ConocoPhillips
Alaska's Oil & Gas Company

2018

WILLOW MARINE MONITORING PROGRAM REPORT

Prepared by:
KINNETIC LABORATORIES INCORPORATED

November 2018

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FINAL REPORT

2018 WILLOW MARINE MONITORING PROGRAM

November 2018

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ACRONYMS AND ABBREVIATIONS

1-D	Simpson's measure of evenness (complement of Simpson's Index)
°	Degrees
#/m^2	Density per m^2
%	Percent
% Fines	Percent fines (silt + clay)
% Rec	Percent recovery
µg/kg	Micrograms per kilogram
µg/mL	Micrograms per milliliter
µm	Micron
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
AggHC	Agglomerative hierarchical clustering
AHC/AHCs	Aliphatic hydrocarbons
AK LNG	Alaska LNG Project
ANIMIDA	Arctic Nearshore Impact Monitoring in the Development Area
APDES	Alaska Pollutant Discharge Elimination System
APHA	American Public Health Association
APP	Alaska Pipeline Project
ARC	Archival samples
ASTM	American Society for Testing and Materials
B&BL	B&B Laboratories
BC	Bray-Curtis dissimilarity index
BOEM	Bureau of Ocean Energy Management
BSMP	Beaufort Sea Monitoring Program
C	Celsius
C2D/C2P	C2-Dibenzothiophene/C2-Phenanthrene-Anthracene
C3D/C3P	C3-Dibenzothiophene/C3-Phenanthrene-Anthracene
C-T-AAS	Combustion-trapping-atomic absorption spectroscopy
cANIMIDA	Continuation of ANIMIDA
CCB	Calibration check blanks
CCV	Continuing calibration verification
cf.	Comparable to (Latin, *confer/conferatur)*
cm	Centimeter(s)
COC	Chain of custody
CPAI	Conoco Phillips Alaska Inc.
CRM	Certified reference material
CV	Coefficient of variation
CTD	Conductivity, temperature, and depth recorder
CVAAS	Cold vapor atomic absorption spectrometry
D	Simpson's Index (Dominance)
DGPS	Differential global positioning system
DMMP	Dredged Material Management Program
DO	Dissolved oxygen
DOT	U.S. Department of Transportation
DQO	Data quality objective
DUP	Duplicate
EIS	Environmental impact statement
EMAP	Environmental Monitoring and Assessment Program
EOM	Extractable organic matter
EPA	United States Environmental Protection Agency
ERL	Effects range low
ERM	Effects range median
FAAS	Flame atomic absorption spectrometry
FID	Flame ionization detection
ft	Feet (or foot)
g	Gram(s)
GC	Gas chromatography
GC/FID	Gas chromatography/flame ionization detection
GC/MS	Gas chromatography/mass spectrometry
GIS	Geographic Information System

GPS	Global positioning system
H	Shannon Diversity Index
HDPE	High density polyethylene
hr	Hour(s)
IATA	International Ait Transport Association
ICP-MS	Inductively coupled plasma-mass spectrometry
ICP-OES	Inductively coupled plasma-optical emission spectroscopy
KLI	Kinnetic Laboratories, Inc.
km	Kilometer(s)
L	Liter(s)
LCS/LCSD	Laboratory control spike/laboratory control spike duplicate
LSR	Local subsistence representative
m^2	Meters squared
m	Meter(s)
MB	Method blank
mL	Milliliter(s)
mm	Millimeter(s)
MDL	Method detection limit
mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter
MMP	2018 Willow Marine Monitoring Program
MRL	Method reporting limit
MS	Mass spectrometry
MS/MSD	Matrix spike/matrix spike duplicate
MTI	Module transfer island
n	Number of individuals
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NS&T	National Status and Trends
NTU	Nephelometric turbidity units
OBS	Optical backscatter
OEPI	Odd-even preference index
PAH/PAHs	Polycyclic aromatic hydrocarbons
PAM	PAH, AHC. and metals samples
PCBs	Polychlorinated biphenyls
PGS	Particle grain size
PSEP	Puget Sound Estuary Program
psu	Practical salinity units
QA	Quality assurance
QA/QC	Quality assurance/quality control
QC	Quality control
R^2	Coefficient of determination (“R squared”)
RF	Response factor
RPD	Relative percent difference
RRF	Relative response factor
S	Species richness
S/T	Steranes and triterpanes
SAP	Sampling and Analysis Plan
SD	Standard deviation
SE	Standard error
SIM	Selective ion monitoring
SL	Screening level
SM	Standard Methods
SOP	Standard operating procedure
sp. or spp.	Species (unidentified)
SQG	Sediment quality guideline
SRM	Standard reference material
SW	Solid waste
TAHC	Total aliphatic hydrocarbons
TC	Total carbon
TDI-BI	TDI Brooks, Inc.
TERL	Trace Environmental Research Lab (Texas A&M University)
TOC	Total organic carbon
TPAH	Total PAH

TPAH^{16P}	Subset of 16 PAHs on EPA's priority pollutant list
TPH	Total petroleum hydrocarbons
TRHC	Total resolved hydrocarbons
TS	Total solids, in percent
TSS	Total suspended solids
TTT	TOC/TVS/TS samples
TVS	Total volatile solids
UCM	Unresolved complex mixture
UI	Unidentified
Unid.	Unidentified
UPGA	Unweighted pair-group average
US	United States
USACE	U.S. Army Corps of Engineers
WAAS	Wide area augmentation system
WGS	World geodetic system
WMG	Wide-mouth glass
wt.	Weight
x	Multiplied by (or times)

1.0 INTRODUCTION

1.1 PROGRAM DESCRIPTION

ConocoPhillips Alaska, Inc. (CPAI) is in the process of planning the marine components of the Willow Development Project located near Atigaru Point along the western shore of Harrison Bay. The 2018 Willow Marine Monitoring Program (MMP) performed by Kinnetic Laboratories, Inc. (KLI) was designed to 1) support the preparation of an environmental impact statement (EIS) and 2) provide information required for any other marine permitting that might be required (e.g., United States Army Corps of Engineers {USACE} or Alaska Pollutant Discharge Elimination System {APDES} permits).

1.2 PROGRAM OBJECTIVES

The Willow MMP was intended to support the preparation of the EIS by providing baseline marine monitoring data from Harrison Bay for the following parameters:

- Sediment quality data – sediment characterization including conventional parameters and some contaminant analyses (metals and hydrocarbons);
- Biological data – benthic infauna and epibenthic organism collection and analyses; and
- Water quality data – water column profiling and total suspended solids/turbidity analyses.

The overall objective of the program was to obtain representative chemical, physical, and biological data for the proposed development area to characterize the existing environment. Chemical parameters chosen for analysis focused on potential oil industry-related contaminants (e.g., hydrocarbons and metals); pesticides, polychlorinated biphenyls (PCBs), and other environmental contaminants not typically associated with oil development that were not expected to be elevated in the study area were not included. Physical parameters included particle grain size (PGS) and other conventional parameters as called for by the *Dredged Material Evaluation and Disposal Procedures – User Manual* (USACE 2016) for the Seattle District. Program components are more fully described in the sections below.

2.0 PROGRAM DESIGN

Collection of sediment, benthos, and water samples was performed during open-water conditions in August 2018 using the R/V *Ukpik* at select stations in Harrison Bay. Sediment was subsampled for the different parameters as required at each station, including the conventional parameters of PGS, total organic carbon (TOC), total volatile solids (TVS), and Total Solids (TS) along with benthic infaunal collection at each of 12 sediment stations. Sediments were also collected for analysis of total metals and hydrocarbons at six prioritized stations. Trawling to collect epibenthic and demersal fish and other organisms was also performed at 13 locations near the sediment sites. In addition to the 12 sediment stations, hydrographic conductivity, temperature, and depth (CTD) profiling was performed at 43 locations over a wider area of Harrison Bay to reflect the local oceanographic conditions, and water samples were collected at 20 of those stations for analysis of total suspended solids (TSS) and turbidity.

2.1 SAMPLING LOCATIONS

Twelve sediment sampling stations (denoted by "S" followed by a number; Table 2-1 and Figure 2-1) were pre-selected based on the proposed location of the module transfer island (MTI) to be constructed in the southwestern portion of Harrison Bay, approximately 1.7 miles off Atigaru Point in a water depth of approximately 8 to 10 feet (ft; 2.4-3 meters {m}). Sediment station selections were located along three transects based on bathymetry data of the area, including the 2018 bathymetric survey data results, and adjusted in the field according to the survey vessel's fathometer readings, with the intention of obtaining data from sampling depths ranging from about 6 to 23 ft (2-7 m). Sediment Station S3 was located at the proposed MTI site which was on the middle transect. These sediment stations were used as the basis for the overall sampling design and included trawling and water quality sampling, as described further below.

Table 2-1. Willow MMP Sediment Station Information.

Station Information						Type of Sample Collection			
Station	Date	Depth		Latitude	Longitude	PGS/TOC/ TVS/TS	PAH/AHC/ Metals	Infauna	CTD
		ft	m						
S1	8/6/18	6.9	2.1	70 34.142	-151 46.683	✓		✓	✓
S2	8/6/18	10.4	3.2	70 35.399	-151 45.880	✓	✓	✓	✓
S3	8/6/18	10.4	3.2	70 36.396	-151 45.302	✓	✓	✓	✓
S4	8/6/18	12.5	3.8	70 37.396	-151 44.550	✓	✓	✓	✓
S5	8/6/18	16.3	5.0	70 38.471	-151 44.049	✓		✓	✓
S6	8/6/18	22.9	7.0	70 39.989	-151 43.116	✓	✓	✓	✓
S7	8/6/18	9.4	2.9	70 35.642	-151 51.418	✓		✓	✓
S8	8/6/18	8.5	2.6	70 37.008	-151 50.776	✓	✓	✓	✓
S9	8/6/18	9.4	2.9	70 37.991	-151 50.258	✓		✓	✓
S10	8/6/18	6.3	1.9	70 33.546	-151 41.940	✓		✓	✓
S11	8/6/18	11.0	3.4	70 34.552	-151 40.989	✓	✓	✓	✓
S12	8/6/18	16.5	5.0	70 36.145	-151 39.348	✓		✓	✓

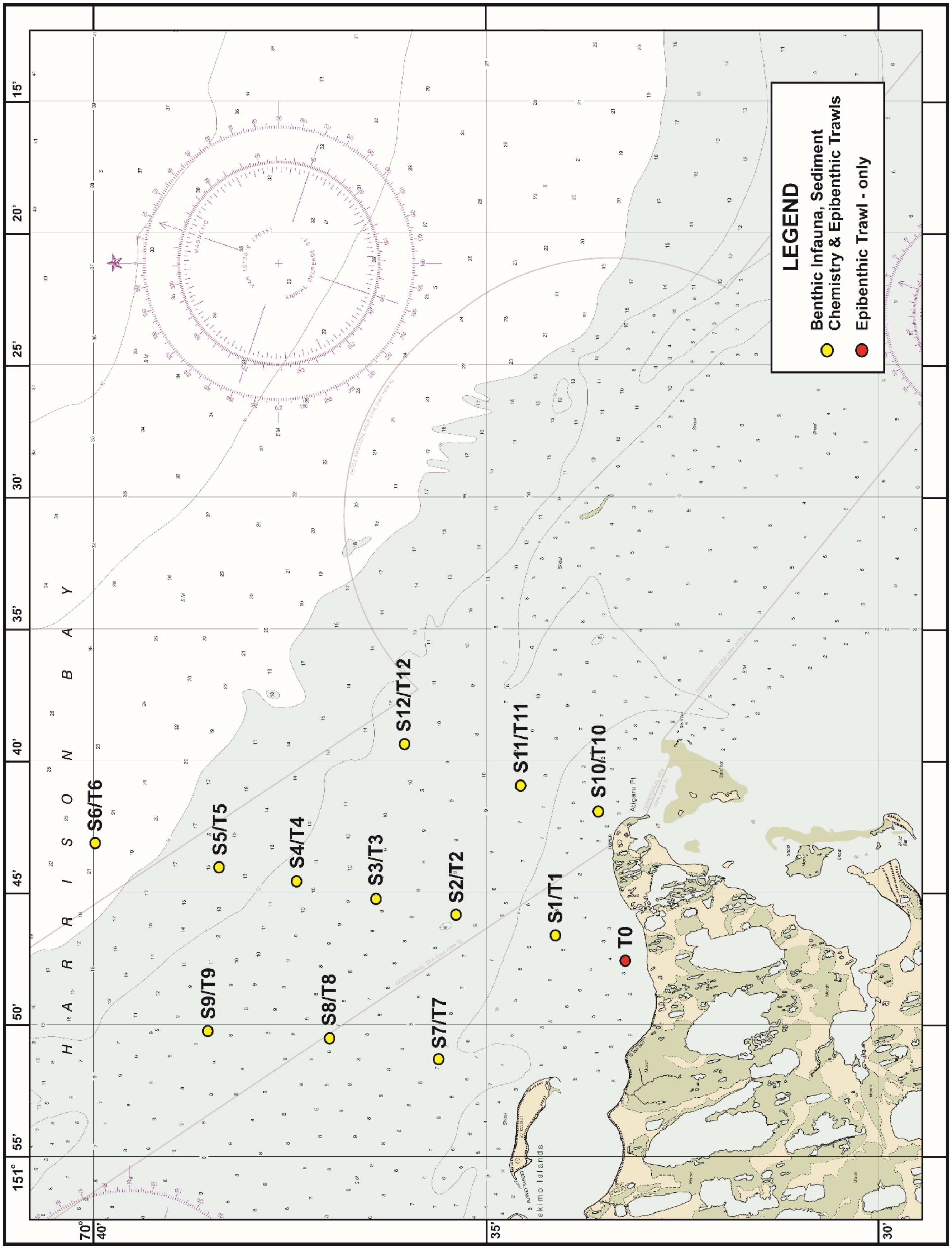


Figure 2-1. Willow MMP Sediment and Trawl Sampling Sites.

Trawling was performed at trawl stations (designated “T” and corresponding numerically to the sediment “S” stations) located in the vicinity of each of the 12 sediment stations as well as at one additional shallow station (T0) inshore of the MTI middle transect (Table 2-2 and as shown in Figure 2-1). Water quality stations as shown in Figure 2-2 (denoted with “W” and a sequential number) and provided in Table 2-3 were located along transects in a wider area to provide synoptic measurements throughout Harrison Bay rather than being confined to the potential construction area.

Table 2-2. Trawl Station Information.

Station	Date	Start				End		
		Depth		Latitude	Longitude	Latitude	Longitude	Trawl Distance (m)
		ft	m					
T0	8/8/18	5.1	1.6	70 33.267	-151 47.601	70 33.696	-151 47.137	848
T1	8/7/18	7.0	2.1	70 34.157	-151 46.274	70 34.110	-151 47.570	807
T2	8/7/18	10.0	3.0	70 35.393	-151 46.155	70 35.387	-151 44.556	989
T3	8/7/18	9.8	3.0	70 36.298	-151 44.842	70 36.535	-151 46.003	842
T3-2	8/7/18	9.6	2.9	70 36.529	-151 46.082	70 36.244	-151 44.669	1021
T4	8/7/18	12.1	3.7	70 37.267	-151 44.131	70 37.557	-151 45.284	893
T5	8/8/18	16.2	4.9	70 38.587	-151 44.412	70 38.393	-151 43.160	852
T6	8/8/18	22.5	6.9	70 39.829	-151 42.644	70 40.265	-151 43.472	958
T7	8/8/18	9.7	3.0	70 35.624	-151 52.138	70 35.647	-151 50.597	954
T8	8/8/18	8.3	2.5	70 36.927	-151 50.008	70 37.076	-151 51.432	922
T9	8/8/18	9.4	2.9	70 38.188	-151 50.887	70 37.889	-151 49.894	827
T10	8/8/18	6.5	2.0	70 33.361	-151 41.444	70 33.685	-151 42.273	792
T11	8/8/18	11.3	3.4	70 34.443	-151 40.277	70 34.595	-151 41.533	827
T12	8/8/18	15.0	4.6	70 36.255	-151 40.122	70 36.098	-151 38.824	854

2.2 SEDIMENT SAMPLING AND ANALYSIS

Sediment characterization and chemistry samples that were collected and analyzed for the Willow MMP included the following:

- Conventional parameters (all 12 sediment stations):
    - PGS;
    - TOC; and
    - TVS.
- Chemical parameters (six sediment stations: S2, S3, S4, S6, S8, and S11):
    - Total metals (aluminum, antimony, arsenic, barium, cadmium, chromium, copper, iron, lead, mercury, nickel, selenium, silver, vanadium, and zinc);
    - Aliphatic hydrocarbons (AHC); and
    - Polycyclic aromatic hydrocarbons (PAH) and select biomarkers.

Table 2-1 indicates which stations were targeted for each type of analysis. All sediment sampling and analyses followed accepted protocols and techniques (e.g., Puget Sound Estuary Program {PSEP}, National Status and Trends, or U.S. Environmental Protection Agency {EPA} methods) as appropriate. For example, low level hydrocarbons in sediments were analyzed as described in proprietary laboratory standard operating procedures (SOPs) using essentially the same methods that have been successfully used for the National Oceanic and Atmospheric Administration’s (NOAA’s) Mussel Watch and National Status and Trends (NS&T) Programs, other Environmental Monitoring and Assessment Program (EMAP)

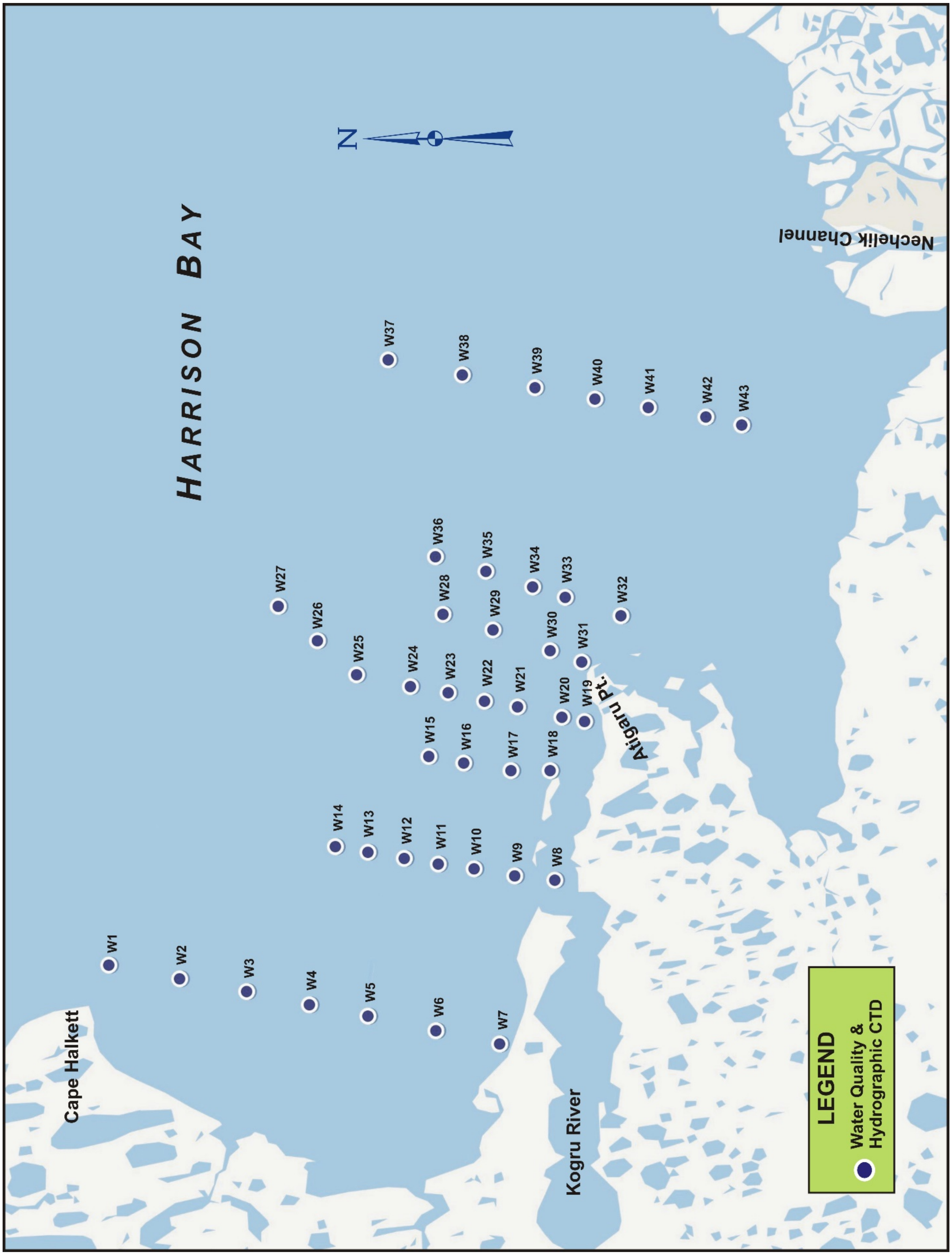


Figure 2-2. Willow MMP Water Quality and Oceanographic Sampling Sites.

Table 2-3. Water Quality and Oceanographic Station Information.

Station Information						Type of Sample Collection		
Station	Date	Depth		Latitude	Longitude	CTD	TSS	Turbidity
		ft	m					
W1	8/8/18	18.3	5.6	70 34.142	-151 46.683	✓	✓	✓
W2	8/8/18	12.0	3.7	70 35.399	-151 45.880	✓		
W3	8/8/18	8.9	2.7	70 36.396	-151 45.302	✓	✓	✓
W4	8/8/18	7.5	2.3	70 37.396	-151 44.550	✓		
W5	8/8/18	7.0	2.1	70 38.471	-151 44.049	✓	✓	✓
W6	8/8/18	6.2	1.9	70 39.989	-151 43.116	✓		
W7	8/8/18	7.7	2.3	70 35.642	-151 51.418	✓	✓	✓
W8	8/9/18	4.9	1.5	70 37.008	-151 50.776	✓	✓	✓
W9	8/9/18	7.9	2.4	70 37.991	-151 50.258	✓		
W10	8/9/18	8.5	2.6	70 33.546	-151 41.940	✓	✓	✓
W11	8/9/18	8.9	2.7	70 34.552	-151 40.989	✓		
W12	8/9/18	9.5	2.9	70 36.145	-151 39.348	✓	✓	✓
W13	8/9/18	9.8	3.0	70 39.765	-151 58.526	✓		
W14	8/9/18	4.9	1.5	70 40.702	-151 58.030	✓		
W15	8/9/18	9.8	3.0	70 37.994	-151 50.155	✓		
W16	8/9/18	8.9	2.7	70 36.983	-151 50.741	✓	✓	✓
W17	8/9/18	9.5	2.9	70 35.625	-151 51.380	✓		
W18	8/9/18	7.9	2.5	70 34.480	-151 51.407	✓	✓	✓
W19	8/9/18	5.6	1.7	70 33.490	-151 47.091	✓	✓	✓
W20	8/9/18	7.2	2.2	70 34.148	-151 46.729	✓	✓	✓
W21	8/9/18	10.5	3.2	70 35.434	-151 45.819	✓	✓	✓
W22	8/9/18	10.2	3.1	70 36.394	-151 45.335	✓	✓	✓
W23	8/9/18	12.8	3.9	70 37.437	-151 44.600	✓	✓	✓
W24	8/9/18	16.7	5.1	70 38.539	-151 44.045	✓		
W25	8/9/18	23.3	7.1	70 40.087	-151 43.043	✓		
W26	8/9/18	28.2	8.6	70 41.214	-151 40.047	✓		
W27	8/9/18	34.8	10.6	70 42.352	-151 37.063	✓		
W28	8/9/18	20.3	6.2	70 37.588	-151 37.753	✓		
W29	8/9/18	15.4	4.7	70 36.136	-151 39.095	✓	✓	✓
W30	8/9/18	11.2	3.4	70 34.490	-151 40.934	✓	✓	✓
W31	8/9/18	6.6	2.0	70 33.567	-151 41.915	✓	✓	✓
W32	8/9/18	7.0	2.1	70 32.432	-151 37.872	✓	✓	✓
W33	8/9/18	9.4	2.9	70 34.041	-151 36.253	✓	✓	✓
W34	8/9/18	15.7	4.8	70 34.996	-151 35.376	✓		
W35	8/9/18	19.5	5.9	70 36.351	-151 34.018	✓		
W36	8/9/18	26.2	8.0	70 37.803	-151 32.723	✓		
W37	8/9/18	40.8	12.4	70 39.177	-151 15.538	✓		
W38	8/9/18	34.7	10.6	70 37.031	-151 16.881	✓		
W39	8/9/18	26.8	8.2	70 34.926	-151 17.956	✓		
W40	8/9/18	20.0	6.1	70 33.186	-151 18.980	✓		
W41	8/9/18	13.0	4.0	70 31.630	-151 19.726	✓		
W42	8/9/18	6.8	2.1	70 29.961	-151 20.537	✓		
W43	8/9/18	5.6	1.7	70 28.905	-151 21.237	✓	✓	✓

studies, the Bureau of Ocean Energy Management's (BOEM's) Arctic Nearshore Impact Monitoring in the Development Area (ANIMIDA) and Beaufort Sea Monitoring Programs (BSMP), and other nationally recognized programs. Sampling and analytical methods are further described in the Sections 3.0 and 4.0 below.

A single sample of each sediment and benthic infauna sample type was targeted for collection at each station; no replication was included in the program as it was designed to provide an overview of sediment characteristics in the study area. Field duplicate quality control (QC) samples were collected for all chemical and conventional sediment parameters from the same grab at one station during the field survey.

2.3 BIOLOGICAL SAMPLING

Biological samples that were collected and analyzed for the MMP included the following:

- Benthic infauna – all 12 sediment stations; sediment grabs were processed through a 1.0-millimeter (mm) sieve, sorted, and identified to the lowest practicable taxon; and
- Fish and epifauna trawling – 14 otter trawls were performed in total, 13 in the vicinity of the 12 sediment stations (with a replicate trawl at the MTI location, T3) and at one additional inshore shallow station (T0).

All biological sampling and analysis followed accepted methods as described in Sections 3.0 and 4.3. Sorting of samples to remove the infauna from the substrate was performed by KLI personnel in Santa Cruz, CA. Biological specimens were identified to the lowest practicable taxonomic grouping. Infaunal crustaceans were identified by Gary Gillingham of KLI; other infaunal groups were referred to outside taxonomists for identification (see Section 4.3). Trawl specimens were largely identified in the field; any trawl specimens that were retained were identified in the laboratory.

2.4 OCEANOGRAPHY AND WATER QUALITY

Water measurements included hydrographic profiling using a conductivity, temperature, and depth (CTD) profiler to characterize the vertical structure of the water column along with collection of turbidity and TSS samples, as these latter parameters are those that would most likely be affected by construction activities. Oceanographic and water quality data that were collected and analyzed for the MMP included the following:

- Hydrographic profiles – 56 vertical profiles (+ QC) of pressure (depth), temperature, conductivity (salinity), pH, dissolved oxygen (DO), and optical backscatter (OBS) turbidity; and
- TSS and nephelometric turbidity samples – 20 stations x 2 depths/station (+ QC).

Hydrographic CTD casts were collected at all water quality stations (as well as the sediment stations). Water samples for the analysis of TSS and turbidity were collected from the surface and bottom at 20 of the water quality stations. All water sampling and analyses followed accepted protocols and techniques as described in Sections 3.3 and 4.2.

3.0 FIELD METHODS

This section provides an overview of the field methods used for the MMP. Original program methods were outlined in the program's *Draft Sampling and Analysis Plan* (SAP, dated 7/18/2018); station locations and some methods were subject to modification just prior to performance of the field effort.

All field sampling was performed using a chartered 50-foot work vessel, the *R/V Ukpik*. Benthic infauna and trawling was performed as permitted by a State of Alaska Department of Fish and Game (ADF&G) Aquatic Resource Permit CF-18-102 obtained by KLI for this MMP. In addition to the survey boat captain and scientific crew, a Local Subsistence Representative (LSR) from Nuiqsut, Bryan Nukapigak, was aboard to observe sampling, watch for protected species such as marine mammals and other species of concern, and represent local interests regarding Harrison Bay and subsistence use of the area.

3.1 SEDIMENT CHEMISTRY AND BENTHIC INFAUNA SAMPLING

Sediment samples for conventional parameters, chemistry, and benthic infaunal analyses were collected using a 0.1-meter squared (m^2) stainless steel/Kynar coated van Veen grab sampler. Van Veen grabs were considered acceptable for sampling if the following parameters were met:

- The sampler was not overfilled;
- Overlying water was present;
- The sediment surface appeared to be relatively undisturbed; and
- The desired target sample depth had been achieved.

Unacceptable grabs were rejected. Once a grab was deemed acceptable, sediment was subsampled for conventional parameters and chemistry (at select stations) or benthic biology, as described below. Two drops of the grab were required at each station to obtain all samples; i.e., physical and chemical parameters were sampled from one grab, and benthic infauna from another collected at the same station.

Samples were collected for conventional sediment parameters, chemistry, and an archival sample (for potential later analysis) by removing sediment representing the top two centimeters (cm) from each acceptable grab. These subsamples were removed from the grab with a decontaminated utensil (see Section 3.4) without including material in contact with the grab surfaces. Sediment was placed in a decontaminated stainless steel mixing bowl for homogenization prior to subsampling for the various analytical parameters. Subsamples were placed in pre-labeled sample containers and immediately chilled on deck. The vessel's engine was shut down whenever possible so that chemistry samples could be collected and processed in an area that was free of vessel exhaust. Clean nitrile gloves were worn during sampling to prevent any contamination of the samples.

For benthic infauna, the full sediment depth within half of the grab was collected; a standard surface area of collection was maintained as required for benthic infauna. Sediment designated for infaunal collection was initially stored in internally and externally labelled 5-gallon buckets with seawater; these were later processed through a 1-mm sieve to collect macrofauna. Retained material was placed in pre-labeled plastic sample jars, dosed with propylene phenoxetol to relax the infauna (to facilitate identification), and preserved in a 10 percent (%) buffered formalin/seawater solution.

Duplicate sediment samples for conventional parameters and chemistry were collected from within the same grab at the S3 (MTI) station for QC purposes. Due to the inherent variability of benthic infauna, no field duplication or other field QC collection was required or appropriate as it was determined that replication was unnecessary for characterizing the general area in the vicinity of the proposed MTI.

3.2 TRAWL SAMPLING

An 8-ft (2.5-m) otter trawl was used to collect demersal fish and epibenthic macrofauna. Trawl samples were collected in 10-minute tows parallel to site bathymetry at a speed of approximately 3 knots (~925 m in length). Global positioning system (GPS) coordinates were recorded as the net initially contacted the bottom and at the end of the tow when the net was hauled back.

Once the net was retrieved at the completion of each trawl, the catch was released into an appropriately sized bucket or tote, sorted, and the biota identified and enumerated. All fish and most invertebrates were identified in the field and released unharmed whenever possible, while representative samples of smaller invertebrates were preserved in buffered 10% formalin and returned to the laboratory for taxonomic confirmation and identification. All fish were measured for fork length prior to release. Fish references used for field identifications included Johnson et al. (2015) and Mecklenburg et al. (2002).

Trawl catch was standardized to catch per 100-m^2 of bottom fished, assuming the width of the trawl while fishing was 2.5 m and calculating the length of the trawl track assuming a straight path between the trawl start and end GPS coordinates. No QC samples were collected in association with trawling, although voucher specimens were retained (as allowed by the collection permit) as necessary.

3.3 HYDROGRAPHIC AND WATER QUALITY SAMPLING

Hydrographic profiles were obtained along seven transects located perpendicular to the local bathymetry using a high-precision SeaBird SBE-19plus V2 SeaCAT CTD equipped with pressure (depth), conductivity (salinity), temperature, pH, DO, and optical backscatter (OBS, another measure of turbidity) sensors. Electronic probe measurements are described by Standard Methods (SM; American Public Health Association {APHA} 2017) procedures as appropriate as indicated in the SAP. Four to nine water quality stations were located along each of the seven transects, for a total of 43 water sampling stations. For QC purposes, one triplicate CTD cast was performed to provide a measure of field and sampling variability.

In addition to CTD casts, discrete water samples were collected at 20 stations for laboratory analysis of TSS and field analysis of turbidity at two depths (surface and bottom). A 1.7-liter (L) Niskin water bottle was used to collect these samples; as contaminant chemistry analyses were not performed, no decontamination of the Niskin bottle was required. The appropriate pre-labeled sample containers for TSS/turbidity were triple-rinsed with sample water from each Niskin prior to filling. TSS samples were collected in pre-labeled high density polyethylene (HDPE) containers and chilled at <4 degrees Celsius (°C) ±2°C until shipment to the laboratory. Turbidity samples were subsampled from the Niskins into marked sample containers or cuvettes for immediate analysis in the field using a portable Hach 2100Q nephelometric turbidity meter following Standard Method 2130B (APHA 2017). Analysis of TSS and turbidity on corresponding field samples allowed direct 1:1 comparison of turbidity versus TSS. QC sampling included the collection of field duplicate water samples for laboratory analysis of TSS and in-field analysis of turbidity (from within the same Niskin bottle); field turbidity analytical ("laboratory") duplication was performed on a minimum of 10% of the samples.

In addition to the in-situ profiling using the CTD, a YSI 556 multi-parameter instrument was used as an in-field check to verify electronic sampling. The YSI was utilized to directly measure temperature, pH, and DO by lowering the YSI probe into the water column.

Due to its high precision and accuracy, the SeaBird CTD requires factory calibration with the exception of the pH probe. Field checks of the CTD were made by comparing against the YSI 556 data. In addition, following the completion of the survey, the CTD was sent to SeaBird's facility for post-survey calibration to further verify sensor measurements and obtain calibration adjustments.

The YSI 556 and HACH 2100Q were calibrated daily when in use or if erroneous measurements were suspected. Field instrumentation for this program included the SeaBird CTD, the YSI 556 multi-probe instrument, and the HACH 2100Q turbidity meter. A copy of the manufacturers' calibration instructions was available for each field instrument. Calibration of pH sensors utilized a three-point calibration with pH 4, 7, and 10 buffer solutions. The DO parameter required calibration in percent saturation, and values were recorded in the field as milligrams per liter (mg/L). Conductivity was calibrated with a manufacturer-prepared solution using the specific conductance scale. Fresh calibration solutions were utilized for each calibration procedure. Temperature was compared against a field thermometer. For the turbidity meter, sealed formazin turbidity calibration solutions (20, 100, and 800 nephelometric turbidity units [NTU]) were used for calibration with confirmation against a secondary Gelex standard. All calibrations performed in the field were recorded on project-specific log forms.

3.4 DECONTAMINATION AND WASTE STREAM DISPOSAL

The van Veen grab and other non-disposable sampling equipment (e.g., scoops and spoons) were scrubbed with dedicated non-metallic bristle brushes and flushed with a deck hose or site-water rinsed to remove large sediment particles. Equipment was then cleaned with an Alconox rinsate solution, rinsed with clean ambient seawater, and triple-rinsed with deionized water as recommended by the *Dredged Material Evaluation and Disposal Procedures User Manual* (DMMP), prepared by the Dredged Material Management Program, US Army Corps of Engineers (USACE 2016). As per this protocol, all sediment sampling equipment was decontaminated using this procedure prior to sampling. No solvents or other cleaning agents were used since no significant sediment contamination was expected. All decontaminated equipment was stored in an environment free of hydrocarbons (exhaust) or metallic surfaces to prevent contamination. Any sampling equipment suspected of contamination was decontaminated again before reuse.

Any sediment or used equipment rinsate solutions that had exhibited any suspected contaminants (i.e., visible sheen or odor) would have been collected for landside disposal, although this did not occur. All residual sediment remaining after sampling activities and equipment rinsate solutions (including seawater mixed with Alconox detergent) were disposed of as close as possible to the sampling locations. Alconox is a water soluble, biodegradable detergent approved by the U.S. Department of Agriculture. All solutions used for calibration of water quality instrumentation were non-hazardous wastes and were discharged after suitable dilution with tap or site water.

The trawl and associated sampling equipment did not require decontamination between trawls or stations, but were rinsed free of sediment and biological residues as much as possible between sets. All trawl components were thoroughly cleaned and inspected prior to shipment to Prudhoe to eliminate the possibility of introducing any nonindigenous invasive species to the area.

3.5 SAMPLING HANDLING

All samples were handled and preserved according to accepted protocols, as shown in Table 3-1, with samples requiring chilling placed on gel ice in coolers on deck. Air temperatures during the survey hovered around 2°C. All sample containers used for the program were pre-cleaned and pre-labelled.

PGS samples were placed in 500-milliliter (mL) wide-mouth glass (WMG) jars. Sediment chemistry samples for TOC/TVS/TS analyses (designated "TTT") were placed in 125-mL WMG containers, while hydrocarbons (PAH/AHC) and metals samples (designated "PAM") and the extra archival samples ("ARC") were placed in 250-mL WMG jars. Most sediment samples were chilled onboard; PAM samples were subject to immediate freezing in the vessel's freezer and remained frozen during shipment to the analytical laboratory. None of the sediment samples required chemical preservatives.

TSS samples were placed in 0.5-L HDPE jars. The short 7-day holding time for these samples necessitated sampling of water quality stations at the end of the survey so samples could be shipped to the analytical laboratory in time to meet the specified holding time. As noted above, turbidity samples were immediately analyzed in the field and did not require storage or shipment.

Benthic samples were placed in externally labelled HDPE containers (typically 500-mL) with redundant internal rag paper labels, relaxed with propylene phenoxetol, and preserved with 10% formalin before being shipped to the laboratory. No chilling was required for these samples.

Table 3-1. Container Types, Holding Times, and Preservation of Samples.

Type of Analysis	Matrix	Container Type	Volume	Holding Time to Extraction	Preservation
Sediment Conventionals and Chemistry Samples					
PGS	Sediment	Glass	500-mL	Not applicable	Ice, 4°C ±2°C
TOC, TVS, TS (TTT)	Sediment	Glass	125-mL; allow space if sample to be frozen	None if frozen ------------------------- 14 days from collection date if refrigerated	Frozen, ice, <0°C --------------------- Ice, 4°C ±2°C
PAH, AHC, Metals (PAM)	Sediment	Glass, w/Teflon liner	250-mL; allow space if sample to be frozen	None if frozen ------------------------- 14 days from collection date if refrigerated for PAH/AHC; 28 days from collection for metals if refrigerated	Frozen, ice, <0°C ---------------------- Ice, 4°C ±2°C
Biological Samples					
Benthic Infauna and Epifauna	Sediment and Trawl	HDPE	500 mL	Not applicable	10% formalin
Water Samples					
TSS	Water	HDPE	0.5 -L	7 days from collection date if refrigerated	Cool, ice, 4°C ±2°C

3.6 VESSEL POSITIONING AND NAVIGATION

Station locations were determined by differentially-corrected GPS navigation utilizing a wide area augmentation system (WAAS) capable GPS. Horizontal positioning accuracy of approximately 10 to 15 feet (3 to 5 m) was utilized for this program.

For sediment grab sampling, the sampling vessel was typically anchored; grabbing was only performed during live-boating operations at the deep Station S6. The sediment station coordinates were determined by taking a GPS fix for each successful sediment sample as the grab contacted the bottom, but the coordinates assigned to each sediment station and reported here reflect the first successful grab's coordinates taken at that station. Positional data from unsuccessful grabs was not reported. Location of all water quality sampling was based on initial deployment of the CTD and/or Niskin bottles; water quality stations were typically collected during live-boat operations. For the trawling efforts, coordinates were taken at the beginning and end of each trawl. Coordinates of each sampling station were recorded on the appropriate log form as described in Section 3.7.

3.7 DOCUMENTATION AND CHAIN OF CUSTODY PROCEDURES

All sampling, sample identification, and sample shipment activities were performed under strict documentation and chain of custody (COC) procedures to maintain sample identification and data integrity, as outlined in the SAP. Customized field sampling log forms, sample labels, and COC forms were used. Field notes including station and navigational information, dates and times, sample identification numbers, general and weather observations, field measurements (e.g., nephelometric turbidity), and other pertinent information as appropriate were recorded on MMP field logs.

Navigational information, including location of grab stations, locations of each CTD cast and water sample, and beginning and end point of each trawl, was recorded on a Garmin© GPSmap 76Cx unit utilizing the latest revision of the World Geodetic System (WGS84) and WAAS. Although station coordinates were manually recorded on field logs at time of sampling to provide redundancy, GPS data used for the MMP were downloaded from the Garmin GPS in the GPS exchange format (.gpx) and loaded into Excel and geographic information system (GIS) software for processing for this report.

External sample labels consisted of self-adhesive, waterproof labels that were preprinted to include program-specific sampling information; additional information was hand entered in waterproof ink by the sampling team. For biological samples (infauna & fish), a second internal waterproof label (cotton paper completed in pencil) was included so a label always remained with the sample during processing.

In addition, digital photographs were taken in the field to document general sampling activities, provide examples of representative sediment grabs and infauna samples, document trawl catches, show site conditions, and record other program conditions as appropriate.

All samples were handled, transferred, and shipped following strict COC procedures; COC forms accompanied all samples from the field to the laboratory to document the transferral of samples from one custodian to another until final receipt. COC forms included all necessary sample identification information, including personnel signatures and date and time of each sample transaction.

Samples were packaged, sealed in coolers with signed COC forms and custody seals, and shipped following procedures outlined in the SAP and in accordance with U.S. Department of Transportation (DOT) and International Air Transport Association (IATA) regulations. No hazardous materials declarations were required as sediment and water samples were shipped chilled or frozen with gel ice and biological samples were preserved with dilute formalin that did not require a hazardous declaration. However, extra care was taken with samples containing formalin, which were sealed with electrical tape, placed in Ziploc plastic bags, surrounded with vermiculite in a double plastic bag over-pack.

Sediment, biological, and water samples were shipped from the Deadhorse Airport to the laboratories via Alaska Airlines Gold Streak or taken off-Slope as personal baggage and later shipped via Anchorage using FedEx priority service. Archival samples were driven down the Haul Road to Anchorage with KLI personnel.

Sample receipt and condition (including temperature, where appropriate) was noted upon receipt at the laboratories by the sample custodians, and internal laboratory tracking procedures were implemented at that time. Completed COC forms were included in the analytical data reports, with any exceptions in handling or sample integrity clearly noted.

4.0 ANALYTICAL METHODS

All sample analyses followed accepted and recommended protocols and techniques (e.g., PSEP or EPA methods). Information on analytical methods used for the Willow MMP is provided in Table 4-1 and summarized briefly below. All analytical results were reported in Excel and submitted in hardcopy data packages.

4.1 SEDIMENT ANALYSES

PGS and TOC/TVS/TS analyses were performed by ALS Environmental in Kelso, WA. All hydrocarbon (PAH/AHC) analyses were performed by B&B Laboratories (B&BL) in College Station, TX, the analytical component of TDI Brooks, Inc. (TDI-BI). B&BL provided dried sediment aliquots to Texas A&M University's Trace Environmental Research Lab (TERL) for trace metals analyses. Additional TS analyses were performed by each individual laboratory if required to report other sediment results on a dry weight basis. All analytical procedures followed the MMP requirements and were fully documented in the method and each laboratory's internal SOPs; these methods were typically referenced in the analytical results packages (Appendix A). Brief descriptions of analytical procedures are provided in the following subsections.

4.1.1 Particle Grain Size

PGS determinations were made following procedures described by the American Society for Testing and Materials (ASTM) Method D422 which is recommended by the PSEP. The determination of PGS (or particle size distribution) is a cumulative frequency distribution of relative amounts of particles in a sample within specified size ranges. Marine sediments have a wide range of particle sizes, and both sieving of the coarse fraction and gravimetric pipetting of the fine fraction are required to obtain accurate grain size distribution data.

For this program, sediment samples were analyzed for 20 different size fractions ranging from < -6 phi for cobble down to > +9.5 corresponding to fine clay particles. The four major size classes for the sediments based on the Wentworth particle distribution scale are shown below:

- gravel (-1 to -6 phi);
- sand (+4 to -1 phi);
- silt (+4 to +8 phi); and
- clay (greater than +8 phi).

4.1.2 Carbons in Sediment

Total organic carbon (TOC) content was measured in oven-dried sediments following EPA's Method 9060A. Percent TOC was determined by analyzing a dried sediment sample after all inorganic carbon had been removed by acidification.

Total Volatile Solids (TVS) provided another measure of the carbon/detritus in the sediments. TVS was analyzed following EPA Method 160.4 Modified and reported in percent.

4.1.3 Metals in Sediment

Trace metals in sediment samples were analyzed following EPA methods with the specific objective of providing low-level method detection limits (MDLs) for the target analytes, as provided in Table 4-2. Samples were analyzed by inductively coupled plasma-optical emission spectrometry (ICP-OES; EPA

Table 4-1. Methods Used for Sediment and Water Analyses.

Parameter	Method	Reference
SEDIMENT		
Conventional Parameters		
Particle Grain Size (PGS; full phi)	ASTM^{1} D422	ASTM (2007)
Total Organic Carbon (TOC)	SW^{2} 9060A	SW 846 (IIIB)
Total Solids (TS)	PSEP^{3}/SM^{4} 2540B	PSEP/SM 2012
Total Volatile Solids (TVS)	EPA^{5} 160.4 Modified	EPA 600 (1983)
Chemical Parameters		
Metals		
Aluminum (Al)	SW 6010D	SW 846 (V)
Antimony (Sb)	SW 6020B	SW 846 (V)
Arsenic (As)	SW 6020B	SW 846 (V)
Barium (Ba)	SW 6010D	SW 846 (V)
Cadmium (Cd)	SW 6020B	SW 846 (V)
Chromium (Cr)	SW 6010D	SW 846 (V)
Copper (Cu)	SW 6010D	SW 846 (V)
Iron (Fe)	SW 6010D	SW 846 (V)
Lead (Pb)	SW 6020B	SW 846 (V)
Mercury (Hg)	SW 7473	SW 846 (III)
Nickel (Ni)	SW 6010D	SW 846 (V)
Selenium (Se)	SW 6020B	SW 846 (V)
Silver (Ag)	SW 6020B	SW 846 (V)
Vanadium (V)	SW 6010D	SW 846 (V)
Zinc (Zn)	SW 6010D	SW 846 (V)
Hydrocarbons		
Aliphatic Hydrocarbons (AHC)	Modified EPA 8015C GC/FID	SW 846 (IV)
Polycyclic Aromatic Hydrocarbons (PAH)	Modified EPA 8270D GC/MS SIM	SW 846 (V)
WATER		
Total Suspended Solids (TSS)	SM 2540D	SM 2012
Turbidity (performed in field)	SM 2130B	SM 2012

[1] ASTM American Society for Testing and Materials (ASTM). 2007. Annual Book of Standards – Soil and Rock I: (D40-D5876), ASTM Volume 04.08, Philadelphia, PA.

[2] SW United States Environmental Protection Agency (EPA). 1986. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods. EPA Publication SW-846, Third Edition; with subsequent revisions as Final Updates I (1993), II (1995), IIA (1994), IIB (1995), III (1997), IIIA (1999), IIIB (2005), IV (2008), and V (2015) shown in parentheses.

[3] PSEP Puget Sound Estuary Program (PSEP). 1986. Recommended protocols for measuring conventional sediment variables in Puget Sound. Final Report. Prepared for U.S. Environmental Protection Agency, Seattle, WA.

[4] SM American Public Health Association (APHA). 2017. Standard Methods for the Examination of Water and Wastewater, 23rd ed., American Public Health Association.

[5] EPA United States Environmental Protection Agency (EPA). 1983. Methods for Chemical Analysis of Water and Wastes. 600/4-79-020. Washington, D.C.

Table 4-2. Trace Metals Target Analytes and Method Detection Limits.

Target Analyte	MDL (mg/kg dry)	Target Analyte	MDL (mg/kg dry)
Aluminum	0.00986	Lead	0.0493
Antimony	0.00493	Mercury	0.00005
Arsenic	0.0246	Nickel	0.246
Barium	0.049	Selenium	0.00493
Cadmium	0.00986	Silver	0.00986
Chromium	0.099	Vanadium	0.099
Copper	0.197	Zinc	0.099
Iron	0.246		

6010D), inductively coupled plasma-mass spectrometry (ICP-MS; EPA 6020B), and combustion-trapping-atomic absorption spectrometry (C-T-AAS for Mercury {Hg}; EPA 7473). Sediment metals data were reported in dry weight. Additional analytical method information, including quality assurance/quality control (QA/QC) information, is provided in the data package provided in Appendix A.

Prior to analysis, sediment samples were digested in polypropylene vessels in a block digester with ultrapure nitric acid, hydrochloric acid, and hydrofluoric acid. The latter acid was necessary in order to solubilize the alumino-silicate mineral lattice in order to achieve a “true total” analysis rather than a “total recoverable” measurement. Following digestion, samples were diluted to volume with deionized water and stored in screw cap HDPE bottles until analysis.

Most analytes were determined using multi-element ICP instruments. Digested samples were diluted as necessary and analyzed using external calibration and internal standards to compensate for slight matrix differences. Off-peak baseline correction and inter-element corrections were utilized in ICP-OES, while reaction cell technology was used to remove molecular ion interferences in ICP-MS. Mercury was determined by direct analysis (C-T-AAS) via sample combustion in a stream of oxygen, trapping of Hg^0 on gold, and measurement of Hg vapor by AAS following heating of the gold trap.

All instrumental methods utilized calibration with a blank and at least three standards that bracketed the sample concentrations. Continuing calibration verification (CCV) and calibration check blanks (CCBs) were analyzed immediately after calibration and following every 10 samples in order to evaluate instrument performance throughout the run.

4.1.4 Hydrocarbon Analyses

The analytical strategy for the analysis of hydrocarbons included the use of compound-specific measurements of organic parameters such as AHC, and select biomarkers to assess hydrocarbon concentrations in sediments. Sample preparation and extraction followed EPA procedures described in B&BL SOP 1003, summarized as follows:

Sediment Preparation and Extraction Procedures

This procedure is an accurate and precise method for the extraction, isolation, and concentration of selected organic compounds from sediment samples. It achieves analyte recoveries equivalent to those from Soxhlet extraction, using less solvent and taking significantly less time. Final extracts can be used in the quantitative determination of PAHs, AHCs, total petroleum hydrocarbons (TPH), and chlorinated hydrocarbons (including planar PCBs) by chromatographic procedures. This procedure is also used to extract sediment samples for gravimetric determination of extractable organic material (EOM).

An automated extraction apparatus (Dionex ASE200 Accelerated Solvent Extractor) was used to extract various organics from 1 to 15 grams (g; usually 15 g if adequate material is present) of pre-dried sediment. The extractions were performed using 100% dichloromethane inside stainless steel extraction cells held at elevated temperature and solvent pressure. The extracted compounds dissolved in the hot solvent were collected in 60-mL glass vials. Extracts were concentrated to a volume of 1 - 3 mL, using an evaporative solvent reduction apparatus (Zymark TurboVap II or water bath), and if necessary, processed through a clean-up column in order to minimize matrix interference. This may have included alumina, silica gel, or sulfur cleanup following EPA accepted protocols (e.g., EPA SW 846 Methods 3610B, 3630C, 3660B).

AHC Determination

The quantitative method utilized for the determination AHCs and TPH in extracts of sediment as described in SOP 1016 and EPA Method 8015C.

Quantitation was performed by high resolution, capillary gas chromatography (GC) with flame ionization detection (FID). Normal alkanes with 9 to 40 carbons (C9 to C40), and the isoprenoids including pristane and phytane were determined with this procedure. The gas chromatograph was temperature-programmed and operated in split mode. The capillary column used was a Restek Scientific RTX-1 (30 m long by 0.25 mm inner diameter and 0.25 micron {µm} film thickness). Carrier flow was regulated by electronic pressure control. The autosampler was capable of making 1 to 5 mL injections. Dual columns and FIDs were used. The data acquisition system utilized was by HP Chemstation software, capable of acquiring and processing GC data.

A calibration curve was established by analyzing each of six calibration standards (1.25, 10, 25, 40, 50 and 100 micrograms/milliliter {µg/mL}) and fitting the data to a straight line using the least square technique. For each analyte of interest, a response factor (RF) was determined for each calibration level. All six response factors were then averaged to produce a mean relative response factor (RRF) for each analyte. If an individual aliphatic hydrocarbon was not in the calibration solutions, an RF was estimated from the average RF of the hydrocarbon eluting immediately before the compound. In addition, appropriate surrogate solutions were added to every sample (including QC samples), and the data corrected based on surrogate recovery up to 100%.

AHC data were reported in dry weight. Target analytes and their MDLs are provided in Table 4-3. Additional analytical method information, including QA/QC information, is provided in the data package provided in Appendix A.

PAH Determination

The laboratory employed a quantitative method as described by B&BL's SOP 1006 for the determination of PAHs in extracts of sediment for this program. This method is a modification of EPA Method 8270D and has been used extensively on the NS&T and other programs. Target PAH analytes and MDLs reported by B&BL for parent molecules and their homologues are listed in Table 4-4. PAH data were reported in in dry weight. Additional analytical method information, including QA/QC information, is provided in the data package provided in Appendix A.

Table 4-3. AHC Target Analytes and Method Detection Limits.

Target Analyte	MDL (mg/kg dry)	Target Analyte	MDL (mg/kg dry)
n-C9	0.012	n-C25	0.007
n-C10	0.021	n-C26	0.008
n-C11	0.016	n-C27	0.011
n-C12	0.019	n-C28	0.011
n-C13	0.045	n-C29	0.021
i-c15	0.016	n-C30	0.013
n-C14	0.013	n-C31	0.015
i-c16	0.004	n-C32	0.012
n-C15	0.016	n-C33	0.021
n-C16	0.004	n-C34	0.016
i-c18	0.004	n-C35	0.015
n-C17	0.003	n-C36	0.016
Pristane	0.003	n-C37	0.017
n-C18	0.004	n-C38	0.019
Phytane	0.006	n-C39	0.019
n-C19	0.005	n-C40	0.019
n-C20	0.012		
n-C21	0.004	Total Petroleum Hydrocarbons	1.40
n-C22	0.003	Total Resolved Hydrocarbons	1.40
n-C23	0.008	Unresolved Complex Mixture	1.40
n-C24	0.005	Extractable Organic Matter	100

Quantitation was performed by capillary gas chromatography/mass spectrometry (GC/MS) in selected ion monitoring mode (SIM). The gas chromatograph was temperature-programmed and operated in splitless mode. The capillary column used was an Agilent Technologies HP-5MS (60 m long by 0.25 mm inner diameter and 0.25 µm film thickness). Carrier flow was by electronic pressure control. The autosampler was capable of making 1 to 5 microliter (µL) injections. The mass spectrometer was capable of scanning from 35 to 500 atomic mass units every second or less, utilizing 70 volts electron energy in electron impact ionization mode. The data acquisition system allowed continuous acquisition and storage of all data during analysis and was capable of displaying ion abundance versus time or scan number.

