1E-06 | 0.00016 | 0.00016 |
| 3- and 4-Methylphenol | 1.4 | 6.0E-08 | 6.4E-07 | 0.05 | 0.05 | 1.2E-06 | 0.00001 | 0.00001 |
| Naphthalene | 0.56 | 2.4E-08 | 1.7E-06 | 0.02 | 0.02 | 1.2E-06 | 0.00009 | 0.00009 |
| N-Nitrosodiphenylamine | 4.74 | 2.0E-07 | 7.2E-06 | NA | NA | NC | NC | 0.0E+00 |
| N-Nitrosodimethylamine | 9 | 3.9E-07 | 1.1E-07 | 0.000008 | 0.000008 | 0.048 | 0.014 | 0.062 |
| Pentachlorophenol | 9.7 | 4.2E-07 | 2.0E-04 | 0.005 | 0.005 | 0.00008 | 0.040 | 0.040 |
| **Pesticides** | | | | | | | | |
| Aldrin | 0.055 | 2.4E-09 | 4.0E-06 | 0.00003 | 0.00003 | 0.00008 | 0.13 | 0.13 |
| beta-BHC | 0.361 | 1.5E-08 | 1.4E-06 | NA | NA | NC | NC | 0.0E+00 |
| gamma-BHC | 0.2 | 8.6E-09 | 7.9E-07 | 0.0003 | 0.0003 | 0.00003 | 0.0026 | 0.0026 |
| alpha-Chlordane | 0.0236 | 1.0E-09 | 7.3E-07 | 0.0005 | 0.0005 | 2.0E-06 | 0.0015 | 0.0015 |
| gamma-Chlordane | 0.00948 | 4.1E-10 | 2.9E-07 | 0.0005 | 0.0005 | 8.1E-07 | 0.00058 | 0.00058 |
| 4,4´-DDD | 0.0137 | 5.9E-10 | 6.3E-07 | NA | NA | NC | NC | 0.0E+00 |
| 4,4´-DDE | 0.021 | 9.0E-10 | 2.1E-06 | NA | NA | NC | NC | 0.0E+00 |
| 4,4'-DDT | 0.011 | 4.7E-10 | 1.4E-06 | 0.0005 | 0.0005 | 9.4E-07 | 0.0028 | 0.0028 |
| Endosulfan I | 0.11 | 4.7E-09 | 1.1E-07 | 0.006 | 0.006 | 7.8E-07 | 0.00002 | 0.00002 |
| Endrin | 0.019 | 8.1E-10 | 2.1E-07 | 0.0003 | 0.0003 | 2.7E-06 | 0.00070 | 0.00071 |
| Heptachlor | 0.11 | 4.7E-09 | 4.6E-06 | 0.0005 | 0.0005 | 9.4E-06 | 0.0092 | 0.0092 |
| Heptachlor Epoxide | 0.07 | 3.0E-09 | 5.3E-07 | 0.000013 | 0.000013 | 0.00023 | 0.040 | 0.041 |
| Methoxychlor | 0.0505 | 2.2E-09 | 5.9E-07 | 0.005 | 0.005 | 4.3E-07 | 0.00012 | 0.00012 |
| **Dioxins/Furans** | | | | | | | | |
| 1,2,3,7,8-PeCDF | 0.00000064 | 2.7E-14 | 5.2E-11 | NA | NA | NC | NC | 0.0E+00 |
| 1,2,3,6,7,8-HxCDF | 0.00000043 | 1.8E-14 | 3.7E-11 | NA | NA | NC | NC | 0.0E+00 |
| 1,2,3,4,6,7,8-HpCDD | 0.0000012 | 5.1E-14 | 1.4E-10 | NA | NA | NC | NC | 0.0E+00 |
| OCDF | 0.000012 | 5.1E-13 | 1.2E-09 | NA | NA | NC | NC | 0.0E+00 |
| OCDD | 0.0000046 | 2.0E-13 | 2.8E-10 | NA | NA | NC | NC | 0.0E+00 |
| **Metals** | | | | | | | | |
| Arsenic | 359 | 1.5E-05 | 1.2E-05 | 0.0003 | 0.0003 | 0.051 | 0.039 | 0.090 |
| Barium | 3060 | 1.3E-04 | 1.0E-04 | 0.2 | 0.014 | 0.00065 | 0.0071 | 0.0078 |
| Cadmium | 0.35 | 1.5E-08 | 1.1E-08 | 0.001 | 0.000025 | 0.00001 | 0.00046 | 0.00047 |
| Chromium | 4.55 | 1.9E-07 | 3.0E-07 | 0.003 | 0.000075 | 0.00006 | 0.0040 | 0.0040 |
| Lead | 6.98 | 3.0E-07 | 2.3E-08 | NA | NA | NC | NC | 0.0E+00 |
| Selenium | 5.88 | 2.5E-07 | 1.9E-07 | 0.005 | 0.005 | 0.00005 | 0.00004 | 0.00009 |
| Silver | 2.04 | 8.7E-08 | 4.0E-08 | 0.005 | 0.0002 | 0.00002 | 0.00020 | 0.00022 |
| Mercury | 0.243 | 1.0E-08 | 7.9E-09 | 0.0003 | 0.000021 | 0.00003 | 0.00038 | 0.00041 |
| | | | | | **Total:** | **0.1** | **0.4** | **0.5** |

## TABLE 5-3

## EXPOSURE DOSES AND RISK CALCULATIONS FOR A CONSTRUCTION WORKER IN CONTACT WITH GROUNDWATER
(Page 4 of 4)

| Constituent | Cgw (µg/l) | Oral Dose (mg/kg/day) | Dermal Dose (mg/kg/day) | Toxicity Values | | Oral Calculated Risk/HI | Dermal Calculated Risk/HI | Total Calculated Risk/HI |
|---|---|---|---|---|---|---|---|---|
| | | | | Oral | Dermal | | | |

| | |
|---|---|
| Cgw | Groundwater concentration |
| CSFd | Cancer slope factor - dermal |
| CSFo | Cancer slope factor - oral |
| ExC | Exposure concentration |
| HI | Hazard index |
| NA | Not available |
| NC | Not calculated |
| NV | Not volatile |
| RfC | Reference concentration |
| RfDd | Reference dose - dermal |
| RfDo | Reference dose - oral |
| URF | Unit risk factor |

# TABLE 5-4

## CONSTRUCTION WORKER BLOOD-LEAD LEVELS

| Parameter | Units | Value |
|---|---|---|
| Maximum Lead Concentration in Groundwater | µg/l | 6.98 |
| Baseline Blood-Lead Concentration | µg/dl | 1.0 |
| Biokinetic Slope Factor | µg/dl per µg/l | 0.4 |
| Groundwater Ingestion Rate | l/day | 0.005 |
| Absorption Factor from Groundwater | unitless | 0.2 |
| Exposure Frequency | days/year | 219 |
| Averaging Time | days/year | 365 |
| Blood-Lead Concentration With Exposure | µg/dl | 1.002 |
| Geometric Standard Deviation | unitless | 1.8 |
| Fetal-to-Maternal Blood-Lead Ratio | unitless | 0.9 |
| Fetal Blood-Lead Level, 95th percentile | µg/dl | 2.4 |

# APPENDICES

# APPENDIX A

# JOHNSON AND ETTINGER VAPOR INTRUSION MODELING

# APPENDIX A

# JOHNSON AND ETTINGER VAPOR INTRUSION MODELING

One exposure pathway evaluated in this risk assessment was inhalation of compounds that volatilize from groundwater and migrate upwards through soil into indoor air. This process is known as vapor intrusion.

To evaluate this pathway, compounds detected in groundwater were screened against Vapor Intrusion Screening Levels (VISLs) developed by the U.S. Environmental Protection Agency (EPA) (EPA, 2014). This screening approach does not take into account any site-specific information, including site lithology. Compounds that had groundwater concentrations that resulted in a screening cancer risk of at least $1 \times 10^{-7}$ or a screening hazard quotient of at least 0.1 were then subjected to a site-specific evaluation. Specifically, they were evaluated using EPA's implementation of the Johnson and Ettinger model (EPA, 2004). This Appendix describes the modeling and provides the model input and output spreadsheets.

The Johnson & Ettinger model partitions compounds from groundwater into soil gas, and then evaluates the upward migration through diffusion and advection. Assumptions are made regarding the vacuum produced in the soil by the building through heating and air conditioning (termed the building-soil pressure differential), the size of cracks in the foundation through which vapors can migrate, and the rate at which air is exchanged between the building and the atmosphere. These assumptions produce an estimate of a compound's concentration inside the building. Risks can then be calculated.

The full version of the Johnson and Ettinger model was used (GW-ADV). While this version allows multiple parameters to be adjusted, default values were used for all parameters with the exception of site-specific inputs for the depth to groundwater and soil lithology. The inputs and outputs from all of the modeling runs are attached to the end of this Appendix.

The modeling was performed for a small, tightly constructed hypothetical future building. The model default parameters for a building (1,000 centimeters by 1,000 centimeters, or about 1,100 square feet; an air exchange rate of one change per four hours) are more typical of a small residence than of the commercial development that is more likely for this property. The air exchange rate is a conservative estimate that assumes a tightly constructed building. It is representative of the lower end of the range of air exchange rates, and is based on data that is thought to be more representative of winter than annual averages (EPA, 2004).

The exposure parameters are discussed in the main text.  It was assumed that the building being evaluated was constructed slab-on-grade, and that the slab extended approximately 6 inches (15 centimeters) below grade.  This assumption is typical of most commercial/industrial buildings.

The subsurface investigation indicated that the depth to groundwater is approximately 4 to 7 feet below ground surface (bgs) during the spring, and 5 to 11 feet bgs the rest of the year.  For the modeling, it was assumed that groundwater was 5 feet bgs.  The upper four feet of soil is a silty clay, with the foot of soil immediately above the water table is typical of a sandy clay.  The bulk density, water-filled porosity, and total porosity values used are the model's default values for these soil types.  Per the model recommendations, it was assumed that the average vapor flow rate into a structure was 5 liters per minute.

The model requires that all building cracks/openings be described in terms of a space between the building walls and foundation.  The default value is a 0.1 centimeter opening.

The Johnson and Ettinger model makes several assumptions.  These include:

- Constituent vapors enter the structure primarily through cracks and openings in the walls and foundation.  Convective transport occurs primarily within the building zone of influence and vapor velocities decrease rapidly with increasing distance from the structure.  Diffusion dominates vapor transport between the constituent source and the building zone of influence.

- All vapors originating from below the building will enter the building unless the floors and walls are perfect vapor barriers.

- All soil properties in a horizontal plane are homogenous.

- The areal extent of a release is greater than that of the building floor in contact with the soil.

- Vapor transport occurs in the absence of convective water movement within the soil column (e.g., evaporation or infiltration), and in the absence of mechanical dispersion.

- There are no chemical transformation processes (e.g., no biodegradation, hydrolysis, etc.).  This assumption is generally accurate for chlorinated hydrocarbons, but overstates risk for petroleum hydrocarbons such as benzene. These latter compounds can be expected to undergo a substantial amount of biodegradation and it is expected that the model overpredicts their indoor air concentrations and risks.

- The soil layer in contact with the structure floor and walls is isotropic with respect to permeability.

- Both the building ventilation rate and the difference in dynamic pressure between the interior of the structure and the soil surface are constant values.

## REFERENCES

U.S. Environmental Protection Agency (EPA), 2004. User's Guide for Evaluating Subsurface Vapor Intrusion Into Buildings. Prepared by Environmental Quality Management, Inc. for U.S. EPA. February.

U.S. Environmental Protection Agency (EPA), 2014. Vapor Intrusion Screening Level (VISL) Calculator. User's Guide. May.

DATA ENTRY SHEET - SCREENING LEVEL RISKS FOR A COMMERCIAL WORKER RESULTING FROM VAPOR INTRUSION OF COMPOUNDS IN GROUNDWATER

GW-ADV
Version 3.1; 02/04

Reset to

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES ☐

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES X

| ENTER Chemical CAS No. (numbers only, no dashes) | ENTER Initial groundwater conc., $C_W$ ($\mu$g/L) | Chemical |
|---|---|---|
| 71432 | 8.42E+00 | Benzene |

MORE ↓

| ENTER Average soil/ groundwater temperature, $T_S$ ($^oC$) | ENTER Depth below grade to bottom of enclosed space floor, $L_F$ (cm) | ENTER Depth below grade to water table, $L_{WT}$ (cm) | ENTER Thickness of soil stratum A, $h_A$ (cm) | ENTER Thickness of soil stratum B, (Enter value or 0) $h_B$ (cm) | ENTER Thickness of soil stratum C, (Enter value or 0) $h_C$ (cm) | ENTER Soil stratum directly above water table, (Enter A, B, or C) | ENTER SCS soil type directly above water table | ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability) | | ENTER User-defined stratum A soil vapor permeability, $k_v$ (cm$^2$) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Totals must add up to value of $L_{WT}$ (cell G28) | | | | | | OR | |
| 10 | 15 | 152 | 121.5 | 30.5 | | B | SC | SiC | | |

MORE ↓

| ENTER Stratum A SCS soil type<br>Lookup Soil | ENTER Stratum A soil dry bulk density, $\rho_b^A$ (g/cm$^3$) | ENTER Stratum A soil total porosity, $n^A$ (unitless) | ENTER Stratum A soil water-filled porosity, $\theta_w^A$ (cm$^3$/cm$^3$) | ENTER Stratum B SCS soil type<br>Lookup Soil Parameters | ENTER Stratum B soil dry bulk density, $\rho_b^B$ (g/cm$^3$) | ENTER Stratum B soil total porosity, $n^B$ (unitless) | ENTER Stratum B soil water-filled porosity, $\theta_w^B$ (cm$^3$/cm$^3$) | ENTER Stratum C SCS soil type<br>Lookup Soil Parameters | ENTER Stratum C soil dry bulk density, $\rho_b^C$ (g/cm$^3$) | ENTER Stratum C soil total porosity, $n^C$ (unitless) | ENTER Stratum C soil water-filled porosity, $\theta_w^C$ (cm$^3$/cm$^3$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SIC | 1.38 | 0.481 | 0.216 | SC | 1.63 | 0.385 | 0.197 | | | | |

MORE ↓

| ENTER Enclosed space floor thickness, $L_{crack}$ (cm) | ENTER Soil-bldg. pressure differential, $\Delta P$ (g/cm-s$^2$) | ENTER Enclosed space floor length, $L_B$ (cm) | ENTER Enclosed space floor width, $W_B$ (cm) | ENTER Enclosed space height, $H_B$ (cm) | ENTER Floor-wall seam crack width, w (cm) | ENTER Indoor air exchange rate, ER (1/h) | ENTER Average vapor flow rate into bldg. OR Leave blank to calculate $Q_{soil}$ (L/m) |
|---|---|---|---|---|---|---|---|
| 10 | 40 | 1000 | 1000 | 244 | 0.1 | 0.25 | 5 |

MORE ↓

| ENTER Averaging time for carcinogens, $AT_C$ (yrs) | ENTER Averaging time for noncarcinogens, $AT_{NC}$ (yrs) | ENTER Exposure duration, ED (yrs) | ENTER Exposure frequency, EF (days/yr) | ENTER Target risk for carcinogens, TR (unitless) | ENTER Target hazard quotient for noncarcinogens, THQ (unitless) |
|---|---|---|---|---|---|
| 70 | 25 | 25 | 250 | 1.0E-06 | 1 |

Used to calculate risk-based groundwater concentration.

END

SCREENING LEVEL RISK CALCULATIONS FOR VAPOR INTRUSION OF COMPOUNDS IN GROUNDWATER:  BENZENE

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

| Indoor exposure groundwater conc., carcinogen (μg/L) | Indoor exposure groundwater conc., noncarcinogen (μg/L) | Risk-based indoor exposure groundwater conc., (μg/L) | Pure component water solubility, S (μg/L) | Final indoor exposure groundwater conc., (μg/L) |
|---|---|---|---|---|
| NA | NA | NA | 1.79E+06 | NA |

INCREMENTAL RISK CALCULATIONS:

| Incremental risk from vapor intrusion to indoor air, carcinogen (unitless) | Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless) |
|---|---|
| 2.9E-08 | 3.5E-04 |

Hazard quotient and cancer risk have been divided by 3 to account for a worker exposure time of 8 hours per day.

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL
DOWN
TO "END"

END

DATA ENTRY SHEET - SCREENING LEVEL RISKS FOR A COMMERCIAL WORKER RESULTING FROM VAPOR INTRUSION OF COMPOUNDS IN GROUNDWATER

GW-ADV
Version 3.1; 02/04

Reset to

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES ☐

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES X

| ENTER | ENTER | |
|---|---|---|
| Chemical CAS No. (numbers only, no dashes) | Initial groundwater conc., $C_W$ ($\mu$g/L) | Chemical |
| 106467 | 5.80E+00 | 1,4-Dichlorobenzene |

MORE ↓

| ENTER | ENTER | ENTER | ENTER | ENTER | ENTER | ENTER | ENTER | ENTER | | ENTER |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Totals must add up to value of $L_{WT}$ (cell G28) | | | | | | | |
| Average soil/ groundwater temperature, $T_S$ ($^oC$) | Depth below grade to bottom of enclosed space floor, $L_F$ (cm) | Depth below grade to water table, $L_{WT}$ (cm) | Thickness of soil stratum A, $h_A$ (cm) | Thickness of soil stratum B, (Enter value or 0) $h_B$ (cm) | Thickness of soil stratum C, (Enter value or 0) $h_C$ (cm) | Soil stratum directly above water table, (Enter A, B, or C) | SCS soil type directly above water table | Soil stratum A SCS soil type (used to estimate soil vapor permeability) | OR | User-defined stratum A soil vapor permeability, $k_v$ ($cm^2$) |
| 10 | 15 | 152 | 121.5 | 30.5 | | B | SC | SiC | | |

MORE ↓

| ENTER | ENTER | ENTER | ENTER | ENTER | ENTER | ENTER | ENTER | ENTER | ENTER | ENTER | ENTER |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Stratum A SCS soil type<br>Lookup Soil | Stratum A soil dry bulk density, $\rho_b^A$ ($g/cm^3$) | Stratum A soil total porosity, $n^A$ (unitless) | Stratum A soil water-fillec porosity, $\theta_w^A$ ($cm^3/cm^3$) | Stratum B SCS soil type<br>Lookup Soil Parameters | Stratum B soil dry bulk density, $\rho_b^B$ ($g/cm^3$) | Stratum B soil total porosity, $n^B$ (unitless) | Stratum B soil water-filled porosity, $\theta_w^B$ ($cm^3/cm^3$) | Stratum C SCS soil type<br>Lookup Soil Parameters | Stratum C soil dry bulk density, $\rho_b^C$ ($g/cm^3$) | Stratum C soil total porosity, $n^C$ (unitless) | Stratum C soil water-filled porosity, $\theta_w^C$ ($cm^3/cm^3$) |
| SIC | 1.38 | 0.481 | 0.216 | SC | 1.63 | 0.385 | 0.197 | | | | |

MORE ↓

| ENTER | ENTER | ENTER | ENTER | ENTER | ENTER | ENTER | ENTER |
|---|---|---|---|---|---|---|---|
| Enclosed space floor thickness, $L_{crack}$ (cm) | Soil-bldg. pressure differential, $\Delta P$ ($g/cm\text{-}s^2$) | Enclosed space floor length, $L_B$ (cm) | Enclosed space floor width, $W_B$ (cm) | Enclosed space height, $H_B$ (cm) | Floor-wall seam crack width, w (cm) | Indoor air exchange rate, ER (1/h) | Average vapor flow rate into bldg. OR Leave blank to calculate $Q_{soil}$ (L/m) |
| 10 | 40 | 1000 | 1000 | 244 | 0.1 | 0.25 | 5 |

MORE ↓

| ENTER | ENTER | ENTER | ENTER | ENTER | ENTER |
|---|---|---|---|---|---|
| Averaging time for carcinogens, $AT_C$ (yrs) | Averaging time for noncarcinogens, $AT_{NC}$ (yrs) | Exposure duration, ED (yrs) | Exposure frequency, EF (days/yr) | Target risk for carcinogens, TR (unitless) | Target hazard quotient for noncarcinogens, THQ (unitless) |
| 70 | 25 | 25 | 250 | 1.0E-06 | 1 |

Used to calculate risk-based groundwater concentration.

END

SCREENING LEVEL RISK CALCULATIONS FOR VAPOR INTRUSION OF COMPOUNDS IN GROUNDWATER: 1,4-DICHLOROBENZENE

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

| Indoor exposure groundwater conc., carcinogen (μg/L) | Indoor exposure groundwater conc., noncarcinogen (μg/L) | Risk-based indoor exposure groundwater conc., (μg/L) | Pure component water solubility, S (μg/L) | Final indoor exposure groundwater conc., (μg/L) |
|---|---|---|---|---|
| NA | NA | NA | 7.90E+04 | NA |

INCREMENTAL RISK CALCULATIONS:

| Incremental risk from vapor intrusion to indoor air, carcinogen (unitless) | Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless) |
|---|---|
| 1.9E-08 | 5.9E-06 |

Hazard quotient and cancer risk have been divided by 3 to account for a worker exposure time of 8 hours per day.

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET - SCREENING LEVEL RISKS FOR A COMMERCIAL WORKER RESULTING FROM VAPOR INTRUSION OF COMPOUNDS IN GROUNDWATER

GW-ADV
Version 3.1; 02/04

Reset to

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES ☐

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES ☒

| ENTER Chemical CAS No. (numbers only, no dashes) | ENTER Initial groundwater conc., $C_W$ (μg/L) | Chemical |
|---|---|---|
| 75718 | 6.93E+01 | Dichlorodifluoromethane |

MORE ↓

| ENTER Average soil/ groundwater temperature, $T_S$ ($^oC$) | ENTER Depth below grade to bottom of enclosed space floor, $L_F$ (cm) | ENTER Depth below grade to water table, $L_{WT}$ (cm) | ENTER Thickness of soil stratum A, $h_A$ (cm) | ENTER Thickness of soil stratum B, (Enter value or 0) $h_B$ (cm) | ENTER Thickness of soil stratum C, (Enter value or 0) $h_C$ (cm) | ENTER Soil stratum directly above water table, (Enter A, B, or C) | ENTER SCS soil type directly above water table | ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability) | OR | ENTER User-defined stratum A soil vapor permeability, $k_v$ ($cm^2$) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 15 | 152 | 121.5 | 30.5 | | B | SC | SiC | | |

Totals must add up to value of $L_{WT}$ (cell G28)

MORE ↓

| ENTER Stratum A SCS soil type | ENTER Stratum A soil dry bulk density, $\rho_b^A$ ($g/cm^3$) | ENTER Stratum A soil total porosity, $n^A$ (unitless) | ENTER Stratum A soil water-filled porosity, $\theta_w^A$ ($cm^3/cm^3$) | ENTER Stratum B SCS soil type | ENTER Stratum B soil dry bulk density, $\rho_b^B$ ($g/cm^3$) | ENTER Stratum B soil total porosity, $n^B$ (unitless) | ENTER Stratum B soil water-filled porosity, $\theta_w^B$ ($cm^3/cm^3$) | ENTER Stratum C SCS soil type | ENTER Stratum C soil dry bulk density, $\rho_b^C$ ($g/cm^3$) | ENTER Stratum C soil total porosity, $n^C$ (unitless) | ENTER Stratum C soil water-filled porosity, $\theta_w^C$ ($cm^3/cm^3$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lookup Soil | | | | Lookup Soil Parameters | | | | Lookup Soil Parameters | | | |
| SIC | 1.38 | 0.481 | 0.216 | SC | 1.63 | 0.385 | 0.197 | | | | |

MORE ↓

| ENTER Enclosed space floor thickness, $L_{crack}$ (cm) | ENTER Soil-bldg. pressure differential, $\Delta P$ ($g/cm\text{-}s^2$) | ENTER Enclosed space floor length, $L_B$ (cm) | ENTER Enclosed space floor width, $W_B$ (cm) | ENTER Enclosed space height, $H_B$ (cm) | ENTER Floor-wall seam crack width, w (cm) | ENTER Indoor air exchange rate, ER (1/h) | ENTER Average vapor flow rate into bldg. OR Leave blank to calculate $Q_{soil}$ (L/m) |
|---|---|---|---|---|---|---|---|
| 10 | 40 | 1000 | 1000 | 244 | 0.1 | 0.25 | 5 |

MORE ↓

| ENTER Averaging time for carcinogens, $AT_C$ (yrs) | ENTER Averaging time for noncarcinogens, $AT_{NC}$ (yrs) | ENTER Exposure duration, ED (yrs) | ENTER Exposure frequency, EF (days/yr) | ENTER Target risk for carcinogens, TR (unitless) | ENTER Target hazard quotient for noncarcinogens, THQ (unitless) |
|---|---|---|---|---|---|
| 70 | 25 | 25 | 250 | 1.0E-06 | 1 |

Used to calculate risk-based groundwater concentration.

END

SCREENING LEVEL RISK CALCULATIONS FOR VAPOR INTRUSION OF COMPOUNDS IN GROUNDWATER:  DICHLORODIFLUOROMETHANE

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

| Indoor exposure groundwater conc., carcinogen (μg/L) | Indoor exposure groundwater conc., noncarcinogen (μg/L) | Risk-based indoor exposure groundwater conc., (μg/L) | Pure component water solubility, S (μg/L) | Final indoor exposure groundwater conc., (μg/L) |
|---|---|---|---|---|
| NA | NA | NA | 2.80E+05 | NA |

INCREMENTAL RISK CALCULATIONS:

| Incremental risk from vapor intrusion to indoor air, carcinogen (unitless) | Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless) |
|---|---|
| NA | 9.5E-03 |

Hazard quotient and cancer risk have been divided by 3 to account for a worker exposure time of 8 hours per day.

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL
DOWN
TO "END"

END

DATA ENTRY SHEET - SCREENING LEVEL RISKS FOR A COMMERCIAL WORKER RESULTING FROM VAPOR INTRUSION OF COMPOUNDS IN GROUNDWATER

GW-ADV
Version 3.1; 02/04

Reset to

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES ☐

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES ☒ X

| ENTER Chemical CAS No. (numbers only, no dashes) | ENTER Initial groundwater conc., $C_W$ (µg/L) | Chemical |
|---|---|---|
| 75343 | 1.02E+03 | 1,1-Dichloroethane |

MORE ↓

| ENTER Average soil/ groundwater temperature, $T_S$ (°C) | ENTER Depth below grade to bottom of enclosed space floor, $L_F$ (cm) | ENTER Depth below grade to water table, $L_{WT}$ (cm) | ENTER Thickness of soil stratum A, $h_A$ (cm) | ENTER Thickness of soil stratum B, (Enter value or 0) $h_B$ (cm) | ENTER Thickness of soil stratum C, (Enter value or 0) $h_C$ (cm) | ENTER Soil stratum directly above water table, (Enter A, B, or C) | ENTER SCS soil type directly above water table | ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability) | OR | ENTER User-defined stratum A soil vapor permeability, $k_v$ ($cm^2$) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 15 | 152 | 121.5 | 30.5 |  | B | SC | SiC |  |  |

Totals must add up to value of $L_{WT}$ (cell G28)

MORE ↓

| ENTER Stratum A SCS soil type | ENTER Stratum A soil dry bulk density, $\rho_b^A$ ($g/cm^3$) | ENTER Stratum A soil total porosity, $n^A$ (unitless) | ENTER Stratum A soil water-fillec porosity, $\theta_w^A$ ($cm^3/cm^3$) | ENTER Stratum B SCS soil type | ENTER Stratum B soil dry bulk density, $\rho_b^B$ ($g/cm^3$) | ENTER Stratum B soil total porosity, $n^B$ (unitless) | ENTER Stratum B soil water-filled porosity, $\theta_w^B$ ($cm^3/cm^3$) | ENTER Stratum C SCS soil type | ENTER Stratum C soil dry bulk density, $\rho_b^C$ ($g/cm^3$) | ENTER Stratum C soil total porosity, $n^C$ (unitless) | ENTER Stratum C soil water-filled porosity, $\theta_w^C$ ($cm^3/cm^3$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lookup Soil |  |  |  | Lookup Soil Parameters |  |  |  | Lookup Soil Parameters |  |  |  |
| SIC | 1.38 | 0.481 | 0.216 | SC | 1.63 | 0.385 | 0.197 |  |  |  |  |

MORE ↓

| ENTER Enclosed space floor thickness, $L_{crack}$ (cm) | ENTER Soil-bldg. pressure differential, $\Delta P$ ($g/cm\text{-}s^2$) | ENTER Enclosed space floor length, $L_B$ (cm) | ENTER Enclosed space floor width, $W_B$ (cm) | ENTER Enclosed space height, $H_B$ (cm) | ENTER Floor-wall seam crack width, w (cm) | ENTER Indoor air exchange rate, ER (1/h) | ENTER Average vapor flow rate into bldg. OR Leave blank to calculate $Q_{soil}$ (L/m) |
|---|---|---|---|---|---|---|---|
| 10 | 40 | 1000 | 1000 | 244 | 0.1 | 0.25 | 5 |

MORE ↓

| ENTER Averaging time for carcinogens, $AT_C$ (yrs) | ENTER Averaging time for noncarcinogens, $AT_{NC}$ (yrs) | ENTER Exposure duration, ED (yrs) | ENTER Exposure frequency, EF (days/yr) | ENTER Target risk for carcinogens, TR (unitless) | ENTER Target hazard quotient for noncarcinogens, THQ (unitless) |
|---|---|---|---|---|---|
| 70 | 25 | 25 | 250 | 1.0E-06 | 1 |

Used to calculate risk-based groundwater concentration.

END

SCREENING LEVEL RISK CALCULATIONS FOR VAPOR INTRUSION OF COMPOUNDS IN GROUNDWATER: 1,1-DICHLOROETHANE

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

| Indoor exposure groundwater conc., carcinogen (μg/L) | Indoor exposure groundwater conc., noncarcinogen (μg/L) | Risk-based indoor exposure groundwater conc., (μg/L) | Pure component water solubility, S (μg/L) | Final indoor exposure groundwater conc., (μg/L) |
|---|---|---|---|---|
| NA | NA | NA | 5.06E+06 | NA |

INCREMENTAL RISK CALCULATIONS:

| Incremental risk from vapor intrusion to indoor air, carcinogen (unitless) | Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless) |
|---|---|
| 7.5E-07 | NA |

Hazard quotient and cancer risk have been divided by 3 to account for a worker exposure time of 8 hours per day.

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET - SCREENING LEVEL RISKS FOR A COMMERCIAL WORKER RESULTING FROM VAPOR INTRUSION OF COMPOUNDS IN GROUNDWATER

GW-ADV
Version 3.1; 02/04

Reset to

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES ☐

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES ☒

| ENTER Chemical CAS No. (numbers only, no dashes) | ENTER Initial groundwater conc., $C_W$ (µg/L) | Chemical |
|---|---|---|
| 100414 | 5.90E+00 | Ethylbenzene |

MORE ↓

| ENTER Average soil/ groundwater temperature, $T_S$ (°C) | ENTER Depth below grade to bottom of enclosed space floor, $L_F$ (cm) | ENTER Depth below water table, $L_{WT}$ (cm) | ENTER Totals must add up to value of $L_{WT}$ (cell G28) Thickness of soil stratum A, $h_A$ (cm) | ENTER Thickness of soil stratum B, (Enter value or 0) $h_B$ (cm) | ENTER Thickness of soil stratum C, (Enter value or 0) $h_C$ (cm) | ENTER Soil stratum directly above water table, (Enter A, B, or C) | ENTER SCS soil type directly above water table | ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability) | OR | ENTER User-defined stratum A soil vapor permeability, $k_v$ (cm$^2$) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 15 | 152 | 121.5 | 30.5 |  | B | SC | SiC |  |  |

MORE ↓

| ENTER Stratum A SCS soil type Lookup Soil | ENTER Stratum A soil dry bulk density, $\rho_b^A$ (g/cm$^3$) | ENTER Stratum A soil total porosity, $n^A$ (unitless) | ENTER Stratum A soil water-fillec porosity, $\theta_w^A$ (cm$^3$/cm$^3$) | ENTER Stratum B SCS soil type Lookup Soil Parameters | ENTER Stratum B soil dry bulk density, $\rho_b^B$ (g/cm$^3$) | ENTER Stratum B soil total porosity, $n^B$ (unitless) | ENTER Stratum B soil water-filled porosity, $\theta_w^B$ (cm$^3$/cm$^3$) | ENTER Stratum C SCS soil type Lookup Soil Parameters | ENTER Stratum C soil dry bulk density, $\rho_b^C$ (g/cm$^3$) | ENTER Stratum C soil total porosity, $n^C$ (unitless) | ENTER Stratum C soil water-filled porosity, $\theta_w^C$ (cm$^3$/cm$^3$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SIC | 1.38 | 0.481 | 0.216 | SC | 1.63 | 0.385 | 0.197 |  |  |  |  |

MORE ↓

| ENTER Enclosed space floor thickness, $L_{crack}$ (cm) | ENTER Soil-bldg. pressure differential, $\Delta P$ (g/cm-s$^2$) | ENTER Enclosed space floor length, $L_B$ (cm) | ENTER Enclosed space floor width, $W_B$ (cm) | ENTER Enclosed space height, $H_B$ (cm) | ENTER Floor-wall seam crack width, w (cm) | ENTER Indoor air exchange rate, ER (1/h) | ENTER Average vapor flow rate into bldg. OR Leave blank to calculate $Q_{soil}$ (L/m) |
|---|---|---|---|---|---|---|---|
| 10 | 40 | 1000 | 1000 | 244 | 0.1 | 0.25 | 5 |

MORE ↓

| ENTER Averaging time for carcinogens, $AT_C$ (yrs) | ENTER Averaging time for noncarcinogens, $AT_{NC}$ (yrs) | ENTER Exposure duration, ED (yrs) | ENTER Exposure frequency, EF (days/yr) | ENTER Target risk for carcinogens, TR (unitless) | ENTER Target hazard quotient for noncarcinogens, THQ (unitless) |
|---|---|---|---|---|---|
| 70 | 25 | 25 | 250 | 1.0E-06 | 1 |

Used to calculate risk-based groundwater concentration.

END

SCREENING LEVEL RISK CALCULATIONS FOR VAPOR INTRUSION OF COMPOUNDS IN GROUNDWATER:  ETHYLBENZENE

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

| Indoor exposure groundwater conc., carcinogen (μg/L) | Indoor exposure groundwater conc., noncarcinogen (μg/L) | Risk-based indoor exposure groundwater conc., (μg/L) | Pure component water solubility, S (μg/L) | Final indoor exposure groundwater conc., (μg/L) |
|---|---|---|---|---|
| NA | NA | NA | 1.69E+05 | NA |

INCREMENTAL RISK CALCULATIONS:

| Incremental risk from vapor intrusion to indoor air, carcinogen (unitless) | Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless) |
|---|---|
| 5.6E-09 | 6.2E-06 |

Hazard quotient and cancer risk have been divided by 3 to account for a worker exposure time of 8 hours per day.

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL
DOWN
TO "END"

END

DATA ENTRY SHEET - SCREENING LEVEL RISKS FOR A COMMERCIAL WORKER RESULTING FROM VAPOR INTRUSION OF COMPOUNDS IN GROUNDWATER

GW-ADV
Version 3.1; 02/04

Reset to

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES ☐

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES ☒

| ENTER<br>Chemical CAS No. (numbers only, no dashes) | ENTER<br>Initial groundwater conc., $C_W$ (µg/L) | Chemical |
|---|---|---|
| 62759 | 9.00E+00 | N-Nitrosodimethylamine |

MORE ↓

| ENTER<br>Average soil/ groundwater temperature, $T_S$ ($^oC$) | ENTER<br>Depth below grade to bottom of enclosed space floor, $L_F$ (cm) | ENTER<br>Depth below grade to water table, $L_{WT}$ (cm) | ENTER<br>Totals must add up to value of $L_{WT}$ (cell G28)<br>Thickness of soil stratum A, $h_A$ (cm) | ENTER<br>Thickness of soil stratum B, (Enter value or 0) $h_B$ (cm) | ENTER<br>Thickness of soil stratum C, (Enter value or 0) $h_C$ (cm) | ENTER<br>Soil stratum directly above water table, (Enter A, B, or C) | ENTER<br>SCS soil type directly above water table | ENTER<br>Soil stratum A SCS soil type (used to estimate soil vapor permeability) | OR | ENTER<br>User-defined stratum A soil vapor permeability, $k_v$ ($cm^2$) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 15 | 152 | 121.5 | 30.5 |  | B | SC | SiC |  |  |

MORE ↓

| ENTER<br>Stratum A SCS soil type<br>Lookup Soil | ENTER<br>Stratum A soil dry bulk density, $\rho_b^A$ ($g/cm^3$) | ENTER<br>Stratum A soil total porosity, $n^A$ (unitless) | ENTER<br>Stratum A soil water-filled porosity, $\theta_w^A$ ($cm^3/cm^3$) | ENTER<br>Stratum B SCS soil type<br>Lookup Soil Parameters | ENTER<br>Stratum B soil dry bulk density, $\rho_b^B$ ($g/cm^3$) | ENTER<br>Stratum B soil total porosity, $n^B$ (unitless) | ENTER<br>Stratum B soil water-filled porosity, $\theta_w^B$ ($cm^3/cm^3$) | ENTER<br>Stratum C SCS soil type<br>Lookup Soil Parameters | ENTER<br>Stratum C soil dry bulk density, $\rho_b^C$ ($g/cm^3$) | ENTER<br>Stratum C soil total porosity, $n^C$ (unitless) | ENTER<br>Stratum C soil water-filled porosity, $\theta_w^C$ ($cm^3/cm^3$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SIC | 1.38 | 0.481 | 0.216 | SC | 1.63 | 0.385 | 0.197 |  |  |  |  |

MORE ↓

| ENTER<br>Enclosed space floor thickness, $L_{crack}$ (cm) | ENTER<br>Soil-bldg. pressure differential, $\Delta P$ ($g/cm-s^2$) | ENTER<br>Enclosed space floor length, $L_B$ (cm) | ENTER<br>Enclosed space floor width, $W_B$ (cm) | ENTER<br>Enclosed space height, $H_B$ (cm) | ENTER<br>Floor-wall seam crack width, w (cm) | ENTER<br>Indoor air exchange rate, ER (1/h) | ENTER<br>Average vapor flow rate into bldg. OR Leave blank to calculate $Q_{soil}$ (L/m) |
|---|---|---|---|---|---|---|---|
| 10 | 40 | 1000 | 1000 | 244 | 0.1 | 0.25 | 5 |

MORE ↓

| ENTER<br>Averaging time for carcinogens, $AT_C$ (yrs) | ENTER<br>Averaging time for noncarcinogens, $AT_{NC}$ (yrs) | ENTER<br>Exposure duration, ED (yrs) | ENTER<br>Exposure frequency, EF (days/yr) | ENTER<br>Target risk for carcinogens, TR (unitless) | ENTER<br>Target hazard quotient for noncarcinogens, THQ (unitless) |
|---|---|---|---|---|---|
| 70 | 25 | 25 | 250 | 1.0E-06 | 1 |

Used to calculate risk-based groundwater concentration.

END

SCREENING LEVEL RISK CALCULATIONS FOR VAPOR INTRUSION OF COMPOUNDS IN GROUNDWATER:  N-NITROSODIMETHYLAMINE

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

| Indoor exposure groundwater conc., carcinogen (μg/L) | Indoor exposure groundwater conc., noncarcinogen (μg/L) | Risk-based indoor exposure groundwater conc., (μg/L) | Pure component water solubility, S (μg/L) | Final indoor exposure groundwater conc., (μg/L) |
|---|---|---|---|---|
| NA | NA | NA | 3.00E+08 | NA |

INCREMENTAL RISK CALCULATIONS:

| Incremental risk from vapor intrusion to indoor air, carcinogen (unitless) | Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless) |
|---|---|
| 7.3E-07 | 3.7E-03 |

Hazard quotient and cancer risk have been divided by 3 to account for a worker exposure time of 8 hours per day.