For PAHs, calibration solutions were prepared at six concentrations ranging from 0.02 to 5 µg/mL by diluting a commercially available solution containing the analytes of interest. For each analyte of interest, an RF was determined for each calibration level. The six response factors were then averaged to produce a mean RRF for each analyte. In addition, appropriate surrogate solutions were added to every sample (including QC samples), and the data corrected based on surrogate recovery up to 100%.

4.2 WATER ANALYSES

Laboratory analyses for TSS were performed by ALS Environmental in Kelso, WA following procedures described by SM 2540D. Nephelometric turbidity samples that were analyzed by KLI personnel on the vessel followed procedures described by SM 2130B. Analytical methods are referenced in Table 4-1.

Table 4-4. PAH Target Analytes and Method Detection Limits.

Target Analyte	MDL (µg/kg dry)	Target Analyte	MDL (µg/kg dry)
cis/trans Decalin	0.132	C4-Naphthobenzothiophenes	0.256
C1-Decalins	0.263	Benz(a)anthracene	0.192
C2-Decalins	0.263	Chrysene/Triphenylene	0.116
C3-Decalins	0.263	C1-Chrysenes	0.232
C4-Decalins	0.263	C2-Chrysenes	0.232
Naphthalene	0.342	C3-Chrysenes	0.232
C1-Naphthalenes	1.03	C4-Chrysenes	0.232
C2-Naphthalenes	0.684	Benzo(b)fluoranthene	0.203
C3-Naphthalenes	0.684	Benzo(k,j)fluoranthene	0.098
C4-Naphthalenes	0.684	Benzo(a)fluoranthene	0.098
Benzothiophene	0.090	Benzo(e)pyrene	0.177
C1-Benzothiophenes	0.180	Benzo(a)pyrene	0.101
C2-Benzothiophenes	0.180	Perylene	1.27
C3-Benzothiophenes	0.180	Indeno(1,2,3-c,d)pyrene	0.050
C4-Benzothiophenes	0.180	Dibenzo(a,h)anthracene	0.064
Biphenyl	0.294	Benzo(g,h,i)perylene	0.088
Acenaphthylene	0.041	**Individual Alkyl Isomers and Hopanes**	
Acenaphthene	0.103	2-Methylnaphthalene	1.30
Dibenzofuran	0.204	1-Methylnaphthalene	0.546
Fluorene	0.183	2,6-Dimethylnaphthalene	0.261
C1-Fluorenes	0.367	1,6,7-Trimethylnaphthalene	0.127
C2-Fluorenes	0.367	1-Methylfluorene	0.191
C3-Fluorenes	0.367	4-Methyldibenzothiophene	0.091
Carbazole	0.150	2/3-Methyldibenzothiophene	0.091
Anthracene	0.115	1-Methyldibenzothiophene	0.091
Phenanthrene	0.208	3-Methylphenanthrene	0.097
C1-Phenanthrenes/Anthracenes	0.077	2/4-Methylphenanthrene	0.097
C2-Phenanthrenes/Anthracenes	0.285	2-Methylanthracene	0.097
C3-Phenanthrenes/Anthracenes	0.285	9-Methylphenanthrene	0.097
C4-Phenanthrenes/Anthracenes	0.285	1-Methylphenanthrene	0.097
Dibenzothiophene	0.116	3,6-Dimethylphenanthrene	0.110
C1-Dibenzothiophenes	0.064	Retene	0.231
C2-Dibenzothiophenes	0.232	2-Methylfluoranthene	0.223
C3-Dibenzothiophenes	0.232	Benzo(b)fluorene	0.125
C4-Dibenzothiophenes	0.232	C29-Hopane	0.575
Fluoranthene	0.333	18a-Oleanane	0.575
Pyrene	0.136	C30-Hopane	0.575
C1-Fluoranthenes/Pyrenes	0.469	C20-TAS	0.575
C2-Fluoranthenes/Pyrenes	0.469	C21-TAS	0.575
C3-Fluoranthenes/Pyrenes	0.469	C26(20S)-TAS	0.575
C4-Fluoranthenes/Pyrenes	0.469	C26(20R)/C27(20S)-TAS	0.575
Naphthobenzothiophene	0.128	C28(20S)-TAS	0.575
C1-Naphthobenzothiophenes	0.256	C27(20R)-TAS	0.575
C2-Naphthobenzothiophenes	0.256	C28(20R)-TAS	0.575
C3-Naphthobenzothiophenes	0.256		

4.3 TAXONOMIC ANALYSES

All sorting, taxonomic identification, and enumeration of benthic infauna samples were performed following standard protocols as recommended by PSEP. Infauna samples were processed by KLI Santa Cruz for transferral to 70% alcohol within seven days of receipt at the laboratory. Samples were sorted under a stereo microscope to remove all organisms from the residual sediment and detritus in each sample. Organisms were placed into five major taxonomic categories or groups: Annelida, Crustacea, Mollusca, Echinodermata, and remaining phyla referred to as the "Miscellaneous" group; each of these groupings was enumerated by the sorter. Sorted organisms were placed into labelled vials with 70% alcohol.

QC for benthics included the resorting of a minimum of 30% by volume of each sample sorted; these samples were resorted by a different individual than the original sorter. Any samples showing more than 5% of the total number of organisms "missed" failed this sorting check, resulting in a 100% resort of that particular sample which was also checked against the 5% resort criteria.

Taxonomic identifications were made to the lowest practicable taxon (typically, to genus or species) by experienced taxonomists with extensive Arctic experience as well as proven successful track records on past or current KLI projects. Taxonomic identification was overseen by Gary Gillingham of KLI, who also performed crustacean taxonomy for the program. Molluscs were forwarded to Allan Fukuyama for identification. Polychaete identification was performed by Leslie Harris, while other "Miscellaneous" taxa were identified by taxonomist Steve Hulsman.

All taxonomic data for the Willow MMP were entered directly into Microsoft Excel© 2016 spreadsheets, which were also used for data storage and manipulation. Summary tables and basic statistics as well as all plots were also produced using Excel. The Excel add-in XLSTAT© 2018.6 was used to calculate most measures of variance and also to perform the Agglomerative Hierarchical Clustering (AggHC) analysis used to define benthic invertebrate grouping patterns among the three transects of 12 stations (S1 to S12) sampled (Addinsoft 2018). The Bray-Curtis dissimilarity distance index (BC) was used to calculate the dissimilarity between station pairs. The Unweighted pair-group average (UPGA) linkage agglomeration method was used to form classes or station groups from the station pair distances that were calculated by BC. The software program PAST 3.21 was used to calculate community-based indices as described in Section 6.2.3; PAST is free software that includes functions for ecological analysis that is available from the University of Oslo in Norway for scientific data analysis (Hammer et al. 2001).

4.4 QUALITY CONTROL

Internal QA/QC was achieved by collecting and/or analyzing a series of field duplicates (DUPs), laboratory duplicates, method blanks (MBs), or laboratory control spike/spike duplicate (LCS/LCSD) samples to ensure that the analytical results were within the limits specified by each method. Each type of physical or chemical analysis required specific types of QC samples or checks. Field QC samples (in this case, field duplicates) were collected in the field and sent to the laboratory for analysis with other environmental samples, or, in the case of turbidity, analyzed in the field. Laboratory QC samples as required by each method were initiated at the laboratory, carried through the analytical process with the field samples, and reported with the analytical results. All QA/QC variances were noted in the laboratory's narrative that accompanied each laboratory report (see appendices). See Section 5.1 for additional information concerning data validation and data quality objectives (DQOs) for this program.

5.0 QUALITY ASSURANCE

The overall quality assurance (QA) objective of the Willow MMP was to provide environmental data of known and documented quality that satisfied the program requirements and that met the prescribed data quality objectives (DQOs). Data review and quality assessment was performed prior to final reporting of sediment and water data to ensure acceptability and applicability of the data.

5.1 DATA QUALITY OBJECTIVES

The DQOs selected for the Willow MMP for precision, accuracy, representativeness, completeness, comparability, and sensitivity are briefly outlined below, with numerical objectives provided where appropriate. These DQOs were selected to ensure that the program data are verifiable and valid. All DQOs were met for the program; should any DQOs have failed to have been met, data would be appropriately flagged and documented as anomalous in this report.

Precision is strictly defined as the degree of mutual agreement among independent measurements as the result of repeated application of the same process under similar conditions; it pertains mostly to chemical and physical data rather than to biological measurements, which preclude repeatability. Precision is often determined for chemical analyses by the analysis of laboratory sample splits (e.g., lab duplicates or matrix spike/matrix spike duplicates {MS/MSDs}) and reported as the relative percent difference (RPD) between duplicates. Analytical precision goals for each parameter are met if RPDs between duplicated measurements conformed to requirements in Table 5-1. RPDs outside specified criteria, if any, would indicate that the analytical system was out of control and would require samples to be reanalyzed, if possible, or the data flagged with the appropriate qualifiers.

Accuracy is a statistical measurement of correctness and includes components of random error (variability due to imprecision) and systematic error (bias). An analytical measurement is accurate when the value reported does not differ from the true value. In chemical analyses, accuracy is typically measured by determining the percent recovery (% Rec) of known concentrations of target analytes that are spiked into a field sample or a blank or laboratory control matrix prior to extraction and analysis. Accuracy goals for the program are provided in Table 5-1. Accuracy goals are considered to be met if individual spiked sample recoveries are within laboratory-listed criteria; any falling outside acceptance criteria would be reanalyzed or appropriately flagged.

Representativeness is a qualitative measure of the degree to which data represent the true environmental conditions for a parameter. Representativeness is a qualitative parameter that is evaluated to determine that measurements are made (e.g., samples are collected and observations are recorded) at locations and in a manner which results in the accurate characterization of the existing conditions. The objective for representativeness for the Willow MMP is largely a function of study design and overall program objectives as described above. Representativeness was achieved in part through use of the standard sampling and analytical techniques and procedures.

Field completeness is a measurement, expressed as a percentage, of the number of valid samples collected divided by the number of those planned for collection. Although the intended completeness of all field efforts is always 100%, an actual DQO of 95% more clearly reflects the fact that the number of samples actually collected may differ from that projected due to variable conditions encountered in the field, including weather and safety considerations.

Table 5-1. Precision and Accuracy Data Quality Objectives.

Parameter	Sample Types	Frequency	Precision (RPD)	Accuracy (% Recovery)
Sediment Analyses				
PGS	Lab Duplicate	1 per batch/20 field samples	N/A	N/A
Total Solids	Lab Duplicate	1 per batch/every 20 field samples	<10	N/A
	Lab Triplicate		<10	N/A
TOC	Method Blank	1 per batch/every 20 field samples	N/A	< 2 x MRL
	Lab Duplicate		<20	N/A
	MS/MSD		<20	70-122
	LCS		N/A	72-122
TVS	Method Blank	1 per batch/20 field samples	N/A	< 2 x MRL
	Lab Duplicate	1 per batch/10 field samples	<20	N/A
Metals	Method Blank	1 per batch/every 20 field samples	N/A	< 2 x MRL
	Lab Duplicate		<30 where concentrations are >3 x MDL	N/A
	Matrix Spike/Blank Spike			80-120
	SRM		Where concentrations are >3 x MDL	± 20 certified
AHC	Method Blank	1 per batch/every 20 field samples	No more than 2 analytes to exceed 3xMDL unless not detected in associated samples or if conc. >10x blank value	N/A
	Lab Duplicate		< 30 if analyte is > 3xMDL; ≤ 2 analyte RPDs with conc. > 3 x MDL can exceed 35	N/A
	MS/MSD or BLK Spike/Dup		<30, no more than 2 analytes >35	40-120 target analytes; average of 60-120 for valid spikes; no more than 2 analytes may exceed 40-120
	SRM – Reference Oil		$\pm 3\sigma$ of laboratory mean	
	Surrogates; all samples	All field and QC samples	N/A	40-120
PAH	Method Blank	1 per batch/every 20 field samples	No more than 2 analytes to exceed 3xMDL unless not detected in associated samples or if conc. >10x blank value	N/A
	Lab Duplicate		< 30 if analyte is > 3xMDL; ≤ 2 analyte RPDs with conc. > 3 x MDL can exceed 35	N/A
	MS/MSD or BLK Spike/Dup		<30, no more than 2 analytes >35 RPD	40-120 for target, except biphenyl (40-140), decalin (25-120), perylene (10-120). No more than 2 analytes > 40-120
	SRM - Sediment		No more than 2 analytes may exceed criteria	± 30 certified
	SRM – Reference Oil			± 20 certified
	Surrogates; all samples	All field and QC samples	N/A	40-120 except d12-perylene (10-120)

Table 5-1. Precision and Accuracy Data Quality Objectives. (Continued)

Parameter	Sample Types	Frequency	Precision (RPD)	Accuracy (% Recovery)
Water Analyses				
TSS	Method Blank	1 per batch/every 10 field samples	N/A	< 2 x MRL
	LCS	1 per batch		85-115
	LCS Duplicate	1 total	<5	85-115
Turbidity (in field)	Lab Duplicate	Every 10 field samples	<20	N/A
	Instrument Calibration MB & SRMs	Daily	<2	N/A
CTD	Field triplicate cast	Once per survey	<5 Coefficient of variation	N/A
	Instrument Calibration	Field check and post-field factory calibration	<2	N/A

N/A Not applicable

Analytical completeness is a measurement of the number of samples producing valid results compared to the number of collected samples, expressed as a percentage. The completeness goal for analytical data for this program is 95%. For completeness requirements, valid results are all reported results that are not rejected during the data validation process. Valid results used to meet completeness objectives are those results that provide defensible estimates of the true concentration of an analyte in a sample. These valid results include data that are not qualified ("flagged"), and data that are qualified but can still be used to meet program objectives. Invalid data are those results which must be excluded from the dataset (e.g., where there is an indication that the prescribed sampling or analytical protocol was not followed, sample results are outside of the control limits established for the method, or lost/contaminated/spilled samples). If analytical data are determined to be invalid or unusable, another sample aliquot may be analyzed as soon as possible (if adequate sample material exists and is within holding time for the method). For this program, the archival (ARC) samples were intended to provide redundancy and allow analysis if samples were lost or rendered unusable.

Comparability is the confidence with which one dataset can be compared to other datasets where appropriate. The objective for the Willow MMP was to produce data with the greatest degree of comparability possible that could be compared to other data as appropriate, although local historical data for some parameters are admittedly sparse. Comparability is achieved by using standard methods for sampling, and physical, chemical, and taxonomic analyses; reporting data in standard units; documentation and assessment of all DQOs; and using standard and comprehensive data handling and validation procedures along with reporting formats.

Sensitivity is the capability of a method or instrument to discriminate between measurement responses representing different levels of the variable of interest. Analytical sensitivity is quantified by determining the minimum concentration or attribute that can be measured at the MDL (see Table 4-3 and Table 4-4) and/or the method reporting limit (MRL).

5.2 DATA REVIEW AND QUALITY ASSESSMENT

All program data were reviewed and evaluated prior to reporting. The data review incorporated field sampling documentation and field measurements as well as all analytical laboratory results. DQOs as provided above were assessed as appropriate. A QA narrative summary was included with each laboratory's final data package; these are also provided in the appendices of this report.

The primary goal of the review and assessment process was to document that applicable method, procedural, and contractual requirements were met during performance of the program, including during field sampling and all laboratory analyses. Verification checks were performed to determine if the data were complete, if sampling and analysis met the program requirements, if DQOs were met, and if procedures outlined in the SAP were followed. Information concerning any conditions encountered in the field or the laboratories that may have affected data quality or overall program requirements or objectives has been noted.

5.3 QUALITY ASSURANCE/QUALITY CONTROL EVALUATION

All sediment and water analytical data for the program underwent QA/QC evaluation according to EPA National Functional Guidelines for inorganic and organic data review (EPA 2017a and 2017b). A brief summary of the evaluation results is presented here; refer to the appendices of the report for analytical laboratory reports and case narratives for detailed QC results and to Appendix E for the QA/QC evaluation.

All sediment, water, and biological environmental samples and associated QC samples (i.e., field duplicates) were collected as required, resulting in a field completeness value of 100%. With the exception of one sediment sample, all samples were received intact under proper COC procedures at the analytical laboratories within the proper temperature ranges and were analyzed within acceptable EPA holding times. One PAM sediment sample arrived at the laboratory with a cracked jar, but since the sample was still frozen, it was deemed acceptable for analysis after discussions between KLI and the laboratory. All biological samples were received intact under proper COC at the biological facilities. In addition, no sample results were deemed invalid during the review and assessment of program data. The analytical completeness for all samples collected was therefore assessed at 100%. For the hydrographic data, 15 pH values were rejected due to anomalous readings on the CTD (<2% of all CTD pH points); all other hydrographic data were deemed acceptable for use on the program. Post-field factory calibrations of the CTD were assessed and utilized where applicable during data processing as described in Appendix E.

The overall quality of the 2018 Willow MMP dataset was assessed and determined to be well within the DQOs as described above and initially outlined in the program SAP. Overall evaluation of the analytical QA/QC data indicates that the chemical and physical data, with few exceptions, were within the established performance criteria and can be used for characterization of sediments and waters as required by program objectives. The full QA/QC evaluation is provided in Appendix E.

6.0 RESULTS

6.1 SEDIMENT QUALITY RESULTS

Sediment quality information collected at each of the twelve study sites included PGS, organic content (TOC and TVS), and TS (total solids as percent solids). In addition, detailed sediment chemistry was obtained at six of the twelve stations (S2, S3, S4, S6, S8, and S11) and analyzed for a suite of metals and hydrocarbons. Sediment sampling information is provided in Table 2-1.

6.1.1 Conventional Parameters

The physical characteristics of sediment can have significant effects on the distribution and bioavailability of contaminants in sediments and also on the distribution and abundance of benthic organisms. For the purpose of discussion in this section, the primary concern is the effects of sediment characteristics on potential contaminants, with biological concerns addressed in other sections of this report. Measurements of PGS included the principle fractions of gravel, sand, silt, and clay, which were categorized according to the Wentworth scale for particle size distribution as well as a detailed breakdown by phi size to aid in any engineering evaluations. PGS measurements of percent fines (% Fines) are also presented, which is defined as the summation of the silt and clay fractions. Measurements of carbon content included TOC and TVS, with TOC being the primary measurement of interest.

In most marine sediments, PGS and organic content have been shown to be highly correlated with one another. Sediments that have a higher percentage of fines tend to also have proportionally greater organic content than do coarse-grained sediments due to a higher surface-to-volume ratio of the sediment particles. The higher surface-to-volume ratio in fine-grain sediments also provides a greater surface area on sediment particles for the sorption of chemical contaminants. For purposes of normalizing inorganic (metals) pollutant parameters, the primary conventional parameter utilized is % Fines (silt + clay fractions). For the purposes of normalizing organic pollutant parameters, the two main measurements that are utilized here are % Fines and TOC.

Results of sediment PGS, TOC, TVS, and percent solids (% solids) are presented in Table 6-1 for each of the twelve sediment sites in addition to the field duplicate (S3-2) results from the proposed MTI location. Detailed laboratory results that include case narratives along with QA/QC results are provided in Appendix A. Fairly large differences were seen between locations with a few of the nearshore sites (Station S1, S2, and S7) and the deeper offshore sites (Stations S6, S11, and S12) having much higher % Fines when compared to the other six sites (Figure 6-1). Overall, the fine fraction ranged from 14.55% at Station S4 to 92.99% at Station S11. This high degree of variability in grain size distribution is typical of the Beaufort nearshore area with primary sources being riverine with lesser amounts due to coastal erosion.

A similar pattern was seen in both TOC and TVS, with higher concentrations associated with fine grain sediments. TOC ranged from 0.26% at Station S4 to 3.88% at Station S11, and TVS ranged from 2.9% at Stations S9 and S10 to 12.9% at Station S11. As expected, TS had an inverse relationship to % Fines with the highest TS concentrations found at locations with higher sand content. This parameter is primarily used to determine dry weight concentrations of metals and hydrocarbons and is highly correlated with grain size.

Table 6-1. Summary of Sediment Grain Size and Conventional Parameters.

Station	S1	S2	S3	S3-2	S4	S5	S6	S7	S8	S9	S10	S11	S12
Grain Size Soil Classification													
% Gravel	0.17	0.10	0.01	0.03	0.07	0.04	0.06	0.01	0.01	0.02	0.16	0.06	0.28
% Sand	24.64	36.72	80.83	78.01	85.38	76.47	31.71	32.10	74.05	81.65	82.99	6.95	13.10
% Silt	63.35	47.91	16.86	19.29	12.70	18.64	41.15	54.38	23.30	16.60	9.82	67.84	58.95
% Clay	11.85	15.27	2.29	2.67	1.85	4.85	27.09	13.52	2.64	1.73	7.03	25.15	27.66
% Fines	75.20	63.18	19.16	21.96	14.55	23.49	68.23	67.89	25.94	18.33	16.85	92.99	86.62
Conventional Parameters													
TOC (%)	1.51	3.25	0.43	0.45	0.26	1.04	1.34	1.97	0.62	0.27	0.66	3.88	2.98
TVS (%)	6.4	9.8	3.4	3.5	3.1	4.4	8.1	7.1	3.6	2.9	2.9	12.9	11.5
% Solids	65.8	57.3	72.9	73.4	73.2	69.3	52.3	58.3	74.2	75.6	74.5	41.7	46.3

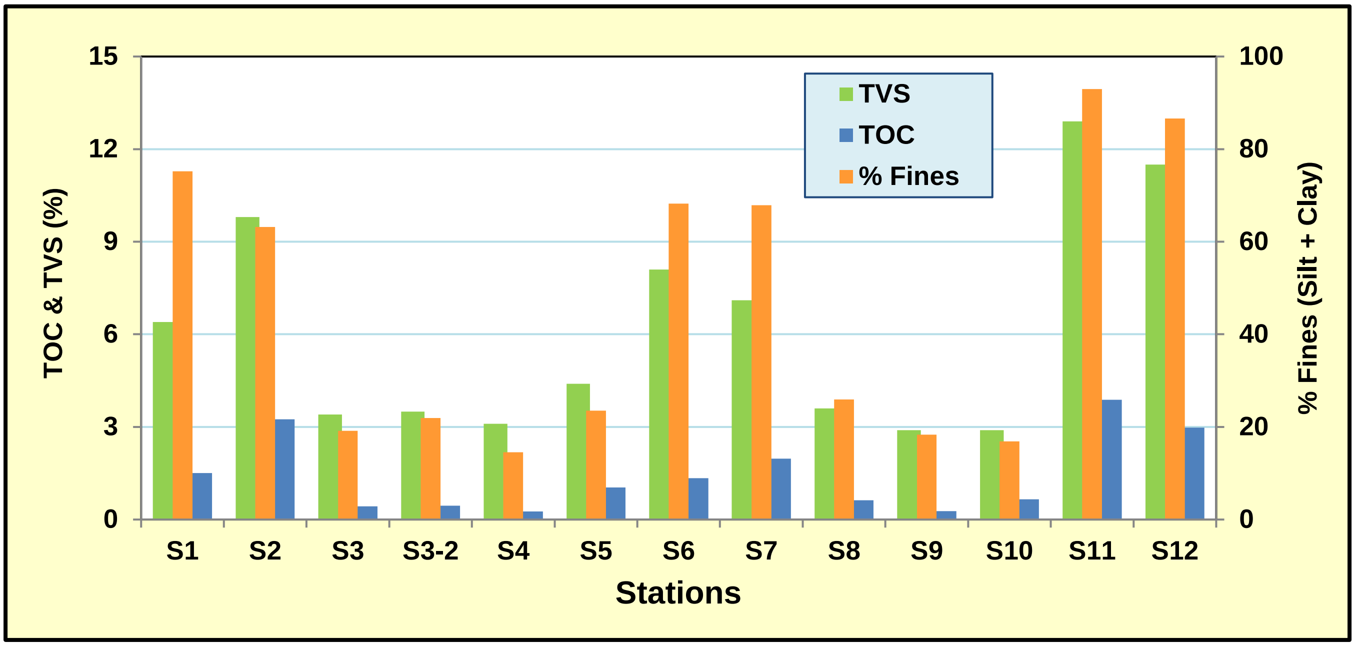


Figure 6-1. Comparison of Sediment TVS, TOC, and % Fines by Station.

Scatter plots with linear regressions of % Fines versus TVS and TVS versus TOC in Figure 6-2 clearly show high correlations between these three parameters with coefficients of determination (R^2) of 0.87 and 0.93, respectively. A high correlation between TVS and TOC is typical since both measurements are examining the organic content in sediments, whereas % Fines do not necessarily have to correlate with organic material but often do as a result of wave and current activity that tend to deposit finer-grained sediment and organic material in more quiescent areas.

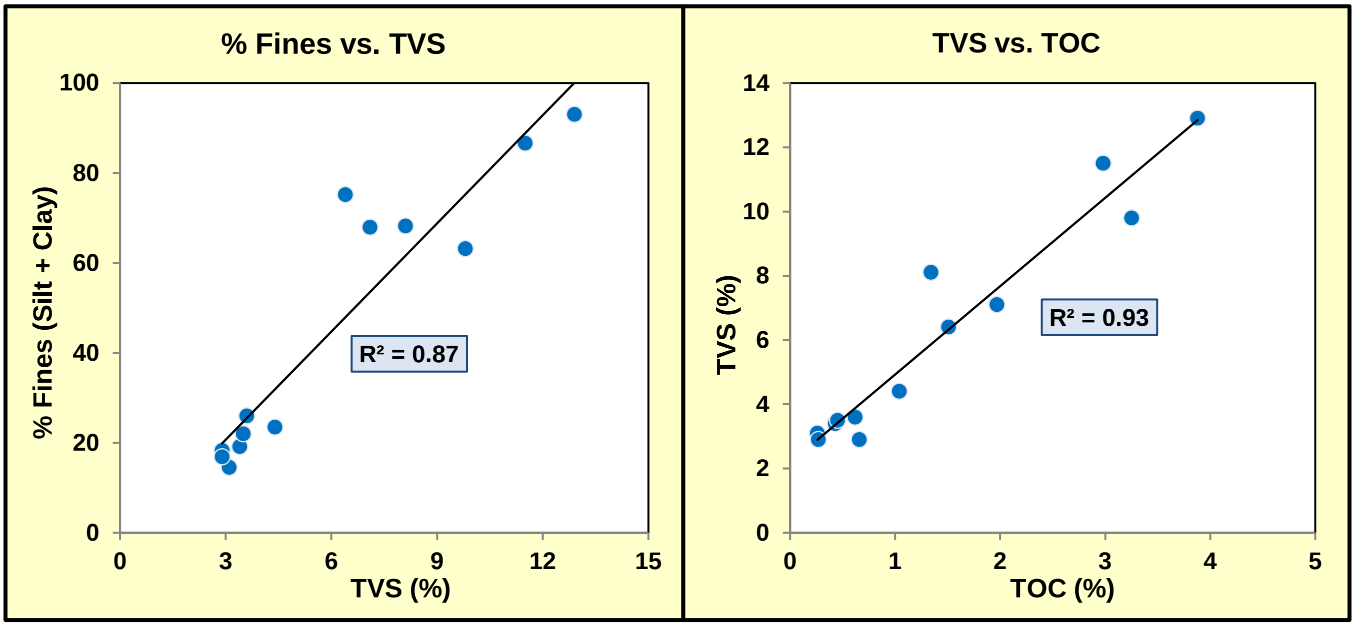


Figure 6-2. Regressions of % Fines vs. TVS and TVS vs. TOC.

6.1.2 Sediment Metals

Analytical results for total metals from the six MMP stations that were examined for contaminant concentrations are summarized in Table 6-2. Where applicable, the data have been compared to the USACE's 2016 DMMP screening levels (SLs; USACE 2016), and NOAA's recommended sediment quality guidelines (SQGs) based on the effects range low (ERL) and effects range median (ERM; Buchman 2008 and O'Connor 2004). The ERL represents the concentration below which adverse effects are expected to rarely occur; the ERM represents the concentration above which adverse effects are frequently expected.

Background ranges provided for the Beaufort Sea are from summarized data from the BOEM's ANIMIDA studies that examined a large number of sites in the Beaufort Sea nearshore and continental shelf area (Exponent 2010; Kasper et al. 2017; and Trefry and Neff 2018).

Station comparisons of select metals are depicted in Figure 6-3 and Figure 6-4; fairly large differences were seen between locations with the highest concentrations generally found at Stations S2, S6, and S11 that all exhibited the highest concentrations of % Fines, TOC, and TVS (Table 6-2). Trefry et al. (2003) found that trace metals in the Beaufort coastal area also correlated well with both aluminum and iron; most metals are generally low in quartz sand or carbonate shell material and high in the fine-grained metal-bearing alumino-silicates contained in silt and clay. Based on these relationships, Trefry developed a technique for examining Beaufort Sea metals concentrations normalized to aluminum or % Fines rather than looking at absolute concentrations in order to highlight any contaminated areas. This same technique is utilized here and presented as scatter plots with regression lines and correlations; these clearly show that differences in metals concentrations between stations can be ascribed to differences in conventional parameters as well as aluminum concentrations.

Table 6-2. Sediment Metals Concentrations in Willow MMP Area.

Parameter	Station								Sediment Screening Values				
	S2	S3	S3-2	S4	S6	S8	S11	Mean[1]	DMMP SLs[2]	Beaufort Sea Background[3]		NOAA[4]	
										Lower	Upper	ERL	ERM
Conventional Parameters													
Silt + Clay (%)	63.18	19.16	21.96	14.55	68.23	25.94	92.99	43.71	-	0.1	99.9	-	-
TOC (%)	3.25	0.43	0.45	0.26	1.34	0.62	3.88	1.46	-	0.02	7.36	-	-
TVS (%)	9.8	3.4	3.5	3.1	8.1	3.6	12.9	6.34	-	-	-	-	-
Metals (mg/kg dry wt.) except Aluminum & Iron (% dry wt.)													
Aluminum (%)	4.54	2.92	2.91	2.72	4.97	2.93	6.32	4.07	-	1.06	7.78	-	-
Antimony	1.08	0.467	0.477	0.403	0.535	0.474	0.722	0.614	150	0.14	1.17	-	-
Arsenic[5]	37.8	15.1	13.0	11.2	15.7	14.2	17.4	18.6	57	1.0	116	8.2	70
Barium	900	692	683	697	572	668	733	710	-	142	2210	-	-
Cadmium	0.209	0.0617	<0.0906	<0.0917	0.16	0.0711	0.211	0.134	5.1	0.03	0.75	1.2	9.6
Chromium[5]	63.9	39.1	38	38.9	65.5	38.2	83.5	54.9	260	12.7	106	81	370
Copper	27.3	8.39	8.37	6.59	24.3	9.22	42.0	19.6	390	3.6	45.8	70	270
Iron (%)	3.69	2.36	2.24	2.05	3.24	2.29	4.09	2.95	-	0.72	6.94	-	-
Lead	19.8	7.89	7.36	6.24	13.1	9.21	17.1	12.2	450	2.8	22.3	46.7	218
Mercury	0.0844	0.0152	0.0173	0.0119	0.0497	0.0202	0.0980	0.0466	0.41	0.003	0.113	0.15	0.71
Nickel[5]	37.4	22.2	22.3	20.9	30.5	23.7	45.1	30.0	-	6.0	48.2	20.9	51.6
Selenium	0.394	<0.103	<0.181	<0.183	0.365	<0.134	0.340	0.253	3	0.38	1.88	-	-
Silver	0.188	0.084J+	0.0997	0.101	0.144	0.084J+	0.238	0.140	6.1	0.01	0.42	1.0	3.7
Vanadium	113	66.3	66.8	62.3	121	68.7	148	96.6	-	25.2	174	-	-
Zinc	91.2	58.9	68.8	52.8	90.9	59.8	119	78.8	410	1.8	136	150	410

[1] Station mean concentrations exclude field duplicate (S3-2) and utilize the MDL where concentrations were not detected.

[2] DMMP Sediment Screening Levels (SLs; USACE 2016). SLs are concentrations at which there are no adverse effects expected.

[3] Range of sediment concentrations in Beaufort Sea coastal area 1999-2015. Source is Exponent (2010), Kasper et al. (2017), and Trefry and Neff (2018) which summarizes data from a large number of locations from BOEM's ANIMIDA, cANIMIDA, and ANIMIDA III studies.

[4] ERLs and ERMs from Buchman (2008) and copper ERL is from O'Connor (2004).

[5] ERL is lower than the natural concentrations of arsenic, chromium, and nickel in the coastal Beaufort Sea (Trefry and Neff 2018).

< Not detected at the MDL shown.

\- Not available.

J+ Data flagged as potentially biased high.

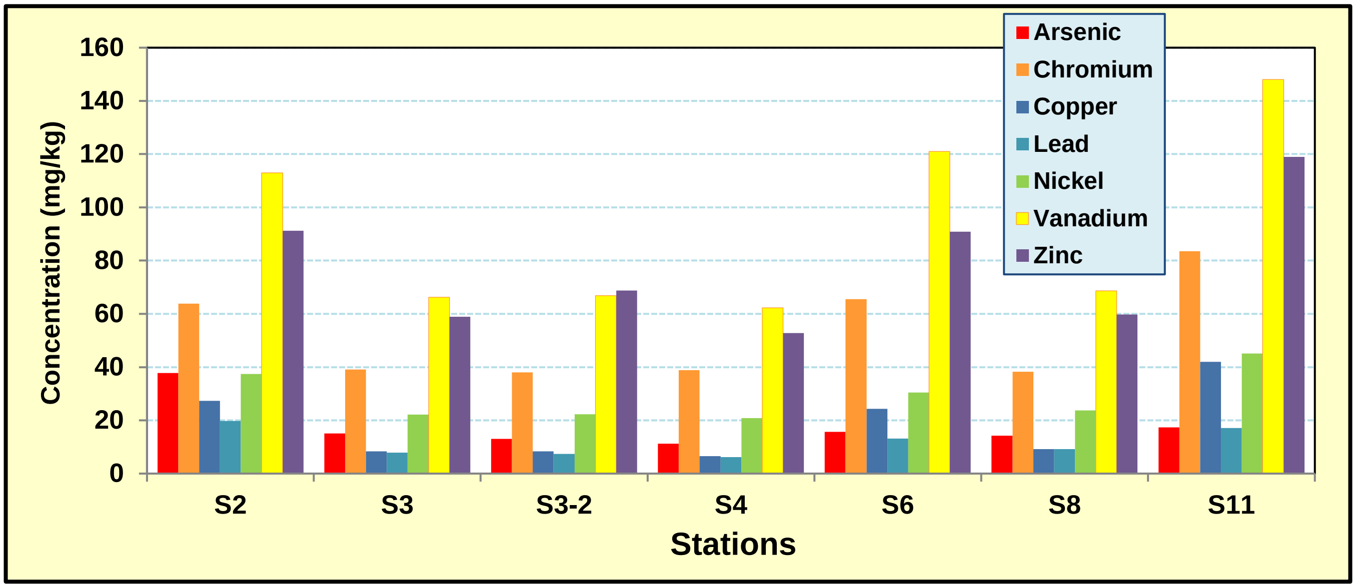


Figure 6-3. Comparison of Arsenic, Chromium, Copper, Lead, Nickel, Vanadium, and Zinc.

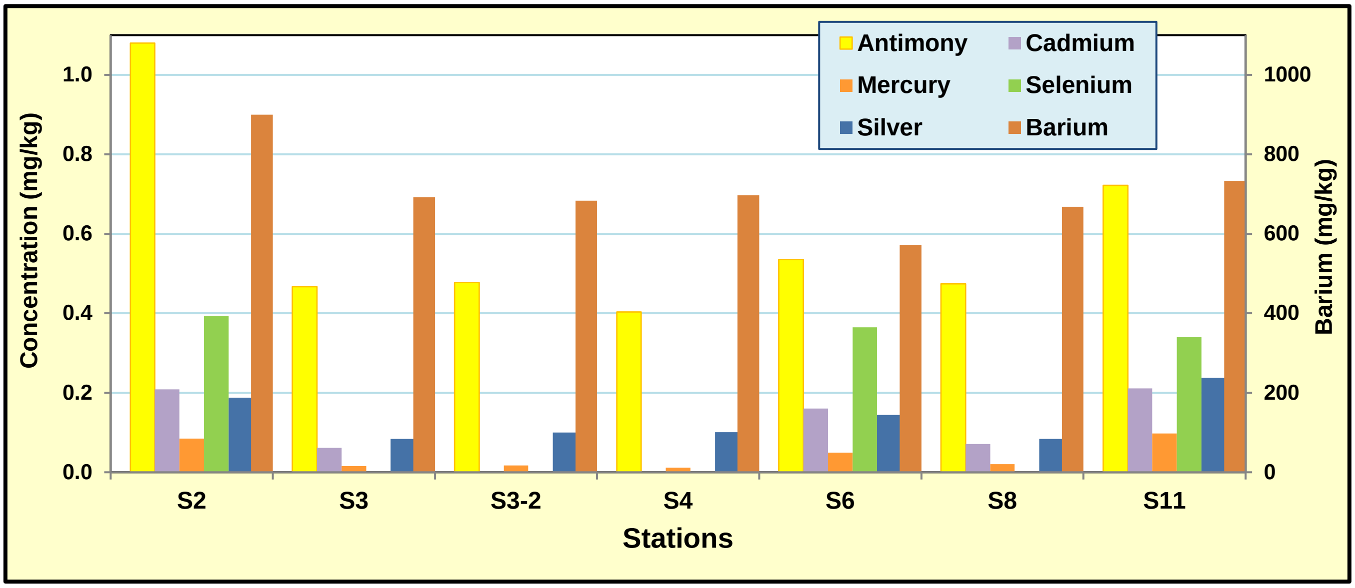


Figure 6-4. Comparison of Antimony, Barium, Cadmium, Mercury, Selenium, and Silver.

Regressions of select metals with % Fines, aluminum, and TOC are presented in Figure 6-5; these clearly show very high correlations with R^2 values well over 0.9. With the exception of arsenic, antimony, and barium, calculated Pearson correlation coefficients between metals and aluminum or conventional parameters were all over 0.9 for one or more concomitant parameters. Arsenic, antimony, and barium were found to be more highly correlated with TOC (0.66 for arsenic, 0.83 for antimony, and 0.58 for barium) than with aluminum, or other conventional parameters. The reason for the lower correlations seen in these three metals is unclear; however, concentrations were within the background range found for Beaufort Sea sediments.

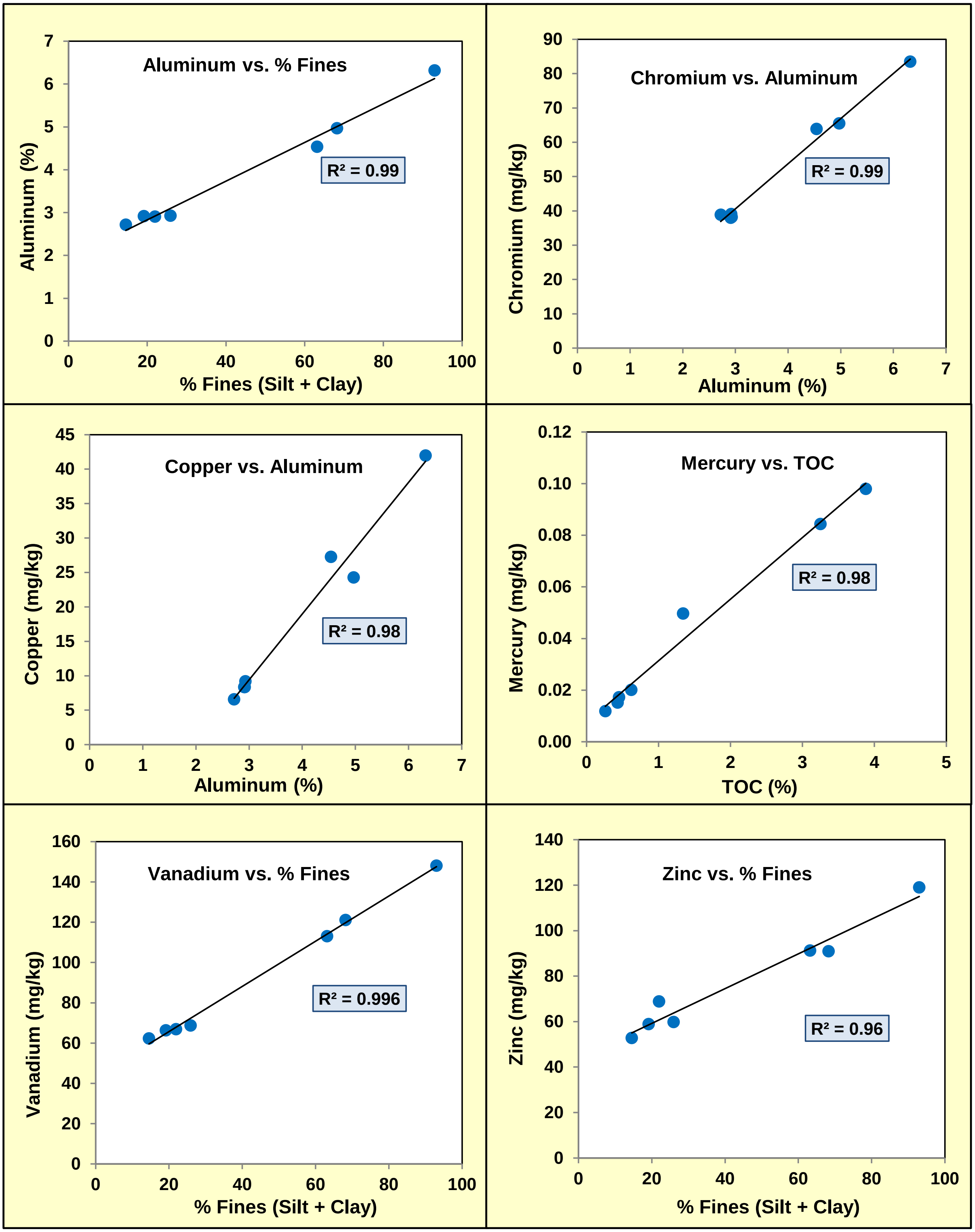


Figure 6-5. Regressions of Select Metals to Aluminum and Conventional Parameters.

Barium was found to range from a low of 572 milligrams/kilogram (mg/kg) to a high of 900 mg/kg with a survey mean of 710 mg/kg compared to a Beaufort Sea background range of 142 to 2210 mg/kg. Even though the ranges were within background concentrations, the low correlation of barium to both % Fines and aluminum and the anomalously high barium/aluminum ratios in some samples indicated that there might have been some enrichment of barium in the study area sediments. This enrichment could be the result of either diagenetic remobilization of barium from deeper sediments or historic offshore drilling activity, or a combination of the two sources. During the 2005 and 2006 ANIMIDA studies, barium anomalies were found in both Harrison and Camden Bays with concentrations and ratios similar to that seen in this study (Exponent 2010). Trefry speculated that the barium anomalies might be due to diagenetic remobilization of barium as reported by numerous authors or from barite inputs from offshore drilling, and that further research was needed (Exponent 2010 and Kasper et al. 2017). A number of authors have documented barium diagenetic remobilization, diffusion, and reprecipitation in marine sediments that might explain the anomalies (McManus et al. 1994; Torres et al. 1996; van Os et al. 1991; Liguori et al. 2016; etc.). Other researchers in Alaska have also noted elevated barium levels in various lakes on the North Slope (Michael Baker 2018), and Guay and Falkner (1998) noted higher barium levels in North American rivers and adjacent estuarine areas when compared to Eurasian Arctic rivers.

In terms of historic drilling activity, there were six exploratory drilling efforts (Antares, Fireweed, Mars, Mukluk, Orion, and Phoenix) that discharged drilling muds and cuttings to either water or sea ice between 1983 and 1990 that were immediately offshore of Harrison Bay in Federal waters, as well as additional inshore drilling in State lease blocks during 1985 and 1986 (Exponent 2010 and Neff 2010). A 2008 study that examined the area in Camden Bay where the 1985 Hammerhead drilling took place found barium concentrations in sediment ranging from 477 to 69,700 mg/kg, but only found elevated barium levels to be statistically significant within 250 m of the drill site (Trefry et al. 2013). Based on this Camden Bay study, it seems unlikely that the MMP sediments would have been affected to any significant extent by historic drilling mud discharges.

In all instances, metals from the Willow MMP were found to be below both the DMMP SLs and NOAA's established ERMs. ERLs were exceeded for some metals at some stations: all seven arsenic, one chromium, and all seven nickel concentrations; however, these three metals have been shown to be naturally high in Beaufort Sea sediments (Exponent 2010 and Trefry et al. 2003). Also, concentrations of chromium and nickel in Beaufort Sea sediments have generally been found to be low when compared to the average for continental crust material (Wedepohl 1995).

The highest arsenic concentration was found at Station S2 at 37.8 mg/kg, compared an ERL of 8.2 mg/kg and a Beaufort Sea background of up to 116 mg/kg. The highest chromium concentration was at Station S11 at 83.5 mg/kg, compared an ERL of 81 mg/kg, a value of 126 mg/kg for average continental crust material (Wedepohl 1995), and Beaufort background concentrations ranging up to 106 mg/kg. Nickel was highest at Station S11 at 45.1 mg/kg compared to an ERL of 20.9 mg/kg, continental crust of 56 mg/kg, and Beaufort background ranging up to 48.2 mg/kg. No other metals exceeded ERL levels, and all were well within typical concentrations for Beaufort Sea sediments. Also, Exponent (2010) found that nearby riverine suspended sediments from the Colville River had similar concentrations (Trefry et al. 2009).

In summary, with the possible exception of potential barium enrichment as explained above, there was no evidence that indicated Willow MMP sediments were contaminated, which is consistent with the regional long-term studies conducted by BOEM. All metals concentrations were within the natural ranges found in the Beaufort Sea nearshore area. For the three metals that did exceed the ERL sediment guideline levels, it was shown that these are typical natural background concentrations for the Beaufort Sea and that concentrations are consistent with erosion of continental crust material.

6.1.3 Sediment Hydrocarbons

Surficial sediment analyses of hydrocarbons included AHC, PAH, and select biomarkers to allow comparison with Beaufort Sea background data collected by BOEM as part of BSMP and ANIMIDA.

AHCs included the saturated n-alkanes (n-C9 through n-C40) plus isoprenoids, where the summation is defined as total AHC (TAHC); total resolved hydrocarbons (TRHC) that includes TAHC analytes plus other resolved but unidentified compounds like plant waxes and lipids; the unresolved complex mixture (UCM); extractable organic matter (EOM); and total petroleum hydrocarbons (TPH) which is the summation of the TRHC and UCM. A summary of AHC parameters by location is presented in Table 6-3 and Figure 6-6. The odd-even preference index (OEPI), a diagnostic indicator that is the ratio of a group of odd-numbered n-alkanes to a group of even-numbered n-alkanes, is also presented. Concentrations of individual AHC for each sample along with QA/QC information are provided in the appendices.

Table 6-3. Sediment Hydrocarbon Concentrations in the Willow MMP Area.

Parameter	Station								Beaufort Background[2]	
	S2	S3	S3-2	S4	S6	S8	S11	Mean[1]	Lower	Upper
Aliphatic Hydrocarbons (mg/kg dry wt.)										
TAHC	21.2	2.6	2.7	1.0	12.8	2.9	30.7	11.9	0.6	100
EOM	751	62	60	38	648	74	1958	588	-	-
TRHC	91.7	11.3	10.6	14.4	56.2	10.8	169.5	59.0	-	-
UCM	92.1	35.6	33.3	20.8	58.5	39.0	105.5	58.6	-	-
TPH	183.8	46.9	44.0	35.2	114.7	49.8	275.0	117.6	-	-
OEPI	4.72	4.63	5.14	5.44	5.11	4.63	5.64	5.03	-	-
Polycyclic Aromatic Hydrocarbons (ug/kg dry wt.)										
TPAH	2114	364	377	203	1513	392	2652	1206	12	2950
TPAH $^{(16P)}$	318	51	53	29	223	56	380	176	-	-
C2D/C2P	0.27	0.28	0.28	0.27	0.25	0.28	0.25	0.27	-	-
C3D/C3P	0.19	0.34	0.31	0.39	0.24	0.30	0.24	0.28	-	-
Select Biomarkers (ug/kg dry wt.)										
C29-Hopane	29.5	5.0	5.1	3.6	14.3	5.8	41.2	16.6	-	-
C30-Hopane	59.0	9.7	9.3	5.4	26.8	10.2	47.1	26.4	-	-
Total S/T10	176.4	29.7	29.3	17.2	88.6	32.8	156.1	83.5	1.5	212

[1] Station mean concentrations exclude field duplicate (S3-2).

[2] Range of sediment concentrations in Beaufort Sea coastal area including Colville River inputs 1999-2015. Sources are Exponent (2010), Kasper et al. (2017), and Neff (2010), which summarize data from a large number of locations from BOEM's ANIMIDA, cANIMIDA, and ANIMIDA III studies.

\- Not available or not calculated.

TPAH$^{(16P)}$ Subset of 16 EPA priority pollutants.

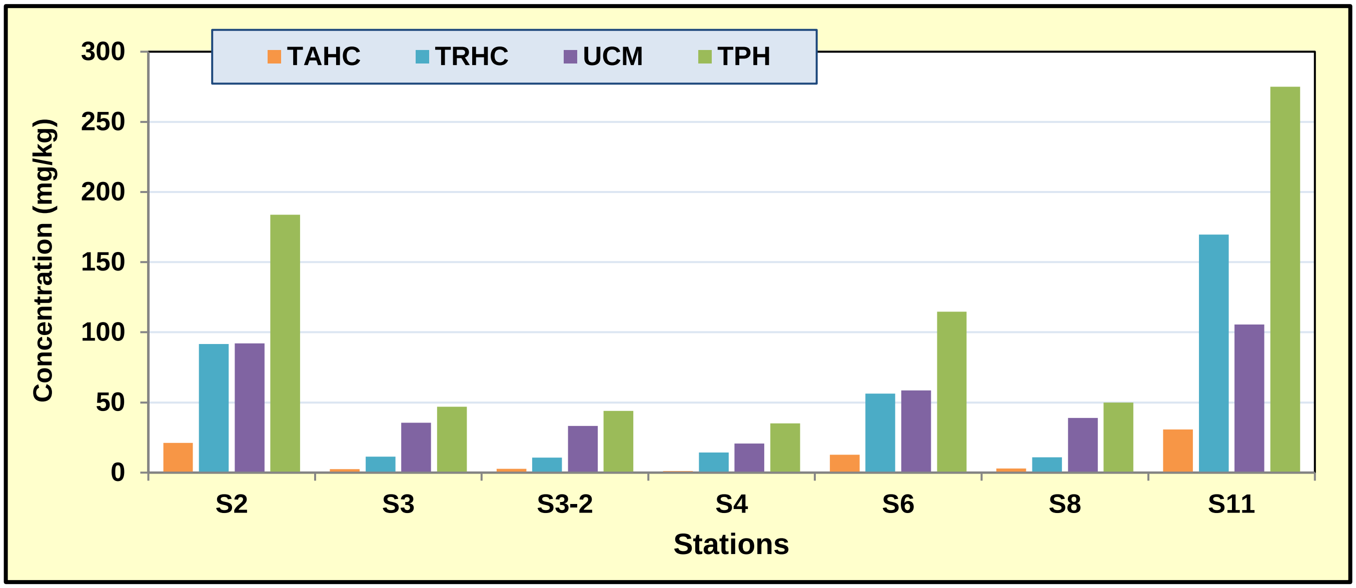


Figure 6-6. Comparison of AHC Parameters by Station.

Concentrations of TAHC in surficial sediments ranged from a low of 1.0 mg/kg at Station S4 to a high of 30.7 mg/kg at Station S11, with a study mean of 11.9 mg/kg compared to a range of 0.6 to 100 mg/kg found in Beaufort Sea background measurements Table 6-3. Data collected during the ANIMIDA studies found TAHC concentrations of 37 mg/kg in Colville River sediments and 47 mg/kg in Colville River peat samples (Neff 2010). As seen with metals, the highest TAHC concentrations were found at Stations S2 and S11, which also exhibited the highest % Fines and organic content as measured by TOC, TVS, and EOM. Similar patterns were seen in the other AHC parameters, with TRHC ranging from 10.6 mg/kg at Station S3-2 to a high of 169.5 mg/kg at Station S11, with a study mean of 59.0 mg/kg. UCM ranged from 20.8 to 105.5 mg/kg with a study mean of 58.6 mg/kg, while TPH ranged from 35.2 to 275 mg/kg with a mean of 117.6 mg/kg. Regressions of AHC parameters versus TOC clearly show a very high degree of correlation between organic content and hydrocarbon concentrations with coefficients of determination (R^2) ranging from 0.92 for TRHC to a high of 0.98 for UCM (Figure 6-7). Pearson correlation coefficients between AHC parameters versus TOC, TVS, EOM, % Fines, and aluminum were all very high and all over 0.9, a clear indication of the need to account for sediment type in any interpretation of absolute hydrocarbon concentrations.

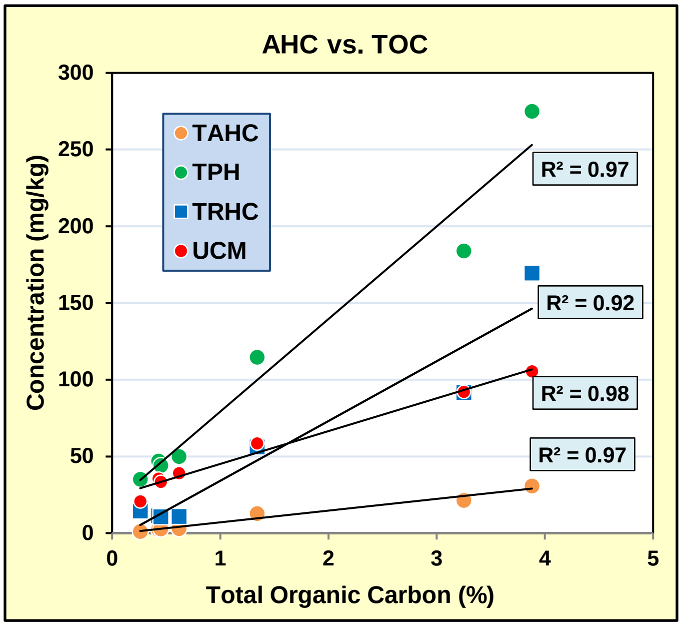


Figure 6-7. AHC vs. TOC Regressions

In examining historic Beaufort Sea data and accompanying interpretative analysis, it is clear that one of the primary sources of saturated aliphatic hydrocarbons is from riverine and coastal peat inputs that are dominated by terrestrial biogenic hydrocarbons with smaller contributions from naturally occurring petroleum hydrocarbons from source rock/shale formations (Neff 2010). One measure of the amount of biogenic inputs is to look at either the carbon preference index or the OEPI, which is defined in this report as the following:

$$\text{OEPI} = (C_{23} + C_{25} + C_{27} + C_{29} + C_{31} + C_{33})/(C_{24} + C_{26} + C_{28} + C_{30} + C_{32} + C_{34})$$

Since odd- and even-numbered alkanes are equally abundant in petroleum, an OEPI close to one is indicated in petroleum sourced-material, whereas biological materials have an odd-numbered preference indicative of biogenic inputs. OEPI's for the Willow MMP surficial sediments ranged from 4.63 to 5.64, which is very similar to that seen in suspended sediment and peat being discharged by the Colville River as documented by Neff (2010); this is indicative of terrestrial biogenic inputs.