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL
DOWN
TO "END"

END

DATA ENTRY SHEET - SCREENING LEVEL RISKS FOR A COMMERCIAL WORKER RESULTING FROM VAPOR INTRUSION OF COMPOUNDS IN GROUNDWATER

GW-ADV
Version 3.1; 02/04

Reset to

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES ☐

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES ☒

| ENTER<br>Chemical CAS No. (numbers only, no dashes) | ENTER<br>Initial groundwater conc., $C_W$ ($\mu$g/L) | Chemical |
|---|---|---|
| 75014 | 9.18E+01 | Vinyl chloride (chloroethene) |

MORE ↓

| ENTER<br>Average soil/ groundwater temperature, $T_S$ ($^oC$) | ENTER<br>Depth below grade to bottom of enclosed space floor, $L_F$ (cm) | ENTER<br>Depth below grade to water table, $L_{WT}$ (cm) | ENTER<br>Totals must add up to value of $L_{WT}$ (cell G28)<br>Thickness of soil stratum A, $h_A$ (cm) | ENTER<br>Thickness of soil stratum B, (Enter value or 0) $h_B$ (cm) | ENTER<br>Thickness of soil stratum C, (Enter value or 0) $h_C$ (cm) | ENTER<br>Soil stratum directly above water table, (Enter A, B, or C) | ENTER<br>SCS soil type directly above water table | ENTER<br>Soil stratum A SCS soil type (used to estimate soil vapor permeability) | OR | ENTER<br>User-defined stratum A soil vapor permeability, $k_v$ ($cm^2$) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 15 | 152 | 121.5 | 30.5 |  | B | SC | SiC |  |  |

MORE ↓

| ENTER<br>Stratum A SCS soil type<br>Lookup Soil | ENTER<br>Stratum A soil dry bulk density, $\rho_b^A$ ($g/cm^3$) | ENTER<br>Stratum A soil total porosity, $n^A$ (unitless) | ENTER<br>Stratum A soil water-filled porosity, $\theta_w^A$ ($cm^3/cm^3$) | ENTER<br>Stratum B SCS soil type<br>Lookup Soil Parameters | ENTER<br>Stratum B soil dry bulk density, $\rho_b^B$ ($g/cm^3$) | ENTER<br>Stratum B soil total porosity, $n^B$ (unitless) | ENTER<br>Stratum B soil water-filled porosity, $\theta_w^B$ ($cm^3/cm^3$) | ENTER<br>Stratum C SCS soil type<br>Lookup Soil Parameters | ENTER<br>Stratum C soil dry bulk density, $\rho_b^C$ ($g/cm^3$) | ENTER<br>Stratum C soil total porosity, $n^C$ (unitless) | ENTER<br>Stratum C soil water-filled porosity, $\theta_w^C$ ($cm^3/cm^3$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SIC | 1.38 | 0.481 | 0.216 | SC | 1.63 | 0.385 | 0.197 |  |  |  |  |

MORE ↓

| ENTER<br>Enclosed space floor thickness, $L_{crack}$ (cm) | ENTER<br>Soil-bldg. pressure differential, $\Delta P$ ($g/cm\text{-}s^2$) | ENTER<br>Enclosed space floor length, $L_B$ (cm) | ENTER<br>Enclosed space floor width, $W_B$ (cm) | ENTER<br>Enclosed space height, $H_B$ (cm) | ENTER<br>Floor-wall seam crack width, w (cm) | ENTER<br>Indoor air exchange rate, ER (1/h) | ENTER<br>Average vapor flow rate into bldg. OR Leave blank to calculate $Q_{soil}$ (L/m) |
|---|---|---|---|---|---|---|---|
| 10 | 40 | 1000 | 1000 | 244 | 0.1 | 0.25 | 5 |

MORE ↓

| ENTER<br>Averaging time for carcinogens, $AT_C$ (yrs) | ENTER<br>Averaging time for noncarcinogens, $AT_{NC}$ (yrs) | ENTER<br>Exposure duration, ED (yrs) | ENTER<br>Exposure frequency, EF (days/yr) | ENTER<br>Target risk for carcinogens, TR (unitless) | ENTER<br>Target hazard quotient for noncarcinogens, THQ (unitless) |
|---|---|---|---|---|---|
| 70 | 25 | 25 | 250 | 1.0E-06 | 1 |
|  |  |  |  | Used to calculate risk-based groundwater concentration. |  |

END

SCREENING LEVEL RISK CALCULATIONS FOR VAPOR INTRUSION OF COMPOUNDS IN GROUNDWATER: VINYL CHLORIDE

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

| Indoor exposure groundwater conc., carcinogen (μg/L) | Indoor exposure groundwater conc., noncarcinogen (μg/L) | Risk-based indoor exposure groundwater conc., (μg/L) | Pure component water solubility, S (μg/L) | Final indoor exposure groundwater conc., (μg/L) |
|---|---|---|---|---|
| NA | NA | NA | 8.80E+06 | NA |

INCREMENTAL RISK CALCULATIONS:

| Incremental risk from vapor intrusion to indoor air, carcinogen (unitless) | Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless) |
|---|---|
| 4.9E-07 | 3.1E-03 |

Hazard quotient and cancer risk have been divided by 3 to account for a worker exposure time of 8 hours per day.

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL
DOWN
TO "END"

END

# APPENDIX B

# DERMAL EXPOSURE PARAMETERS FOR GROUNDWATER

# APPENDIX B

## DERMAL EXPOSURE PARAMETERS FOR GROUNDWATER

Under the U.S. Environmental Protection Agency's (EPA's) Dermal Guidance, the evaluation of dermal exposure in groundwater utilizes the parameter $DA_{event}$ (EPA, 2004). For organic compounds, the parameter $DA_{event}$ is calculated one of two ways depending on whether the time of exposure ($t_{event}$) is greater or less than the time required for the chemical to reach steady state conditions (t*) as it is taken up from water and diffuses across the skin into the bloodstream.

If $t_{event} \leq t^*$, the following equation applies:

$$DA_{event} = 2\ FA \text{ x } K_p \text{ x } C_w \text{ x } CF1 \text{ x } CF2 \text{ x } \sqrt{\frac{6\ \tau_{event} \text{ x } t_{event}}{\pi}}$$

If $t_{event}$ is greater than t*, then $DA_{event}$ is calculated as follows:

$$DA_{event} = FA \text{ x } K_p \text{ x } C_w \text{ x } CF1 \text{ x } CF2 \text{ x } \left[\frac{t_{event}}{1+B} + 2\tau_{event}\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

where:

$DA_{event}$ = Absorbed dose per event ($mg/cm^2$-event)

FA = Fraction absorbed (unitless)

$K_p$ = Dermal permeability coefficient of compound in water (cm/hr)

$C_w$ = Constituent concentration in water (µg/l)

CF1 = Conversion factor 1 (0.001 mg/µg)

CF2 = Conversion factor 2 (0.001 $l/cm^3$)

$\tau_{event}$ = Lag time per event (hr/event)

$t_{event}$ = Event duration (hr/event)

$t^*$ = Time to reach steady state (hr) = $2.4 * \tau_{event}$

B = Ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis (unitless)

The values of $DA_{event}$, including the parameters necessary for its calculation, are provided in Table B-1. These calculations are based on an event duration of 1 hour, the assumed amount of time construction workers are in contact with groundwater on a given day.

For inorganic constituents, $DA_{event}$ is calculated as follows:

$$DA_{event} = K_p \times C_w \times CF1 \times CF2 \times t_{event}$$

These parameters were previously defined in the equations for organic constituents.

---

**REFERENCES**

U.S. Environmental Protection Agency (EPA), 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005. July.

U.S. Environmental Protection Agency (EPA), 2012. Regional Screening Level (RSL) Chemical-Specific Parameters Supporting Table. April.

# TABLE B-1

## DERMAL ABSORBED DOSE PER EVENT CALCULATION PARAMETERS
(Page 1 of 3)

| | Fraction Absorbed FA (unitless) | Dermal Permeability Coefficient Kp (cm/hr) | Lag Time Per Event $\tau_{event}$ (hr/event) | Time to Reach Steady-State t* (hrs) | Stratum Corneum/ Epidermis Permeability Coefficient Ratio B (unitless) | Normalized Absorbed Dose Per Event $DA_{event}$ (mg/cm$^2$-event)[(a)] |
|---|---|---|---|---|---|---|
| **Volatile Organic Compounds** | | | | | | |
| Acetone | 1 | 0.000512 | 0.22 | 0.53 | 0.0015 | 0.00074 |
| Benzene | 1 | 0.0149 | 0.29 | 0.69 | 0.051 | 0.023 |
| n-Butylbenzene | 1 | 0.225 | 0.59 | 2.29 | 1.00 | 0.48 |
| sec-Butylbenzene | 1 | 0.301 | 0.59 | 2.34 | 1.34 | 0.64 |
| tert-Butylbenzene | 1 | 0.149 | 0.59 | 2.33 | 0.66 | 0.32 |
| Carbon disulfide | 1 | 0.0114 | 0.28 | 0.67 | 0.038 | 0.018 |
| Chlorobenzene | 1 | 0.0282 | 0.45 | 1.08 | 0.12 | 0.052 |
| Chloroethane | 1 | 0.00607 | 0.24 | 0.58 | 0.019 | 0.0089 |
| Chloroform | 1 | 0.00683 | 0.49 | 1.18 | 0.029 | 0.013 |
| Chloromethane | 1 | 0.00328 | 0.20 | 0.48 | 0.0090 | 0.0046 |
| Cyclohexane | 1 | 0.102 | 0.31 | 0.75 | 0.36 | 0.16 |
| 1,2-Dichlorobenzene | 1 | 0.0446 | 0.70 | 1.68 | 0.21 | 0.10 |
| 1,3-Dichlorobenzene | 1 | NA | NA | NA | NA | NA |
| 1,4-Dichlorobenzene | 1 | 0.0453 | 0.70 | 1.68 | 0.21 | 0.10 |
| 1,1-Dichloroethane | 1 | 0.00675 | 0.38 | 0.90 | 0.026 | 0.012 |
| 1,2-Dichloroethane | 1 | 0.0042 | 0.38 | 0.90 | 0.016 | 0.0073 |
| 1,1-Dichloroethene | 1 | 0.0117 | 0.37 | 0.88 | 0.044 | 0.020 |
| cis-1,2-Dichloroethene | 1 | 0.011 | 0.37 | 0.88 | 0.042 | 0.019 |
| trans-1,2-Dichloroethene | 1 | 0.011 | 0.37 | 0.88 | 0.042 | 0.019 |
| Dichlorodifluoromethane | 1 | 0.00895 | 0.50 | 1.20 | 0.038 | 0.017 |
| 1,4-Dioxane | 1 | 0.000332 | 0.33 | 0.79 | 0.0012 | 0.00055 |
| Ethylbenzene | 1 | 0.0493 | 0.41 | 0.99 | 0.20 | 0.090 |
| Ethyl ether | 1 | 0.00235 | 0.27 | 0.66 | 0.0078 | 0.0036 |
| Isopropylbenzene | 1 | 0.0897 | 0.50 | 1.19 | 0.38 | 0.17 |
| p-Isopropyltoluene | 1 | NA | NA | NA | NA | NA |
| Methylcyclohexane | 1 | NA | NA | NA | NA | NA |
| Methylene chloride | 1 | 0.00354 | 0.31 | 0.75 | 0.013 | 0.0057 |
| MTBE | 1 | 0.00211 | 0.33 | 0.79 | 0.0076 | 0.0035 |
| n-Propylbenzene | 1 | 0.0939 | 0.50 | 1.19 | 0.40 | 0.18 |
| Tetrahydrofuran | 1 | 0.00125 | 0.27 | 0.64 | 0.0041 | 0.0019 |
| Toluene | 1 | 0.0311 | 0.35 | 0.83 | 0.11 | 0.052 |
| 1,2,4-Trichlorobenzene | 1 | 0.0705 | 1.09 | 2.62 | 0.37 | 0.20 |
| 1,1,1-Trichloroethane | 1 | 0.0126 | 0.59 | 1.41 | 0.056 | 0.027 |
| Trichloroethene | 1 | 0.0116 | 0.57 | 1.37 | 0.051 | 0.024 |
| 1,2,4-Trimethylbenzene | 1 | 0.0857 | 0.50 | 1.19 | 0.36 | 0.17 |
| Vinyl chloride | 1 | 0.00838 | 0.24 | 0.57 | 0.025 | 0.012 |
| m,p-Xylene | 1 | 0.0532 | 0.41 | 0.99 | 0.21 | 0.10 |
| o-Xylene | 1 | 0.0471 | 0.41 | 0.99 | 0.19 | 0.086 |
| Xylenes, Total | 1 | 0.05 | 0.41 | 0.99 | 0.20 | 0.091 |

## TABLE B-1

## DERMAL ABSORBED DOSE PER EVENT CALCULATION PARAMETERS
(Page 2 of 3)

| | Fraction Absorbed FA (unitless) | Dermal Permeability Coefficient Kp (cm/hr) | Lag Time Per Event $\tau_{event}$ (hr/event) | Time to Reach Steady-State t* (hrs) | Stratum Corneum/ Epidermis Permeability Coefficient Ratio B (unitless) | Normalized Absorbed Dose Per Event $DA_{event}$ (mg/cm$^2$-event)$^{(a)}$ |
|---|---|---|---|---|---|---|
| **Semivolatile Organic Organic Compounds** | | | | | | |
| Aniline | 1 | 0.00186 | 0.35 | 0.84 | 0.0069 | 0.0032 |
| Benzaldehyde | 1 | 0.00383 | 0.41 | 0.99 | 0.015 | 0.0070 |
| Benzoic Acid | 1 | 0.00565 | 0.51 | 1.22 | 0.024 | 0.011 |
| Bis-(2-ethylhexyl)phthalate | 0.4 | 1.13 | 16.18 | 72.88 | 8.59 | 5.0 |
| 4-Chloro-3-methylphenol | 1 | 0.0285 | 0.66 | 1.59 | 0.13 | 0.064 |
| Diphenylamine | 1 | 0.0373 | 0.93 | 2.24 | 0.19 | 0.10 |
| 3- and 4-Methylphenol | 1 | 0.00777 | 0.42 | 1.02 | 0.031 | 0.014 |
| Naphthalene | 1 | 0.0466 | 0.55 | 1.32 | 0.20 | 0.10 |
| N-Nitrosodiphenylamine | 1 | 0.0145 | 1.35 | 3.25 | 0.079 | 0.047 |
| N-Nitrosodimethylamine | 1 | 0.000251 | 0.27 | 0.66 | 0.00083 | 0.00039 |
| Pentachlorophenol | 1 | 0.127 | 3.26 | 12.55 | 0.80 | 0.63 |
| **Pesticides** | | | | | | |
| Aldrin | 0.8 | 0.293 | 11.63 | 47.73 | 2.15 | 2.2 |
| beta-BHC | 1 | 0.0206 | 4.47 | 10.73 | 0.14 | 0.12 |
| gamma-BHC | 1 | 0.0206 | 4.47 | 10.73 | 0.14 | 0.12 |
| alpha-Chlordane | 0.7 | 0.107 | 20.73 | 79.69 | 0.83 | 0.94 |
| gamma-Chlordane | 0.7 | 0.107 | 20.73 | 79.69 | 0.83 | 0.94 |
| 4,4´-DDD | 0.8 | 0.251 | 6.52 | 26.23 | 1.73 | 1.4 |
| 4,4´-DDE | 0.8 | 0.545 | 6.35 | 27.29 | 3.74 | 3.0 |
| 4,4'-DDT | 0.7 | 0.628 | 10.16 | 44.27 | 4.55 | 3.9 |
| Endosulfan I | 0.9 | 0.00286 | 19.98 | 47.96 | 0.022 | 0.032 |
| Endrin | 1 | 0.0326 | 14.29 | 34.29 | 0.24 | 0.34 |
| Heptachlor | 0.9 | 0.143 | 12.96 | 50.14 | 1.06 | 1.3 |
| Heptachlor Epoxide | 1 | 0.0209 | 15.92 | 38.22 | 0.16 | 0.23 |
| Methoxychlor | 1 | 0.0428 | 9.07 | 21.76 | 0.31 | 0.36 |
| **Metals** | | | | | | |
| Arsenic | | 0.001 | NA | NA | NA | 0.001 |
| Barium | | 0.001 | NA | NA | NA | 0.001 |
| Cadmium | | 0.001 | NA | NA | NA | 0.001 |
| Chromium | | 0.002 | NA | NA | NA | 0.002 |
| Lead | | 0.0001 | NA | NA | NA | 0.0001 |
| Selenium | | 0.001 | NA | NA | NA | 0.001 |
| Silver | | 0.0006 | NA | NA | NA | 0.0006 |
| Mercury | | 0.001 | NA | NA | NA | 0.001 |
| **Dioxins/Furans** | | | | | | |
| 1,2,3,7,8-PeCDF | 0.8 | 0.39 | 8.4 | 51.8 | 2.7 | 2.5 |
| 1,2,3,6,7,8-HxCDF | 0.5 | 0.52 | 13.2 | 70.3 | 3.9 | 2.6 |
| 1,2,3,4,6,7,8-HpCDD | 0.2 | 1.26 | 25.2 | 120.8 | 10.0 | 3.5 |
| OCDF | 0.2 | 0.99 | 32.2 | 155.9 | 8.0 | 3.1 |
| OCDD | 0.1 | 1.09 | 39.6 | 190.5 | 9.0 | 1.9 |

## TABLE B-1

## DERMAL ABSORBED DOSE PER EVENT CALCULATION PARAMETERS
(Page 3 of 3)

| | Fraction Absorbed FA (unitless) | Dermal Permeability Coefficient Kp (cm/hr) | Lag Time Per Event $\tau_{event}$ (hr/event) | Time to Reach Steady-State t* (hrs) | Stratum Corneum/ Epidermis Permeability Coefficient Ratio B (unitless) | Normalized Absorbed Dose Per Event $DA_{event}$ ($mg/cm^2$-event)$^{(a)}$ |
|---|---|---|---|---|---|---|

(a) $DA_{event}$ is a normalized value assuming a groundwater concentration of 1 µg/l

| | |
|---|---|
| HpCDD | Heptachlorodibenzo-p-dioxin |
| HxCDF | Hexachlorodibenzofuran |
| MTBE | Methyl tert-butyl ether |
| NA | not applicable or not available |
| OCDD | Octachlorodibenzo-p-dioxin |
| OCDF | Octachlorodibenzofuran |
| PeCDF | Pentachlorodibenzofuran |

# APPENDIX C – GOVERNING DOCUMENTS

## C-1 Health & Safety Plan

# Health and Safety Plan
# (Environmental, Assessment, and Remediation)

**Prepared By:**
**Cardno**
**1142 West 2320 South**
**West Valley City, Utah 84119**

**Prepared For:**
**NT Development**
**6400 West North Temple Frontage Road**
**Salt Lake City, Utah**
**Cardno Project No. 819AR00640.004**

**July 29, 2022**

# Health and Safety Plan
# Review and Approval

**Client:** NT Development **Project No.** 819AR00640

**Project Description:** 6400 West North Temple Frontage Road

**Prepared By:** James Grippa **Title:** Senior Field Supervisor **Date:** 09/13/2019

**Revised By:** Jonathan Thompson **Title:** Environmental Scientist **Date:** 5/6/2022

| | | |
|---|---|---|
| David Cline | | |
| Project Manger | Signature | Date |
| Peter Petro | Peter A. Petro | 7/29/22 |
| Reviewer’s Name | Signature | Date |

This Health and Safety Plan (HASP) has been written for the use of Cardno and its employees. It may also be used as a guidance document by properly trained and experienced Cardno subcontractors. However, Cardno does not guarantee the health or safety of any person entering this Site.

Due to the potentially hazardous nature of this Site and the activity occurring thereon, it is not possible to discover, evaluate, and provide protection for all possible hazards which may be encountered. Strict adherence to the health and safety guidelines set forth herein will reduce, but not eliminate, the potential for injury at this Site. The health and safety guidelines in this Plan were prepared specifically for this Site and should not be used on any other Site without prior research by trained health and safety specialists.

Cardno claims no responsibility for use of this Plan by others. The HASP is written for the specific Site conditions, purposes, dates, and employees specified and must be amended if these conditions change.

# Table of Contents

**Tables**

# Appendices

# 1 Emergency Information

## 1.1 Emergency Telephone Numbers

| | |
|---|---|
| On-site Emergency Contact (if available at operating facility) | **(801) 896-6797** |
| Fire and Police | **911** |
| Local Police Number | **(801) 395-8221** |
| Local Fire Department Number | **(801) 629-8221** |
| Nationwide Call Before You Dig | **811** |
| CORE Health (Cardno Nurse Line) | **1-855-CARDNO1, 1-855-227-3661** |
| Poison Control Center | **(800) 222-1222** |
| National Response Center | **(800) 424-8802** |

## 1.2 Spills

| | |
|---|---|
| Local Health Department (Salt Lake County Health Department Spills) | **(801) 580-6681** |
| State Environmental Agency (UDEQ) | **(801) 536-4400** |

## 1.3 Hospital

| | |
|---|---|
| Urgent Care (CareNow Urgent Care) | **(801) 973-2588** |

Note: 1/5/2022 JRT. Verified phone number and address. Clinic is open until 19:00 hours. After hours, please go to your nearest ER.

**Directions to CareNow Urgent Care: 441 S Redwood Rd, Salt Lake City, UT 84104**

- **Leave Subject Property via gate at 7200 West.**
- **Merge onto I-80 E to UT-68 S/1700 W/S Redwood Rd. Take exit 118 from I-80 E**
- **Follow UT-68 S/1700 W/S Redwood Rd to your destination**
- **Approximate travel time is 11 minutes.**

## 1.4 Emergency Assembly Location

Emergency evacuation Rally point is south of the main gate at of the Subject Site entrance outside of the fence.

## 1.5 First Aid Measures

In the event that employee exhibit symptoms of exposure call **CORE Health** immediately in first-aid assessment process. The following procedures will be used: **Petroleum Product Exposure**

> Eye Contact: Flush eye immediately with copious amount of water for a minimum of 15 minutes. Repeat until irritation is eliminated and seek medical attention.

> Skin Contact: Wash exposed area with soap and water for at least 15 minutes. If dermatitis or severe reddening occurs, seek medical attention.

> Inhalation: Move the person into fresh air. If symptoms persist, seek medical attention.

> Ingestion: Do not induce vomiting. Seek immediate medical attention.

## 1.6 Local Public Utility Service Providers:

| | |
|---|---|
| **Gas Number** | **(877) 542-2630** |
| **Electric Utility Number** | **(877) 508-5088** |
| **Sewer/Water Number** | **(801) 483-6900** |

## 1.7 Additional Contingency Telephone Numbers

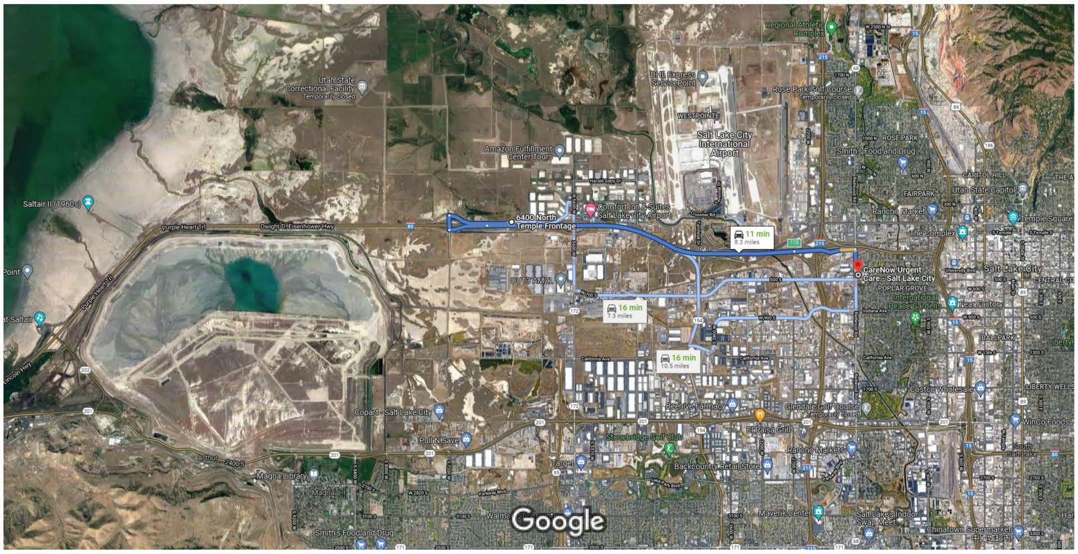
| | |
|---|---|
| Cardno (Local Cardno Office, State) | **(801) 256-3800** |
| David Cline, Project Manager | **(810) 558-1353** |
| TBD, Site Safety and Health Officer | **(XXX) XXX-XXXX** |
| TBD, Site Safety and Health Officer | **(XXX) XXX-XXXX** |
| Peter Petro, HSE Director Americas West | **(707) 338-3386** |
| Eric Rice, NT Development Project Manager | **(801) 726-0707** |
| Local or State Department of Occupational Safety & Health Administration | **(801) 530-6855** |
| Chemical Transportation Emergency Center (CHEMTREC) | **(800) 424-9300** |
| Utah Poison Control Center | **(800) 222-1222** |

Note: CHEMTREC is a public service of the American Chemistry Council (formerly known as the Chemical Manufacturers Association). CHEMTREC can usually provide hazard information, warnings, and guidance when given the identification number or the name of the product and the nature of the problem. CHEMTREC can also get employees in contact with the appropriate experts.

**NOTE:** For additional emergencies/important contacts, refer to your Cardno Lifelines Card

# EMERGENCY MEDICAL ROUTE TO HOSPITAL

Google Maps 6400 N Temple Frontage to CareNow Urgent Care - Salt Lake City Drive 8.3 miles, 11 min



Imagery ©2022 Landsat / Copernicus, Maxar Technologies, State of Utah, USDA Farm Service Agency, Map data ©2022 1 mi

6400 N Temple Frontage
Salt Lake City, UT 84116

**Get on I-80 E**

3 min (1.9 mi)

1. Head west on N Temple Frontage toward N 6500 W

1.0 mi

2. Turn left onto N 7200 W

0.2 mi

3. Turn left to merge onto I-80 E toward Salt Lake City

0.6 mi

**Continue on I-80 E to UT-68 S/1700 W/S Redwood Rd. Take exit 118 from I-80 E**

6 min (6.0 mi)

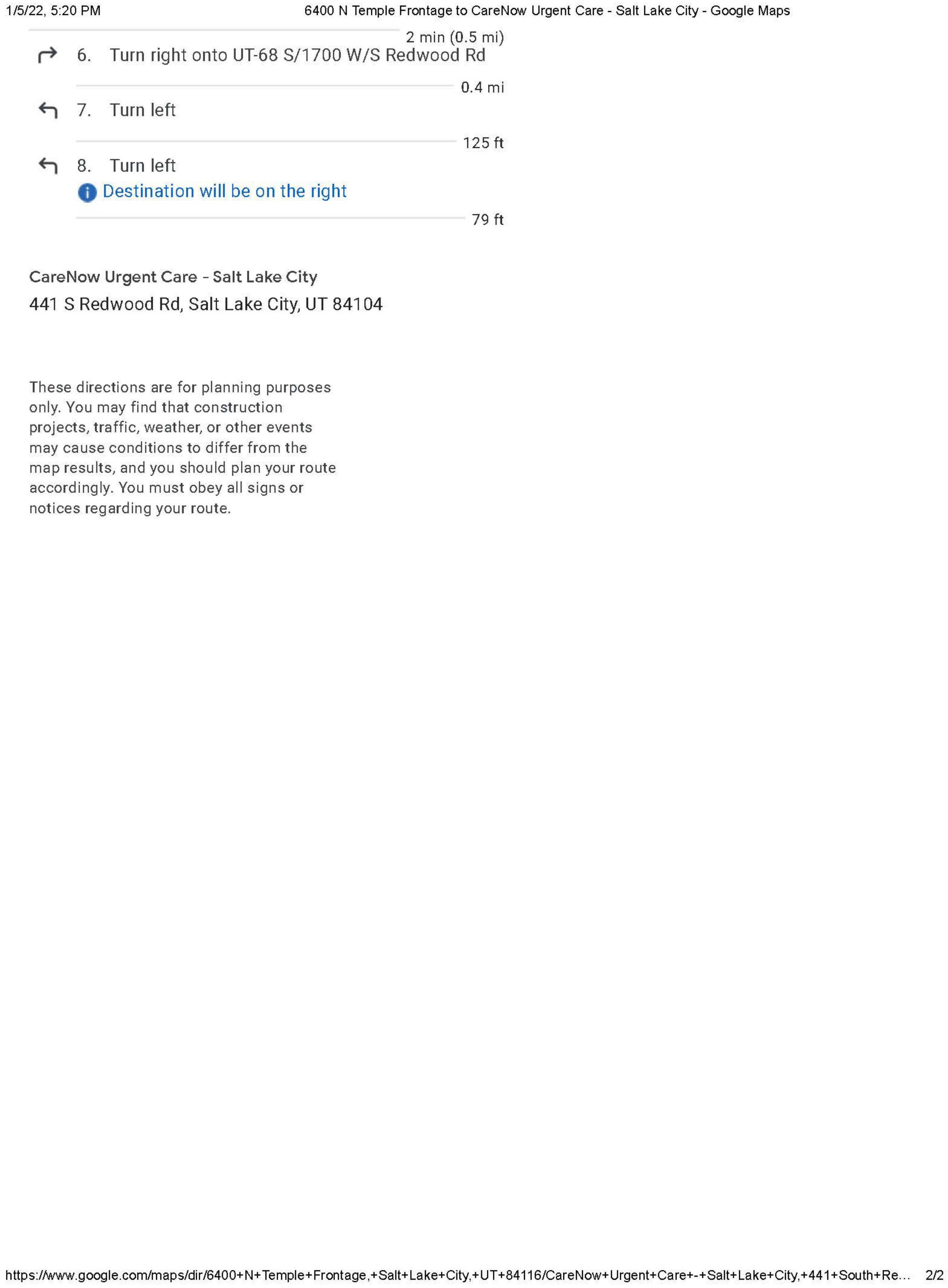
4. Merge onto I-80 E

5.0 mi

5. Take exit 118 for Redwood Rd/UT-68

1.0 mi

**Follow UT-68 S/1700 W/S Redwood Rd to your destination**



1/5/22, 5:20 PM 6400 N Temple Frontage to CareNow Urgent Care - Salt Lake City - Google Maps

2 min (0.5 mi)

↱ 6. Turn right onto UT-68 S/1700 W/S Redwood Rd

0.4 mi

↰ 7. Turn left

125 ft

↰ 8. Turn left

ⓘ Destination will be on the right

79 ft

**CareNow Urgent Care - Salt Lake City**

441 S Redwood Rd, Salt Lake City, UT 84104

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

https://www.google.com/maps/dir/6400+N+Temple+Frontage,+Salt+Lake+City,+UT+84116/CareNow+Urgent+Care+-+Salt+Lake+City,+441+South+Re… 2/2

# 2 Introduction

## 2.1 Scope and Applicability of the Site Health and Safety Plan

This Health and Safety Plan (HASP) has been prepared by Cardno for the activities associated with soils vapor sampling, groundwater sampling, excavation of municipal solid waste (MSW), stockpiling, and placement of MSW in new solid waste repository at the Airport West VCP Phase 1 Area 6400 North Temple Frontage Road, Salt Lake City, Utah (Site).

The health and safety protocols established in this HASP adhere to 29 Code of Federal Regulations (CFR) 1910.120 and incorporated by reference Utah Administrative Code R614-1-4, and based on past field experiences, specific Site conditions, and chemical hazards known or anticipated to be present from available Site data. The following HASP is intended solely for use during the proposed activities described in the project documents and technical specifications. Specifications herein are subject to review and revision based on actual conditions encountered in the field during Site characterization activities. Such changes may be instituted by using the HASP List of Approved Amendments and/or Changes (see Appendix C).

Before Site operations begin, all employees, including subcontractors for Cardno covered by this plan, involved in these operations will have read and understood this HASP and all revisions. All Site employees have the authority to “Stop Work” if unsafe conditions are present or discovered during Site activities. Before work begins, all affected employees will sign the Health and Safety Plan Acknowledgment Form (see Appendix C). By signing this form, all individuals recognize the requirements of the HASP, known or suspected hazards, and will adhere to the protocols required for the project Site.

For additional information regarding the Cardno policies referenced in this HASP, refer to Cardno’s Learning Management System (LMS) or contact your regional health and safety manager.

This site safety plan will be on site anytime employees are present to work at or access the site.

## 2.2 Historical Overview

The subject property is located at 6400 West North Temple Frontage Road in Salt Lake City, Utah. The site is occupied by the inactive North Salt Lake Landfill, adjacent pastureland, and roadways.

The former North Temple Landfill (NTL) is located between downtown Salt Lake City and the Great Salt Lake, along US Interstate 80 (I-80) on the north frontage road between 5600 West and 7200 West, within the northwest portion of Salt Lake County, Utah. The NTL Site is approximately 765 acres in area. The Phase 1 Area is approximately 250 acres of the NTL Site located in the southeast corner of the NTL Site. The NTL is a closed municipal landfill that was operated by Salt Lake City Corporation from 1959 until 1979. The topography of the NTL is relatively flat, with mounding and depressions due to trenching cell construction and varying landfill practices during operation. There is a perimeter fence with several locked gates for access to the NTL.

The North Temple Frontage Road is adjacent to both the NTL and Phase 1 Area along the south perimeter with a canal situated between the road and the property perimeters. Adjacent NTL east of the NTL and Phase 1 Area is a commercial warehouse development.

The full extent of the work to be performed will be dependent upon results of laboratory analysis conducted during the field effort. The scope of the investigation includes several operational activities. This includes:

- Groundwater sampling of 13 existing groundwater monitoring wells
- Sampling of soil vapor associated with excavation and placement of the MSW

- Management of investigative derived materials (IDM)
- Excavation of the MSW in the Phase 1 Area
- Stockpiling of excavated MSW
- Placement in a new solid waste repository
- Handling, treatment, and disposal of leachate

## 2.3 Visitors

All visitors to the Site must be instructed about the hazards of the activities that Cardno or its subcontractors are performing. All visitors must sign the Cardno Visitors Log (see Appendix C).

## 2.4 Subcontractor Activities

All subcontractors used at the Site have been Pre-Approved in the Cardno Subcontractor Prequalification System. The subcontractors will be excavating and transporting MSW into a new engineered impoundment. The subcontractors will handle, treat and dispose of leachate. Subcontractors will install a geosynthetic clay cover.

## 2.5 Project Organization

All employees and visitors who may enter work areas on this Site must comply with the requirements of this HASP. All Site employees have the authority to "Stop Work" if unsafe conditions are present. The specific responsibilities and authority of management, safety and health, and other employees on this Site are detailed in the following sections.

## 2.6 Site Safety and Health Officer (SSHO)

The Site Safety and Health Officer (SSHO) has the responsibility and authority to develop and implement this HASP and to verify compliance. The SSHO reports to the Project Manager (PM). The SSHO is on-site during all work operations and has the responsibility to halt Site work if unsafe conditions are detected. The responsibilities of the SSHO at the Site include the following:

> Managing the health and safety functions on the site.

> Ensuring site monitoring, employee training, and effective selection and use of personal protective equipment (PPE).

> Conducting daily Tailgate Safety Meetings for site employees and subcontractors and summarize the training on the Tailgate Meeting Form (see Appendix C). The following topics should be covered during safety meetings:

  - Hazard Communication (i.e., SDS location, and container labeling, chemical hazards of non-routine tasks).
  - Determine applicability of Standard Operating Procedures (SOP) in Section 9.0 and communicate procedures.
  - Review site safety requirements.
  - Give refresher training on heat or cold stress (Sections 6.2 and 6.3) when appropriate
  - Review site emergency procedures.
  - Discuss location and use of a rig kill switch for drilling/boring operations.

> Conducting daily safety inspections of the site looking for unsafe acts or conditions and providing corrective action as appropriate.

## 2.7 Site Supervisor

The Site Supervisor is responsible for field operations and reports to the PM. The Site Supervisor is the on-site coordinator and overseer of operations. It is the Site Supervisor's duty to maintain site security, supervise the employees on the site, coordinate the activities of the subcontractor personnel, and check that the HASP is followed and modified when necessary. The Site Supervisor’s specific responsibilities include:

> Executing the work plan and schedule as detailed by the Project Manager.

> Coordination with the SSHO on health and safety issues.

> Ensuring Site work compliance with the requirements of the HASP.

> Before site activities, contact the hospital emergency room, local fire department, and local police department, as applicable. If outside town, contact county officials and local emergency services.

## 2.8 Project Manager (PM)

The PM has the primary responsibility for the fulfillment of the terms of the contract and overseeing operations for the purpose that includes meeting legal and safety requirements. It is the PM's responsibility to keep the project on schedule, within budget, and communicate with the client regarding the progress toward specified goals.

The PM will inform the Health and Safety Director of all HASP modifications, violations, injuries, exposures, and near-miss situations. The PM responsibilities include:

> Provide employees time to read and understand the site Health and Safety Plan (HASP) before fieldwork.

> Conduct project start-up health and safety briefing for: Field personnel, the Site Supervisor, the project team.

> Check that each subcontractor is pre-approved and that each subcontractor’s site employees have appropriate HAZWOPER Training Certificates and other medical clearances to perform site work.

> That hazards identified during any site audits are corrected. If necessary for immediate hazards, shut down field operations if hazards cannot be corrected or the hazards present an immediate threat to life and health.

## 2.9 Health and Safety Director (HSD)

The Health and Safety Director (HSD) is responsible for providing professional health and safety advice and oversight management to the project. The HSD will review and provide support for concerns regarding the health and safety of field employees assigned to this project, including:

> If requested by the Project Manager, approval of Routine HASP.

> Approval of all Non-Routine HASP.

> Review of incident reports, inspections, and air monitoring results.

> When required, the HSD will conduct a field audit of the site to evaluate the adequacy of the program and implement the necessary changes through the HASP.

## 2.10 Project Field Team

The Project Team includes technicians, engineers, scientists, geologists, and possibly subcontractors who perform field activities. Each individual team member will be responsible for understanding and personally complying with the HASP and Site health and safety requirements. Project Team members will report health and safety violations to either the Site Supervisor or the SSHO. Health and safety responsibilities, as discussed in this Plan, which are shared by all site employees include:

- Complying with the requirements of the HASP.
- Reporting unsafe acts or conditions.
- Retain copies at the Site of the following health and safety records:
  - Current HAZWOPER Training Certificate.
  - Respiratory Protection Training Certificate and current fit test record for potential respirator users.
  - Physician's approval for hazardous-waste fieldwork and/or respirator use.
  - First-aid/CPR and bloodborne pathogens training certificate.

# 3 Task/Operation Health and Safety Risk Analysis Summary

This section of the HASP describes the safety and health hazards associated with the Site work and control measures selected to protect employees. The purpose of the Job Safety Analysis (JSA) is to identify the routine safety and health hazards associated with the routine Site tasks and operations. Using this information, appropriate control methods are selected to eliminate the identified risks or effectively control them.

## 3.1 Job Safety Analysis (JSA)

Each specific JSA appears on a separate copy of the spreadsheets in Appendix A. A single JSA may be used for a task/operation performed in multiple locations if the hazards, potential exposures, and controls are the same at each location.

## 3.2 Health Analysis and Chemical Risk Assessment

Chemicals may be purchased and transported to the site to support site characterization and remediation operations. The principal chemical contaminants at the Site are expected to be Total Petroleum Hydrocarbons/Diesel range (TPH-DRO), Volatile Organic Compounds (VOC), Semi volatile Organic Compounds (SVOC), RCRA metals, and Oil & Grease (Waste Oil).

Additionally, the Hazard Communication Program requires Cardno to provide employees, contractors, subcontractors, and visitors with information on the health effects of these chemicals and necessary actions to protect against exposure. This information is transmitted through Safety Data Sheets (SDS), the NIOSH Pocket Guide, container labels, training, and a written Hazard Communication program.

Site activities will adhere to the Cardno Hazard Communication Program (Program). All Site personnel, including subcontractors, will be briefed on this Program as part of the Site orientation training before starting work. In accordance with this Program, the PM and Site Supervisor will check that each chemical brought to the Site is accompanied by its SDS. A copy of each SDS will be made available to each site employee who may be potentially exposed to the chemical. In addition, the Site Supervisor will check that all subcontractors bring at least one copy of SDS for each chemical they bring onto the Site. The Site Supervisor will also check that all chemical containers brought to the site to determine if they are labeled as to its contents and appropriate hazard warnings. Compliance with the SDS requirements includes employees having access to the listed PPE for use and spill response.

## 3.3 Risks Associated with Excavation and Stockpiling MSW

Excavation and stockpiling operations will conform to the JSA and client expectation. During excavation and stockpiling operations, the subsurface is penetrated enabling soil and/or groundwater sampling procedures. Contaminated soil cuttings and groundwater may be brought to the surface, creating a potential for exposure through skin contact and inhalation of vapors. The open excavation and stockpiling also creates a conduit for vapors to be released to the atmosphere. However, the amount of vapors released to the atmosphere is relatively small and vapors are usually quickly diluted and dispersed in air. Air monitoring is required to determine if protective equipment is necessary, as described in Section 5.0 of this HASP.

In addition to these chemical risks, the risk of excavating a buried utility, such as a gas, water, electric line, or underground storage tank or other structures, is always present. Cardno will follow the accepted clearance procedures for pre-notification, clearance, and marking of underground utilities in the vicinity of the intrusive groundwork.

Risks of injury associated with the excavation and stockpiling operation exists. The risks of working near overhead electrical lines also present a safety hazard. The SSHO will check for the presence of overhead lines and other obstructions. No excavation operations will be performed within 10 feet of overhead lines with voltages 0-50 kV. For other voltages refer to Cardno's Electrical Safety Policy.

. All employees will confirm to Cardno's heavy equipment exclusion zone (HEEZ). This safe work practice requires only the heavy equipment operator and a spotter to be within the swing and movement radius of any heavy equipment. At all times will the spotter remain in view of the equipment operator and two-way communication will be in use while the equipment is on. At any point in time the operator loses sight of the spotter the equipment is powered down. Any other employee nearing the operating equipment will not approach until the equipment is powered down. A discussion will be held with the excavator operator on each excavator at the startup of the field work to discuss emergency shut-down procedures and documented as part of a safety Inspection such as the Monthly Heavy Equipment Safety Inspection Checklist found in Appendix C.

### 3.4 Noise Hazards and Controls

Exposure to high levels of noise may occur when working near drill rigs or other heavy equipment. Also, depending upon where the work is being performed, local equipment (e.g., airports, factory machines, etc.) may produce high levels of noise. Employees exposed to noise levels in excess of the action level of 85 decibels (A-weighted, Slow Response) will be included into the Cardno's hearing conservation program. The SSHO may evaluate employee noise exposures using a Noise Survey Meter or a Noise Dosimeter. The HSD may conduct additional noise monitoring to determine the appropriate response to be taken. Employees will be provided with ear plugs and/or earmuffs when exposed to noise levels in excess of the 8-hour Permissible Exposure Limit (PEL) of 90 decibel (A-weighted, Slow Response). This hearing protection shall have a Noise Reduction Rating (NRR) to protect hearing in accordance applicable OSHA regulation 1910.95 and Utah Occupational Safety and Health Field Operations Manual (UAC R614-1-6. Personal Protective Equipment), including the NRR de-rating factor of [(NRR-7)/2].

### 3.5 Biological Hazards

Site activities on this site may expose employees to other hazards such as poisonous plants, insects, animals, and indigenous pathogens. Protective clothing and respiratory protection equipment are available to employee. Employees will receive training on how to identify poisonous plants, animals, and insects, and mitigation measures to greatly reduce the chances of exposure. Thoroughly washing any exposed body parts, clothing, and equipment will also protect against infections. If working in wooded/grassy areas, use appropriate insect repellants (containing DEET and/or Permethrin) and apply them per the manufacturers' directions.

# 4 Air Monitoring and Personal Protective Equipment

### 4.1 Site Air Monitoring Requirements

To prevent exposure to hazardous conditions and aid in the selection of personal protective equipment, monitoring for the presence of airborne contaminants will occur when knowledge of the site indicates their potential presence. One or more of the following direct-reading instruments may be used to aid in this determination. High Ionization Potential [11.7 eV] Photoionization Detectors (PID), MultiRAE five gas multimeter will measure non-specific organic gases, vapors, combustible methane, carbon monoxide, oxygen, and hydrogen sulfide. To differentiate for the presence of chlorinated compounds Drager Gas Detection Tubes using a Dräger X-act® 5000 pump will be utilized when there is a higher value from the PID when compared to MulitRAE readings. To qualitatively evaluate for metals and other non-volatile compounds a DustTrak™ will measure dust concentrations in the air. These instruments should be calibrated, or bump tested daily and whenever the readings may be erratic. All readings should be recorded in the field log books.

The breathing zone of the employee(s) anticipated to have the highest potential for exposure for each task will be monitored using an appropriate combination of some or all of these direct-reading instruments. Air monitoring will occur every 15 minutes during non-intrusive activities, or every 5 feet of penetration during intrusive activities. Site tasks and air monitoring requirements are shown in Table 4-1. Additional Site monitoring may occur at the discretion of the SSHO, Site Supervisor, or HSD.

**NOTE: All air monitoring equipment must be calibrated as per manufacturer's instructions.**

**Table 4-1 Site Air Monitoring Requirements**

| Site Activity | Instrument | Frequency | Location | Caution |
|---|---|---|---|---|
| Drilling | PID | Every 15 minutes or 5 feet of penetration | In breathing zone of person nearest activity | Communicate with equipment operator before sampling |
| | CGI | Every 15 minutes or 5 feet of penetration | In work area near activity | Communicate with equipment operator before sampling |
| | Detector tubes | As indicated in Table 5-2 when exceed PID limits | In breathing zone of person nearest activity | Strong odors may require further testing. |
| | DustTrak™ | Every 15 minutes or 5 feet of penetration | In work area near activity | Communicate with equipment operator before sampling |
| Well Development & Ground water sampling | PID | Every 15 minutes | In breathing zone of person nearest activity | Strongest likely concentration when opening cover |
| | CGI | Every 15 minutes | In work area near activity | Strongest likely concentration when opening cover |
| | Detector tubes | Every 15 minutes | In breathing zone of person nearest activity | Strongest likely concentration when opening cover |
| Landfill Excavation | PID | Every 15 minutes | In breathing zone of person nearest activity | Strongest likely concentration when opening cover |
| | CGI | Every 15 minutes | In work area near activity | Strongest likely concentration when opening cover |
| | Detector tubes | Every 15 minutes | In breathing zone of person nearest activity | Strongest likely concentration when opening cover |
| | DustTrak™ | Every 15 minutes or 5 feet of penetration | In work area near activity | Communicate with equipment operator before sampling |

Air monitoring results obtained from the breathing zone during field activities will be recorded in field logbooks or approved site data sheets. All such records will also include the location, date/time, weather conditions, person monitored, background concentration, and identification of specific contaminant whenever possible. Air monitoring information will be utilized to evaluate employee exposure and assess the appropriateness of PPE for site conditions. The PPE for the Site are discussed in Section 5.2. Photoionization detector (PID), MultiRAE, combustible gas indicator (CGI), and/or detector tube, DustTrak™ dust readings measured in the employees breathing zone will be used to determine the level of protection required. PID readings refer to readings above background, which are sustained for at least 5 minutes and are measured during the performance of field tasks. PID readings are used for general screening.

## 4.2 Action Levels for Personal Protection Equipment

The first and foremost means of protecting employees from injuries or exposures is to eliminate the exposure. The general hierarchy for controlling potential exposures is: (1) Engineering Controls; (2) Administrative Controls; and (3) the use of PPE. PPE is a means of preventing injury or exposure when exposure elimination and/or other control means are not feasible.

The initial level of protection and the Action Levels at which the PPE will be upgraded are determined based on the identification of specific chemicals expected to be present at a Site and the established OSHA Permissible Exposure Levels (PEL) or ACGIH Threshold Limit Values (TLVs), whichever is lower. In the event more than one chemical is expected or exists at a Site, the most hazardous chemical will dictate the level of personal protection required. Table 4-2 shows the action levels for levels of personal protection equipment.

### Table 4-2 Action Levels for Personal Protection Equipment

| Monitoring Equipment | Hazard | Action Level Above Background | Action |
|---|---|---|---|
| PID/MultiRAE | VOC | <10 ppm | Level D. Sustained readings will be checked using detection tubes, positive responses on tubes will require immediate withdrawal. Contact the PM and HSE for further instructions |
| | | 10 to 50 ppm | Level C. Move upwind and continue air monitoring, cease operations, use detector tube(s) for (contaminant) and reference Table 4-3 below. |
| | | >50 ppm | Immediate withdrawal. Contact the PM and HSD for further instructions to proceed. |
| MultiRAE | $O_2$ | <19.5% | Immediate withdrawal. Contact the PM and HSD for further instructions to proceed |
| | | 19.5% to 23% | Level D. Normal oxygen concentrations |
| | | >23% | Immediate withdrawal. Contact the PM and HSD for further instructions to proceed. Shutdown all ignition sources |
| MultiRAE | H2S | <10 ppm | Level D. |
| | | 1 to 20 ppm | Level C. Move upwind and continue air monitoring, cease operations, or use detector tube(s) for (contaminant) and reference Table 4-3 below. |
| | | >20 ppm | Immediate withdrawal. Contact the PM and HSD for further instructions to proceed. |
| MultiRAE | $CH_4$ | < 10% LEL | Level D. |
| | | 10% LEL | Immediate withdrawal at 10% lower explosive limit. Contact the PM and HSD for further instructions to proceed. Shutdown all ignition sources |
| MultiRAE | CO | <35 ppm | Level D. |
| | | >50 ppm | Immediate withdrawal. Contact the PM and HSD for further instructions to proceed. |

If readings exceed the range for level of protection indicated, employees should withdraw and not return until an appropriate level of protection has been donned. Upgrading protection shall be communicated to the SSHO, who will in turn convey this information to the HSD. Upon review of PID, MultiRAE, DustTrak™ and detector tube measurements, the HSD may further adjust the PPE requirements.

Any upgrading to higher levels of protection may require additional personal sampling using National Institute for Occupational Safety and Health (NIOSH) or Occupational Safety and Health Administration (OSHA) methods for the collection and analysis of airborne contaminants.

Air monitoring equipment used on the Site should be calibrated with the following:

Calibration/Response Check

| **Types** | **Frequency** | **Gas Standard** |
|---|---|---|
| PID | Daily | 100 ppm isobutylene in air |
| MultiRAE | Daily | 100 ppm isobutylene in air |

Field personnel, in conjunction with the Site Supervisor and SSHO, may choose to allow ventilation of vapors before resuming work (rather than using higher levels of PPE). If ventilation is conducted, additional air monitoring will be performed prior to the resumption of work to determine the level of PPE required.

**Table 4-3 Chemical Table**

| Chemical | CAS No. | PEL$^A$ | STEL$^A$ | TWA$^A$ | IDLH$^A$ | IP | BP | VP |
|---|---|---|---|---|---|---|---|---|
| 1,1-Dichloroethane | 75-34-3 | 100 | --- | 100 | 3,000 | 11.06 | 135 | 182 |
| 1,4-Dioxane | 123-91-1 | 100 | --- | 1 | 500 | 9.13 | 214 | 29 |
| Benzene[1] [carc] | 71-43-2 | 1 | 5 | 0.1 | 500 | 9.24 | 176 | 75 |
| Carbon tetrachloride | 56-23-5 | 10 | 25 | 2 | 200 | 11.47 | 170 | 91 |
| cis-1,2-Dichloroethene [skin] | 156-59-2 | 200 | ---- | 200 | --- | --- | 140 | 400 |
| Methylene chloride [carc] | 75-09-2 | 25 | 125 | App A | 2,300 | 11.32 | 104 | 350 |
| Tetrachloroethene [carc] | 127-18-4 | 100 | 200 | App A | 150 | 9.32 | 250 | 14 |
| Trichloroethene [carc] | 79-01-6 | 100 | 200 | App A | 1,000 | 9.45 | 189 | 58 |
| Vinyl chloride [carc] | 75-01-4 | 1 | 5 | App A | --- | 9.99 | 7 | 3.3 |

| Chemical | CAS No. | PEL$^A$ | STEL$^A$ | TWA$^A$ | IDLH$^A$ | IP | BP | VP |
|---|---|---|---|---|---|---|---|---|
| 1-Methylnaphthalene [skin] | 90-12-0 | --- | ---- | 0.5 | --- | --- | 464 | --- |
| 2-Methylnaphthalene | 91-57-6 | --- | ---- | 0.5 | --- | --- | 466 | <1 |
| Benz(a)anthracene [skin], [carc] | 56-55-3 | ---- | ---- | --- | --- | --- | | --- |
| Benzo(a)pyrene [skin], [carc] | 50-32-8 | 0.2$^B$ | ---- | 0.1$^B$ | --- | --- | 351 | --- |
| Benzo(b)fluoranthene [carc] | 205-99-2 | --- | ---- | --- | --- | --- | | <0.0E-5 |
| Bis(2-ethylhexyl) phthalate | 117-81-7 | 5 | 10 | 5 | 5,000 | --- | 727 | <0.01 |
| Chrysene [carc] | 218-01-9 | 0.2$^B$ | ---- | 0.1$^B$ | --- | --- | 838 | --- |

Notes:
Cas. No. = Chemical abstract number
App A = Substances determined by NIOSH to represent potential occupational carcinogens. Occupational exposure to these substances should be limited to the lowest feasible levels possible. Use of only the most reliable and protective respirators be used these include (1) self-contained breathing apparatus with full face in positive pressure mode or (2) a supplied air respirator full face in positive pressure mode.
PEL = Permissible exposure limit: 8-hour, time-weighted average (Occupational Safety and Health Administration [OSHA])
STEL = Short-term exposure limit: 15-minute time-weighted average (ACGIH)
TWA = Time-weighted average: 8 hour, [same as TLV], American Conference of Governmental Industrial Hygienists [ACGIH])
[carc] = Substance identified as a suspected or confirmed carcinogen
[skin] = Substance may be absorbed through the skin, the mucous membranes, or the eyes.
1 = Federal OSHA benzene limits given for PEL and STEL; STEL has a 50-minute duration limit
--- = No data published for the listed chemical in the NIOSH pocket guide
A = All chemical concentrations are in parts of gas or vapor per million parts air (ppmv) unless otherwise noted
B = If noted by ‘B’ concentrations are in milligrams per cubic meter (mg/m$^3$) and NOT parts of gas or vapor per million parts air (ppmv).

IP = Ionization potential measured in electron volts (eV)
BP = Boiling Point measured in degree Fahrenheit (°F)
VP = Vapor Pressure measured in milligrams of mercury

If site conditions indicate the possibility of elevated organic compound levels, air monitoring will be performed to determine whether employees are being exposed to airborne concentrations above the PELs listed in Table 4-3. Since identifying specific compounds will be difficult using current organic vapor or photo-ionization detector (PID) technology the cumulative reading will require action if the gasoline PEL is exceeded, except where a specific known chemical or group of chemicals has been identified, then specific analyzers will be used. All air monitoring equipment will show calibration data within manufacturer specifications and the manufacturer's instruction manual will be on site. Calibration gases include 100 ppmv Isobutylene and 100 ppm Hexane. Multi-gas meters will use calibration gases specific to that unit's analyzers and at concentrations that are protective of employee exposure health. Employees are trained to know and understand the response factor of the calibration gas to the monitoring instrument for the chemicals listed in Table 4-3 (Section 6.4) to identify the when the real-time instrument reading is approaching the exposure limit.

Bump testing is required to ensure the proper operation of air monitoring equipment. Bump testing is measuring a known concentration of gas against the measured reading provided by the air-monitoring instrument. Instrumentation readings that fall within the technical specifications of the instrument are within calibration. This health and safety plan requires bump testing when there exist conditions for hydrogen sulfide gas to be present or an environment where an employee can work in an oxygen deficient or enriched atmosphere.

All $H_2S$ personal gas monitors must be bump tested within the last 24 hours prior to use. The daily bump test prior to use is done to ensure the device is not defective. Any $H_2S$ monitor that fails the initial bump test shall not be used and the employee who was assigned that monitor may not enter the area where monitoring is required.

Note: Records of the bump test results will be documented on the daily field notes, any client required permits, as well as in the equipment calibration log.

Employees shall perform a bump test for the $O_2$ personal monitor every day the meter is in use or at least every six months to ensure that the personal gas monitor is not defective. Any $O_2$ monitor that fails the initial bump test shall not be used and the work requiring the $O_2$ monitor will not be conducted until the monitor is repaired or replaced.

Note: Records of the bump test results will be documented on the daily field notes, any client required permits, as well as in the equipment calibration log.

## 4.3 Levels of Protection

Levels of protection for Site activities are described on the Site Air Monitoring Summary. The protection levels may include all or some of the following, based on work scope.

Level D:

> Work uniform – Long pants and shirt with sleeves (no tank tops) – refer to Personal Protective Equipment in Section 5.2.
> Disposable, inner nitrile gloves.
> Chemical-resistant boots with steel toe.
> Safety glasses with side shields.
> High Visibility Reflective Vest: Class 1, Class 2, or Class 3 (select based on traffic speed).
> Hard hat.
> Disposable, chemical-resistant outer boot covers. *
> Hearing protection. *

LEVEL C:

> Half-face or full face, air purifying respirator (NIOSH approved).
> Disposable, hooded, chemical resistant clothing.
> Disposable, chemical resistant outer gloves.
> Disposable, inner nitrile gloves.

- Chemical resistant boots with steel toe.
- Disposable boot covers.
- Hard hat.
- Safety Glasses with side shields.
- High Visibility Reflective Vest: Class 1, Class 2, or Class 3 (select based on traffic speed)
- Coveralls. *
- Hearing protection. *

*Optional Equipment, depending on conditions/exposures.

### 4.4 Respiratory Protection

Respiratory protection requirements are described in detail in the Cardno Respiratory Protection Program. Basic rules of respiratory usage are listed below:

- Facial hair that interferes with a satisfactory fit of the mask-to-face seal is not allowed on employees who are required to wear respirators.
- Respirator cartridges should be replaced after approximately 8-hours of continuous or intermittent usage, unless otherwise noted. Cartridges should also be replaced if they become damaged, after the expiration date is exceeded, if vapor smell breakthrough occurs, or if filters become clogged causing resistance to breathing.
- Contact lenses may be worn when respiratory protection is required, in conjunction with additional eye protection to protect against particles or splashes, provided there is no interference with the respirator seal.
- Respirators shall be cleaned and disinfected after each day's use or more often, if necessary.
- Prior to donning, respirators will be inspected for worn or deteriorated parts. Emergency respirators or self-contained devices will be inspected at least once a month and after each use.
- After donning, employees shall perform a positive and negative user fit-check to determine if a good seal has been achieved.
- Each employee shall make sure that they have an annual respirator fit test, medical clearance and respiratory protection training.

## 5 Health Surveillance Program

### 5.1 Employee Medical Examinations

All employees involved in work at the Site will participate in Cardno’s Medical Surveillance Program administered by Health Resources. Additionally, when respirators are required (as determined by the SSHO and project manager), each employee will also have current respirator clearance.

A post project, follow up exam may be required if an exposure incident is reported, or an employee shows specific symptoms associated with the known or suspected hazardous chemicals. The HSD and the Project Manager will determine when post project exams are required.

### 5.2 Heat Stress Program

This procedure applies to all employees when heat stress conditions exist at project sites.

### 5.2.1 Training

The SSHO will have received acceptable training in first aid and Cardiopulmonary Resuscitation (CPR), including training in heat related illnesses. The SSHO shall also be trained on the requirements of the Cardno Policy for Industrial Hygiene, which contains the requirement for Heat Stress monitoring. All employees should be capable of recognizing and treating the signs and symptoms of heat stress conditions. During potential heat stress conditions, ice should be readily available to rapidly cool victims.

### 5.2.2 Fluid Replacement

Water will be made available at the Site for employee fluid replacement. When heat stress is determined to be a problem by the SSHO, employees will be provided with balanced, electrolyte solutions to replace fluid and electrolyte loss. Employees will be provided with replacement fluids at a minimum rate of 8 ounces every 15 to 20 minutes per person.

### 5.2.3 Acclimatization

Acclimatization is a gradual physiological adaptation that improves an individual’s ability to tolerate heat stress. Full-heat acclimatization requires up to 3 weeks of continued physical activity under heat-stress conditions similar to those anticipated for the work. Its loss begins when the work activity in the heat stress conditions is discontinued. A noticeable loss usually occurs within 3 – 4 days.

### 5.2.4 Rest Breaks

When heat stress conditions are applicable, all rest breaks should be taken out of the zone of exclusion into a cooler, shaded, rest area. If these conditions are not available, more frequent rest breaks will be taken.

### 5.2.5 Heat Stress Monitoring

Heat Stress and heat strain are conditions resulting from environmental factors including temperature, relative humidity, radiant heat transfer, and air movement, as they are affected by clothing. The primary objective of the heat stress management program is to prevent heat stroke which is life threatening and the most serious of the heat-induced disabilities. Extra caution should be taken for employees who are not acclimated to working in the heat.

The following Heat Stress Index should be used as a guide to evaluate heat stress situations. If the Heat Stress exceeds 105 degrees Fahrenheit, contact the HSD prior to work for detailed guidance.

**Heat Stress Index**

| Temp. °F | Relative Humidity | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 10% | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% |
| 105 | 98 | 104 | 110 | 120 | 132 | | | | |
| 102 | 97 | 101 | 108 | 117 | 125 | | | | |
| 100 | 95 | 99 | 105 | 110 | 120 | 132 | | | |
| 98 | 93 | 97 | 101 | 106 | 110 | 125 | | | |
| 96 | 91 | 95 | 98 | 104 | 108 | 120 | 128 | | |
| 94 | 89 | 93 | 95 | 100 | 105 | 111 | 122 | | |
| 92 | 87 | 90 | 92 | 96 | 100 | 106 | 114 | 122 | |
| 90 | 85 | 88 | 90 | 92 | 96 | 100 | 106 | 114 | 122 |
| 88 | 82 | 86 | 87 | 89 | 93 | 95 | 100 | 106 | 115 |
| 86 | 80 | 84 | 85 | 87 | 90 | 92 | 96 | 100 | 109 |
| 84 | 78 | 81 | 83 | 85 | 86 | 89 | 91 | 95 | 99 |
| 82 | 77 | 79 | 80 | 81 | 84 | 86 | 89 | 91 | 95 |
| 80 | 75 | 77 | 78 | 79 | 81 | 83 | 85 | 86 | 89 |
| 78 | 72 | 75 | 77 | 78 | 79 | 80 | 81 | 83 | 85 |
| 76 | 70 | 72 | 75 | 76 | 77 | 77 | 77 | 78 | 79 |
| 74 | 68 | 70 | 73 | 74 | 75 | 75 | 75 | 76 | 77 |

**NOTES: Add 10° F when protective clothing is being used; Add 10° F when in direct sunlight**

| HSI Temp | Category | Injury Threat |
|---|---|---|
| Above 130° F | Extreme Danger | No work unless emergency exists. Contact Cardno HSD and Corporate Risk Management Department prior to proceeding. Heat cramps or exhaustion likely, heat stroke possible if exposure is prolonged and there is physical activity. |
| 105° to 130° F | Danger | Contact HSD prior to proceeding. Requires strict adherence to ACGIH Heat Stress Guidelines, including use of on-site WBGT equipment. Heat cramps or exhaustion likely, heat stroke possible if exposure is prolonged and there is physical activity. |
| 90° to 105° F | Extreme Caution | Heat cramps or exhaustion likely, heat stroke possible if exposure is prolonged and there is physical activity. |
| 80° to 90° F | Caution | Heat cramps or exhaustion likely, heat stroke possible if exposure is prolonged and there is physical activity. |
| Below 80° F | Normal Range | Typical conditions for time of year. Little or no danger under normal circumstances. As always, anticipate problems and work safely. |

## 5.3 Cold Stress Program

This procedure applies to all employees who perform field work in cold environments at risk of cold stress injury and intended to protect employees from the most severe effects of cold stress.

### 5.3.1 Training

Cardno Site employees have been trained in cold stress as part of their HAZWOPER 40-hour initial training. Site employees will receive refresher training by the SSHO in cold stress safety and health procedures. The training program will include, as a minimum, instruction in the following areas:

- Proper first-aid treatment.
- Proper clothing practices.
- Proper eating and drinking habits.
- Recognition of impending frostbite.
- Recognition of the signs and symptoms of impending hypothermia or excessive cooling of the body when shivering does not occur.
- Safe working practices.

The SSHO will be trained in first-aid, CPR, and cold stress conditions.

### 5.3.2 Environmental Monitoring

Frostbite and hypothermia are two types of cold injury that employees must be protected against during the performance of field duties. The objective is to prevent the deep body temperature from falling below

96.8° F and to prevent cold injury to body extremities. Two factors influence the development of a cold injury the ambient temperature, and wind velocity.

The SSHO will monitor environmental conditions by recording ambient temperature and estimated wind-speed. Information contained in Tables 6-1 and 6-2 will be used to evaluate the possibility of hypothermia among employees on-site.

### 5.3.3 Protective Clothing and Rest Breaks

Use appropriate cold weather clothing when temperatures are at or below 40° F as exposed skin surfaces must be protected. These protective items can include facemask, hand wear, and footwear. Employees handling evaporative solvents during cold stress conditions will take special precautions to avoid soaking gloves and clothing because of the added danger of prolonged skin contact and evaporative cooling. Employees will wear protective clothing appropriate for the level of cold and planned physical activity. The objective is to protect all parts of the body, with emphasis on the hands and feet. Eye protection against glare and ultraviolet light should be worn in snowy and icy conditions.

The work rate should not be so great as to cause heavy sweating that could result in wet clothing. If heavy work must be done, opportunities for rest breaks will be provided where employees have the opportunity to change into dry clothing. Conversely, plan work activities to minimize time spent sitting or standing still. Rest breaks should be taken in a warm, dry area. Windbreaks can also be used to shield the work area from the cooling effects of wind.

### 5.3.4 Identification and Treatment of Cold Stress

When frostbite, hypothermia, or other cold stress symptoms are suspected, treat the patient to relieve symptoms or transport them to the medical facility identified in Section 1.

**Table 5-1 Threshold Limit Values Work/Warm-up Schedule**

| Air-Temperature-- Sunny Sky | | No Noticeable Wind | | 5 mph Wind | | 10 mph Wind | | 15 mph Wind | | 20 mph Wind | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| °C (approx.) | °F (approx.) | Max. Work Period | No. of Breaks | Max. Work Period | No. of Breaks | Max. Work Period | No. of Breaks | Max. Work Period | No. of Breaks | Max. Work Period | No. of Breaks |
| -26° to -28° | -15° to -19° | (Norm. Breaks) 1 | | (Norm. Breaks) 1 | | 75 min | 2 | 55 min | 3 | 40 min | 4 |
| -29° to -31° | -20° to -24° | (Norm. Breaks) 1 | | 75 min | 2 | 55 min | 3 | 40 min | 4 | 30 min | 5 |
| -32° to -34° | -25° to -29° | 75 min | 2 | 55 min | 3 | 40 min | 4 | 30 min | 5 | Non-emergency work should cease | |
| -35° to -37° | -30° to -34° | 55 min | 3 | 40 min | 4 | 30 min | 5 | Non-emergency work should cease | | Non-emergency work should cease | |
| -38° to -39° | -35° to -39° | 40 min | 4 | 30 min | 5 | Non-emergency work should cease | | Non-emergency work should cease | | Non-emergency work should cease | |
| -40° to -42° | -40° to -44° | 30 min | 5 | Non-emergency work should cease | | Non-emergency work should cease | | Non-emergency work should cease | | Non-emergency work should cease | |
| -43° & below | -45° & below | Non-emergency work should cease | | Non-emergency work should cease | | Non-emergency work should cease | | Non-emergency work should cease | | Non-emergency work should cease | |

1. Schedule applies to any 4-hour work period with moderate to heavy work activity, with warm-up periods of ten. (10) Minutes in a warm location and with an extended break (e.g., lunch) at the end of the 4-hour work period in a warm location. For Light-to-Moderate Work (limited physical movement): apply the schedule on step lower. For example, at -35°C (-30°F) with no noticeable wind (Step 4), an employee at a job with little physical movement should have a maximum work period of 40 minutes with 4 breaks in a 4-hour period (Step 5).
2. The following is suggested as a guide for estimating wind velocity if accurate information is not available: 5 mph: light flag moves; 10 mph: light flag fully extended: 15 mph: raises a newspaper sheet: 20 mph: blowing and drifting snow.
3. If only the wind chill cooling rate is available, a rough rule of thumb for applying it rather than the temperature and wind velocity factors given above would be 1) special warm-up breaks should be initiated at a wind chill cooling rate of about 1750 watts per square meter (W/m$^2$); 2) all non-emergency work should have ceased at or before a wind chill of 2250 W/m$^2$. In general, the warm-up schedule provided above slightly under-compensates for the wind at the warmer temperatures, assuming acclimatization and clothing appropriate for winter work. On the other hand, the chart slightly overcompensates for the actual temperatures in the cooler ranges because windy conditions rarely prevail at extremely low temperatures.
4. TLVs apply only for employees in dry clothing.

* Adapted from Occupational Health & Safety Division, Department of Labor.

### Table 5-2 Cooling Power of Wind on Exposed Flesh

Expressed as an Equivalent Temperature (Under Calm Conditions)

| **Estimated Wind Speed (mph)** | **Actual Temperature Reading (degrees F)** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **50** | **40** | **30** | **20** | **10** | **0** | **-10** | **-20** | **-30** | **-40** | **-50** | **-60** |
| | **Equivalent chill Temperature (degrees F)** | | | | | | | | | | | |
| calm | 50 | 40 | 30 | 20 | 10 | 0 | -10 | -20 | -30 | -40 | -50 | -60 |
| 5 | 48 | 37 | 27 | 16 | 6 | -5 | -15 | -26 | -36 | -47 | -57 | -68 |
| 10 | 40 | 28 | 16 | 4 | -9 | -24 | -33 | -46 | -58 | -70 | -83 | -95 |
| 15 | 36 | 22 | 9 | -5 | -18 | -32 | -45 | -58 | -72 | -85 | -99 | -112 |
| 20 | 32 | 18 | 4 | -10 | -25 | -39 | -53 | -67 | -82 | -96 | -110 | -121 |
| 25 | 30 | 16 | 0 | -15 | -29 | -44 | -59 | -74 | -88 | -104 | -118 | -133 |
| 30 | 28 | 13 | -2 | -18 | -33 | -48 | -63 | -79 | -94 | -109 | -125 | -140 |
| 35 | 27 | 11 | -4 | -20 | -35 | -51 | -67 | -82 | -98 | -113 | -129 | -145 |
| 40 | 26 | 10 | -6 | -21 | -37 | -53 | -69 | -85 | -100 | -116 | -132 | -148 |
| (Wind speeds > 40 mph have little additional effect) | **LITTLE DANGER**<br>If < hr. with dry skin. Maximum danger of false sense of security | | | | **INCREASING DANGER**<br>Danger from freezing of exposed flesh within one minute. | | | **GREAT DANGER**<br>Flesh may freeze within 30 seconds. | | | | |
| | Trench foot and immersion foot may occur at any point on this chart. | | | | | | | | | | | |

*Developed by U.S. Army Research Institute of Environmental Medicine, Natick, MA.

# 6 Site Security and Control

## 6.1 Work Zones

Restricted Site areas will include, but not necessarily be limited to, the following zones:

> **Exclusion Zone or Hot Zone** - any area where contamination is either known or likely to be present in concentrations that could pose a threat to human health and safety or that potential for harm to employees exists because of the type of work activities being conducted. Appropriate PPE and warning signs should be utilized in this area.

> **Contamination Reduction Zone** - any area where employees conduct personal and equipment decontamination.

> **Support Zone** - areas where access is controlled, but the chance to encounter hazardous materials or conditions are minimal.

Access to the work zones will be controlled by work zone delineators (e.g., traffic cones, flags, vehicles, DOT approved devices, temporary, or permanent fencing, and/or safety barrier tape). Figure 6-1 is an example of a work zone. Additionally, Cardno employees should follow the requirements of the Employee Health and Safety Policy Manual, Work Zones in Traffic Areas for additional information.

In the event on-site employees must upgrade their personal protective equipment, the work zones may require substantial modification in order to provide for the safety of nearby employees not associated with this work. Any upgrade level will be communicated by the Site Supervisor to the PM. The PM will then inform the HSD of this occurrence.

Exceptions and Modifications:

None

## 6.2 Buddy System

The Buddy System will be used at all times by field employees in the Exclusion Zones (Level C Protection only). The Buddy System means that employees work in pairs and stay in close visual contact to be able to observe one another and summon rapid assistance in case of emergency. No one is to perform fieldwork alone without the approval of the Branch Safety Officer and/or the Regional Safety Officer.

## 6.3 Site Communication

A loud and clear form of communication should be made available for site employees entering the work zones. Site communication may be in the form of hand signals, voice, or other communication devices. All forms of communication should be understood by all employees on the site prior to starting work.

# 7 Decontamination Procedures

## 7.1 Employee Decontamination

All employees must complete appropriate decontamination procedures in a way that is responsive to actual Site conditions before leaving the Site. The decontamination of employees and equipment will be performed within the exclusion and contamination reduction zones. Wash tubs containing an appropriate decontamination solution and soft bristle brushes will be used to decontaminate personal protective clothing and boots. Deionized water will be used for the final rinse. The SSHO will visually inspect all PPE and other equipment once decontamination procedures are completed. In general, the four types of decontamination solutions to be considered for PPE include:

- Water for removal of low-molecular weight hydrocarbons, inorganic compounds, salts, some organic acids, and other polar compounds.
- Dilute acids (vinegar) for removal of basic (caustic) compounds, amines, and hydrazine.
- Dilute bases (soaps and detergents) for removal of acidic compounds, phenols, thiols, and some nitro and sulfonic compounds.
- Organic solvents for removal of nonpolar compounds (organic).

LEVEL D/LEVEL C:

Work at the Subject Site will primarily be done in remote settings. The project activities require frequent movement of operations between well sites. Decontamination will be managed on a personal basis prior to entry into any vehicle when travelling between sites.

- Establish a segregated equipment drop.
- Remove disposable, outer boot covers, if applicable.
- Remove chemical resistant, outer gloves, if applicable.
- Remove hard hat and goggles, safety glasses, or face shield.
- Remove disposable, inner gloves.
- Remove full-face air purifying respirator (Level C only).

Everyone will be responsible for inspecting and decontaminating their own respirator in accordance with the Cardno Respiratory Protection Program.

At a minimum the hands and face of each employee must be thoroughly washed upon leaving the work area. Trash receptacles will be provided for all disposable clothing. Commercial laundries or cleaning establishments that decontaminate clothing or equipment will be informed of the potentially harmful effects of exposure.

## 7.2 Equipment Decontamination

The subcontractor will decontaminate field equipment according to the work plan. This may include manual removal of gross contamination with shovels or other tools, followed by a high-pressure, hot water sprayer. Because decontamination at the high-pressure, hot water station poses the possibility of a splash and/or mist inhalation hazard, the task should be performed using Level D personal protective equipment at a minimum.

Field tool including split-barrel soil samplers, brass liners, and sample knives and trowels will be decontaminated. The field tools may be scrubbed visually clean using a detergent solution (Alconox/Liquinox) with water and a stiff, long-bristled scrub brush. Following the solution scrubbing, the tools may be rinsed with distilled water or isopropyl alcohol.

**Equipment Decontamination**

Gross Removal By:

☒ Hand Scrubbing

☒ Cold High-Pressure Wash

☐ Hot High-Pressure Wash

☐ Steam Cleaning

☐ Other (specify): ____

☒ Clean Rinse

☒ Decon solution (specify): Alqanox non-phosphate cleaning solutions

## 7.3 Disposition of Decontamination Wastes

All materials and equipment used for decontamination should be disposed of in accordance with local, State, and/or Federal Regulations. Clothing, tools, buckets, brushes, and all other equipment that is contaminated must be properly packaged and stored on the Site until disposal arrangements are finalized. Clothing not completely decontaminated on-site should be secured in plastic bags before being removed from the site.

# 8 Standard Operating Procedures

The following Standard Operating Procedures (SOPs) will be applied to each location and activity where work is performed on a hazardous chemical site. As hazards increase or decrease on the site, the applicability of each SOP must be determined by the SSHO with the approval of any changes by the Project Manager or the HSD.

## 8.1 Employee Precautions

1. Eating, drinking, chewing gum or tobacco, smoking, and any practice that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited in the exclusion and contamination reduction zone or in any area known to be contaminated.
2. When decontamination procedures for outer garments are in effect, the entire body should be thoroughly washed as soon as possible after the protective garment is removed.
3. Contact with contaminated or suspected contaminated surfaces should be avoided. When possible, do not walk-through puddles, leachate, or discolored surfaces; kneel on the ground; or lean, sit, or place equipment on drums, containers, or the ground.
4. Medicines and alcohol can increase the effects from exposure to toxic chemicals. Employees should not take prescribed drugs at hazardous waste operations where the potential for absorption, inhalation, or ingestion of toxic substances exists unless specifically approved by a qualified physician. Alcoholic beverage intake should be minimized or avoided.
5. All employees must be familiar with Standard Operating Procedures and any additional instructions and information contained in this HASP. All visitors and subcontractors will read the HASP before entering the Site.
6. All employees will be aware of symptoms for heat or cold stress.
7. All employees will be familiar with the chemicals used on-site and the associated hazards as described in each respective safety data sheet (SDS). The SDS for the chemicals on-site will be available and located in the company vehicle.

### 8.2 Operations

1. All employees going to the site must be adequately trained and thoroughly briefed on anticipated hazards, equipment, safety practices, emergency procedures, and communications.
2. Employees on the site must use the Buddy System when engaged in Level C work and above. The purpose of the Buddy System is to provide rapid assistance to employees in the event of an emergency.
3. Visual contact must be maintained between pairs of site and safety personnel. Entry team members should remain close to assist each other during emergencies.
4. Employees should practice unfamiliar operations before the actual procedure.
5. Entrance and exit locations must be designated, and emergency escape routes delineated. Warning signals for site evacuation must be established by the SSHO before field activities.
6. Communications using radios, hand signals, or other means, must be always maintained between initial entry employees. Emergency communications should be prearranged in case of radio failure, the necessity for evacuating the site, or other reasons.
7. Wind indicators visible to all employees should be strategically located throughout the site.
8. Employees and equipment in the contaminated area should be minimized, consistent with effective site operations.
9. Work areas for various operational activities will be established.
10. Procedures for leaving a contaminated area will be planned and implemented before going to the site. Work areas and decontamination procedures will be established based on expected site conditions.
11. Frequent and regular inspections of site operations will be conducted by the SSHO to check compliance with this HASP. If changes in operation occur, the HASP must be modified to reflect these changes.
12. All electrical equipment (power tools, extension cords, instruments, radios, etc.) will conform with Cardno’s Electrical Policy. The SSHO will ensure that electrical equipment is free from recognized hazards that may cause physical harm to employees.
13. Fire prevention and protection (appropriate signs for flammable liquids, smoking areas, storage areas of combustible or flammable materials, etc.) will be according to Cardno’s Fire Protection Policy.
14. Site Tailgate Safety Meetings will be held daily to discuss anticipated site conditions and daily activities. This meeting will be summarized in field logbooks and the Tailgate Safety Meeting Form (see Appendix C).

# 9 Contingency Plan

This chapter of the HASP describes potential emergencies at this site and the procedures for responding to those emergencies.

### 9.1 Medical Emergencies

1. The name, address, telephone number, travel distance, and travel time to the nearest medical treatment facility are found in the Emergency Information section (see Section 1) of this HASP. A map and direction for locating the facility is available in the Emergency Information section (see Section 1) of this HASP.
2. Emergency routes will be verified and driven before any Site activities. It may be quicker to transport a person with minor injuries than to wait for Emergency Medical Services (EMS) to respond. Check with the local authorities for response times. Life threatening emergency situations will only be handled by emergency medical services.

3. Before mobilization on-site, the Site Supervisor will contact the local hospital emergency room personnel, local fire department, and local police department to brief them regarding the scope and hazards associated with the scheduled fieldwork. If the site is outside an established town, contact will be made with county officials and local emergency services.
4. An emergency first-aid kit with contents per Cardno First Aid Policy will be readily available on the site, and employees will have first-aid training. The first-aid kit also contains equipment necessary to protect first-aid providers against exposure to blood-borne pathogens. All first-aid providers will have received Bloodborne Pathogens training and can receive vaccinations according to the Cardno's Bloodborne Pathogens Policy if exposed to bodily fluids.
5. Any employee who becomes ill or injured in the exclusion zone must be decontaminated as well as possible with consideration to which risk will be greater, the spread of contamination or the health of the individual. If the injury or illness is minor, full decontamination (remove contaminated clothing and wash hands and face with soap and water, See Section 8.0) should be completed and first-aid administered before transport. If the employee's condition is serious, at least partial decontamination should be completed (i.e., complete disrobing of the victim and redressing in clean coveralls or wrapping in a blanket). First-aid should be administered while awaiting an ambulance or paramedics.
6. The following steps should be followed if an injury or illness case occurs:
    > Check the Scene.
    > If safe to do so, check the condition of the injured.
    > Call 911 if the victim is unconscious or your training dictates to do so.
    > Care for the injured. Always use "Universal Precautions".
    > Call CORE Health (855) 282-6331, if the injury is non-life threatening. CORE Health will assist you with the location of the nearest clinic, if referral is needed.
7. Provisions must be made to identify the substance to which the employee has been exposed. This information must be given to medical personnel.

## 9.2 Emergency Equipment

1. A personal eyewash unit that meets ANSI Z358.1-1998, Section 6 will be available in each Cardno field vehicle at the site if corrosive chemicals (chemicals with a pH of <3 or >11) will be on-site.
2. An emergency first-aid kit with contents as per Cardno First Aid Policy. The Site Supervisor shall be trained and certified in first aid and CPR.
3. An emergency spill cleanup kit will be always available at the site. Unplanned releases will be reported to the SSHO and/or Site Supervisor as soon as possible.
4. Sufficient water and/or multipurpose dry chemical (Class A, B, and C) fire extinguishers, rated not less than 2A:10B:C, will be maintained on the Site to cope with any situation until emergency services arrive.

## 9.3 Spill Containment

All hazardous substances and contaminated soils, liquids, and other residues are to be contained, stored, and labeled in accordance with federal, state, and local regulations. When drumming wastes ensure the following practices are implemented:

- Ensure waste material is compatible with the container (i.e., do not put highly acidic or alkaline wastes in steel drums).
- Drums shall be inspected before waste is put inside. Ensure drums are not rusted or damaged.
- Ensure proper labeling is applied that identifies the type of waste, date, and contact information on to drum before placing waste.

- Only leave drums open when adding or removing the contents, otherwise drums are to be closed, which means the bung or drum ring is on and securely snug.
- Preferred spacing of drums for on-site storage shall be 36 inches whenever possible. Drums need to be visibility inspected and readily accessible for emergency response.

Spill containment materials shall be on site during management of drums in the event of failure or leak. Locations of drums and bins should minimize the possibility of contents leaving the site in the event of a failure of the containment. For containers containing flammable materials, fire extinguishing equipment shall be present and ready for use to control incipient fires. Drums shall not be used to work from or stand upon.

## 9.4 Flammable Conditions

In the event that combustible vapors exceed 10 percent of the LEL, or strong odors are detected in the borehole, the following actions should be taken:

> Continue investigation using extreme caution. Personal protective equipment may need to be upgraded.

> Allow vapors to dissipate or use intrinsically safe mechanical ventilation.

> If atmospheric conditions do not change, call in the listed sequence:

  - Project Manager.
  - Regional Safety Coordinator.
  - Fire Department

> Provide answering employees with the call back numbers of locations, directions, and situation assessment.

## 9.5 Site Evacuation Conditions

The following conditions will necessitate the cessation of field work in the area of concern, withdrawal from the work area, and revisions to this HASP:

> Fires and/or explosions.

> Unexploded ordnance is detected.

> A major incident or injury occurs.

> Flammable atmosphere readings above 10 percent LEL.

> Oxygen readings above 23.5 percent oxygen concentration.

> Oxygen readings at or below 19.5 percent oxygen concentration.

> PID readings over 50 ppm sustained for more than 5 minutes.

> Detector tube readings over the maximum Action Level for the contaminant specified.

> DustTrack™ readings of sustained measurements greater than nuisance dust limits

## 9.6 Emergency Communication System

Emergency contacts and telephone numbers are provided at the beginning of this HASP. Field crews will have some communication device at each active work location. These may include radios, mobile telephones, or walkie-talkies. Such communication devices will have sufficient range to contact the field office and/or emergency services. If an emergency occurs on-site, the Site Supervisor is responsible for checking that appropriate emergency contact has been notified. At the time of the emergency response, the Site Supervisor or designee will brief the emergency personnel on the status of the emergency, including Site conditions.