The overall distribution of individual alkanes/isoprenoids was found to be very similar between the six MMP sampling sites; the primary difference in overall concentration was a result of differences in organic content. An AHC distribution profile from Station S2 is depicted in Figure 6-8; this shows a clear odd-to-even preference in the n-alkanes with the most abundant being in the C19 to C33 range, similar to that reported for the Colville River by Neff (2010). For comparison, a reference crude oil analyzed by the laboratory for QC, also shown in Figure 6-8, shows a typical dominance in the lower molecular-weight alkanes (n-C9 through n-C20) and an OEPI in the higher molecular-weight alkanes that is closer to one.

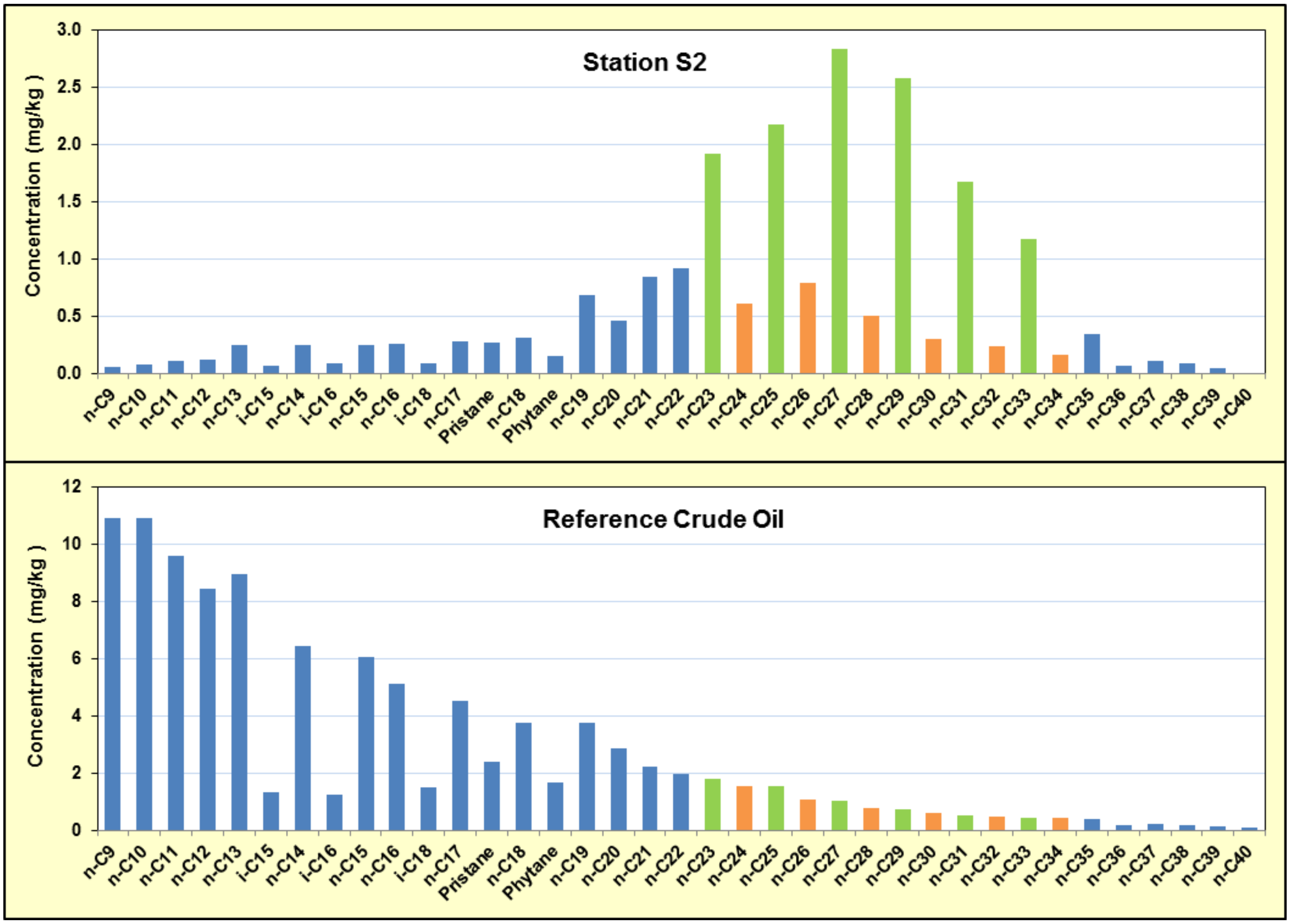


Figure 6-8. AHC Distribution for Station S2 and Reference Crude Oil.

Analysis of PAHs included a suite of 44 individual PAH analytes. Concentrations of total PAH (TPAH) ranged from 203 micrograms/kilogram (µg/kg) at Station S4 to a high of 2652 µg/kg at Station S11, with a study mean of 1206 µg/kg, and a Beaufort Sea background range of 12 to 2950 µg/kg (Table 6-3 and Figure 6-9). A summary of BSMP and ANIMIDA data compiled by Neff (2010) found the riverine inputs of TPAH varied substantially between the Canning, Colville, Kuparuk, and Sagavanirktok Rivers, both among rivers and between years; some of the highest concentrations were found in the Colville River sediments which ranged from a low of 140 µg/kg to a high of 2634 µg/kg, which is very similar to the highest concentrations seen during the Willow MMP. Note that for summation purposes in this report, two biogenic PAHs, retene and perylene, have been excluded from TPAH to be consistent with and to allow direct comparison with BSMP and ANIMIDA study results.

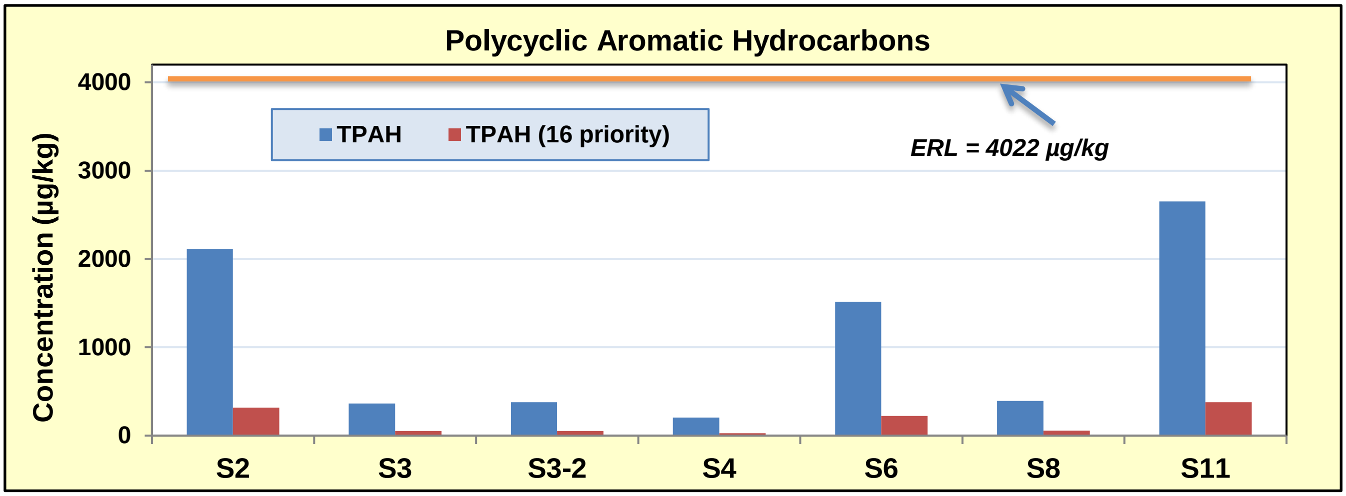


Figure 6-9. Comparison of TPAH Concentration by Station.

A subset of 16 PAHs that are on EPA's priority pollutant list were also summed ($TPAH^{16P}$) and found to range from 29 to 380 µg/kg, with a study mean of 176 µg/kg, which is over an order of magnitude lower than NOAA's ERL level of 4022 µg/kg (Figure 6-9). As seen with metals and AHCs, PAHs were found to be highly correlated with the concomitant sediment parameters of TVS and % Fines as shown by the regressions in Figure 6-10. Similar high correlations were also found for TOC and aluminum, with Pearson correlation coefficients of 0.97 and 0.96, respectively.

The overall fingerprint of individual PAHs between stations was found to be very similar with differences in concentrations directly related to sediment conventional parameters. A PAH distribution from Station S2 is shown in Figure 6-11, with pyrogenic combustion-related PAHs highlighted in red, biogenic perylene shown in green, and other major groupings (e.g., naphthalenes, phenanthrene/anthracenes, etc.) highlighted by different colors to aid interpretation. A nearly identical PAH pattern in both concentration and distribution was documented in Colville River sediments by Exponent (2010), which further confirms the source of hydrocarbons found during the 2018 MMP (Figure 6-12).

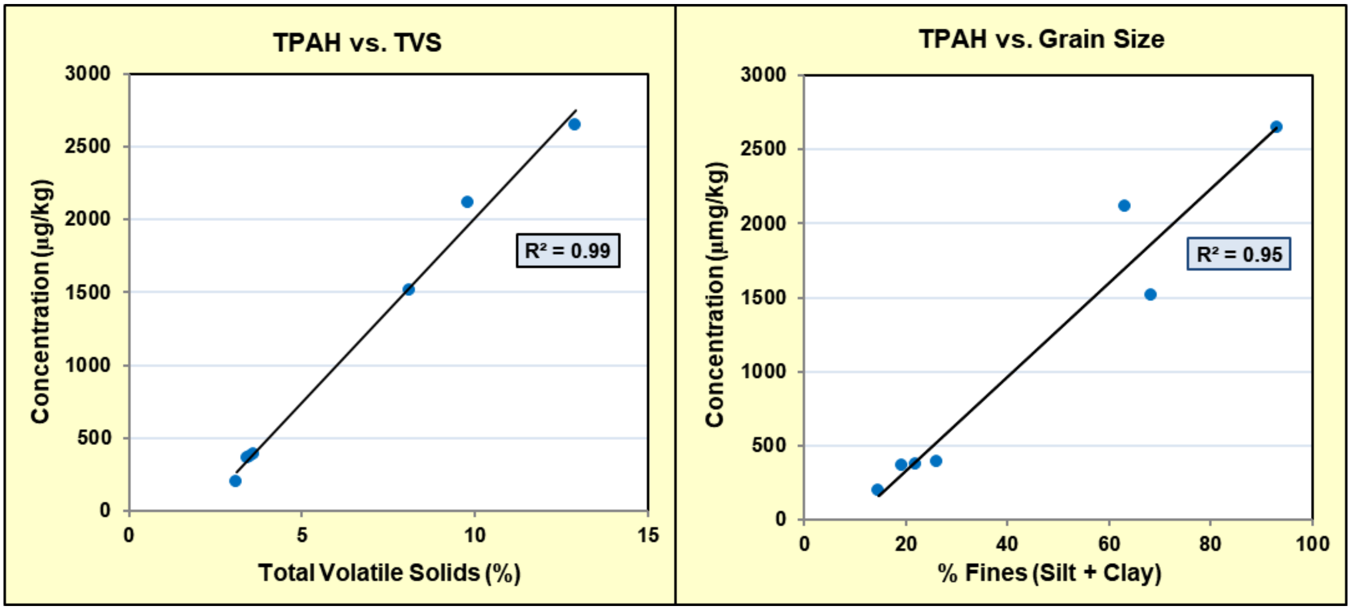


Figure 6-10. Scatter Plots and Regressions of TPAH vs. TVS and % Fines.

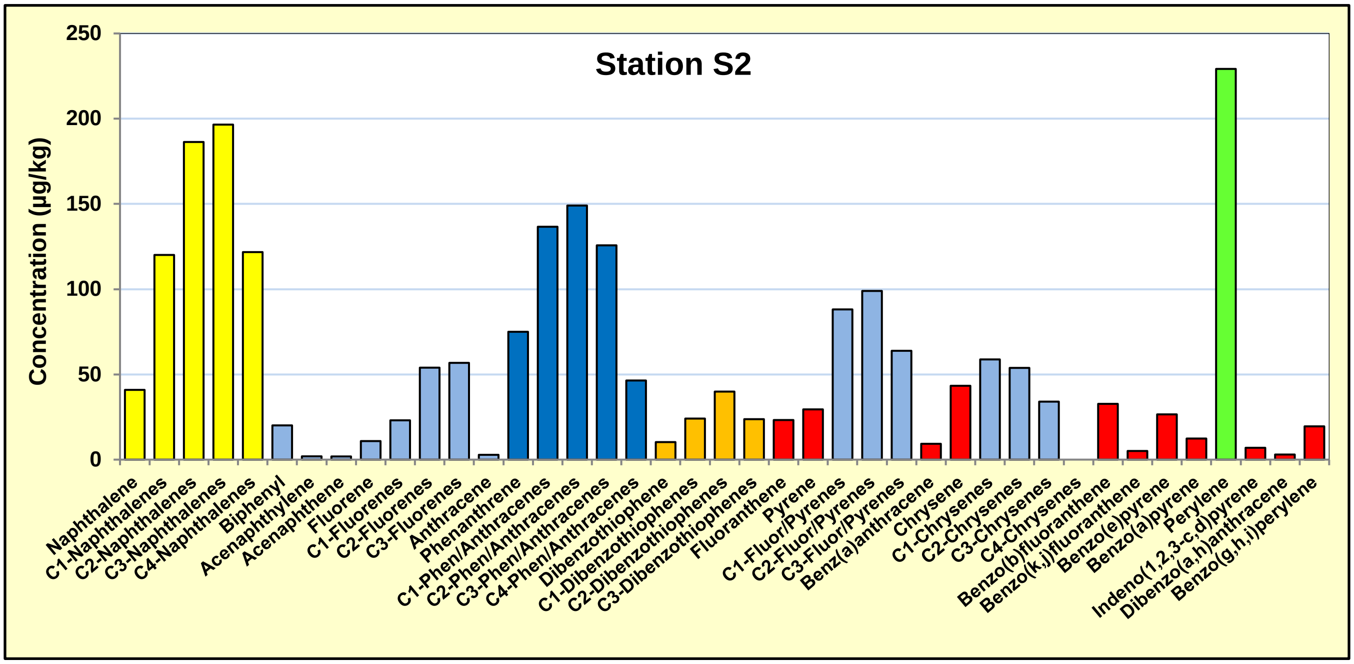


Figure 6-11. Sediment PAH Distribution from Station S2.

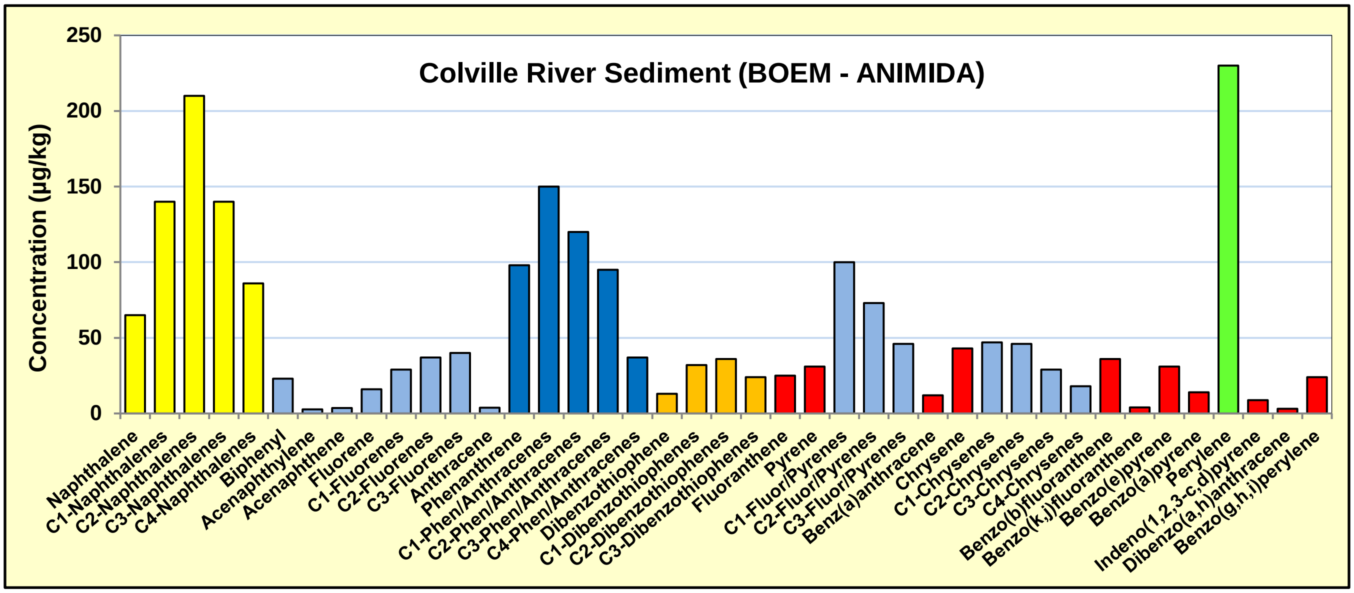


Figure 6-12. Colville River Sediment PAH Distribution, ANIMIDA Study (Exponent 2010).

A technique that is utilized for source identification is to examine double ratio plots of various hydrocarbon parameters to tease out differences when overall concentrations levels are similar. One comparison often used is the double ratio of C2-Dibenzothiophene/C2-Phenanthrene-Anthracene (C2D/C2P) versus C3-Dibenzothiophene/C3-Phenanthrene-Anthracene (C3D/C3P). When these ratios for MMP sediments are overlaid on ANIMIDA results (Figure 6-13), it can clearly be seen that the MMP sediments from Western Harrison Bay plot with the general Beaufort Sea background and are very similar to historic sediment samples from the Colville River. Also, ratios for North Slope crude oils are much higher and clearly fall well outside the range of that seen for Beaufort Sea sediments and other regional riverine and peat input sources.

In addition to the AHCs and PAHs, surficial sediments were analyzed for select biomarkers that included 10 steranes and triterpanes (S/T). Two prominent biomarkers, C29-hopane and C30-hopane, and Total S/T show a similar pattern to other hydrocarbon parameters, with the highest concentrations found at Stations S2 and S11 (Figure 6-14). As with other sediment hydrocarbon concentrations, biomarkers were found to be highly correlated with % Fines, TOC, and TVS.

With few exceptions, past studies conducted by BOEM have shown that Beaufort Sea sediments are free from any anthropogenic sources of hydrocarbon contamination and that the AHC, PAH, and biomarker distributions are naturally occurring and highly correlated with riverine and coastal erosion inputs. BOEM found a strong link between natural sources of hydrocarbon inputs from the Colville River, mostly shales, coal, and peat, to that seen in regional sediments. The hydrocarbon distributions found in the MMP sediments were found to be very similar to that reported by BOEM studies that reflect the natural background from regional sources such as the Colville River, with no evidence of petroleum contamination.

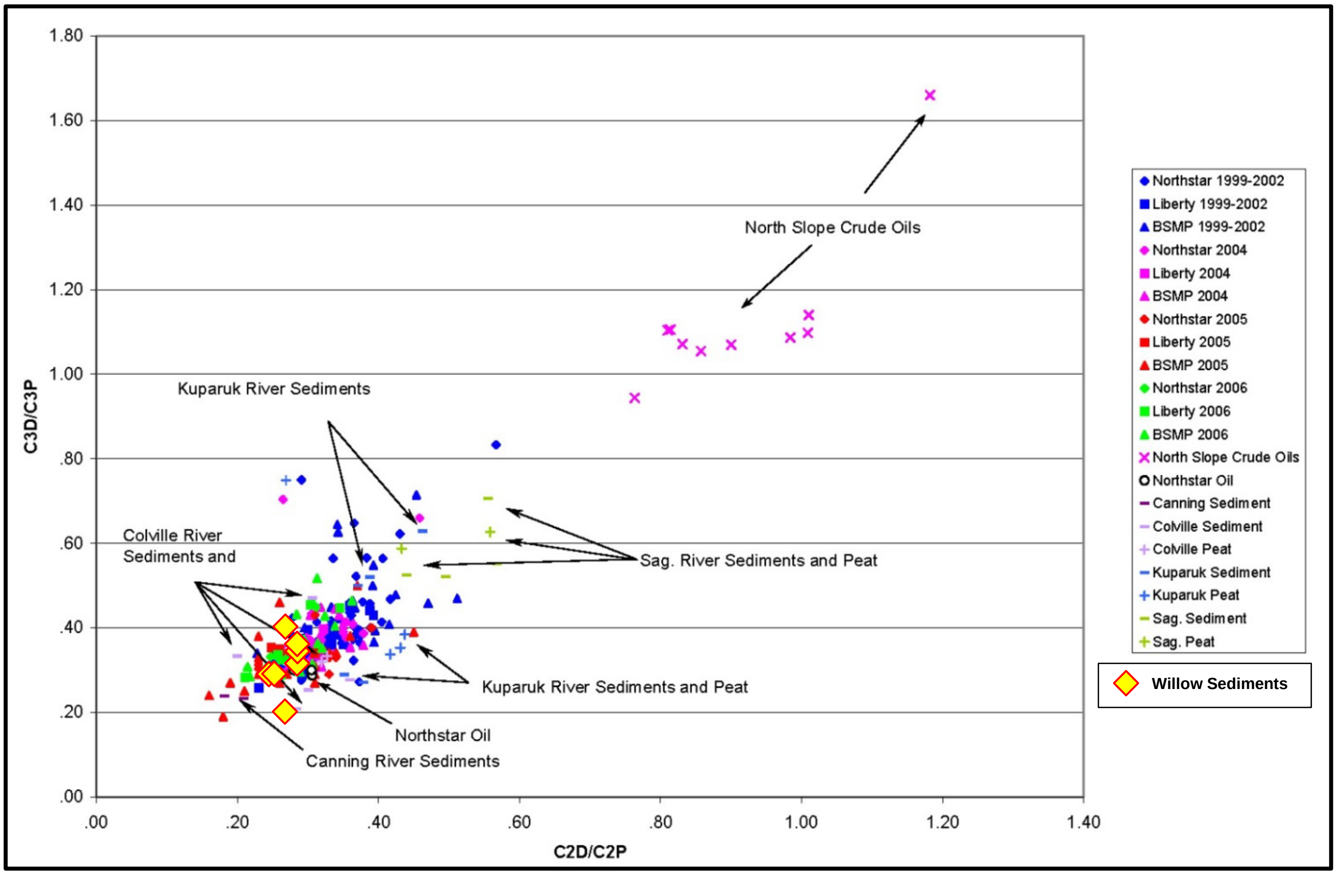


Figure 6-13. **Double Ratio Source Plot C2D/C2P vs. C3D/C3P for Willow MMP Sediments in Comparison to BSMP and ANIMIDA Results from Exponent (2010).**

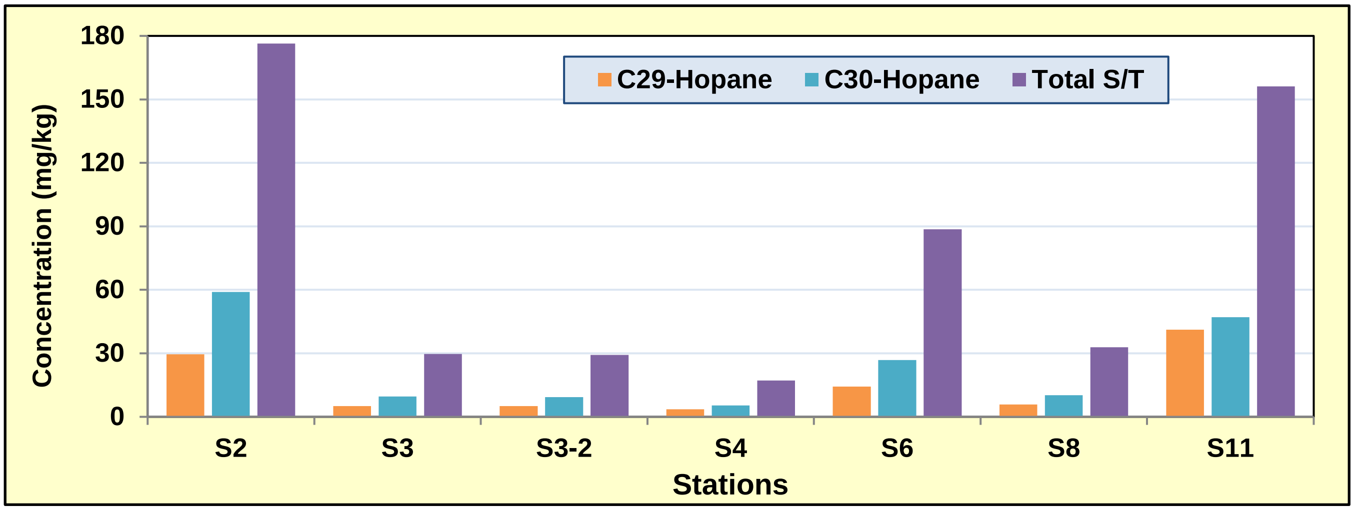


Figure 6-14. **Summary of Biomarker Concentrations by Station.**

6.2 BENTHIC INFAUNAL RESULTS

Benthic sampling station information is provided in Table 2-1. The arrangement of the MMP benthic stations as depicted on Figure 2-1 included station placement forming three transects with increasing distance (and to some degree, depth contours) from the shoreline outward towards the north. Stations S7, S8, and S9 (Transect 1) are farthest west, while Stations S10, S11, and S12 (Transect 3) are farthest east, with the remaining six stations along the middle Transect 2. Transect 2 includes the proposed MTI location at Station S3, which is basically in the middle of all 12 benthic stations. Benthic data are presented here in three different ways, depending on the intent and type of analysis used. They have been arranged either by numeric station sequence, by transect, or by cluster classes or groupings. In some cases, station depths as well as % Fines and TOC are addressed as possible explanatory parameters for patterns that were observed in the data.

The benthic invertebrate species and taxa that were found were divided into four major taxonomic categories or groups: Annelida, Crustacea (Arthropoda), Mollusca, and Miscellaneous Phyla. As is standard and for comparative purposes with other studies, counts of the number of individuals for each taxa by station totals were converted to number per square meter ($\#/m^2$) units. As each benthic infaunal sample equalled 0.05 m^2 in surface area, all totals were multiplied by 20 to provide the community structure measure referred to here as density.

Abundance (number of individuals) and number of taxa seen at each station by major taxon groups are presented in Table 6-4. Data for ranked abundances, relative frequency, and relative abundance by station for each taxa are provided in Table 6-5. Relative frequency is defined as the percentage of occurrence that a given taxa has among stations, while relative abundance is the percentage of the total abundance of an individual taxa. Ranked data for calculated density by taxa are in Table 6-6, and summary statistics for the major taxon groups, community, and diversity related indices are in Table 6-7 and Table 6-8, respectively.

The proportion of major taxon abundance and numbers of taxa for all stations are presented in Figure 6-15. The abundance and number of taxa for the major taxon groups arranged by transect and station are presented in Figure 6-16 and Figure 6-17 and for abundances and taxa overall in Figure 6-18. Figure 6-19 and Figure 6-20 show the top five most abundant and frequently occurring taxa by transect and station.

6.2.1 Species Abundance and Density

A total of 1640 benthic organisms were enumerated at all 12 of the benthic infauna stations sampled during the Willow MMP (Table 6-4 and Table 6-7, Figure 6-15). In terms of total counts, ~58% (n=950) of all the benthic organisms for the combined stations were annelids. The molluscs were the second most abundant group, accounting for ~30% (n=493) of all individuals recorded. Crustaceans were the third most abundant group, accounting for ~9% (n=148) overall, followed by the remaining miscellaneous taxa which comprised ~3% (n=49) of the overall organism count. Summary abundance statistics for the four major taxon groups are presented in Table 6-7. The variation in abundance among stations is clearly shown and is due to the wide range in differences seen among each major taxon.

The abundance of the annelids among stations varied greatly (Table 6-4 and Figure 6-16). Annelid abundance ranged from a high of 178 individuals at Station S7, to a low of only 4 individuals at Stations S6 and S12. Transects 1 and 3 showed annelid abundances that trended downward with distance from shore, while Transect 2 varied with distance due to increased abundances at Stations S4 and S5. Annelid

Table 6-4. Species and Taxa Abundance by Station and Overall Totals.

Major		Transect 2 (Middle)						Transect 1 (West)			Transect 3 (East)			Sum
Taxon Group	**Taxa**	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	**S9**	**S10**	**S11**	**S12**	**Total**
Annelida														
Oligochaeta	Oligochaeta UI	20	3						2		1	3		29
Polychaeta	*Amastigos* sp. Beaufort 1	3							3					6
Polychaeta	*Ampharete* sp. Beaufort 1	17	57	9	62	152		108	59	19	35			518
Polychaeta	*Aricidea (Aricidea)* sp. Beaufort 1					1		2						3
Polychaeta	*Bipalponephtys cornuta*					1		1						2
Polychaeta	*Capitella capitata* Cmplx	2	1										1	4
Polychaeta	*Chaetozone ruffi*	3		12	5	3		23	20	12				78
Polychaeta	*Chone* sp. Beaufort 1												1	1
Polychaeta	*Eteone longa-flava* Cmplx	1	5		1	1								8
Polychaeta	Euclymeninae					1								1
Polychaeta	*Leitoscoloplos* spp.					1								1
Polychaeta	*Marenzelleria arctia*		2	2		1	3	17	3	1		2	2	33
Polychaeta	*Orbinia* spp.			1					2	4				7
Polychaeta	*Prionospio cirrifera*		11		1	7	1			1				21
Polychaeta	*Prionospio* spp. *								1					1
Polychaeta	*Pygospio elegans*								2	2				4
Polychaeta	*Scoloplos armiger* Cmplx									7				7
Polychaeta	*Sphaerodoridium* sp. Beaufort 1				1			2						3
Polychaeta	*Sphaerodoridium* sp. Beaufort 2					3								3
Polychaeta	*Terebellides* sp. Beaufort 1	2						2						4
Polychaeta	*Tharyx alaskensis*	88	10					23	2		59	29		211
Polychaeta	*Travisia* cf *forbesi*				2	1				2				5
	Annelid Number of Taxa	**8**	**7**	**4**	**6**	**11**	**2**	**8**	**9**	**8**	**3**	**3**	**3**	**22**
	Annelid Number of Individuals	**136**	**89**	**24**	**72**	**172**	**4**	**178**	**94**	**48**	**95**	**34**	**4**	**950**
Crustacea														
Amphipoda	*Crassicorophium* cf *clarencense*					1								1
Amphipoda	*Monoculopsis longicornis*							1		1				2
Amphipoda	*Monoporeia affinis*										1			1
Amphipoda	*Onisimus affinis*	1												1
Amphipoda	*Pontoporeia femorata*	14						1			2	3		20
Amphipoda	*Priscillina armata*				2				2					4
Cumacea	*Diastylis sulcata*	49	5			1	1	7	3		4	25	2	97
Euphausiacea	*Thysanoessa raschi*							1						1
Isopoda	*Saduria entomon*					1	1				2		1	5
Mysidacea	*Mysis nordenskioldi*	1												1
Ostracoda	Podocopids UI *	1	4		2	1		6					1	15
	Crustacea Number of Taxa	**5**	**2**	**0**	**2**	**4**	**2**	**5**	**2**	**1**	**4**	**2**	**3**	**11**
	Crustacea Number of Individuals	**66**	**9**	**0**	**4**	**4**	**2**	**16**	**5**	**1**	**9**	**28**	**4**	**148**
Mollusca														
Bivalvia	*Axinopsida serricata*						1							1
Bivalvia	*Boreacola maltzani*	2	11	40	65	22		15	124	139			10	428
Bivalvia	*Cyrtodaria kurriana*	1						1	15	9	3			29
Bivalvia	*Liocyma fluctuosa*					3	2							5
Bivalvia	*Macoma balthica*										2			2
Bivalvia	*Portlandia intermedia*			1	3	5	8	1	1		1		1	21
Gastropoda	*Cylichna attonsa*			1										1
Gastropoda	*Retusa* spp.		4		1			1						6
	Mollusca Number of Taxa	**2**	**2**	**3**	**3**	**3**	**3**	**4**	**3**	**2**	**3**	**0**	**2**	**8**
	Mollusca Number of Individuals	**3**	**15**	**42**	**69**	**30**	**11**	**18**	**140**	**148**	**6**	**0**	**11**	**493**
Miscellaneous														
Nemertea	*Carinoma mutabilis*	2	2								1			5
Nemertea	Nemertea UI *			1							1			2
Nemertea	*Tetrastemma* spp.		1											1
Priapulida	*Halicryptus spinulosus*	12	1	2	1	3		4	3		6	2	3	37
Priapulida	*Priapulus caudatus*					1		1						2
Priapulida	Priapulids UI *					2								2
	Miscellaneous Number of Taxa	**2**	**3**	**2**	**1**	**3**	**0**	**2**	**1**	**0**	**3**	**1**	**1**	**6**
	Miscellaneous Number of Individuals	**14**	**4**	**3**	**1**	**6**	**0**	**5**	**3**	**0**	**8**	**2**	**3**	**49**
	Total Number of Taxa	**17**	**14**	**9**	**12**	**21**	**7**	**19**	**15**	**11**	**13**	**6**	**9**	**47**
	Total Number of Individuals	**219**	**117**	**69**	**146**	**212**	**17**	**217**	**242**	**197**	**118**	**64**	**22**	**1640**

* Taxa not used in calculation of diversity-related indices.

Table 6-5. Percent Frequency of Occurrence and Ranking by Total Abundance for all Taxa.

Rank	Major Taxon Group	Taxa	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	Total # Indiv	% Freq of Occur	% of All Indiv	Cum % of All Indiv
1	Annelida	*Ampharete* sp. Beaufort 1	17	57	9	62	152		108	59	19	35			518	75.0	32	32
2	Mollusca	*Boreacola maltzani*	2	11	40	65	22		15	124	139			10	428	75.0	26	58
3	Annelida	*Tharyx alaskensis*	88	10					23	2		59	29		211	50.0	13	71
4	Crustacea	*Diastylis sulcata*	49	5			1	1	7	3		4	25	2	97	75.0	5.9	76.5
5	Annelida	*Chaetozone ruffi*	3		12	5	3		23	20	12				78	58.3	4.8	81.2
6	Misc.	*Halicryptus spinulosus*	12	1	2	1	3		4	3		6	2	3	37	83.3	2.3	83.5
7	Annelida	*Marenzelleria arctia*		2	2		1	3	17	3	1		2	2	33	75.0	2.0	85.5
8	Mollusca	*Cyrtodaria kurriana*	1						1	15	9	3			29	41.7	1.8	87.3
9	Annelida	Oligochaeta UI	20	3						2		1	3		29	41.7	1.8	89.0
10	Mollusca	*Portlandia intermedia*			1	3	5	8	1	1		1		1	21	66.7	1.3	90.3
11	Annelida	*Prionospio cirrifera*		11		1	7	1			1				21	41.7	1.3	91.6
12	Crustacea	*Pontoporeia femorata*	14						1			2	3		20	33.3	1.2	92.8
13	Crustacea	Podocopids UI*	1	4		2	1		6					1	15	50.0	0.9	93.7
14	Annelida	*Eteone longa-flava* Cmplx	1	5		1	1								8	33.3	0.5	94.2
15	Annelida	*Orbinia* spp.			1					2	4				7	25.0	0.4	94.6
16	Annelida	*Scoloplos armiger* Cmplx									7				7	8.3	0.4	95.1
17	Annelida	*Amastigos* sp. Beaufort 1	3							3					6	16.7	0.4	95.4
18	Mollusca	*Retusa* spp.		4		1			1						6	25.0	0.4	95.8
19	Misc.	*Carinoma mutabilis*	2	2								1			5	25.0	0.3	96.1
20	Mollusca	*Liocyma fluctuosa*					3	2							5	16.7	0.3	96.4
21	Crustacea	*Saduria entomon*					1	1				2		1	5	33.3	0.3	96.7
22	Annelida	*Travisia* cf *forbesi*				2	1				2				5	25.0	0.3	97.0
23	Annelida	*Capitella capitata* Cmplx	2	1										1	4	25.0	0.2	97.3
24	Crustacea	*Priscillina armata*				2				2					4	16.7	0.2	97.5
25	Annelida	*Pygospio elegans*								2	2				4	16.7	0.2	97.7
26	Annelida	*Terebellides* sp. Beaufort 1	2						2						4	16.7	0.2	98.0
27	Annelida	*Aricidea (Aricidea)* sp. Beaufort 1					1		2						3	16.7	0.2	98.2
28	Annelida	*Sphaerodoridium* sp. Beaufort 1				1			2						3	16.7	0.2	98.4
29	Annelida	*Sphaerodoridium* sp. Beaufort 2					3								3	8.3	0.2	98.5
30	Annelida	*Bipalponephtys cornuta*					1		1						2	16.7	0.1	98.7
31	Mollusca	*Macoma balthica*										2			2	8.3	0.1	98.8
32	Crustacea	*Monoculopsis longicornis*							1		1				2	16.7	0.1	98.9
33	Misc.	Nemertea UI*			1							1			2	16.7	0.1	99.0
34	Misc.	Priapulids UI*					2								2	8.3	0.1	99.1
35	Misc.	*Priapulus caudatus*					1		1						2	16.7	0.1	99.3
36	Mollusca	*Axinopsida serricata*						1							1	8.3	0.1	99.3
37	Annelida	*Chone* sp. Beaufort 1												1	1	8.3	0.1	99.4
38	Crustacea	*Crassicorophium* cf *clarencense*					1								1	8.3	0.1	99.5
39	Mollusca	*Cylichna attonsa*			1										1	8.3	0.1	99.5
40	Annelida	Euclymeninae					1								1	8.3	0.1	99.6
41	Annelida	*Leitoscoloplos* spp.					1								1	8.3	0.1	99.6
42	Crustacea	*Monoporeia affinis*										1			1	8.3	0.1	99.7
43	Crustacea	*Mysis nordenskioldi*	1												1	8.3	0.1	99.8
44	Crustacea	*Onisimus affinis*	1												1	8.3	0.1	99.8
45	Annelida	*Prionospio* spp.*								1					1	8.3	0.1	99.9
46	Misc.	*Tetrastemma* spp.		1											1	8.3	0.1	99.9
47	Crustacea	*Thysanoessa raschi*							1						1	8.3	0.1	100

* Taxa not used in calculation of diversity-related indices.

Table 6-6. Ranking of Species and Taxa by Overall Density[1].

Major Taxon Group	Taxa	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	Average Density (#/m^2)
Annelida	*Ampharete* sp. Beaufort 1	340	1140	180	1240	3040		2160	1180	380	700			863
Mollusca	*Boreacola maltzani*	40	220	800	1300	440		300	2480	2780			200	713
Annelida	*Tharyx alaskensis*	1760	200					460	40		1180	580		352
Crustacea	*Diastylis sulcata*	980	100			20	20	140	60		80	500	40	162
Annelida	*Chaetozone ruffi*	60		240	100	60		460	400	240				130
Misc.	*Halicryptus spinulosus*	240	20	40	20	60		80	60		120	40	60	62
Annelida	*Marenzelleria arctia*		40	40		20	60	340	60	20		40	40	55
Mollusca	*Cyrtodaria kurriana*	20						20	300	180	60			48
Annelida	Oligochaeta UI	400	60						40		20	60		48
Mollusca	*Portlandia intermedia*			20	60	100	160	20	20		20		20	35
Annelida	*Prionospio cirrifera*		220		20	140	20			20				35
Crustacea	*Pontoporeia femorata*	280						20			40	60		33
Annelida	Podocopids UI	20	80		40	20		120					20	25
Annelida	*Eteone longa-flava* Cmplx	20	100		20	20								13
Annelida	*Orbinia* spp.			20					40	80				12
Annelida	*Scoloplos armiger* Cmplx									140				12
Mollusca	*Amastigos* sp. Beaufort 1	60							60					10
Annelida	*Retusa* spp.		80		20			20						10
Annelida	*Carinoma mutabilis*	40	40								20			8
Misc.	*Liocyma fluctuosa*					60	40							8
Mollusca	*Saduria entomon*					20	20				40		20	8
Crustacea	*Travisia* cf *forbesi*				40	20				40				8
Annelida	*Capitella capitata* Cmplx	40	20										20	7
Crustacea	*Priscillina armata*				40				40					7
Annelida	*Pygospio elegans*								40	40				7
Annelida	*Terebellides* sp. Beaufort 1	40						40						7
Annelida	*Aricidea (Aricidea)* sp. Beaufort 1					20		40						5
Annelida	*Sphaerodoridium* sp. Beaufort 1				20			40						5
Annelida	*Sphaerodoridium* sp. Beaufort 2					60								5
Annelida	*Bipalponephtys cornuta*					20		20						3
Annelida	*Macoma balthica*										40			3
Annelida	*Monoculopsis longicornis*							20		20				3
Mollusca	Nemertea UI			20							20			3
Crustacea	Priapulids UI					40								3
Misc.	*Priapulus caudatus*					20		20						3
Mollusca	*Axinopsida serricata*						20							2
Crustacea	*Chone* sp. Beaufort 1												20	2
Mollusca	*Crassicorophium* cf *clarencense*					20								2
Crustacea	*Cylichna attonsa*			20										2
Crustacea	Euclymeninae					20								2
Misc.	*Leitoscoloplos* spp.					20								2
Crustacea	*Monoporeia affinis*										20			2
Crustacea	*Mysis nordenskioldi*	20												2
Misc.	*Onisimus affinis*	20												2
Annelida	*Prionospio* spp.								20					2
Misc.	*Tetrastemma* spp.		20											2
Crustacea	*Thysanoessa raschi*							20						2
	Density (#/m^2)	**4380**	**2340**	**1380**	**2920**	**4240**	**340**	**4340**	**4840**	**3940**	**2360**	**1280**	**440**	**2733**

[1] Number of individuals (n) per 0.05 m^2 sample. Because 1 m^2 / 0.05 m^2 = 20; density is n per sample x 20.

Table 6-7. Abundance and Number of Taxa Summary Statistics for Major Taxon Groups.

Major Taxon Group	Sum	Median	Mean	Standard Deviation SD (n-1)	Standard Error of the Mean (SE)	Variation Coefficient (CV)
Total Abundance						
Annelida	950	80.5	79.2	60.0	17.3	0.73
Crustacea	148	4.5	12.3	18.6	5.4	1.44
Mollusca	493	16.5	41.1	51.8	15.0	1.21
Miscellaneous	49	3.0	4.1	3.9	1.1	0.92
All	**1640**	**132.0**	**136.7**	**80.8**	**23.3**	**0.6**
Number of Taxa						
Annelida	22	6.5	6.0	2.9	0.8	0.47
Crustacea	11	2.0	2.7	1.6	0.4	0.56
Mollusca	8	3.0	2.5	1.0	0.3	0.38
Miscellaneous	6	1.5	1.6	1.1	0.3	0.66
All	**47**	**12.5**	**12.8**	**4.7**	**1.4**	**0.4**

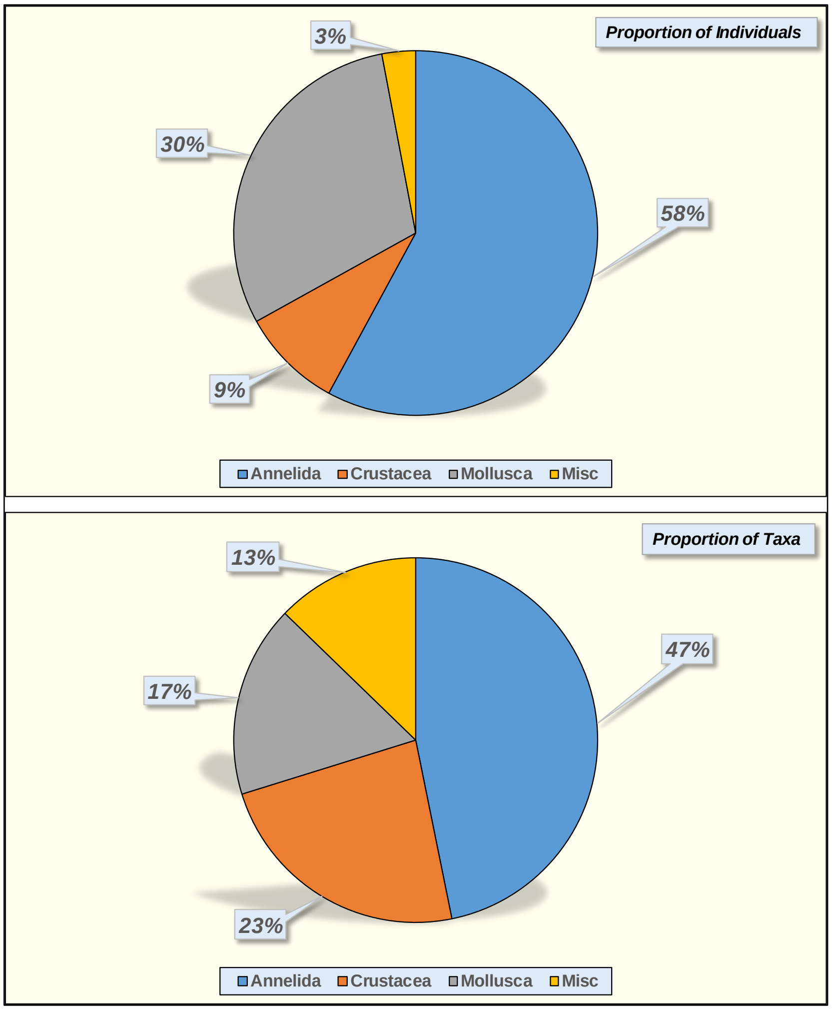


Figure 6-15. Major Taxon Proportion of Individuals and Taxa at All Stations.

Table 6-8. Summary Statistics of Community and Related Diversity Indices by Transect.

Station/ Indices	Number of Individuals (n)	Density of Individuals (#/m^2)[1]	Number of Taxa or Richness (S)[2]	Dominance (D)[3]	Simpson (1-D)[4] or Evenness	Shannon Diversity (H)[5]
S7	211	4340	18	0.30	0.70	1.70
S8	241	4840	14	0.33	0.67	1.48
S9	197	3940	11	0.51	0.49	1.13
S1	218	4380	16	0.23	0.77	1.81
S2	113	2340	13	0.28	0.72	1.72
S3	68	1380	8	0.39	0.61	1.23
S4	144	2920	11	0.39	0.61	1.18
S5	209	4240	19	0.54	0.46	1.15
S6	17	340	7	0.24	0.76	1.40
S10	117	2360	12	0.34	0.66	1.39
S11	64	1280	6	0.35	0.65	1.19
S12	21	440	8	0.24	0.76	1.49
All	1620	-	43	-	-	-
Minimum	17	340	6	0.23	0.46	1.13
Maximum	241	4840	19	0.54	0.77	1.81
Median	130.5	2640	11.5	0.34	0.66	1.40
Mean	135	2733.3	11.9	0.35	0.65	1.41
SD (n-1)	80.1	1615.7	4.3	0.10	0.10	0.24
SE	23.1	466.4	1.2	0.03	0.03	0.07
LCL (95%)	84.1	1706.7	9.2	0.28	0.59	1.25
UCL (95%)	185.9	3759.9	14.6	0.41	0.72	1.56
CV	0.6	0.57	0.3	0.28	0.15	0.16

[1] Number of individuals (n) per 0.05 m^2 sample. Because 1 m^2 / 0.05 m^2 = 20; density is n per sample x 20.

[2] S is often referred to as Species Richness and is defined here as distinct species and taxa. Four taxa out of 47 were not used in calculating the indices because they were not distinct from other species (i.e., *Prionospio* spp. is not distinct from *Prionospio cirrifera*) or poorly represented as infauna in grab samples and by the 1.0 mm screening process (i.e., Podocopids).

[3] The PAST program defines Dominance (D) as the “Simpson’s Index”); it ranges from 0 to 1. A value of 1 means one taxon dominates the community. The unbiased form of D is used here.

4 The PAST program defines Simpson’s (1-D) as 1- Dominance (D); it ranges from 0 to 1. A value of 1 means all taxa are equally present. This index is often referred to as Simpson’s Index by many authors. According to PAST, this index measures evenness of the community.[5] The PAST program defines Shannon (H) as the Shannon Index. It is often referred to as the Shannon Diversity Index. The index values increase as both the richness and evenness of the community increase. The unbiased form of H is used here.

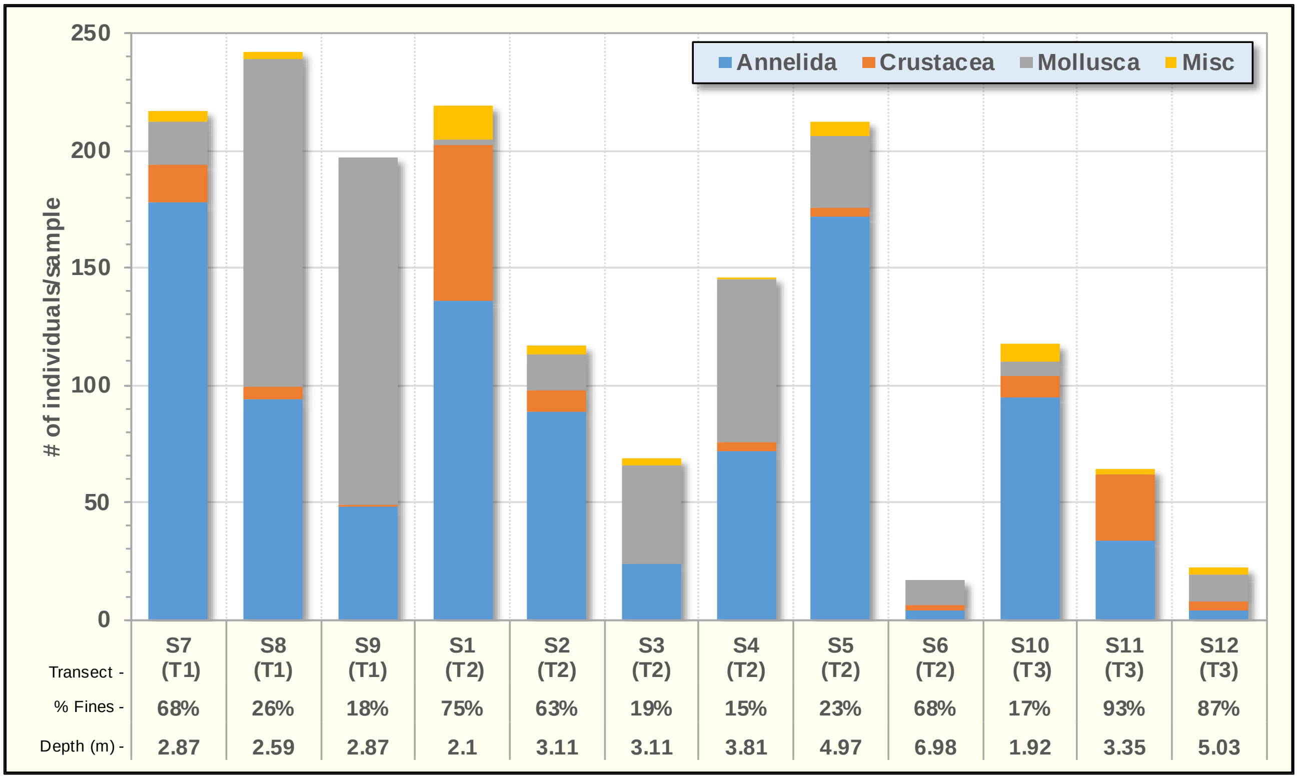


Figure 6-16. Abundance of Major Taxon Groups Arranged by Transect and Station.

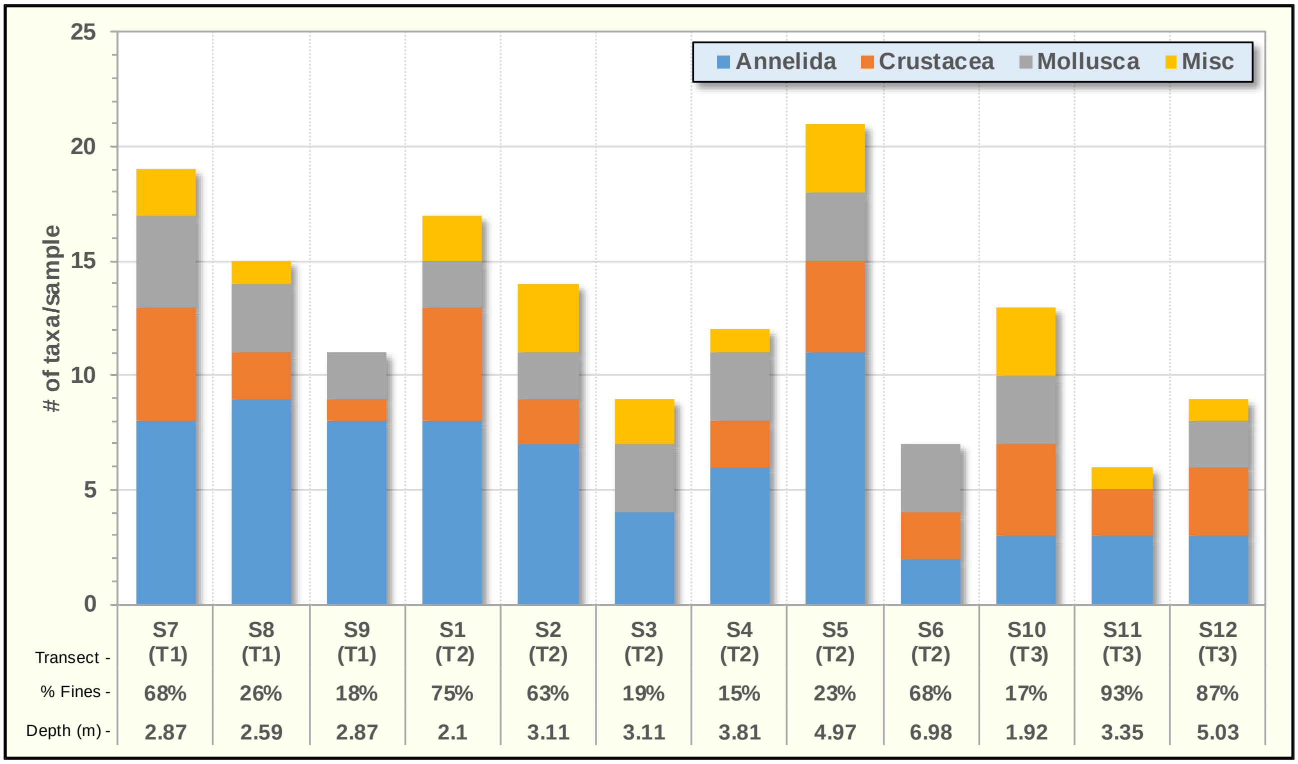


Figure 6-17. Number of Taxa for Major Taxon Groups Arranged by Transect and Station.