Field employees will use hand signals if there are noisy working conditions on the Site. The hand signals that will be used are shown below and will be reviewed by the SSHO during the on-site safety briefing.

| **Signal** | **Meaning** |
|---|---|
| Hands on top of head | Need assistance |
| Grip partner′s wrist or place both hands around partner′s arm | Leave area immediately |
| Thumbs up | OK; I am all right |
| Thumbs down | No; Negative |
| Hand gripping throat | Cannot breathe; Out of air |

### 9.7 Emergency Response Follow-Up

If there is an incident, near-miss, or emergency response, the SSHO will notify the Project Manager and HSD. The Project Manager or the Branch Safety Officer will complete a Supervisor’s Investigation Report (SIR) (Appendix 51-1) and submit to the appropriate regional distribution list. Prior to resuming work, a site safety meeting should be held to discuss the circumstances surrounding the incident and what should be done to prevent a reoccurrence.

## 10 Employee Training

### 10.1 Pre-Assignment and Annual Refresher Training

All Cardno employees and Subcontractor employees will participate in routine health and safety education and training programs. These programs are designed to provide employees with a thorough knowledge of hazardous materials, health and safety hazard potential, and Federal Occupational Safety and Health Administration (OSHA) requirements published in 29 Code of Federal Regulations (CFR) Part 1910. According to 29 CFR 1910.120(e), Site employees will have received 40 hours of initial Hazardous Waste Operations & Emergency Response (HAZWOPER) instruction and 24 hours of supervised field experience. Attending an annual 8-hour HAZWOPER refresher training session maintains this initial training. It is the responsibility of the Project Manager and each subcontractor’s supervising manager to determine if the subcontractor employee meets these training requirements.

### 10.2 Site Supervisor’s Training

On-site Managers and Supervisors on hazardous waste sites who are directly responsible for or who supervise employees engaged in hazardous wastes operations receive, in addition to the initial 40 HAZWOPER training, 8 additional hours of specialized supervisory training in compliance with the OSHA regulations. This training includes training on the employer’s safety and health program and the associated employee training program, personal protective equipment program, spill containment program, and health hazards monitoring procedure and techniques.

### 10.3 Site Safety Training and Briefing Topics

The SSHO will conduct Site-specific health and safety briefing for field employees before the start of all field work. Briefing attendees will include the Site Supervisor, the Project Team, and Subcontractor employees. At the conclusion of the meeting, employees are to sign the HASP Agreement and Acknowledgement Form in the Appendices. As additional employees are assigned to the site, it is the responsibility of the SHSO to ensure that new employees are briefed on health and safety protocols and ensure that they have reviewed and signed the HASP Agreement and Acknowledgement Form. Items to be covered include:

> Site-specific health and safety rules.
> Client-specific health and safety rules.
> Health effects of various chemicals used on the site.
> Emergency response actions pertaining to operations on-site.

Additionally, daily site Tailgate Safety Meetings will be conducted to review past activities, plan ahead for new or changed operations, to understand any near-miss and “lessons learned, establish safe working procedures for anticipated hazards, and provide pertinent safety and health training and motivation. The SSHO will complete the Tailgate Safety Meeting Form located in the Appendices.

## 10.4 Visitors

All visitors entering the designated work zones will be subject to all applicable health and safety requirements during field operations at the Site. All visitors to a work Site will be given the opportunity to review the HASP, will be escorted at all times, and will be required to stay a safe distance from site activities. The Site Supervisor and/or the SSHO will be responsible for briefing all visitors on the site hazards, safety precautions, and the emergency response plan.

# APPENDIX A
# Job Safety Analysis (JSA)

# APPENDIX B

## List of Approved Amendments/changes
## HASP Acknowledgement/Agreement Form
## Visitors Log
## Tailgate Safety Meeting Form
## Air Quality Monitoring Record
## Equipment Calibration Log
## Checklist for Subsurface Investigation
## Monthly Heavy Equipment Safety Inspection Checklist

## HEALTH AND SAFETY PLAN (HASP)
### List of Approved Amendments/Changes

| Date | Name | Signature | Changes/Comments | Section Added |
|---|---|---|---|---|
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## HEALTH AND SAFETY PLAN (HASP)
## Acknowledgement/Agreement Form

**(All Cardno, Subcontractor, & Client Employees Must Sign)**

Client Site Name: Airport West VCP Phase 1 Area Remedial Action

Cardno Project No. **819AR00640**____________________ Task No. **XXX**______________

I acknowledge I have reviewed a copy of the Health and Safety Plan for this project, understand it, and agree to comply with all of its provisions. I also understand I could be prohibited by the Site Health and Safety Coordinator or other Cardno employees from working on this project for not complying with any aspect of this Health and Safety Plan:

| PRINT NAME | SIGNATURE | COMPANY | DATE |
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## HEALTH AND SAFETY PLAN (HASP)
### Visitors Log

Client Site Name: Airport West VCP Phase 1 Area Remedial Action

Cardno Project No**. 819AR00640** Task No. XXX

| PRINT NAME | SIGNATURE | COMPANY | DATE |
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**HEALTH AND SAFETY PLAN (HASP)**
**Tailgate Safety Meeting Form**

**Site Name & Number:** Airport West VCP Phase 1 Area Remedial Action

**Cardno Project Number:** **819AR00640**

**Work Being Performed:** **Groundwater Sampling, Soil Vapor Sampling, Excavation of MSW, Stockpiling of MSW, Placement in new Solid Waste Repository, Leachate Management**

**Date & Time of Meeting:**

**Name of Presenter:**

**NOTE: On the initial day of the project, the Project Manager or designee should conduct a visual inspection of the project site (using the Site Safety Checklist) prior to the Tailgate Safety Meeting. This inspection should include a review of project site equipment, hazards, and specific job tasks, activities, or operations to be performed for that day. These specific items must be covered during the Tailgate Safety Meeting. For subsequent days, any changes to the site or operations must be covered in the Tailgate Safety Meeting. In addition, "Task-Specific" Job Safety Analysis (JSA) for the tasks/activities at the project site must be integrated into the HASP and Tailgate discussions.**

**Itemize the Specific Topics Discussed (if more space is needed use the back of this page):**

☐ Are all employees, okay? ☐ Are all employees physically able to perform their job duties? ☐ "Shared Learning" items?
☐ Has PPE been checked? ☐Emergency evacuation area identified. ☐ Asked for Sub interactions or questions?

☐ **Client Requirements** - By checking the box to the left, the Presenter of the Tailgate Meeting acknowledges that all Client-specific requirements have been completed for both Cardno and Subcontractor employees.

**Participants (if needed, list additional participants on back of this page):**

| Print Name | Signature | Company | Date |
|---|---|---|---|
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A Tailgate Safety Meeting must be conducted and documented at the beginning of each workday when two or more Cardno employees and/or Subcontractor representatives are present on site. Employees, client representatives and subcontractors who arrive at the site after the Tailgate Safety Meeting has been conducted must be briefed on the topics and acknowledge by signing this form. The JSA must be completed at the beginning of each day when one or more Cardno employees and/or subcontractor representatives are present on a site.

## HEALTH AND SAFETY PLAN (HASP)
## Air Quality Monitoring Record

| DATE | TIME | LOCATION | INSTRUMENT | CONCENTRATION (UNITS) | SAMPLED BY |
|---|---|---|---|---|---|
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# HEALTH AND SAFETY PLAN (HASP)
## Equipment Calibration Log

| DATE | INSTRUMENT/ MODEL NO. | ZERO ADJUST OK? | CALIBRATION GAS (PPM) | READING (PPM) | LEAK CHECK | PERFORMED BY | COMMENTS |
|---|---|---|---|---|---|---|---|
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# CHECK LIST FOR SUBSURFACE CLEARANCE

MUST be filled out PRIOR to the Start of Field Activities
NO subsurface work in road Right of Ways or Off-Site (property boundary) without Written Authorization

**Site Name:**

**Site Address:** **6400 N. Temple Frontage Rd, SLC, UT**

**Project No.:** **819AR00640**

To understand and use this checklist correctly you must refer to and follow the Cardno Subsurface Investigation Procedures.

| | **Person Verifying Each Item to Place Initials On Lines Below and Sign Bottom of Page** | **Comments** |
|---|---|---|
| **PRE-DRILLING PREPARATION** | X | |
| Review definition of “Critical” and “Non-Critical” areas. | X | |
| Request as-built drawings, and/or approval to use private utility locator service and/or air knife to locate/protect subsurface utilities. | X | |
| Obtain Site access agreement. | X | |
| Pre-plan boring locations. | X | |
| Establish surface boring method. | X | |
| Obtain permits and clearances. | N/A | |
| Do borehole and utility mark outs. | X | |
| Establish Site-specific Health and Safety Plan | X | |
| Notify Client, owner, operator prior to mobilization. | X | |
| | | |
| **ON-SITE PROCEDURES** | X | |
| Conduct tailgate safety meeting with topics as indicated in procedure. | | |
| Read and follow Drilling/Probing procedures | | |
| --1. Do Site walk and verify that utility location checklist is complete. | X | |
| --2. Locate all mark outs and planned borehole locations. Start intrusive procedures at least 5 feet away from and perpendicular to utility mark outs. | X | |
| --3. Break surface cover. | X | |
| --4. Do surface boring to required depth using hand auger, post-hole digger, shovel or “air knife”. | N/A | |
| --5. If necessary, use alternate procedure for surface boring. | X | |
| --6. Collect soil samples by hand auguring to required depth. | N/A | |
| --7. Protect the borehole from pedestrian and vehicular traffic. | X | |

*Buried utilities can be found at any depth, but are most often found within the first 5 feet below the ground surface. Proceed slowly and with extra caution when working within 5 feet of the ground surface.

NOTES:

**SIGNATURE** **DATE**

---

## CHECK LIST FOR SUBSURFACE CLEARANCE

MUST be filled out PRIOR to the Start of Field Activities
NO subsurface work in road Right of Ways or Off-Site (property boundary) without Written Authorization

**Site Address:** ______________________________ **If Present --**

______________________________

| **Site Safety Documents (on-site during activities)** | **"Yes or No"** | | **Fill Out, as applicable** |
|---|---|---|---|
| Utility Staking Request Form (properly completed for current scope of work)? | **Yes** | **No** | Ticket # and Expir. Date: # / / |
| Site Health and Safety Plan? | **Yes** | **No** | Hospital Location Map Available **Yes** **No** |

| **Utility Identification "color"<br>Above Ground (AG) / Buried (B)** | | | | **Identify on a Site Map the Location of ALL Lines & Meters (or actual utility) and Indicate Nearest Building Quadrant (NE, SE, SW, or NW)** | | | |
|---|---|---|---|---|---|---|---|
| Natural Gas (Yellow) / Staked? | AG / B | **Yes** | **No** | NW | NE | SE | SW |
| Electrical (Red) / Staked? | AG / B | **Yes** | **No** | NW | NE | SE | SW |
| Telephone/Fiber Optic (Orange) / Staked? | AG / B | **Yes** | **No** | NW | NE | SE | SW |
| Cable TV (Orange) / Staked? | AG / B | **Yes** | **No** | NW | NE | SE | SW |
| Water (Blue) / Staked? | AG / B | **Yes** | **No** | NW | NE | SE | SW |
| Sewer (Green) / Staked? | AG / B | **Yes** | **No** | NW | NE | SE | SW |

| **Significant Site Features** | | | **Site Feature Located in Closest Property Quadrant (NE, SE, SW, or NW). Also Identify on Site Map.** |
|---|---|---|---|
| UST system (UST cavity, dispenser islands, piping runs, vent pipes etc.)? | **Yes** | **No** | |
| Above Ground Storage Tanks – ASTs (dispenser islands, piping runs)? | **Yes** | **No** | |
| Electrical Transformers? | **Yes** | **No** | |
| Area Lighting (Pole mounted lighting, etc.)? | **Yes** | **No** | |
| Signage with electrical power (Business/Company signs, etc.)? | **Yes** | **No** | |
| Underground lawn/landscaping sprinkler system? | **Yes** | **No** | |
| Storm drain basins / man-ways and potential connecting conduits/lines? | **Yes** | **No** | |

| **Other** | | | **"Other" Concerns Located in Closest Property Quadrant (NE, SE, SW, or NW). Identify on Site Map.** |
|---|---|---|---|
| Pavement distress (Cracked pavement, "buckled" asphalt, etc.)? | **Yes** | **No** | |

*Buried utilities can be found at any depth, but are most often found within the first 5 feet below the ground surface. Proceed slowly and with extra caution when working within 5 feet of the ground surface.
NOTES:

______________________________

SIGNATURE DATE

## Monthly Mobile/Heavy Equipment Safety Inspection Checklist

This form is to be completed by the qualified operator of the equipment

| | | | | | |
|---|---|---|---|---|---|
| Date: | | Project No.: | | Site/Location: | |
| Equipment Type: | | Model No.: | | Odometer: | |
| Operator/Inspector Name: | | | | Machine Hours: | |

**Warning:** Do not operate a malfunctioning machine until corrective measures have been taken and all discrepancies have been cleared by a qualified operator/mechanic. In addition to elements on this checklist, the owner's manual for the specific piece of equipment being operated may contain other daily inspection checks and/or preventative maintenance procedures.

| | | | |
|---|---|---|---|
| **General Safety** | ☐ Operator Qualification | ☐ PPE Supplies | ☐ Fire Extinguisher (ready-to-use) |
| | ☐ Owner's Manual (present) | ☐ Driver Check (decal in place) | ☐ First-Aid Kit (present & stocked) |
| | ☐ Manufacturer Specs Followed | ☐ Access Ladder (secure and ok) | ☐ Housekeeping (clean) |
| | ☐ Emergency Kit (signs, flares) | ☐ Flashlight | ☐ Markers (cones, barricades, etc.) |
| **Vehicle, Engine, and Hydraulic Systems** (note any added fluid) | ☐ Engine Oil (fluid level, condition) | ☐ Fuel Level | ☐ Other Fluid |
| | ☐ Transmission (fluid level, fluid condition, unit operation) | ☐ Brake Fluid | ☐ Steering (power steering fluid level, no play in steering) |
| | ☐ Radiator (coolant level, hose condition) | ☐ Fan Belts (tension/condition) | ☐ Brakes (vehicle, parking) |
| | ☐ Hydraulic System (fluid level, fluid condition, hose condition, cylinders, leakage) | ☐ Chassis (proper lubrication) | ☐ Tires (condition, inflation) |
| | ☐ Outriggers (operational, if equipped) | ☐ | ☐ |
| **Tracked Vehicles** | ☐ Track Tension (proper tension) | ☐ Plates and/or Shoes | ☐ Grouser Plates |
| | ☐ Rollers | ☐ Drive Sprockets | |
| **Lights and Alarms** (clean and functional) | ☐ Headlights (hi, low, run beams) | ☐ Parking Lights | ☐ Revolving Flashing Lights (if required) |
| | ☐ Reverse Lights (backup) | ☐ Equipment Work Lights | ☐ Horn |
| | ☐ Brake/Taillights | ☐ Turn Signals/Hazard Flashers | ☐ Reverse Alarms (backup) |
| **Vehicle Cab** (clean and functional) | ☐ Seatbelts (if required) | ☐ Windshield Wipers | ☐ Body Damage |
| | ☐ Housekeeping | ☐ 2 Way Communication | ☐ Speed/Hour Meter |
| | ☐ Fuel Gauge | ☐ Horn (operational) | ☐ Windshield (glass ok, clean) |
| | ☐ Controls Operational | ☐ Mirrors (rear view, side) | |

| Maintenance/ Equipment Request | Corrected By: | Date: |
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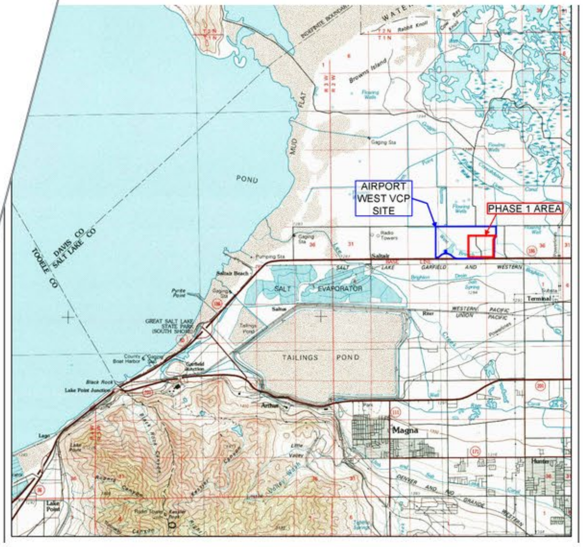
| Inspectors Signature: | | |
| | | Date |

## C-2 Quality Assurance Project Plan

# Quality Assurance Project Plan

## Airport West VCP

July 31, 2022



## Contact Information

Cardno
1142 West 2320 South
Suite A
West Valley City, UT, 84119, USA
Telephone: 801-519-4257
www.cardno.com

[insert signature here]

Author(s) David K. Cline, P.E.

[insert signature here]

Approved By Russell Hamblin

## Document Information

| | |
|---|---|
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| Date Approved | Month XX, 2018 |

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|---|---|---|---|---|
| 1.0 | 01/07/2021 | DRAFT | David K. Cline | |
| 2.0 | 06/29/2022 | Redline DERR Comment Responses | David Cline | |
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# Table of Contents

# Appendices

# Tables

Acronyms

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|---|---|
| TBD | To Be Determined |

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# 1 Introduction

This Quality Assurance Project Plan (QAPP) documents the planning, implementation, assessment, and specific quality assurance (QA) and quality control (QC) activities for conducting the proposed remedial activities at the Phase I area of the former North Temple Landfill (NTL) located in Salt Lake City, Utah.

This QAPP was prepared in accordance with guidelines presented in the U.S. Environmental Protection Agency's (EPA) Brownfields Pilot QAPP Crosswalk— R8 FQPForm-2023 R0 (20211028). The content of this QAPP is organized by the following four elements:

- Project Management and Objectives
- Measurement/Data Acquisition
- Assessment/Oversight
- Data Review

The Project Management section addresses the basic area of project management, including the project history and objectives and roles and responsibilities of the project personnel. The sub-elements of Project Management (Title, Table of Contents, and Distribution list) are presented in the beginning of this QAPP. The remaining elements under Project Management are discussed in this section.

The NTL identified as the Airport West site entered into the Voluntary Cleanup Program (VCP) with the Utah Department of Environmental Quality's (UDEQ) Division of Environmental Response and Remediation (DERR). Under the VCP, further investigation and construction work will be accomplished in coordination with state regulatory agencies.

## 1.1 Project Organization

Personnel responsibilities and communication pathways are discussed in this section.

### CARDNO *Project Manager*

Ensures project performance to comply and implement necessary actions to accomplish project objectives described in the approved sampling and analysis plan (SAP) plans. Serves as liaison between NT Development (NT), Division of Environmental Response and Remediation (DERR), and the project team.

The current copy of the QAPP will be distributed electronically to the Project Team by Cardno’s Project Manager (PM).

David Cline, P.E., will be Cardno's project manager and contact for this project. Mr. Cline can be reached at:

Cardno now Stantec
1142 West 2320 South Suite A, West Valley, UT 84119
Tel: (801) 519-4257

***DERR Project Manager***

Oversees sampling and analysis performance for compliance with the SAP. Provides technical review on project deliverables. Communicates project findings tothe public and all interested parties.

***NT Development Representative***

Authorizes activities of CARDNO. Changes in project scope require approval by NT's representative. Communicates with CARDNO's PM and DERR's Project Manager.

***Site Manager***

Oversees field operations and sampling. Provides onsite technical support and supervises implementation of sampling procedures described in the SAP, and corrective actions during field activities. Observes field activities for adherence to the Health and Safety Plan (HASP), to be prepared separately. Serves as liaison between CARDNO's PM, and on-site DERR personnel. Directs and supervises on-site personnel and subcontractors.

On-site personnel will be 40 Hr OSHA HAZWOPER certified. Sampling personnel will be trained and as soil and groundwater samplers.

***Quality Assurance Officer***

Ensures that sample receipt and custody forms are properly handled. Ensures that internal quality control (QC) measures and analytical methods are performed as required. Oversees quality assurance (QA) activities to ensure compliance with the SAP. Provides QA review of analytical data and prepare QA summary. Implements corrective actions as necessary. Reports to CARDNO's Project Manager.

**CARDNO *Health and Safety Officer***

Ensures that the health and safety guidelines are followed. Documents health and safety issues or concerns affecting the project. Communicates with the Project Team. Reports to CARDNO's Project Manager.

***AWAL Project Manager***

Ensures that performance standards are met for analytical methods specified in the QAPP. Reviews internal QC measures and analytical methods as required. Oversees preparation of laboratory analysis and QC summary reports. Prepares, implements, and documents corrective actions if necessary. Communicates with CARDNO's Site Manager.

***Subcontractors***

Implement sampling activities as outlined in the SAP under the supervision and direction of CARDNO's Site Manager.

## 1.2 SAP Planning/Problem Definition

The goal of the SAP is to provide data that will allow decision makers to better evaluate and manage the proposed remediation of the landfill, and to provide data to address comments by DERR.

- .

Provide leachate data to design a system to treat the leachate generated during landfill dewatering operations.

## 1.3 Quality Objectives and Measurement Performance Criteria

Quality objectives include outputs from the systematic planning process used to design the SAP and performance criteria that are prescribed to provide reliability and accuracy of measurement data, and apply to all aspects of sample handling, analysis, data management, and reporting. This section discusses the quality objectives for the project and the performance criteria to achieve those objectives.

### 1.3.1 Data Quality Indicators

Performance criteria are expressed in terms of data quality indicators. The principal indicators of data quality are precision, bias, accuracy, representativeness, comparability, completeness, and sensitivity. These data quality indicators are discussed below. The QC criteria or control limits that will be used to assess these indicators for each analysis are presented in **Table AI**.

Precision: Precision is a measure of reproducibility of measurements of the same characteristic, usually under a given set of conditions.

Field precision will be assessed by the collection and analysis of field duplicates and will be expressed as relative percent difference (RPD).

Duplicate samples are analyzed to check for matrix variability and analytical method reproducibility. At a minimum, one field duplicate will be collected for every 10 samples by media and analyzed for the same parameters listed for other media samples.

The control limits for accuracy automatically identify the precision of a method. In the analysis of samples in a batch, if the recoveries of the analyte of interest are within control limits, then the precision also is within control. Precision also may be calculated in terms of Relative Percent Difference (RPD).

Precision will be assessed by comparing the analytical results between matrix spike and matrix spike duplicate (MS/MSD) for organic analysis, and between laboratory duplicates for inorganic analysis. The relative percent difference (RPD) will be calculated for each pair of duplicate analyses using the following equation:

$$RPD = \frac{X_1 - X_2}{(X_1 + X_2)/2}(100\%),$$

*Where:*

*RPD* = relative percent different, and

*X1, X2* = value of sample 1 and sample 2.

RPDs may be compared to the laboratory-established RPD control limits for the analysis. Precision of duplicates depends on sample homogeneity and analytical method controls.

Accuracy: Accuracy is the degree of agreement of a measurement or average of measurements with an accepted reference or "true" value and is a measure of bias in the system. The accuracy of a measurement system is affected by errors introduced through the sampling process, field contamination, preservation, handling, sample matrix, sample preparation, and analytical techniques.

The achievement of accurate data in the field will be addressed using field and trip blanks and through the adherence to all sample handling, preservation, and holding times.

Field blanks, consisting of distilled, de-ionized water poured into sample containers in the field, are used to assess whether aqueous samples have been compromised by airborne contaminants. Field blanks will be collected during sampling of aqueous matrices for volatile organic compounds at a frequency of 1 per day or 1 per 10 samples per matrix, whichever is more frequent.

Results for blank, matrix spikes, LCS, and surrogates will be the primary indicators of accuracy. These results will be used to control accuracy by requiring that they meet specific criteria. As spiked samples are analyzed, spike recoveries will be calculated and compared to acceptance limits.

The calculation formula for percent recovery is:

$$R\% = \frac{(C1 - C2)}{C3}\ (100\%)$$

*Where:*

*R%* = Spike amount recovered,

*C1* = Concentration of analyte in spiked sample,

*C2* = Concentration of analyte in non-spiked sample, and

*C3* = Concentration of spike added.

Acceptance limits will be based upon laboratory performance as previously established for similar samples. In this approach, the control limits reflect the minimum and maximum recoveries expected for individual measurements for an in-control system. Recoveries outside the established limits indicate some assignable cause, other than normal measurement error, and possible need for corrective action. Corrective actions may include recalibration of the instrument, reanalysis of the QC sample, reanalysis of the samples in the batch, re-preparation of samples in the batch, or flagging the data as suspect if the problems cannot be resolved. For contaminated samples, recovery of matrix spikes may depend on sample homogeneity, matrix interference, and dilution requirements for quantitation.

Completeness: Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount expected under normal conditions.

Field completeness is a measure of the amount of valid measurements obtained from all the measurements taken in the project. Field completeness for this project will be greater than 90 percent.

The project laboratories will provide data meeting QC acceptance criteria for a minimum of 90 percent of the samples tested using the SW-846 and other standard methods. At the completion of sample analysis testing, the percent completeness will be calculated by the following equation:

$$C\% = \frac{S}{R}\ (100\%)$$

Where:

C = completeness,

S = number of successful analyses, and

*R* = number of requested analyses.

Successful laboratory analyses can only be accomplished if both the field and laboratory portions of the project are successful. Factors that adversely affect completeness include:

- Receipt of samples in broken containers.
- Receipt of samples in which chain of custody or sample integrity is compromised in some way.
- Samples received with insufficient volume to perform initial analyses or repeat analyses, if initial efforts do not meet QC acceptance criteria.
- Improperly preserved samples.
- Samples held in the field or laboratory longer than expected, thereby jeopardizing holding time requirements.
- Samples that have unclear analyses requests.

Representativeness: Representativeness qualitatively expresses the degree to which data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

Representativeness expresses the degree to which a sample represents a source material, an environmental media, or a geochemical process. Representativeness is a qualitative parameter, dependent on the proper design of the sampling program and proper choice of extraction and analytical methods. The sampling network described in Section 3.0 of the SAP was designed to provide data representative of Site conditions. During development of this network, consideration was given to existing analytical data, and physical setting and processes. Representativeness will be satisfied by following the methods and procedures discussed in the SAP.

The characteristic of representativeness cannot be quantified. Subjective factors to be taken into account as follows:

- Degree of homogeneity of a site.
- Degree of homogeneity of a sample taken from one point in a site.
- Available information on which a sampling plan is based.

Field duplication and field replication, as defined under precision, also are used to assess representativeness. Two samples that are collected at the same location and at the same time are considered equally representative of this condition, at a given point in space and time.

Representativeness in the laboratory is ensured by using the proper analytical procedures, meeting sample holding times, and analyzing and assessing field duplicated samples. Within the laboratory, precautions are taken to extract from the sample container an aliquot representative of the whole sample.

Comparability: Comparability expresses the confidence with which one data set can be compared with another. The extent to which existing and new analytical data will be comparable depends on the similarity of sampling and analytical methods. The new physical and chemical data, however, may not be directly comparable to existing data because of temporal changes in the environment and differences in analytical procedures and QA objectives.

Comparability is dependent on the proper design of the sampling program and will be satisfied by ensuring that the field procedures (presented in Section 4.0 of the SAP) are followed and that proper sampling techniques are used.

Planned analytical data will be comparable when similar sampling and analytical methods are used. Comparability also is dependent on similar QA objectives.

Sensitivity: Sensitivity is the capability of a method or instrument to discriminate between small differences in analyte concentration. Detection limits and project requirements will be compared in order to select a method with the necessary detection limits to meet the project goals.

The Analytical methods and Detection Limits for the target analytes are presented in Table A3.

### 1.3.2 Level of Quality Control Effort

There are five commonly accepted analytical levels that address various data uses and the QA/QC effort and methods required to achieve the desired level of Quality. These levels are:

Level I: Field screening using portable instruments. Field measurements of specific conductance, pH, temperature, turbidity, and dissolved oxygen will be made during groundwater purging to ensure representative groundwater samples are collected. Field parameters are to be recorded at regular intervals to document stability within the borehole groundwater. The readings should vary less than 10 percent prior to collection of analytical samples.

Level II: Field analysis using more sophisticated portable analytical instruments. None proposed for this project.

Level III: Physical property measurements and chemical analyses performed in an offsite laboratory using ASTM or SW-846, 3rd. Edition, Final Update ill methods. Quality control procedures are those described in SW-846 or developed at the laboratory. CARDNO will review and evaluate laboratory data generated by using laboratory quality control summary reports provided by the laboratory. Laboratory quality control summary reports will include a case narrative and QC MS/MSD performed on site specific samples. A Level ill analytical QC effort will be performed for this project.

Level IV: Chemical analyses performed in an offsite analytical laboratory using SW- 846, 3rd. Edition, Final Update ill methods. Quality control procedures are those described in SW-846. Data validation based on a comprehensive set of raw and quality control data provided by the laboratory. None proposed for this project.

Level V: Chemical analyses performed in an offsite analytical laboratory using nonstandard or modified USEPA analytical methods. None proposed for this project.

# 2 Measurement/Data Acquisition

This section describes how project data will be collected, measured, and documented. Proper implementation of these activities will help ensure that resulting data are scientifically sound, of known and documented quality, and suitable for their intended use.

This section addresses quality control activities that will be performed during each phase of data collection and generation, from sampling to data reporting, evaluatingQC acceptance limits, and the performance of corrective actions for non-conformances. It is important to remember that each phase of data collection and generation is interdependent and that, therefore, quality must be factored into all project activities or tasks. The final two QAPP sections, Assessment/Oversight and Data Review, evaluate the activities or tasks described in this section.

## 2.1 Sampling Tasks

### 2.1.1 Sampling Design and Rationale

The rationale for the sampling design and the selection of sampling locations, sample types, and analytical parameters are done in consideration of review by DERR and evaluation of previous site characterization data generated at the Phase I area of the NTL. The overall strategy for the SAP, including the sample media, sample type, sample locations, and number of samples to be collected, is presented in the SAP.

### 2.1.2 Sampling Procedures and Requirements

Sample collection and field measurement procedures for soil, groundwater, surface water and non-aqueous phase liquids (NAPLs) sampling are described in Sampling Methods, of the SAP. The SAP also describes sampling locations, and analytical methods for all sample matrices.

Sample analyses, matrices, method numbers, containers and sample size requirements, preservation methods, and holding times associated with the analyses to be performed are listed. All sample containers will be provided by the analytical laboratory. For those analyses requiring preservation, the laboratory will provide "pre-preserved" sample containers with the appropriate preservative as specified in the applicable analytical method and as listed in the SAP.

Sampling equipment that will be used during the SAP is provided in, Sampling Methods, of the SAP. Additional information on sampling equipment is presented below.

QC is the set of activities that are performed for the purposes of monitoring, measuring, and controlling the performance of a measurement process. QC samples provide measurable data quality indicators used to evaluate the different components of the measurement system, including sampling and analysis. QC measurements in the field will include the collection of field soil, groundwater, water, and NAPL QC samples. The field QC samples are described below in the QC Sample section.

The QAPP identifies the QC samples, and their respective acceptance limits, that will be used during the project to monitor the quality of various preparatory and analytical steps and to perform the QC activities. In addition, the QAPP describes in numerical terms what constitutes acceptable performance for the QC sample and what corrective actions to be taken if the QC sample fails these criteria. Also, a description of how the QC data and results are to be documented and reported to the data user will be identified. These analytical QC are described below in the QC Sample section.

### 2.1.3 Inaccessible Site

In the event the sampling site is not accessible, the Site PM will be notified and accommodations to provide access with a schedule time will be provided.

## 2.2 Analytical Tasks

This section lists the project analytical laboratories, references the analytical methods that will be used.

### 2.2.1 Analytical Laboratories

Samples will be analyzed by laboratories certified by the State of Utah.

### 2.2.2 Analytical Laboratory Certification

All laboratories will be required to have current Utah laboratory certifications for the analytical methods used.

### 2.2.3 Sample Preparation Methods

Sample preparation methods for the analysis of soil and water samples will be as follows:

- Method 5030C for Volatile Organic Compound (VOC) preparation for soil/water.
- Method 3051A for Metals Preparation for soil.
- Method 7471B for Mercury in soil.
- Method 3005A for Metals Preparation for water.
- Method 7470A for Mercury for water.
- Method 3546 for Semi-volatile Organic (SVOC) preparation for soil.
- Method 3511 for SVOC preparation for water.
- Method 3535 for Solid-Phase Extraction (SPE) preparation for water
- Method 3545 for Poly-chlorinated biphenyl's (PCBs) preparation for soil.
- Method 537.1 for PFAS in soil and water.
- Method 6200 for Field Portable X-Ray Fluorescence Spectrometry

### 2.2.4 Analytical Methods

Laboratory analysis methods will be those described in:

- Test Methods for Evaluating Solid Waste, Laboratory Manual - Physical/Chemical

Methods, SW-846, 3rd Edition (U.S. Environmental Protection Agency, 1986, as amended through August 2002).

- *Methods for Chemical Analyses of Waster and Wastes,* EPA-600/ 4-79-020 (U.S. Environmental Protection Agency, 1983).

- *Standard Methods for the Examination of Water and Wastewater,* 20th Edition [American Public Health Association, (APHA, et al. 1999].

Soil, water, and NAPL samples will be analyzed for the following as shown in

Table A4:

- Diesel Range Total Petroleum Hydrocarbons (TPH) by 8015D.
- Total Recoverable Petroleum Hydrocarbons by Method 9070A.
- VOCs by EPA Method 8260D by GC/MS for soil/water.
- SVOCs by EPA Method 8270E.
- RCRA 8 Metals by EPA 6020B.
- PCBs by EPA Method 8082A
- Pesticides by EPA Method 8081B
- Total Suspended Solids by SM2540D.
- Fluorinated Alkyl Substances by Method 537 (modified).

Single Ion Monitoring (SIM) methods may be utilized when reaching low detection limits for selected compounds are not achievable by standard methods. The SIM method is routinely used for detection of 8270 PAH compounds and other compounds with low EPA RSL values in lieu of an MCL.

### 2.2.5 Calibration Procedures and Frequency

This section discusses general requirements for instrument calibration and standards preparation and traceability. Test specific calibration details for the applicable methods are shown in the laboratory Standard Operating Procedures (SOPs), which can be supplied upon request.

Instrumentation calibration is necessary for accurate sample quantitation. Calibrations establish the dynamic range of an instrument, establish response factors to be used for quantitation, and demonstrate instrument sensitivity. Criteria for calibration are method specific are taken from the published analytical methods, and are executed as described in each method's SOP. Accurate sample quantitation also relies on accurate standards. Standards accuracy may be established by tracing the quantitation standard to a source of known and documented quality or by comparingstandards from different sources. Instrument calibrations and standards are unambiguously documented so that the process of calibration can be re-created.

Standards: The accuracy of sample target analyte quantitation is directly related to the accuracy of the standards used for instrument calibration. To ensure the highest quality standard, primary reference standards are obtained from the National Institute of Standards and Technology (NIST), EPA CRADA vendors, or other reliablecommercial sources. When standards are received at the laboratory, the date received, supplier, lot number, purity and concentration, and expiration date are recorded in a standard log book. Vendor certifications sent with the standards also are filed.

Standards purchased may be in a pure form, in a stock, or working standard solution. Commonly, dilutions are made from vendor standards. All standards made are givena unique standard identification number and have the following information recorded in a standards logbook: source of standard used to prepare dilution; preparer's initials; initial concentration; final concentration; solvent; source and lot number of solvents; volume of final solution; and volume of standard diluted. After preparation and before routine use, standards are validated. Validation procedures range from a check for chromatographic purity to verification of the concentration of the standard using a standard prepared at a different time or obtained from a different source. Reagents also are examined for purity by subjecting an aliquot or sub-sample to the analytical method in which it will be used. Standards are routinelychecked for signs of deterioration (e.g., discoloration, formation of precipitates, and changes in concentration) and are discarded if deterioration is suspected or their expiration date has passed. Expiration dates may be taken from the vendor recommendation, the analytical methods, or from internal research.

Organic Methods Calibration: The field of chromatography involves various instrumentation and detection systems. While calibration requirements vary depending on the type of analytical system and methodology, the following principles of calibration generally apply: calibration occurs before any sample quantitation; initial multipoint calibrations are performed periodically; daily standards are analyzed prior to sample analysis; and continuing calibration standards are analyzed at a specific frequency throughout the sample analysis. Sample quantitation may be based on initial, daily, or continuing calibration. Sample quantitation may be with an external calibration technique or with an internal standard calibration technique. Internal standard techniques require internal standards to be spiked in all samples and standards and then quantitate target analytes relative to the internal standard response. Internal standard techniques are always used for gas chromatography/mass spectrometry (GC/MS) methods and may be used for GC methods.

Gas Chromatography: This section discusses general calibration techniques for non-GC/MS methods such as SW8080A, SW8020A and SW8010B. External or internal standard calibration techniques may be used for calibrating the gas chromatograph.

Initial calibrations are performed on initial instrument set up, on failure of the daily or continuing standard, and on any major change in the system. However, before initial calibrations are performed, the instrument operating conditions are verified, any routine preventative maintenance is performed, and an instrument blank is analyzed to test for, or show the absence of, interferences. The initial multipoint calibration consists of a standard containing each analyte of interest at least five concentration levels for SW846-8000A series methods. One of these standards should be approximately at the RL. The other standards should bracket the concentration range expected in real samples, but not exceed the working linear range of the detector being used. From the initial calibration, calibration factors are calculated for each analyte of interest to evaluate the system performance. The calibration factors, for analyses not using internal standards, are calculated as follows:

$$CF = \frac{A}{M}$$

*Where:*

$CF$ = calibration factor,

$A$ = area of the analyte peak, and

$M$ = mass of target analyte injected.

The CF is used to evaluate instrument response linearity for each analyte of interest across the calibrated range. Linearity is determined by the correlation coefficient, r, of the best fit linear or non-linear line, or the percent relative standard deviation (%RSD).For example, the linear correlation coefficient is calculated as follows:

Where: r

$$r = \frac{n\sum(xy) - \sum x \sum y}{\sqrt{\left[n\sum(x^2) - \left(\sum x\right)^2\right]\left[n\sum(y^2) - \left(\sum y^2\right) - \left(\sum y\right)^2\right]}}$$

$x$ = calibration concentration,

$y$ = instrument response (peak area), and

$n$ = number of calibration points (x, y data pairs).

The %RSD is calculated as follows:

$$RSD \quad \frac{S}{X}(100\%)$$

Where:

$x$ = mean of the five *CF* for a particular compound, and

$s$ = standard deviation of the *CF* for that compound.

For SW846 methods, the %RSD generally must be less than or equal to 20 percent, orthe correlation coefficient, r, must be greater than or equal to 0.995. The use of r or %RSD must be uniformly applied to a calibration sequence and instrument. The initial calibration is checked at least daily by injecting a daily calibration standard. This standard is usually the mid-range standard of the initial calibration and is injected before any samples or method blanks are analyzed. The percent difference (%D) is calculated and should be within 15 percent of the average responsefactor of the initial calibration curve or the quantitated value should be within 15 percent of the expected value. Generally, a continuing calibration standard is analyzed every ten samples and at the end of an analytical run to further evaluate system performance. The %D of the continuing calibration standards must, depending on the method, either meet the same criteria as the daily standard or be within 15 percent of the daily standard CF. Percent Difference is calculated as:

$$\%D = \frac{2(R_1 - R_2)}{R_1 + R_2}(100)$$

Where:

*%D* = percent difference,

*R1* = average *CF* from initial calibration, and

*R2* = *CF* from continuing calibration.

*Gas Chromatography/Mass Spectrometry (GC/MS):* Every 12 hours, prior to calibration or sample analysis, the mass spectrometer must be tuned. Generally, for volatiles methods, bromofluorobenzene (BFB) is used and for semi-volatile methods, decafluorotriphenylphosphine (DFTPP) is used. Tuning criteria generally are given inthe methods and are stated in the method specific SOPs.

Initial calibrations are performed on instrument setup, on failure of the continuing standard, or on any major change in the system. Initial calibrations for SW846 methods use at least five calibration concentrations with the lowest standard at approximately the RL. Initial calibrations must contain all analytes of interest and contain internal standards. The initial calibration is evaluated on certain key compounds referred to as System Performance Calibration Compounds (SPCC) and Calibration Check Compounds (CCC). The SPCC evaluates system sensitivity and the CCC evaluates system linearity. A relative response factor (RF) is calculated for the analyte of interest relative to the internal standard whose retention time is closestto that compound. The RF is calculated as follows:

$$RF = \left(\frac{A_x}{A_{IS}}\right) x \left(\frac{C_{IS}}{C_x}\right)$$

*Where:*

$A_x$ = area of quantitation ion for the compound being measured,

$A_{is}$ = area of quantitation ion for the specific internal standard,

$C_{is}$ = concentration of the specific internal standard, and

$C_x$ = concentration of the compound being measured.

From the RF at each concentration, an average RF is calculated. The SPCC are checked for a minimum average RF and the CCC are checked for maximum percentrelative standard deviation (%RSD) of their RF across calibration concentrations.

%RSD is calculated as follows:

$$\%\boldsymbol{RSD} = (\boldsymbol{s}/\boldsymbol{x})\mathbf{100}$$

*Where:*

*RSD* = Relative standard deviation,

x = Mean of five initial RFs for a compound, and

s = Standard deviation of the RFs for a compound.