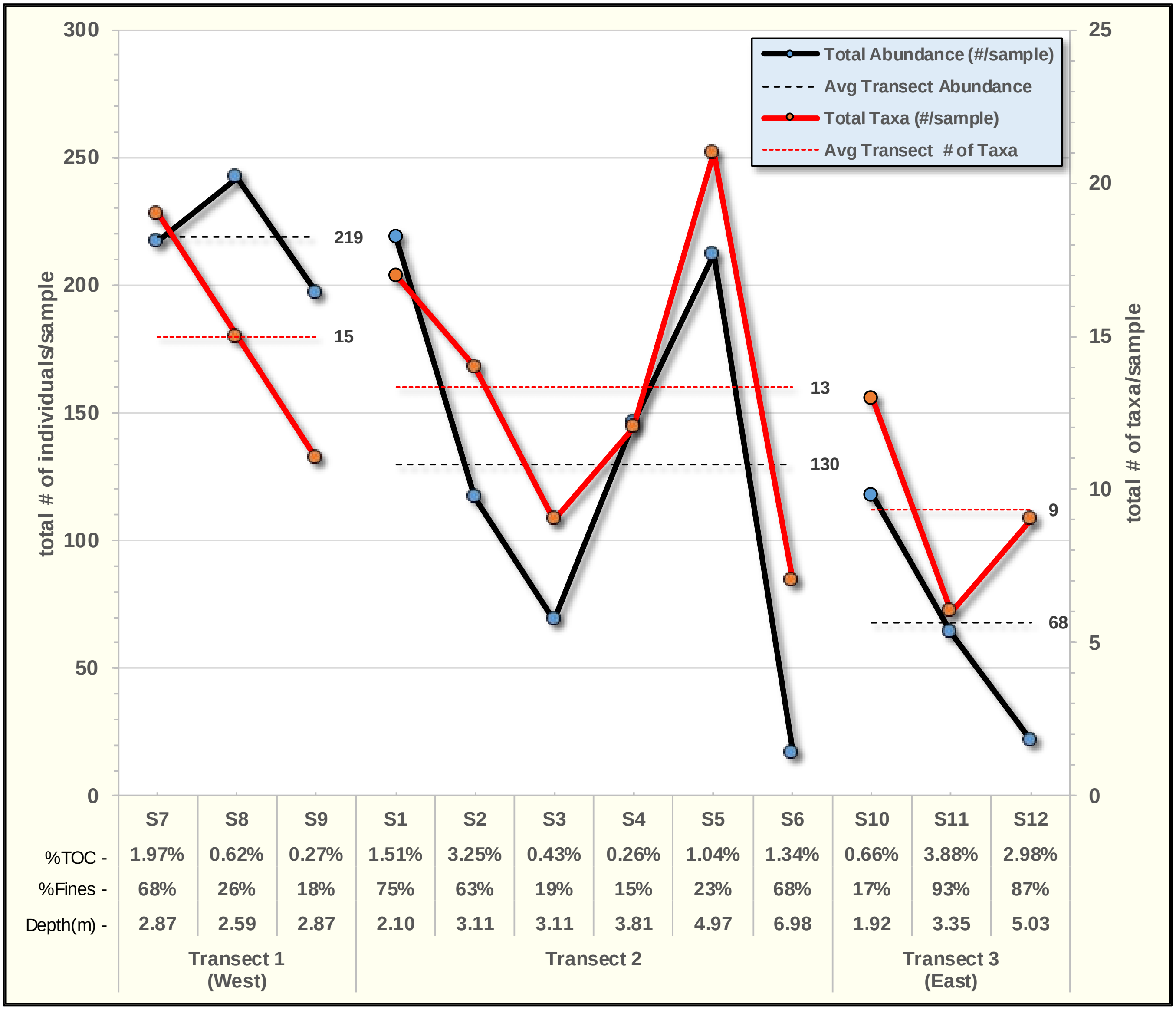


Figure 6-18. Total Abundance and Number of Taxa Arranged by Transect and Station.

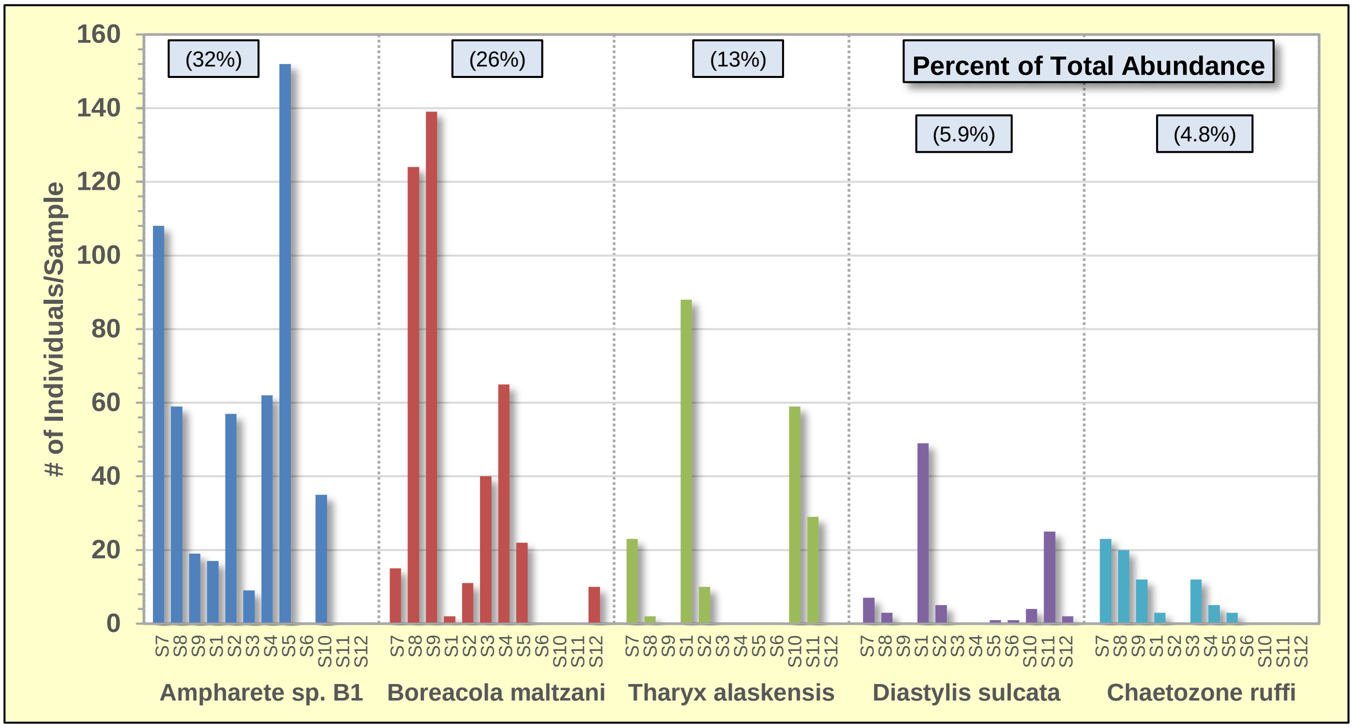


Figure 6-19. Top Five Most Abundant Taxa Arranged by Transect.

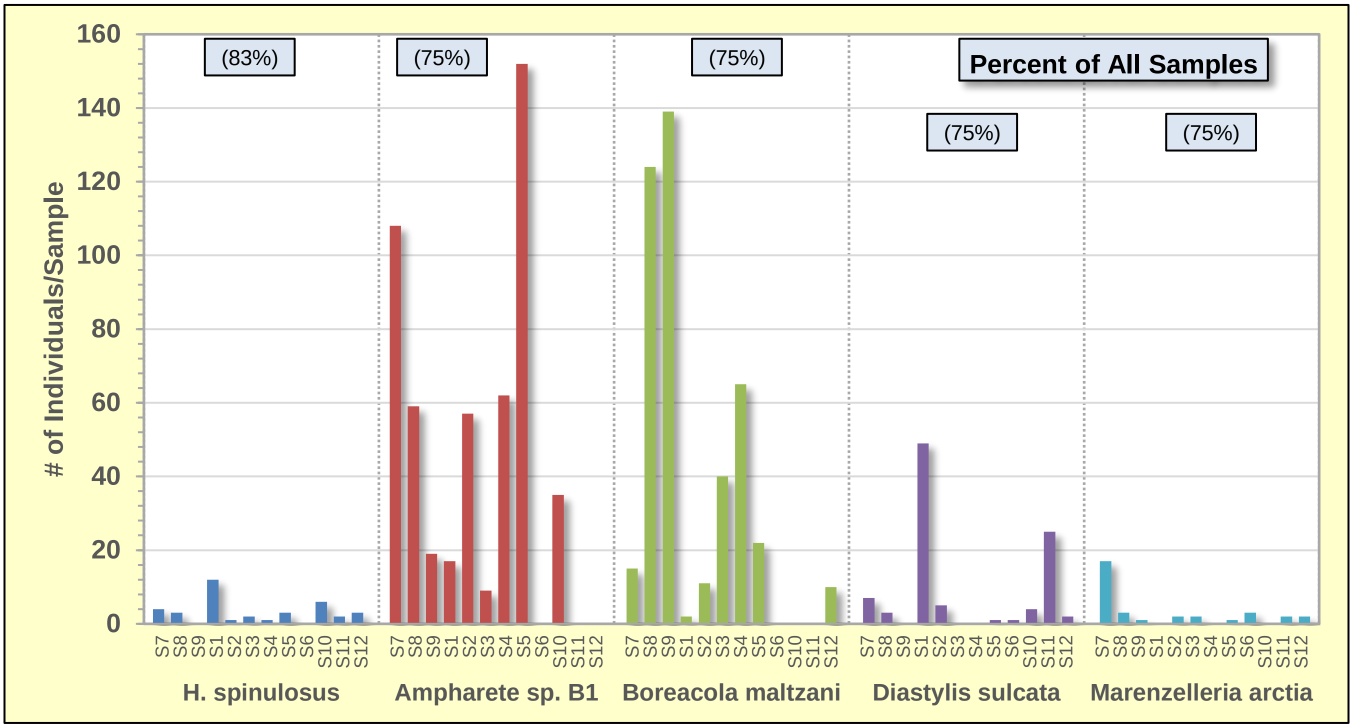


Figure 6-20. Top Five Most Frequently Occurring Taxa Arranged by Transect.

abundance as a group did not appear to be tied to the percentage of fine particles in the sediment. This may be because different annelid taxa are dominant at different sites and transects and cannot be easily generalized by depth and particle size as a group.

The composition of the molluscs among stations also varied greatly in abundance (Table 6-4 and Figure 6-16). Mollusc abundance ranged from a high of 148 individuals at Station S9, followed by 140 at Station S8, to a low of only three individuals at Station S1, but with none seen at Station S11. A different pattern than that observed for the annelids was seen among transects, where each transect exhibited a different trend with distance from shore. The molluscs appeared to be most abundant at sites with lower % Fines (< 30%) and lowest at sites with high % Fines and a high proportion of crustaceans and annelids present.

The composition among stations of the crustaceans, like the annelids and molluscs, varied greatly in abundance (Table 6-4 and Figure 6-16). Crustacean abundance ranged from a high of 66 individuals at Station S1, the shallowest station, to no individuals at Station S3, the proposed MTI location. The stations with the highest crustacean numbers all had % Fines greater than 65%. As suggested above, the highest abundance of crustaceans were at stations with the lowest abundances of molluscs.

The abundance of the miscellaneous taxa (those other than annelid, mollusc, and crustacea) among sites was always low and ranged from a high of 14 individuals at Station S1 to none at Stations S6 and S9 (Table 6-4 and Figure 6-16). No clear patterns with % Fines or depth were seen due to the low abundances that were found. However, the second shallowest location, Station S1, did have the most individuals along with the highest numbers of crustaceans found, very low numbers of molluscs, and relatively high numbers of annelids.

The five most abundant species and taxa are presented by descending ranked abundance order in Table 6-5 and Figure 6-19. Together, these five comprised 81.2% of all individuals at all stations sampled. Table 6-6 also expresses these rankings as density (#/m^2) which includes all taxa and stations as well. Three annelids, one mollusc, and one crustacean were in these top five dominant taxa. These taxa ranked in their descending order of abundance were *Ampharete sp*. Beaufort 1, *Boreacola maltzani*, *Tharyx alaskensis*, *Diastylis sulcata*, and *Chaetozone ruffi*.

The annelid *Ampharete* sp. Beaufort 1 was the most abundant benthic organism found in this study. It comprised 32% of all individuals and was found at 75% of all stations (Table 6-4 and Table 6-5; Figure 6-19 and Figure 6-20). This provisional species of *Ampharete* made up 55% of annelid abundance; it was absent at Stations S6, S11, and S12 and showed low numbers (n=9) at Station S3. Its highest abundances were found at Stations S5 (n=152) and S7 (n=108). Neither depth nor the percentage of sediment fines and TOC explain the distribution and occurrence of this species. This species may be what other taxonomists from other studies have called *Ampharete vega*, but is likely to be a new undescribed species (see Leslie Harris' comments in Appendix B). Where this species occurred, its density ranged from 180 to 3040 individuals/m^2 among stations (Table 6-6). The average density of *Ampharete* sp. Beaufort 1 among all stations was 863/m^2.

The second most abundant species overall was the mollusc *Boreacola maltzani*. It comprised 26% of all individuals found and occurred at 75% of all the stations (Table 6-4 and Table 6-5; Figure 6-19 and Figure 6-20). *B. maltzani* made up 87% of mollusc abundance. This species was not found at Stations S6, S10, and S11 and was most abundant at Stations S9 (n=139) and S8 (n=124). This species favored Transects 1 and 2, except for the deepest location at Station S6, and had only 10 individuals representing all of Transect 3 at Station S12. The MTI site (Station S3) had 40 individuals of this species. Sediment fines may explain its abundance patterns and distribution, as it was abundant at five of six stations having the lowest % Fines; this species was not seen at Station S10, which also has low % Fines. Where this species occurred, its density ranged from 40 to 2780 individuals/m^2 among stations (Table 6-6). The average density of *B. maltzani* among all stations was 713/m^2.

The annelid *Tharyx alaskensis* was the third most abundant species. This species made up 13% of all individuals but only occurred at half of all the stations (Table 6-4 and Table 6-5; Figure 6-19). *T. alaskensis* made up 22% of annelid abundance. It was present along all three transects at those sites nearest the shoreline in relatively shallow water and was most abundant at Station S1 (n=88) followed by Stations S10, S11 and S7. No individuals of this species were see at the MTI location, Station S3. The percentage of sediment fines and TOC content did not appear to influence its distribution pattern. Where it occurred, the range in density of *T. alaskensis* among stations was 40 to 1760/m^2 and the average among all stations was 352/m^2 (Table 6-6).

The fourth most abundant species was the crustacean *Diastylis sulcata*. This cumacean species made up only ~6% of all individuals but occurred at 75% of the stations (Table 6-4 and Table 6-5; Figure 6-19 and Figure 6-20). *D. sulcata* made up 66% of crustacean abundance. This species was not found at Stations S4, the MTI site S3, or at Station S9. It was most abundant at Stations S1 (n=49) and S11 (n=25). These two sites had % Fines ranging from 75% to 93%. *D. sulcata* had a density range of 20 to 980/m^2 among stations where it occurred; the average density among all stations was 162/m^2 (Table 6-6).

The fifth most abundant species was another annelid, *Chaetozone ruffi*, which comprised just ~5% of all individuals found and occurred at ~58% of all the stations (Table 6-4 and Table 6-5; Figure 6-19). *C. ruffi* made up 8% of annelid abundance. This species only occurred along Transects 1 and 2 and was most common along Transect 1, where it was the most abundant at Stations S7 (n=23) and S8 (n=20) but did not occur at all at Stations S2 and S6 along this transect. Only 12 individuals were found at Station S3. This species occurred in a wide range of depths and sediment % Fines. Where it occurred, the range in density of *C. ruffi* among stations was 60 to 460/m^2; the average among all stations was 130/m^2 (Table 6-6).

Figure 6-20 also depicts abundance for two species that were not among the top five dominant taxa numerically, but they were among the five taxa most commonly occurring. These were the priapulid worm species *Halicryptus spinulosus*, in the miscellaneous taxon group, and the annelid *Marenzelleria arctia*. *H. spinulosus* was the most commonly occurring taxa overall and was found in ~83% of all samples taken. This species made up 76% of the miscellaneous taxon group abundance and accounted for a little more than 2% of all of the individuals found, making it ranked sixth in overall abundance. Never more than 12 (Station S1) individuals were found at any station. Where it occurred, the range in density of *H. spinulosus* among stations was 20 to 240/m^2 and the average among all stations was 62/m^2 (Table 6-6). The annelid *Marenzelleria arctia* was found in 75% of all samples and was ranked seventh in abundance, accounting for 2% overall. *M. arctia* made up only 3.5% of annelid abundance. This species was most abundant at Station S7 with 17 individuals, but at all other stations, three or less occurred. Only four individuals from both species were found at the MTI location, Station S3. Where *M. arctia* occurred, the range in its density among stations was 20 to 340/m^2 and the average among all stations was only 55/m^2 (Table 6-6.)

Abundance among all 12 stations ranged from 17 individuals per sample (0.05 m^2) at Station S6 to 242 at Station S8 (Table 6-4), and in terms of density, ranged from 340 to 4840/m^2 (Table 6-6). The average number of individuals at all stations was 136.7 individuals per sample (Table 6-7), while the average density overall was 2733/m^2 (Table 6-6). The breakdown among the four major taxon groups per sample was 79.2, 12.3, 41.1, and 4.1 individuals per sample for annelids, crustacean, molluscs, and miscellaneous taxa, respectively (Table 6-7), which calculates to densities of 1584, 246, 822, and 82/m^2, respectively.

Total abundance among transects shows a general trend of decreasing numbers of individuals from west (Transect 1) to east (Transect 3) along the coastline. As shown in Figure 6-18, this is easiest to see if the average number of individuals per transect is examined. Transect 1 average abundance was 219, Transect 2 was 130, and Transect 3 was just 68 individuals per transect. In terms of density, this equated to 4380, 2600, and 1360/m^2. Transect 3 was more than three times lower than Transect 1 in average abundance. Average abundance was roughly halved between Transect 1 and 2, and again between Transect 2 and 3. The physical parameters of depth, % Fines, and TOC do not assist in explaining this trend, so other factors such as exposure must be at work, as sediments at Transect 3 are likely more subject to reworking by waves and currents off Atigaru Point. Overall, the average abundance among stations was ~137 individuals per sample, expressed as a density of 2733/m^2. The density at Station S3 was 1380/m^2, or approximately half of the overall average.

6.2.2 Numbers of Taxa and Species

Table 6-4, Table 6-7, Figure 6-15 and Figure 6-17 show the number of taxa by major taxon group among all stations. Forty seven taxa were recorded over all 12 stations. The annelids comprised the largest number with 22 taxa, followed by the crustaceans with 11, the molluscs with eight, and the miscellaneous taxa with six. The proportion of annelids to the total was 47%, followed by crustaceans at 23%, the molluscs at 17%, and the miscellaneous taxa at 13%. The greatest number of annelid taxa was found Station S5 with 11, and the least number was seen at Station S6, with only two. The number of crustacean taxa ranged from none at the Station S3 MTI location to a high of five at Stations S1 and S7. The number of mollusc taxa ranged from none at Station S11 to four at Station S7. Miscellaneous taxa ranged from none recorded at Stations S6 and S9 to three at Stations S2, S5, and S10.

Overall, Station S5 had the greatest number of taxa, or species richness, with 21, while Station S11 exhibited the fewest with only six taxa recorded. Four stations (S3, S6, S11, and S12) had fewer than 10 taxa, all with fewer than 70 individuals (Table 6-4 and Figure 6-18). The average number of taxa among transects, like abundance, showed a general west to east trend with declining numbers of taxa. However, this trend was much less pronounced than that seen for abundance. Transect 1 averaged 15 taxa, Transect 2 had 13, and Transect 3 averaged 9, as shown in Figure 6-18.

6.2.3 Community Indices

Table 6-8 provides summary statistics for several community and diversity related indices. Numbers of individuals (n; abundance), density (#/m^2), species richness (S; number of taxa), dominance (D or Simpson's Index), Simpson's (1-D) or evenness, and Shannon's Diversity Index (H) were calculated for each station, along with averages and various measures of dispersion for all stations. The unbiased forms of D, Simpson's (1-D), and H were calculated for a finite population. Simpson's Index (D) was originally called a diversity index, but in reality it is a measure of dominance within the community. Its complement, 1-D, is often referred to a measure of diversity within a community, but only in terms of evenness. Only the 43 taxa that were determined to be uniquely identifiable out of 47 were used to calculate these indices, as noted in Table 6-4 and Table 6-5. Abundance, density, and numbers of taxa have been previously discussed, so only the three biodiversity indices will be briefly discussed here.

Dominance (D) used here is the Simpson Index, with a scale from zero (all taxa were equally present) to one (one taxon dominated the community completely). As the value of D increases, diversity typically decreases. Dominance along Transects 1 and 2 tended to increase with distance from the shoreline. One exception was seen along Transect 2, where D dropped dramatically from Station S5 (highest D, 0.54) to the deeper Station S6 (second lowest, 0.24). Station S1 had the lowest D with 0.23. Transect 3 did not show the same trend as the other two transects, with much less change in D among stations.

Simpson's (1-D) is known as a measure of diversity in terms of community evenness (how close in number each taxa is of the different members that make up the richness of a sample) and is the mirror image or mathematical complement of D; it therefore shows exactly the opposite mathematical trends among the transects. As Simpson's (1-D) increases, diversity also tends to increase in the sense of evenness within the community.

Shannon H is a diversity index that incorporates both richness and evenness of the community. As community richness and evenness increase, so do H and diversity. This measure tended to track roughly the same as did D among transects and with distance from shore. Shannon H ranged from a low of 1.13 and 1.15 at Stations S9 and S1, respectively, to a high of 1.81 at Station S1. The MTI site, Station S3, was in mid-range in terms of D (0.39) and on the lower side in terms of Shannon H (1.23) as compared to all other stations.

6.2.4 Community Similarity and Cluster Analysis (AggHC)

Cluster analyses were performed to help examine community structure of the Willow MMP benthic dataset. An AggHC cluster analysis dendrogram of station classes that were formed using the results of the similarity analysis are provided in Figure 6-21. Figure 6-22 shows a somewhat different comparative view of the cluster analysis results using a ranked profile plot of class centroids or average class positions for each taxa. This plot also compares the resulting classes to station depth, TOC, and % Fines with overall station density and numbers of taxa to show possible influencing factors that may be contributing to the formation of the cluster classes. Figure 6-23 shows an additional view of the cluster analyses shown as a heat map in table form, with the relative importance and magnitude of each taxa color coded for each class. Figure 6-24 depicts a map of the stations and classes that were formed along with the dominant taxa comprising them.

The Bray Curtis (BC) dissimilarity measure (distance) and unweighted pair-group average (UPGA) linkage method (cluster dendrogram) were used to define classes from 32 of the possible 43 taxa that were found. The same dataset used to calculate the community indices was used. Eleven taxa from that dataset with only a single occurrence (singletons) were not used in this analysis so that the dimensionality of the data was reduced and to improve the presentation quality of the analysis results. The single occurrence of each of the eleven taxa appear to have had no noticeable effect on the outcome of the analysis classes that were formed, so they were not included in the analysis presented in this report.

Five station classes or cluster groups were formed by the analysis. These classes formed around the co-occurring dominant taxa found at each site. Where the same taxon was dominant at multiple sites and species richness was relatively high, the analysis tended to form a single class with multiple stations. Where abundances and species richness were low, the analysis tended to form single-station classes. The classes are presented in the order displayed by the resulting cluster dendrogram.

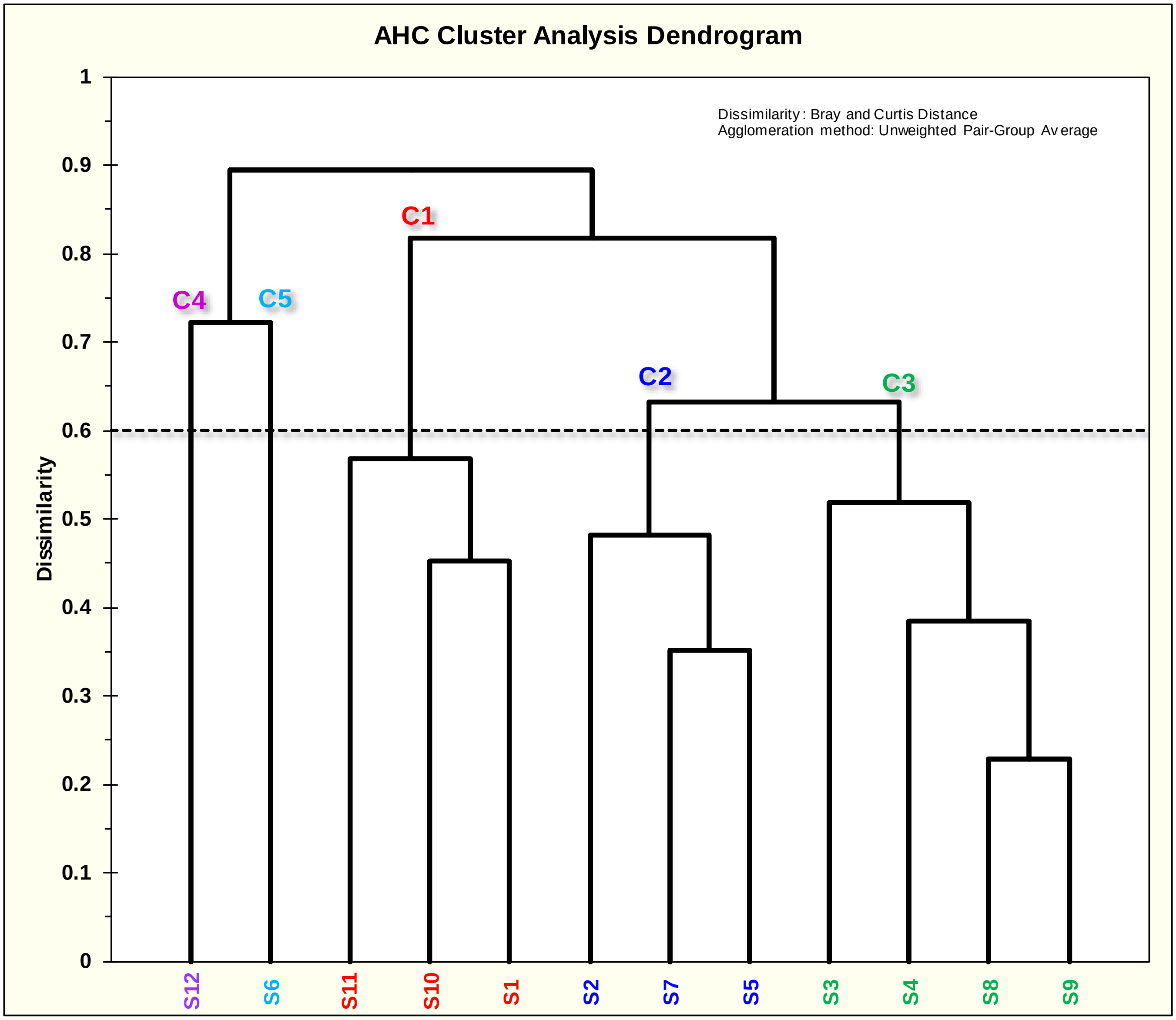
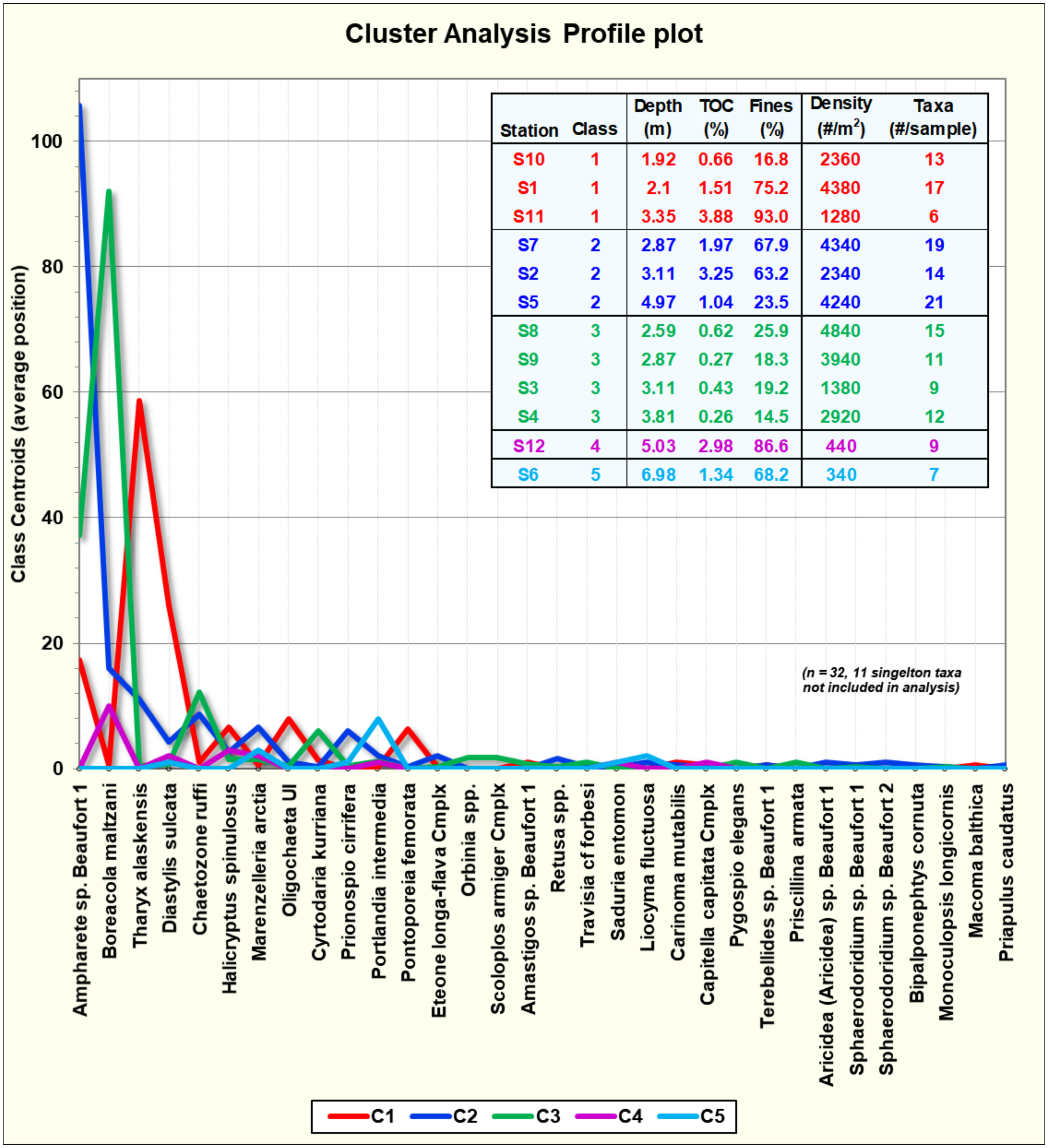
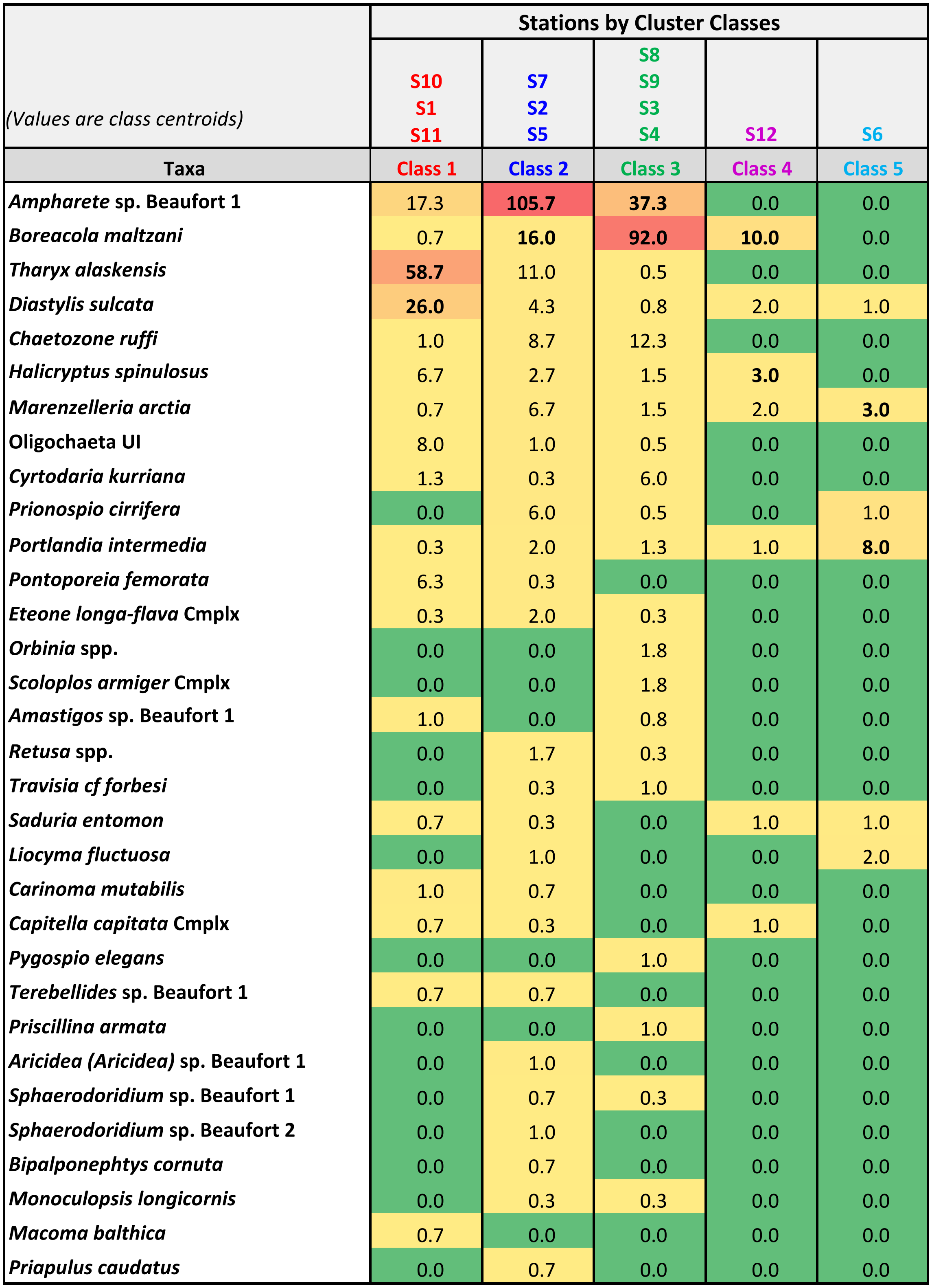


Figure 6-21. AggHC Cluster Analysis Dendrogram of Station Classes.



Station	Class	Depth (m)	TOC (%)	Fines (%)	Density (#/m^2)	Taxa (#/sample)
S10	1	1.92	0.66	16.8	2360	13
S1	1	2.1	1.51	75.2	4380	17
S11	1	3.35	3.88	93.0	1280	6
S7	2	2.87	1.97	67.9	4340	19
S2	2	3.11	3.25	63.2	2340	14
S5	2	4.97	1.04	23.5	4240	21
S8	3	2.59	0.62	25.9	4840	15
S9	3	2.87	0.27	18.3	3940	11
S3	3	3.11	0.43	19.2	1380	9
S4	3	3.81	0.26	14.5	2920	12
S12	4	5.03	2.98	86.6	440	9
S6	5	6.98	1.34	68.2	340	7

Figure 6-22. AggHC Cluster Analysis Profile Plot of Class Centroids by Taxa.



(Values are class centroids)	Stations by Cluster Classes				
	S10 S1 S11	S7 S2 S5	S8 S9 S3 S4	S12	S6
Taxa	**Class 1**	**Class 2**	**Class 3**	**Class 4**	**Class 5**
***Ampharete* sp. Beaufort 1**	17.3	**105.7**	**37.3**	0.0	0.0
Boreacola maltzani	0.7	**16.0**	**92.0**	**10.0**	0.0
Tharyx alaskensis	**58.7**	11.0	0.5	0.0	0.0
Diastylis sulcata	**26.0**	4.3	0.8	2.0	1.0
Chaetozone ruffi	1.0	8.7	12.3	0.0	0.0
Halicryptus spinulosus	6.7	2.7	1.5	**3.0**	0.0
Marenzelleria arctia	0.7	6.7	1.5	2.0	**3.0**
Oligochaeta UI	8.0	1.0	0.5	0.0	0.0
Cyrtodaria kurriana	1.3	0.3	6.0	0.0	0.0
Prionospio cirrifera	0.0	6.0	0.5	0.0	1.0
Portlandia intermedia	0.3	2.0	1.3	1.0	**8.0**
Pontoporeia femorata	6.3	0.3	0.0	0.0	0.0
***Eteone longa-flava* Cmplx**	0.3	2.0	0.3	0.0	0.0
***Orbinia* spp.**	0.0	0.0	1.8	0.0	0.0
***Scoloplos armiger* Cmplx**	0.0	0.0	1.8	0.0	0.0
***Amastigos* sp. Beaufort 1**	1.0	0.0	0.8	0.0	0.0
***Retusa* spp.**	0.0	1.7	0.3	0.0	0.0
Travisia cf forbesi	0.0	0.3	1.0	0.0	0.0
Saduria entomon	0.7	0.3	0.0	1.0	1.0
Liocyma fluctuosa	0.0	1.0	0.0	0.0	2.0
Carinoma mutabilis	1.0	0.7	0.0	0.0	0.0
***Capitella capitata* Cmplx**	0.7	0.3	0.0	1.0	0.0
Pygospio elegans	0.0	0.0	1.0	0.0	0.0
***Terebellides* sp. Beaufort 1**	0.7	0.7	0.0	0.0	0.0
Priscillina armata	0.0	0.0	1.0	0.0	0.0
***Aricidea (Aricidea)* sp. Beaufort 1**	0.0	1.0	0.0	0.0	0.0
***Sphaerodoridium* sp. Beaufort 1**	0.0	0.7	0.3	0.0	0.0
***Sphaerodoridium* sp. Beaufort 2**	0.0	1.0	0.0	0.0	0.0
Bipalponephtys cornuta	0.0	0.7	0.0	0.0	0.0
Monoculopsis longicornis	0.0	0.3	0.3	0.0	0.0
Macoma balthica	0.7	0.0	0.0	0.0	0.0
Priapulus caudatus	0.0	0.7	0.0	0.0	0.0

Figure 6-23. AggHC Cluster Analysis Heat Map of Station Classes.

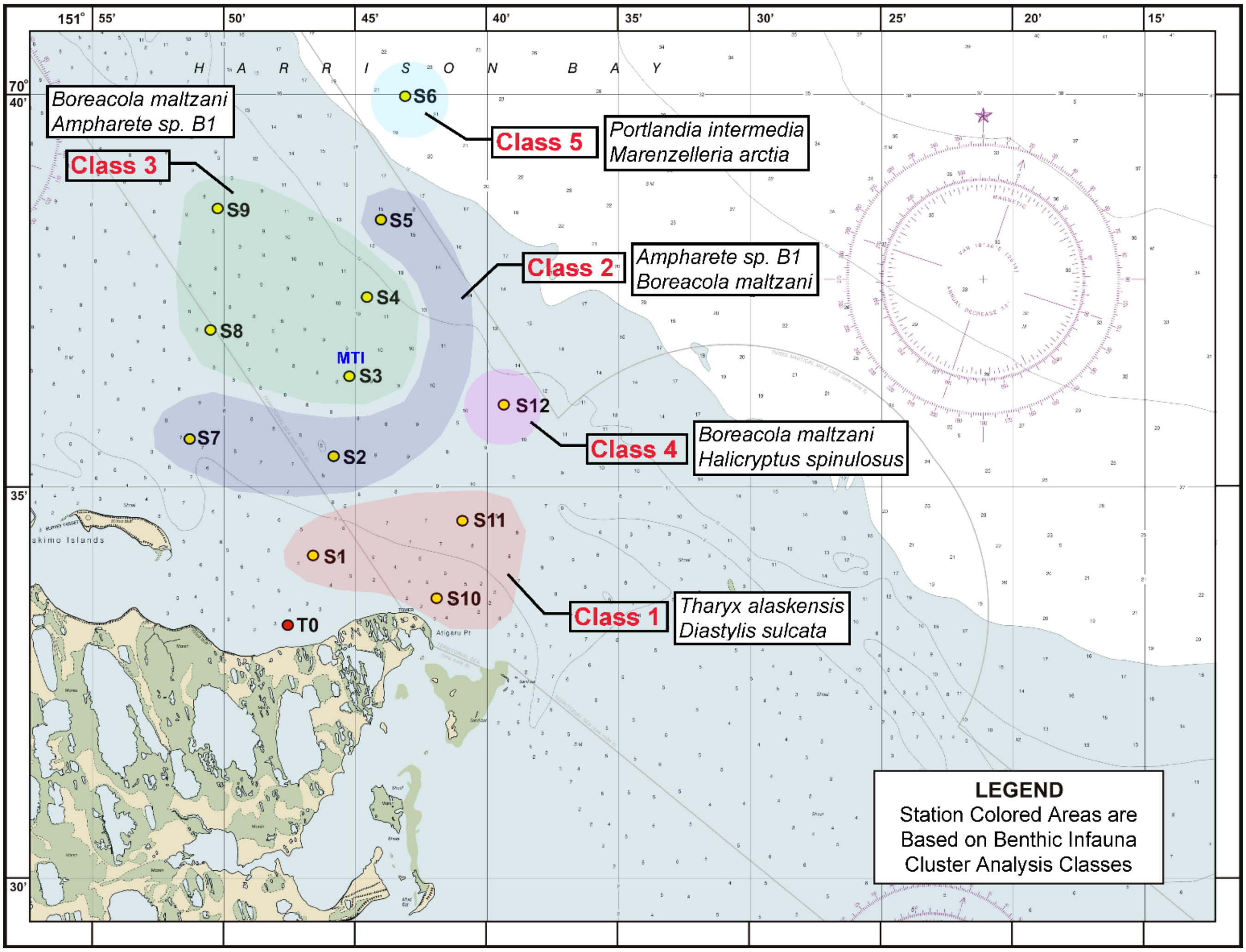


Figure 6-24. Map of AggHC Cluster Classes and Dominant Taxa.

Class 1 included Stations S10, S1, and S11, all of which were dominated primarily by the annelid *Tharyx alaskensis* and the crustacean *Diastylis sulcata*. Class 2 included Stations S7, S2, and S5; the annelid *Ampharete* sp. Beaufort 1 heavily dominated these sites along with, but to a lesser degree, the mollusc *Boreacola maltzani*. This class had the highest species richness. Class 3 included Stations S8, S9, S3, and S4, which was dominated by *Boreacola maltzani* and *Ampharete* sp. Beaufort 1. This class includes the area of the proposed MTI (Station S3). Percent fines for Class 3 were generally on the coarse side and ranged from 14.5 to 25.9%. Class 4 and 5 both included just a single station each, Stations S12 and S6, respectively. Class 4 was dominated, in low numbers, by *Boreacola maltzani* and the miscellaneous taxon priapulid worm *Halicryptus spinulosus*, while Class 5 was dominated by the mollusc *Portlandia intermedia* (ranked 10th among stations overall in abundance) and the annelid *Marenzelleria arctia*, also in low numbers. Both of these classes were in the deepest water of all of the stations, especially Class 5, and exhibited sediment fines greater than 68%.

6.2.5 Comparison with Previous Studies

Data from the BOEM ANIMIDA study was used for comparison purposes. Station 6F is the closest recently sampled site to the Willow MMP that has benthic infaunal data available (sampled in August 2014; Kasper, et al. 2017). This station was located within central Harrison Bay, approximately 12 miles east of the current MMP Station S6. Three replicate benthic samples were taken in 13-14 m of water, approximately twice the depth of deepest Willow MMP station (S6). Sediment at ANIMIDA Station 6F exhibited % Fines at 8.5% and a TOC of 1.95%, as compared to the MMP Station S6 that had much finer grained sediments (68% Fines) and a TOC content of 1.34%. The surface area sampled for benthics at Station 6F was twice the size of that sampled for the Willow MMP (0.1 m^2 vs 0.05 m^2).

Nineteen taxa overall were recorded at ANIMIDA Station 6F. Reported data included ten annelid taxa, seven crustacean taxa, and two molluscan taxa, with no miscellaneous phyla reported. For each of the three samples from Station 6F, the number of taxa ranged from six to ten, with an average of about seven. MMP Station S6 had seven taxa total, with no miscellaneous phyla recorded. In terms of species richness, the Willow MMP Station S6 and ANIMIDA Station 6F samples are roughly comparable, even with potential surface area differences. The density of the three major taxonomic groups (annelids, molluscs, and crustaceans) listed at ANIMIDA Station 6F was low and ranged from 110 to 210/m^2 for the three samples, with an average of 150/m^2. The MMP Station S6 exhibited the lowest density of all 12 MMP samples at 340/m^2. This indicates the general density of organisms at ANIMIDA Station 6F was somewhat less than half that seen at Willow Station S6. In contrast, the average density of the three major taxon groups for all 12 MMP stations sampled during 2018 was calculated at 2652/m^2.

Only eight genera of taxa were found to be in common between ANIMIDA Station 6F and all 12 Willow MMP stations. This included four annelids, three crustaceans, and one mollusc. Between ANIMIDA Station 6F and MMP Station S6, only four genera were in common: two annelids, one crustacean, and one mollusc. Due to the inherent diversity in benthic communities, seemingly large differences in the taxa present among relatively close geographic areas is not unusual and should, in fact, be expected. The MMP certainly exhibited high variability among taxa across the 12 stations that were sampled. High variability in the number of individuals in these communities is also common, and should always be expected in these types of environments.

Benthic infauna seen at the MTI site, MMP Station S3, appeared to consist of a typical benthic assemblage that was dominated by the bivalve *Boreacola maltzani* (n=40) and, to a lesser extent, the polychaetes *Chaetozone ruffi* (n=12) and *Ampharete* sp. Beaufort 1 (n=9). Overall abundance at Station S3 was recorded at 69 organisms, in the mid- to low range compared to all stations (n=17 – 242). Species richness was also low (S=7) compared to the range of 7 to 19 taxa seen over all stations. Clustering analyses indicated that Station S3 was more closely grouped with nearby Stations S4, S6, and S9 than with other stations sampled; this grouping contained more stations than any other AggHC cluster class, indicative of the relative similarity of this four-station group as opposed to the other AggHC groups that all contained fewer stations. These stations tended to have coarser grain size and a higher abundance of bivalves than most other stations.

In summary, benthic infauna data collected during the 2018 Willow MMP showed large differences in overall abundance and diversity among the 12 sampling sites, some of which could be explained by depth and/or sediment characteristics. Overall, the area covered by the Willow MMP appears to be a typical soft-bottom benthic environment with high variability as seen elsewhere along the Beaufort Sea coast. No evidence of any type of hard bottom or boulder patch environment was seen during the sampling effort.

6.3 TRAWLING RESULTS

Trawling to collect epibenthic and demersal fish and other organisms was performed at 13 locations near the sediment sites, including two replicate trawls at the proposed MTI location, Station T3, and one inshore shallow location, Station T0 (Figure 2-1 and Table 2-2). All trawls performed had a bottom contact duration of 10 minutes.

6.3.1 Fish

All fish identifications were made in the field, and no unidentified fish were collected, nor were any specimens retained for vouchers. Fish were released alive at the sampling sites whenever possible after identification, measurement, and recording. Trawl data are provided in Appendix C.

Overall fish catch was low, with only 84 fish recorded in total for the 14 trawls performed (Table 6-9). Abundance represents number of specimens caught, while total catch per bottom area is abundance normalized by unit surface area of the bottom fished to eliminate differences caused by varying tow speeds or length of tows. Catches were normalized to a 100 meters-squared (m^2) area assuming a trawl width of 2.5 m and a straight trawl track between start and end GPS coordinates.

Trawling at the shallow-most inshore location, Station T0, yielded the most fish, accounting for ~45% of the total catch, with 1.79 fish collected/100 m^2. Overall, the three shallowest trawls (Stations T0, T10, and T1) closest to Atigaru Point accounted for about two-thirds of the overall fish catch, yielding 38, 10, and 8 fish, respectively, with the highest total catch per bottom area as well. Higher abundances at these inshore stations compared to those offshore were expected, as many Arctic fish species, especially the Arctic cod and cisco, were expected to be found in the brackish warmer plume nearer shore during summer months. For example, Cannon et al. (1991), studying juvenile Arctic cod in habitats ranging from very shallow nearshore areas in Prudhoe Bay to areas farther out on the continental shelf between mid-July and mid-August, found that Arctic cod were concentrated in warmer, lower salinity waters closer to shore, in depths between 3 and 7 ft. Earlier studies by Craig (1984) indicated that dominant marine species such as Arctic cod and fourhorn sculpin move to nearshore waters later in summer as salinities increase in these areas, to feed on the abundant epibenthic crustaceans found there.

Station T3, the proposed MTI site, included collection of two replicate trawls performed in opposing directions, and each yielded only three juvenile Arctic cod specimens at around 0.13 fish/100 m^2. Other stations with bottom depths of ~3 m (or 9 ft) similar to the Station T3 (MTI site) ranged from no fish at Stations T2 and T11 to five collected at Station T9. Offshore deeper stations of >3.7 m (12 ft) in depth (Stations T4, T5, T6, and T12) had fish catch that ranged from 2 - 5 fish, with normalized catch data showing some variability (0.08 - 0.22 fish/100 m^2). Trawls performed at Stations T2 and T11 yielded no fish at all.

Table 6-9. Fish Catch Abundance and Catch by Area (per 100 m^2).

Station	T0	T1	T2	T3	T3-2	T4	T5	T6	T7	T8	T9	T10	T11	T12	Total
Abundance (Number Caught)															
Boreogadus saida (Arctic cod)	23	5		3	3	5	2	2	1	3	4	2		2	55
Coregonus autumnalis (Arctic cisco)	4											1			5
Liparis tunicatus (Kelp snailfish)							1				1			1	3
Myoxocephalus quadricornis (Fourhorn sculpin)	9	3										7			19
Osmerus mordax (Rainbow smelt)	1														1
Pleuronectes glacialis (Arctic flounder)	1														1
Total	38	8	0	3	3	5	3	2	1	3	5	10	0	3	84
Total Catch per 100 m^2 of Bottom Area Fished															
Boreogadus saida (Arctic cod)	1.08	0.25		0.14	0.12	0.22	0.09	0.08	0.04	0.13	0.19	0.10		0.09	2.55
Coregonus autumnalis (Arctic cisco)	0.19											0.05			0.24
Liparis tunicatus (Kelp snailfish)							0.05				0.05			0.05	0.14
Myoxocephalus quadricornis (Fourhorn sculpin)	0.42	0.15										0.35			0.93
Osmerus mordax (Rainbow smelt)	0.05														0.05
Pleuronectes glacialis (Arctic flounder)	0.05														0.05
Total	1.79	0.40	0	0.14	0.12	0.22	0.14	0.08	0.04	0.13	0.24	0.51	0	0.14	3.96

Figure 6-25. Arctic Cod and Fourhorn Sculpin.

Diversity of fish catch was quite low, with only six species of fish collected in total. Arctic cod (*Boreogadus saida*) was the most abundant species overall (n=55, or 65% of catch), followed by fourhorn sculpin (*Myoxocephalus quadricornis*), of which 19 (23%) were collected (Figure 6-25); these two species together accounted for 88% of the overall catch. Arctic cisco (*Coregonus autumnalis*) was the third most-abundant species collected, with only five specimens recorded, four of which were collected at Station T0, and the fifth seen at Station T10. Three kelp snailfish (*Liparis tunicatus*) were collected at three of the offshore locations (Stations T5, T9, and T12) where cold marine water was found at the bottom (see Section 6.4). The other two fish species identified included one Arctic flounder (*Pleuronectes glacialis*) and one rainbow smelt (*Osmerus mordax*), both of which were collected at Station T0.

Although not showing a high degree of diversity, this assemblage is in general agreement with prior fish studies, including long-term monitoring of fish in the nearshore Beaufort Sea performed over the last ~35 years in conjunction with oil industry activities (e.g., McCain et al. 2014). Moulton and Tarbox (1987) trawled both near- and offshore locations near Prudhoe Bay and documented the dominance of Arctic cod (98% of catch), with minor catches of kelp snailfish, fourhorn sculpin, and rainbow smelt, along with Pacific sand lance (*Ammodytes hexapterus*), capelin (*Mallotus villosus*), and least cisco (*Coregonus sardinella)*. Craig (1984) identified Arctic cod and fourhorn sculpin as the dominant species, along with Arctic and least cisco and Dolly Varden char (*Salvelinus malma);* together, these five dominant species accounted for about 90% of all fish captured along the Alaska and western Yukon coastlines.

Distribution over all trawl samples collected for the MMP was quite varied, ranging from zero fish collected to the high of 38 fish caught at Station T0. Of all species, Arctic cod were the most widely distributed, being seen in all 12 trawls that retained fish; this was the only fish species recorded in six of the 12 trawls that exhibited fish. Fourhorn sculpin were found in three of the shallower trawls (Stations T0, T1, and T10), and kelp snailfish were caught at three locations (Stations T5, T9, and T12). Arctic cisco were found at only two locations (Station T0 and T10), and the single Arctic flounder was caught at the shallow Station T0.

The majority of the fish captured in the trawls were small and recorded as juveniles (< 150 mm in length). Arctic cod specimens ranged from ~60 to 102 mm in fork length, with a median of 79 mm. About 96% of the Arctic cod measured <100 mm in length. Fourhorn sculpin observed in the trawls ranged from 63 to 152 mm in length, with a median of ~92 mm overall. About 63% of the fourhorn sculpin were <100 mm in length, and only one was considered adult at 152 mm in length. Arctic cisco specimens ranged from 116 to 168 mm in length, quite large compared to most other fish caught during the survey. The kelp snailfish that were collected ranged from 54 – 82 mm, while the Rainbow smelt measured 94 mm in length. The single specimen of Arctic flounder caught at Station T0 dwarfed most of the other fish collected, measuring 186 mm.

Normalized fish catch ranged from 0 (Stations T2 and T11) to high of 1.79 at the shallow Station T0, with an overall mean catch of 0.28/100 m^2 at all stations, but most fell within the 0.04 to 0.24/100 m^2 range. In reference, without taking seasonality or depths into account, these normalized catches compare favorably with studies performed using the same type of equipment near or in Prudhoe Bay in support of the Alaska LNG Project, which exhibited similar catches of 0.07 to 0.29/100 m^2 (AK LNG 2015), 0.11 to 0.39/100 m^2 (APP 2012), and 0.28 to 1.42/100 m^2 (AK LNG 2014).

It should be noted that seasonal timing of any Arctic fish sampling effort can result in a high degree of variability between results. This is the result of large differences in water mass properties with varying weather conditions; these change the oceanographic conditions, resulting in more marine species being caught when waters are more saline, or fewer marine species (more anadromous or amphidromous fish) being seen in warmer and less saline (brackish) estuarine conditions. See Section 6.4.

6.3.2 Invertebrates

Some invertebrate identifications were made in the field, with a small representative sample of as few organisms as possible collected and retained for identification in the laboratory. Unless retained, invertebrates were released alive at the sampling sites as soon as possible after recording. Trawl data are provided in Appendix C.

Invertebrates were much more abundant in the trawls than fish, with an overall catch of 1006 specimens recorded over all 14 trawls. Abundance of major taxonomic groupings, including isopods, other crustacea, and molluscs, are depicted graphically in Figure 6-26, and tabular data are provided in Table 6-10. For some taxa that were colonial in nature, such as Hydrozoa, only presence ("P") was noted as these cannot be enumerated. Some species noted were pelagic rather than epibenthic in nature, but these specimens were also recorded as part of the trawl catch.

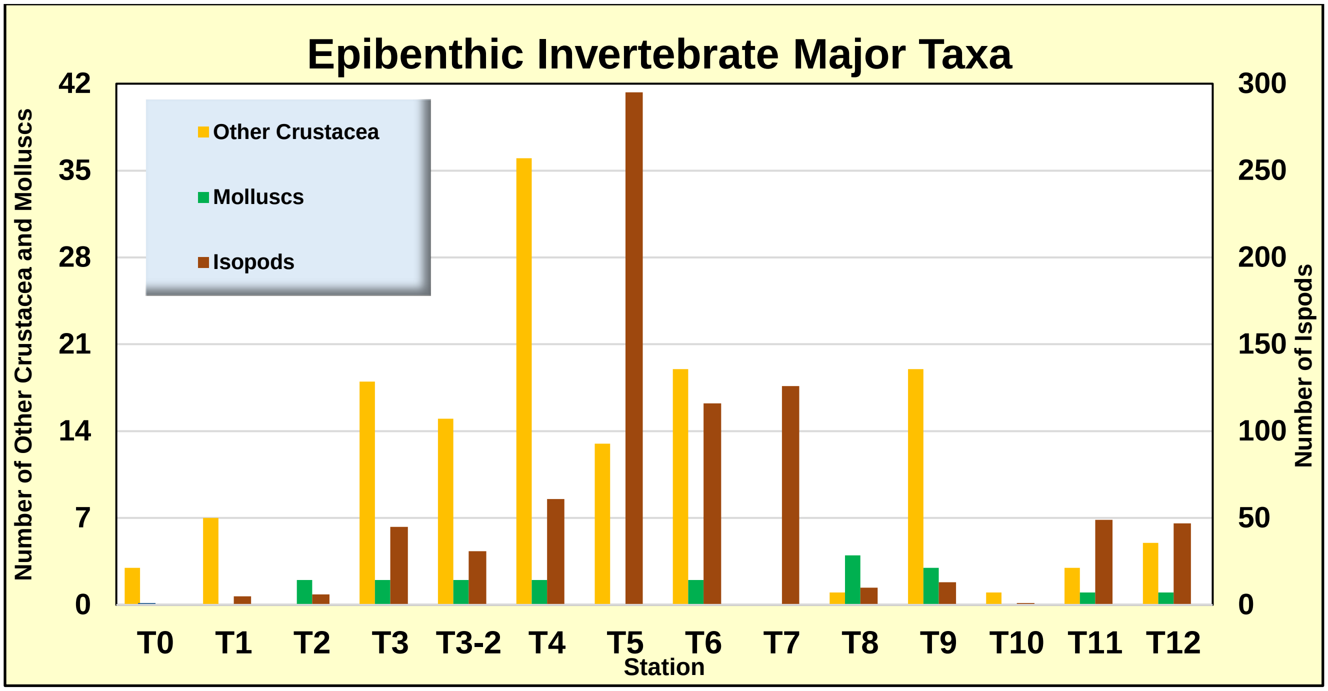


Figure 6-26. Major Epibenthic Invertebrate Taxonomic Groupings in Trawls.

Table 6-10. Invertebrate Catch Abundance and Catch by Area (per 100 m^2).

Station	T0	T1	T2	T3	T3-2	T4	T5	T6	T7	T8	T9	T10	T11	T12	Total
CRUSTACEA															
Amphipoda															
Acanthostepheia behringiensis								2							2
Atylus carinatus								1							1
Gammarida, unidentified												1	1	3	5
Gammaracanthus loricatus				1			1								2
Gammarus setosus	1														1
Onisimus affinis								2							2
Euphausiidae															
Pelagic euphausiid					11										11
Mysida (Mysid Shrimp)															
Mysidae, unidentified		7		15		36	12	14		1	19		2	2	108
Mysis segerstralei				1	4										5
Neomysis rayii	2			1											3
Isopoda															
Saduria spp.		5	6	45	31	61	295	116	125	10	13	1	49	47	804
Saduria entomon									1						1
Crustacea Total	3	12	6	63	46	97	308	135	126	11	32	2	52	52	945
Crustacea/100 m^2	0.14	0.59	0.24	2.99	1.80	4.34	14.5	5.64	5.28	0.48	1.55	0.10	2.52	2.44	42.6
MOLLUSCA															
Cryptonatia affinis (Arctic moon snail)			2	2	2	1		1		4	3		1	1	17
Portlandia spp. (clam)						1									1
Volutopsius castaneus?								1							1
Mollusca Total	0	0	2	2	2	2	0	2	0	4	3	0	1	1	19
Mollusca/100 m^2	0	0	0.08	0.10	0.08	0.09	0	0.08	0	0.17	0.15	0	0.05	0.05	0.84
POLYCHAETA															
Phyllodocida, unid.							1								1
Polychaeta Total	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Polychaeta/100 m^2	0	0	0	0	0	0	0.05	0	0	0	0	0	0	0	0.05
MISCELLANEOUS TAXA															
CNIDARIA/HYDROZOA															
Tubularia indivisa	P								P						P
Cnidaria (pelagic jelly)			1	4		1			22	7			5		40
ASCIDIACEA															
Rhizomolgula globularis (sea grape)	1														1
Group Total	1	0	1	4	0	1	0	0	22	7	0	0	5	0	41
Miscellaneous/100 m^2	0.05	0	0.04	0.19	0	0.04	0	0	0.92	0.30	0	0	0.24	0	1.79
Overall Abundance	4	12	9	69	48	100	309	137	148	22	35	2	58	53	1006
Overall/100 m^2	0.19	0.59	0.36	3.28	1.88	4.48	14.5	5.72	6.21	0.95	1.69	0.10	2.81	2.48	45.2

Figure 6-27. Trawl Catch Showing a Predominance of *Saduria* spp.

Crustaceans comprised ~94% of the overall invertebrate catch. The benthic isopod *Saduria* spp. was the most abundant crustacean recorded (n=805; Figure 6-27), accounting for ~85% of the overall crustacean catch and ~80% of the overall invertebrate catch. Most specimens were likely to be *Saduria entomon*, but only one specimen was retained for laboratory identification; both *S. sabini* and *S. sibirica* had also been identified in samples during 2011 or 2014 (APP 2012; AK LNG 2014). *Saduria* were caught in all trawls except the shallow-most Station T0, but several of the other shallow stations (T1 and T10) exhibited much lower abundances and catch/100 m^2 than some of the deeper stations. Only one specimen was seen at Station T10, while Stations T1 and T2 had only 5 and 6 specimens, respectively. *Saduria* spp. were most abundant at Stations T5 (n=295 or 13.85/100 m^2), T7 (n=125), and T6 (n=116). These organisms are generally ubiquitous in nearshore waters of the North Slope, as was seen during nearshore AK LNG studies in 2014, when they were recorded in 11 out of 12 trawls performed (AK LNG 2014).

The benthopelagic mysid shrimp (Mysida, all species combined) accounted for an additional 12% of the overall crustacean catch across all sites, while the remainder included both amphipods and pelagic euphausiids, each accounting for a little over 1% of the catch. These reported abundances are likely underestimated of the true number present at the time of sampling because these semi-pelagic organisms are smaller than the mesh size of the trawl net and poorly sampled using this technique, but this type of sampling does provide some information on species presence and diversity. Both *Mysis segerstralei* (formerly *M. relicta*) and *Neomysis rayii* were identified in the laboratory voucher specimens; other mysid species remained unidentified in the larger taxonomic grouping of Mysida. Five species of amphipods were identified in the laboratory samples (*Acanthostepheia behringiensis*, *Atylus carinatus*, *Gammaracanthus loricatus*, *Gammarus setosus*, and *Onisimus affinis*); other amphipods belonging to the infraorder Gammarida were released rather than being retained for laboratory identification.

Molluscs comprised less than 2% of the total invertebrate catch. The Arctic moon snail (*Cryptonatia affinis*) was the dominant mollusc collected, with n=17 recorded overall (0.75/100 m^2). These moon snails were seen in nine of the 14 trawls performed, and whole or fragmented egg cases assumed to belong to this species were also noted at Stations T6, T9, and T12. One clam (*Portlandia* spp.) and one gastropod whelk (*Volutopsius castaneus?*) were also identified in the voucher specimens.

Miscellaneous taxa comprised about 4% (1.79/100 m^2) of the overall invertebrate catch, excluding non-enumerated organisms. Unidentified planktonic Cnidaria medusoid forms (Hydroid medusa or "jellies") were also noted in some of the trawl samples, particularly at Station T7 where 22 specimens were recorded. Like some crustaceans, these pelagic organisms are only opportunistically collected by the trawl, as many pass through the mesh. Though expected to be under-sampled by the trawl, these organisms are individual in nature and were subject to enumeration.

Other miscellaneous taxa included a stalked hydroid attached to the telson of the isopod *Saduria* spp. at Station T7 and adhering to a dead bivalve shell at Station T0; this organism has been identified as *Tubularia indivisa* and has been found in the past in the Prudhoe Bay nearshore area on small pebble substrates (AK LNG 2015). Although these organisms have individual polyps, they tend to form sessile colonies and may be fused together, so while their presence has been noted, they have not been enumerated.

In addition, a solitary tunicate commonly referred to as a “sea grape” and identified as *Rhizomolgula globularis* was collected in one trawl at Station T0; this species was a predominant organism seen during nearshore sampling in conjunction with the AK LNG project in 2015 (AK LNG 2015).

A single polychaete of the order Phyllodocida was collected at Station T5 with the voucher specimens, although identification was not made to the species level. Numerous empty polychaete worm tubes were collected by the trawl (wrapped around the net’s mesh), including at Stations T3, T4, T5, T7, and T8. While these were noted, no live polychaetes were collected other than in the single voucher sample at Station T5, and this taxon is likely underestimated by trawling. For additional information on polychaetes found in the Willow MMP area, please refer to Section 6.2 for benthic sampling results.

6.3.3 Algae

General observations were made of the macroalgae opportunistically collected during the trawling effort. The limited algal specimens seen in the MMP trawls included only dead drift material, including pieces of detrital algae and unattached pieces of finely branched or filamentous algae entangled in the trawl net upon retrieval. Peat and other terrestrial detritus were also retained in the trawls, especially at the shallow stations. No trawls returned substrate (pebbles or cobble) with attached live algal specimens with intact holdfasts, nor was there any indication of the presence of an enriched boulder patch-type of environment at any of the stations that were either grab-sampled or trawled during the MMP.

6.4 HYDROGRAPHIC AND WATER QUALITY RESULTS

Water quality information was collected from each sediment/benthic and water quality station and included in situ measurements of conductivity, temperature, salinity, pH, DO, and OBS as well as discrete samples taken at a subset of stations for analysis of TSS and nephelometric turbidity. Sampling was performed at all 12 of the sediment/benthic stations concurrent with sediment grabs as well as at during a larger scale synoptic survey that included 43 water quality stations in western Harrison Bay (Table 2-3).

Hydrographic measurements at the sediment Stations S1 through S12 were all obtained on 6 August 2018 during a period of light (1-10 knot) variable winds that were primarily from a northeasterly direction. The area-wide hydrographic survey measurements (Stations W1 through W43) were obtained two days later and spanned a 25-hr period that began in the late afternoon on 8 August and continued through most of the next day. Meteorological conditions during this period were also relatively calm with wind speeds ranging from 2 to 12 knots, beginning as northeasterly on 8 August and swinging around to northwesterly and increasing in speed on 9 August. Overall, winds would be considered fairly light with small waves and minimal wave-induced mixing and resuspension of bottom sediments.

As a result of shifting winds and tidal fluctuations, the corresponding water levels varied throughout the sampling as depicted in Figure 6-28. Semidiurnal tidal fluctuations of 0.5 to 0.75 ft can be seen superimposed on small wind-induced storm surge fluctuations that were also in the 0.5 ft range. Astronomical tides in the Beaufort Sea are mixed, semi-diurnal (having two unequal highs and lows per cycle), and approach the continental shelf orthogonally from the north with little phase change and similar amplitude along the entire coastline (Kowalik and Matthews 1982; Okkonen 2016). Therefore, tidal measurements made at West Dock would be expected to be representative of conditions in Harrison Bay, although wind-induced fluctuations could vary 1–2 ft along the coast due to differences between locations in wind speed and direction, bathymetry, and orientation of the coastline. Along the Beaufort Sea coastline, easterly winds typically result in falling water levels, and westerly winds result in rising water levels. This phenomenon is caused by the Coriolis effect that forces moving water to the right in the Northern Hemisphere; westerly winds produce a positive onshore surge (increase in water level) and easterly winds produce a negative offshore surge (decrease in water level). Since winds were relatively calm during the sampling effort, wind-induced fluctuations were found to be small with a slight increase during sampling as the winds shifted from a northeasterly to a northwesterly direction.

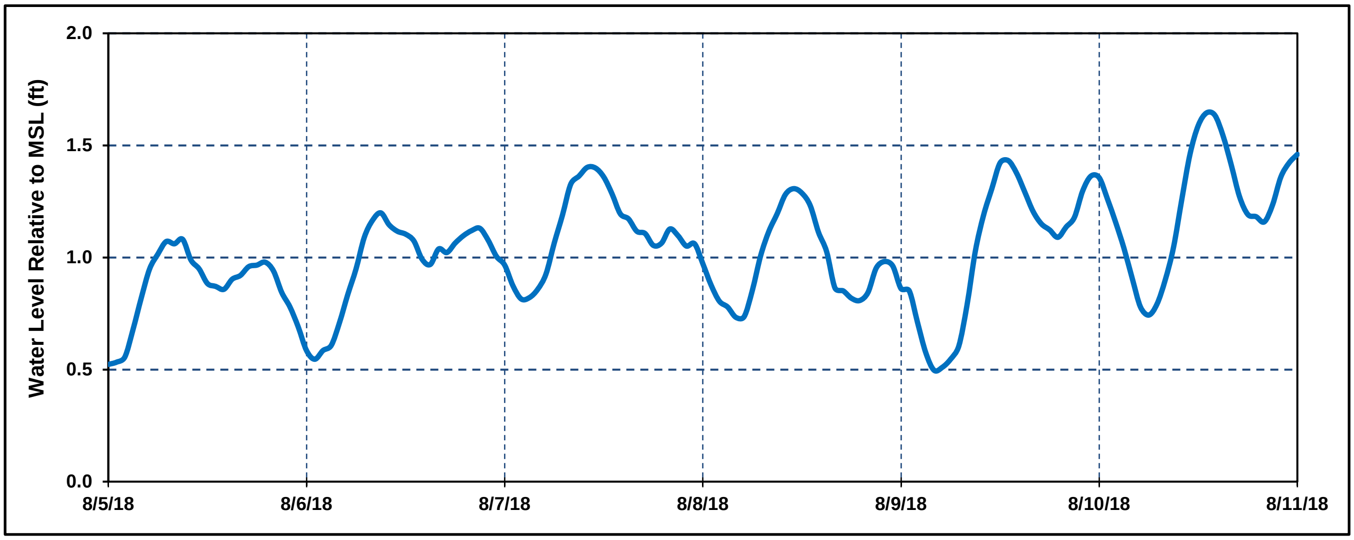


Figure 6-28. Observed Water Level Fluctuations at West Dock Prudhoe STP.

Summary hydrographic data are presented in Table 6-11 for near-surface (0.5 m depth) and near-bottom measurements at each site. Refer to Appendix D for complete hydrographic CTD profiles that include data listings and profile plots for each location. Since measurements within the study area were performed on different days and are synoptic in nature, the results are a reflection of the prevailing oceanographic and meteorological conditions on the day that the measurements were made. Therefore, care should be taken in trying to compare measurements between days, since conditions at a specific site can change substantially over the course of a short time-span due to the influence and proximity of the Colville and Kogru Rivers and changing wind, wave, and current conditions.

At the deeper locations, a two-layer vertical structure was found, with warmer brackish water overlying a colder marine layer with a fairly sharp pycnocline at approximately the 4-5 m depth. A pool of fresher water was also seen offshore at the surface, which is probably the result of recent ice melt (Figure 6-29). At shallower (< 4 m depth) locations, including the proposed MTI, the vertical structure was found to be fairly well mixed (Figure 6-30). Water temperatures that were measured at all sites and depths for all CTD profiles obtained during the monitoring effort ranged from a low of -1.41ºC in the deeper offshore marine layer to 7.24ºC with warmer conditions found at the surface and closer to the coast. A similar vertical structure was found in salinity, with values ranging from 9.82 psu at the surface in ice-melt water offshore to a high of 31.44 psu within the deeper marine layer. In general, the oceanographic conditions were typical of the early summer regime, with relatively warm brackish water dominating the nearshore environment and extending offshore in the top 3-4 m of the surface. This onshore-offshore difference can clearly be seen in Figure 6-31 and Figure 6-32 that depict planar views of bottom salinity and bottom temperature, respectively. The warmer brackish band of water can clearly be seen extending along the coast and into the southern portion of Harrison Bay.

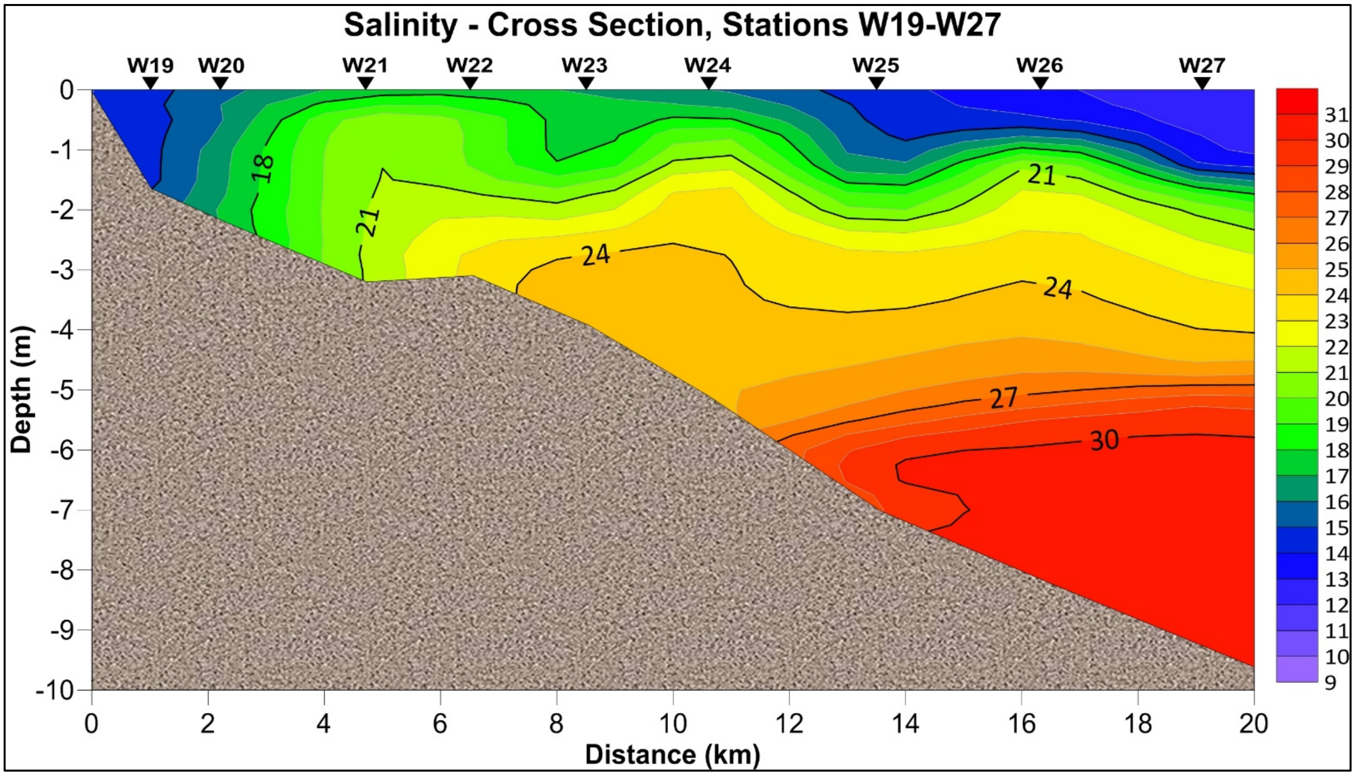


Figure 6-29. Salinity Cross Section Extending from Nearshore (W19) to Offshore (W27).

Table 6-11. Hydrographic CTD Summary of Surface and Bottom Measurements.

Station	Date	Depth	Depth (m)	Cond (S/m)	Temp (°C)	Salinity (psu)	OBS (NTU)	pH	DO (mg/L)
S1	8/6/18	surface	0.50	1.53	6.02	14.44	7.98	8.08	10.48
		bottom	1.75	2.35	2.70	25.45	5.94	7.88	11.02
S2	8/6/18	surface	0.50	2.31	3.72	24.19	4.13	8.00	10.83
		bottom	2.50	2.38	2.43	26.00	1.64	7.97	11.19
S3	8/6/18	surface	0.50	2.30	3.64	24.11	2.21	7.99	10.80
		bottom	2.50	2.37	2.32	25.96	2.21	7.98	11.19
S4	8/6/18	surface	0.50	2.20	2.89	23.54	0.81	8.02	11.29
		bottom	3.25	2.37	2.10	26.14	1.96	7.98	11.26
S5	8/6/18	surface	0.50	2.00	3.20	21.02	0.90	8.04	11.23
		bottom	4.25	2.35	1.84	26.15	0.46	7.96	11.55
S6	8/6/18	surface	0.50	1.98	3.01	20.92	0.98	8.04	11.32
		bottom	6.00	2.37	1.09	26.98	0.65	7.96	11.48
S7	8/6/18	surface	0.50	1.89	5.26	18.55	5.63	8.07	10.51
		bottom	2.25	2.40	2.31	26.33	3.46	7.94	11.14
S8	8/6/18	surface	0.50	2.20	4.24	22.54	3.60	8.03	10.87
		bottom	2.00	2.33	3.03	24.95	3.18	7.99	11.07
S9	8/6/18	surface	0.50	2.25	3.50	23.68	1.42	8.02	11.02
		bottom	2.25	2.30	2.96	24.69	1.42	8.00	11.08
S10	8/6/18	surface	0.50	1.64	6.48	15.31	9.54	8.10	10.45
		bottom	1.50	2.34	3.11	25.04	21.69	7.94	11.05
S11	8/6/18	surface	0.50	2.29	3.66	24.06	5.73	7.99	11.12
		bottom	2.75	2.43	1.73	27.22	4.88	7.97	11.37
S12	8/6/18	surface	0.50	2.27	2.28	24.76	0.70	8.01	11.57
		bottom	4.25	2.38	2.09	26.29	1.86	7.99	11.33
W1	8/8/18	surface	0.50	1.51	3.81	15.23	0.90	8.15	11.15
		bottom	5.00	2.54	0.63	29.54	2.39	7.90	11.08
W2	8/8/18	surface	0.50	1.60	4.03	16.05	0.78	8.12	11.11
		bottom	3.25	2.08	4.37	21.13	1.67	8.01	10.83
W3	8/8/18	surface	0.50	1.79	4.53	17.88	1.23	8.06	10.88
		bottom	2.25	1.80	4.53	17.94	1.14	8.06	10.88
W4	8/8/18	surface	0.50	1.81	5.98	17.28	3.22	8.05	10.31
		bottom	2.00	1.84	6.05	17.57	3.52	8.05	10.27
W5	8/8/18	surface	0.50	1.79	6.52	16.87	4.76	8.04	10.11
		bottom	1.75	1.79	6.52	16.87	4.68	8.05	10.12
W6	8/8/18	surface	0.50	1.69	6.89	15.70	11.02	8.03	9.92
		bottom	1.50	1.69	6.89	15.70	8.69	8.03	9.95
W7	8/8/18	surface	0.50	1.68	7.24	15.36	5.78	8.03	9.83
		bottom	1.75	1.68	7.24	15.36	5.65	8.04	9.88
W8	8/9/18	surface	0.50	1.47	6.94	13.47	6.43	8.02	9.85
		surface	0.50	1.67	6.55	15.63	5.96	8.05	9.95
W9	8/9/18	bottom	2.00	1.70	6.44	15.95	6.01	8.05	9.74
		surface	0.50	1.82	5.90	17.43	3.37	8.05	10.13
W10	8/9/18	bottom	2.00	1.92	5.54	18.73	2.62	8.03	10.32
		surface	0.50	1.89	4.28	19.16	0.86	8.06	10.88
W11	8/9/18	bottom	2.25	1.93	4.25	19.51	0.95	8.05	10.83
		surface	0.50	1.83	4.23	18.50	0.92	8.07	10.94
W12	8/9/18	surface	0.50	1.83	4.23	18.50	0.92	8.07	10.94
		bottom	2.50	1.92	4.31	19.40	0.73	8.06	10.90
W13	8/9/18	surface	0.50	1.85	4.15	18.69	0.82	8.09	10.94
		bottom	2.50	2.24	4.07	23.18	1.13	8.00	11.26
W14	8/9/18	surface	0.50	1.79	4.15	18.08	0.81	8.08	10.98
		bottom	1.25	1.79	4.15	18.08	0.84	8.08	10.99
W15	8/9/18	surface	0.50	1.95	3.95	19.93	0.88	8.06	10.92
		bottom	2.50	2.23	3.91	23.19	2.21	8.00	10.49
W16	8/9/18	surface	0.50	2.05	4.40	20.80	1.17	8.05	10.71
		bottom	2.25	2.06	4.45	20.93	1.07	8.05	10.72
W17	8/9/18	surface	0.50	1.76	6.18	16.67	4.53	8.07	10.03
		bottom	2.50	2.10	5.43	20.67	2.91	8.00	10.43

Table 6-11. Hydrographic CTD Summary of Surface and Bottom Measurements. (cont.)

Station	Date	Depth	Depth (m)	Cond (S/m)	Temp (°C)	Salinity (psu)	OBS (NTU)	pH	DO (mg/L)
W18	8/9/18	surface	0.50	1.64	6.38	15.38	5.81	8.06	10.14
		bottom	2.00	1.66	6.36	15.59	5.85	8.07	10.08
W19	8/9/18	surface	0.50	1.57	6.26	14.69	8.47	8.08	10.24
		bottom	1.25	1.57	6.25	14.71	8.40	8.08	10.26
W20	8/9/18	surface	0.50	1.66	6.24	15.69	4.84	8.07	10.19
		bottom	1.75	1.76	6.10	16.73	4.29	8.05	10.13
W21	8/9/18	surface	0.50	2.07	4.54	20.94	2.01	8.04	10.68
		bottom	2.75	2.10	4.62	21.22	1.67	8.03	10.56
W22	8/9/18	surface	0.50	2.00	4.74	19.98	1.78	8.05	10.74
		bottom	2.75	2.24	4.01	23.21	2.38	8.00	10.28
W23	8/9/18	surface	0.50	1.69	3.78	17.13	0.75	8.11	11.14
		bottom	3.50	2.36	3.42	25.01	1.90	7.95	10.74
W24	8/9/18	surface	0.50	1.81	3.87	18.43	2.29	8.07	11.02
		bottom	4.50	2.31	3.39	24.46	1.56	7.97	10.64
W25	8/9/18	surface	0.50	1.45	3.57	14.60	0.86	8.19	11.39
		bottom	6.25	2.48	-0.56	29.92	0.77	7.94	12.30
W26	8/9/18	surface	0.50	1.40	3.45	14.18	2.70	-	11.17
		bottom	7.75	2.48	-1.14	30.48	1.24	7.95	12.13
W27	8/9/18	surface	0.50	1.24	3.31	12.43	1.33	-	11.57
		bottom	9.50	2.49	-1.30	30.83	1.16	7.95	12.28
W28	8/9/18	surface	0.50	1.46	3.77	14.64	0.98	8.17	11.39
		bottom	5.50	2.40	2.77	26.03	1.81	7.93	10.95
W29	8/9/18	surface	0.50	1.63	3.94	16.46	0.92	8.12	11.25
		bottom	4.00	2.28	3.66	23.89	2.13	7.96	10.73
W30	8/9/18	surface	0.50	1.84	5.88	17.65	3.68	8.05	10.19
		bottom	2.75	1.86	5.80	17.89	3.50	8.05	10.22
W31	8/9/18	surface	0.50	1.63	6.24	15.37	15.85	8.07	10.24
		bottom	1.50	1.78	6.05	16.94	13.47	8.04	10.23
W32	8/9/18	surface	0.50	1.73	6.22	16.32	5.23	8.07	10.20
		bottom	1.75	1.77	6.03	16.87	6.14	8.07	10.24
W33	8/9/18	surface	0.50	1.89	5.82	18.27	3.20	8.07	10.16
		bottom	2.25	2.43	4.02	25.35	6.43	7.95	10.59
W34	8/9/18	surface	0.50	1.85	5.19	18.12	2.00	8.06	10.56
		bottom	4.00	2.19	4.35	22.39	2.12	7.99	10.68
W35	8/9/18	surface	0.50	1.51	3.85	15.21	1.17	8.17	11.38
		bottom	5.50	2.38	2.64	25.87	1.80	7.96	11.03
W36	8/9/18	surface	0.50	1.26	3.42	12.58	1.22	-	11.57
		bottom	7.50	2.49	-0.92	30.43	1.32	7.93	12.27
W37	8/9/18	surface	0.50	0.99	3.17	9.82	1.51	-	11.84
		bottom	11.25	2.53	-1.40	31.44	0.48	7.91	12.76
W38	8/9/18	surface	0.50	1.38	3.25	13.98	1.26	-	11.52
		bottom	9.50	2.52	-1.15	31.14	1.40	7.93	12.48
W39	8/9/18	surface	0.50	1.48	3.38	15.02	4.87	-	11.43
		bottom	7.25	2.49	-0.27	29.82	0.69	7.95	12.19
W40	8/9/18	surface	0.50	1.60	3.76	16.16	1.08	8.13	11.33
		bottom	5.25	2.28	3.16	24.31	0.61	7.98	11.29
W41	8/9/18	surface	0.50	1.74	3.96	17.61	1.62	8.08	11.18
		bottom	3.25	2.02	3.88	20.79	1.06	8.02	11.23
W42	8/9/18	surface	0.50	2.19	5.04	21.97	2.97	8.03	10.46
		bottom	1.50	2.19	5.04	21.97	3.14	8.03	10.48
W43	8/9/18	surface	0.50	2.04	5.56	20.01	5.34	8.04	10.32
		bottom	1.25	2.04	5.56	20.00	5.81	8.04	10.37

- Data not available.

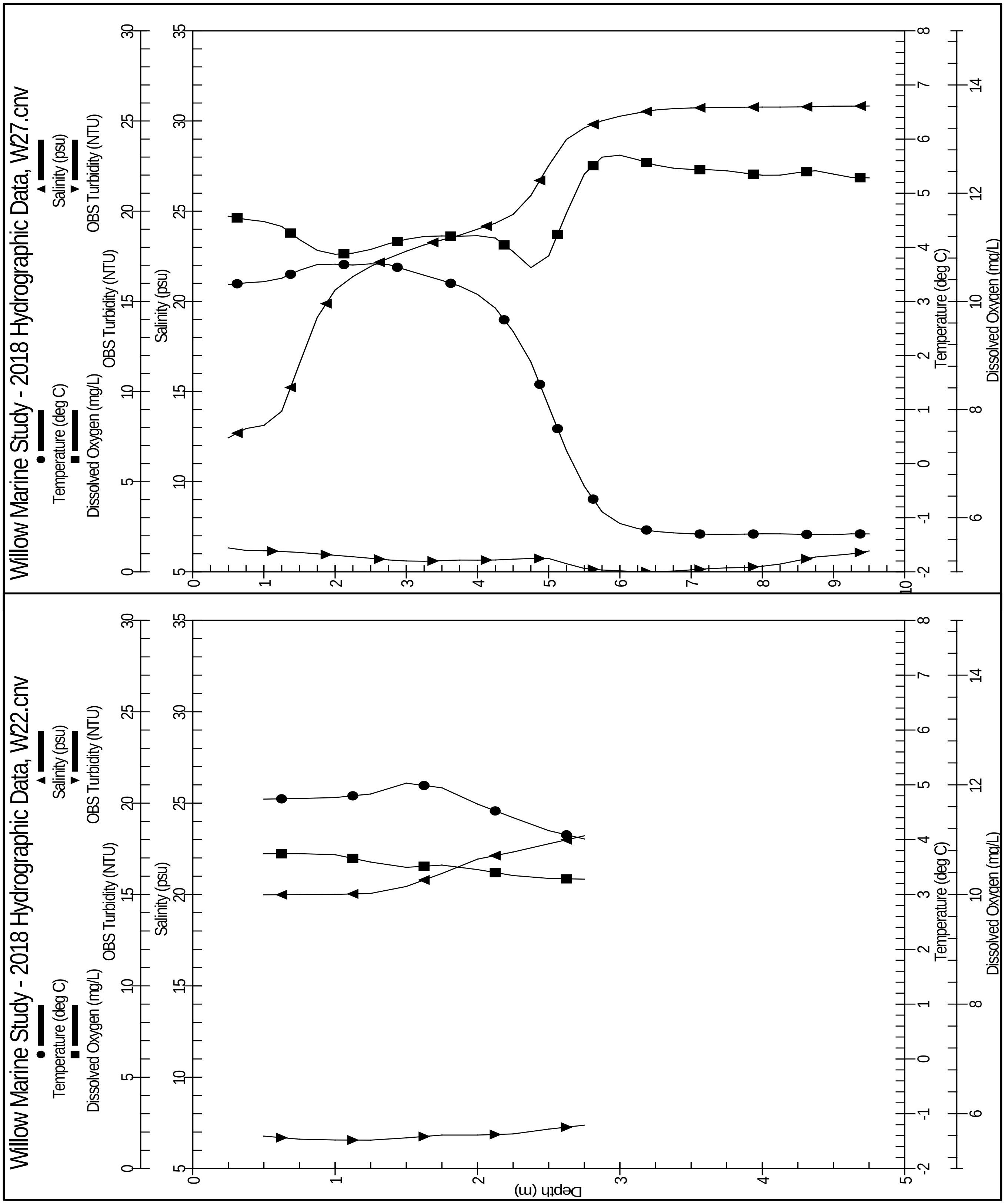


Figure 6-30. Hydrographic Profiles from MTI (W22) and a Deeper Offshore Location (W27).

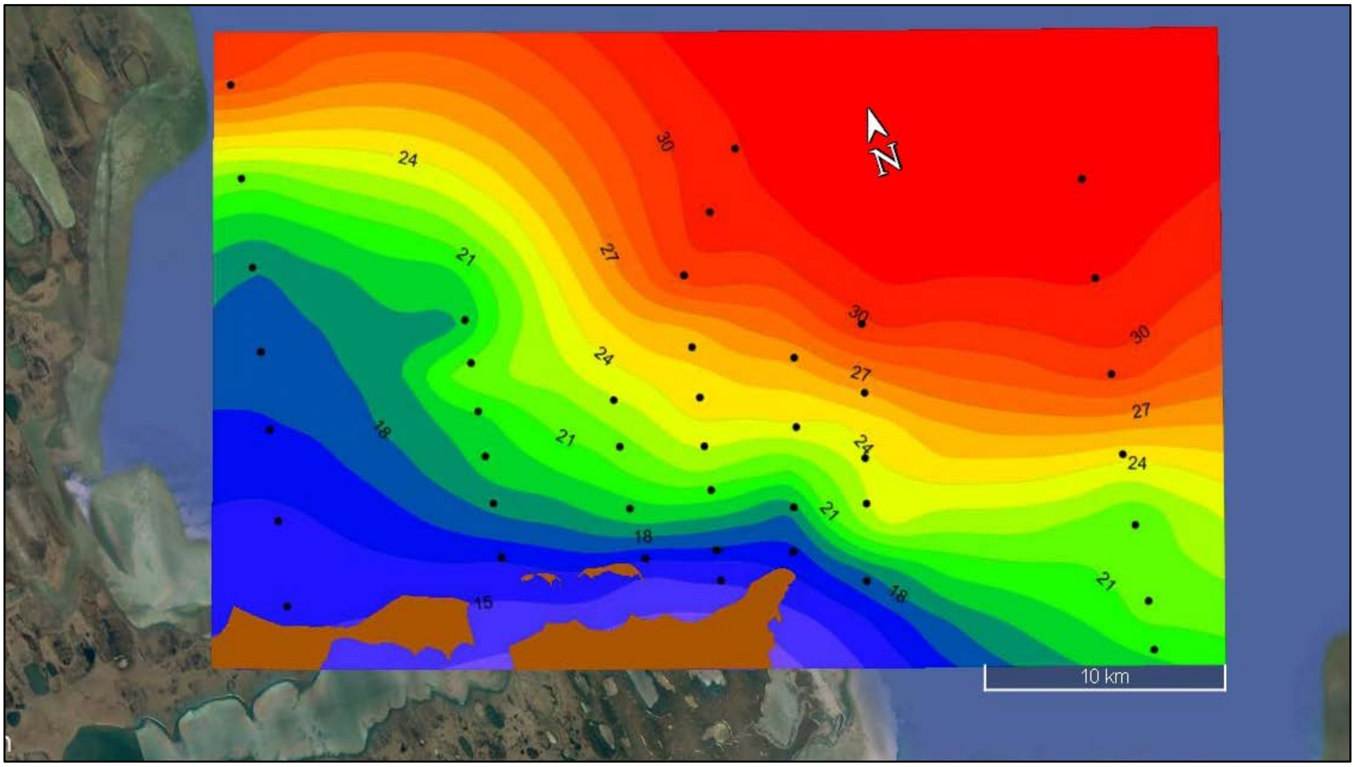


Figure 6-31. Bottom Salinity in Western Harrison Bay, 8-9 August 2018.

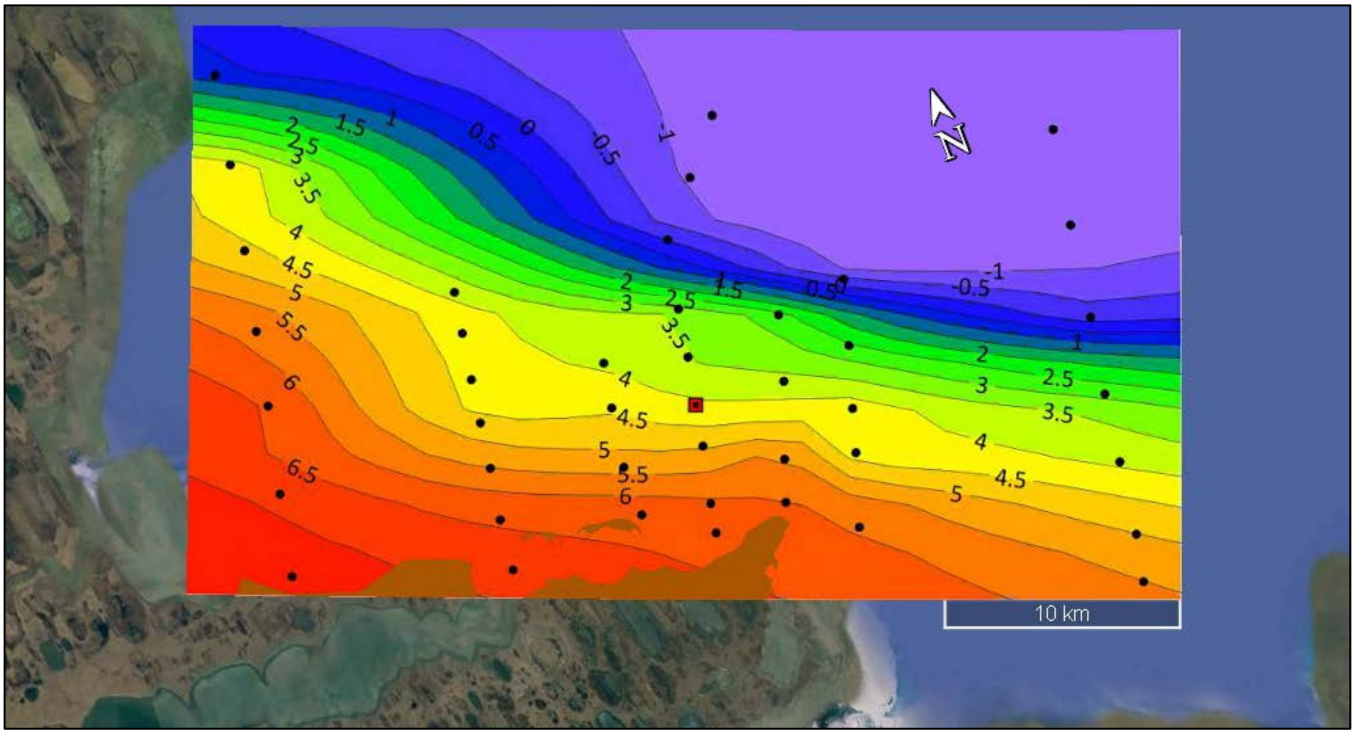


Figure 6-32. Bottom Temperature in Western Harrison Bay, 8-9 August 2018.

DO levels were found to be high and either at or near 100% saturation, ranging from a low of 9.74 mg/L to a high of 12.97 mg/L (Figure 6-33). Variations in DO were primarily related to temperature, with colder marine water having a higher saturation level than the warmer brackish surface waters (Figure 6-34).

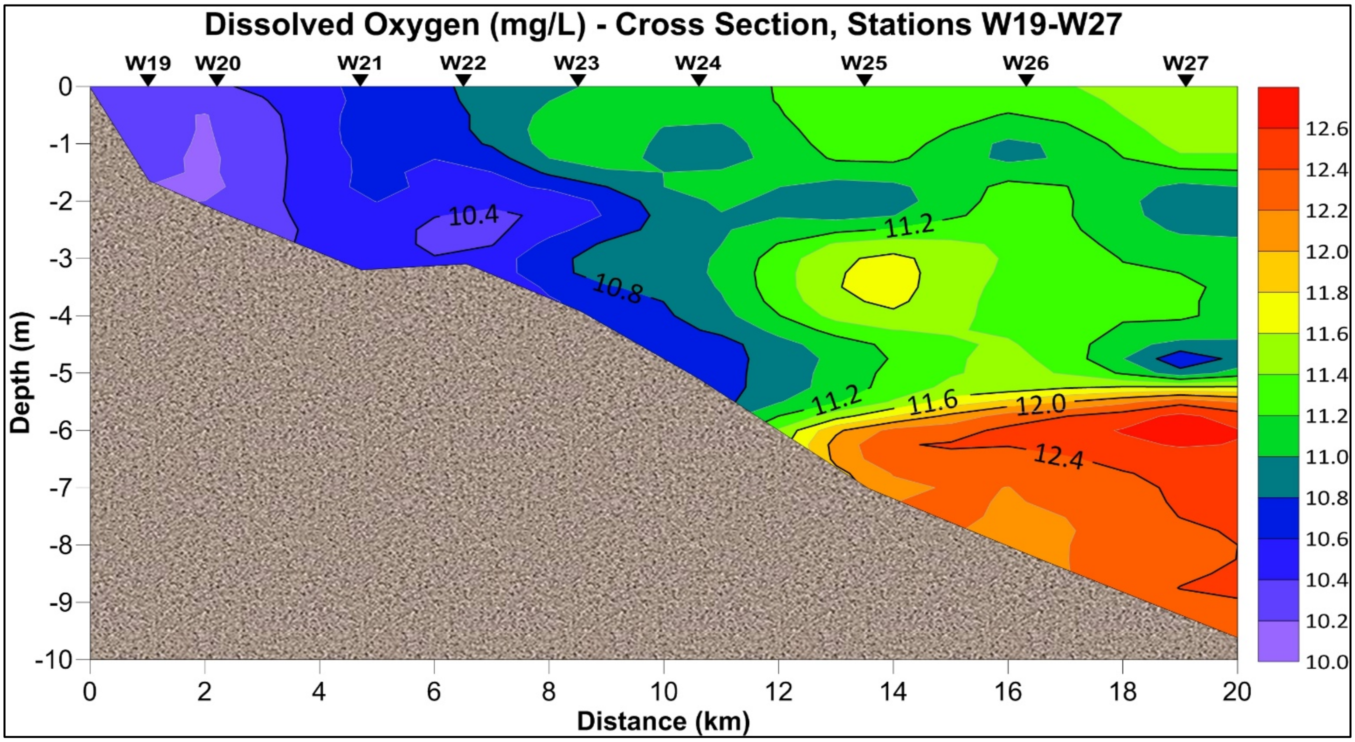


Figure 6-33. DO Cross Section Extending from Nearshore (W19) to Offshore (W27).

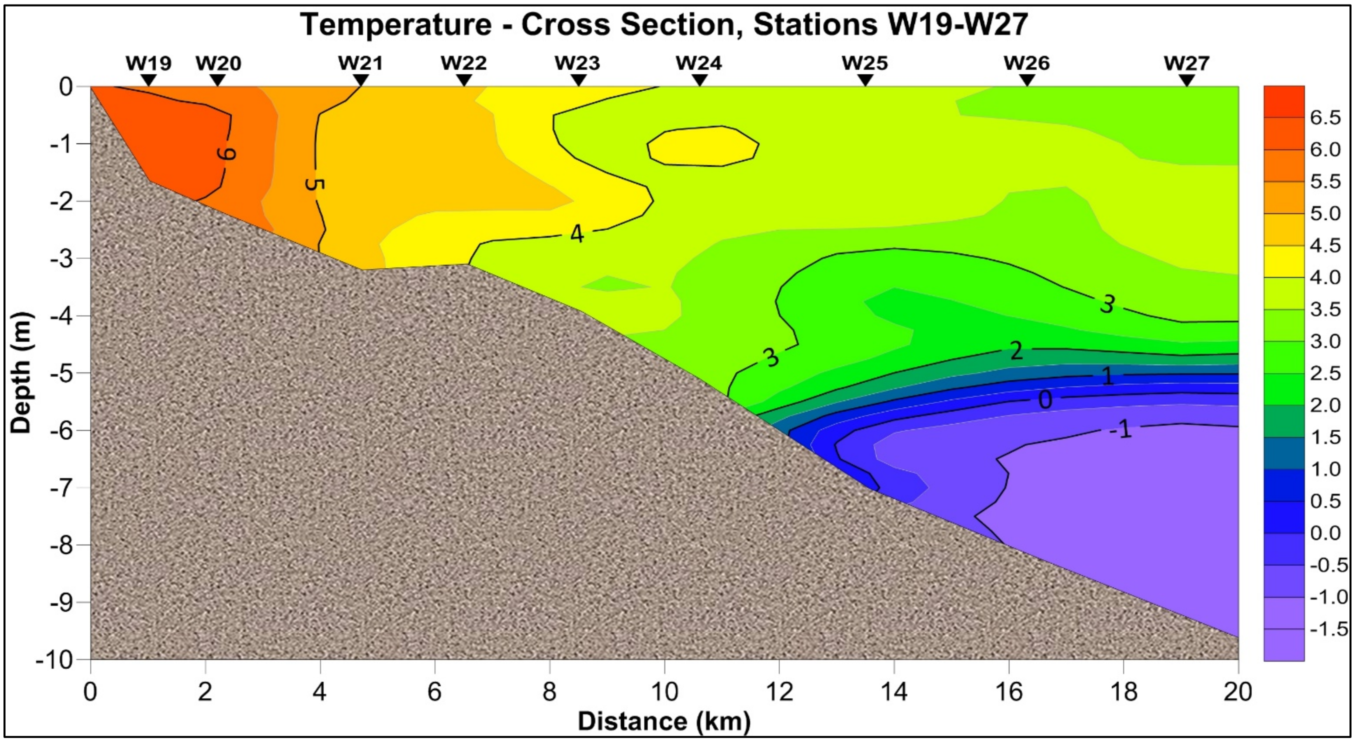


Figure 6-34. Temperature Cross Section Extending from Nearshore (W19) to Offshore (W27).

Measurements of pH ranged from a low of 7.88 to a high of 8.19 with higher values generally found in the warmer brackish water, although some of the differences seen were probably related to large vertical temperature variations and the slower response of the pH sensor relative to temperature.

Measurements of suspended sediment and turbidity were examined by three different methods at some of the water quality stations. Table 6-12 presents results of discrete water sample analyses of TSS and nephelometric turbidity as well as a comparison to OBS measurements that were obtained with the SeaBird CTD. TSS measurements ranged from 6.0 to 27.6 mg/L at the surface and from 6.6 to 32.8 mg/L at the bottom. The highest measurement was recorded at Station W31 located in shallow water off Atigaru Point due to wave-induced resuspension of bottom sediments during the sampling effort. A similar trend was seen for both field-analyzed turbidity and CTD OBS measurements, where levels ranged from 1.74 to 21.4 NTU for turbidity and from 0.73 to 15.85 NTU for OBS, with the highest levels for both also found at Station W31. In general, both TSS and turbidity were found to be slightly higher at nearshore locations, although overall levels of both were low as a result of the relatively quiescent wind and wave climate during the survey effort.

OBS measurements across all sites and depths for all CTD profiles ranged from a low of 0.01 NTU found in the deeper marine waters to 27.37 NTU nearshore at Station S10. CTD cross-section plots of OBS clearly show a nearshore band of turbid water that extended along the coastline (Figure 6-35). Since the wind and waves were minimal during much of the survey effort, it is believed that this coastal band was the result of riverine influences and it appears to correlate with warm brackish water seen in the same area.

Table 6-12. TSS, Turbidity, and OBS Results.

Site	Sample Date	TSS (mg/L)		Turbidity (NTU)		OBS Turbidity (NTU)	
		Surface	Bottom	Surface	Bottom	Surface	Bottom
W1	8/8/2018	6.0	12.4	1.89	3.00	0.90	2.39
W3	8/8/2018	6.0	6.6	2.29	2.51	1.23	1.14
W5	8/8/2018	9.4	9.2	6.80	6.62	4.76	4.68
W7	8/8/2018	10.0	10.6	8.13	8.02	5.78	5.65
W8	8/9/2018	19.4	22.6	8.51	8.15	6.43	7.70
W10	8/9/2018	10.2	8.6	5.37	5.17	3.37	2.62
W12	8/9/2018	6.2	6.6	2.36	1.74	0.92	0.73
W16	8/9/2018	7.2	6.8	2.08	2.19	1.17	1.07
W18	8/9/2018	10.2	12.8	8.58	8.58	5.81	5.85
W19	8/9/2018	16.4	12.8	12.40	11.70	8.47	8.40
W20	8/9/2018	11.8	9.6	6.92	6.21	4.84	4.29
W21	8/9/2018	7.2	9.0	2.81	2.45	2.01	1.67
W22	8/9/2018	8.6	7.8	2.75	3.10	1.78	2.38
W23	8/9/2018	6.8	7.8	2.11	3.58	0.75	1.90
W29	8/9/2018	6.8	8.8	2.07	3.48	0.92	2.13
W30	8/9/2018	9.2	9.0	5.53	5.59	3.68	3.50
W31	8/9/2018	27.6	32.8	19.90	21.40	15.85	13.47
W32	8/9/2018	12.2	11.2	7.81	7.44	5.23	6.14
W33	8/9/2018	8.2	11.6	4.58	6.77	3.20	6.43
W43	8/9/2018	13.8	13.8	7.18	7.19	5.34	5.81

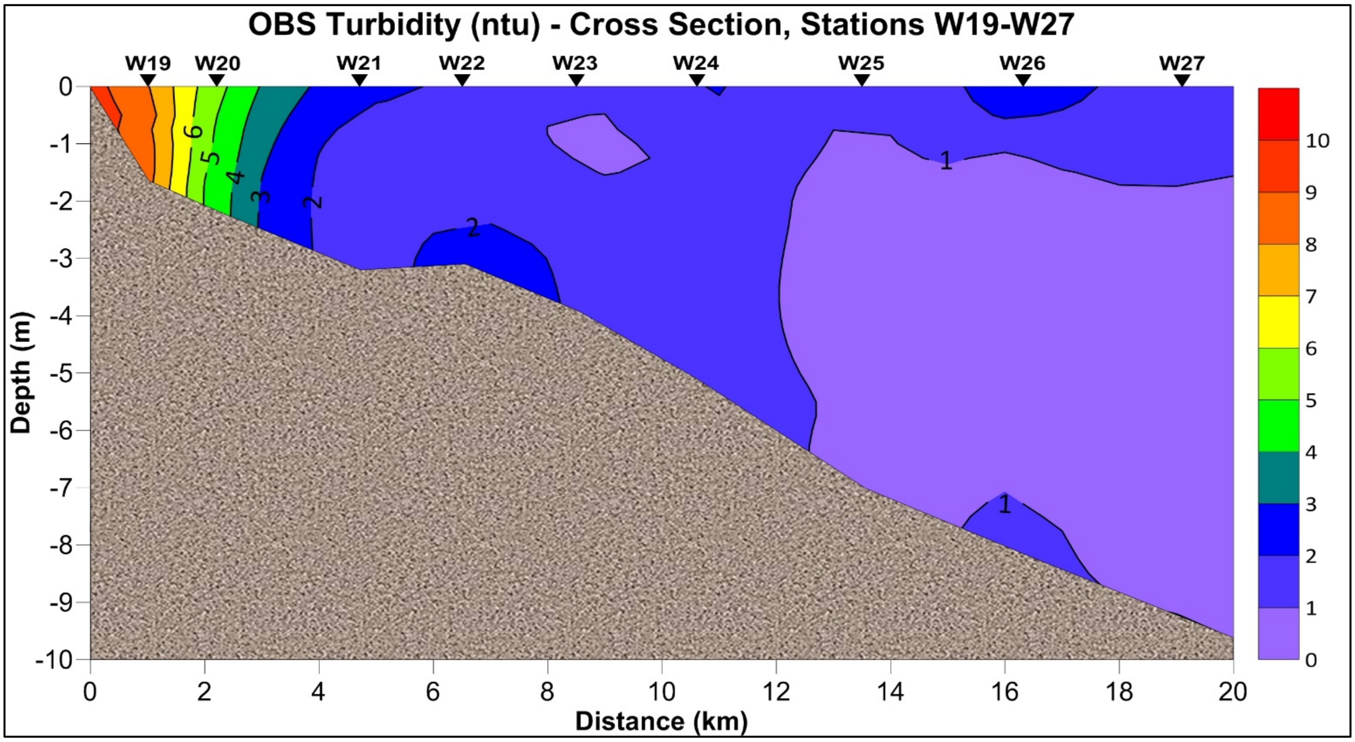


Figure 6-35. OBS Turbidity Cross Section Extending from Nearshore (W19) to Offshore (W27).