After the initial calibration has been found acceptable, and before sample analysis, and every 12-hours during sample analysis, a tuning standard and calibration standard must be analyzed. The acceptance criteria for continuing standards (usually the midlevel standard of the initial calibration) is based on SPCC and CCC criteria, retention time criteria, and internal standard area criteria. SPCCs are checked for instrument sensitivity and CCC compounds are checked for daily drift from the average RF of the initial calibration. Percent difference criteria must be met in the

RFs of CCCs. Percent difference is calculated as follows:

$$\%D = \left( \frac{RF_c - RF_i}{RF_i} \right) 100 \Big|$$

*Where:*

%D = percent difference,

$RF_i$ = average relative response factor from initial calibration, and

$RF_c$ = Relative response factor from current calibration check standard.

The internal standard retention times in the continuing calibration standard must bewithin 30 seconds of the previous continuing calibration standard and the internal standard areas must be within a factor of two from the last continuing calibration standard.

If any criteria are failed during initial, continuing, or tuning calibration, corrective action must be taken before sample analyses may proceed.

<u>Metals Methods Calibration:</u> Environmental metals analyses commonly use either atomic absorption (AA) or inductively coupled plasma (ICP) emission spectroscopy. For both of these techniques, after the initial instrument calibration, the calibration is monitored through the analysis of initial and continuing calibration verification standards (ICV, CCV) and initial and continuing calibration blanks (ICB, CCB).

*Inductively Coupled Plasma (ICP):* The ICP or Trace ICP is calibrated daily prior to any sample analyses using criteria prescribed in the analytical method. The calibration is then verified using a standard from an independent source (ICV). The working rangeof the instrument is established each quarter year with a linear range verification check standard. Sample quantitation may not be performed outside the linear range.

An initial instrument calibration is established daily by analyzing a minimum of two standards, one of which is a calibration blank. The calibration is monitored throughout the day by analyzing CCB and a CCV after every 10 samples. The CCV is a standard at the mid-range of the calibration. If the verification standard and blank do not meet established criteria, corrective action must be performed. The corrective action procedures include examination of instrument performance and analysis information, consultation with the group leader, and a decision path to determine if recalibration and reanalysis of samples back to the previously acceptable calibration check is warranted.

An inter-element check standard is analyzed at the beginning and end (or after 8 hours) of each analytical run on the ICP to verify that inter-element and background correction factors have remained constant. Results outside of the established criteria trigger reanalysis of samples.

Wet Chemistry and Other Methods Calibration: The field of conventional, non-metals analysis (wet chemistry) involves a variety of instrumental and wet chemical techniques. Although calibration and standardization procedures vary depending on the type of system and analytical methodology required for a specific analysis, the general principles of calibration apply universally. Each system is calibrated prior to analyses being conducted. Calibration consists of defining the working range by use of a series of standard solutions and identifying potential interferences. The calibration is checked on an ongoing basis to ensure that the system remains within specifications. If the ongoing calibration check does not meet established criteria, corrective action must be performed. The corrective action procedures include examination of instrument performance and analysis information, consultation with the group leader, and a decision path to determine if recalibration and reanalysis of samples back to the previous acceptable calibration check is warranted.

## 2.3 Sample Collection Documentation, Handling, and Custody

Sample handling and documentation are important parts of investigations generating data that will be used for studies, evaluations and designs. Samples must be placed in appropriate sample containers, properly preserved and stored, and traceable from the time of sample collection until sample data are introduced in approved plans and documents. Therefore, written records (e.g., chain-of custody and field sampling forms, logbooks) must exist for each sample throughout sample collection, transport, storage, and analytical activities.

### 2.3.1 Sample Containers, Preservatives, Turnaround Times and Holding Times

Sample analyses, matrices, method numbers, containers and sample size requirements, preservation methods, and holding times associated with the analysesto be performed are listed in **Table A4.**

Custody is one of several factors necessary for the admissibility of environmental data as evidence in a court of law. Custody procedures help to satisfy the two major requirements for admissibility: relevance and authenticity. Sample custody is addressed in three parts: field sample collection, laboratory analysis, and final evidence files. Final evidence files, including all originals of laboratory reports and purge files, are maintained under document control in a secure area.

Turnaround times will be standard per the laboratory contracted.

A sample or evidence file is under your custody if:

- The item is in actual possession of a person.
- The item is in the view of the person after being in actual possession of the person.
- The item was in actual physical possession but is locked up to prevent tampering.

The item is in a designated and identified secure area.

### 2.3.2 Field Custody Procedures

Field Forms: Field Investigation Daily Reports and Sampling Records (Field Forms)will be used to document data collection activities. Entries will be described with sufficient detail so that field activities can be reconstructed without reliance on memory.

A Field Investigation Daily Report (FIDR) will include the date, start time, weather, equipment calibration, names of all sampling team members present, and the signature or initials of the person making the entry. The names of visitors to the site, field sampling or investigation team personnel, and the purpose of their visit also will be recorded on the FIDR.

Field measurements will be recorded on the Field Forms and will include the type of sampling, time, sample description, and volume and number of containers. All entries will be made in ink, and erasures will not be made. If an incorrect entry is made, the information will be crossed out with a single line. Whenever a sample is collected or a measurement made, a detailed description of the sample location shall be recorded. All equipment used to make measurements will be identified.

A sample identification number will be assigned before sample collection. Field duplicate samples will receive an entirely separate sample identification number.

*Chain-of-Custody Protocol:* Chain-of-custody protocol will be followed to maintain and document sample possession. The principal documents used include:

- Sample labels and seals
- Field Forms
- Chain-of-Custody Records
- Shipping Records (where applicable)

Each sample will be labeled and when shipped have a custody seal affixed to its container cap immediately after collection. All bottle/jar labels and seals will be provided by the laboratory. Each label will include, at a minimum, the following information:

- Project identifier.
- Initials of collector.
- Date and time of collection.
- Number that uniquely identifies the sample and its collection location. An example of the sample numbering system for this project is: NTL-DH-IOs 7/08. Where "NTL" is the project identifier; DH indicates that it is a drill hole sample; "10" is the unique sample location identifier (the sample numbering sequence will be blind and will not indicate to the laboratory which samples are duplicates, splits, or field blanks); "s" indicates that the sample is a "soil" matrix; and "10/99" denotes the month the sample was collected.
- General analysis group if the container has preservative.
- Preservative (if any).

A custody seal will be affixed to all samples if leaving the direct custody of the sampling such as in shipping, to prevent tampering during shipment to the laboratory. If any custody seals are found broken when the laboratory receives a sample shipment, analysis will not be performed unless there is incontrovertible evidence the samples were not compromised.

Broken or missing custody seals will benoted on the Chain-of-Custody Records by the receiving analytical laboratory.

Samples will be kept in CARDNO's possession until the end of each day, when they willbe delivered to the analytical laboratory in person. A sample will be considered in CARDNO's custody if it is in the field team's possession or it is in a designated secure area, under CARDNO's control.

A Chain-of-Custody Record must be completed for and accompany every sample and every shipment of samples to the analytical laboratory to establish the documentation necessary to trace sample possession from the time of collection. The Chain-of- Custody Records will contain, at a minimum, the following information:

- Sample identification
- Signature of collector
- Date and time of collection
- Place of collection
- Sample matrix
- Signatures of persons involved in the chain of possession
- Inclusive dates of possession

The Chain-of-Custody Record also will be used to indicate what analyses are required. The level of laboratory quality control, turnaround time and special reporting will be noted.

Following proper sealing and labeling, sample containers will be placed in a cooler preserved to 4 ± 2 ° C. The cooler will be closed and sealed with a custody seal if shipped.

*Shipping:* As a contingency, shipping procedures are included in the QAPP in the event that it becomes necessary to ship samples to an approved analytical laboratory.In lieu of shipping samples, it is planned to have the samples delivered directly to Utah certified laboratory.

All samples are to be accompanied by a properly completed chain-of-custody form. The original record will accompany the shipment, and the pink and yellow copies willbe retained by the sampler for return to CARDNO's office. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents transfer of custody of samples from the sampler to another person, to the permanent laboratory, or to/from a secure storage area.

Samples will be properly packaged for shipment and dispatched to the laboratory for analysis, with a separate, signed custody record enclosed in each sample box or cooler. Shipping containers will be locked and secured with strapping tape and custody seals for shipment to the laboratory. The preferred procedure includes use ofa custody seal attached to the front right and back left of the cooler. The custody sealsare covered with clear plastic tape. The cooler is strapped shut with strapping tape in at least two locations.

Samples will be shipped to the laboratory using a courier under a bill of lading. Receipts of bills of lading will be retained as part of the permanent documentation. The courier will not sign off on the custody form as it will be sealed inside the samplecooler and the custody seals remain intact.

### 2.3.3 Laboratory Custody Procedures

Samples delivered to AWAL are received by the Sample Control, assigned an accession number, and individually numbered accordingly. Documentation of custody seal integrity, temperature, and sample preservations are made on the sample control worksheet or condition upon receipt form. The chain of custody form is checked against the samples for proper numbers and requested tests, sample conditions is checked and samples are placed in cold storage to await analysis. Any problems are documented on the sample control communication form. The laboratory project manager will either resolve the problem internally or contact CARDNO's project manager for resolution.

Samples are received by the sample custodian or designee and logged into the laboratory system. Each time a sample or its extract is removed from a refrigerator, itis logged out. When the sample or its extract is returned to the refrigerator, it is logged back in by the same person.

For samples receiving analysis for volatile compounds, sample containers are placedin separate refrigerators. The sample refrigerators are kept at 4 ± 2 ° C. The refrigerators storing samples for volatile analysis are monitored for contamination with holding blanks.

Thirty to sixty days after a laboratory report has been generated and mailed to CARDNO, the samples are transferred from cold storage to the sample disposal area.

### 2.3.4 Final Evidence Files

The final evidence file will be the central repository for all documents that constitutes evidence relevant to sampling and analysis activities as described in this work plan. CARDNO is the custodian of the evidence file and maintains the contents of evidence files for this project, including all relevant records, reports, logs, field notebooks, pictures, subcontractor reports and data reviews in a secured, limited access area and under custody of the CARDNO Facility manager.

The final evidence file will include at a minimum:

- Field investigation daily reports
- Photographs
- Drawings
- Sampling records (Field Forms)
- Laboratory data deliverables
- Data validation reports
- Data assessment reports
- Progress reports, QA reports, interim project reports, etc.

All custody documentation (tags, forms, air bills, etc.)

## 2.4 Quality Control Samples

This section addresses quality control samples only. QC is the set of activities that are performed for the purposes of monitoring, measuring, and controlling the performance of a measurement process. QC samples provide measurable data qualityindicators used to evaluate the different components of the measurement system, including sampling and analysis.

Each QC sample's value is based on its contribution to measuring precision,accuracy/bias, contamination, and sensitivity.

QC check samples will be assessed for both field and laboratory operations to ensure overall precision/bias and accuracy throughout the project. Field QC samples will include field duplicate and blank samples. The frequency of field QC check samples is summarized in **Table A2** and discussed below. Laboratory QC parameters, criteria,and frequency are specified in the analytical procedures referenced in this section. Comparison of QC samples against established criteria is performed during the datareview process described in Section 4.

### 2.4.1 Field Quality Control Samples

QC procedures for pH, conductivity, temperature, and dissolved oxygen of samples will include calibrating the instruments as described in this section, and checking the reproducibility of the measurements by taking multiple reading on a single sample or reference standard. Assessment of field sampling precision and bias will be made by collecting field duplicates and field blanks for laboratory analysis.

Field Duplicate Sample: Duplicate samples are analyzed to check for matrix variability and analytical method reproducibility. One field duplicate will be collected for every 10 investigative samples by media and analyzed for the same parameters listed for other media samples. Duplicate samples will be collected byfilling alternate sample containers.

Blank Samples: At least one type of blank sample (Rinsate, transfer or trip) will be collected for each day that water or soil samples are collected. Blank samples will becollected, preserved, labeled, and treated like any other sample. They will be sent "blind" (i.e., not identified as a QC sample) to the laboratory. The type of blank sample will be noted in the field logbook.

*Rinsate Blank Samples:* Rinsate (or equipment) blank samples will be collected when sampling equipment will be decontaminated for re-use. Rinsate samples are used to assess whether sampling equipment has been properly decontaminated between sample locations. Rinsate will be obtained by passing distilled water through the sampling device and capturing the water in a sample container.

*Transfer Blank Samples:* Transfer blank samples will be prepared when no Rinsate blank samples are collected. The purpose of a transfer blank sample is to monitor forentrainment of contaminants into the sample from existing atmospheric conditions at the sampling location during the sample collection process. A Transfer blank sampleis prepared by filling sample containers with distilled or de-ionized water at a given sampling location. Transfer blank samples will be analyzed for the same parameters as the environmental samples.

*Trip Blanks Samples:* Trip blank samples will be submitted whenever a water sample within a batch (every 20 samples) is being analyzed for Volatile Organic Compounds (VOCs), with a minimum of one trip blank sample submitted every day water samples are collected. VOCs samples are susceptible to contamination by diffusion of organic contaminants through the septum of the sample vial. Trip blanks are analyzed to monitor for possible sample contamination during shipping of VOCs only. Trip blanks are prepared in the laboratory by filling preserved VOC vials (with no headspace) with organic-free water. Trip blanks accompany the sample containers during transit from the laboratory to the site, collection, and shipment to the laboratory. The blanks are stored with the samples in the laboratory.

*Agency Split Sample*: Agency split samples will be coordinated with the DERR representative. Agency Split samples will be incorporated into the SAP and arranged in advance with the DERR PM to schedule the selected sample locations for the split samples.

### 2.4.2 Analytical Quality Control Samples

Method quality control determines whether a method is performing within acceptable limits of precision and accuracy. Such control has a laboratory component and a matrix component to this determination. The laboratory component measures the performance of the laboratory analytical processes during the sample analyses. The matrix component measures the method performance on a specific matrix. Some quality control elements uniquely measure the laboratory component of method performance, but all QC elements that measure the matrix component also contain the laboratory component.

Method blanks and laboratory control samples uniquely measure the laboratory component of method performance. Matrix spikes, matrix spike duplicates, laboratory sample duplicates, surrogates, and post-digestion spikes measure the matrix component of method performance.

On a project or sampling event level, additional quality control elements are used to assess field sampling techniques and environmental conditions during sample collection and transportation. Field sample duplicates (in contrast to laboratory sample duplicates), field blanks, equipment blanks, and trip blanks are used to assess field precision and accuracy. Because these QC elements are related to field activities, they are mentioned in this laboratory QAPP only in the context of routine sample analyses. Further discussion on the application and interpretation of these field elements is provided in the previous subsection.

Batch: Many analytical laboratory processes include batch processes and therefore the batch is a basic unit for the frequency of some quality control elements. Two types of lab process batches can be identified: the preparation and instrument batch. A preparation batch is defined as a group of 20 or fewer samples that are prepared (e.g., extracted or digested) within the same time period or in limited continuous sequential time periods. Samples in each batch should be of similar matrix (e.g., soil, sludge, liquid waste, water), be treated in a similar manner, and use the same reagents. The instrument batch is a group of samples that are analyzed together within the same analytical run sequence or in continuous sequential time periods. The instrument batch may contain more than one preparation batch. In general, if an instrument is not used for periods of time (e.g., overnight) or is shut down, then a new instrument batch must be started.

The quality control batch (QC batch) is the fundamental quality control unit for this project and is a set of up to 20 field samples that behave similarly and are processed using the same procedures, reagents, and standards within the same time period. A method blank, laboratory control sample, and matrix spike/matrix spike duplicate (or sample duplicate and a single matrix spike) are included in the QC batch. Field quality control samples are included as discrete samples in the batch sample count but laboratory quality control samples (stated above) are not included in the count of field samples. For methods that require independent preparation prior to analysis, the QC batch is defined by preparation batch, and for methods that do not require independent preparation, the QC batch is defined by the instrument batch. A volatile organic analysis (VOA) by GC or GC/MS is an example of the latter because the sample preparation (purge and trap) is performed as part of the instrumental analysis. In addition, for VOA GC and GC/MS analyses the sample preparation is more of a sequential, rather than batch, process. For the purpose of QC frequency, VOA GC and GC/MS batches are defined as 20 or fewer samples analyzed within a calibration (and for GCMS, tune) time period, or within sequential continuous calibration time periods. For VOA GC and GC/MS analyses, a batch may extend over a calibration and tune.

Preparation batch samples and QC generally should be analyzed in the same instrument batch. In some instances (e.g., sample dilutions, reanalysis to verify results, expedited TAT), the QC samples may not be run with all samples from the preparation batch. Samples not run with the preparation QC must meet the following conditions:

- All samples from the preparation batch must be clearly associated with their corresponding preparation QC, and appropriate corrective is performed on all from the preparation batch.
- All instrument QC criteria are met.
- Instrument cleanliness must be proven with the preparation method blank, an instrument blank, or a clean method blank from another batch.

In summary, the basic unit for quality control is the QC batch, and it may be initiated at the preparation or instrument stage of the sample analysis process.

Method Blank: The method blank is a quality control sample that consists of all reagents specific to the method and is carried through every aspect of the procedure including preparation, cleanup, and analysis. The method blank is used to identify any interference or contamination of the analytical system that may lead to the reporting of elevated analyte concentrations or false positive data. Some inorganics methods do not have a distinct preparation, and for these tests, the instrument blank, which contains all reagents used with samples and is equivalent to the method blank, is considered the method blank. A method blank is included in each QC batch.

Instrument Blank: An instrument blank is used to monitor the cleanliness of the instrument portion of a sample analysis process. Instrument blanks are usually just the solvent or acid solution of the standard used to calibrate the instrument. With the exception of metals analyses, instrument blanks are analyzed for each instrument batch whenever a method blank is not analyzed in that instrument batch. Routine metals analyses receive an instrument blank every 10 samples. Instrument blanks are also analyzed on an as-needed basis for troubleshooting.

Laboratory Control Sample (LCS): A laboratory control sample is a well- characterized, laboratory-generated sample used to monitor the laboratory analytical process independent of matrix effects. It is spiked with a known quantity of analyte of interest, is prepared with each batch of samples, and is taken through the entire sample preparation and analysis process. The LCS measures the accuracy of the process by the recovery of spiked target analyte in a controlled matrix or matrix-free sample. LCS results, together with matrix spike results, can establish the presence of matrix effects. For methods where there is no distinct preparation, a continuing calibration standard may be used as the LCS, if it meets all LCS criteria.

<u>Duplicate Control Sample (DCS):</u> Duplicate control samples are two LCSs prepared and analyzed together. Accuracy (recovery) and within-batch precision may be determined when DCS are used. DCS are evaluated according to LCS criteria for accuracy and MS/MSD criteria (if available) for precision. DCS may be used when matrix spikes are not amenable to the sample or method, when insufficient sample volume is received for matrix spikes or sample duplicates, or client specific requirements. For methods that have no distinct preparation, two consecutive calibration standards may be used as a DCS, if all other DCS criteria are met.

<u>Matrix Spikes and Matrix Spike Duplicates (MS/MSD):</u> To measure matrix specific method performance, a field sample is spiked with a known quantity of target analytes before preparation and analysis. The target analytes spiked are listed in the laboratory SOP and are the same as those spiked into the LCS. The spiked sample is called a matrix spike (MS) and, if another aliquot of the sample is also spiked, the second sample is called a matrix spike duplicate (MSD). The accuracy of the matrix specific method performance may be determined by the recovery of the spiked analytes after native concentrations of the spike analytes are subtracted. If a matrix spike duplicate (MSD) is analyzed, the matrix specific precision of the method may be calculated. In general, for organic and inorganic analyses, an MS/MSD pair are prepared and analyzed with each QC batch of up to 20 field samples.

<u>Sample Duplicates (SD):</u> A sample duplicate (SD) is a second aliquot of an environmental sample (taken from the same container if possible) that is processed with the first aliquot of that sample. The results are compared to the first aliquot analysis to determine the matrix specific method precision of the analysis. The matrix specific method precision may be calculated by dividing the difference in the results by the average. Sample duplicates are prepared and analyzed for some inorganic analyses that are not amenable to matrix spiking.

<u>Surrogate Compounds:</u> GC, GC/MS, and HPLC analyses include the addition, subsequent quantitation, and ultimate recovery calculation of surrogate compounds. Surrogate compounds are:

- Compounds not requested for analysis
- Compounds that do not interfere with the determination of required analytes of interest
- Compounds that are not naturally occurring, yet are chemically similar to the required analytes
- Compounds exhibiting similar response to analytes under determination

When used by a method, surrogate compounds are added to every sample, LCS, MS/MSD, and method blank at the beginning of the sample preparation, and the surrogate recovery is used to monitor matrix effects and sample preparation.

Surrogate control criteria are applied to all field samples and QC samples and re-analysis and re-extraction may be performed if surrogate criteria are not met.

Surrogate compounds are given in the Facility SOP.

<u>Internal Standards:</u> Internal standards are compounds not found in the sample, are added at the time of instrumental analysis, are used to quantitate results, and are used to correct for injection

variability. Although GC and ICP methods may use internal standards, mass spectrometer methods require them.

### 2.4.3 Laboratory Batch Quality Control Logic

Frequency of Batch Quality Control: For organics and inorganics analyses each QC batch will contain a method blank, an LCS, and an MS/MSD pair. There are a few exceptions to the QC frequency stated above due to the nature of the analyses or method specific requirements. Some methods, usually wet chemistry methods, are not amenable to matrix spikes (e.g., pH). For these methods, laboratory sample duplicates are usually substituted for the matrix spikes. When there are exceptions tothe general QC frequency stated above, these exceptions will be clearly stated in the

Facility SOP, and the basic concepts of batch control and matrix and laboratory performance assessment and control will remain intact.

Batch Quality Control Logic: This section provides a general description of the QC batch control logic and the corrective actions that will be used. For the method- specific application of this general description, please refer to specific SOPs. Batches are controlled by method blanks and LCS. Matrix spike recoveries and relative percent difference (whether from matrix spikes or sample duplicate analyses) will be reviewed for systematic trends and errors, as well as the effect of the matrix on method performance. Surrogate recoveries will be reviewed for matrix effects as well as individual sample errors.

Batch Quality Control Logic - Method Blanks: The method blank is included in each

QC batch and measures laboratory introduced contamination for the batch. An acceptable method blank has no target analytes greater than the project specific reporting limit (PSRL) and must have acceptable surrogate recoveries. If target analytes are present in the method blank above the PSRL, then they must be less than the higher of 5 percent of the sample concentration, or 5 percent of the regulatory limit. Any method blank with target analyte concentration greater than the PSRL must be documented as a nonconformance, and addressed in the project or case narrative.

If these criteria are not met, corrective action is implemented. The first step of corrective action is to assess the effect on the samples. For example, if an analyte is found only in the blank but not in any batch samples, re-extraction and re-analysis of the batch may not be necessary. Investigating and eliminating the source of the contamination and documenting the evaluation may be the appropriate action in sucha scenario. In general, corrective action will be executed in the following order: reanalysis of the method blank, re-analysis of the samples, re-preparation and reanalysis of all affected QC batch samples and QC.

It is a goal to have no detected target analytes in the method blanks, but analytes may be periodically detected in blanks due to the nature of the analysis or the PSRL of the analyte. For example, in organic volatile analyses, methylene chloride, acetone, and 2-butanone (MEK) may sometimes be found in the method blank, and in organic semi-volatiles analyses, the phthalate esters may sometimes be found in the method blank. For ICP or GFAA metals analyses, copper, zinc, iron, and lead (GFAA and Trace ICP only) may sometimes be found in method blanks. For these common laboratory contaminants, data may be reported with qualifiers if the concentration of the analyte is less than five times the reporting limit (RL) for organic methods, and less than two times the RL for inorganic methods. Any lab contaminants found in the method blank are discussed in the report narrative. Blank subtraction is not performed (unless required by the method). CARDNO will be contacted if batch re-preparations do not lead to method blanks that meet the above criteria.

Batch Quality Control Logic - LCS: LCS are evaluated by comparing the recovery of spiked target analytes with the laboratory-generated acceptance criteria. For organic analyses, the LCSs are spiked with a set of compounds representative of the target analyte list and for inorganic analyses LCSs are spiked with all target analytes. The analytes spiked into the LCS are listed in the method-specific tables. When a limited spike list is used, all spiked compounds must be within the recovery windows for the batch to be considered acceptable, and when a full spike list is used a batch may be considered acceptable for those analytes that had acceptable recoveries in the LCS. If analytes are outside the acceptance windows, corrective action must be initiated.

The first step of the corrective action process is to evaluate the effect on the samples; for example, if an analyte in the LCS has a recovery above the upper acceptance window, and other QC elements of the batch and sample analysis indicate that other samples in the batch were not affected, re-analysis or re-preparation of the batch may not be necessary. Corrective action consists of an attempt to locate the cause of the non-conformance and the documentation of the evaluation in the laboratory report narrative. For example, if an LCS spiked analyte does not have an acceptable recovery, but the MS/MSD pair does for the same analyte (and there is no matrix interference in the MS/MSD pair for that analyte), then the batch may be accepted, with an explanation of the evaluation in the report narrative. In general, for LCS withlimited spike lists, if a compound or element spiked into the LCS has an unacceptable recovery, the LCS, method blank, and all batch samples must be re-extracted and re- analyzed. For LCS with full target analyte spike lists, the batch samples, method blank, and LCS must be re-prepared and re-analyzed for the failed analyte.

Intermediate corrective action may include re-analysis of the LCS, but the re-analysismust be performed in real time, to properly determine that the instrument excursion was isolated to the LCS analysis only.

Matrix Spike Evaluation: For organic and inorganic methods amenable to matrix spikes, an MS/MSD pair is analyzed with each QC batch of samples. Both organic and inorganic batches are evaluated for matrix precision and accuracy. Accuracy is evaluated by calculating the recovery of spiked analyte and precision is evaluated bycalculating the relative percent difference (RPD) of the recoveries (see Section 5.0 for equations). The recovery and RPD are compared to the laboratory generated acceptance limits. If a matrix spike analyte fails precision or accuracy criteria, corrective action must be initiated.

Matrix spike data evaluation is more complex than blank or LCS data evaluation since matrix spikes measure matrix effects in addition to sample preparation and analysis effects. The heterogeneity of soil, grab sampling, and sequential collection of water samples further complicates the evaluation since matrix spike accuracy and precision assumes that the native concentration in the three analyses (the original sample, the spiked sample, and the duplicate spiked sample) is constant. However, appropriately trained personnel aware of the data's end use may improve data quality by an evaluation of matrix spike data. In consideration of these limitations, the laboratory will not qualify data based on matrix spike performance but will perform corrective actions as outlined in the following paragraphs, and note MS failures in the narrative.

When an MS/MSD pair fails in accuracy or precision for any spiked analyte, the causeof the failure will be investigated. If there is significant evidence to indicate that the sample matrix interfered with the precision and accuracy assessment (e.g., significant chromatographic peaks interfere with target analyte identification in a GC analysis, orpoor post-spike recovery occurs for a metals analysis) this evidence will be clearly documented in the laboratory report case narrative and no further corrective action may be necessary. If the native concentration of target analytes in the non-spiked sample is high relative to the spiking concentration, the differences in the native concentration between the non-spiked sample and the spiked sample may contributea significant error to the precision and accuracy calculations making the accuracy and precision measures unrepresentative of the true method and matrix performance. Forthis reason, if the native concentration is four or more times the spiked concentration, the matrix spike recoveries will not be calculated, the matrix-spikes will not be re- analyzed or re-prepared, and no further corrective action may be necessary. Finally, if, in the judgment of the analyst, an analytical process error has occurred appropriate re-analysis or re-preparation steps are implemented. In all situations, the evaluation and corrective actions performed will be clearly and completely documented in the laboratory report case narrative.

For analyses using a MS and sample duplicate (DU), the single matrix spike sample is evaluated for accuracy and the sample and DU are assessed for precision. The assessment follows the same logic and reporting convention as described above.

For those analyses that do not allow matrix spikes, an LCS and sample duplicate will be analyzed with each batch of samples. Batch control will be the same as that described for LCS. The within-batch precision is measured by calculating the relativepercent difference (RPD) of any target analytes found in the primary and duplicate analysis of the sample if the reported concentration of the target analyte is greater than five times the RL. The acceptance windows for LCS accuracy, and the associated corrective actions for failed QC, are based on laboratory generated acceptance criteria.

Laboratory Batch Quality Control for Field Blanks: This section outlines the qualitycontrol applied to trip, transfer and equipment blanks from sampling activities.

Trip blank vials are sent with empty sample containers to the field and are shippedback to the laboratory with field samples to measure potential contamination from storage, collection, and shipment in the field and laboratory. Transfer blanks are created in the field and are intended to measure background contamination in the field. Regardless of the matrix of the project samples, trip and transfer blanks and reagent water and are usually only analyzed for volatile contamination. Trip and Transfer blanks may be processed without site-specific matrix spike samples: they may be processed with matrix spikes or sample duplicates from another site, if the matrix adequately matches the matrix of the field or trip blank. If matrix spikes or sample duplicates from another project are not available, these field or trip blanks may be analyzed with a duplicate control sample (DCS).

Equipment blanks assess the decontamination procedures of the field sampling equipment, and consist of reagent water, or water known to be free of target analytes.Equipment blanks are usually analyzed for all the parameters, which are to be performed on the associated samples. Equipment blanks from water sampling equipment are processed in the same manner as the associated field samples, because their matrices are compatible.

### 2.4.4 Other Quality Control Elements

Reagents: Laboratory reagent water that meets the resistivity requirements of Type II water, as described in Standard Methods, is checked daily. The resistivity of the water is measured and recorded in a logbook. Method blanks are routinely analyzed for purity and accompany each batch tested. High-purity reagents are purchased as required by each test method and the date received, batch or lot, lot number, supplier, and date opened is documented.

Establishment and Use of Control Limits: The project laboratories will monitor the spike percent recovery in laboratory control samples (LCS), matrix spikes (MS) and matrix spike duplicates (MSD), and the surrogate recovery in all samples, blanks, andLCS where surrogates are used. The relative percent differences of matrix spike/matrix spike duplicates, or sample/duplicates depending on the method, are also monitored.

If, at any time during the analysis, the process is out of control as indicated by unacceptable QC sample accuracy or precision, corrective action must be taken and documented. The following three steps must be addressed:

- What actions were taken to bring the process back into control?
- What actions were taken to prevent reoccurrence of the out-of-control situation?
- What was done with the data collected while the process was out of control?

Results of performance evaluation samples can also be used as an indicator of laboratory data quality, and help in evaluating the impact of out-of-control situations.

## 2.5 Analytical Data Reporting Format

Analytical data will be reported to CARDNO using a standard format that includes sample results and QC results. Laboratory reports will be signed by the laboratory manager and the project manager.

### 2.5.1 Inorganics and General Chemistry Analyses

Standard report deliverables for metals analyses will include sample/sample duplicate results and RPDs; matrix spike concentration, results, and percent recovery;method blank results; dates of digestion and analysis; and blank spike concentration and percent recovery. "Results" as used here is understood to mean a measured concentration, as differentiated from the concentration of material spiked into a sample. Other inorganics, (geochemical indicator parameters) typically include sample/ sample duplicate results and RPDs; matrix spike concentration, results, and percent recovery; method blank results; and blank spike concentration, results, and percent recovery as report deliverables.

### 2.5.2 Organic Analyses

A typical report will include the following: dates of sampling, receipt, extraction, andanalysis; method blank results, MS/MSD concentrations, results, percent recovery, and RPDs; surrogate percent recovery; and blank spike and blank spike duplicate concentrations, results, percent recovery, and RPDs.

# 3 Assessment and Oversight

This section discusses the assessments, response actions, and QA and QC activities associated with implementation of the project. The type and frequency of assessments that will be conducted during the SAP are described. Assessments of both field and laboratory operations will be conducted as outlined in this section.

## 3.1 Field Activities

The CARDNO QA officer or designee will conduct at least one field performance review during the project to evaluate whether field procedures, sample identification control,chain-of custody procedures, and field documentation procedures are being implemented as outlined in the SAP and QAPP. If deficiencies are noted during the review, the QA Officer will immediately institute the necessary corrective actions. If field procedures require corrective action, a follow-up review will be conducted to ensure that the correction actions have been implemented. The results of the field review along with any corrective actions identified will be documented in a summary report that will be provided to the CARDNO's PM and will be available to DERR upon request.

A readiness review will be conducted prior to initiation of field sampling to ensure that all necessary preparations have been made for efficient and effective completionof the project field work. The CARDNO PM will verify that all field equipment has beenassembled for the field work and that all subcontractors have been scheduled. Any deficiencies noted during this readiness review will be corrected prior to initiation offield activities.

A readiness review will also be completed of the analytical data prior to the distribution of the final data to the project team members or others. The CARDNO QA officer will verify that all results have been received from the laboratory and that dataassessment and validation have been completed. The CARDNO QA officer will notify thedata users when the data are ready for use.

## 3.2 Laboratory Activities

### 3.2.1 Performance Evaluation Review:

Performance evaluation reviews are an independent means of establishing the qualityof measurement data by analysis of samples provided specially for the evaluation.

During a performance evaluation review, the performances of the laboratory technicians and the instrumentation or analytical systems on which they work are evaluated. A performance evaluation review is accomplished by providing performance evaluation samples containing specific pollutants (in appropriate matrices) whose identities and /or concentrations are unknown to the technician.

AWAL participates in both internal and external performance testing to examine theoverall laboratory performance as well as to quality for various federal, state, and independent certification programs. AWAL is required to perform at least two performance test studies each year per program using approved performance test samples to comply with NELAP requirements.

The laboratory will be responsible for implementing corrective action for analytical procedures. For the specific analytical methods, corrective action procedures are described in the individual methods or are described in the laboratory QA Manual. If QC data are unacceptable, the analytical data will require re-analysis of the affected sample or qualifying of these data in the final data report. If corrective actions are warranted by the laboratory, the laboratory PM will document the corrective action(s)and forward this information to the PM.

### 3.2.2 System and Technical Laboratory Reviews:

System and technical reviews are performed by the laboratory QA Manager accordingto a predetermined schedule and when requested by laboratory management. CARDNO may conduct a laboratory review at the request of the CARDNO QA officer should corrective actions be needed during the project. This review will be project specific and will focus only on the performance of the laboratory PM and the CARDNO PM. The report will also be available to DERR upon request.

### 3.2.3 Reports to Management

Results of any field and laboratory review, corrective action reports, and performance evaluations will be placed on file and will be available to the DERR upon request.\ The QA reports, as discussed in Section 2.0 will be submitted with the SAP report. Any deficiencies in the laboratory's abilities to meet QC criteria will be included in the report.

# 4 Data Review

This section discusses the QA activities that will occur after the data collection or generation phase of the project is completed. Implementation of these actions ensuresthat the data conform to the specified criteria, thus achieving the project objectives.

## 4.1 Data Reduction

### 4.1.1 Field Data Reduction Procedures

Field data reduction procedures will be minimal in scope compared to those implemented in the laboratory setting. Only direct read instrumentation will be used in the field. The use of a thermometer, and pH, dissolved oxygen, conductivity, and turbidity meters will generate directly read measurements. Such data will be written into field records immediately after measurements are taken. If errors are made, results will be legibly crossed out, initialed, and dated by the field member and corrected in a space adjacent to the original (erroneous) entry.

### 4.1.2 Laboratory Data Reduction Procedures

In most cases, calculations from raw data are included in discussions of analytical procedures presented in the EPA methods. These data reduction and review procedures will not be repeated here. Details of data reduction, calibration, andreporting not addressed elsewhere are discussed in this section.

Data reduction calculations used for this project are typically included on the standard reporting forms developed by the laboratories and associated with each individual method or groups of methods. Calculations not present on standard reporting forms include computer-based data reduction programs. The laboratory is responsible for maintaining a list of these data reduction programs and for being able to demonstrate their validity. The complete calculation procedures used in computer-based data reduction programs (e.g., GC/MS and GC analyses) are based on the calculation procedures specified in each method and will not be covered here.

Some instruments are configured to operate without computers. For these, the signal is recorded as a strip chart trace, numerical output on a printer strip, or direct readingfrom a digital or analog dial. In such cases, additional work is required by the analystto reduce the data to a reportable format. The original signal must be multiplied by a calibration factor or compared with a standard curve. The aliquot result must be divided by the mass or volume of sample to produce a concentration-based final result. Most calculations are carried out on hand-held scientific calculators; simple programs are used for some. All these data are recorded in a dedicated lab notebook or bench sheet for the particular determination in question.

Some laboratory tests, such as titrations or sensory evaluations, do not have instrumental raw data. For these, the quantitative result or observation is recorded directly on a bench sheet by the assigned analyst. Calculations like those describedhere may be needed; these are recorded in the same lab notebook.

Data storage and documentation will be maintained using logbooks and data sheets that will be kept on file. Computer acquired data are stored on magnetic tape, floppy disks, or other media.

## 4.2 Data Validation

### 4.2.1 Procedures Used to Validate Field Data

Procedures to evaluate field data for this project primarily include checking for transcription errors and review of the field sampling forms on the part of field crew members. This task will be the responsibility of the CARDNO QA Officer, who will otherwise not participate in making any of the field measurements.

### 4.2.2 Procedures Used to Validate Laboratory Data

The laboratory system for ensuring valid data includes several levels of review. Each level demands specific action to prevent the unqualified release of erroneous data and to correct any problems discovered during the review process. All analytical data generated are extensively checked for accuracy and completeness. The data validation process consists of data generation, reduction, and three levels of review, as described as follows.

Level 1 Review: The analyst who generates the analytical data has the prime responsibility for the correctness and completeness of the data. All data are generatedand reduced following protocols specified in laboratory SOPs. Each analyst reviews the quality of his or her work based on an established set of guidelines. The analyst reviews the data package to ensure that:

- Sample preparation information is correct and complete.
- Analysis information is correct and complete.
- The appropriate SOPs have been followed.
- Analytical results are correct and complete.
- QC samples are within established control limits; blanks are acceptable.
- Special sample preparation and analytical requirements have been met.
- Documentation is complete (e.g., all anomalies in the preparation and analysishave been documented, out of control forms, if required, are complete, holdingtimes are documented, etc.).

This initial review step, performed by the analyst is designated Level 1 review. Level 1 data review is documented and the signature of the reviewer and the date or reviewis recorded. The analyst then passes the data package to an independent reviewer who performs a Level 2 review.

Level 2 Review: Level 2 review is performed by a group leader or senior analyst whose function is to provide an independent review of the data package. This reviewis structured to ensure that:

- Calibration data are scientifically sound, appropriate to the method, and completely documented.
- QC samples are within established guidelines.
- Qualitative identification of sample components is correct.
- Quantitative results are correct.

- Documentation is complete and correct (e.g., anomalies in the preparation and analysis have been documented, out-of-control forms, if required, are complete, holding times are documented, etc.).
- The data are ready for incorporation into the final report.
- The data package is complete and ready for data archive.

Level 2 review is structured so that all calibration data and QC sample results are reviewed, and all of the analytical results from 10 percent of the samples are checked back to the bench sheet. If no problems are found with the data package, the review is considered complete. If any problems are found with the data package, an additional 10 percent of the samples are checked to the bench sheet. The process continues until no errors are found or until the data package has been reviewed in its entirety. Level 2 data review is documented and the signature of the reviewer and the date of review recorded. The reviewed data are then approved for release and a final report is prepared.

Level 3 Review: Before the report is released to the client, the laboratory project manager reviews the report to ensure:

- The data meets the overall objectives of the project.
- Overall completeness.
- Client requests completed.
- Comparative data check.
- Non-conformances are properly documented and narrated.

This review is the Level 3 review. The Level 3 review is documented and thesignature of the reviewer and date of review are recorded.

Each step of this review process involves evaluation of data quality based on both the results of the QC data and the professional judgment of those conducting the review.This application of technical knowledge and experience to the evaluation of the data is essential in ensuring that data are consistently of high quality.

Procedures for Handling Unacceptable Data: All QC information will be recorded in laboratory bench sheets, logbooks, or printouts. It is the analyst's responsibility to check the QC information against *limits* for the analysis. When a QC sample analysis (blank, spike, check standard, replicate, or similar sample) shows that the analysis of that batch of samples is not in control, the analyst will perform corrective action or bring the matter to the attention of the group leader. The group leader will, if necessary, consult with the laboratory QA manager or the laboratory project manager to determine whether the analysis can proceed, if selected samples should be rerun, orif specific corrective action needs to be taken before analyzing additional samples. Out-of-control analyses must be documented. The analyst or group leader will file anonconformance memo with the laboratory QA manager for lab analysis out of control events that require documentation.

#### 4.2.3 Independent Data Validation

It is assumed that a full CLP-equivalent data validation will not be required for the SAP. Laboratory data will be evaluated by the CARDNO QA officer. A summary statement addressing the usability of the data will be included in the Results Report.

## 4.3 Data Reporting

Data reporting procedures shall be carried out for field and laboratory operations as indicated in the following sections.

### 4.3.1 Field Data Reporting

Field data reporting shall be conducted principally through the transmission of reportsheets containing tabulated results of all measurements made in the field, and documentation of all field calibration activities.

### 4.3.2 Laboratory Data Reporting

For this work plan, the respective analytical laboratories will provide CARDNO with a standard deliverable package. Laboratory reports will contain acceptance limits for surrogates, LCS, and matrix spikes and will report method blanks whenever they areused. The laboratory report will unambiguously link batch quality control with samples of that batch.

Each laboratory report will have a narrative section that summarizes comments pertinent to the batch of samples reported. The narrative section will be used to document corrective actions.

## 4.4 Record Preservation

NT shall retain, during this VCP process and for a minimum of 6 years after its termination, all data, records, and documents now in its possession or control or which come into its possession or in the possession of its contractors and successors,which relate to the work performed pursuant to this SAP.

### 4.4.1 Data Archival and Retrieval

All submitted data summary report which will include the complete laboratory analysis reports will be archived onto digital removable data storage drives and maintain by owner for permanent storage and retrieval.

# APPENDIX A

## Laboratory Methods and Control Limits

## TABLES

# Tables

**Table A1**
**Precision and Accuracy Goals**
NTL/Quality Assurance Project Plan, Salt Lake City, Utah

| Analyte | Reference Method | Matrix Precision [a] (Relative percent Difference) | Matrix Accuracy [b] (Percent Recovery) | LCS Accuracy [c] (Percent Recovery) |
|---|---|---|---|---|
| **Volatile Organic Compounds** | SW 846<br>8260D | | | |
| Water | | 20 | 70-130 | 70-130 |
| Soil | | 20 | 70-130 | 70-130 |
| **Semi volatile Organic Compounds** | SW846<br>8270E | | | |
| Water | | 20 | 30-150 | 50-130 |
| Soil | | 20 | 30-150 | 50-130 |
| **Semi volatile Organic Compounds** | SW846<br>8270E - SIM | | | |
| Water | | 20 | 30-150 | 50-130 |
| Soil | | 20 | 30-150 | 50-130 |
| **Total Petroleum Hydrocarbons** | | | | |
| Diesel Range | SW846 8015D | | | |
| Water | | 25 | 60 to 161 | 25 to 181 |
| Soil | | 98 | 10 to 230 | 25 to 121 |
| **Total Petroleum Hydrocarbons** | | | | |
| Gasoline Range | SW8469070A | | | |
| Water | | 25 | 66 to 145 | 69 to 126 |
| Soil | | 25 | 66 to 145 | 69 to 126 |
| **TRPH** | SW846 | 34 | 64 to 132 | 64 to 132 |
| Water | 1664A-SGT | 34 | 64 to 132 | 64 to 132 |
| Soil | | | | |
| **Fluorinated Alkyl Substances** | 537<br>(modified) | | | |
| Water | | 30 | 25-150 | 25-150 |
| Soil | | 30 | 25-150 | 25-150 |
| **D-Lits Metals in water (mg/L)** | | | | |
| Arsenic | 6020B | 20 | 70 to 130 | 85 to 115 |
| Barium | 6020B | 20 | 70 to 130 | 85 to 115 |
| Cadmium | 6020B | 20 | 70 to 130 | 85 to 115 |
| Chromium | 6020B | 20 | 75 to 125 | 75 to 125 |
| Lead | 6020B | 20 | 70 to 130 | 80 to 120 |
| Mercury | 7470B | 20 | 80 to 120 | 85 to 115 |
| Silver | 6020B | 20 | 70 to 130 | 85 to 115 |
| Hexavalent Chromium | 7196A | | | |
| **Polychlorinated Biphenyl** | SW846 8081 | | | |
| Water | | 20 | 70-130 | 70-130 |
| | | 20 | 70-130 | 70-130 |
| **Pesticides** | SW846 | 20 | 85 to 115 | 85 to 115 |
| Water | 8270E | | | |
| Soil | | | | |
| **Herbicides** | SW846 | 10 | 85 to 115 | 85 to 115 |
| Water | 8270E | | | |
| Soil | | | | |
| **Hexavalent Chromium** | 3060/7196A | 10 | 80 to 120 | 85 to 115 |
| Soil | | | | |
| TSS | SM2540D | dup 20 | na | 80 to 120 |

Notes:

a) The control limit is applicable for sample values greater than or equal to five times the detection limit. A control limit of =/- the detection limit (=/- two times the detection limit for soil samples) will be used for sample values less than five times the detection limit.

b) The control limit is not applicable if the sample concentration exceeds the spike concentration by a factor of four or more.

c) LCS - laboratory control sample.

## Table A2
## Field Duplicate and Blank Sample Requirements
NTL/Quality Assurance Project Plan
Salt Lake City, Utah

| Task and Sample Matrix | Anticipated Number of Environmental Samples | Field Duplicates [a] | Field Blanks [b] | Trip Blanks [c] |
|---|---|---|---|---|
| **Soil Sampling** | | | | |
| Inorganic compound in DH | 22 | 3 | 3 | |
| Organic compound in DH | 22 | 3 | 3 | 3 |
| **Water Sampling** | | | | |
| Inorganic compound in DH | 12 | 2 | 2 | |
| Organic compound in DH | 12 | 2 | | 2 |
| Organic compound in TP | 8 | 2 | | 2 |

Notes:

a) See Section 2.4 of the QAPP for further details on field duplicate and blank sample requirements.

b) Field blank samples will be collected at a rate of one blank sample per matrix per day or one for each 20 samples collected, whichever is fewer. Field blank samples will include rinsate blank samples and transfer blank samples. If no rinsate blank sample is collected for a day of sampling, a transfer blank will be submitted for the same analyses as the environmental samples.

c) Trip blank samples will be collected at a rate of one sample each day of groundwater or trench water sampling.

## TableA3
## Analytical Methods and Detection Limits

NTL/Quality Assurance Project Plan
Salt Lake City, Utah

| | | | | Approximate Reporting Limit [a] | |
|---|---|---|---|---|---|
| **Analyte** | **Matrix** | **Reference Method** | **Description** | **Water (ug/L)** | **Soil (mg/kg)** |
| Volatile Organic Compounds | Water, Soil | SW 846 8260D | GC/MS | 1-20 | 0.001-0.02 |
| Semi volatile Organic Compounds | Water, Soil | SW846 8270E | GC/MS | 10-40 | 0.340-1 |
| Semi volatile Organic Compounds | Water, Soil | SW846 8270E-SIM | GC/MS | 0.3-0.7 | 0.007-013.4 |
| Total Petroleum Hydrocarbons Diesel Range | Water, Soil | SW846 8015D | GC | 8000 | 20.0 |
| Total Petroleum Hydrocarbons Gasoline Range | Water, Soil | SW846 9070A | GC/MS + P&T[2] | 20 | 0.02 |
| TRPH | Water, Soil | SW846 1664A-SGT | general extraction | 3000 | 150 |
| Fluorinated Alkyl Substances | Water, Soil | 537 (modified) | GC/MS | 1.7-48[b] | 0.25-0.36[c] |
| Metals | Water, Soil | SW846 6020B | ICP/MS | 0.00009-.04 | 0.04-10 |
| Arsenic | Water, Soil | SW846 6020B | | 0.001004 | 0.5 |
| Barium | Water, Soil | SW846 6020B | | 0.001558 | 5 |
| Cadmium | Water, Soil | SW846 6020B | | 0.000126 | 0.5 |
| Chromium | Water, Soil | SW846 6020B | | 0.0045 | 10 |
| Lead | Water, Soil | SW846 6020B | | 0.00146 | 3 |
| Mercury | Water, Soil | EPA 7470B/7471B | CVAA | 0.0000396 | 0.04 |
| Silver | Water, Soil | | | 0.000442 | 0.3 |
| Hexavalent Chromium | Water, Soil | SW846 7196A/ 3060/7196A | | 0.005 | 2 |
| Wet Chemistry | | | | | |
| | | | | | |
| Poly-Chlorinated Biphenyls | Water, Soil | SW846 8082A | GC/MS | 0.054 to 0.9 | 0.057 to 0.070 |

Notes:
a) Reporting limits are matrix and analyte specific and may be higher due to analytical interferences.
b) Reporting limits are reported in ng/L.
c) Reporting limits are reported in ug/Kg.
µg/L - micrograms per liter.
mg/kg - milligrams per kilogram.

## Table A4
## Sample Analyses Matrices, Containers, Preservation Methods, Method Numbers, and Holding Times

NTL/Quality Assurance Project Plan
Salt Lake City, Utah

| Parameter | Number of Containers | Container Volume | Container Material | Preservation | Method | Maximum Holding Times<br>Sampling to Analysis,Days |
|---|---|---|---|---|---|---|
| **Compound Soil** | | | | | | |
| Arsenic | 1 | 4 oz | plastic or glass | cool4°C | SW846 6020B | 6 months |
| TPH DROCw-$C_{28}$ | 1 | 4oz | glass | cool4°C | SW846 8015D | 14 ext/40 analysis |
| TPH GRO $C_6$-$C_{10}$ | 1 | 4 oz | glass | cool4°C | SW846 9070A | 14 |
| TRPH | 1 | 4 oz | glass | cool4°C | SW846 1664A-SGT | 28 |
| PCBs | 1 | 4oz | glass | cool4°C | SW846 8082 | 7 |
| PFAS | 1 | 4oz | plastic | cool4°C | 537 (modified) | 14 |
| VOCs | 1 | 4 oz | glass | cool4°C | SW846 8260D | 14 |
| SVOCs (a) | 1 | 4oz | glass | cool4°C | SW846 8270E | 7 |
| Hexavalent Chromium | 1 | 4oz | glass | cool4°C | 3060/7196A | 14 |
| **Water** | | | | | | |
| RCRA 8 Metals | 1 | 500 ml | plastic | cool 4°C, $HNO_3$ | SW846 6020B/7470B | 6 months |
| PFAS | 1 | 4oz | plastic | cool4°C | 537 (modified) | 14 |
| Hexavalent Chromium | 1 | 4oz | glass | cool4°C | 7196A | 14 |
| TPH ORO $C_{10}$-$C_{28}$ | 2 | 1 L | amber glass | cool4°C | SW846 8015B | 14 ext/40 analysis |
| TPH GRO Cs-C10 | 3 | 40ml VOA | glass/teflon | cool 4°C, HCL | SW846 8260B | 14 |
| TRPH | 1 | 1 L | amber glass | cool 4°C, HCL | SW846 1664A-SGT | 28 |
| PCBs | 1 | 2L | amber glass | cool4°C | SW846 8082 | 7 |
| Pesticides | 1 | 1 L | amber glass | cool 4°C, HCL | SW846 8270E | 14 |
| PCBs | 1 | 4oz | glass | cool4°C | SW846 8082 | 7 |
| SVOCs (a) | 3 | 1 L | amber glass | Cool 4°C | SW846 8270E | 14 |
| Herbicides | 1 | 1 L | amber glass | cool 4°C, HCL | SW846 8270E | 14 |
| TSS | 1 | 1000 ml | plastic | cool4°C | SM2540D | 7 |
| VOCs | 3 | 40 ml VOA | glass/teflon | cool 4°C, HCL | SW846 8260D | 14 |

Notes:

(a) Includes SIM analysis

* For high level analysis, collect a 1O gram sample in each of two pre-weighed 40 ml VOA vials that have 1O ml of methanol already in the vial; then cool to 4°C.

°C - temperature Celsius; g – gram; ml – milliliter.

# Appendix A

## Laboratory Methods and Control Limits

| AWAL Soil Metals by 6020B | Units | MDL | RL |
|---|---|---|---|
| Arsenic | mg/kg | 0.1365 | 0.5 |
| Barium | mg/kg | 1.375 | 5 |
| Cadmium | mg/kg | 0.073 | 0.5 |
| Chromium | mg/kg | 1.87 | 10 |
| Lead | mg/kg | 1.16 | 3 |
| Selenium | mg/kg | 0.19 | 2 |
| Silver | mg/kg | 0.0725 | 0.3 |
| **AWAL Soil Mercury by 7471B** | **Units** | **MDL** | **PQL** |
| Mercury | mg/kg | 0.00938 | 0.04 |

| AWAL Water Metals by 6020B | Units | MDL | RL |
|---|---|---|---|
| Arsenic | mg/L | 0.001004 | 0.004 |
| Barium | mg/L | 0.001558 | 0.002 |
| Cadmium | mg/L | 0.000126 | 0.0007 |
| Chromium | mg/L | 0.0045 | 0.04 |
| Lead | mg/L | 0.00146 | 0.002 |
| Selenium | mg/L | 0.000608 | 0.002 |
| Silver | mg/L | 0.000442 | 0.002 |
| Cr VI in water by 7196A | mg/L | 0.00239 | 0.005 |
| **AWAL Water Mercury by 7470B** | **Units** | **MDL** | **PQL** |
| Mercury | mg/L | 0.0000396 | 0.00009 |

| Pace Cr VI | Units | MDL | PQL |
|---|---|---|---|
| Pace Cr VI in soil by 3060/7196A | mg/kg | 0.65 | 2 |

| | | | |
|---|---|---|---|
| Pace Cr VI in soil by 3060/7199 | mg/kg | 0.25 | 1 |

each sample's RL and MDL are adjusted to reflect the dry weight of the sample

MDLs are routinely updated as required by NELAP

| 8260D | MDL ug/kg | PQL ug/kg |
|---|---|---|
| 1,1,1-Trichloroethane | 0.578 | 2 |
| 1,1,2,2-Tetrachloroethane | 0.312 | 2 |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | 0.934 | 2 |
| 1,1,2-Trichloroethane | 0.178 | 2 |
| 1,1-Dichloroethane | 0.418 | 2 |
| 1,1-Dichloroethene | 0.531 | 2 |
| 1,2,3-Trichlorobenzene | 0.475 | 2 |
| 1,2,4-Trichlorobenzene | 0.39 | 2 |
| 1,2-Dibromo-3-chloropropane | 0.558 | 5 |
| 1,2-Dibromoethane | 0.26 | 2 |
| 1,2-Dichlorobenzene | 0.258 | 2 |
| 1,2-Dichloroethane | 0.285 | 2 |
| 1,2-Dichloropropane | 0.215 | 2 |
| 1,3-Dichlorobenzene | 0.282 | 2 |
| 1,4-Dichlorobenzene | 0.351 | 2 |
| 1,4-Dioxane | 27.7 | 50 |
| 2-Butanone | 3.02 | 10 |
| 2-Hexanone | 1.75 | 5 |
| 4-Methyl-2-pentanone | 1.68 | 5 |
| Acetone | 6.99 | 10 |
| Benzene | 0.249 | 2 |
| Bromochloromethane | 0.239 | 2 |
| Bromodichloromethane | 0.538 | 2 |
| Bromoform | 0.626 | 2 |
| Bromomethane | 2.61 | 5 |
| Carbon disulfide | 0.794 | 2 |
| Carbon tetrachloride | 0.419 | 2 |
| Chlorobenzene | 0.197 | 2 |
| Chloroethane | 1.07 | 2 |
| Chloroform | 0.66 | 2 |
| Chloromethane | 1.27 | 3 |
| cis-1,2-Dichloroethene | 0.329 | 2 |
| cis-1,3-Dichloropropene | 0.305 | 2 |
| Cyclohexane | 0.8 | 2 |
| Dibromochloromethane | 0.578 | 2 |
| Dichlorodifluoromethane | 0.891 | 2 |
| Ethylbenzene | 0.472 | 2 |
| Isopropylbenzene | 1.22 | 2 |
| m,p-Xylene | 0.514 | 2 |
| Methyl Acetate | 1.6 | 5 |
| Methyl tert-butyl ether | 0.431 | 2 |
| Methylcyclohexane | 0.736 | 2 |
| Methylene chloride | 2.38 | 5 |
| Naphthalene | 0.856 | 2 |
| o-Xylene | 0.386 | 2 |
| Styrene | 0.654 | 2 |

| | | |
|---|---|---|
| Tetrachloroethene | 0.372 | 2 |
| Toluene | 0.376 | 2 |
| trans-1,2-Dichloroethene | 0.261 | 2 |
| trans-1,3-Dichloropropene | 0.285 | 2 |
| Trichloroethene | 0.356 | 2 |
| Trichlorofluoromethane | 0.234 | 2 |
| Vinyl chloride | 0.196 | 1 |

| 8260D Water | MDL ug/L | PQL ug/L |
|---|---|---|
| 1,1,1-Trichloroethane | 0.193 | 2 |
| 1,1,2,2-Tetrachloroethane | 0.301 | 2 |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | 1.82 | 2 |
| 1,1,2-Trichloroethane | 0.144 | 2 |
| 1,1-Dichloroethane | 0.245 | 2 |
| 1,1-Dichloroethene | 0.953 | 2 |
| 1,2,3-Trichlorobenzene | 1.15 | 2 |
| 1,2,4-Trichlorobenzene | 1.2 | 2 |
| 1,2-Dibromo-3-chloropropane | 0.508 | 5 |
| 1,2-Dibromoethane | 0.132 | 2 |
| 1,2-Dichlorobenzene | 0.432 | 2 |
| 1,2-Dichloroethane | 0.131 | 2 |
| 1,2-Dichloropropane | 0.185 | 2 |
| 1,3-Dichlorobenzene | 0.463 | 2 |
| 1,4-Dichlorobenzene | 0.44 | 2 |
| 1,4-Dioxane | 6.97 | 50 |
| 2-Butanone | 3.2 | 10 |
| 2-Hexanone | 0.56 | 5 |
| 4-Methyl-2-pentanone | 0.281 | 5 |
| Acetone | 1.49 | 10 |
| Benzene | 0.193 | 2 |
| Bromochloromethane | 0.328 | 2 |
| Bromodichloromethane | 0.349 | 2 |
| Bromoform | 0.417 | 2 |
| Bromomethane | 3.6 | 5 |
| Carbon disulfide | 0.517 | 2 |
| Carbon tetrachloride | 0.668 | 2 |
| Chlorobenzene | 0.18 | 2 |
| Chloroethane | 1.03 | 2 |
| Chloroform | 0.31 | 2 |
| Chloromethane | 0.297 | 3 |
| cis-1,2-Dichloroethene | 0.147 | 2 |
| cis-1,3-Dichloropropene | 0.276 | 2 |
| Cyclohexane | 0.289 | 2 |
| Dibromochloromethane | 0.318 | 2 |
| Dichlorodifluoromethane | 0.248 | 2 |
| Ethylbenzene | 0.27 | 2 |
| Isopropylbenzene | 0.652 | 2 |
| m,p-Xylene | 0.402 | 2 |
| Methyl Acetate | 0.443 | 5 |
| Methyl tert-butyl ether | 0.218 | 2 |
| Methylcyclohexane | 0.212 | 2 |
| Methylene chloride | 0.703 | 2 |
| Naphthalene | 1.16 | 2 |
| o-Xylene | 0.471 | 2 |
| Styrene | 0.56 | 2 |

| | | |
|---|---|---|
| Tetrachloroethene | 0.396 | 2 |
| Toluene | 0.957 | 2 |
| trans-1,2-Dichloroethene | 0.3 | 2 |
| trans-1,3-Dichloropropene | 0.341 | 2 |
| Trichloroethene | 0.245 | 2 |
| Trichlorofluoromethane | 0.417 | 2 |
| Vinyl chloride | 0.254 | 1 |

| 8270E Soil | MDL ug/kg | PQL ug/kg |
|---|---|---|
| 1,1´-Biphenyl | 57.5 | 340 |
| 1,2,4,5-Tetrachlorobenzene | 38.9 | 340 |
| 2,2´-Oxybis(1-chloropropane) | 40.4 | 340 |
| 2,3,4,6-Tetrachlorophenol | 150 | 340 |
| 2,4,5-Trichlorophenol | 45.2 | 340 |
| 2,4,6-Trichlorophenol | 42.9 | 340 |
| 2,4-Dichlorophenol | 48.6 | 340 |
| 2,4-Dimethylphenol | 62 | 340 |
| 2,4-Dinitrophenol | 126 | 670 |
| 2,4-Dinitrotoluene | 67.1 | 340 |
| 2,6-Dinitrotoluene | 77.8 | 340 |
| 2-Chloronaphthalene | 42.3 | 340 |
| 2-Chlorophenol | 43.4 | 340 |
| 2-Methylnaphthalene | 38.3 | 340 |
| 2-Methylphenol | 50.4 | 340 |
| 2-Nitroaniline | 38.8 | 340 |
| 2-Nitrophenol | 37.7 | 340 |
| 3&4-Methylphenol | 148 | 340 |
| 3,3´-Dichlorobenzidine | 89.7 | 340 |
| 3-Nitroaniline | 34.5 | 1000 |
| 4,6-Dinitro-2-methylphenol | 45.4 | 670 |
| 4-Bromophenyl phenyl ether | 39.4 | 340 |
| 4-Chloro-3-methylphenol | 50.4 | 340 |
| 4-Chloroaniline | 32.2 | 340 |
| 4-Chlorophenyl phenyl ether | 40.2 | 340 |
| 4-Nitroaniline | 39.9 | 1000 |
| 4-Nitrophenol | 74.1 | 670 |
| Acenaphthene | 37.3 | 340 |
| Acenaphthylene | 34.6 | 340 |
| Acetophenone | 89.8 | 340 |
| Anthracene | 37.8 | 340 |
| Atrazine | 48.9 | 340 |
| Benz(a)anthracene | 42.5 | 340 |
| Benzo(a)pyrene | 54.8 | 340 |
| Benzo(b)fluoranthene | 58.4 | 340 |
| Benzo(g,h,i)perylene | 53.8 | 340 |
| Benzo(k)fluoranthene | 45.9 | 340 |
| Bis(2-chloroethoxy)methane | 38.9 | 340 |
| Bis(2-chloroethyl) ether | 40.3 | 340 |
| Bis(2-ethylhexyl) phthalate | 179 | 340 |
| Butyl benzyl phthalate | 58.1 | 340 |
| Caprolactam | 132 | 800 |
| Carbazole | 37.4 | 340 |
| Chrysene | 43.9 | 340 |
| Di-n-butyl phthalate | 54.5 | 340 |
| Di-n-octyl phthalate | 65.7 | 340 |

| | | |
|---|---|---|
| Dibenz(a,h)anthracene | 53.3 | 340 |
| Dibenzofuran | 36.3 | 340 |
| Diethyl phthalate | 47.8 | 340 |
| Dimethyl phthalate | 44 | 340 |
| Fluoranthene | 44.5 | 340 |
| Fluorene | 41.5 | 340 |
| Hexachlorobenzene | 41.3 | 340 |
| Hexachlorobutadiene | 36.3 | 340 |
| Hexachlorocyclopentadiene | 58.6 | 340 |
| Hexachloroethane | 39.2 | 340 |
| Indeno(1,2,3-cd)pyrene | 50.5 | 340 |
| Isophorone | 49.5 | 340 |
| N-Nitrosodiphenylamine | 90.3 | 340 |
| N-nitrosodipropylamine | 54.2 | 340 |
| Naphthalene | 48.3 | 340 |
| Nitrobenzene | 37.2 | 340 |
| Pentachlorophenol | 107 | 340 |
| Phenanthrene | 39.8 | 340 |
| Phenol | 146 | 340 |
| Pyrene | 50.9 | 340 |

| 8270E Water | MDL ug/L | PQL ug/L |
|---|---|---|
| 1,1´-Biphenyl | 3.11 | 10 |
| 1,2,4,5-Tetrachlorobenzene | 3.32 | 10 |
| 2,2´-Oxybis(1-chloropropane) | 3.66 | 10 |
| 2,3,4,6-Tetrachlorophenol | 5.67 | 10 |
| 2,4,5-Trichlorophenol | 4.03 | 10 |
| 2,4,6-Trichlorophenol | 4.39 | 10 |
| 2,4-Dichlorophenol | 3.28 | 10 |
| 2,4-Dimethylphenol | 3.15 | 10 |
| 2,4-Dinitrophenol | 8.69 | 10 |
| 2,4-Dinitrotoluene | 8.26 | 10 |
| 2,6-Dinitrotoluene | 8.45 | 10 |
| 2-Chloronaphthalene | 3.27 | 10 |
| 2-Chlorophenol | 1.53 | 10 |
| 2-Methylnaphthalene | 3.33 | 10 |
| 2-Methylphenol | 2.03 | 10 |
| 2-Nitroaniline | 8.67 | 10 |
| 2-Nitrophenol | 5.25 | 10 |
| 3&4-Methylphenol | 6.86 | 10 |
| 3,3´-Dichlorobenzidine | 6.78 | 10 |
| 3-Nitroaniline | 7.69 | 10 |
| 4,6-Dinitro-2-methylphenol | 5.73 | 10 |
| 4-Bromophenyl phenyl ether | 3.07 | 10 |
| 4-Chloro-3-methylphenol | 2.42 | 10 |
| 4-Chloroaniline | 3.17 | 10 |
| 4-Chlorophenyl phenyl ether | 3.38 | 10 |
| 4-Nitroaniline | 7.55 | 10 |
| 4-Nitrophenol | 5.92 | 10 |
| Acenaphthene | 3.19 | 10 |
| Acenaphthylene | 2.99 | 10 |
| Acetophenone | 3.8 | 10 |
| Anthracene | 2.88 | 10 |
| Atrazine | 3.68 | 10 |
| Benz(a)anthracene | 2.94 | 10 |
| Benzaldehyde | 12.2 | 40 |
| Benzo(a)pyrene | 3.23 | 10 |
| Benzo(b)fluoranthene | 3.34 | 10 |
| Benzo(g,h,i)perylene | 8.1 | 10 |
| Benzo(k)fluoranthene | 3.23 | 10 |
| Bis(2-chloroethoxy)methane | 3.66 | 10 |
| Bis(2-chloroethyl) ether | 3.99 | 10 |
| Bis(2-ethylhexyl) phthalate | 3.86 | 10 |
| Butyl benzyl phthalate | 4.08 | 10 |
| Caprolactam | 7.44 | 25 |
| Carbazole | 2.96 | 10 |
| Chrysene | 2.95 | 10 |
| Di-n-butyl phthalate | 3.47 | 10 |

| | | |
|---|---|---|
| Di-n-octyl phthalate | 4.01 | 10 |
| Dibenz(a,h)anthracene | 3.48 | 10 |
| Dibenzofuran | 3.1 | 10 |
| Diethyl phthalate | 3.23 | 10 |
| Dimethyl phthalate | 3.62 | 10 |
| Fluoranthene | 3.71 | 10 |
| Fluorene | 3.13 | 10 |
| Hexachlorobenzene | 3.19 | 10 |
| Hexachlorobutadiene | 3.6 | 10 |
| Hexachlorocyclopentadiene | 5.99 | 10 |
| Hexachloroethane | 3.54 | 10 |
| Indeno(1,2,3-cd)pyrene | 3.44 | 10 |
| Isophorone | 3.05 | 10 |
| N-Nitrosodiphenylamine | 5.85 | 10 |
| N-nitrosodipropylamine | 3.82 | 10 |
| Naphthalene | 3.23 | 10 |
| Nitrobenzene | 3.53 | 10 |
| Pentachlorophenol | 9.14 | 10 |
| Phenanthrene | 2.96 | 10 |
| Phenol | 1.33 | 10 |
| Pyrene | 2.6 | 10 |

| 8270E SIM PNA | MDL ug/kg | PQL ug/kg |
|---|---:|---:|
| 1-Methylnaphthalene | 2.85 | 6.7 |
| 2-Methylnaphthalene | 3.61 | 6.7 |
| Acenaphthene | 1.15 | 6.7 |
| Acenaphthylene | 1.2 | 6.7 |
| Anthracene | 0.979 | 6.7 |
| Benz(a)anthracene | 1.37 | 13.4 |
| Benzo(a)pyrene | 1.13 | 6.7 |
| Benzo(b)fluoranthene | 1.38 | 6.7 |
| Benzo(g,h,i)perylene | 1.44 | 6.7 |
| Benzo(k)fluoranthene | 3.09 | 6.7 |
| Chrysene | 1.9 | 6.7 |
| Dibenz(a,h)anthracene | 1.48 | 6.7 |
| Fluoranthene | 1.24 | 6.7 |
| Fluorene | 1.12 | 6.7 |
| Indene | 1.09 | 6.7 |
| Indeno(1,2,3-cd)pyrene | 1.29 | 6.7 |
| Naphthalene | 3.37 | 6.7 |
| Phenanthrene | 4.03 | 13.4 |
| Pyrene | 1.45 | 6.7 |

| 8270E SIM PNA Water | MDL ug/L | PQL ug/L |
|---|---|---|
| 1-Methylnaphthalene | 0.0877 | 0.5 |
| 2-Methylnaphthalene | 0.0516 | 0.2 |
| Acenaphthene | 0.127 | 0.2 |
| Acenaphthylene | 0.133 | 0.2 |
| Anthracene | 0.121 | 0.5 |
| Benz(a)anthracene | 0.12 | 0.2 |
| Benzo(a)pyrene | 0.0781 | 0.1 |
| Benzo(b)fluoranthene | 0.105 | 0.2 |
| Benzo(g,h,i)perylene | 0.119 | 0.2 |
| Benzo(k)fluoranthene | 0.158 | 0.3 |
| Chrysene | 0.101 | 0.3 |
| Dibenz(a,h)anthracene | 0.142 | 0.2 |
| Fluoranthene | 0.0859 | 0.2 |
| Fluorene | 0.0759 | 0.3 |
| Indene | 0.14 | 0.2 |
| Indeno(1,2,3-cd)pyrene | 0.118 | 0.2 |
| Naphthalene | 0.13 | 0.2 |
| Phenanthrene | 0.233 | 0.5 |
| Pyrene | 0.0996 | 0.3 |

## About Cardno

Cardno is an ASX-200 professional infrastructure and environmental services company, with expertise in the development and improvement of physical and social infrastructure for communities around the world. Cardno's team includes leading professionals who plan, design, manage, and deliver sustainable projects and community programs. Cardno is an international company listed on the Australian Securities Exchange [ASX:CDD].

## Cardno Zero Harm

At Cardno, our primary concern is to develop and maintain safe and healthy conditions for anyone involved at our project worksites. We require full compliance with our Health and Safety Policy Manual and established work procedures and expect the same protocol from our subcontractors. We are committed to achieving our Zero Harm goal by continually improving our safety systems, education, and vigilance at the workplace and in the field. Safety is a Cardno core value and through strong leadership and active employee participation, we seek to implement and reinforce these leading actions on every job, every day.

**www.cardno.com**

## C-3 Soil/Waste Materials Management Plan

## Soil/Waste Materials Management Plan

The fundamental concept in the Phase I waste excavation is to relocate the waste to an onsite repository instead of exporting the waste to offsite landfills. Plan view details of the repository are included in **Figure 13/Appendix A-13**. The operation of the repository will mimic that of all operating MSW landfills in as much as many of the operating and environmental controls will be very similar:

- Waste will be covered daily using alternate daily cover tarps.
- Soil cover will be used in intermediate lifts.
- Exposed soil cover will be protected from erosion with hydroseeding or other measures.
- Odor control devices will operate in the vicinity of the working areas.
- Air emission monitoring will take place during waste placement.
- The repository will be inside the compliance boundary of Phase I and within the proposed groundwater monitoring well network.
- A RCRA Subtitle-D compliant cap system will be completed when waste filling operations are complete **(See Appendix A-24).**
- The completed cap will be vegetated and maintained as greenspace.

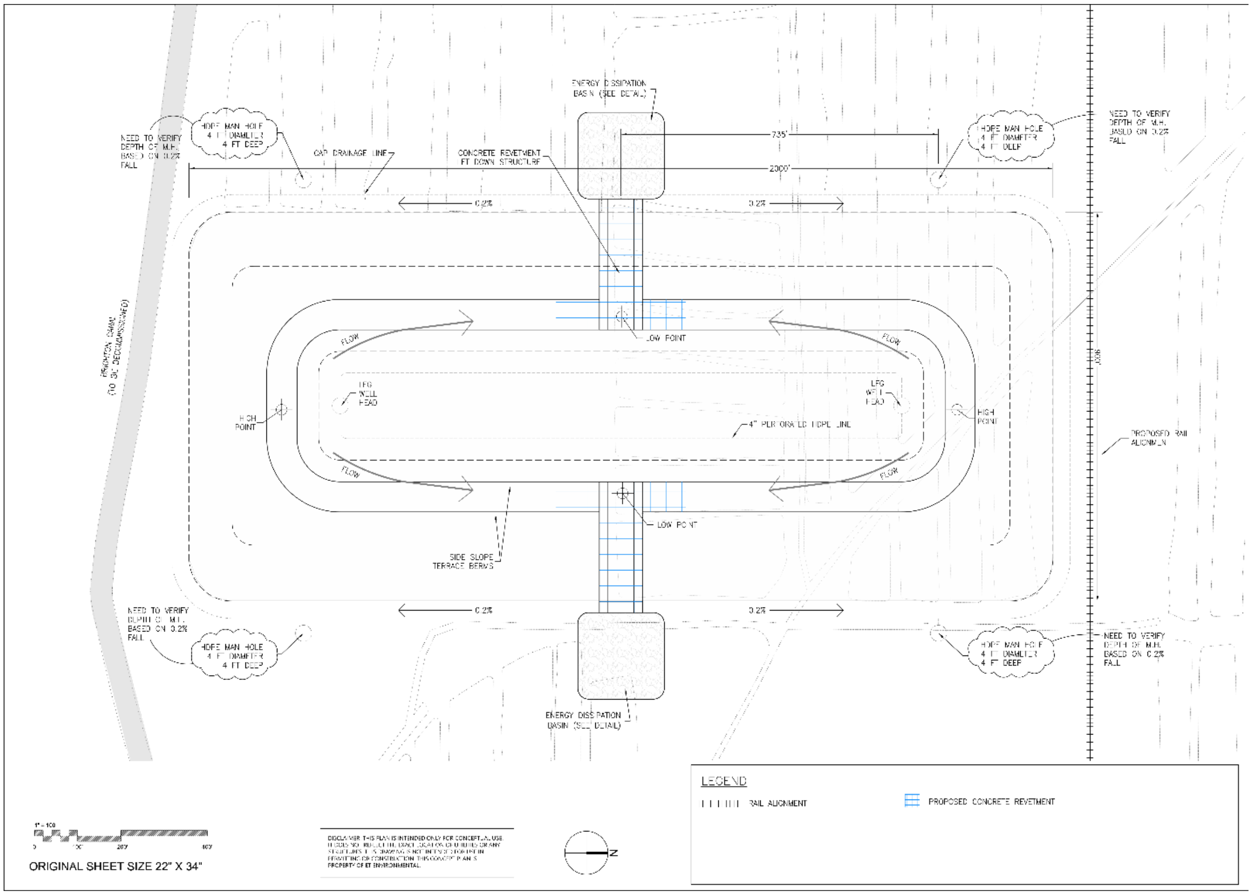

*Figure 13 – Repository Plan View (See Also Appendix A-13)*

Upon mobilization, the excavation operations will commence simultaneously in the Bonneville Pile area and the Northern section of Phase I. The Initial site operation will be to prepare the waste repository. This will consist of minor excavation and leveling of the footprint of the repository, and if needed, the placement of (previously) crushed concrete up to a depth of 12” to provide a stable foundation for waste placement. The clearing and grubbing materials will be stockpiled for future disposal and or composted. Any waste exhumed in the base preparation will be placed into the repository footprint **(See Figure 14/Appendix A-14).**

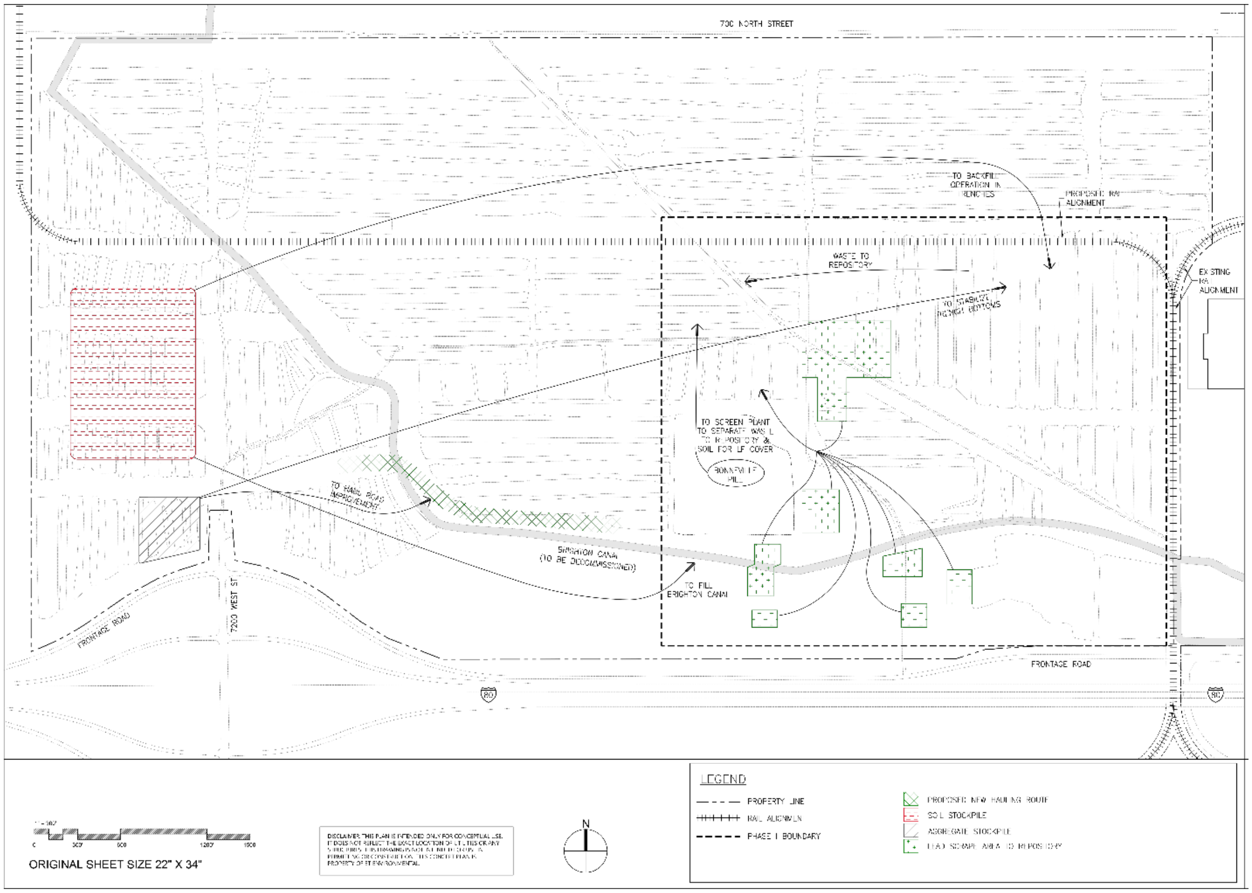

*Figure 14 – Material Flow Diagram (See Also Appendix A-14)*

Once the MSW is removed and placed in the repository, the repository will be capped with an intermediate layer of soil (6” minimum). The intermediate soil layer may be hydroseeded depending on climatic conditions, as we anticipated delaying final cap construction for 60 days following topping out to allow for settlement to occur.

When the final cap construction begins, the intermediate soil cover layers and any existing vegetation will be regraded to a minimum of 6” soil cover. The soil cover will comply with the specifications suggested in Appendix D. This layer will be subgrade for the placement of the geo-composite clay layer (GCL) (See product information in Appendix D) and it will be inspected for presence of any rocks or other sharp material prior to placement of the GCL. Only clean non-environmentally impacted material will be utilized in the soil layer supporting the final vegetative cover of the cap.

The final repository cover will have a geonet wet drainage layer which will terminate into a toe drain, consisting of a 4” PVC pipe. The pipe will be sloped for gravity drainage to HDPE manholes which will function as temporary storage. This liquid is percolate through the vegetative cap and should be stormwater. It will be tested and if clean, can be disposed in the future stormwater management system when the Phase I Development is complete. During the interim period of time, the HDPE manholes will be pumped when full and disposed off-site.

The repository also features perforated LFG collection piping to be installed in the highest portion of the repository crest **(See Figure 15)**. These collector pipes will exit the final liner in vertical wellheads with sampling ports. LFG accumulation (if present) can be monitored and tested for methane and pressure periodically. If a significant amount of internal pressure builds up, then the well heads can be connected to a solar powered utility flare for combustion. Based on previous studies, very little LFG accumulation is expected.

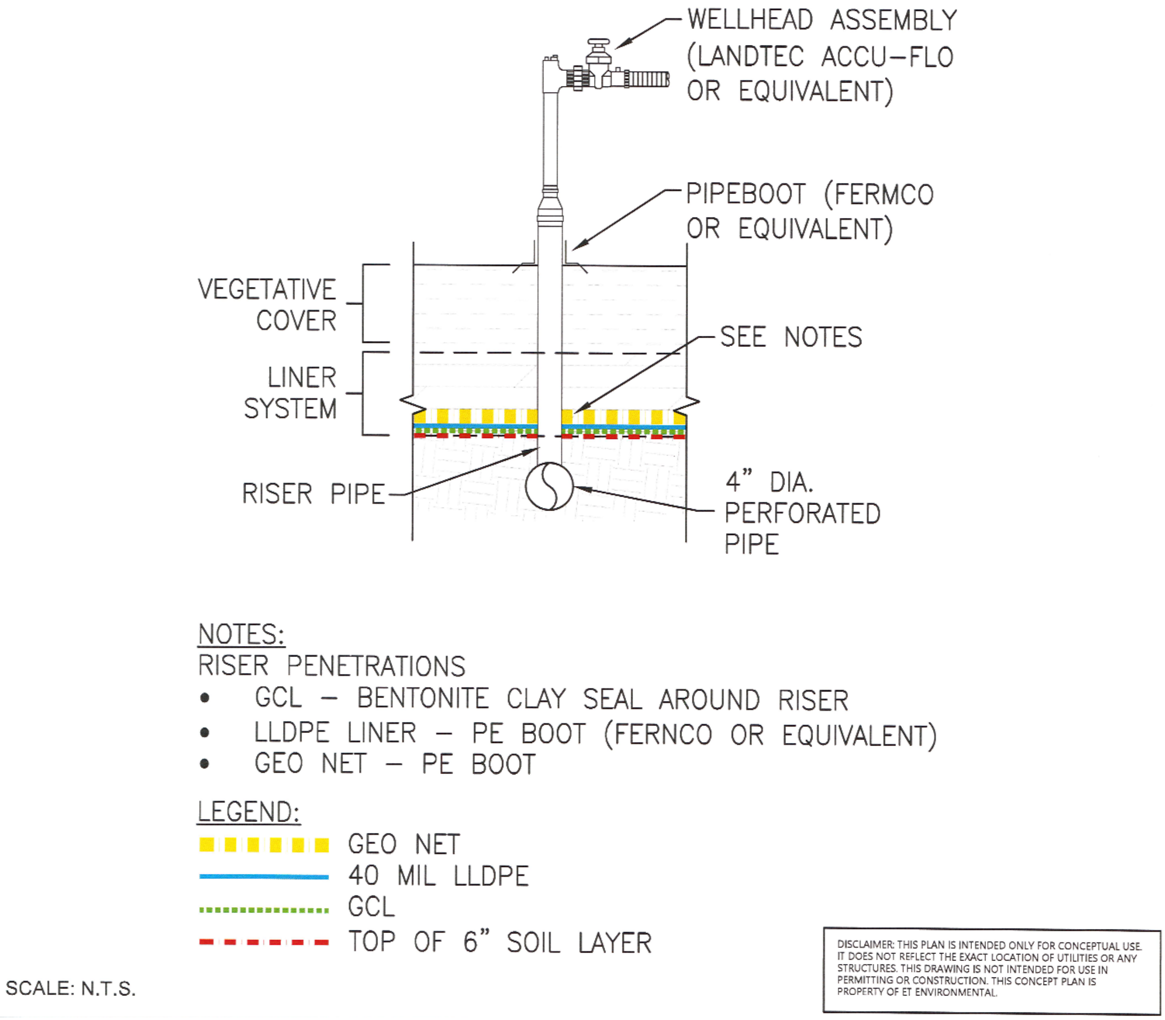

*Figure 15 – Landfill Gas Wellhead (See Also Appendix A-15)*

## Waste Excavation

Waste excavation efforts will begin with the removal of the soil cover material which will be placed and stockpiled adjacent to the trench to be utilized as backfill or cover material in the repository. Waste will then be removed from the cell exposing the side cell walls and the cell clay bottom.