A regression of TSS versus turbidity indicated a high degree of correlation with an R^2 value of 0.80 as depicted in Figure 6-36, although as already mentioned, the levels of both were much lower than would typically be seen during higher wind and wave events. Similarly, a regression of OBS to turbidity showed an even higher degree of correlation, with an R^2 value of 0.96, although turbidity measurements obtained

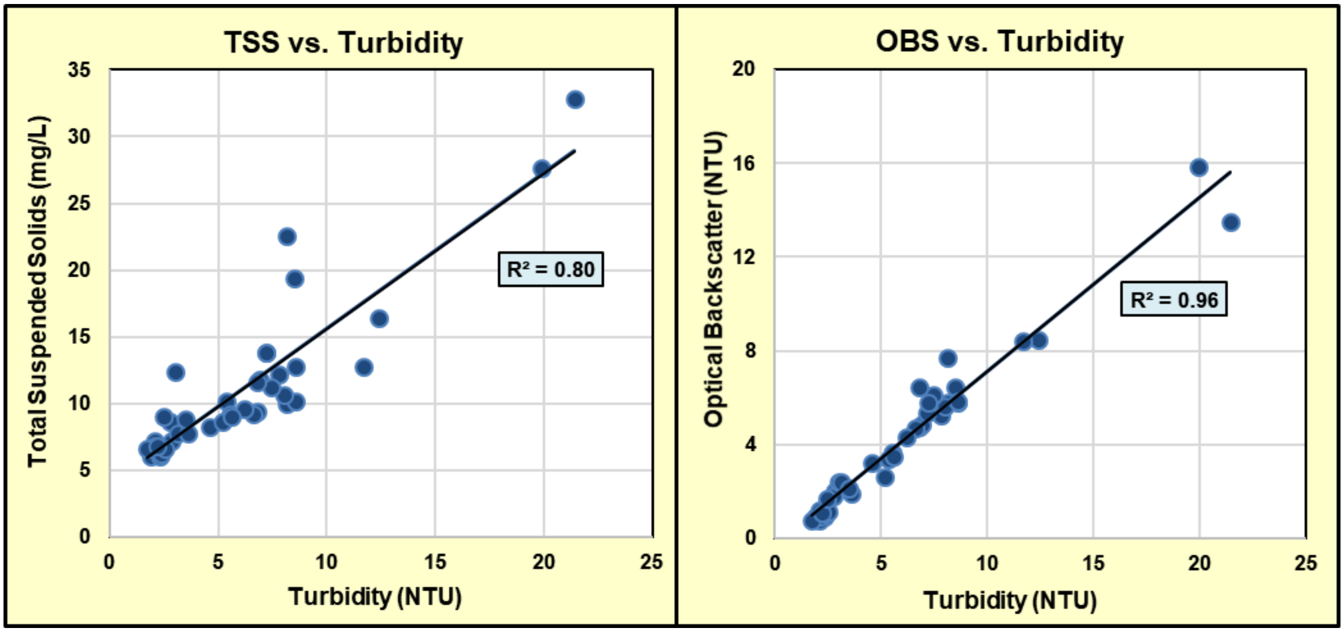


Figure 6-36. TSS and OBS vs. Turbidity Regressions.

by OBS methodology were slightly lower than the nephelometric measurements. These differences are probably related to measurement technology differences since OBS measures a 180º reflection from the particles in the water column, whereas the nephelometric methodology measures a 90º deflection as a result of particles.

As has been reported in numerous other oceanographic studies that were conducted in the nearshore region of the Beaufort Sea over the past 40 years, the hydrographic and water quality conditions that were seen in 2018 reflect current meteorological and oceanographic conditions at the actual time of sampling. Water quality conditions such as temperature and salinity are dependent on seasonal timing, riverine influences, air temperature, and recent wind activity. The dominant forcing mechanism in driving the circulation on the inner continental shelf (<50 m depth) and in nearshore waters is wind stress, with water level variations and density gradients having a lesser influence. Nearshore currents generally run in an east-west direction, parallel to the local bathymetry and in the same direction as the prevailing wind stress. Water properties are then advected along the coast and redistributed by the regional circulation patterns. These same oceanographic processes affect transport of suspended sediment and sediment quality conditions in the Beaufort nearshore region. These influences, along with regional oceanographic processes such as upwelling, have been found to be very important in affecting onshore-offshore exchange of water mass properties. Easterly winds tend to upwell cooler marine water onto the continental shelf, whereas westerly winds result in surface water piling against the coast and downwelling of marine waters. Similarly, suspended sediment and turbidity are strongly influenced by wind and wave conditions, which result in the resuspension of bottom sediment as a result of high wind and storm events. In addition, riverine plumes that discharge into the nearshore environment tend to have higher turbidity levels compared to marine waters.

Hydrographic (temperature and salinity) conditions recorded during the 2018 survey effort were representative of the early open-water season where a two-layer structure still existed, a result of the spring freshet and ice melt forming a warm brackish layer nearshore, and extending offshore at the surface, and a cold marine layer at deeper locations (3-4 m depths). At the time of sampling in early August, no major storm events had occurred, so the warm brackish coastal boundary layer was still a very prominent feature with a very well-defined pycnocline. Turbidity and TSS conditions found during 2018 were generally much lower than those typically seen because of the relatively quiescent wind and wave climate during the monitoring effort. However, a coastal band of higher TSS and turbidity was documented; this was probably associated with river discharge from the Colville River with a lesser influence from the Kogru River located within the study area.

7.0 REFERENCES

Addinsoft. 2018. XLSTAT Statistical and Data Analysis Solution. Boston, USA. https://www.xlstat.com.

Alaska LNG. 2014. Alaska LNG 2014 Marine Sampling Program – Evaluation of Test Trench Dredging and Disposal Reuse. Document No. USAG-EX-SRZZZ-00-0011.

Alaska LNG. 2015. Alaska LNG 2015 Marine Sampling Program – Evaluation of Potential Disposal Reuse Sites. Document No. USAG-EX-SRZZZ-00-000004-000.

APHA. 2017. American Public Health Association (APHA). Standard Methods for the Examination of Water and Wastewater, 23rd ed., American Public Health Association.

APP. 2012. Alaska Pipeline Project. 2011 West Dock Marine Sampling Program – Marine Sediment, Water Quality, and Biological Sampling. USAG-UR-SRWDF-000010.

ASTM. 1993. American Society for Testing and Materials (ASTM). Annual Book of Standards - Soil and Rock I: (D40-D5876), ASTM Volume 04.08, Philadelphia, PA.

Buchman, M.F. 2008. NOAA Screening Quick Reference Tables. NOAA OR&R Report 08-1, Seattle WA, Office of Response and Restoration Division, National Oceanic and Atmospheric Administration, 34 pp.

Cannon, T.C., D.R. Glass, and C.M. Prewitt. 1991. Habitat Use Patterns of Juvenile Arctic Cod in the Coastal Beaufort Sea near Prudhoe Bay, Alaska. American Fisheries Society Symposium 11:157-162.

Craig, P.C. 1984. Fish Use of Coastal Waters of the Alaskan Beaufort Sea: A Review. Transactions of the American Fisheries Society, 113:265-282.

EPA. 1983. Methods for Chemical Analysis of Water and Wastes. 600/4-79-020. Washington, D.C.

EPA. 1986. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods. EPA Publication SW-846, Third Edition; with subsequent Final Updates I (1993), II (1995), IIA (1994), IIB (1995), III (1997), IIIA (1999), IIIB (2005), IV (2008), and V (2015).

EPA. 2017. National Functional Guidelines for Inorganic Superfund Methods Data Review. EPA 540-R-2017-001. January 2017.

EPA. 2017. National Functional Guidelines for Organic Superfund Methods Data Review. EPA 540-R-2017-002. January 2017.

Exponent. 2010. cANIMIDA Task 2 – Hydrocarbon and Metal Characterization of Sediments in the cANIMIDA Study Area. Final Report. Prepared by Exponent. Submitted to U.S. Dept. of Interior, Minerals Management Service. OCS Study MMS 2010-004.

Guay, C.K. and K.K. Falkner. 1998. A Survey of Dissolved Barium in the Estuaries of Major Arctic Rivers and Adjacent Seas. *Continental Shelf Research.* Vol. 18, pp 859-882.

Hammer, Ø., Harper, D.A.T., Ryan, P.D. 2001. PAST: Paleontological Statistics Software Package for Education and Data Analysis. *Palaeontologia Electronica* 4(1): 9 pp. http://palaeo-electronica.org/2001_1/past/issue1_01.htm

Johnson, S.W., A.D. Neff, and M.R. Lindeberg. 2015. A Handy Field Guide to the Nearshore Marine Fishes of Alaska. NOAA Technical Memorandum NMFS-AFSC-293.

Kasper, J., K.H. Dunton, S.V. Schonberg, J. Trefry, B. Bluhm, G. Durell, S. Wisdom, and J. Blank. 2017. Arctic Nearshore Impact Monitoring in Development Area (ANIMIDA) III: Contaminants, Sources, and Bioaccumulation. U.S. Dept. of the Interior, Bureau of Ocean Energy Mgt., Alaska OCS Region, Anchorage, AK. OCS Study BOEM 2013-032. 280 pp.

Kowalik, Z. and J.B. Matthews. 1982. The M2 Tide in the Beaufort and Chukchi Seas. *Journal of Physical Oceanography* 12:743-746.

KLI. 2018. Draft 2018 Harrison Bay Marine Monitoring Program Sampling and Analysis Plan. Prepared by Kinnetic Laboratories for ConocoPhillips Alaska. July 18, 2018.

Liguori, B.T.P., M.G. De Almeida, and C.E. De Rezende. 2016. Barium and its Importance as an Indicator of (Paleo)Productivity. *Annals of the Brazilian Academy of Sciences.* 88(4): 2093-2103.

McCain, K.A., S.W. Raborn, R.G. Fechhelm. 2014. Draft Report. Year 31 of the Long-Term Monitoring of Nearshore Beaufort Sea Fishes in the Prudhoe Bay Region: 2013 Annual Report. Report for BP Exploration (Alaska) Inc. by LGL Alaska Research Associates, Inc., Anchorage, Alaska. 77 pp.

McManus, J., W.M. Berelson, G.P. Klinkhammer, T.E. Kilgore, and D.E. Hammond. 1994. Remobilization of Barium in Continental Marine Sediments. *Geochimica et Cosmochimica Acta*. 58(22):4899-4907.

Mecklenburg, C.W., T.A. Mecklenburg, and L.K Thorsteinson. 2002. Fishes of Alaska. Published by American Fisheries Society, Bethesda, MD.

Michael Baker International. 2018. Alpine Satellite Development Plan (ASDP) Water Quality Monitoring. Prepared for ConocoPhillips Alaska.

Moulton, L.L. and K.E. Tarbox. 1987. Analysis of Arctic Cod Movements in the Beaufort Sea Nearshore Region, 1978-79. *Arctic*. 40(1):43-49.

Neff, J.M. 2010. Continuation of the Arctic Nearshore Impact Monitoring in the Development Area (cANIMIDA): Synthesis, 1999-2007. Final Report, OCS Study BOEM 2010-032.

O'Connor, T.P. 2004. The Sediment Quality Guideline, ERL is Not a Chemical Concentration at the Threshold of Sediment Toxicity. *Marine Pollution Bulletin*. Volume 49, 383-385.

Okkonen, S. 2016. Sea Level Measurements along the Alaskan Chukchi and Beaufort Coasts. Final Report, OCS Study BOEM 2016-075. Coastal Marine Institute, University of Alaska, Fairbanks.

PSEP. 1986. Recommended Protocols for Measuring Conventional Sediment Variables in Puget Sound. Final Report. Prepared for U.S. Environmental Protection Agency, Seattle, WA.

Torres, M.E., H.J. Brunsack, G.Bohrmann, and K.C. Emeis. 1996. Barite Fronts in Continental Margin Sediments; A New Look at Bariuim Remobilization in the Zone of Sulfate Reduction and Formation of Heavy Barites in Diagenetic Fronts. *Chemical Geology*. 127:125-139.

Trefry, J.H., R.D. Rember, R.P. Trocine, and J.S. Brown. 2003. Trace Metals in Sediments Near Offshore Oil Exploration and Production Sites in the Alaskan Arctic. *Environmental Geology*, Volume 45, September 2003: pp 149-160.

Trefry J.H., T.P. Trocine, M.B. Alkire, C.M. Semmler, M.A. Savoie, and R.D. Rember. 2009. Sources, Concentrations, Composition, Partitioning and Dispersion Pathways for Suspended Sediments and Potential Metal Contaminants in the Coastal Beaufort Sea. OCS Study MMS 2009-014. US Department of Interior, Anchorage.

Trefry, J.H., K.H. Dunton, R.P. Trocine, S.V. Schonberg, N.D. McTigue, E.S. Hersh, and T.J. McDonald. 2013. Chemical and Biological Assessment of Two Offshore Drilling Sites in the Alaskan Arctic. *Marine Environmental Research*, 86:35-45.

Trefry, J.H. and J.M. Neff. 2018. Effects of Offshore Oil Exploration and Development in the Alaskan Beaufort Sea: A Three-Decade Record for Sediment Metals. Integrated Environmental Assessment and Management, Volume 9999, 1-15.

USACE. Dredged Material Management Program. 2016. Dredged Material Evaluation and Disposal Procedures (User Manual). August 2016.

van Os, B.J.H, J.J. Middelburg, and G.J. de Lange. 1991. Possible Diagenetic Mobilization of Barium in Sapropelic Sediment from the Eastern Mediterranean. *Maine Geology*, Vol. 100, Issues 1-4, pp 125-136.

Wedepohl, K.H. 1995. The Composition of the Continental Crust. *Geochimica et Cosmochimica Acta*, 59:1217-1232.

FINAL REPORT

2018 WILLOW MARINE MONITORING PROGRAM

November 2018

APPENDICES

Prepared for:

ConocoPhillips
Alaska's Oil & Gas Company
P.O. Box 100360
Anchorage, AK 99510-0360

Prepared by:

KINNETIC LABORATORIES INCORPORATED
704 West 2nd Ave.
Anchorage, AK 99501

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Appendix A

Willow Marine Monitoring Program
Sediment Results

November 2018

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ALS Environmental
ALS Group USA, Corp
1317 South 13th Avenue
Kelso, WA 98626
T : +1 360 577 7222
F : +1 360 636 1068
www.alsglobal.com

November 02, 2018

Analytical Report for Service Request No: K1807591
Revised Service Request No: K1807591.01

Mark Savoie
Kinnetic Laboratories, Incorporated
704 W. 2nd Ave
Anchorage, AK 99501

RE: 2018 Harrison Bay MMP / 5089.03

Dear Mark,

Enclosed is the revised report for the sample(s) submitted to our laboratory August 11, 2018
For your reference, these analyses have been assigned our service request number **K1807591.**

A Case Narrative was added to this report.

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. The test results meet requirements of the current NELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP-accredited analytes, refer to the certifications section at www.alsglobal.com. All results are intended to be considered in their entirety, and ALS Group USA Corp. dba ALS Environmental (ALS) is not responsible for use of less than the complete report. Results apply only to the items submitted to the laboratory for analysis and individual items (samples) analyzed, as listed in the report.

We apologize for any inconvenience this may have created.

Please contact me if you have any questions. My extension is 3364. You may also contact me via email at howard.holmes@alsglobal.com.

Respectfully submitted,

ALS Group USA, Corp. dba ALS Environmental

Howard Holmes
Project Manager

REVISED
9:02 am, Nov 02, 2018

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Table of Contents

Acronyms

ASTM	American Society for Testing and Materials
A2LA	American Association for Laboratory Accreditation
CARB	California Air Resources Board
CAS Number	Chemical Abstract Service registry Number
CFC	Chlorofluorocarbon
CFU	Colony-Forming Unit
DEC	Department of Environmental Conservation
DEQ	Department of Environmental Quality
DHS	Department of Health Services
DOE	Department of Ecology
DOH	Department of Health
EPA	U. S. Environmental Protection Agency
ELAP	Environmental Laboratory Accreditation Program
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
LOD	Limit of Detection
LOQ	Limit of Quantitation
LUFT	Leaking Underground Fuel Tank
M	Modified
MCL	Maximum Contaminant Level is the highest permissible concentration of a substance allowed in drinking water as established by the USEPA.
MDL	Method Detection Limit
MPN	Most Probable Number
MRL	Method Reporting Limit
NA	Not Applicable
NC	Not Calculated
NCASI	National Council of the Paper Industry for Air and Stream Improvement
ND	Not Detected
NIOSH	National Institute for Occupational Safety and Health
PQL	Practical Quantitation Limit
RCRA	Resource Conservation and Recovery Act
SIM	Selected Ion Monitoring
TPH	Total Petroleum Hydrocarbons
tr	Trace level is the concentration of an analyte that is less than the PQL but greater than or equal to the MDL.

Inorganic Data Qualifiers

*	The result is an outlier. See case narrative.
#	The control limit criteria is not applicable. See case narrative.
B	The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
E	The result is an estimate amount because the value exceeded the instrument calibration range.
J	The result is an estimated value.
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
i	The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
X	See case narrative.
Q	See case narrative. One or more quality control criteria was outside the limits.
H	The holding time for this test is immediately following sample collection. The samples were analyzed as soon as possible after receipt by the laboratory.

Metals Data Qualifiers

#	The control limit criteria is not applicable. See case narrative.
J	The result is an estimated value.
E	The percent difference for the serial dilution was greater than 10%, indicating a possible matrix interference in the sample.
M	The duplicate injection precision was not met.
N	The Matrix Spike sample recovery is not within control limits. See case narrative.
S	The reported value was determined by the Method of Standard Additions (MSA).
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
W	The post-digestion spike for furnace AA analysis is out of control limits, while sample absorbance is less than 50% of spike absorbance.
i	The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
X	See case narrative.
+	The correlation coefficient for the MSA is less than 0.995.
Q	See case narrative. One or more quality control criteria was outside the limits.

Organic Data Qualifiers

*	The result is an outlier. See case narrative.
#	The control limit criteria is not applicable. See case narrative.
A	A tentatively identified compound, a suspected aldol-condensation product.
B	The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
C	The analyte was qualitatively confirmed using GC/MS techniques, pattern recognition, or by comparing to historical data.
D	The reported result is from a dilution.
E	The result is an estimated value.
J	The result is an estimated value.
N	The result is presumptive. The analyte was tentatively identified, but a confirmation analysis was not performed.
P	The GC or HPLC confirmation criteria was exceeded. The relative percent difference is greater than 40% between the two analytical results.
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
i	The MRL/MDL or LOQ/LOD is elevated due to a chromatographic interference.
X	See case narrative.
Q	See case narrative. One or more quality control criteria was outside the limits.

Additional Petroleum Hydrocarbon Specific Qualifiers

F	The chromatographic fingerprint of the sample matches the elution pattern of the calibration standard.
L	The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of lighter molecular weight constituents than the calibration standard.
H	The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of heavier molecular weight constituents than the calibration standard.
O	The chromatographic fingerprint of the sample resembles an oil, but does not match the calibration standard.
Y	The chromatographic fingerprint of the sample resembles a petroleum product eluting in approximately the correct carbon range, but the elution pattern does not match the calibration standard.
Z	The chromatographic fingerprint does not resemble a petroleum product.

ALS Group USA Corp. dba ALS Environmental (ALS) - Kelso
State Certifications, Accreditations, and Licenses

Agency	Web Site	Number
Alaska DEH	http://dec.alaska.gov/eh/lab/cs/csapproval.htm	UST-040
Arizona DHS	http://www.azdhs.gov/lab/license/env.htm	AZ0339
Arkansas - DEQ	http://www.adeq.state.ar.us/techsvs/labcert.htm	88-0637
California DHS (ELAP)	http://www.cdph.ca.gov/certlic/labs/Pages/ELAP.aspx	2795
DOD ELAP	http://www.denix.osd.mil/edqw/Accreditation/AccreditedLabs.cfm	L16-58-R4
Florida DOH	http://www.doh.state.fl.us/lab/EnvLabCert/WaterCert.htm	E87412
Hawaii DOH	http://health.hawaii.gov/	-
ISO 17025	http://www.pjlabs.com/	L16-57
Louisiana DEQ	http://www.deq.louisiana.gov/page/la-lab-accreditation	03016
Maine DHS	http://www.maine.gov/dhhs/	WA01276
Minnesota DOH	http://www.health.state.mn.us/accreditation	053-999-457
Nevada DEP	http://ndep.nv.gov/bsdw/labservice.htm	WA01276
New Jersey DEP	http://www.nj.gov/dep/enforcement/oqa.html	WA005
New York - DOH	https://www.wadsworth.org/regulatory/elap	12060
North Carolina DEQ	https://deq.nc.gov/about/divisions/water-resources/water-resources-data/water-sciences-home-page/laboratory-certification-branch/non-field-lab-certification	605
Oklahoma DEQ	http://www.deq.state.ok.us/CSDnew/labcert.htm	9801
Oregon – DEQ (NELAP)	http://public.health.oregon.gov/LaboratoryServices/EnvironmentalLaboratoryAccreditation/Pages/index.aspx	WA100010
South Carolina DHEC	http://www.scdhec.gov/environment/EnvironmentalLabCertification/	61002
Texas CEQ	http://www.tceq.texas.gov/field/qa/env_lab_accreditation.html	T104704427
Washington DOE	http://www.ecy.wa.gov/programs/eap/labs/lab-accreditation.html	C544
Wyoming (EPA Region 8)	https://www.epa.gov/region8-waterops/epa-region-8-certified-drinking-water-	-
Kelso Laboratory Website	www.alsglobal.com	NA

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. A complete listing of specific NELAP-certified analytes, can be found in the certification section at www.ALSGlobal.com or at the accreditation bodies web site.

Please refer to the certification and/or accreditation body's web site if samples are submitted for compliance purposes. The states highlighted above, require the analysis be listed on the state certification if used for compliance purposes and if the method/anlayte is offered by that state.

Case Narrative

ALS Environmental—Kelso Laboratory
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REVISED
9:02 am, Nov 02, 2018

Client: Kinnetic Laboratories, Incorporated
Service Request: K1807591
Project: 2018 Harrison Bay MMP
Date Received: 08/11/2018
Sample Matrix: Sediment

CASE NARRATIVE

All analyses were performed consistent with the quality assurance program of ALS Environmental. This report contains analytical results for samples designated for Tier II data deliverables. When appropriate to the method, method blank results have been reported with each analytical test. Surrogate recoveries have been reported for all applicable organic analyses. Additional quality control analyses reported herein include: Laboratory Duplicate (DUP), Matrix Spike (MS), Matrix/Duplicate Matrix Spike (MS/DMS), Laboratory Control Sample (LCS), and Laboratory/Duplicate Laboratory Control Sample (LCS/DLCS).

Sample Receipt:

Twenty six sediment samples were received for analysis at ALS Environmental on 08/11/2018. The samples were received in good condition and consistent with the accompanying chain of custody form. The samples were stored in a refrigerator at 4ºC upon receipt at the laboratory.

General Chemistry:

No significant anomalies were noted with this analysis.

Approved by ______________________

Date 11/02/2018

Chain of Custody

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
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K1807591

Chain of Custody Record

Page 1 of 2

To: **ALS Environmental** **1317 South 13th Avenue** **Kelso, WA 98626** **(360) 577-7222** **1-800-695-7222** **Contact: Howard Holmes (Howard.Holmes@alsglobal.com)**	KLI PO #: AK18-1019 **Quote #: 91641** **Lab #:**	**From:** **Kinnetic Laboratories, Inc** **704 West 2nd Ave.** **Anchorage, AK 99501** **(907) 276-6178** **Contact: Mark Savoie**

Project: **2018 HARRISON BAY MMP** **Matrix:** **Sediment** **Project #:** **5089.03**

Complete by: **Standard TAT**

SampleID	StationID	Sample Date	Sample Time	Sample Type	Analysis	Container	Pres	No. of Bottles	LabID	Condition Upon Receipt
HB18-TTT-S1-1	S1-1	8/6/18	1138	Grab	TVS/160.4; TOC/9060; TS/PSEP	125-mL WMGJ	4° C	1		
HB18-TTT-S2-1	S2-1		1036	Grab	TVS/160.4; TOC/9060; TS/PSEP	125-mL WMGJ	4° C	1		
HB18-TTT-S3-1	S3-1		0929	Grab	TVS/160.4; TOC/9060; TS/PSEP	125-mL WMGJ	4° C	1		
HB18-TTT-S3-2	S3-2		0929	Grab	TVS/160.4; TOC/9060; TS/PSEP	125-mL WMGJ	4° C	1		
HB18-TTT-S4-1	S4-1		1207	Grab	TVS/160.4; TOC/9060; TS/PSEP	125-mL WMGJ	4° C	1		
HB18-TTT-S5-1	S5-1		1336	Grab	TVS/160.4; TOC/9060; TS/PSEP	125-mL WMGJ	4° C	1		
HB18-TTT-S6-1	S6-1		1358	Grab	TVS/160.4; TOC/9060; TS/PSEP	125-mL WMGJ	4° C	1		
HB18-TTT-S7-1	S7-1		1552	Grab	TVS/160.4; TOC/9060; TS/PSEP	125-mL WMGJ	4° C	1		
HB18-TTT-S8-1	S8-1		1515	Grab	TVS/160.4; TOC/9060; TS/PSEP	125-mL WMGJ	4° C	1		
HB18-TTT-S9-1	S9-1		1436	Grab	TVS/160.4; TOC/9060; TS/PSEP	125-mL WMGJ	4° C	1		
HB18-TTT-S10-1	S10-1		1638	Grab	TVS/160.4; TOC/9060; TS/PSEP	125-mL WMGJ	4° C	1		
HB18-TTT-S11-1	S11-1		1709	Grab	TVS/160.4; TOC/9060; TS/PSEP	125-mL WMGJ	4° C	1		
HB18-TTT-S12-1	S12-1		1754	Grab	TVS/160.4; TOC/9060; TS/PSEP	125-mL WMGJ	4° C	1		

Data Report MUST include the following: Sample ID, Analytical Method, Detection Limit, Date of Extraction if applicable, Date of Analysis, Analytical Results, and Signature of QA Reviewer. All times on this sheet are military time. Email sample receipt confirmations, PDF reports, and EDDs to msavoie@kinneticlabs.net. EDD REQUIRED.

Special Instructions/Comments: **See quote list of analytes and detection limits.**

Sampled and Relinquished By:	Date/Time:	Transporter	Received By:	Date/Time:
	8/10/18 1005	AK Goldstreak	DANIEL PUPTON	8-11-18 1000
Relinquished By:	**Date/Time:**	**Transporter**	**Received By:**	**Date/Time:**

v20020904

V 1/2

K1807591

Chain of Custody Record

Page 2 of 2

To: ALS Environmental 1317 South 13th Avenue Kelso, WA 98626 (360) 577-7222 1-800-695-7222 Contact: Howard Holmes (Howard.Holmes@alsglobal.com)	KLI PO #: AK18-1019 Quote #: 91641 Lab #:	From: Kinnetic Laboratories, Inc 704 West 2nd Ave. Anchorage, AK 99501 (907) 276-6178 Contact: Mark Savoie

Project: 2018 HARRISON BAY MMP **Matrix:** Sediment **Project #:** 5089.03

Complete by: Standard TAT

SampleID	StationID	Sample Date	Sample Time	Sample Type	Analysis	Container	Pres	No. of Bottles	LabID	Condition Upon Receipt
HB18-PGS-S1-1	S1-1	8/6/18	1138	Grab	ASTM D422M/PartSize ASTMEB	500-mL WMGJ	4° C	1		
HB18-PGS-S2-1	S2-1		1036	Grab	ASTM D422M/PartSize ASTMEB	500-mL WMGJ	4° C	1		
HB18-PGS-S3-1	S3-1		0929	Grab	ASTM D422M/PartSize ASTMEB	500-mL WMGJ	4° C	1		
HB18-PGS-S3-2	S3-2		0929	Grab	ASTM D422M/PartSize ASTMEB	500-mL WMGJ	4° C	1		
HB18-PGS-S4-1	S4-1		1207	Grab	ASTM D422M/PartSize ASTMEB	500-mL WMGJ	4° C	1		
HB18-PGS-S5-1	S5-1		1336	Grab	ASTM D422M/PartSize ASTMEB	500-mL WMGJ	4° C	1		
HB18-PGS-S6-1	S6-1		1358	Grab	ASTM D422M/PartSize ASTMEB	500-mL WMGJ	4° C	1		
HB18-PGS-S7-1	S7-1		1552	Grab	ASTM D422M/PartSize ASTMEB	500-mL WMGJ	4° C	1		
HB18-PGS-S8-1	S8-1		1515	Grab	ASTM D422M/PartSize ASTMEB	500-mL WMGJ	4° C	1		
HB18-PGS-S9-1	S9-1		1436	Grab	ASTM D422M/PartSize ASTMEB	500-mL WMGJ	4° C	1		
HB18-PGS-S10-1	S10-1		1638	Grab	ASTM D422M/PartSize ASTMEB	500-mL WMGJ	4° C	1		
HB18-PGS-S11-1	S11-1		1709	Grab	ASTM D422M/PartSize ASTMEB	500-mL WMGJ	4° C	1		
HB18-PGS-S12-1	S12-1		1754	Grab	ASTM D422M/PartSize ASTMEB	500-mL WMGJ	4° C	1		

Data Report MUST include the following: Sample ID, Analytical Method, Detection Limit, Date of Extraction if applicable, Date of Analysis, Analytical Results, and Signature of QA Reviewer. All times on this sheet are military time. Email sample receipt confirmations, PDF reports, and EDDs to msavoie@kinneticlabs.net. EDD REQUIRED.

Special Instructions/Comments: See quote list of analytes and detection limits.

Sampled and Relinquished By:	Date/Time:	Transporter	Received By:	Date/Time:
	8/10/18 1005	AK Goldstreak	Daniel Pupton	8-11-18 1000
Relinquished By:	**Date/Time:**	**Transporter**	**Received By:**	**Date/Time:**

v20020904

ALS

PC H2

Cooler Receipt and Preservation Form

Client KINNETIC LABS Service Request K18 07591

Received: 8-11-18 Opened: 8-11-18 By: JSP Unloaded: 8-11-18 By: JSP

1. Samples were received via? USPS Fed Ex UPS DHL PDX [✓ Courier] Hand Delivered
2. Samples were received in: (circle) [✓ Cooler] Box Envelope Other ______ NA
3. Were custody seals on coolers? NA Y [✓ N] If yes, how many and where? ______

If present, were custody seals intact? Y N If present, were they signed and dated? Y N

Raw Cooler Temp	Corrected. Cooler Temp	Raw Temp Blank	Corrected Temp Blank	Corr. Factor	Thermometer ID	Cooler/COC ID [✓ NA]	Tracking Number [✓ NA]	Filed
5.3	5.3	2.1	2.1	0.0	390			
6.0	5.9	5.3	5.2	-0.1	371			

4. Packing material: Inserts Baggies [✓ Bubble Wrap] [✓ Gel Packs] Wet Ice Dry Ice Sleeves ______
5. Were custody papers properly filled out (ink, signed, etc.)? NA [✓ Y] N
6. Were samples received in good condition (temperature, unbroken)? *Indicate in the table below.* NA [✓ Y] N
   If applicable, tissue samples were received: Frozen Partially Thawed Thawed
7. Were all sample labels complete (i.e analysis, preservation, etc.)? NA [✓ Y] N
8. Did all sample labels and tags agree with custody papers? *Indicate major discrepancies in the table on page 2.* NA [✓ Y] N
9. Were appropriate bottles/containers and volumes received for the tests indicated? NA [✓ Y] N
10. Were the pH-preserved bottles (*see SMO GEN SOP*) received at the appropriate pH? *Indicate in the table below* [✓ NA] Y N
11. Were VOA vials received without headspace? *Indicate in the table below.* [✓ NA] Y N
12. Was C12/Res negative? [✓ NA] Y N

Sample ID on Bottle	Sample ID on COC	Identified by:

Sample ID	Bottle Count Bottle Type	Out of Temp	Head-space	Broke	pH	Reagent	Volume added	Reagent Lot Number	Initials	Time

Notes, Discrepancies, & Resolutions: ______

7/25/16

Page ____ *of* ____

Total Solids

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
Phone (360)577-7222 Fax (360)636-1068
www.alsglobal.com

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807591
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/6/18
Sample Matrix:	Sediment	**Date Received:**	08/11/18
Analysis Method:	160.4 Modified	**Units:**	Percent
Prep Method:	None	**Basis:**	Dry, per Method

Solids, Total Volatile

Sample Name	Lab Code	Result	MRL	Dil.	Date Analyzed	Q
HB18-TTT-S1-1	K1807591-001	**6.40**	0.10	1	08/13/18 17:07	
HB18-TTT-S2-1	K1807591-002	**9.80**	0.10	1	08/13/18 17:07	
HB18-TTT-S3-1	K1807591-003	**3.40**	0.10	1	08/13/18 17:07	
HB18-TTT-S3-2	K1807591-004	**3.50**	0.10	1	08/13/18 17:07	
HB18-TTT-S4-1	K1807591-005	**3.10**	0.10	1	08/13/18 17:07	
HB18-TTT-S5-1	K1807591-006	**4.40**	0.10	1	08/13/18 17:07	
HB18-TTT-S6-1	K1807591-007	**8.10**	0.10	1	08/13/18 17:07	
HB18-TTT-S7-1	K1807591-008	**7.10**	0.10	1	08/13/18 17:07	
HB18-TTT-S8-1	K1807591-009	**3.60**	0.10	1	08/13/18 17:07	
HB18-TTT-S9-1	K1807591-010	**2.90**	0.10	1	08/13/18 17:07	
HB18-TTT-S10-1	K1807591-011	**2.90**	0.10	1	08/13/18 17:07	
HB18-TTT-S11-1	K1807591-012	**12.9**	0.10	1	08/13/18 17:07	
HB18-TTT-S12-1	K1807591-013	**11.5**	0.10	1	08/13/18 17:07	
Method Blank	K1807591-MB	ND U	0.10	1	08/13/18 17:07	

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807591
Project	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/06/18
Sample Matrix:	Sediment	**Date Received:**	08/11/18
Analysis Method:	160.4 Modified	**Units:**	Percent
Prep Method:	None	**Basis:**	Dry, per Method

Replicate Sample Summary
Solids, Total Volatile

Sample Name:	Lab Code:	MRL	Sample Result	Duplicate Result	Average	RPD	RPD Limit	Date Analyzed
HB18-TTT-S1-1	K1807591-001DUP	0.10	6.40	6.60	6.50	3	20	08/13/18
HB18-TTT-S11-1	K1807591-012DUP	0.10	12.9	12.9	12.9	<1	20	08/13/18

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Analytical Report

Client: Kinnetic Laboratories, Incorporated
Service Request: K1807591
Project: 2018 Harrison Bay MMP/5089.03
Date Collected: 08/6/18
Sample Matrix: Sediment
Date Received: 08/11/18

Analysis Method: PSEP TS
Units: Percent
Prep Method: None
Basis: As Received

Solids, Total

Sample Name	Lab Code	Result	MRL	Dil.	Date Analyzed	Q
HB18-TTT-S1-1	K1807591-001	**65.8**	-	1	08/14/18 13:51	
HB18-TTT-S2-1	K1807591-002	**57.3**	-	1	08/14/18 13:51	
HB18-TTT-S3-1	K1807591-003	**72.9**	-	1	08/14/18 13:51	
HB18-TTT-S3-2	K1807591-004	**73.4**	-	1	08/14/18 13:51	
HB18-TTT-S4-1	K1807591-005	**73.2**	-	1	08/14/18 13:51	
HB18-TTT-S5-1	K1807591-006	**69.3**	-	1	08/14/18 13:51	
HB18-TTT-S6-1	K1807591-007	**52.3**	-	1	08/14/18 13:51	
HB18-TTT-S7-1	K1807591-008	**58.3**	-	1	08/14/18 13:51	
HB18-TTT-S8-1	K1807591-009	**74.2**	-	1	08/14/18 13:51	
HB18-TTT-S9-1	K1807591-010	**75.6**	-	1	08/14/18 13:51	
HB18-TTT-S10-1	K1807591-011	**74.5**	-	1	08/14/18 13:51	
HB18-TTT-S11-1	K1807591-012	**41.7**	-	1	08/14/18 13:51	
HB18-TTT-S12-1	K1807591-013	**46.3**	-	1	08/14/18 13:51	
HB18-PGS-S1-1	K1807591-014	**64.1**	-	1	08/14/18 13:51	
HB18-PGS-S2-1	K1807591-015	**57.0**	-	1	08/14/18 13:51	
HB18-PGS-S3-1	K1807591-016	**72.5**	-	1	08/14/18 13:51	
HB18-PGS-S3-2	K1807591-017	**73.9**	-	1	08/14/18 13:51	
HB18-PGS-S4-1	K1807591-018	**73.2**	-	1	08/14/18 13:51	
HB18-PGS-S5-1	K1807591-019	**69.5**	-	1	08/14/18 13:51	
HB18-PGS-S6-1	K1807591-020	**51.8**	-	1	08/14/18 13:51	
HB18-PGS-S7-1	K1807591-021	**58.8**	-	1	08/14/18 16:47	
HB18-PGS-S8-1	K1807591-022	**71.8**	-	1	08/14/18 16:47	
HB18-PGS-S9-1	K1807591-023	**73.0**	-	1	08/14/18 16:47	
HB18-PGS-S10-1	K1807591-024	**76.2**	-	1	08/14/18 16:47	
HB18-PGS-S11-1	K1807591-025	**42.0**	-	1	08/14/18 16:47	
HB18-PGS-S12-1	K1807591-026	**43.2**	-	1	08/14/18 16:47	

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807591
Project	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/06/18
Sample Matrix:	Sediment	**Date Received:**	08/11/18
		Date Analyzed:	08/14/18

Triplicate Sample Summary
General Chemistry Parameters

Sample Name:	HB18-TTT-S1-1	**Units:**	Percent
Lab Code:	K1807591-001	**Basis:**	As Received
Analysis Method:	PSEP TS		
Prep Method:	None		

Analyte Name	MRL	Sample Result	Duplicate K1807591-001DUP Result	Triplicate K1807591-001TRP Result	Average	RSD	RSD Limit
Solids, Total	-	65.8	65.7	66.4	66.0	<1	10

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807591
Project	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/06/18
Sample Matrix:	Sediment	**Date Received:**	08/11/18
		Date Analyzed:	08/14/18

Triplicate Sample Summary
General Chemistry Parameters

Sample Name:	HB18-TTT-S10-1	**Units:**	Percent
Lab Code:	K1807591-011	**Basis:**	As Received
Analysis Method:	PSEP TS		
Prep Method:	None		

Analyte Name	MRL	Sample Result	Duplicate K1807591-011DUP Result	Triplicate K1807591-011TRP Result	Average	RSD	RSD Limit
Solids, Total	-	74.5	74.8	74.8	74.7	<1	10

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

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Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807591
Project	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/06/18
Sample Matrix:	Sediment	**Date Received:**	08/11/18
		Date Analyzed:	08/14/18

Triplicate Sample Summary
General Chemistry Parameters

Sample Name:	HB18-PGS-S7-1	**Units:**	Percent
Lab Code:	K1807591-021	**Basis:**	As Received
Analysis Method:	PSEP TS		
Prep Method:	None		

Analyte Name	MRL	Sample Result	Duplicate K1807591-021DUP Result	Triplicate K1807591-021TRP Result	Average	RSD	RSD Limit
Solids, Total	-	58.8	59.0	58.9	58.9	<1	10

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General Chemistry

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
Phone (360)577-7222 Fax (360)636-1068
www.alsglobal.com

RIGHT SOLUTIONS | RIGHT PARTNER

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807591
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/6/18
Sample Matrix:	Sediment	**Date Received:**	08/11/18
Analysis Method:	9060	**Units:**	Percent
Prep Method:	Method	**Basis:**	Dry, per Method

Carbon, Total Organic (TOC)

Sample Name	Lab Code	Result		MRL	Dil.	Date Analyzed	Date Extracted	Q
HB18-TTT-S1-1	K1807591-001	**1.51**		0.10	1	08/27/18 13:39	8/27/18	
HB18-TTT-S2-1	K1807591-002	**3.25**		0.10	1	08/27/18 13:39	8/27/18	
HB18-TTT-S3-1	K1807591-003	**0.43**		0.10	1	08/27/18 13:39	8/27/18	
HB18-TTT-S3-2	K1807591-004	**0.45**		0.10	1	08/27/18 13:39	8/27/18	
HB18-TTT-S4-1	K1807591-005	**0.26**		0.10	1	08/27/18 13:39	8/27/18	
HB18-TTT-S5-1	K1807591-006	**1.04**		0.10	1	08/27/18 13:39	8/27/18	
HB18-TTT-S6-1	K1807591-007	**1.34**		0.10	1	08/27/18 13:39	8/27/18	
HB18-TTT-S7-1	K1807591-008	**1.97**		0.10	1	08/27/18 13:39	8/27/18	
HB18-TTT-S8-1	K1807591-009	**0.62**		0.10	1	08/27/18 13:39	8/27/18	
HB18-TTT-S9-1	K1807591-010	**0.27**		0.10	1	08/27/18 13:39	8/27/18	
HB18-TTT-S10-1	K1807591-011	**0.66**		0.10	1	08/27/18 13:39	8/27/18	
HB18-TTT-S11-1	K1807591-012	**3.88**		0.10	1	08/27/18 13:39	8/27/18	
HB18-TTT-S12-1	K1807591-013	**2.98**		0.10	1	08/27/18 13:39	8/27/18	
Method Blank	K1807591-MB	ND	U	0.10	1	08/27/18 13:39	8/27/18	

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807591
Project	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/06/18
Sample Matrix:	Sediment	**Date Received:**	08/11/18
		Date Analyzed:	08/27/18

Replicate Sample Summary
General Chemistry Parameters

Sample Name:	HB18-TTT-S1-1	**Units:**	Percent
Lab Code:	K1807591-001	**Basis:**	Dry, per Method

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample K1807591-001DUP Result	Average	RPD	RPD Limit
Carbon, Total Organic (TOC)	9060	0.10	1.51	1.52	1.52	<1	20

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ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807591
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/06/18
Sample Matrix:	Sediment	**Date Received:**	08/11/18
		Date Analyzed:	08/27/18
		Date Extracted:	08/27/18

Duplicate Matrix Spike Summary
Carbon, Total Organic (TOC)

Sample Name:	HB18-TTT-S1-1	**Units:**	Percent
Lab Code:	K1807591-001	**Basis:**	Dry, per Method
Analysis Method:	9060		
Prep Method:	Method		

		Matrix Spike K1807591-001MS			**Duplicate Matrix Spike** K1807591-001DMS					
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**% Rec**	**Result**	**Spike Amount**	**% Rec**	**% Rec Limits**	**RPD**	**RPD Limit**
Carbon, Total Organic (TOC)	1.51	3.90	2.41	99	3.92	2.41	100	70-122	<1	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807591
Project:	2018 Harrison Bay MMP/5089.03	**Date Analyzed:**	08/27/18
Sample Matrix:	Sediment	**Date Extracted:**	08/27/18

Lab Control Sample Summary
Carbon, Total Organic (TOC)

Analysis Method:	9060	**Units:**	Percent
Prep Method:	Method	**Basis:**	Dry, per Method
		Analysis Lot:	604203

Sample Name	Lab Code	Result	Spike Amount	% Rec	% Rec Limits
Lab Control Sample	K1807591-LCS	0.59	0.60	98	72-122

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Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807591
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	8/6/2018
Sample Matrix:	Sediment	**Date Received:**	8/11/2018
		Date Analyzed:	8/28/2018

Particle Size Determination
ASTM D422M

Sample Name: HB18-PGS-S1-1
Lab Code: K1807591-014

Sand Fraction: Dry Weight (Grams)	10.9543
Sand Fraction: Weight Recovered (Grams)	10.9532
Sand Fraction: Percent Recovery	99.99

Description	**Phi Size**	**Dry Weight (Grams)**	**Percent of Total Weight Recovered**
Gravel, Medium	<-2 Ø	0.0000	0.00
Gravel, Fine	-2 Ø to -1 Ø	0.0444	0.16
Sand, Very Coarse	-1 to 0 Ø	0.0360	0.13
Sand, Coarse	0 to 1 Ø	0.0556	0.19
Sand, Medium	1 to 2 Ø	0.1115	0.39
Sand, Fine	2 to 3 Ø	0.5344	1.87
Sand, Very Fine	3 to 4 Ø	6.0154	21.10
75.0 µm	4 Ø	7.2050	25.27
31.3 µm	5 Ø	5.2400	18.38
15.6 µm	6 Ø	3.2050	11.24
7.8 µm	7 Ø	1.7100	6.00
3.9 µm	8 Ø	1.0000	3.51
1.95 µm	9 Ø	0.8000	2.81
0.98 µm	> 10 Ø	1.4450	5.07
		27.4023	96.10

dba ALS Environmental
Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807591
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	8/6/2018
Sample Matrix:	Sediment	**Date Received:**	8/11/2018
		Date Analyzed:	8/28/2018

Particle Size Determination
ASTM D422M

Sample Name: HB18-PGS-S2-1
Lab Code: K1807591-015

Sand Fraction: Dry Weight (Grams)	11.4787
Sand Fraction: Weight Recovered (Grams)	11.4492
Sand Fraction: Percent Recovery	99.74

Description	**Phi Size**	**Dry Weight (Grams)**	**Percent of Total Weight Recovered**
Gravel, Medium	<-2 Ø	0.0000	0.00
Gravel, Fine	-2 Ø to -1 Ø	0.0243	0.10
Sand, Very Coarse	-1 to 0 Ø	0.1014	0.40
Sand, Coarse	0 to 1 Ø	0.2201	0.86
Sand, Medium	1 to 2 Ø	0.7413	2.90
Sand, Fine	2 to 3 Ø	3.2669	12.79
Sand, Very Fine	3 to 4 Ø	4.7477	18.59
75.0 µm	4 Ø	4.5900	17.97
31.3 µm	5 Ø	2.7150	10.63
15.6 µm	6 Ø	2.6000	10.18
7.8 µm	7 Ø	1.9400	7.59
3.9 µm	8 Ø	1.1650	4.56
1.95 µm	9 Ø	1.0450	4.09
0.98 µm	> 10 Ø	1.5650	6.13
		24.7217	96.78

dba ALS Environmental
Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807591
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	8/6/2018
Sample Matrix:	Sediment	**Date Received:**	8/11/2018
		Date Analyzed:	8/28/2018

Particle Size Determination
ASTM D422M

Sample Name: HB18-PGS-S3-1
Lab Code: K1807591-016

Sand Fraction: Dry Weight (Grams)	37.5937
Sand Fraction: Weight Recovered (Grams)	37.4468
Sand Fraction: Percent Recovery	99.61

Description	**Phi Size**	**Dry Weight (Grams)**	**Percent of Total Weight Recovered**
Gravel, Medium	<-2 Ø	0.0000	0.00
Gravel, Fine	-2 Ø to -1 Ø	0.0040	0.01
Sand, Very Coarse	-1 to 0 Ø	0.0134	0.03
Sand, Coarse	0 to 1 Ø	0.0550	0.13
Sand, Medium	1 to 2 Ø	0.1707	0.39
Sand, Fine	2 to 3 Ø	15.7077	35.85
Sand, Very Fine	3 to 4 Ø	16.9399	38.66
75.0 µm	4 Ø	4.5700	10.43
31.3 µm	5 Ø	1.5300	3.49
15.6 µm	6 Ø	0.5100	1.16
7.8 µm	7 Ø	0.2550	0.58
3.9 µm	8 Ø	0.1400	0.32
1.95 µm	9 Ø	0.1800	0.41
0.98 µm	> 10 Ø	0.6150	1.40
		40.6907	92.86

dba ALS Environmental
Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807591
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	8/6/2018
Sample Matrix:	Sediment	**Date Received:**	8/11/2018
		Date Analyzed:	8/28/2018

Particle Size Determination
ASTM D422M

Sample Name: HB18-PGS-S3-2
Lab Code: K1807591-017

Sand Fraction: Dry Weight (Grams)	41.4481
Sand Fraction: Weight Recovered (Grams)	41.3734
Sand Fraction: Percent Recovery	99.82

Description	**Phi Size**	**Dry Weight (Grams)**	**Percent of Total Weight Recovered**
Gravel, Medium	<-2 Ø	0.0000	0.00
Gravel, Fine	-2 Ø to -1 Ø	0.0161	0.03
Sand, Very Coarse	-1 to 0 Ø	0.0395	0.08
Sand, Coarse	0 to 1 Ø	0.0934	0.19
Sand, Medium	1 to 2 Ø	0.2521	0.51
Sand, Fine	2 to 3 Ø	22.8074	46.03
Sand, Very Fine	3 to 4 Ø	14.1399	28.54
75.0 µm	4 Ø	6.2950	12.71
31.3 µm	5 Ø	1.8850	3.80
15.6 µm	6 Ø	0.6450	1.30
7.8 µm	7 Ø	0.4050	0.82
3.9 µm	8 Ø	0.2850	0.58
1.95 µm	9 Ø	0.2150	0.43
0.98 µm	> 10 Ø	0.7800	1.57
		47.8584	96.60

dba ALS Environmental
Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807591
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	8/6/2018
Sample Matrix:	Sediment	**Date Received:**	8/11/2018
		Date Analyzed:	8/28/2018

Particle Size Determination
ASTM D422M

Sample Name: HB18-PGS-S4-1
Lab Code: K1807591-018

Sand Fraction: Dry Weight (Grams)	43.7150
Sand Fraction: Weight Recovered (Grams)	43.7005
Sand Fraction: Percent Recovery	99.97

Description	**Phi Size**	**Dry Weight (Grams)**	**Percent of Total Weight Recovered**
Gravel, Medium	<-2 Ø	0.0000	0.00
Gravel, Fine	-2 Ø to -1 Ø	0.0333	0.07
Sand, Very Coarse	-1 to 0 Ø	0.0923	0.19
Sand, Coarse	0 to 1 Ø	0.0551	0.11
Sand, Medium	1 to 2 Ø	0.1141	0.23
Sand, Fine	2 to 3 Ø	25.8152	52.66
Sand, Very Fine	3 to 4 Ø	14.0638	28.69
75.0 µm	4 Ø	4.9050	10.00
31.3 µm	5 Ø	0.6750	1.38
15.6 µm	6 Ø	0.2150	0.44
7.8 µm	7 Ø	0.1750	0.36
3.9 µm	8 Ø	0.0850	0.17
1.95 µm	9 Ø	0.0550	0.11
0.98 µm	> 10 Ø	0.7300	1.49
		47.0138	95.90

dba ALS Environmental
Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807591
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	8/6/2018
Sample Matrix:	Sediment	**Date Received:**	8/11/2018
		Date Analyzed:	8/28/2018

Particle Size Determination
ASTM D422M

Sample Name:	HB18-PGS-S5-1
Lab Code:	K1807591-019

Sand Fraction: Dry Weight (Grams)	38.1448
Sand Fraction: Weight Recovered (Grams)	38.1250
Sand Fraction: Percent Recovery	99.95

Description	**Phi Size**	**Dry Weight (Grams)**	**Percent of Total Weight Recovered**
Gravel, Medium	<-2 Ø	0.0000	0.00
Gravel, Fine	-2 Ø to -1 Ø	0.0188	0.04
Sand, Very Coarse	-1 to 0 Ø	0.1078	0.23
Sand, Coarse	0 to 1 Ø	0.1100	0.23
Sand, Medium	1 to 2 Ø	0.1875	0.40
Sand, Fine	2 to 3 Ø	25.7649	54.44
Sand, Very Fine	3 to 4 Ø	8.8267	18.65
75.0 µm	4 Ø	5.1450	10.87
31.3 µm	5 Ø	1.5300	3.23
15.6 µm	6 Ø	1.0100	2.13
7.8 µm	7 Ø	0.8500	1.80
3.9 µm	8 Ø	0.6400	1.35
1.95 µm	9 Ø	0.6050	1.28
0.98 µm	> 10 Ø	0.9750	2.06
		45.7707	96.71

dba ALS Environmental
Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807591
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	8/6/2018
Sample Matrix:	Sediment	**Date Received:**	8/11/2018
		Date Analyzed:	8/28/2018

Particle Size Determination
ASTM D422M

Sample Name: HB18-PGS-S6-1
Lab Code: K1807591-020

Sand Fraction: Dry Weight (Grams)	5.7069
Sand Fraction: Weight Recovered (Grams)	5.6895
Sand Fraction: Percent Recovery	99.70

Description	**Phi Size**	**Dry Weight (Grams)**	**Percent of Total Weight Recovered**
Gravel, Medium	<-2 Ø	0.0000	0.00
Gravel, Fine	-2 Ø to -1 Ø	0.0108	0.06
Sand, Very Coarse	-1 to 0 Ø	0.0947	0.55
Sand, Coarse	0 to 1 Ø	0.1047	0.61
Sand, Medium	1 to 2 Ø	0.0542	0.32
Sand, Fine	2 to 3 Ø	2.8498	16.65
Sand, Very Fine	3 to 4 Ø	2.3094	13.50
75.0 µm	4 Ø	0.8800	5.14
31.3 µm	5 Ø	1.3750	8.04
15.6 µm	6 Ø	2.2250	13.00
7.8 µm	7 Ø	2.5450	14.87
3.9 µm	8 Ø	1.5800	9.23
1.95 µm	9 Ø	1.2750	7.45
0.98 µm	> 10 Ø	1.7700	10.34
		17.0736	99.78

dba ALS Environmental
Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807591
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	8/6/2018
Sample Matrix:	Sediment	**Date Received:**	8/11/2018
		Date Analyzed:	8/28/2018

Particle Size Determination
ASTM D422M

Sample Name: HB18-PGS-S7-1
Lab Code: K1807591-021

Sand Fraction: Dry Weight (Grams)	7.8414
Sand Fraction: Weight Recovered (Grams)	7.8000
Sand Fraction: Percent Recovery	99.47

Description	**Phi Size**	**Dry Weight (Grams)**	**Percent of Total Weight Recovered**
Gravel, Medium	<-2 Ø	0.0000	0.00
Gravel, Fine	-2 Ø to -1 Ø	0.0029	0.01
Sand, Very Coarse	-1 to 0 Ø	0.0316	0.15
Sand, Coarse	0 to 1 Ø	0.1180	0.57
Sand, Medium	1 to 2 Ø	0.4824	2.33
Sand, Fine	2 to 3 Ø	4.1912	20.22
Sand, Very Fine	3 to 4 Ø	1.8360	8.86
75.0 µm	4 Ø	5.7800	27.89
31.3 µm	5 Ø	2.4950	12.04
15.6 µm	6 Ø	1.6150	7.79
7.8 µm	7 Ø	1.3900	6.71
3.9 µm	8 Ø	0.8750	4.22
1.95 µm	9 Ø	0.6800	3.28
0.98 µm	> 10 Ø	1.2500	6.03
		20.7471	100.10

dba ALS Environmental
Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807591
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	8/6/2018
Sample Matrix:	Sediment	**Date Received:**	8/11/2018
		Date Analyzed:	8/28/2018

Particle Size Determination
ASTM D422M

Sample Name: HB18-PGS-S8-1
Lab Code: K1807591-022

Sand Fraction: Dry Weight (Grams)	41.0573
Sand Fraction: Weight Recovered (Grams)	40.9840
Sand Fraction: Percent Recovery	99.82

Description	Phi Size	Dry Weight (Grams)	Percent of Total Weight Recovered
Gravel, Medium	<-2 Ø	0.0000	0.00
Gravel, Fine	-2 Ø to -1 Ø	0.0058	0.01
Sand, Very Coarse	-1 to 0 Ø	0.0664	0.14
Sand, Coarse	0 to 1 Ø	0.0846	0.18
Sand, Medium	1 to 2 Ø	0.1723	0.36
Sand, Fine	2 to 3 Ø	16.2621	33.64
Sand, Very Fine	3 to 4 Ø	18.3155	37.89
75.0 µm	4 Ø	8.4600	17.50
31.3 µm	5 Ø	1.6750	3.46
15.6 µm	6 Ø	0.5100	1.05
7.8 µm	7 Ø	0.3450	0.71
3.9 µm	8 Ø	0.3400	0.70
1.95 µm	9 Ø	0.2150	0.44
0.98 µm	> 10 Ø	0.6900	1.43
		47.1417	97.52

dba ALS Environmental
Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807591
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	8/6/2018
Sample Matrix:	Sediment	**Date Received:**	8/11/2018
		Date Analyzed:	8/28/2018

Particle Size Determination
ASTM D422M

Sample Name: HB18-PGS-S9-1
Lab Code: K1807591-023

Sand Fraction: Dry Weight (Grams)	43.3498
Sand Fraction: Weight Recovered (Grams)	43.2880
Sand Fraction: Percent Recovery	99.86

Description	**Phi Size**	**Dry Weight (Grams)**	**Percent of Total Weight Recovered**
Gravel, Medium	<-2 Ø	0.0000	0.00
Gravel, Fine	-2 Ø to -1 Ø	0.0117	0.02
Sand, Very Coarse	-1 to 0 Ø	0.0444	0.09
Sand, Coarse	0 to 1 Ø	0.0354	0.07
Sand, Medium	1 to 2 Ø	0.1511	0.31
Sand, Fine	2 to 3 Ø	25.2261	51.78
Sand, Very Fine	3 to 4 Ø	13.2737	27.24
75.0 µm	4 Ø	6.7950	13.95
31.3 µm	5 Ø	0.7550	1.55
15.6 µm	6 Ø	0.2350	0.48
7.8 µm	7 Ø	0.0900	0.18
3.9 µm	8 Ø	0.1550	0.32
1.95 µm	9 Ø	0.0850	0.17
0.98 µm	> 10 Ø	0.5800	1.19
		47.4374	97.36

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807591
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	8/6/2018
Sample Matrix:	Sediment	**Date Received:**	8/11/2018
		Date Analyzed:	8/28/2018

Particle Size Determination
ASTM D422M

Sample Name: HB18-PGS-S10-1
Lab Code: K1807591-024

Sand Fraction: Dry Weight (Grams)	26.1246
Sand Fraction: Weight Recovered (Grams)	26.0809
Sand Fraction: Percent Recovery	99.83

Description	**Phi Size**	**Dry Weight (Grams)**	**Percent of Total Weight Recovered**
Gravel, Medium	<-2 Ø	0.0213	0.07
Gravel, Fine	-2 Ø to -1 Ø	0.0287	0.09
Sand, Very Coarse	-1 to 0 Ø	0.0971	0.31
Sand, Coarse	0 to 1 Ø	1.0508	3.37
Sand, Medium	1 to 2 Ø	8.2900	26.56
Sand, Fine	2 to 3 Ø	15.7488	50.46
Sand, Very Fine	3 to 4 Ø	0.6125	1.96
75.0 µm	4 Ø	0.8400	2.69
31.3 µm	5 Ø	0.6000	1.92
15.6 µm	6 Ø	0.6400	2.05
7.8 µm	7 Ø	0.9750	3.12
3.9 µm	8 Ø	0.7200	2.31
1.95 µm	9 Ø	0.5750	1.84
0.98 µm	> 10 Ø	0.8900	2.85
		31.0892	99.61

dba ALS Environmental
Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807591
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	8/6/2018
Sample Matrix:	Sediment	**Date Received:**	8/11/2018
		Date Analyzed:	8/28/2018

Particle Size Determination
ASTM D422M

Sample Name: HB18-PGS-S11-1
Lab Code: K1807591-025

Sand Fraction: Dry Weight (Grams)	1.3981
Sand Fraction: Weight Recovered (Grams)	1.3366
Sand Fraction: Percent Recovery	95.60

Description	**Phi Size**	**Dry Weight (Grams)**	**Percent of Total Weight Recovered**
Gravel, Medium	<-2 Ø	0.0000	0.00
Gravel, Fine	-2 Ø to -1 Ø	0.0075	0.06
Sand, Very Coarse	-1 to 0 Ø	0.0261	0.19
Sand, Coarse	0 to 1 Ø	0.0569	0.42
Sand, Medium	1 to 2 Ø	0.1437	1.06
Sand, Fine	2 to 3 Ø	0.4444	3.29
Sand, Very Fine	3 to 4 Ø	0.2700	2.00
75.0 µm	4 Ø	1.4650	10.84
31.3 µm	5 Ø	3.1300	23.16
15.6 µm	6 Ø	2.7900	20.65
7.8 µm	7 Ø	1.8000	13.32
3.9 µm	8 Ø	1.0400	7.70
1.95 µm	9 Ø	0.9450	6.99
0.98 µm	> 10 Ø	1.4200	10.51
		13.5386	100.19

dba ALS Environmental
Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807591
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	8/6/2018
Sample Matrix:	Sediment	**Date Received:**	8/11/2018
		Date Analyzed:	8/28/2018

Particle Size Determination
ASTM D422M

Sample Name: HB18-PGS-S12-1
Lab Code: K1807591-026

Sand Fraction: Dry Weight (Grams)	2.3601
Sand Fraction: Weight Recovered (Grams)	2.3135
Sand Fraction: Percent Recovery	98.03

Description	**Phi Size**	**Dry Weight (Grams)**	**Percent of Total Weight Recovered**
Gravel, Medium	<-2 Ø	0.0000	0.00
Gravel, Fine	-2 Ø to -1 Ø	0.0370	0.28
Sand, Very Coarse	-1 to 0 Ø	0.0226	0.17
Sand, Coarse	0 to 1 Ø	0.0388	0.29
Sand, Medium	1 to 2 Ø	0.0527	0.40
Sand, Fine	2 to 3 Ø	0.7454	5.60
Sand, Very Fine	3 to 4 Ø	0.8854	6.65
75.0 µm	4 Ø	1.9650	14.76
31.3 µm	5 Ø	1.5700	11.79
15.6 µm	6 Ø	2.1200	15.92
7.8 µm	7 Ø	2.2000	16.52
3.9 µm	8 Ø	1.1050	8.30
1.95 µm	9 Ø	1.0000	7.51
0.98 µm	> 10 Ø	1.5800	11.87
		13.3219	100.04

dba ALS Environmental
Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807591
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	8/6/2018
Sample Matrix:	Sediment	**Date Received:**	8/11/2018
		Date Analyzed:	8/28/2018

Particle Size Determination
ASTM D422M

Sample Name: HB18-PGS-S12-1
Lab Code: K1807591-026DUP

Sand Fraction: Dry Weight (Grams)	2.3633
Sand Fraction: Weight Recovered (Grams)	2.2902
Sand Fraction: Percent Recovery	96.91

Description	**Phi Size**	**Dry Weight (Grams)**	**Percent of Total Weight Recovered**
Gravel, Medium	<-2 Ø	0.0000	0.00
Gravel, Fine	-2 Ø to -1 Ø	0.0076	0.06
Sand, Very Coarse	-1 to 0 Ø	0.0200	0.15
Sand, Coarse	0 to 1 Ø	0.0270	0.20
Sand, Medium	1 to 2 Ø	0.0429	0.32
Sand, Fine	2 to 3 Ø	0.7014	5.28
Sand, Very Fine	3 to 4 Ø	0.9269	6.97
75.0 µm	4 Ø	1.6150	12.15
31.3 µm	5 Ø	1.8650	14.03
15.6 µm	6 Ø	2.1600	16.24
7.8 µm	7 Ø	2.1150	15.91
3.9 µm	8 Ø	1.2300	9.25
1.95 µm	9 Ø	1.1800	8.87
0.98 µm	> 10 Ø	1.5100	11.36
		13.4008	100.78

TDI-Brooks International, Inc.
"Providing Scientific Services On A Global Basis"

B&B Client Number: J18346

Client Address: Kinnetic Laboratories Inc.
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Anchorage, AK 99501

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B&B Laboratories, Inc.

Kinnetic Laboratories, Inc.
Project #5089.03

Determination of:

Aliphatic Hydrocarbons (ALI), Total Petroleum Hydrocarbons (TPH), and Polycyclic Aromatic Hydrocarbons (PAHs) in Sediment Samples

September 14, 2018

Technical Report 18-3808

Narrative

Case Narrative

Sample Receipt and Storage

B&B Laboratories received a shipment of one (1) ice chest on August 14, 2018 in College Station, Texas. The ice chest arrived sealed and in good condition.

Cooler Number	Temperature	Samples Received	Sample Custody Corrective Action Report (SCCAR)
1	2.7 °C 2.1°C Temperature Blank	Seven (7) sediment samples in 250 mL jars.	109

The sediment samples were logged in according to B&B Laboratories standard operating procedure (B&B 1009) and stored in an access-controlled freezer (<-16.0°C) prior to analysis. See Supporting Documents for the information related to the sample received broken during shipping.

The sediment samples were analyzed for Total Petroleum Hydrocarbons (TPH) and C_9 to C_{40} Aliphatic Hydrocarbons (ALI) by GC/FID, Polycyclic Aromatic Hydrocarbons (PAH) by GC/MS-SIM and selected biological markers by GC/MS-SIM.

The analytical results for ALI, TPHs, PAH, selected hopane's, and TAS compounds in the sediment samples are included in this report.

Sample Preparation and Extraction

Extraction of Sediments for Aliphatic, Aromatic and Chlorinated Hydrocarbons and Total Petroleum Hydrocarbons (Synopsis of SOP 1003)

This standard operating procedure provides an accurate and precise method for extraction, isolation, and concentration of selected organic compounds from soil and sediment samples. It achieves analyte recoveries equivalent to those from Soxhlet extraction, using less solvent and taking significantly less time. Final extracts can be used in the quantitative determination of polycyclic aromatic hydrocarbons (PAHs), aliphatic hydrocarbons, total petroleum hydrocarbon (TPH), and chlorinated hydrocarbons (including planar PCBs) by chromatographic procedures. This procedure is also used to extract soil and sediment samples for gravimetric determination of extractable organic material (EOM).

An automated extraction apparatus (Dionex ASE200 Accelerated Solvent Extractor) is used to extract various organics from 1 to 15 g (usually 15 g if adequate material is present) of pre-dried sample. The extractions are performed using 100% dichloromethane inside stainless-steel extraction cells held at elevated temperature and solvent pressure. The extracted compounds dissolved in the hot solvent are collected in 60-mL glass vials. Extracts are concentrated to a volume of 1 - 3 mL, using an evaporative solvent reduction apparatus (Zymark TurboVap II or water bath), and if necessary, processed through a clean-up column in order to minimize matrix interference.

Determination of Percent Moisture in Tissues, Soils and Sediment

Percent moisture (weight/weight basis) is determined in samples by measuring the loss in mass of the sample due to drying at 104 °C to a constant weight. Typically, between one and two grams of sample are used for the determination. Wet and dried samples are weighed to the nearest milligram. This procedure is documented in B&B SOP 1012, *Preparation of Tissue, Water, Soils, and Sediment for Extraction*.

Analytical Methods

Aliphatic and Total Petroleum Hydrocarbon Determination by Gas Chromatography/Flame Ionization Detection (Synopsis of SOP 1016)

The quantitative method described in this document is for the determination of aliphatic hydrocarbons and total petroleum hydrocarbons in extracts of water, sediment, and biological tissue. Quantitation is performed by high resolution, capillary gas chromatography with flame ionization detection (GC/FID). Normal alkanes with 9 to 40 carbons (C_8 to C_{40}), and the isoprenoids pristane and phytane are determined with this procedure. The gas chromatograph is temperature-programmed and operated in split mode. The capillary column is a Restek Scientific RTX-1 (30 m long by 0.25 mm ID and 0.25 □m film thickness). Carrier flow is regulated by electronic pressure control. The autosampler is capable of making 1 to 5 ml injections. Dual columns and FIDs are used. The data acquisition system is by HP Chemstation software, capable of acquiring and processing GC data.

A calibration curve is established by analyzing each of 6 calibration standards (1.25, 10, 25, 40, 50 and 100 μg/ml), and fitting the data to a straight line using the least square technique. For each analyte of interest, a response factor (RF) is determined for each calibration level. All 6 response factors are then averaged to produce a mean relative response factor for each analyte. If an individual aliphatic hydrocarbon is not in the calibration solutions, a RF is estimated from the average RF of the hydrocarbon eluting immediately before the compound.

Aromatic Hydrocarbon Determination by Selected Ion Monitoring – Gas Chromatography/Mass Spectrometry (Synopsis of SOP 1006)

This quantitative method is for the determination of polycyclic aromatic hydrocarbons (PAHs) and their alkylated homologues in extracts of water, sediment, and biological tissue. Quantitation is performed by capillary gas chromatography/mass spectrometry (GC/MS) in selected ion monitoring mode (SIM). The gas chromatograph is temperature-programmed and operated in splitless mode. The capillary column is a Agilent Technologies HP-5MS (60 m long by 0.25 mm ID and 0.25 μm film thickness). Carrier flow is by electronic pressure control. The autosampler is capable of making 1 to 5 μL injections. The mass spectrometer is capable of scanning from 35 to 500 AMU every second or less, utilizing 70 volts electron energy in electron impact ionization mode. The data acquisition system allows continuous acquisition and storage of all data during analysis and is capable of displaying ion abundance versus time or scan number.

Calibration solutions are prepared at six concentrations ranging from 0.02 to 5 μg/mL by diluting a commercially available solution containing the analytes of interest. For each analyte of interest, a relative response factor (RRF) is determined for each calibration level. The 6 response factors are then averaged to produce a mean relative response factor for each analyte.

The analytical methods employed for PAH, n-alkanes and biomarkers are listed in Table 1.

Table 1. Standard Operating Procedures for each analytical test.

Matrix	Extraction	PAH	n-alkanes
Sediment	B&B 1003	B&B 1006	B&B 1016

Data Reporting

The reporting units for each analyte are listed in Table 2. Data Qualifier Definitions are listed in Table 3. The method detection limits (MDL) for each analyte are listed in Tables 4.

Table 2. Analytical reporting units.

Matrix	PAH	n-alkanes
Sediment	ng/dry g	μg/dry g

Table 3. Data Qualifier Definitions.

Qualifier	Definition
B	Analyte detected in the method blank greater than 3X MDL
D	Diluted Value
E	Analyte concentration exceeds the calibration range of the GC/MS for that specific analysis.
I	Analytical interference
J	Analyte detected below the method detection limit
L	Loss due to matrix effect
NA	Not Applicable
U	Analyte not detected
X	Analyte <3X MDL
Y	Spiked level of analyte <50% of the native concentration
*	Outside QA limits, refer to narrative

Table 4. Method Detection Limits

Aliphatics Unit of measure	**Sediment MDLs** μg/dry g
n-C9	0.012
n-C10	0.021
n-C11	0.016
n-C12	0.019
n-C13	0.045
i-c15	0.016
n-C14	0.013
i-c16	0.004
n-C15	0.016
n-C16	0.004
i-c18	0.004
n-C17	0.003
Pristane	0.003
n-C18	0.004
Phytane	0.006
n-C19	0.005
n-C20	0.012
n-C21	0.004
n-C22	0.003
n-C23	0.008
n-C24	0.005
n-C25	0.007
n-C26	0.008
n-C27	0.011
n-C28	0.011
n-C29	0.021
n-C30	0.013
n-C31	0.015
n-C32	0.012
n-C33	0.021
n-C34	0.016
n-C35	0.015
n-C36	0.016
n-C37	0.017
n-C38	0.019
n-C39	0.019
n-C40	0.019
Total Petroleum Hydrocarbons	1.40
Total Resolved Hydrocarbons	1.40
Unresolved Complex Mixture	1.40
Extractable Organic Matter	100

Table 4 (continued). Detection Limits

PAH Unit of measure	**Sediment MDLs** ng/dry g
cis/trans Decalin	0.132
C1-Decalins	0.263
C2-Decalins	0.263
C3-Decalins	0.263
C4-Decalins	0.263
Naphthalene	0.342
C1-Naphthalenes	1.03
C2-Naphthalenes	0.684
C3-Naphthalenes	0.684
C4-Naphthalenes	0.684
Benzothiophene	0.090
C1-Benzothiophenes	0.180
C2-Benzothiophenes	0.180
C3-Benzothiophenes	0.180
C4-Benzothiophenes	0.180
Biphenyl	0.294
Acenaphthylene	0.041
Acenaphthene	0.103
Dibenzofuran	0.204
Fluorene	0.183
C1-Fluorenes	0.367
C2-Fluorenes	0.367
C3-Fluorenes	0.367
Carbazole	0.150
Anthracene	0.115
Phenanthrene	0.208
C1-Phenanthrenes/Anthracenes	0.077
C2-Phenanthrenes/Anthracenes	0.285
C3-Phenanthrenes/Anthracenes	0.285
C4-Phenanthrenes/Anthracenes	0.285
Dibenzothiophene	0.116
C1-Dibenzothiophenes	0.064
C2-Dibenzothiophenes	0.232
C3-Dibenzothiophenes	0.232
C4-Dibenzothiophenes	0.232
Fluoranthene	0.333
Pyrene	0.136
C1-Fluoranthenes/Pyrenes	0.469
C2-Fluoranthenes/Pyrenes	0.469
C3-Fluoranthenes/Pyrenes	0.469
C4-Fluoranthenes/Pyrenes	0.469
Naphthobenzothiophene	0.128
C1-Naphthobenzothiophenes	0.256
C2-Naphthobenzothiophenes	0.256
C3-Naphthobenzothiophenes	0.256
C4-Naphthobenzothiophenes	0.256

Table 4 (continued). Detection Limits

PAH Unit of measure	**Sediment MDLs** ng/dry g
Benz(a)anthracene	0.192
Chrysene/Triphenylene	0.116
C1-Chrysenes	0.232
C2-Chrysenes	0.232
C3-Chrysenes	0.232
C4-Chrysenes	0.232
Benzo(b)fluoranthene	0.203
Benzo(k,j)fluoranthene	0.098
Benzo(a)fluoranthene	0.098
Benzo(e)pyrene	0.177
Benzo(a)pyrene	0.101
Perylene	1.27
Indeno(1,2,3-c,d)pyrene	0.050
Dibenzo(a,h)anthracene	0.064
C1-Dibenzo(a,h)anthracenes	0.129
C2-Dibenzo(a,h)anthracenes	0.129
C3-Dibenzo(a,h)anthracenes	0.129
Benzo(g,h,i)perylene	0.088
2-Methylnaphthalene	1.30
1-Methylnaphthalene	0.546
2,6-Dimethylnaphthalene	0.261
1,6,7-Trimethylnaphthalene	0.127
1-Methylfluorene	0.191
4-Methyldibenzothiophene	0.091
2/3-Methyldibenzothiophene	0.091
1-Methyldibenzothiophene	0.091
3-Methylphenanthrene	0.097
2-Methylphenanthrene	0.097
2-Methylanthracene	0.097
4/9-Methylphenanthrene	0.097
1-Methylphenanthrene	0.097
3,6-Dimethylphenanthrene	0.110
Retene	0.231
2-Methylfluoranthene	0.223
Benzo(b)fluorene	0.125
C29-Hopane	0.575
18a-Oleanane	0.575
C30-Hopane	0.575
C20-TAS	0.575
C21-TAS	0.575
C26(20S)-TAS	0.575
C26(20R)/C27(20S)-TAS	0.575
C28(20S)-TAS	0.575
C27(20R)-TAS	0.575
C28(20R)-TAS	0.575

Quality Assurance/Quality Control – Sediment

Total Petroleum Hydrocarbons (TPH) and Aliphatic Hydrocarbons (ALI)

The quality assurance/quality control procedure for this program included the analyses of a method blank, a blank spike, a matrix spike/matrix spike duplicate, and laboratory duplicate of no more than 19 samples. The SRM is a petroleum sample (NIST SRM 2779) that is analyzed with each TPH/ALI run and for which controls are established based on performance. Method blanks are used to determine that sample preparation and analyses are free of contaminants. The matrix spike/matrix spike duplicate are used to measure accuracy and precision of the analysis. The laboratory duplicate sample is used to determine the precision of the analysis.

The appropriate surrogate solution is added to every sample including quality control samples. The data are corrected based on surrogate recovery up to 100%. Refer to Table 5 for Method Performance Criteria for Aliphatic Hydrocarbons and TPH.

Polycyclic Aromatic Hydrocarbons (PAH)

The quality assurance/quality control procedure for this program included the analyses of a method blank, a blank spike, a matrix spike/matrix spike duplicate, laboratory duplicate and a sediment SRM (NIST SRM 1944) of no more than 19 samples. A standard reference oil (NIST 2779) was analyzed with this data set. Method blanks are used to determine that sample preparation and analyses are free of contaminants. The matrix spike/matrix spike duplicate is used to measure accuracy and precision of the analysis. The laboratory duplicate sample is used to determine the precision of the analysis. A SRM is a material for which a mean and confidence interval are certified for specific analytes. SRMs are selected based on matrix similarities as well as type and level of certified analytes. All SRMs are traceable to NIST. SRMs are used to verify analytical accuracy.

The appropriate surrogate solution is added to every sample including quality control samples. The data are corrected based on surrogate recovery up to 100%. Refer to Table 6 for Method Performance Criteria for PAH.

Quality Assurance/Quality Control Variances – Sediment

Total Petroleum Hydrocarbons (TPH)

Initial Calibration (Six-point)

Observation

- No variances were observed.

Initial Calibration Verification and Continuing Calibration Verification (The ICV is prepared from a second source.)

Observation

- No variances were observed.

Surrogate Recoveries

Observation

- No variances were observed.

Method Blank

Observation

- No variances were observed.

Blank Spike

Observation

- No variances were observed.

Matrix Spike/Matrix Spike Duplicate

Observation

- No variances were observed.

Laboratory Duplicate

Observation

- No variances were observed.

Additional QC Batch Information

Observation

- i-C16 exceeded the QC criteria for ALI-SRM2779-20-04 Reference Oil.

Comment

- It is unknown why this analyte did not meet the QC criteria; however, this variance does not impact the overall data quality.

Polycyclic Aromatic Hydrocarbons (PAH)

Initial Calibration (Six-Point)

Observation

- No variances were observed.

Initial Calibration Verification and Continuing Calibration Verification (The ICV is prepared from a second source.)

Observation

- No variances were observed.

Surrogate Recoveries

Observation

- No variances were observed.

Method Blank

Observation

- No variances were observed.

Blank Spike

Observation

- 1-Methylphenanthrene exceeded the QC criteria for ENV3865C Blank Spike.

Comment

- It is unknown why this analyte did not meet the QC criteria; however, this variance does not impact the overall data quality.

Matrix Spike/Matrix Spike Duplicate

Observation

- No variances were observed.

Laboratory Duplicate

Observation

- No variances were observed.

Standard Reference Materials

Observation

- No variances were observed.

TABLE 5. Method Performance Criteria for Alkanes/Isoprenoids Compounds and Total Petroleum Hydrocarbons

Element or Sample Type	Minimum Frequency	Measurement Quality Objective/ Acceptance Criteria	Corrective Action
Initial Calibration (all target analytes, except i-C13, i-C14, i-C15 and i-C18)	Prior to every sequence, or as needed based on continuing calibration/verification check.	6-point calibration curve %RSD ≤ 15%	Resolve before proceeding.
Continuing Calibration Verification (CCV)	Every 12 hours or every 10 field samples, whichever is more frequent	%R target analytes 80-120%	Perform Instrument Maintenance. Re-analyze affected samples.
Initial Calibration Verification (Second Source or can be met if CCV is second source)	Per initial calibration	%R target analytes 80-120%	Resolve before proceeding.
SRM 2779 Reference Oil (Instrument SRM)	One per batch per GC sequence	Baseline resolution of n-C17 from pristine, and analytes must be ±3σ of laboratory derived mean	Resolve before proceeding.
Performance Evaluation Mixture (PEM)	One per batch per GC sequence	%R 75-125%	Resolve before proceeding.
Matrix Spike/Matrix Spike Duplicate (Sediments, Soils, Tissues only)	One per batch/every 20 field samples	%R 40% - 120% for target analytes; average %R 60-120% for valid spikes, RPD ≤30%. No more than 2 analytes may exceed 40-120%	Evaluate impact to data, discuss with manager, determine if corrective action is needed.
Blank Spike/Blank Spike Duplicate	One per batch/every 20 field samples	%R 40% - 120% for target analytes; RPD ≤30%. No more than 2 analytes may exceed 40-120%	Evaluate impact to data, discuss with lab manager, determine if corrective action is needed.
Method Blank	One per batch/every 20 field samples	No more than 2 analytes to exceed 3x MDL unless analyte not detected in associated sample(s) or analyte concentration >10x blank value	Resolve before proceeding. QA coordinator may be contacted to resolve issues surrounding 'minor exceedances'.
Laboratory Duplicate (not required for aqueous samples)	One per batch/every 20 field samples	RPD ≤ 30% if analyte concentration is 3x greater than the MDL, no more than 2 individual analyte RPDs with conc. 3x MDL can exceed 35%.	Evaluate impact to data, discuss with lab manager, determine if corrective action is needed.
Mass Discrimination	Initial calibration and CCVs (mid-level)	Ratio for the raw areas of n-C36 / n-C20 ≥0.70	Resolve before proceeding.
Internal Standard (IS)	Every sample	50% - 200% of the area of the IS in the associated calibration standard	Resolve before proceeding.
Surrogates	Every sample	%R 40-120%	Re-extract affected samples. Evaluate impact to data, discuss with lab manager, determine if corrective action is needed.

Table 6. Method Performance Criteria for Extended PAH (Parent and Alkyl Homologs) and Related Compounds.

Element or Sample Type	Minimum Frequency	Measurement Quality Objective/ Acceptance Criteria	Corrective Action
Tuning	Prior to every sequence	Tune as specified in laboratory SOP	Resolve before proceeding.
Initial Calibration (All parent PAH and selected alkyl homologue PAH)	Prior to every sequence, or as needed based on continuing calibration/verification check.	6-point calibration curve over two orders of magnitude RPD ≤ 20%	Resolve before proceeding.
Continuing Calibration Verification (CCV)	Every 12 hours or 6-9 field samples	%R target analytes 80-120%	Perform instrument maintenance. Re-analyze affected samples.
Initial Calibration Verification (Second Source or can be met if CCV is second source)	Per initial calibration	%R target analytes 80-120%	Resolve before proceeding.
SRM 1941b for sediment; SRM 1974c for tissue If available use SRMs for appropriate matrices	One per batch/every 20 field samples	Within ±30% of NIST 95% uncertainty range for analytes within the quantitation range. No more than 2 analytes may exceed this criterion.	Resolve before proceeding.
SRM 2779 Reference Oil	One per batch/every 20 field samples	Peak resolution >80% of 4/9-methylphenanthrene from 1-methylphenanthrene (m/z 192). Within ±20% of NIST 95% uncertainty range for analytes within the quantitation range. No more than 2 analytes may exceed this criterion.	Resolve before proceeding.
Matrix Spike/Matrix Spike Duplicate (Sediments, Soils, Tissues only)	One per batch/every 20 field samples	%R 40% - 120% for target analytes, except biphenyl (40-140%), decalin (25-120%) and perylene (10-120%); RPD ≤30%, average %R 60-120% for valid spikes. No more than 2 analytes may exceed 40-120% recovery or >35% RPD.	Evaluate impact to data, discuss with lab manager to determine if corrective action is needed.
Blank Spike/Blank Spike Duplicate	One per batch/every 20 field samples	See MS/MSD criteria above.	Evaluate impact to data, discuss with lab manager to determine if corrective action is needed.
Method Blank	One per batch/every 20 field samples	No more than 2 analytes to exceed 3x target MDL unless analyte not detected in associated sample(s) or analyte concentration >10x blank value	Resolve before proceeding. Lab manager may be contacted to resolve issues.
Laboratory Duplicate (not required for aqueous samples)	One per batch/every 20 field samples	RPD ≤ 30% if analyte concentration is 3x greater than the MDL, no more than 2 individual analyte RPDs with conc. 3x MDL can exceed 35%.	Evaluate impact to data, discuss with lab manager, and determine if corrective action is needed.

Table 6. Continued. Method Performance Criteria for Extended PAH (Parent and Alkyl Homologs) and Related Compounds.

Element or Sample Type	Minimum Frequency	Measurement Quality Objective/ Acceptance Criteria	Corrective Action
Mass Discrimination	Initial calibration and CCVs (mid-level)	Ratio for the concentration of Benzo[g,h,i]perylene to phenanthrene ≥0.70	Resolve before proceeding.
Internal Standard (IS)	Every sample	50% - 200% of the area of the IS in the associated calibration standard	Resolve before proceeding.
Surrogates	Every sample	%R 40-120% except d12-perylene which is 10-120%	Re-extract affected samples. Evaluate impact to data, discuss with lab manager, if corrective action is needed.

B&B Laboratories makes no representation or certifications as to the method of sample collection, sample identification, or transporting/handling procedure used prior to the receipt of samples by B&B Laboratories. To the best of my knowledge, the information contained in this report in accurate and complete.

We appreciate the opportunity to serve your analytical needs and please do not hesitate to contact us should you have any questions.

9/19/2018

Juan A. Ramirez — Date
Laboratory Manager

Sediment Samples

Sample/Analyses Description

Kinnetic Labs - Harrison Bay
Sample Inventory

#	Laboratory ID	Sample ID	Collection Date	Received Date	Analysis	Matrix	Comments	B&B SDG	Client Project #
1	RCA1041	HB18-PAM-S2-1	08/06/18	08/14/18	PAH, ALI	Sediment		18081401	5089.03
2	RCA1042	HB18-PAM-S3-1	08/06/18	08/14/18	PAH, ALI	Sediment		18081401	5089.03
3	RCA1043	HB18-PAM-S3-2	08/06/18	08/14/18	PAH, ALI	Sediment	received broken	18081401	5089.03
4	RCA1044	HB18-PAM-S6-1	08/06/18	08/14/18	PAH, ALI	Sediment		18081401	5089.03
5	RCA1045	HB18-PAM-S8-1	08/06/18	08/14/18	PAH, ALI	Sediment		18081401	5089.03
6	RCA1046	HB18-PAM-S11-1	08/06/18	08/14/18	PAH, ALI	Sediment		18081401	5089.03
7	RCA1047	HB18-PAM-S4-1	08/06/18	08/14/18	PAH, ALI	Sediment		18081401	5089.03

Total Petroleum Hydrocarbons/ Aliphatic Hydrocarbons/ Extractable Organic Matter Concentrations

Kinnetic Labs - Harrison Bay
Aliphatic Hydrocarbon and Total Petroleum Hydrocarbon Data
Client Submitted Samples

Laboratory ID	RCA1041.D	RCA1042.D	RCA1043.D	RCA1044.D
Sample ID	HB18-PAM-S2-1	HB18-PAM-S3-1	HB18-PAM-S3-2	HB18-PAM-S6-1
Matrix	Sediment	Sediment	Sediment	Sediment
Collection Date	08/06/18	08/06/18	08/06/18	08/06/18
Received Date	08/14/18	08/14/18	08/14/18	08/14/18
Extraction Date	08/30/18	08/30/18	08/30/18	08/30/18
Extraction Batch	ENV3865	ENV3865	ENV3865	ENV3865
Date Acquired	06-Sep-2018, 00:55:35	06-Sep-2018, 03:16:19	06-Sep-2018, 04:26:55	06-Sep-2018, 05:37:13
Method	B&B SOP1016	B&B SOP1016	B&B SOP1016	B&B SOP1016
Sample Dry Weight (g)	15.05	15.01	15.02	15.01
Sample Wet Weight (g)	27.12	20.56	19.86	29.51
% Dry	55	73	76	51
% Moisture	45	27	24	49
% Lipid (dry)	NA	NA	NA	NA
% Lipid (wet)	NA	NA	NA	NA
Dilution	1X	1X	1X	1X

Target Compounds	Su. Corrected Conc. (µg/dry g)	Q	Su. Corrected Conc. (µg/dry g)	Q	Su. Corrected Conc. (µg/dry g)	Q	Su. Corrected Conc. (µg/dry g)	Q
n-C9	0.056		<0.012	U	<0.012	U	0.044	
n-C10	0.081		<0.021	U	<0.021	U	0.061	
n-C11	0.116		<0.016	U	<0.016	U	0.073	
n-C12	0.123		<0.019	U	<0.019	U	0.081	
n-C13	0.251		0.067		0.040	J	0.239	
i-C15	0.072		0.059		0.018		0.088	
n-C14	0.251		0.054		0.043		0.170	
i-C16	0.088		<0.004	U	<0.004	U	0.032	
n-C15	0.254		0.046		0.047		0.128	
n-C16	0.262		0.062		0.047		0.123	
i-C18	0.086		<0.004	U	0.021		0.049	
n-C17	0.281		0.056		0.056		0.201	
Pristane	0.272		0.044		0.042		0.124	
n-C18	0.319		0.050		0.055		0.229	
Phytane	0.153		<0.006	U	<0.006	U	0.084	
n-C19	0.685		0.080		0.081		0.549	
n-C20	0.468		0.097		0.082		0.212	
n-C21	0.849		0.091		0.092		0.698	
n-C22	0.917		0.098		0.095		0.420	
n-C23	1.925		0.209		0.200		1.028	
n-C24	0.616		0.073		0.076		0.367	
n-C25	2.178		0.228		0.239		1.017	
n-C26	0.793		0.092		0.069		0.295	
n-C27	2.834		0.336		0.432		1.861	
n-C28	0.509		0.059		0.071		0.308	
n-C29	2.581		0.297		0.312		1.737	
n-C30	0.302		0.036		0.038		0.234	
n-C31	1.672		0.201		0.201		1.344	
n-C32	0.235		0.021		0.026		0.132	
n-C33	1.179		0.117		0.168		0.503	
n-C34	0.167		0.019		0.022		0.131	
n-C35	0.347		0.105		0.151		0.241	
n-C36	0.065		<0.016	U	<0.016	U	<0.016	U
n-C37	0.114		<0.017	U	<0.017	U	<0.017	U
n-C38	0.094		<0.019	U	<0.019	U	<0.019	U
n-C39	0.052		<0.019	U	<0.019	U	<0.019	U
n-C40	<0.019	U	<0.019	U	<0.019	U	<0.019	U
Total Alkanes	21.2		2.6		2.7		12.8	
Total Petroleum Hydrocarbons	184		47		44		115	
Total Resolved Hydrocarbons	92		11		11		56	
Unresolved Complex Mixture	92		36		33		59	
EOM (µg/dry g)	751		62	J	60	J	648	

Surrogate (Su)	Su Recovery (%)	Su Recovery (%)	Su Recovery (%)	Su Recovery (%)
n-dodecane-d26	88	84	84	93
n-eicosane-d42	101	108	107	110
n-triacontane-d62	97	107	106	100

Kinnetic Labs - Harrison Bay
Aliphatic Hydrocarbon and Total Petroleum Hydrocarbon Data
Client Submitted Samples

Laboratory ID	RCA1045.D	RCA1046.D	RCA1047.D
Sample ID	HB18-PAM-S8-1	HB18-PAM-S11-1	HB18-PAM-S4-1
Matrix	Sediment	Sediment	Sediment
Collection Date	08/06/18	08/06/18	08/06/18
Received Date	08/14/18	08/14/18	08/14/18
Extraction Date	08/30/18	08/30/18	08/30/18
Extraction Batch	ENV3865	ENV3865	ENV3865
Date Acquired	06-Sep-2018, 06:47:25	06-Sep-2018, 07:58:04	06-Sep-2018, 09:08:16
Method	B&B SOP1016	B&B SOP1016	B&B SOP1016
Sample Dry Weight (g)	15.02	15.00	15.01
Sample Wet Weight (g)	20.75	29.13	21.60
% Dry	72	51	69
% Moisture	28	49	31
% Lipid (dry)	NA	NA	NA
% Lipid (wet)	NA	NA	NA
Dilution	1X	1X	1X

Target Compounds	Su. Corrected Conc. (µg/dry g)	Q	Su. Corrected Conc. (µg/dry g)	Q	Su. Corrected Conc. (µg/dry g)	Q
n-C9	<0.012	U	0.072		<0.012	U
n-C10	<0.021	U	0.126		<0.021	U
n-C11	<0.016	U	0.126		<0.016	U
n-C12	<0.019	U	0.138		<0.019	U
n-C13	0.043	J	0.282		0.026	J
i-C15	0.023		0.083		0.018	
n-C14	0.044		0.174		<0.013	U
i-C16	<0.004	U	0.050		<0.004	U
n-C15	0.051		0.212		<0.016	U
n-C16	0.047		0.189		0.031	
i-C18	<0.004	U	0.073		<0.004	U
n-C17	0.065		0.331		<0.003	U
Pristane	0.051		0.220		<0.003	U
n-C18	0.070		0.376		0.037	
Phytane	0.019		0.142		<0.006	U
n-C19	0.090		0.893		0.048	
n-C20	0.061		0.417		<0.012	U
n-C21	0.142		1.674		0.061	
n-C22	0.106		1.004		0.055	
n-C23	0.242		2.725		0.095	
n-C24	0.086		0.861		0.044	
n-C25	0.269		2.699		0.103	
n-C26	0.102		0.654		0.038	
n-C27	0.380		5.157		0.154	
n-C28	0.075		0.709		0.034	
n-C29	0.330		4.325		0.139	
n-C30	0.037		0.481		<0.013	U
n-C31	0.231		2.954		0.099	
n-C32	0.028		0.387		<0.012	U
n-C33	0.132		1.507		0.041	
n-C34	0.014	J	0.342		<0.016	U
n-C35	0.115		0.724		<0.015	U
n-C36	<0.016	U	0.158		<0.016	U
n-C37	<0.017	U	0.298		<0.017	U
n-C38	<0.019	U	0.130		<0.019	U
n-C39	<0.019	U	<0.019	U	<0.019	U
n-C40	<0.019	U	<0.019	U	<0.019	U
Total Alkanes	2.9		30.7		1.0	
Total Petroleum Hydrocarbons	50		275		35	
Total Resolved Hydrocarbons	11		170		14	
Unresolved Complex Mixture	39		105		21	
EOM (µg/dry g)	74	J	1958		38	J

Surrogate (Su)	Su Recovery (%)	Su Recovery (%)	Su Recovery (%)
n-dodecane-d26	79	95	82
n-eicosane-d42	109	111	103
n-triacontane-d62	105	100	102

Kinnetic Labs - Harrison Bay
Aliphatic Hydrocarbon and Total Petroleum Hydrocarbon Data
Method Blank Report

Laboratory ID	ENV3865A.D
Sample ID	Method Blank
Matrix	Sediment
Collection Date	NA
Received Date	NA
Extraction Date	08/30/18
Extraction Batch	ENV3865
Date Acquired	05-Sep-2018, 17:53:15
Method	B&B SOP1016
Sample Dry Weight (g)	15.04
Sample Wet Weight (g)	NA
% Dry	NA
% Moisture	NA
% Lipid (dry)	NA
% Lipid (wet)	NA
Dilution	1X

Target Compounds	Su. Corrected Conc. (µg/dry g)	Q	Q	3X MDL Conc. (µg/dry g)	Actual MDL Conc. (µg/dry g)
n-C9	<0.012	U		0.037	0.012
n-C10	<0.021	U		0.064	0.021
n-C11	<0.016	U		0.049	0.016
n-C12	<0.019	U		0.056	0.019
n-C13	<0.045	U		0.134	0.045
i-C15	<0.016	U		0.049	0.016
n-C14	<0.013	U		0.039	0.013
i-C16	<0.004	U		0.013	0.004
n-C15	<0.016	U		0.049	0.016
n-C16	<0.004	U		0.013	0.004
i-C18	<0.004	U		0.011	0.004
n-C17	<0.003	U		0.010	0.003
Pristane	<0.003	U		0.008	0.003
n-C18	<0.004	U		0.011	0.004
Phytane	<0.006	U		0.018	0.006
n-C19	<0.005	U		0.015	0.005
n-C20	<0.012	U		0.037	0.012
n-C21	<0.004	U		0.012	0.004
n-C22	<0.003	U		0.010	0.003
n-C23	<0.008	U		0.024	0.008
n-C24	<0.005	U		0.016	0.005
n-C25	<0.007	U		0.021	0.007
n-C26	<0.008	U		0.023	0.008
n-C27	<0.011	U		0.032	0.011
n-C28	<0.011	U		0.033	0.011
n-C29	<0.021	U		0.064	0.021
n-C30	<0.013	U		0.038	0.013
n-C31	<0.015	U		0.044	0.015
n-C32	<0.012	U		0.035	0.012
n-C33	<0.021	U		0.064	0.021
n-C34	<0.016	U		0.049	0.016
n-C35	<0.015	U		0.044	0.015
n-C36	<0.016	U		0.047	0.016
n-C37	<0.017	U		0.052	0.017
n-C38	<0.019	U		0.057	0.019
n-C39	<0.019	U		0.056	0.019
n-C40	<0.019	U		0.056	0.019
Total Alkanes					
Total Petroleum Hydrocarbons	<1.4	U		4.20	1.40
Total Resolved Hydrocarbons	<1.4	U		4.20	1.40
Unresolved Complex Mixture	<1.4	U		4.20	1.40
EOM (µg/dry g)	NA			300	100

Surrogate (Su)	Su Recovery (%)
n-dodecane-d26	81
n-eicosane-d42	108
n-triacontane-d62	108

Kinnetic Labs - Harrison Bay
Aliphatic Hydrocarbon and Total Petroleum Hydrocarbon Data
Blank Spike Report

Laboratory ID	ENV3865C.D
Sample ID	Blank Spike
Matrix	Sediment
Collection Date	NA
Received Date	NA
Extraction Date	08/30/18
Extraction Batch	ENV3865
Date Acquired	05-Sep-2018, 20:14:09
Method	B&B SOP1016
Sample Dry Weight (g)	1.00
Sample Wet Weight (g)	NA
% Dry	NA
% Moisture	NA
% Lipid (dry)	NA
% Lipid (wet)	NA
Dilution	1X

Target Compounds	Su. Corrected Conc. (µg/dry g)	Recovery (%)	Q	Spike Amount (µg)
n-C9	6.61	66		10.0
n-C10	7.61	76		10.0
n-C11	8.33	83		10.0
n-C12	8.48	86		9.84
n-C13	9.42	94		10.1
n-C14	9.25	94		9.84
n-C15	9.27	93		10.0
n-C16	9.54	95		10.0
n-C17	9.69	98		9.92
Pristane	9.78	98		9.94
n-C18	9.89	99		10.0
Phytane	9.62	98		9.82
n-C19	9.73	98		10.0
n-C20	9.94	99		10.0
n-C21	9.92	99		10.0
n-C22	10.4	103		10.0
n-C23	10.1	102		9.94
n-C24	9.81	99		9.90
n-C25	9.90	99		10.0
n-C26	9.93	99		10.0
n-C27	10.0	100		10.0
n-C28	10.3	104		9.95
n-C29	10.5	104		10.1
n-C30	10.2	101		10.1
n-C31	10.0	100		10.0
n-C32	10.3	104		9.89
n-C33	10.2	102		10.1
n-C34	10.1	101		10.0
n-C35	9.96	100		9.94
n-C36	10.3	102		10.0
n-C37	9.85	98		10.1
n-C38	9.54	95		10.1
n-C39	9.69	98		9.92
n-C40	9.06	91		10.0
Average %Recovery		96		

Surrogate (Su)	Su Recovery (%)
n-dodecane-d26	87
n-eicosane-d42	104
n-triacontane-d62	106

Kinnetic Labs - Harrison Bay
Aliphatic Hydrocarbon and Total Petroleum Hydrocarbon Data
Matrix Spike Report

Laboratory ID	RCA1041.D	ENV3865D.D	ENV3865E.D
Sample ID	HB18-PAM-S2-1	Matrix Spike (HB18-PAM-S2-1)	Matrix Spike Duplicate (HB18-PAM-S2-1)
Matrix	Sediment	Sediment	Sediment
Collection Date	08/06/18	08/06/18	08/06/18
Received Date	08/14/18	08/14/18	08/14/18
Extraction Date	08/30/18	08/30/18	08/30/18
Extraction Batch	ENV3865	ENV3865	ENV3865
Date Acquired	06-Sep-2018, 00:55:35	05-Sep-2018, 21:24:17	05-Sep-2018, 22:34:55
Method	B&B SOP1016	B&B SOP1016	B&B SOP1016
Sample Dry Weight (g)	15.05	15.05	15.02
Sample Wet Weight (g)	27.12	27.12	27.07
% Dry	55	55	55
% Moisture	45	45	45
% Lipid (dry)	NA	NA	NA
% Lipid (wet)	NA	NA	NA
Dilution	1X	1X	1X

Target Compounds	Su. Corrected Conc. (µg/dry g)	Q	Su. Corrected Conc. (µg/dry g)	Q	Recovery (%)	Q	Q	Su. Corrected Conc. (µg/dry g)	Q	Recovery (%)	Q	Q	RPD (%)	Q	Spike Amount (µg)
n-C9	0.056		0.418		55			0.393		51			6		10.0
n-C10	0.081		0.564		72			0.537		68			5		10.0
n-C11	0.116		0.643		79			0.629		77			2		10.0
n-C12	0.123		0.671		84			0.668		83			0		9.8
n-C13	0.251		0.838		88			0.832		87			1		10.1
i-C15	0.072		NA					NA							
n-C14	0.251		0.845		91			0.857		92			1		9.8
i-C16	0.088		NA					NA							
n-C15	0.254		0.850		90			0.857		90			1		10.0
n-C16	0.262		0.871		92			0.874		92			0		10.0
i-C18	0.086		NA					NA							
n-C17	0.281		0.916		96			0.910		95			1		9.9
Pristane	0.272		0.911		97			0.936		100			3		9.94
n-C18	0.319		0.964		97			0.956		96			1		10.0
Phytane	0.153		0.779		96			0.748		91			4		9.8
n-C19	0.685		1.326		97			1.317		95			1		10.0
n-C20	0.468		1.112		97			1.109		96			0		10.0
n-C21	0.849		1.478		95			1.480		94			0		10.0
n-C22	0.917		1.586		101			1.571		98			1		10.02
n-C23	1.925		2.559		96		Y	2.538		92		Y	1		9.94
n-C24	0.616		1.245		96			1.237		94			1		9.90
n-C25	2.178		2.811		95		Y	2.794		92		Y	1		10.0
n-C26	0.793		1.420		94			1.404		91			1		10.0
n-C27	2.834		3.515		102		Y	3.461		93		Y	2		10.0
n-C28	0.509		1.143		96			1.124		93			2		9.9
n-C29	2.581		3.283		105		Y	3.225		95		Y	2		10.06
n-C30	0.302		0.941		96			0.927		93			1		10.1
n-C31	1.672		2.221		82		Y	2.341		100		Y	5		10.0
n-C32	0.235		0.752		79			0.769		81			2		9.89
n-C33	1.179		1.912		110			1.896		107			1		10.1
n-C34	0.167		0.888		108			0.868		105			2		10.0
n-C35	0.347		1.067		109			1.052		106			1		9.9
n-C36	0.065		0.758		104			0.778		107			3		10.0
n-C37	0.114		0.736		93			0.743		94			1		10.1
n-C38	0.094		0.601		76			0.596		75			1		10.1
n-C39	0.052		0.706		99			0.697		98			1		9.9
n-C40	<0.019	U	0.595		90			0.601		90			1		10.0
Average %Recovery					93					92					

Surrogate (Su)	Su Recovery (%)	Su Recovery (%)	Su Recovery (%)
n-dodecane-d26	88	91	86
n-eicosane-d42	101	105	110
n-triacontane-d62	97	99	99

Kinnetic Labs - Harrison Bay
Aliphatic Hydrocarbon and Total Petroleum Hydrocarbon Data
Laboratory Duplicate Report

Laboratory ID	RCA1042.D	ENV3865F.D
Sample ID	HB18-PAM-S3-1	Duplicate (HB18-PAM-S3-1)
Matrix	Sediment	Sediment
Collection Date	08/06/18	08/06/18
Received Date	08/14/18	08/14/18
Extraction Date	08/30/18	08/30/18
Extraction Batch	ENV3865	ENV3865
Date Acquired	06-Sep-2018, 03:16:19	05-Sep-2018, 23:45:04
Method	B&B SOP1016	B&B SOP1016
Sample Dry Weight (g)	15.01	15.02
Sample Wet Weight (g)	20.56	20.57
% Dry	73	73
% Moisture	27	27
% Lipid (dry)	NA	NA
% Lipid (wet)	NA	NA
Dilution	1X	1X

Target Compounds	Su. Corrected Conc. (µg/dry g)	Q	Su. Corrected Conc. (µg/dry g)	Q	RPD (%)	Q	Q	MDL (µg/dry g)	3X MDL (µg/dry g)
n-C9	<0.012	U	<0.012	U	0			0.012	0.037
n-C10	<0.021	U	<0.021	U	0			0.021	0.064
n-C11	<0.016	U	<0.016	U	0			0.016	0.049
n-C12	<0.019	U	<0.019	U	0			0.019	0.056
n-C13	0.067		0.067		0		X	0.045	0.134
i-C15	0.059		0.056		5			0.016	0.049
n-C14	0.054		0.055		2			0.013	0.039
i-C16	<0.004	U	<0.004	U	0			0.004	0.013
n-C15	0.046		0.044		4		X	0.016	0.049
n-C16	0.062		0.066		6			0.004	0.013
i-C18	<0.004	U	0.035		0			0.004	0.011
n-C17	0.056		0.056		0			0.003	0.010
Pristane	0.044		0.047		7			0.003	0.008
n-C18	0.050		0.057		13			0.004	0.011
Phytane	<0.006	U	<0.006	U	0			0.006	0.018
n-C19	0.080		0.080		0			0.005	0.015
n-C20	0.097		0.103		6			0.012	0.037
n-C21	0.091		0.096		5			0.004	0.012
n-C22	0.098		0.097		1			0.003	0.010
n-C23	0.209		0.203		3			0.008	0.024
n-C24	0.073		0.075		3			0.005	0.016
n-C25	0.228		0.233		2			0.007	0.021
n-C26	0.092		0.096		4			0.008	0.023
n-C27	0.336		0.334		1			0.011	0.032
n-C28	0.059		0.059		0			0.011	0.033
n-C29	0.297		0.308		4			0.021	0.064
n-C30	0.036		0.035		3		X	0.013	0.038
n-C31	0.201		0.192		5			0.015	0.044
n-C32	0.021		0.023		9		X	0.012	0.035
n-C33	0.117		0.110		6			0.021	0.064
n-C34	0.019		0.018		5		X	0.016	0.049
n-C35	0.105		0.101		4			0.015	0.044
n-C36	<0.016	U	<0.016	U	0			0.016	0.047
n-C37	<0.017	U	<0.017	U	0			0.017	0.052
n-C38	<0.019	U	<0.019	U	0			0.019	0.057
n-C39	<0.019	U	<0.019	U	0			0.019	0.056
n-C40	<0.019	U	<0.019	U	0			0.019	0.056
Total Alkanes	2.6		2.6		2				
Total Petroleum Hydrocarbons	47		50		6			1.40	4.20
Total Resolved Hydrocarbons	11		10		9			1.40	4.20
Unresolved Complex Mixture	36		40		10			1.40	4.20
EOM (µg/dry g)	62	J	60	J	3				