The northern boundary of Phase I will be adjusted, if necessary, to allow for the complete excavation of the waste cells. The presence of MSW is suspected adjacent to the short line rail track along the eastern border but is not believed to exist under the rail. The excavation will progress to the east, approaching the rail and the determination will be made as to whether the rail bed is underlain with MSW or not. If waste is determined to exist under the rail spur, we will consult with the property owner (Patriot Rail) to determine the best course of action in consultation with UDEQ.

### Dry Waste Operations

As the excavation of waste from the old landfill commences, the dry waste will be placed in off-road haul vehicles, covered and transported to the repository and placed. The dry waste will be compacted by a Caterpillar 836 LF compactor (or similar). Geosynthetic polyethylene tarps will be used to cover waste. The tarp covers will remain until a soil cover layer is placed. In this application, and in every other application of tarps used as daily cover, sandbags will be placed on the tarps at the end of the day to prevent dislocation by wind. This excavation operation will continue as described until the waste excavation encounters leachate (see below).

The second operation will be the excavation and relocation of the “Bonneville Pile”, waste which was previously relocated from the former NTL East Landfill and placed on the NTL site under a previously approved plan with UDEQ. The clean cover material will be removed from the Bonneville Pile and stockpiled and used in the backfilling operation of the waste cells as discussed is Section 5.2.8. Previous investigation of the material within the Bonneville Pile indicates the waste is both dry and mixed with approximately 50% soil fines. The intent will be to segregate the soil fraction and the waste fraction by processing the excavated material through a trommel screen. The soil fines will be stockpiled and either used as trench backfill or utilized within the repository construction as appropriate, with the waste being placed in the repository in a similar fashion as the waste being excavated from the cells. Soil from this process to be utilized as trench backfill will first be tested for RCRA 8 metals, VOC’s, and SVOC’s every 5,000 cubic yards following standard procedures to ensure the material is suitable for backfill. The stockpiled soil to be utilized as trench backfill will also be evaluated in accordance with Utah asbestos regulations.

### Wet Waste Operations

As the excavation progresses to the north and west in Phase I, it is anticipated that leachate will be encountered in the excavation, thus a fraction of waste to be excavated will be wet. Wet waste removed from the trenches will be placed trench-side on geosynthetic tarps to drain free liquids back into the excavation. The trench side waste will be covered with tarps and left for 48-72 hours to drain before transportation to the repository.

The remnant leachate in the cell will be pumped to the leachate storage pond prior to being directed to the leachate evaporation system. The leachate pond is sized for 50,000 gallons of storage based on the estimation of leachate to be generated in Phase I.

The leachate, if any, contained within the waste cells beneath the repository will be dewatered using displacement pumps. Approximate locations of these displacement pumps are included in **Figure**

**16/Appendix A-16.** 12" diameter sumps will be drilled into each trench and insert slotted 8" diameter PVC casings. Pump intakes will be situated at the bottom of the casing and the pumpage will be collected in the leachate pond which will supply the evaporator. These details are included in **Figure 17/Appendix A-17** below. This process will begin before the repository footprint is developed to ensure sump/trench access is maintained. The waste trenches will be dewatered along with the immediate area surrounding perimeter of the Bonneville Pile. Multiple pumping attempts will be made until a measurable quantity of leachate can no longer be extracted. The well points will be decommissioned as the site excavation process proceeds.

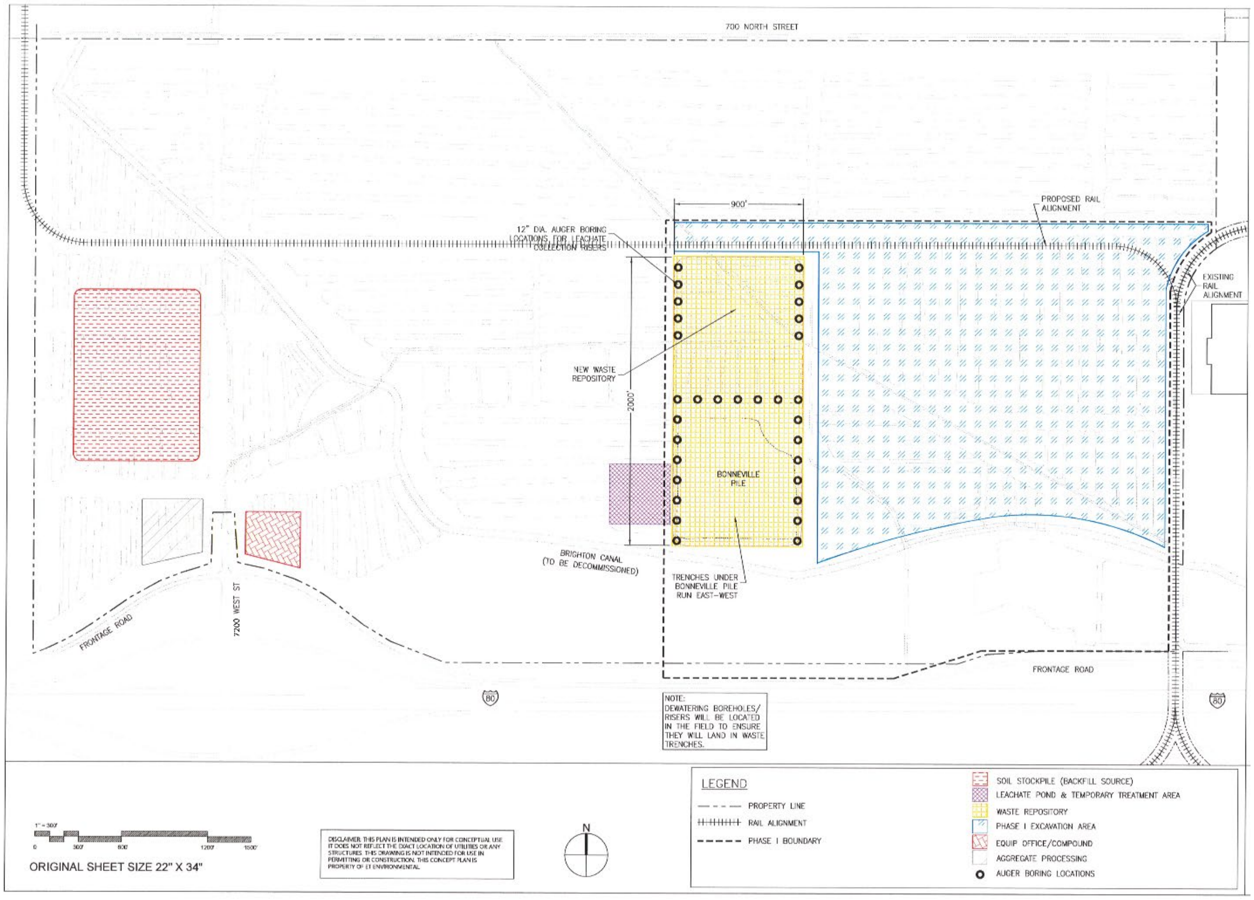

*Figure 16 – Leachate Dewatering Plan (See Also Appendix A-16)*

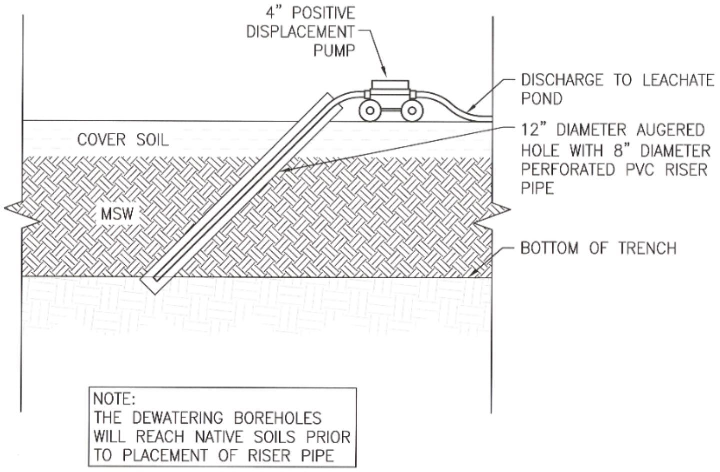

*Figure 17 – Leachate Dewatering Detail (See Also Appendix A-17)*

Prior test pit excavation demonstrated that what we have referred to as “dry waste” (waste that was above the level of leachate saturation) is typically damp and does not generate dust upon the excavation from the waste cells. As such, we do not anticipate having to precondition the MSW with moisture for grading/hauling/depositing the repository.

The haul roads in Phase I will be decommissioned after end of the remediation process. Prior to the aggregate being removed and stockpiled, the X-Ray Fluorescent Scanner (XRF) utilizing EPA Method 6200 will used to scan the haul road surface for potential contamination. If clean, the aggregate will be removed and stockpiled. Where we find exceedances, the materials will be isolated and placed in the repository. Given that no waste will be hauled west of Phase I, the haul roads will not be scraped for lead removal.

## Lead Shot Removal and Repository Placement

After the commencement of the waste excavation, the portion of the site south of the Brighton Canal (the site of a Sporting Clays Range) will be addressed. The remedy will be removal of the upper 6" of soil and vegetation for those areas identified as containing the lead shot. This material will be placed in the repository. **Figure 18**, which is a zoomed in version of **Appendix A-11,** illustrates the areas in green that have lead shot contamination that will require removal. Prior to this effort, representatives from the owner and UDEQ will conduct a visual reconnaissance of these areas, including the cover of the Bonneville Pile, and determine the estimated boundaries of scraping as needed.

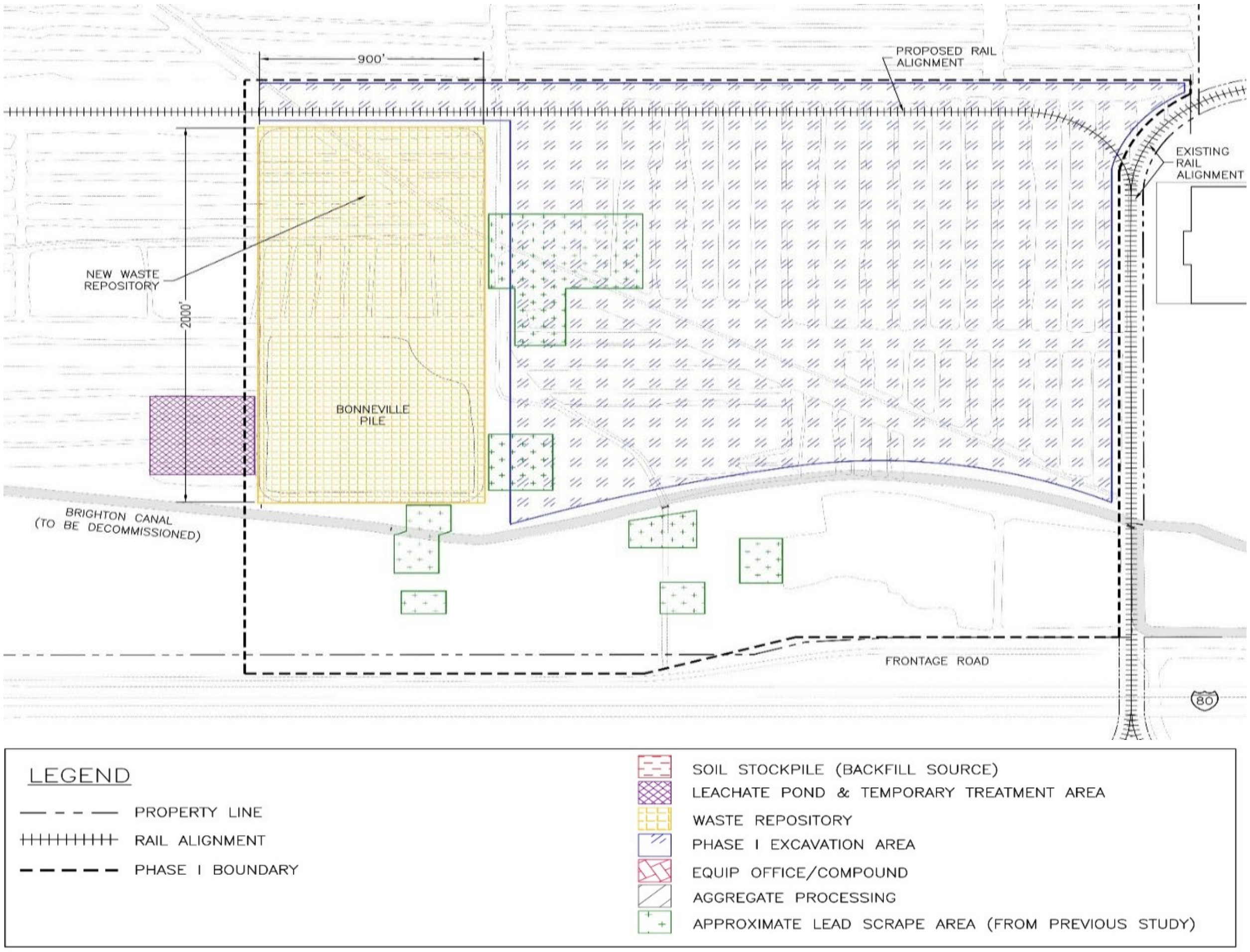

*Figure 18 – Lead Shot Removal Areas (In Green)*

## Brighton Canal Decommissioning

SITLA, in cooperation with the Brighton Canal Company and Property Reserve, Inc. (PRI), will divert the transport of irrigation water across the NTL site prior to the onset of remediation activities. As such, the Brighton Canal will be decommissioned in its reach within the Phase I area **(Figure 19/Appendix A-19)**. The canal will be dewatered, de-mucked, and backfilled to grade with on-site clean fill material. The goal is to remove sediment down to native soils which we anticipate being at depths between 6 and 12 inches. The de-mucked material will be stored in a stockpile and will subsequently be tested with an XRF utilizing EPA Method 6200. Any impacted soils will be placed in the repository.

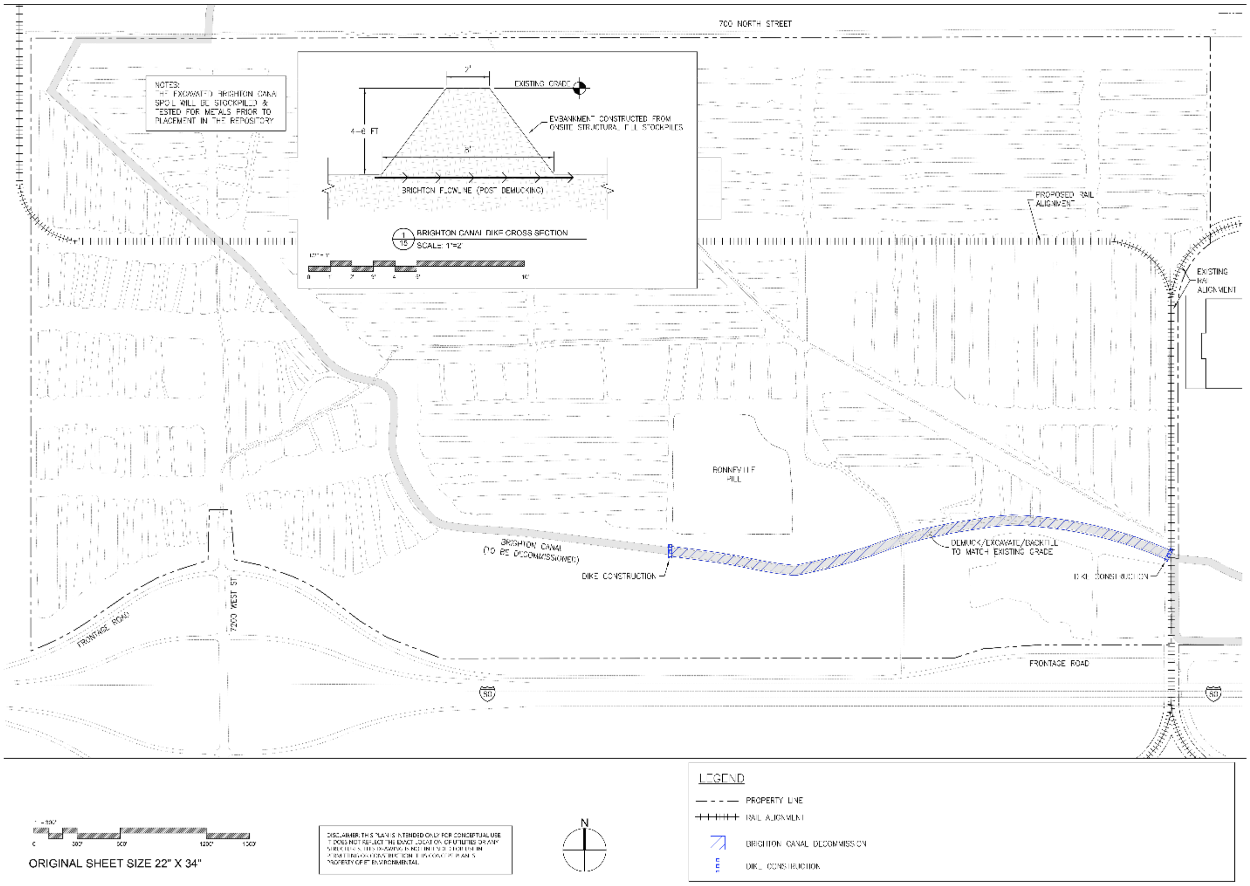

*Figure 19 – Brighton Canal Decommissioning (See Also Appendix A-19)*

## C-4 Storm Water Pollution Prevention Plan

# A: SWPPP Template (Utah) – Instructions

DWQ has developed this Storm Water Pollution Prevention Plan (SWPPP) template for construction sites permitted under the Construction General Storm Water Permit (CGP). The template gives you a framework to ensure that your SWPPP addresses the necessary elements required by the permit. It may be helpful to use this template with EPA's guidance on *Developing Your Storm Water Pollution Prevention Plan* (SWPPP Guide). Both are available on DWQ's construction storm water website at https://deq.utah.gov/water-quality/general-construction-storm-water-updes-permits

This template covers most of the SWPPP elements that the Utah CGP requires, however, you are encouraged to customize this template to reflect unique conditions at the site or address a requirement not covered in the provided sections.

### *Using the SWPPP Template*

Each section of this template includes instructions and space for project information. You should read the instructions for each section before you complete that section. If you require additional clarification, the instructions often reference a permit section where you can find the exact wording for the requirement as well as other resources that may be useful. For a cleaner document you may want to delete instructions when finished. This template was developed in Word so that you can easily add tables and additional text. Some sections may require only a brief description or not apply at all to your project, while others may require several pages of explanation.

### *Tips for completing the SWPPP template*

- If there is more than one key player affecting storm water for your project, consider coordinating development of your SWPPP with the other key players.
- Make sure you inform subcontractors about limitations or special requirements if their work intersects with SWPPP requirements. You might write a section of your SWPPP specifically for a subcontractor and deliver that section to the sub-contractor before his work commences.
- Modify this SWPPP template so that it addresses the requirements in your construction general permit and meets the needs of your project. Be sure to include important aspects of the SWPPP that go beyond the boundaries of the project.
- EPA's guidance on Developing Your Storm Water Pollution Prevention Plan (SWPPP Guide) can be accessed here: https://www3.epa.gov/npdes/pubs/sw_swppp_guide.pdf

# Storm Water Pollution Prevention Plan

# for:

Airport West VCP – Phase I Remediation
6550 West North Temple Frontage
Salt Lake City, Utah 84104

## Operator:

NT Development, LLC
1700 South 4650 West
Salt Lake City, Utah 84104
801-973-9090

## Primary SWPPP Contact

NT Development, LLC
Eric A. Rice
1700 South 4650 West
Salt Lake City, Utah 84104
801-973-9090
eric@ntdevelopment.net

## SWPPP Preparation Date:

__/__/__

## UPDES Permit Tracking Number:

UTR_____

*(Note: This is the Stormwater Pollution Prevention Plan template obtained from the Division of Water Quality. This plan will be revised, finalized and approved with Salt Lake City prior to the onset of the site construction activities for the Phase I remedial efforts and will ensure that Salt Lake City's MS4 UPDES requirements are met. Furthermore, this plan is not intended to address the Storm Water Prevention efforts for the subsequent development of this parcel. Those measures will be developed during the master planning of the development and in accordance with Salt Lake City's regional stormwater masterplan.)*

# Contents

# SECTION 1: CONTACT INFORMATION/ RESPONSIBLE PARTIES

**Instructions (CGP 7.3.1./7.3.7.):**

- Identify the staff members that are part of the project's storm water team as well as their responsibilities. The storm water team is comprised of individuals who are responsible for the development of the SWPPP, any later modifications to it, installing and maintaining storm water controls, conducting site inspections, and making corrective actions where required.
- Each member of the storm water team must have ready access to either an electronic or paper copy of the 2019 CGP and the SWPPP.
- Starting January 1, 2021: A SWPPP writer for a site greater than 5 acres, with a perennial surface water within 50 feet of the project, or with a steep slope (70% or 35 degrees or more) must hold a certification to demonstrate that they are a "qualified person" per CGP Part 7.2.
- The following personnel, at a minimum, must receive training on their responsibilities (CGP Part 7.3.7/6.1):
  - ✓ Personnel who are responsible for the design, installation, maintenance, and/or repair of storm water controls (including pollution prevention measures);
  - ✓ Personnel responsible for the application and storage of treatment chemicals;
  - ✓ Personnel who are responsible for conducting inspections (must hold a certification) as required in Part 4.1.; and
  - ✓ Personnel who are responsible for taking corrective actions as required in Part 5.
- A sample training log is provided in Appendix F. Certifications can also be recorded in this appendix.
- For more on training, see *SWPPP Guide*, Chapter 8.

## 1.1 Storm Water Team

| Name and/or Position, and Contact | Responsibilities, Qualifications, and Training |
|---|---|
| Insert name of responsible person<br>Insert Company Name<br>Insert Position<br>Insert Telephone Number<br>Insert Email | Insert Responsibility, Qualifications, and Trainings |
| Insert name of responsible person<br>Insert Company Name<br>Insert Position<br>Insert Telephone Number<br>Insert Email | Insert Responsibility, Qualifications, and Trainings |
| Insert name of responsible person<br>Insert Company Name<br>Insert Position<br>Insert Telephone Number<br>Insert Email | Insert Responsibility, Qualifications, and Trainings |

[Insert or delete rows as necessary.]

# SECTION 2: NATURE OF CONSTRUCTION ACTIVITIES

## 2.1 Construction Site Estimates

**Instructions (CGP 7.3.2.b.-c.):**

- Estimate the area to be disturbed by excavation, grading, or other construction activities, including dedicated off-site borrow and fill areas.

The following are estimates for the construction site.

| | |
|---|---|
| Total project area (lot size): | acres |
| Construction site area to be disturbed: | acres |

## 2.2 Construction Activity Descriptions

**Instructions (CGP 7.3.2.a., d. & g.):**

- Briefly describe the nature of the construction activity and approximate time frames.
- For more information see CGP Part 7.3.2 and *SWPPP Guide*, Chapter 3.A.

Describe the general scope of the work for the project, major phases of construction, etc:
INSERT TEXT HERE
Describe any on-site and off-site construction support activity areas:
INSERT TEXT HERE
Typical site business days and times:
INSERT TEXT HERE

## 2.3 Phase/Sequence of Construction Activity

**Instructions (CGP 7.3.2.e.):**

- Describe the intended construction sequencing and timing of major activities, including any opportunities for phasing grading and stabilization activities to minimize the overall amount of disturbed soil that will be subject to potential erosion at one time. Also, describe opportunities for timing grading and stabilization so that all or a majority of the soil disturbance occurs during a time of year with less erosion potential (i.e., during the dry or less windy season).
- For more information, see *SWPPP Guide*, Chapter 4, ESC Principle 2. It might be useful to develop a separate, detailed site map for each phase of construction.

Phase I

- Describe phase and activities
- Duration of phase (start date, end date)
- List BMPs associated with this phase
- Describe stabilization methods for this phase (describe any temporary stabilization methods that will be used before final stabilization)

Phase II

- Describe phase and activities
- Duration of phase (start date, end date)
- List BMPs associated with this phase
- Describe stabilization methods for this phase (describe any temporary stabilization methods that will be used before final stabilization)

[Repeat as needed]

## 2.4 Maps

**Instructions (CGP 7.3.3.):**

- Attach site maps. For most projects, a series of site maps is recommended. The first should show the undeveloped site and its current features. An additional map or maps should be created to show the developed site or for more complicated sites show the major phases of development.

**These maps should include the following:**

- Boundaries of the property
- Locations of earth-disturbing activities, including demolition, and note any phasing;
- Direction(s) of storm water flow and approximate slopes before and after major grading activities;
- Type and extent of pre-construction cover (vegetative cover, pavement, etc.);
- Locations of stockpiles and material storage;
- Water crossings and all water of the state within one mile downstream of the site's discharge point;
- Designated points where vehicles enter onto paved roads;
- Locations of structures and other impervious surfaces upon completion of construction;
- On-site and off-site construction support activity areas covered by the permit;
- Storm water and authorized non-storm water discharge locations to inlets or waters of the state;
- Locations of all potential pollutant-generating activities;
- Locations of storm water controls, including natural buffer areas; and
- Locations where polymers, flocculants, or other treatment chemicals will be used and stored.
- For more information, see *SWPPP Guide*, Chapter 3.C.

The SWPPP site map(s) are filed in Appendix A

# SECTION 3: WATER QUALITY

## 3.1 Discharge Information

**Instructions(CGP 1.4.):**

- A Municipal Separate Storm Sewer System (MS4) is a storm water conveyance system owned and operated by a state, city, town, county, district, association, or other public body. If you discharge to one of these systems mark "yes" and identify which MS4.You must submit your SWPPP to this MS4 for review. A list of MS4s that are currently designed under a Utah municipal storm water permit can be found here: https://documents.deq.utah.gov/water-quality/stormwater/DWQ-2018-006843.xlsx

Does your project/site discharge storm water into a Municipal Separate Storm Sewer System (MS4)? ☐ Yes ☐ No

List the MS4 that receives the discharge from the construction project: INSERT TEXT HERE

## 3.2 Receiving Waters

**Instructions (CGP 3.1.):**

- In the below table, list the name of the first surface water(s) that would receive discharges from your site. Multiple rows are provided in case your site discharges in multiple locations which flow to different surface waters. For discharges that enter a storm sewer system prior to discharge, the first surface water to which you discharge is the water body that receives the storm water discharge from the storm sewer system. You may need to contact the storm sewer system owner to find out where it discharges to.
- See http://wq.deq.utah.gov for impairment or quality information. Use this to identify the status in column 2 of Table 1. Select the waterbody you wish to look-up and find the results from the 20XX Assessment on the left hand side.
- For more information on TMDLs and impaired waters visit https://deq.utah.gov/water-quality/watershed-monitoring-program/approved-tmdls-watershed-management-program or www.epa.gov/tmdl/impaired-waters-and-stormwater.
- If any of the surface waters you listed are impaired, provide specified information about pollutants causing the impairment in column 3 of Table 1. Your SWPPP should specifically include measures to prevent the discharge of these pollutants.
- If any of the surface waters you listed are identified as a Category 1 or 2 water (a Category 1 water is only found within Forest Service boundaries) provide the category in column 3 of Table 1.
- For more information, see CGP Part 3.1 and 3.2 and *SWPPP Guide*, Chapter 3.B.

**Names of Receiving Waters**

| Name of Receiving Water (first surface water that receives storm water or where storm system discharges to) | Is the water impaired or high quality? | If high quality: Is it Category 1 or 2?<br>If impaired: List pollutants that the waterbody is impaired for |
|---|---|---|
| 1. | ☐ Not high quality/impaired<br>☐ Impaired, has approved TMDL<br>☐ Impaired, no TMDL<br>☐ High quality | |
| 2. | ☐ Not high quality/impaired<br>☐ Impaired, has approved TMDL<br>☐ Impaired, no TMDL<br>☐ High quality | |

[Insert or delete rows as necessary.]

## 3.3 Impaired Waters

**Instructions (CGP 3.2.):**

- If you discharge to an impaired water as listed in the above table, provide information on additional efforts that will be taken to control the release of impairment causing pollutants. This is especially important for projects discharging to a surface water with an EPA approved TMDL for sediment or nutrients and an extra effort must be provided to prevent sediment from leaving the site.

Description of additional precautions taken if you are discharging to an impaired surface water. State if no impairment causing pollutants are on site:

INSERT TEXT HERE

## 3.4 High Water Quality

**Instructions (CGP 3.2.):**

- If you discharge to a high quality water as listed in the above, provide information on additional efforts that will be taken to control the release of pollutants. Per CGP Part 1.1.7, you can discharge to a Category 1 water if your discharge is temporary and limited and where best management practices will be employed to minimize pollution effects. Discharge to Category 2 waters is allowed only if the discharge will not lower the water quality of the water body.

Description of additional precautions taken to minimize pollution effects if you are discharging to a high quality surface water:

INSERT TEXT HERE

# SECTION 4: POLLUTION PREVENTION STANDARDS

## 4.1 Potential Sources of Pollution

**Instructions (CGP 7.3.2.f.):**

- Identify and list all potential sources of sediment, which may reasonably be expected to affect the quality of storm water discharges from the construction site.
- Identify and describe all potential sources of pollution or pollutant-generating activity (e.g., paving operations; concrete, paint, and stucco washout and waste disposal; solid waste storage and disposal), other than sediment, which could be exposed to rainfall or snowmelt, and may reasonably be expected to discharges from the construction site.

For more information, see *SWPPP Guide*, Chapter 3.A.

| **Pollutant-Generating Activity** | **Pollutants or Pollutant Constituents** (that could be discharged if exposed to storm water) | **Location on Site** (or reference SWPPP site map where this is shown) |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

[Include additional rows as necessary.]

## 4.2 Non-Storm Water Discharges

**Instructions (CGP 7.3.4.):**

- Identify all allowable sources of non-storm water discharges and how they will be controlled. A list of allowable non-storm water discharges are found in the CGP Part 1.2.3.
- For more information, see *SWPPP Guide*, Chapter 3.A.

Check allowable non-storm water discharges that are present and describe the measures used to reduce them or prevent them from contributing pollutants to discharges:

| Authorized Non-Storm Water Discharges | Present | Comments/Controls |
|---|---|---|
| Discharges from emergency fire-fighting activities | ☐ Y ☐ N | |
| Fire hydrant flushing | ☐ Y ☐ N | |
| Properly managed landscape irrigation (excludes fertilizer injector systems) | ☐ Y ☐ N | |
| Properly managed vehicle and equipment wash water with no soaps, solvents, or detergents | ☐ Y ☐ N | |
| Water used to control dust | ☐ Y ☐ N | |
| Drinking water, includes uncontaminated water line flushing | ☐ Y ☐ N | |
| External building washdown with no soaps, solvents, detergents, or hazardous substances | ☐ Y ☐ N | |
| Pavement wash waters with no detergents or toxic or hazardous materials. Must have a sediment basin, sediment trap, of similarly effective control prior to discharge. | ☐ Y ☐ N | |
| Uncontaminated air conditioning or compressor condensate | ☐ Y ☐ N | |
| Uncontaminated, non-turbid discharges of ground water (from natural sources) or spring water | ☐ Y ☐ N | |
| Uncontaminated foundation or footing drains | ☐ Y ☐ N | |

## *4.3 Dewatering Practices*

**Instructions (CGP 1.2.5. and 2.3.7.):**

If you will be discharging storm water that is removed from excavations, trenches, foundations, vaults, or other similar points of accumulation, it must be permitted by UPDES permit UTG070000 (Construction Dewatering and Hydrostatic Testing Permit) unless it can be managed onsite through percolation or evaporation. The permit can be found at https://deq.utah.gov/water-quality/current-updes-permits in the bottom table. Call DWQ at 801-536-4300 for more information.

- Include schedule and general locations of dewatering. Dewatering locations must be on the site map.

☐ Check box if section not applicable to this site (Note: If not applicable skip to next section)

Describe the general scope of dewatering practices for the project and any BMPs used to manage the dewatering practices:

INSERT TEXT HERE

4.3.1: (Place name of BMP here – reference to detailed instructions in Appendix H if necessary)

BMP Description:

| | |
|---|---|
| ***Installation Schedule/Instructions:*** | |
| ***Maintenance and Inspection:*** | |
| ***Responsible Staff:*** | |
| ***Design Specifications and Drawings:*** | |

## *4.4 Natural Buffers or Equivalent Sediment Controls*

**Instructions (CGP Part 7.3.5.b.(1), 2.2.1, and Appendix A):**

This section only applies if a surface water is located within 50 feet your construction activities. If this is the case, review CGP Part 2.2.1. and Appendix A of the CGP for information on how to comply with the buffer requirements.

- Describe the compliance alternative that was chosen to meet the buffer requirements, and include any required documentation supporting the alternative selected. The compliance alternative selected must be maintained throughout the duration of permit coverage. However, if you select a different compliance alternative during your period of permit coverage, you must modify your SWPPP to reflect this change.
- If you qualify for one of the exceptions in CGP Part A.2.2., include documentation related to your qualification for such exceptions.
- Review Appendix A of the CGP for step-by-step instructions and examples on how to comply with the different buffer alternatives.

**Buffer Compliance Alternatives**

Are there any surface waters within 50 feet of your project's earth disturbances?

☐ YES ☐ NO

(Note: If "no", no further documentation is required. Delete the rest of Section 4.3 below this point.)

List the water body: INSERT TEXT HERE

**Check the compliance alternative that you have chosen:**

☐ I will provide and maintain a 50-foot undisturbed natural buffer around the surface water.

☐ It is infeasible to provide and maintain a full 50-foot undisturbed natural buffer. I will provide and implement erosion and sediment controls to achieve the required sediment load reduction for my conditions.

- Reason that a 50' buffer could not be maintained: INSERT TEXT HERE
- Width of buffer that will be retained: INSERT TEXT HERE
- Additional controls used to achieve equivalent sediment load reduction of a 50' buffer: INSERT TEXT HERE
- Description of the calculations and assumptions used to determine sediment load reductions: INSERT TEXT HERE

☐ The project qualifies as "small residential lot" disturbing less than an acre. The natural buffer is preserved in accordance with CGP A.2.3., storm water is treated by site erosion and sediment controls before discharge, natural buffers are shown on the site map, and buffer areas are marked on site. Select one of the 2 alternatives for small residential lots:

☐ Alternative 1: Using Table A-1 in CGP for requirements

- Width of buffer that will be retained: INSERT TEXT HERE
- Additional controls to be used: INSERT TEXT HERE

☐ Alternative 2: Using Tables A-2 through A-7 in CGP for requirements

- Width of buffer that will be retained: INSERT TEXT HERE
- Sediment Risk Level Determined: INSERT TEXT HERE
- Additional controls to be used: INSERT TEXT HERE

☐ I qualify for one of the exceptions in Part A.2.2. (If you have checked this box, provide information on the applicable buffer exception that applies, below.)

☐ There is no discharge of storm water through the area between the disturbed portions of the site and the surface water that is located within 50 feet.

☐ No natural buffer exists due to preexisting development disturbances that occurred prior to the initiation of planning for this project.

☐ For a linear project, site constraints (e.g., limited right-of-way) make it infeasible for me to meet any of the compliance alternatives.

- Reason it is infeasible: INSERT TEXT HERE
- Buffer width retained or supplemental controls used: INSERT TEXT HERE

☐ Buffer disturbances are authorized under a CWA Section 404 permit.

- Describe earth disturbances in buffer area: INSERT TEXT HERE

*(Note: This exception does not apply to portions upland of the Section 404 permitted work.)*

☐ Buffer disturbances will occur for the construction of a water-dependent structure or water access area (e.g., pier, boat ramp, and trail).

- Describe earth disturbances in buffer area: INSERT TEXT HERE

# SECTION 5: EROSION AND SEDIMENT CONTROLS – BMPS

## 5.1 List of Erosion and Sediment BMPs on Site

**Instructions (CGP Part 2.2. and 7.3.5):**

- Identify best management practices (BMPs) that will be implemented on site to control erosion and sediment transport from storm water.
- Use the below CGP requirements and the pollutant generating activates identified in SWPPP section 4.1. to determine where BMPs are necessary. Fill out the rightmost column with BMPs you are selecting. Some requirements may not apply to your site.
- For each BMP you must provide a description of the control, any design specifications, routine maintenance specifications, a schedule for storm water control implementation/installation, and the staff responsible for maintaining the BMP. These details are listed in the BMP section below the table.
- BMPs are listed as examples, you may use BMPs not listed.
- Details and design specifications can be provided in this section or in Appendix H if they are large.
- Perimeter control maintenance must include removal of sediment before it has accumulated to one-half the above-ground height of the control.
- For more information, see *SWPPP Guide*, Chapter 4.
- BMP guidance may be found in your MS4's or other local jurisdiction's design manual, guidance manuals listed in Appendix D of the *SWPPP Guide*, or EPA's National Menu of BMPs https://www.epa.gov/npdes/national-menu-best-management-practices-bmps-stormwater#constr

| CGP Requirement | Example BMPs | EPA SWPPP Guide Section | BMPs Selected (Name and Reference Number if applicable) |
|---|---|---|---|
| Preserve vegetation where possible and direct storm water to vegetated areas when feasible (CGP 2.2.2.) | Phasing to minimize disturbance, signs/fences to protect areas not being disturbed. | Chapter 4, ESC Principle 1 | |
| Install sediment controls along perimeter areas that receive pollutant discharges (CGP 2.2.3.). | Silt fence, fiber rolls, earth berms | Chapter 4, ESC Principle 7 | |
| Minimize sediment track-out (CGP 2.2.4.) | Restrict access, stabilize exits, track-out pads, tire washing station, clean-up sediments | Chapter 4, ESC Principle 9 | |
| Manage stockpiles with perimeter controls and locate away from storm water conveyances (CGP 2.2.5.) | Sediment barriers downgradient, proper location, covered stockpiles, diverting storm water from stockpiles | Chapter 4, ESC Principle 4 | |
| Minimize dust (CGP 2.2.6.) | Water application, mulching, chemical dust suppression techniques | | |
| Minimize steep slope disturbance (CGP 2.2.7.) | Erosion control blankets, tackifiers, protect slopes from disturbance | Chapter 4, ESC Principle 5 | |
| Preserve topsoil (CGP 2.2.8.) | Stockpile topsoil | Chapter 4, ESC Principle 1 | |
| Minimize soil compaction where final cover is vegetation (CGP 2.2.9.) | Restrict vehicle access, recondition soils before seeding | | |
| Protect storm drain inlets (CGP 2.2.10.) | Inserts, rock-filled bags, covers | Chapter 4, ESC Principle 6 | |
| Slow down runoff with erosion controls and velocity dissipation devices (CGP 2.2.11.) | Check dams, riprap | Chapter 4, ESC Principle 3 | |

| | | | |
|---|---|---|---|
| Appropriately design any sediment basins or impoundments (CGP 2.2.12.) | Design to 2-year 24-hour storm or 3,600 cubic feet per acre drained, include design specifications | Chapter 4, ESC Principle 8 | |
| Follow requirements for any treatment chemicals (polymers, flocculants, coagulants, etc.) | Store in leak proof containers and cover, proper training, minimize use | | |
| Stabilize exposed portions of site with 14 days of inactivity (CGP 2.2.14). | Seeding, erosion control blankets, gravel, hydromulch | Chapter 9 | |

5.1.1: (Place name of BMP here – reference to detailed instructions in Appendix H if

***BMP Description/Instructions:***

| | |
|---|---|
| ***Installation Schedule:*** | |
| ***Maintenance and Inspection:*** | |
| ***Responsible Staff:*** | |
| ***Design Specifications and Drawings:*** | |

5.1.2: (Place name of BMP here – reference to detailed instructions in Appendix H if necessary)

***BMP Description/Instructions:***

| | |
|---|---|
| ***Installation Schedule:*** | |
| ***Maintenance and Inspection:*** | |
| ***Responsible Staff:*** | |
| ***Design Specifications and Drawings:*** | |

5.1.3: (Place name of BMP here – reference to detailed instructions in Appendix H if necessary)

***BMP Description/Instructions:***

| | |
|---|---|
| ***Installation Schedule:*** | |
| ***Maintenance and Inspection:*** | |

| | |
|---|---|
| ***Responsible Staff:*** | |
| ***Design Specifications and Drawings:*** | |

5.1.4: (Place name of BMP here – reference to detailed instructions in Appendix H if necessary)

***BMP Description/Instructions:***

| | |
|---|---|
| ***Installation Schedule:*** | |
| ***Maintenance and Inspection:*** | |
| ***Responsible Staff:*** | |
| ***Design Specifications and Drawings:*** | |

5.1.5: (Place name of BMP here – reference to detailed instructions in Appendix H if necessary)

***BMP Description/Instructions:***

| | |
|---|---|
| ***Installation Schedule:*** | |
| ***Maintenance and Inspection:*** | |
| ***Responsible Staff:*** | |
| ***Design Specifications and Drawings:*** | |

[Repeat as needed]

**Instructions (CGP 7.3.5.b.(2)):**

- For areas where perimeter controls are not feasible on a linear construction site, include a description of why it is not feasible and other practices that will be implemented to minimize discharges of pollutants from the site.

## 5.2 Linear Site Perimeter Control Exemption

☐ Check box if section not applicable to this site (Note: If not applicable skip to next section)

If the site is linear and perimeter controls are not feasible, describe other practices in use: INSERT TEXT HERE

## 5.3 Final Stabilization

**Instructions (CGP 7.3.5.b.(6) and 2.2.14.b.):**

- Describe procedures for final stabilization. If final cover is vegetation, you must establish uniform perennial vegetation that provides 70% or more of the vegetative cover that existed prior to earth-disturbing activities. Exception: Arid, semi-arid, and drought stricken areas are required to be seeded/planted so that the before mentioned vegetative requirement is expected to be met within 3 years. Establishment of vegetation is not required, however additional erosion controls may be needed.
- You can amend or add to this section as areas of your project are finally stabilized.
- Update your site plans to indicate areas that have achieved final stabilization.

Description of final stabilization practices and schedule:

| Type of stabilization (vegetation/landscaped, graveled, paved, etc.) | Location | Implementation Schedule |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

# SECTION 6: BMPS - POLLUTION PREVENTION/OPERATIONAL CONTROLS

## 6.1 Spill Prevention and Response

**Instructions CGP Part 7.3.5.b.(7):**

- Describe the spill prevention and control plan. Include ways to reduce the chance of spills, stop the source of spills, contain and clean up spills, dispose of materials contaminated by spills, and train personnel responsible for spill prevention and control.
- Some projects/site may be required to develop a Spill Prevention Control and Countermeasure (SPCC) plan under a separate regulatory program (40 CFR 112). If you are required to develop an SPCC plan, or you already have one, you should include references to the relevant requirements from your plan.
- The plan must include the materials and method of containment and for flowing liquid, cleanup, disposal and follow the minimum spill controls below.
- For more information, see *SWPPP Guide*, Chapter 5, P2 Principle 6.

Describe spill procedures and materials available for expeditious containment, clean-up and disposal of spills:
INSERT TEXT HERE OR REFERENCE DOCUMENT

Identify the employee responsible for detection and response of spills and leaks:
INSERT TEXT HERE

Any discharges in 24 hours equal to or in excess of the reportable quantities listed in 40 CFR 117, 40 CFR 110, and 40 CFR 302 will be reported to the National Response Center and the Division of Water Quality (DWQ) as soon as practical after knowledge of the spill is known to the permittees. The permittee shall submit within 14 calendar days of knowledge of the release a written description of: the release (including the type and estimate of the amount of material released), the date that such release occurred, the circumstances leading to the release, and measures taken and/or planned to be taken to the Division of Water Quality (DWQ), 288 North 1460 West, P.O. Box 144870, Salt Lake City, Utah 84114-4870. The Storm Water Pollution Prevention Plan must be modified within14 calendar days of knowledge of the release to provide a description of the release, the circumstances leading to the release, and the date of the release. In addition, the plan must be reviewed to identify measures to prevent the reoccurrence of such releases and to respond to such releases, and the plan must be modified where appropriate.

| Agency | Phone Number |
|---|---|
| National Response Center | (800) 424-8802 |
| Division of Water Quality ( DWQ)<br>24-Hr Reporting | (801)-231-1769<br>(801) 536-4123 |
| Salt Lake County Health Department Emergency Response | (801) 580-6681 |

| Material | Media Released To | Reportable Quantity |
|---|---|---|
| Engine oil, fuel, hydraulic & brake fluid | Land | 25 gallons |
| Paints, solvents, thinners | Land | 100 lbs (13 gallons) |
| Engine oil, fuel, hydraulic & brake fluid | Water | Visible Sheen |
| Antifreeze, battery acid, gasoline, engine degreasers | Air, Land, Water | 100 lbs (13 gallons) |
| Refrigerant | Air | 1 lb |

## 6.2 Pollution Prevention Controls

**Instructions (CGP Part 2.3. and 7.3.5):**

- Describe the key good housekeeping and pollution prevention (P2) BMPs that will be implemented to control pollutants in storm water (CGP Part 2.3).
- Use the below CGP requirements and the pollutant generating activates identified in SWPPP section 4.1. which were not addressed with the erosion and sediment BMPs to determine where BMPs are necessary.
- For each BMP you must provide a description of the control, any design specifications, routine maintenance specifications, a schedule for storm water control implementation/installation, and the staff responsible for maintaining the BMP.
- BMPs are listed as examples, you may use BMPs not listed.
- Details and design specifications can be provided in this section or in Appendix H.
- For more information, see *SWPPP Guide*, Chapter 5.
- Consult your state's or local jurisdiction's design manual or resources in Appendix D of the *SWPPP Guide*.
- For more information or ideas on BMPs, see EPA's National Menu of BMPs https://www.epa.gov/npdes/national-menu-best-management-practices-bmps-stormwater#constr

| CGP Requirements | Example BMPs | EPA SWPPP Guide Section | BMPs Selected (Name and Reference Number if applicable) |
|---|---|---|---|
| Equipment and vehicle fueling (CGP 2.3.1) | Spill kits, SPCCP, drip pans, locate activities away from conveyances, use secondary containment | Chapter 5, P2 Principle 4 | |
| Equipment and vehicle washing (CGP 2.3.2.) | Locating away from surface waters and storm water conveyances, directing wash waters to a sediment basin or | Chapter 5, P2 Principle 5 | |

| | | | |
|---|---|---|---|
| | sediment trap, using filtration devices | | |
| Storage, handling, and disposal of building products and waste (CGP 2.3.3.) | Cover (plastic sheeting / temporary roofs), secondary containment, leakproof containers, proper dumpsters, secured portable toilets, locate away from storm water conveyances | Chapter 5, P2 Principle 1 and 2 | |
| Washing of stucco, paint, concrete, form release oils, curing compounds, etc. (CGP 2.3.4.) | Leak proof containers, lined pits, locate away from storm water conveyances | Chapter 5, P2 Principle 3 | |
| Properly apply fertilizer (CGP 2.3.5) | Follow manufacture specifications, document deviations in applications, avoid applications to frozen ground, before heavy rains, or to storm water conveyances | | |

6.2.1.: (Place name of BMP here – reference to detailed instructions in Appendix H if necessary)

***BMP Description/Instructions:***

| | |
|---|---|
| ***Installation Schedule:*** | |
| ***Maintenance and Inspection:*** | |
| ***Responsible Staff:*** | |
| ***Design Specifications and Drawings:*** | |

6.2.2.: (Place name of BMP here – reference to detailed instructions in Appendix H if necessary)

***BMP Description/Instructions:***

| | |
|---|---|
| ***Installation Schedule:*** | |
| ***Maintenance and Inspection:*** | |
| ***Responsible Staff:*** | |
| ***Design Specifications and Drawings:*** | |

6.2.3.: (Place name of BMP here – reference to detailed instructions in Appendix H if necessary)

***BMP Description/Instructions:***

| | |
|---|---|
| ***Installation Schedule:*** | |
| ***Maintenance and Inspection:*** | |
| ***Responsible Staff:*** | |
| ***Design Specifications and Drawings:*** | |

6.2.4: (Place name of BMP here – reference to detailed instructions in Appendix H if necessary)

***BMP Description/Instructions:***

| | |
|---|---|
| ***Installation Schedule:*** | |
| ***Maintenance and Inspection:*** | |
| ***Responsible Staff:*** | |
| ***Design Specifications and Drawings:*** | |

6.2.5: (Place name of BMP here – reference to detailed instructions in Appendix H if necessary)

***BMP Description/Instructions:***

| | |
|---|---|
| ***Installation Schedule:*** | |
| ***Maintenance and Inspection:*** | |
| ***Responsible Staff:*** | |
| ***Design Specifications and Drawings:*** | |

6.2.6: (Place name of BMP here – reference to detailed instructions in Appendix H if necessary)

***BMP Description/Instructions:***

| | |
|---|---|
| ***Installation Schedule:*** | |
| ***Maintenance and Inspection:*** | |
| ***Responsible Staff:*** | |
| ***Design Specifications and Drawings:*** | |

[Repeat as needed]

# SECTION 7: SPECIAL CONDITIONS

**Instructions:**

The conditions listed below require additional details or actions added to your SWPPP. If they do not apply you may delete them from this SWPPP.

## 7.1 Emergency Related Projects

**Instructions (CGP 1.1.5):**

- For emergency activities that require immediate authorization but last longer than 30 days, a SWPPP may be submitted within 30 days of starting work.
- To be an emergency related project it must be considered a public emergency and the cause must be documented along with the description of necessary construction to reestablish effected public services.

Emergency-Related Project? ☐ Yes ☐ No

DESCRIBE THE NATURE OF THE PUBLIC EMERGENCY AND WHY IMMEDIATE AUTHORIZATION WAS NECESSARY.

## 7.2 UIC Class 5 Injection Wells

**Instructions (CGP 7.3.8.):**

- If you are using any of the following storm water controls at your site as they are described below, you must document any contact you have had with DWQ for implementing the requirements for underground injection wells in the Safe Drinking Water Act and DEQ's implementing regulation at UAC R317-7.
- There may be additional local requirements related to such structures
- For the State UIC Contact at DWQ call (801) 536-4300.

☐ Check box if section not applicable to this site (Note: If not applicable skip to next section)

Class V UIC Wells on site (all must be reported to DWQ for inventory):

☐ Infiltration trenches (if storm water is directed to any shaft or hole that is deeper than its widest surface dimension or has a subsurface fluid distribution system)

☐ Commercially manufactured pre-cast or pre-built subsurface detention vault/infiltration system

☐ Drywell, seepage pit, or improved sinkhole (if storm water is directed to any shaft or hole that is deeper than its widest surface dimension or has a subsurface fluid distribution system)

Description of your Class V Injection Well and any local requirements:

INSERT DESCRIPTION AND ANY DWQ OR LOCAL REQUIREMENTS

Description of any additional BMPs used in conjunction with the UIC well.

| 7.2.1: (Place name of BMP here – reference to detailed instructions in Appendix H if necessary) | |
|---|---|
| ***BMP Description/Instructions:*** | |
| ***Installation Schedule:*** | |
| ***Maintenance and Inspection:*** | |
| ***Responsible Staff:*** | |
| ***Design Specifications and Drawings:*** | |

## *7.3 Chemical Treatment*

**Instructions (see CGP 2.2.13. and 7.3.5.b.(5)):**

- If you are using treatment chemicals at your site, provide details for each of the items below. This information is required as part of the SWPPP requirements in CGP Part 7.2.9.b.

☐ Check box if section not applicable to this site (Note: If not applicable skip to next section)

### *Soil Types*

List all the soil types (including soil types expected to be found in fill material) that are expected to be exposed during construction and that will be discharged to locations where chemicals will be applied: INSERT TEXT HERE

### *Treatment Chemicals*

List all treatment chemicals that will be used at the site and explain why these chemicals are suited to the soil characteristics: INSERT TEXT HERE

Describe the dosage of all treatment chemicals you will use at the site or the methodology you will use to determine dosage: INSERT TEXT HERE

Provide information from any applicable Safety Data Sheets (SDS): INSERT TEXT HERE

Describe how each of the chemicals will stored: INSERT TEXT HERE

Include references to applicable state or local requirements affecting the use of treatment chemicals, and copies of applicable manufacturer's specifications regarding the use of your specific treatment chemicals and/or chemical treatment systems: INSERT TEXT HERE

### *Special Controls for Cationic Treatment Chemicals (if applicable)*

If you have been authorized by DWQ to use cationic treatment chemicals, identify the specific controls and implementation procedures you are required to implement to ensure that your use of cationic treatment chemicals will not lead to a violation of water quality standards or harm aquatic life: INSERT TEXT HERE

### Schematic Drawings of Storm Water Controls/Chemical Treatment Systems

Provide schematic drawings of any chemically-enhanced storm water controls or chemical treatment systems to be used for application of treatment chemicals: INSERT TEXT HERE

### Training

Describe the training that personnel who handle and apply chemicals have received prior to permit coverage, or will receive prior to the use of treatment chemicals: INSERT TEXT HERE

# SECTION 8: INSPECTIONS & CORRECTIVE ACTIONS

## *8.1 Inspections*

**Instructions (CGP Part 4.2-4.4.3):**

- Select an inspection schedule. These are minimum frequencies, you may inspect more frequently. If so describe what your schedule would be.
- For more on this topic, see *SWPPP Guide*, Chapters 6 and 8.
- Also, see suggested inspection form in Appendix B of the *SWPPP Guide*.

**Minimum Inspection Schedule Requirements:**

| |
|---|
| **Standard Frequency:** |
| ☐ Once every 7 calendar days. |
| ☐ Once every 14 calendar days and within 24 hours of the end of a storm event of 0.5 inches or greater. Rain gauge/weather station used: Gauge or station for rainfall depth |
| **Increased Frequency (if applicable):** |
| ☐ *Sites discharging to impaired or high quality waters:* Once every 7 calendar days and within 24 hours of the end of a storm event of 0.5 inches or greater. |
| **Decreased Frequency (if applicable):** |
| ☐ *Arid areas:* once a month and within 24 hours of a 0.5 inch storm event or greater. |
| ☐ *Semi-arid areas*: once a month and within 24 hours of a 0.5 inch storm event or greater during the dry season: List months for dry season (also select the inspection schedule followed outside of the dry season). |
| ☐ *Frozen conditions with work suspended – must have 3 months of continuous expected frozen conditions based on historical averages:* no inspections List months of suspended inspections(also select the inspection schedule followed when not frozen) |
| ☐ *Frozen conditions with continued activities - must have 3 months of continuous expected frozen conditions based on historical averages*: once per month List months of frozen conditions (also select the inspection schedule followed when not frozen) |
| **Other:** |
| ☐ Describe alternative frequency: List alternative schedule, must meet minimum requirements |

Inspection Reports are filed in Appendix C

## *8.2 Corrective Actions*

**Instructions:**

- A sample corrective action report is provided in Appendix D.
- Whenever a storm water control requires repair or replacement (beyond routine maintenance), a control necessary for permit compliance was never installed or was installed incorrectly, your discharges cause an exceedance of applicable water quality standards, or a prohibitive discharge has occurred, you must log corrective actions taken.
- This log should describe actions taken, date completed, whether a SWPPP modification was required.
- In some cases corrective actions may be documented on the inspection form. This is an acceptable alternative as long as corrective actions that occur outside of inspections are also documented.

Correction Action Report is filed in Appendix D.

## *8.3 Delegation of Authority*

**Instructions:**

- Identify the individual(s) or specifically describe the position where the construction site operator has delegated authority for the purposes of signing inspection reports, certifications, or other information in Section 1.1 of the SWPPP.
- Each inspection report must be signed in accordance with CGP Part 9.16 of the permit.
- If a delegation letter is necessary, see Appendix E of this template and keep a signed copy with this SWPPP.
- For more on this topic, see *SWPPP Guide*, Chapter 7.

See the signed delegation of authority forms in Appendix E.

# SECTION 9: RECORDKEEPING

## 9.1 Recordkeeping

**Instructions (CGP 7.3.10. and 9.10.):**

- The following is a list of records you must have accessible on site (electronically or paper) for inspectors to review:
  - ✓ A copy of the construction general permit (Appendix I)
  - ✓ The signed and certified NOI form or permit application form (Appendix B)
- Copies of the SWPPP and all reports required by the permit must be retained for at least three years from the date that the site is finally stabilized.
- For more on this subject, see *SWPPP Guide*, Chapter 6.C.

## 9.2 Log of Changes to the SWPPP

**Instructions (CGP Part 7.5.3):**

- Create a log here of changes and updates to the SWPPP. You should include additions of new BMPs, replacement of failed BMPs, significant changes in the activities or their timing on the project, changes in personnel, changes in inspection and maintenance procedures, updates to site maps, and so on.
- Instead of using the table, SWPPPs can also be redlined to show changes as long as the redlines are initialed and dated.

| Description of the Amendment | Date of Amendment | Amendment Prepared by [Name(s) and Title] |
|---|---|---|
| | | |
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# SECTION 10: CERTIFICATION

**Instructions:**

- The SWPPP should be signed and certified by the owner and/or the general contractor. Attach a copy of the NOI and a copy of the General Storm Water Permit for Construction Activity. You can get a copy of the General Storm Water Permit for Construction Activity on the same web page that this template was obtained (https://deq.utah.gov/water-quality/general-construction-storm-water-updes-permits)

## Owner

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

| | |
|---|---|
| Name: | Title: |
| Signature: | Date: |

## General Contractor

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

| | |
|---|---|
| Name: | Title: |
| Signature: | Date: |

## SWPPP APPENDICES

Attach the following documentation to the SWPPP:

***Appendix A – Site Maps***

***Appendix B – NOI***

***Appendix C – Inspection Reports***

***Appendix D –Corrective Action Report***

***Appendix E – Subcontractor Certifications/Agreements/Delegation of Authority (see CGP 9.16(1)b.)***

***Appendix F – Training Logs and Certifications (see CGP 6)***

***Appendix G – Additional Information (i.e., Other permits such as dewatering, stream alteration, wetland; and out of date swppp documents)***

***Appendix H – BMP Instruction and Detail Specifications***

***Appendix I – Construction General Permit***

# Appendix A: Site Maps

Include any site maps in this appendix. For site map requirements review SWPPP section 2.5.

# Appendix B: NOI

Include a copy of your NOI in this appendix. The NOI must be signed.

# Appendix C: Inspection Reports

Place all completed inspection reports in this appendix. You may also put blank inspection reports here to be completed.

You are encouraged to create your own inspection forms for each site. Inspection reports must have the following information:

1) The inspection date.
2) The UPDES ID number (UTRXXXXX).
3) Name and title of personnel making the inspections.
4) Summary of inspection findings and any necessary corrective actions:
    a. Are storm water controls properly installed and operational? If failed then why?
    b. Presence of any conditions that could lead to spills or leaks.
    c. Locations where new or modified controls are necessary.
    d. Signs of visible erosion or sediment depositing related to your discharges.
    e. Any incidents of noncompliance.
    f. Visual quality of any discharges occurring.
5) Rainfall amount if the inspection was trigger by a precipitation event.
6) If it was unsafe to inspect any areas of the site, a description of the area and reason.

# Appendix D: Corrective Action Report

An example corrective action report has been included in this appendix. Review SWPPP section 8.2 for corrective action requirements. You can also create your own form or include corrective actions on your inspection form.

# Appendix D – *Sample* Corrective Action Report

| **Inspection Date** | **Inspector Name(s)** | **Description of BMP Deficiency** | **Corrective Action Needed (including planned date/responsible person)** | **Date Action Taken/Responsible person** |
|---|---|---|---|---|
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# Appendix E: Subcontractor Certifications/Agreements/Delegation of Authority (CGP 9.16.(1)b.)

A sample subcontractor agreement form and delegation of authority form have been included in this appendix. If these are used, keep complete signed forms here.

# SUBCONTRACTOR CERTIFICATION
# STORM WATER POLLUTION PREVENTION PLAN

Project Number: ______________________________

Project Title: ______________________________

Operator(s): ______________________________

As a subcontractor, you are required to comply with the Storm water Pollution Prevention Plan (SWPPP) for any work that you perform on-site. Any person or group who violates any condition of the SWPPP may be subject to substantial penalties or loss of contract. You are encouraged to advise each of your employees working on this project of the requirements of the SWPPP. A copy of the SWPPP is available for your review at request.

Each subcontractor engaged in activities at the construction site that could impact storm water must be identified and sign the following certification statement:

**I certify under the penalty of law that I have read and understand the terms and conditions of the SWPPP for the above designated project and agree to follow the BMPs and practices described in the SWPPP.**

This certification is hereby signed in reference to the above named project:

Company: ______________________________

Address: ______________________________

Telephone Number: ______________

Type of construction service to be provided: ______________________________

______________________________

______________________________

Signature: ______________

Title: ______________

Date: ______________

# Delegation of Authority

I, ____________________________, hereby designate the person or specifically described position below to be a duly authorized representative for the purpose of overseeing compliance with environmental requirements, including the UPDES "General Permit for Storm Water Discharges Associated with Construction Activity" (CGP), at the construction site:

____________________________________________________, Permit No. UTR_________________

The designee is authorized to sign all reports required by the Permit and other information requested by the Director of the Utah Division of Water Quality, or by an authorized representative of the Executive Secretary.

Name of Person or Position: _________________________________________________________

Owner/Operator:________________________________________________________________

Mailing Address: _________________________________________________________________

City, State, Zip Code: ______________________________________________________________

Phone Number: __________________________________________________________________

By signing this authorization, I confirm that I meet the requirements to make such a designation as set forth in Part 9.16 of the CGP, and that the designee above meets the definition of a "duly authorized representative" as set forth in Part 9.16.b. of the CGP.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name: _______________________________________________________

Title: ________________________________________________________

Signature: ____________________________________________________

Date: ____________________________

# Appendix F: Training Logs and Certifications (see CGP 6)

A sample training log has been included in this appendix to keep track of trainings that have been provided. At a minimum, storm water team members that require training should be provided with the following if it relates to their duties (CGP Part 6.3.):

- The permit deadlines associated with installation, maintenance, and removal of storm water controls and with stabilization;
- The location of all storm water controls on the site required by this permit and how they are to be maintained;
- The proper procedures to follow with respect to the permit's pollution prevention requirements; and
- When and how to conduct inspections, record applicable findings, and take corrective actions

Certifications for SWPPP inspectors or writers can also be placed in this appendix.

# Appendix F – *Sample* SWPPP Training Log

## Storm Water Pollution Prevention Training Log

Project Name:

Project Location:

Instructor's Name(s):

Instructor's Title(s):

Course Location: ________________________ Date: ______________

Course Length (hours): ____________________

Storm Water Training Topic: *(check as appropriate)*

☐ **Erosion Control BMPs** ☐ **Emergency Procedures**

☐ **Sediment Control BMPs** ☐ **Good Housekeeping BMPs**

☐ **Non-Storm Water BMPs**

Specific Training Objective:________________________________________

______________________________________________________

Attendee Roster: *(attach additional pages as necessary)*

| No. | Name of Attendee | Company |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |
| 7 | | |
| 8 | | |
| 9 | | |
| 10 | | |

# Appendix G: Additional Information

Use this appendix for additional information such as other permits (dewatering, stream alteration, etc.) or out of date SWPPP documents.

# Appendix H: BMP Instruction and Detail Specifications

Use this appendix if complete BMP specifications are not provided in Section 5 or 6 of the SWPPP.

# Appendix I: Construction General Permit

If all storm water team members access the CGP via the internet while on site the following link to access the Construction General Permit is sufficient:

http://construction.stormwater.utah.gov

Otherwise, include a printed out copy of the Construction General Permit in this appendix.

## C-5 Special Waste Handling & Off-Site Management

## Special Waste Handling & Off-Site Management

The numerous test pit explorations conducted on the site has confirmed that the majority of the waste deposited is MSW. A substantial fraction of the waste mass are scrap tires that will need to be separated from waste being relocated into the repository. We may encounter other less numerous non-MSW materials as the excavated proceeds.

The strategy for dealing with non-MSW materials will be to pre-position small lined, roll off containers at or near the area of waste excavation operation and to segregate those wastes in the following manner:

- Tires – for transport to Liberty Tire Recyclers
- White goods (or other large metallic items) for local scrap metal processor
- Unidentifiable or suspect materials for testing and evaluation
- Used drums and/or significant, non-leachate fluids (no free liquids will be deposited in the repository)

The Excavation will be overseen by Ninigret/ET/CARDNO professionals and a third-party observer. The third-party observer will be selected from local engineering firms with experience in solid waste and/or remediation projects. That person will be on-site during all excavation operations.

The observer's duties will be to identify items which are not characteristic to MSW and to see that those items are segregated from the waste stream destined for redeposition. The proposed segregation system will be to separate tires, white goods, and any very large mass items (i.e., sofa, engine block, etc.) into roll-off containers for alternate disposal or recycling. The observer would also oversee environmentally suspect materials (also to be segregated and tested) that could be encountered in the excavation.

The field chain of command would have the observer reporting to the field engineer and/or field superintendent regarding any concerning observations. The observer will be given the authority to intercede with the site contractor and stop work if the field management team are not present.

In any case of suspect material (i.e., a 55-gallon drum), the item will be segregated into a roll-off container and covered. The work area will be flagged, and the excavation sequence will advance forward 100 feet and resume. Areas in the trench will be examined and samples taken of suspect soil or perched groundwater for laboratory analysis. Determination of outcomes will depend on test results this area will remain "as-is" until testing data is made available. However, any free liquid associated with the discovery of suspect materials (not typical leachate) encountered would not be placed in the repository but instead would be transported off-site to the appropriate licensed disposal facility. The analytical results will be shared with DERR and a determination of risk will be made. If the material proves hazardous, provisions will be made to send the material to a RCRA TSD facility. If non-hazardous, the material will be placed in the repository.

## Asbestos Containing Material Removal and Relocation

The waste in the existing cells is believed to have been placed in the landfill between 1958 and 1978. It is possible that asbestos containing materials (ACM) were disposed of at this facility during that time. The types of ACM that could have been disposed of during the timeframe would generally be expected to be associated with demolition and construction debris such as pipe insulation, floor tiles, roofing shingles and other related construction materials. Prior to the initiation of the waste excavation efforts, a specific asbestos design document will be developed which will address federal, state and local asbestos rules and regulations. This design document will be developed by a state certified asbestos project designer, and subsequently approved by the UDEQ's Division of Air Quality, establishing the means and methodologies that will be utilized to minimize potential impacts from the interaction with asbestos containing material should such material be identified during the remediation efforts.

## C-6 Community Air Monitoring Plan

## Community Air Monitoring Plan

Despite the considerable degradation of the old MSW in the land fill, excavation of waste and extraction of leachate create opportunities for fugitive emissions, as compared to the current covered composition on-site.

In order to establish an understanding of existing (baseline) conditions at the Site, and prior to the initiation of any site remediation efforts, a site wide emission scan was conducted using remote sensing technology where small but detectable methane emissions were identified in certain locations of the landfill. The range of $CH_4$ detected was 20 ppm to 80 ppm. The total site area where emissions were detected comprised 0.17% of the total site area, and 0.06% of the site area emitted over 60 ppm. As a point of reference, The New Source Performance Standards (NSPS) threshold for methane emissions is 500 ppm.

Although the methane emissions identified in the Phase I area (in the above-mentioned site scan) were minimal, an additional aerial drone scan will be undertaken during waste removal operations as well as after the excavated trenches are backfilled.

### Air/Odor/Emission Monitoring

As referenced in several sections of the plan, various types of air and vapor monitoring will be used in the active remediation phase.

- Emission monitoring at point of excavation. Using hand-held PID monitoring, site personnel will be at trench-side monitoring for off gassing of vapor/LFG emissions.
- Emission monitoring at repository. The same procedure as above will take place at the point of waste placement.
- Leachate pond/evaporation. Periodically, emissions will be monitored at the pond and evaporator.
- Odor/emission monitoring at sensitive perimeter receptors. The PID and the field olfactometer will be used together (to objectively characterize odor reading with PID readings) at both trench excavation and along the sensitive receptors at the north, east, and south property boundaries.
- Aerial drone scans to measure LFG emissions will be performed at the mid-point of the remediation and at the end when the landfill cap is complete.

The readings will be documented in the daily/weekly reports. The excavator operator and attending personnel will have PPE available if the PID readings support additional protective action. The odor control plan is shown below in **Figure 27**.

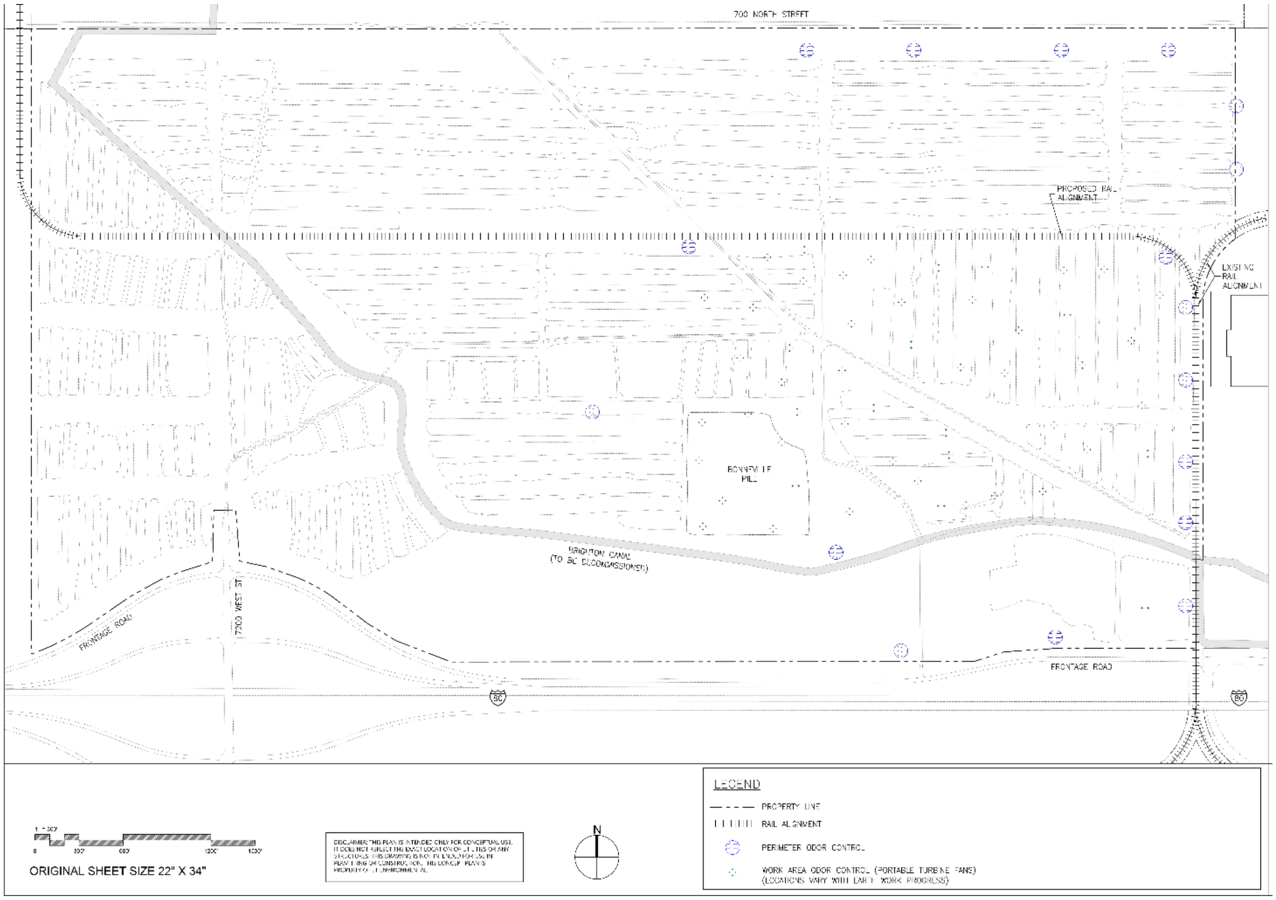

*Figure 27 – Odor Control Plan (See also Appendix A-27)*

During the site characterization phase, an aerial drone with remote sensing technology for methane detection was used to establish pre-RAP background emission data. The results were included in the 2021 Phase I SI and only one area in the SW corner of the site (beyond Phase I) has noticeable emission (80ppm). We intend to rescan the site during the excavation phase, and we will adjust the flight schedule to correspond to the excavation operation in the North part of Phase I and the reclamation of the Bonneville pile, which should approximately be at the 60-day milestone following contractor mobilization. The drone will also re-scan after the excavation efforts have been completed and the waste has been relocated in the repository.

The emission data collected in the Phase I RAP (PID, aerial drone, field olfactometry) will be analyzed to provide future vapor intrusion risk indication for the future phases of remediation. The vapor intrusion barriers would consist of gravel zones for vapor collection, overlain by HDPE membranes beneath foundation and floor slabs with active vapor collection, piping and filtration.

# APPENDIX D – Quality Assurance & Other Documents

## D-1 Geosynthetic Clay Layer Quality Assurance

# GCL QUALITY ASSURANCE SUMMARY

This summary outlines the Geosynthetic Clay Liner (GCL) Construction Quality Assurance (CQA) for handling, deployment, placement of cover material, and testing of the liner. An official CQA manual will be written upon approval of the Remedial Action Plan.

## Material Delivery & Storage:

Any damage to the GCL during off-loading and storage will be documented. The GCL will be stored in a prepared location protected from excessive heat, puncture, water flow or accumulation or any other potentially damaging conditions. The storage location will have a prepared surface which is level, dry, and well-drained and the GCL will not be stacked more than 3 to 4 rolls high.

## Liner Deployment

When deploying the GCL, heavy equipment should be used with a spreader bar to support the liner roll. When cutting the GCL to fit in a confined space, a sharp utility knife should be used to avoid tearing the liner. For installation, wet weather conditions should be avoided. In the case the GCL has been prematurely hydrated (hydrated without confining pressure), the manufacturer should be contacted to assess whether the liner should be replaced. The GCL should be installed without stretching or stress on the liner, in a relaxed state, but not wrinkled. The anchor trench should have rounded edges to avoid excess stress on the liner. When unrolling the liner, care should be taken to avoid damage from friction as the liner drags across the ground. If there is a potential for damage due to friction on the ground, the liner panel can be unrolled on top of an already installed liner panel, then dragged horizontally into place. Panels will be placed with the long dimension parallel with the maximum slope and should only be placed otherwise if the slope is less than 4:1 or when the slope length is less than 10 ft.

### Seaming

The liner overlap zone should not contain any dirt when the continuous Bentonite bead is poured. Using a sand pouring vessel such as a watering can (without the sprinkler head) is more effective than pouring from the bag to achieve a continuous bentonite bead. A CQA engineer will give verbal approval of the seam upon visual inspection before the edge of the panel is flipped into place. The acceptable overlap is from 0.5 ft to 0.8 ft. The target rate of bentonite application is 0.25 lbs per ft. 1 ft - 2 ft or greater overlap is recommended for the transverse sides (the ends of the roll) of the liner to prevent any loss due to liner relaxation after placement. Even greater overlap is recommended for a GCL being covered only with a geomembrane.

### Repairs

To Repair installed liner which has been damaged:

1. Manually remove and clean cover material from within a 2 ft radius around the damaged area, using a broom to clean as thoroughly as possible.
2. Pour a bead of bentonite clay around the damaged area at a rate of 0.5 lbs per linear ft around the damaged area.
3. Cut a patch of new GCL and install it over the damaged area with at least 2 ft extending beyond the damaged area in all directions and carefully backfill over the patch.

## Placement of Cover Materials

Since the GCL is fragile to heavy traffic, it is recommended to only install it once the cover material is on hand to be installed on top of the liner. If there is an area where the GCL has been installed already and there must be heavy traffic in that area, a layer, 2 ft to 3 ft thick of screened cohesive soil cover should be applied over the liner for protection.

Cover material should be free of any large stones (greater than 3/8”), sticks, and other potentially damaging materials. Cover should never be dropped from a loader bucket high above the GCL, but instead placed on the GCL from as low as possible. It is recommended that no heavy equipment come in direct contact with the GCL and any tracked equipment as well because it will damage the liner if driven directly on the GCL.

## Conformance Testing

Below are examples of conformance tests which verify whether the GCL meets specified requirements.

Bentonite Mass Per Unit Area - ASTM D 5993

Bentonite Swell Index and Fluid Loss - ASTM D 5890

[These methods and others will be described in the official GCL CQA upon RAP approval]

## D-2 LLDPE Geomembrane Liner Quality Assurance

# LLDPE GEOMEMBRANE LINER QUALITY ASSURANCE SUMMARY

This summary outlines the 40 mil LLDPE Geomembrane Liner (GL) Construction Quality Assurance (CQA) for liner deployment, seam testing, repairs, and inspection. An official CQA plan will be written upon approval of the Remedial Action Plan and prior to onset of liner construction.

## Material Delivery & Storage:

The GL will be stored in a prepared location protected from excessive heat, puncture, or any other potentially damaging conditions. The storage location will have a prepared surface, not wooden pallets, and the geomembrane will not be stacked more than 3 rolls high.

## Earthwork

The subgrade will be free of any abrupt breaks in grade, sharp objects, or organic material. The earthwork will be firmly compacted, providing an unyielding foundation for the GL.

## Liner Deployment

1. Personnel working on the GL will not be permitted to smoke or wear damaging footwear or engage in any other activity that could potentially damage the liner.
2. The Liner will be loaded down with adequate weights such as sandbags to prevent any movement from wind uplift.
3. Tools and equipment will be used properly to prevent any damage from trafficking or other means.
4. Unrolling and handling of the liner will be conducted in such a way to prevent any crimping, scoring, or damage to the membrane.
5. Deployment will proceed in weather conditions with temperatures between 40°F and 122°F, no precipitation or moisture (fog or dew), or in the presence of excessive winds.

### Seams

Seams will be oriented parallel to maximum slope (down, not across slopes) and no T-seams will be located closer than 5 feet from the toe of the slope. There will be enough overlap at seams for peel testing to be performed.

Welding Methods will include Hot Wedge Welding, Extrusion Fillet Welding and these methods will be described in the CQA manual.

## Field Testing Procedures

### Seam Testing

There will be 1 destructive test sample taken per 500 LF of seam. Each hole created from sample collection will be immediately repaired and vacuum tested. Each sample will be 12 inches wide by 42 inches long, with the seam centered lengthwise.

Tests will be conducted at the beginning of each seaming period and at least once every 4 hours, per unit of seaming equipment used that day. If a test fails, the seaming equipment used will be decommissioned until the unit is repaired and successful seams are produced.

Test Failure

When a sample fails a destructive field test, the seam will be reconstructed between the failed location and any passed location, at least 10 feet away. A test can be conducted 10 feet away from the failed location to acquire a passed location. Over the length of the seam failure, the old seam will be cut out and repaired with an approved method.

### Defects and Repairs

All areas of the membrane will be examined for penetrations, defects, holes, and blisters. The surface of the membrane will be clean during inspection and the inspection will be conducted in normal daylight.

1. Holes smaller than ¼ inch will be repaired via extrusion cap welding. Holes larger than ¼ inch, as well as blisters, will be repaired via patching.
2. Tears will be repaired with patching. If a tear is in an area of particular stress such as on a slope, the ends of the tear will be rounded to prevent tear propagation prior to patching.
3. Patches will be rounded in shape, made of the same material and thickness as the GL, and will extend 6 inches beyond the edge of the defect. Patches will be applied using the extrusion welding method.

### Cover Soil Placement

Extreme caution will be taken to ensure the liner is not damaged by equipment: slow speeds (5 mph limit), no sudden starts or stops, or changes of direction. Soil will be placed on side slopes from bottom to top.

### Penetrations

Any penetrations for piping or anchors will have compatible seals with reasonable access for liner welding equipment. Each seal will be inspected for integrity and isolated from seasonal expansion and contraction of the liner.

### Final GL Acceptance

The Geomembrane will be accepted when the following conditions are met; installation is complete, and verification of all field seams, repairs, and testing is complete.

## D-3 Public Notice Form

# PUBLIC NOTICE
# UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY
# VOLUNTARY CLEANUP PROGRAM

The Utah State Institutional Trust Lands Administration (SITLA) is seeking public comment on a Remedial Action Plan detailing the cleanup of a portion of the former North Temple Landfill, also known as Airport West, located at approximately 6500 West North Temple Frontage Road. The cleanup incorporates the removal of municipal solid waste from an approximate 175-acre area (identified as Phase I) which will be consolidated into a new on-site repository. Long-term monitoring will be conducted to ensure the protectiveness of the remedy for the future commercial/industrial land use planned for this site. The Phase I area is situated between 700 North and the North Temple Frontage Road within the southeast corner of the landfill.

A 30-day public comment period to receive comments on the Remedial Action Plan under the Utah Department of Environmental Quality's Voluntary Cleanup Program (VCP) will commence on August 10, 2022, and end at 5 p.m. on September 09, 2022.

A copy of the Remedial Action Plan, titled Airport West VCP Remedial Action Plan, can be reviewed at the Division of Environmental Response and Remediation Public Notices website at: https://deq.utah.gov/environmental-response-and-remediation/public-notices-utah-division-of-environmental-response-and-remediation

In addition, the RAP prepared for this site is available on-line at http://eqedocs.utah.gov/ using the search phrase "Airport West VCP". It is also available on the Utah State Institutional Trust Lands Administration website at https://trustlands.utah.gov/?p=74

Written comments will be accepted until 5:00 p.m. on September 09, 2022. Written comments should be directed to the following person and address:

David Bird, Project Manager
Division of Environmental Response and Remediation
Department of Environmental Quality
P.O. Box 144840
195 North 1950 West
Salt Lake City, UT 84114-4840
(801) 536-4100

Comments can also be submitted electronically by email to: dgbird@utah.gov.

In compliance with the Americans with Disabilities Act, individuals with special needs (including auxiliary communicative aids and services) should contact Larene Wyss, Office of Human Resources at (801) 503-5618, Telecommunications Relay Service 711, or by email at lwyss@utah.gov.