Surrogate (Su)	Su Recovery (%)	Su Recovery (%)
n-dodecane-d26	84	84
n-eicosane-d42	108	104
n-triacontane-d62	107	105

Laboratory ID	FID30463F.D
Sample ID	ALI-SRM2779-20-04
Matrix	Reference Oil
Collection Date	NA
Received Date	NA
Extraction Date	NA
Extraction Batch	ENV3865
Date Acquired	06-Sep-2018, 10:18:33
Method	B&B SOP1016
Sample Weight (mg)	20.0
Dilution	1X

Target Compounds	Su. Corrected Conc. (µg/mg)	Q	Q	Dev. (%)	B&B Average	- 3 σ Conc. (µg/mg)	+ 3 σ Conc. (µg/mg)
n-C9	10.9			7	11.8	9.72	13.9
n-C10	10.9			1	10.8	8.96	12.7
n-C11	9.6			1	9.72	8.17	11.3
n-C12	8.44			1	8.35	6.96	9.74
n-C13	8.98			19	7.56	5.75	9.38
i-C15	1.33			15	1.56	1.08	2.05
n-C14	6.44			4	6.70	5.60	7.80
i-C16	1.24		*	51	2.50	2.01	2.99
n-C15	6.06			4	6.29	5.29	7.30
n-C16	5.13			3	5.29	4.35	6.23
i-C18	1.50			5	1.57	1.22	1.93
n-C17	4.52			1	4.47	3.70	5.23
Pristane	2.40			1	2.42	1.99	2.84
n-C18	3.77			4	3.61	3.14	4.08
Phytane	1.68			10	1.53	1.24	1.82
n-C19	3.75			14	3.28	2.66	3.90
n-C20	2.87			2	2.81	2.37	3.25
n-C21	2.23			4	2.33	1.95	2.72
n-C22	1.97			4	2.04	1.70	2.39
n-C23	1.81			1	1.83	1.53	2.13
n-C24	1.56			5	1.64	1.35	1.92
n-C25	1.56			14	1.37	1.17	1.57
n-C26	1.08			6	1.15	0.967	1.33
n-C27	1.05			14	0.918	0.772	1.06
n-C28	0.770			1	0.780	0.635	0.925
n-C29	0.740			2	0.753	0.643	0.863
n-C30	0.605			8	0.658	0.547	0.769
n-C31	0.540			1	0.547	0.457	0.638
n-C32	0.490			1	0.486	0.407	0.565
n-C33	0.439			6	0.467	0.375	0.559
n-C34	0.455			8	0.422	0.350	0.493
n-C35	0.389			14	0.342	0.278	0.407
n-C36	0.206	J		2	0.201	0.156	0.246
n-C37	0.229	J		11	0.207	0.158	0.256
n-C38	0.195	J		15	0.169	0.129	0.208
n-C39	0.148	J		7	0.160	0.124	0.196
n-C40	0.122	J		21	0.154	0.118	0.190
Total Petroleum Hydrocarbons	548			5	574	452	695

Surrogate (Su)	Su Recovery (%)
n-dodecane-d26	102
n-eicosane-d42	101
n-triacontane-d62	95

Kinnetic Labs - Harrison Bay
Aliphatic Hydrocarbon and Total Petroleum Hydrocarbon Data
ICV Report

Laboratory ID	FID30461H.D
Sample ID	ALI-WKICV-25-003
Matrix	Solution
Collection Date	NA
Received Date	NA
Extraction Date	NA
Extraction Batch	ENV
Date Acquired	03-Sep-2018, 22:58
Method	B&B SOP1016
Sample Volume (mL)	1.00

Target Compounds	Concentration (µg/mL)	Recovery (%)	LCM Certified Conc. (ug/mL)
n-C9	24.16	96	25.04
n-C10	24.71	99	25.01
n-C11	24.88	99	25.02
n-C12	24.43	98	25.04
n-C13	24.42	98	25.01
n-C14	24.58	98	25.02
n-C15	24.21	97	25.01
n-C16	24.02	96	25.01
n-C17	24.71	99	25.04
Pristane	23.49	94	25.01
n-C18	24.73	99	25.02
Phytane	26.06	104	25.04
n-C19	24.52	98	25.03
n-C20	24.51	98	25.02
n-C21	24.99	100	25.03
n-C22	24.61	98	25.02
n-C23	24.95	100	25.03
n-C24	24.62	98	25.01
n-C25	24.89	100	25.02
n-C26	24.96	100	25.02
n-C27	25.34	101	25.01
n-C28	24.01	96	25.01
n-C29	25.78	103	25.03
n-C30	25.00	100	25.03
n-C31	24.96	100	25.01
n-C32	25.60	102	25.02
n-C33	23.98	96	25.02
n-C34	25.26	101	25.03
n-C35	23.61	94	25.02
n-C36	23.60	94	25.02
n-C37	25.51	102	25.04
n-C38	23.89	95	25.03
n-C39	24.38	97	25.02
n-C40	24.71	99	25.02

Surrogate (Su)	Concentration (µg/mL)		
n-dodecane-d26	24.71	99	25.00
n-eicosane-d42	25.21	101	25.00
n-triacontane-d62	25.40	102	25.00

Kinnetic Labs - Harrison Bay
Aliphatic Hydrocarbon and Total Petroleum Hydrocarbon Data
CCV Report

Laboratory ID	FID30463B.D	FID30463E.D	FID30463H.D
Sample ID	ALI-WKCCV-25-010	ALI-WKCCV-25-010	ALI-WKCCV-25-010
Matrix	Solution	Solution	Solution
Collection Date	NA	NA	NA
Received Date	NA	NA	NA
Extraction Date	NA	NA	NA
Extraction Batch	ENV	ENV	ENV
Date Acquired	05-Sep-2018, 14:21:14	06-Sep-2018, 02:06:15	06-Sep-2018, 12:39:18
Method	B&B SOP1016	B&B SOP1016	B&B SOP1016
Sample Volume (mL)	1.00	1.00	1.00

Target Compounds	ALI-WKCCV-25-010 Certified Conc. (µg/mL)	Concentration (µg/mL)	Recovery (%)	Concentration (µg/mL)	Recovery (%)	Concentration (µg/mL)	Recovery (%)
n-C9	24.98	25.41	102	25.61	103	25.44	102
n-C10	25.07	25.84	103	26.09	104	26.24	105
n-C11	25.09	25.93	103	26.28	105	26.52	106
n-C12	24.61	25.50	104	25.85	105	26.06	106
n-C13	25.18	25.45	101	25.83	103	25.97	103
n-C14	24.60	25.61	104	25.90	105	25.87	105
n-C15	25.05	25.33	101	25.42	101	25.38	101
n-C16	25.01	25.33	101	25.30	101	25.29	101
n-C17	24.79	25.25	102	25.42	103	25.53	103
Pristane	24.85	25.46	102	25.66	103	25.75	104
n-C18	24.92	25.46	102	25.53	102	25.58	103
Phytane	24.55	24.99	102	25.08	102	25.04	102
n-C19	24.92	25.30	102	25.31	102	25.36	102
n-C20	25.10	25.63	102	25.78	103	25.58	102
n-C21	25.02	25.52	102	25.52	102	25.53	102
n-C22	25.05	26.17	105	26.05	104	26.04	104
n-C23	24.86	25.92	104	25.87	104	25.78	104
n-C24	24.76	25.28	102	25.21	102	25.13	101
n-C25	24.98	25.32	101	25.16	101	25.08	100
n-C26	25.02	25.50	102	25.38	101	25.24	101
n-C27	25.11	25.73	102	25.57	102	25.42	101
n-C28	24.87	25.36	102	25.14	101	24.89	100
n-C29	25.16	26.48	105	26.22	104	25.83	103
n-C30	25.15	26.11	104	25.80	103	25.35	101
n-C31	25.08	25.75	103	25.73	103	25.63	102
n-C32	24.72	25.49	103	24.89	101	24.81	100
n-C33	25.18	25.85	103	25.68	102	24.74	98
n-C34	25.11	26.15	104	25.69	102	27.02	108
n-C35	24.85	25.52	103	25.06	101	24.76	100
n-C36	25.06	26.28	105	27.27	109	25.43	102
n-C37	25.17	25.39	101	24.93	99	24.73	98
n-C38	25.16	24.71	98	24.27	96	24.41	97
n-C39	24.80	24.83	100	24.53	99	24.32	98
n-C40	24.97	23.49	94	22.84	91	23.25	93

Surrogate (Su)		Concentration (µg/mL)		Concentration (µg/mL)		Concentration (µg/mL)	
n-dodecane-d26	25.00	25.03	100	25.43	102	25.63	103
n-eicosane-d42	25.00	25.28	101	25.31	101	25.29	101
n-triacontane-d62	25.00	25.70	103	25.27	101	24.84	99

Total Petroleum Hydrocarbons Chromatograms

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Operator     : Mike Gaskins
Instrument   :   HP5890
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Sample Name: HB18-PAM-S2-1
Misc Info    :
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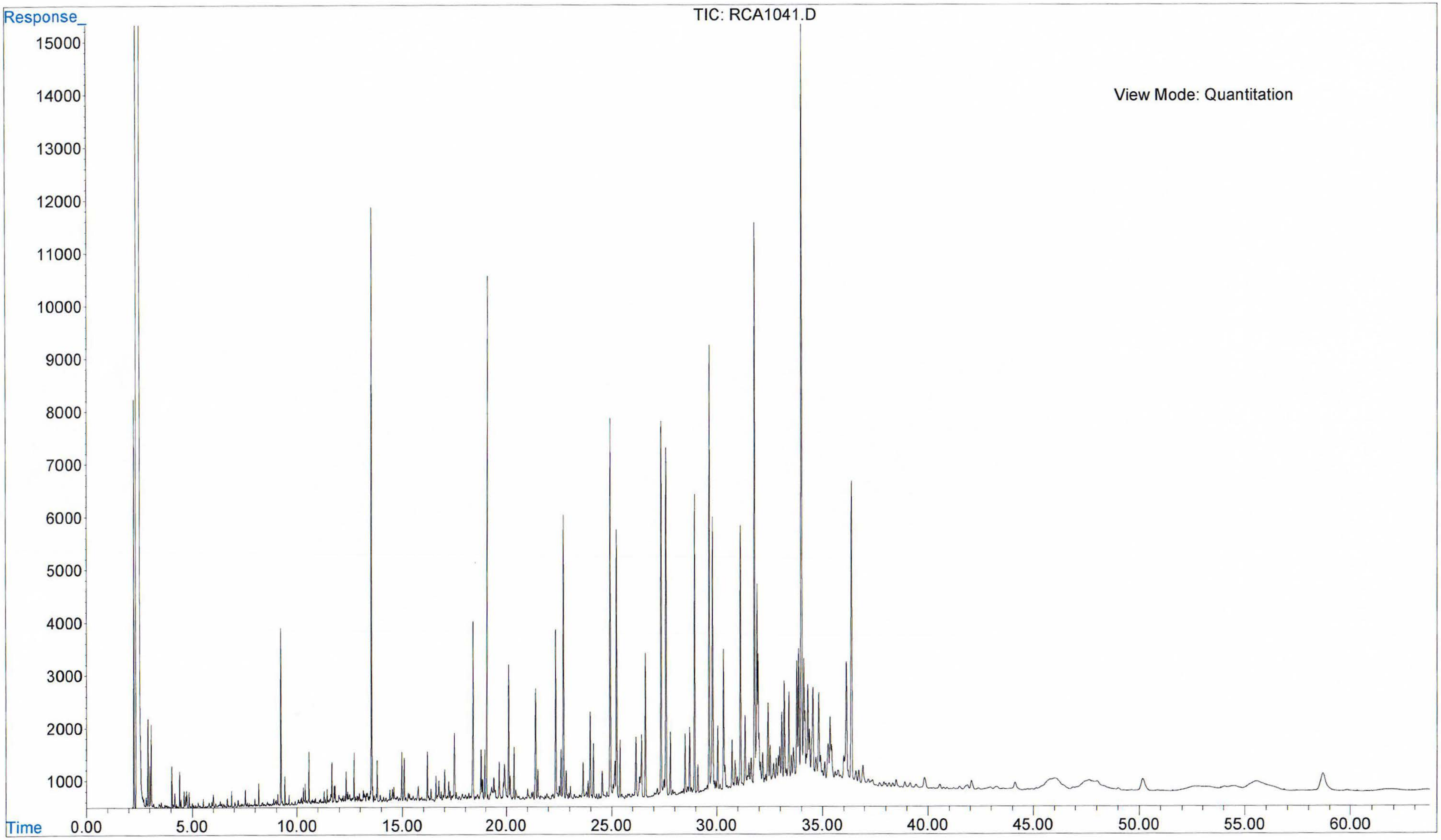

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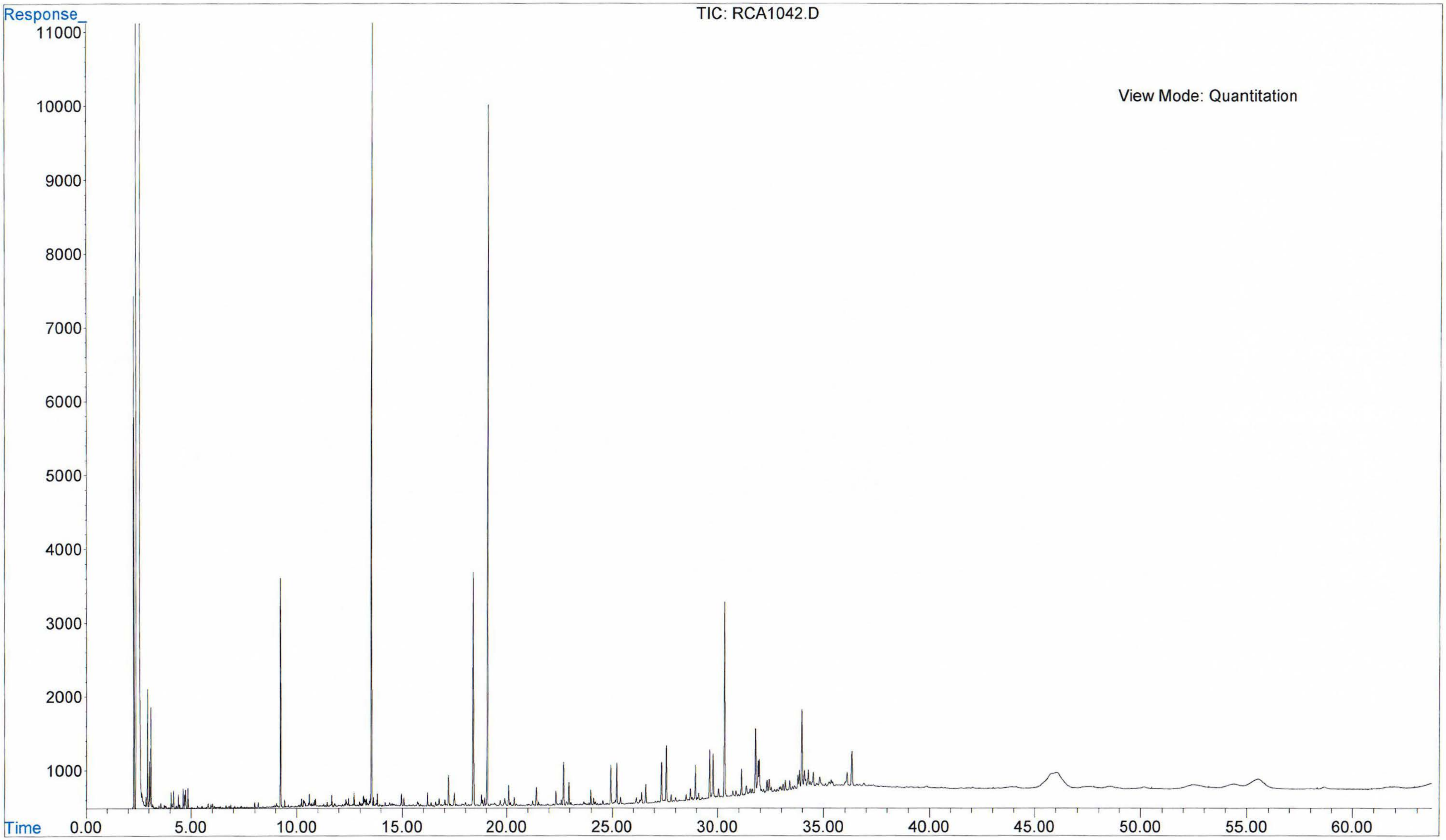

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Operator     : Mike Gaskins
Instrument :    HP5890
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Sample Name: HB18-PAM-S3-2
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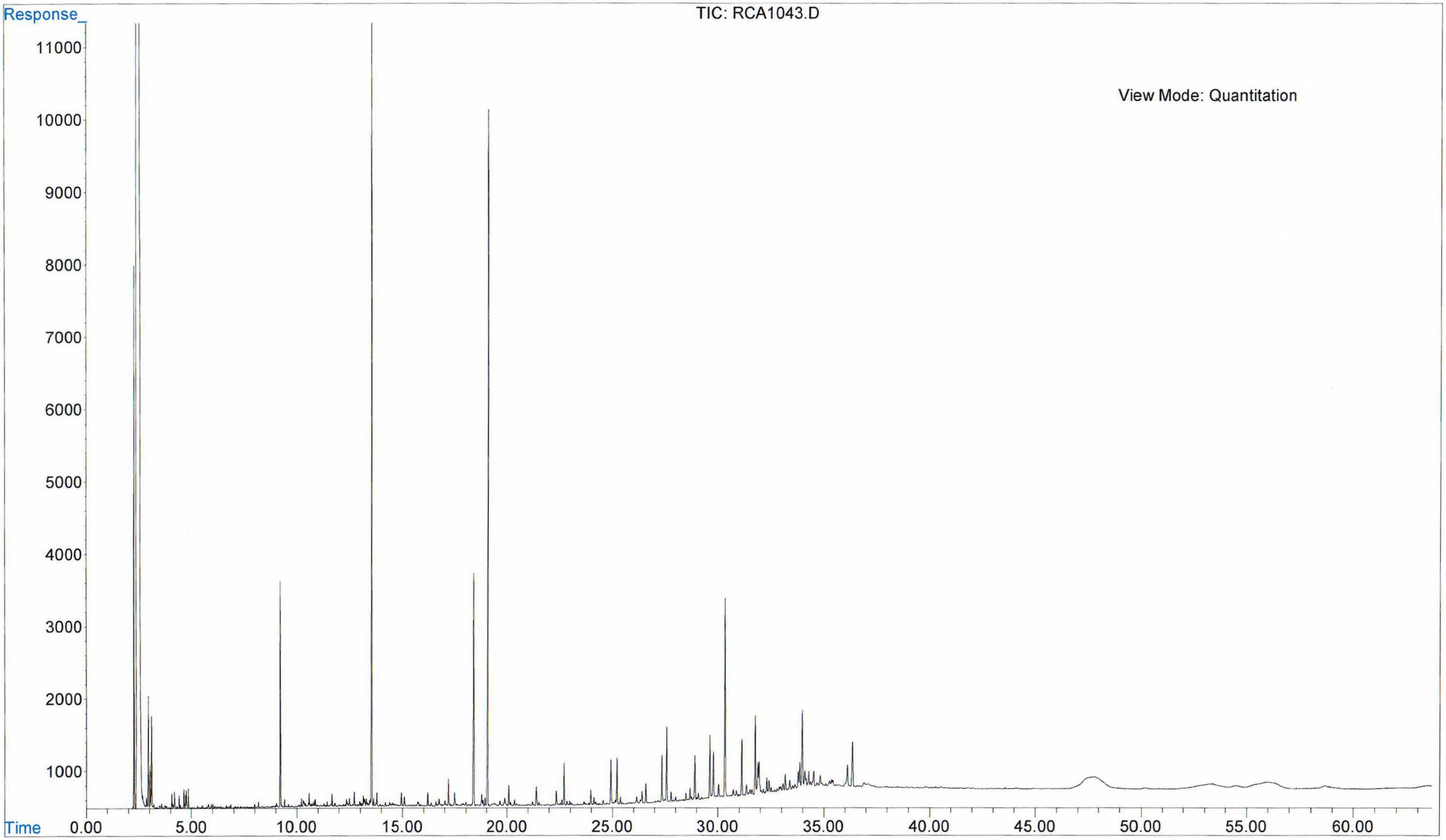

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Operator    : Mike Gaskins
Instrument  :    HP5890
Acquired    : 06-Sep-2018, 05:37     using AcqMethod ALI2012.M
Sample Name: HB18-PAM-S6-1
Misc Info   :
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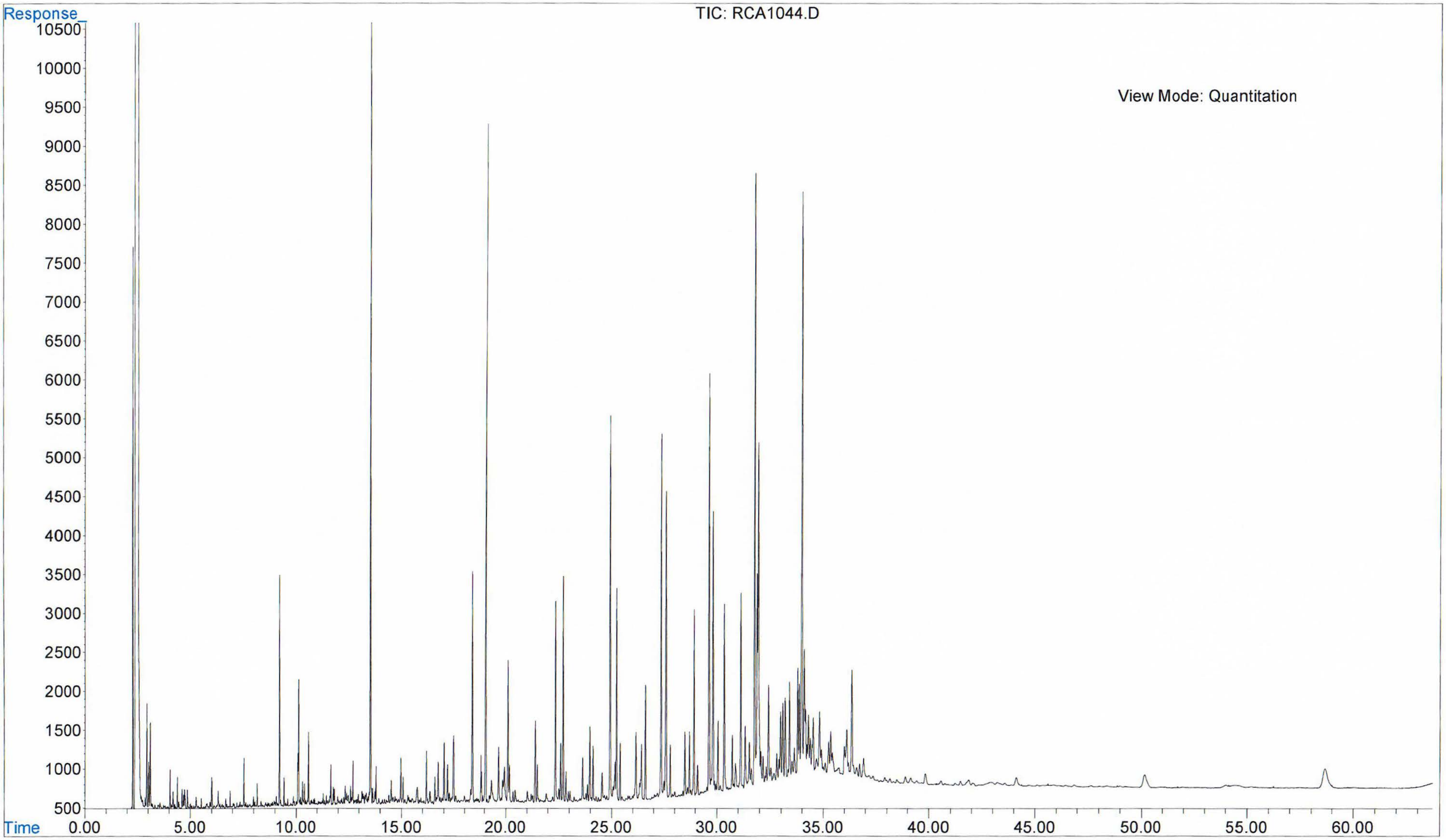

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Operator    : Mike Gaskins
Instrument :   HP5890
Acquired    : 06-Sep-2018, 06:47     using AcqMethod ALI2012.M
Sample Name: HB18-PAM-S8-1
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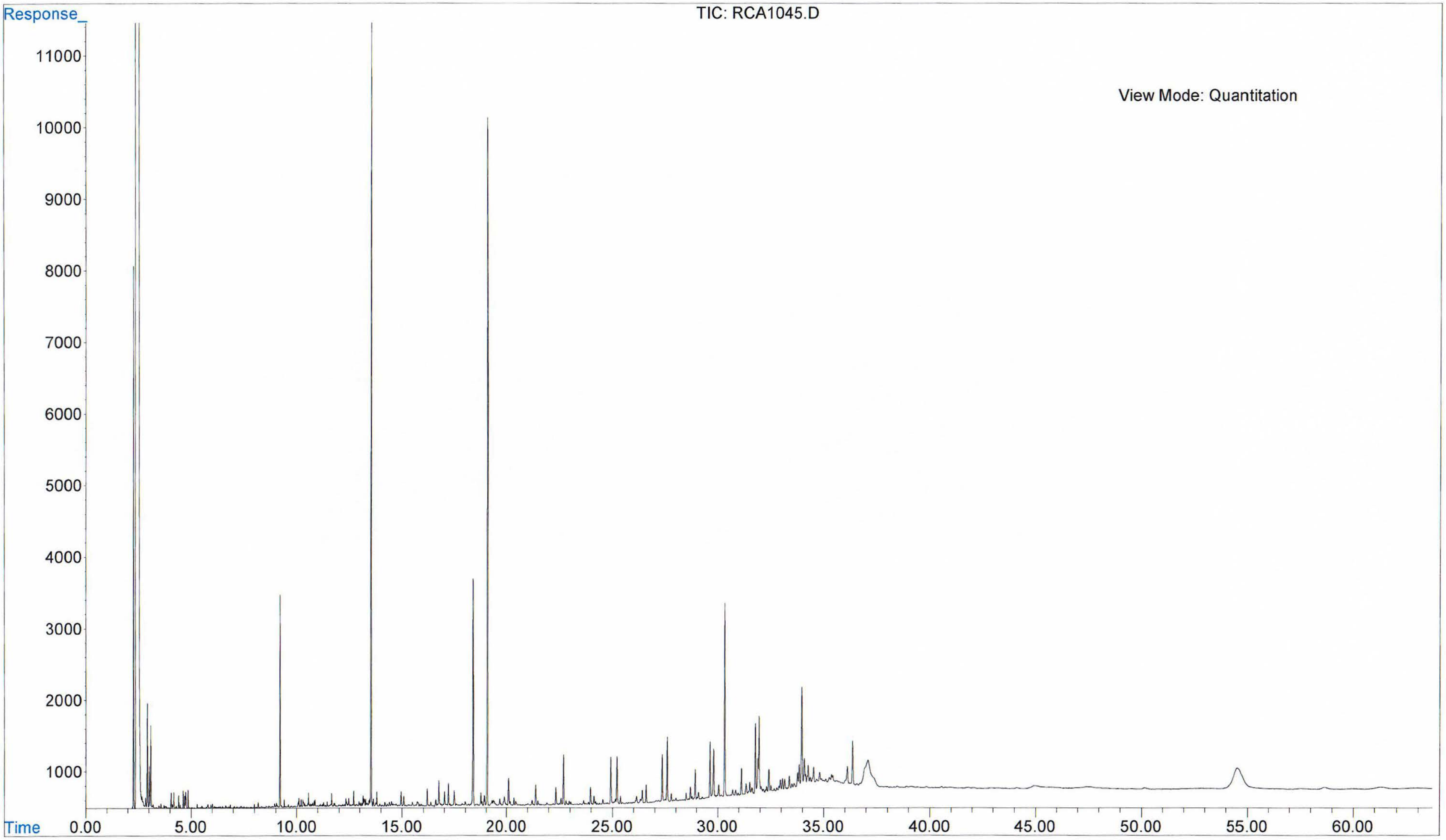

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Operator    : Mike Gaskins
Instrument  :    HP5890
Acquired    : 06-Sep-2018, 07:58      using AcqMethod ALI2012.M
Sample Name: HB18-PAM-S11-1
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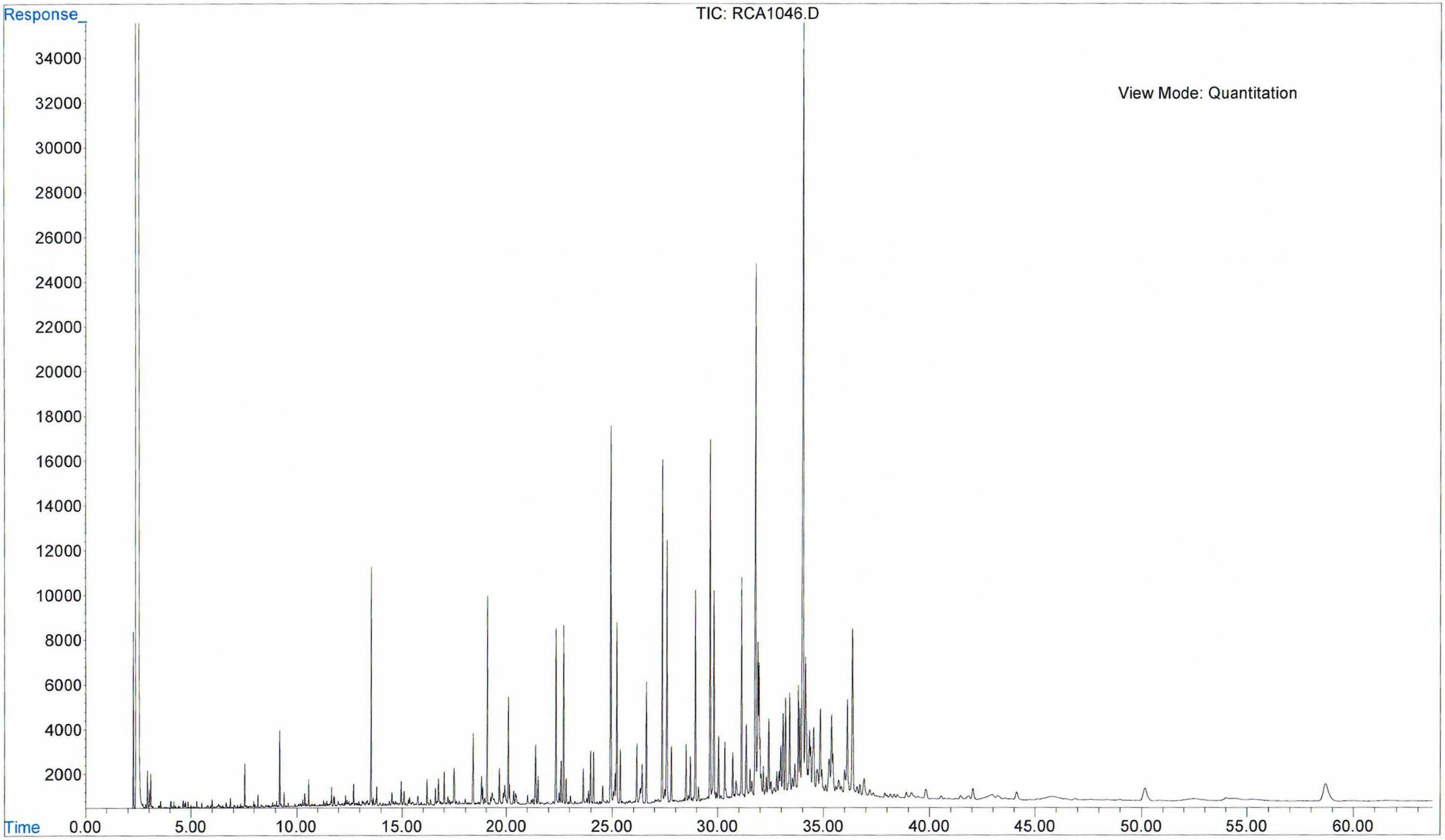

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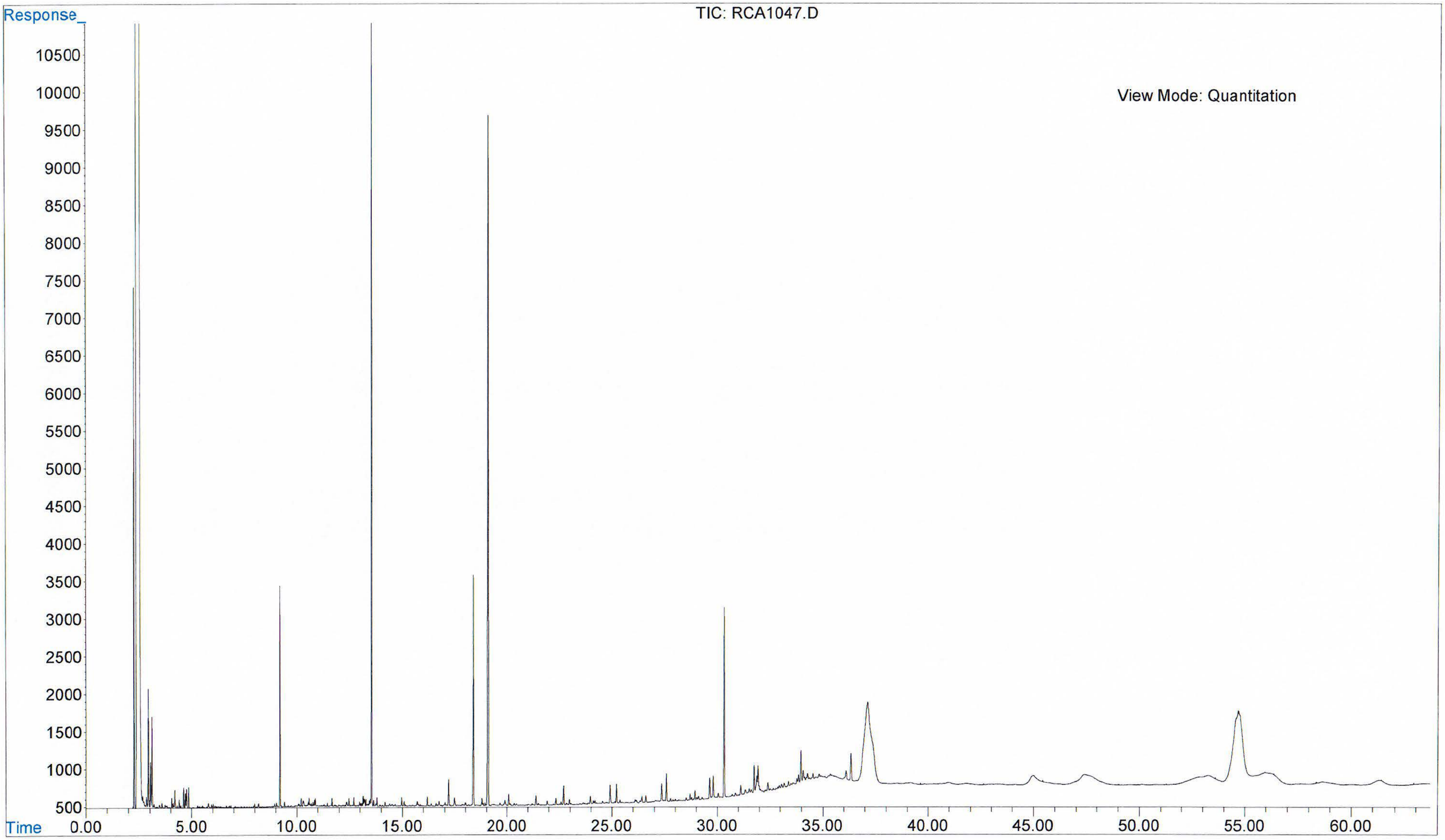
Operator   : Mike Gaskins
Instrument :   HP5890
Acquired   : 06-Sep-2018, 09:08   using AcqMethod ALI2012.M
Sample Name: HB18-PAM-S4-1
Misc Info   :



Aliphatic Mass Discrimination Ratio

Kinnetic Labs - Harrison Bay

Aliphatic Hydrocarbon and Total Petroleum Hydrocarbon Data

Mass Discrimination

Laboratory ID	Sample ID	n-C20 (Area)	n-C36 (Area)	n-C36/n-C20 ratio	Q
FID30461B.D	ALI-WKC1-1.25-003	6077	5644	0.93	
FID30461C.D	ALI-WKC2-10-003	43270	42340	0.98	
FID30461D.D	ALI-WKC3-25-003	108488	106889	0.99	
FID30461E.D	ALI-WKC4-40-003	172774	167965	0.97	
FID30461F.D	ALI-WKC5-50-003	236897	230298	0.97	
FID30461G.D	ALI-WKC6-100-003	571112	554200	0.97	
FID30461H.D	ALI-WKICV-25-003	113466	106611	0.94	
FID30461J.D	ALI-WKCCV-25-010	104433	119083	1.14	
FID30463B.D	ALI-WKCCV-25-010	101293	101345	1.00	
FID30463E.D	ALI-WKCCV-25-010	101789	105067	1.03	
FID30463H.D	ALI-WKCCV-25-010	102724	99635	0.97	

Qualifiers (Q): Ratio of n-C36 to n-C20 needs to be > 0.70

Aliphatic Internal Standard Area Data

Kinnetic Labs - Harrison Bay
Aliphatic Hydrocarbon and Total Petroleum Hydrocarbon Data
Area of Internal Standards

Laboratory ID	Sample ID	Internal Standard 1 n-hexadecane-d34			Q	Internal Standard 2 5α-androstane			Q
		Response (Area)	50% (Area)	200% (Area)		Response (Area)	50% (Area)	200% (Area)	
FID30461D.D	**ALI-WKC3-25-003**	**187071**	**93536**	**374142**		**218105**	**109053**	**436210**	
FID30461H.D	**ALI-WKICV-25-003**	**204318**				**237483**			
FID30461J.D	**ALI-WKCCV-25-010**	**179644**				**208354**			
FID30463B.D	**ALI-WKCCV-25-010**	**174484**				**202740**			
FID30463F.D	ALI-SRM2779-20-04	251905				311097			
FID30463D.D	ALI-WKPem-004	229577				270665			
ENV3865A.D	Method Blank	171116				200240			
ENV3865C.D	Blank Spike	177149				205583			
ENV3865D.D	Matrix Spike (HB18-PAM-S2-1)	177157				201139			
ENV3865E.D	Matrix Spike Duplicate (HB18-PAM-S2-1)	179128				204108			
ENV3865F.D	Duplicate (HB18-PAM-S3-1)	169954				195253			
RCA1041.D	HB18-PAM-S2-1	179740				203750			
RCA1042.D	HB18-PAM-S3-1	164952				189658			
RCA1043.D	HB18-PAM-S3-2	169704				195354			
FID30463E.D	**ALI-WKCCV-25-010**	**175475**				**202535**			
RCA1044.D	HB18-PAM-S6-1	164234				182441			
RCA1045.D	HB18-PAM-S8-1	169398				194202			
RCA1046.D	HB18-PAM-S11-1	173165				193477			
RCA1047.D	HB18-PAM-S4-1	163294				187827			
FID30463H.D	**ALI-WKCCV-25-010**	**179720**				**205975**			

Polycyclic Aromatic Hydrocarbon Concentration

B&B Laboratories
Project J18346
Report 18-3808

Kinnetic Labs - Harrison Bay
Polycyclic Aromatic Hydrocarbon Data
Client Submitted Samples

Client Project #5089.03

Laboratory ID	RCA1041.D	RCA1042.D	RCA1043.D	RCA1044.D	RCA1045.D	RCA1046.D
Sample ID	HB18-PAM-S2-1	HB18-PAM-S3-1	HB18-PAM-S3-2	HB18-PAM-S6-1	HB18-PAM-S8-1	HB18-PAM-S11-1
Matrix	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Collection Date	08/06/18	08/06/18	08/06/18	08/06/18	08/06/18	08/06/18
Received Date	08/14/18	08/14/18	08/14/18	08/14/18	08/14/18	08/14/18
Extraction Date	08/30/18	08/30/18	08/30/18	08/30/18	08/30/18	08/30/18
Extraction Batch	ENV3865	ENV3865	ENV3865	ENV3865	ENV3865	ENV3865
Date Acquired	9/5/18 6:52	9/5/18 9:10	9/5/18 10:19	9/5/18 11:29	9/5/18 12:38	9/5/18 13:48
Method	B&B SOP1006	B&B SOP1006	B&B SOP1006	B&B SOP1006	B&B SOP1006	B&B SOP1006
Sample Dry Weight (g)	15.05	15.01	15.02	15.01	15.02	15.00
Sample Wet Weight (g)	27.12	20.56	19.86	29.51	20.75	29.13
% Dry	55	73	76	51	72	51
% Moisture	45	27	24	49	28	49
% Lipid (dry)	NA	NA	NA	NA	NA	NA
% Lipid (wet)	NA	NA	NA	NA	NA	NA
Dilution	1X	1X	1X	1X	1X	1X

Target Compounds	Su. Corrected Conc. (ng/dry g)	Q	Su. Corrected Conc. (ng/dry g)	Q	Su. Corrected Conc. (ng/dry g)	Q	Su. Corrected Conc. (ng/dry g)	Q	Su. Corrected Conc. (ng/dry g)	Q	Su. Corrected Conc. (ng/dry g)	Q
cis/trans Decalin	20.1		4.33		4.07		14.9		5.17		28.5	
C1-Decalins	28.9		5.59		5.61		20.1		6.73		34.3	
C2-Decalins	34.9		7.24		7.74		19.3		8.74		35.3	
C3-Decalins	49.8		18.4		18.2		28.3		21.7		43.0	
C4-Decalins	29.2		11.3		8.70		20.9		12.4		22.2	
Naphthalene	40.9		4.75		4.73		27.0		5.57		61.3	
C1-Naphthalenes	120		13.6		14.3		89.7		16.9		188	
C2-Naphthalenes	186		22.6		24.9		141		24.6		239	
C3-Naphthalenes	197		25.4		28.9		126		29.4		219	
C4-Naphthalenes	122		16.2		16.3		72.0		16.9		130	
Benzothiophene	<0.1	U	<0.1	U	<0.1	U	<0.1	U	<0.1	U	<0.1	U
C1-Benzothiophenes	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U
C2-Benzothiophenes	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U
C3-Benzothiophenes	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U
C4-Benzothiophenes	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U
Biphenyl	20.1		3.17		3.30		18.2		3.30		30.0	
Acenaphthylene	1.93		0.252		0.272		1.19		0.248		2.23	
Acenaphthene	1.86		0.367		0.292		1.73		0.395		2.68	
Dibenzofuran	25.1		3.01		3.04		14.8		3.40		27.0	
Fluorene	10.9		1.68		1.72		12.8		1.79		17.6	
C1-Fluorenes	23.1		3.11		3.86		24.8		3.56		36.0	
C2-Fluorenes	54.0		8.98		8.95		44.3		9.30		71.1	
C3-Fluorenes	56.8		15.5		14.7		50.4		13.1		71.8	
Carbazole	6.27		0.853		0.896		6.13		0.941		9.41	
Anthracene	2.83		0.426		0.421		1.62		0.457		3.04	
Phenanthrene	75.0		11.2		12.2		61.2		12.1		104	
C1-Phenanthrenes/Anthracenes	137		23.7		25.6		107		25.6		175	
C2-Phenanthrenes/Anthracenes	149		28.3		30.2		102		31.3		172	
C3-Phenanthrenes/Anthracenes	126		20.2		21.4		74.3		21.8		139	
C4-Phenanthrenes/Anthracenes	46.4		28.7		25.0		68.8		30.7		171	
Dibenzothiophene	10.3		1.80		1.91		9.17		1.94		14.5	
C1-Dibenzothiophenes	24.1		4.35		4.70		19.3		4.82		30.7	
C2-Dibenzothiophenes	39.9		7.94		8.34		25.5		8.61		42.5	
C3-Dibenzothiophenes	23.7		6.80		6.59		17.5		6.59		34.0	
C4-Dibenzothiophenes	12.6		3.35		2.69		8.15		2.94		10.2	
Fluoranthene	23.2		3.92		4.01		11.7		4.45		23.2	
Pyrene	29.5		5.08		5.22		15.8		5.69		28.0	
C1-Fluoranthenes/Pyrenes	88.1		15.5		14.4		51.5		15.5		98.2	
C2-Fluoranthenes/Pyrenes	99.0		14.2		15.1		61.5		16.6		104	
C3-Fluoranthenes/Pyrenes	63.8		11.9		12.8		34.4		12.7		67.4	
C4-Fluoranthenes/Pyrenes	41.9		8.67		7.61		21.6		8.65		33.6	
Naphthobenzothiophene	40.2		6.01		6.44		21.6		7.40		36.5	
C1-Naphthobenzothiophenes	46.3		9.01		9.05		28.8		9.71		44.3	
C2-Naphthobenzothiophenes	37.7		9.42		9.55		23.3		9.90		33.4	
C3-Naphthobenzothiophenes	20.6		5.78		6.51		14.2		6.59		19.7	
C4-Naphthobenzothiophenes	7.26		2.29		2.19		5.84		2.45		7.53	
Benz(a)anthracene	9.29		1.30		1.32		4.08		1.43		7.88	
Chrysene/Triphenylene	43.3		8.35		8.29		29.3		8.92		46.8	
C1-Chrysenes	58.8		10.8		11.6		37.8		11.5		63.2	
C2-Chrysenes	53.8		10.0		10.6		36.6		10.5		57.1	
C3-Chrysenes	34.0		6.61		6.99		23.5		6.53		34.5	
C4-Chrysenes	<0.2	U	2.61		2.67		11.6		2.63		16.2	
Benzo(b)fluoranthene	32.7		5.65		5.83		21.1		6.11		35.1	
Benzo(k,j)fluoranthene	5.08		0.924		0.85		2.66		0.881		4.72	
Benzo(a)fluoranthene	<0.1	U	<0.1	U	<0.1	U	<0.1	U	<0.1	U	<0.1	U
Benzo(e)pyrene	26.5		4.98		5.26		21.1		5.35		31.7	
Benzo(a)pyrene	12.4		2.24		2.28		6.85		2.32		13.1	
Perylene	229		39.9		39.2		184		46.8		256	
Indeno(1,2,3-c,d)pyrene	6.95		1.12		1.11		4.45		1.18		<0.1	U
Dibenzo(a,h)anthracene	2.99		0.225		0.482		2.55		0.586		3.93	
C1-Dibenzo(a,h)anthracenes	<0.1	U	<0.1	U	<0.1	U	<0.1	U	<0.1	U	<0.1	U
C2-Dibenzo(a,h)anthracenes	<0.1	U	<0.1	U	<0.1	U	<0.1	U	<0.1	U	<0.1	U
C3-Dibenzo(a,h)anthracenes	<0.1	U	<0.1	U	<0.1	U	<0.1	U	<0.1	U	<0.1	U
Benzo(g,h,i)perylene	19.5		3.39		3.54		19.3		3.56		26.4	
Total PAHs	2707		493		502		1922		539		3255	

Kinnetic Labs - Harrison Bay
Polycyclic Aromatic Hydrocarbon Data
Client Submitted Samples

Laboratory ID	RCA1041.D		RCA1042.D		RCA1043.D		RCA1044.D		RCA1045.D		RCA1046.D	
Sample ID	HB18-PAM-S2-1		HB18-PAM-S3-1		HB18-PAM-S3-2		HB18-PAM-S6-1		HB18-PAM-S8-1		HB18-PAM-S11-1	
Matrix	Sediment		Sediment		Sediment		Sediment		Sediment		Sediment	
Collection Date	08/06/18		08/06/18		08/06/18		08/06/18		08/06/18		08/06/18	
Received Date	08/14/18		08/14/18		08/14/18		08/14/18		08/14/18		08/14/18	
Extraction Date	08/30/18		08/30/18		08/30/18		08/30/18		08/30/18		08/30/18	
Extraction Batch	ENV3865		ENV3865		ENV3865		ENV3865		ENV3865		ENV3865	
Date Acquired	9/5/18 6:52		9/5/18 9:10		9/5/18 10:19		9/5/18 11:29		9/5/18 12:38		9/5/18 13:48	
Method	B&B SOP1006		B&B SOP1006		B&B SOP1006		B&B SOP1006		B&B SOP1006		B&B SOP1006	
Sample Dry Weight (g)	15.05		15.01		15.02		15.01		15.02		15.00	
Sample Wet Weight (g)	27.12		20.56		19.86		29.51		20.75		29.13	
% Dry	55		73		76		51		72		51	
% Moisture	45		27		24		49		28		49	
% Lipid (dry)	NA		NA		NA		NA		NA		NA	
% Lipid (wet)	NA		NA		NA		NA		NA		NA	
Dilution	1X		1X		1X		1X		1X		1X	
Target Compounds	Su. Corrected Conc. (ng/dry g)	Q	Su. Corrected Conc. (ng/dry g)	Q	Su. Corrected Conc. (ng/dry g)	Q	Su. Corrected Conc. (ng/dry g)	Q	Su. Corrected Conc. (ng/dry g)	Q	Su. Corrected Conc. (ng/dry g)	Q
Individual Alkyl Isomers and Hopanes												
2-Methylnaphthalene	101		11.5		11.9		77.1		14.3		160	
1-Methylnaphthalene	75.9		8.54		9.14		55.2		9.30		96.8	
2,6-Dimethylnaphthalene	28.1		3.30		3.73		23.2		3.81		39.6	
1,6,7-Trimethylnaphthalene	21.8		2.63		2.97		14.4		3.17		25.5	
1-Methylfluorene	16.0		2.43		2.55		18.4		2.66		26.7	
4-Methyldibenzothiophene	17.0		3.23		3.48		13.7		3.56		21.7	
2/3-Methyldibenzothiophene	9.40		1.62		1.74		8.11		1.78		12.7	
1-Methyldibenzothiophene	4.65		0.753		0.831		2.93		0.862		5.06	
3-Methylphenanthrene	32.8		5.01		5.48		28.7		5.50		46.0	
2-Methylphenanthrene	42.8		6.61		7.18		35.5		7.26		57.4	
2-Methylanthracene	3.47		0.405		0.422		1.26		0.481		2.86	
4/9-Methylphenanthrene	50.8		7.93		8.68		38.6		8.64		66.2	
1-Methylphenanthrene	47.7		10.9		11.5		34.8		11.4		55.1	
3,6-Dimethylphenanthrene	8.67		1.45		1.58		6.93		1.59		11.7	
Retene	398		40.0		39.0		88.6		44.4		263	
2-Methylfluoranthene	11.7		1.87		1.96		6.82		2.13		12.7	
Benzo(b)fluorene	14.3		2.66		2.65		10.3		2.88		18.5	
C29-Hopane	29.5		5.01		5.09		14.3		5.81		41.2	
18a-Oleanane	<0.6	U	<0.6	U	<0.6	U	<0.6	U	<0.6	U	<0.6	U
C30-Hopane	59.0		9.66		9.34		26.8		10.2		47.1	
C20-TAS	5.06		1.12		1.11		2.74		1.15		4.64	
C21-TAS	4.78		1.36		1.07		2.50		1.28		4.04	
C26(20S)-TAS	5.03		0.99		1.00		3.50		1.14		5.16	
C26(20R)/C27(20S)-TAS	21.0		3.52		3.44		11.5		3.86		19.8	
C28(20S)-TAS	17.6		2.86		2.97		8.63		3.35		12.2	
C27(20R)-TAS	21.0		3.11		3.11		12.2		3.75		13.1	
C28(20R)-TAS	13.4		2.11		2.14		6.42		2.37		8.72	
Surrogate Recovery (%)												
Naphthalene-d8	83		81		80		79		77		86	
Acenaphthene-d10	98		91		89		94		88		105	
Phenanthrene-d10	90		91		90		89		90		92	
Chrysene-d12	96		94		91		90		93		94	
Perylene-d12	97		91		87		93		78		99	

Kinnetic Labs - Harrison Bay
Polycyclic Aromatic Hydrocarbon Data
Client Submitted Samples

Laboratory ID	RCA1047.D
Sample ID	HB18-PAM-S4-1
Matrix	Sediment
Collection Date	08/06/18
Received Date	08/14/18
Extraction Date	08/30/18
Extraction Batch	ENV3865
Date Acquired	9/5/18 14:57
Method	B&B SOP1006
Sample Dry Weight (g)	15.01
Sample Wet Weight (g)	21.60
% Dry	69
% Moisture	31
% Lipid (dry)	NA
% Lipid (wet)	NA
Dilution	1X

Target Compounds	Su. Corrected Conc. (ng/dry g)	Q
cis/trans Decalin	2.88	
C1-Decalins	3.13	
C2-Decalins	4.97	
C3-Decalins	8.10	
C4-Decalins	4.10	
Naphthalene	2.34	
C1-Naphthalenes	6.76	
C2-Naphthalenes	10.8	
C3-Naphthalenes	13.6	
C4-Naphthalenes	7.57	
Benzothiophene	<0.1	U
C1-Benzothiophenes	<0.2	U
C2-Benzothiophenes	<0.2	U
C3-Benzothiophenes	<0.2	U
C4-Benzothiophenes	<0.2	U
Biphenyl	1.95	
Acenaphthylene	0.082	
Acenaphthene	0.159	
Dibenzofuran	1.55	
Fluorene	0.942	
C1-Fluorenes	1.87	
C2-Fluorenes	5.09	
C3-Fluorenes	9.36	
Carbazole	0.511	
Anthracene	0.207	
Phenanthrene	6.06	
C1-Phenanthrenes/Anthracenes	14.5	
C2-Phenanthrenes/Anthracenes	17.7	
C3-Phenanthrenes/Anthracenes	10.5	
C4-Phenanthrenes/Anthracenes	13.7	
Dibenzothiophene	1.14	
C1-Dibenzothiophenes	2.61	
C2-Dibenzothiophenes	4.86	
C3-Dibenzothiophenes	4.09	
C4-Dibenzothiophenes	1.79	
Fluoranthene	2.16	
Pyrene	2.94	
C1-Fluoranthenes/Pyrenes	9.21	
C2-Fluoranthenes/Pyrenes	9.87	
C3-Fluoranthenes/Pyrenes	5.93	
C4-Fluoranthenes/Pyrenes	3.70	
Naphthobenzothiophene	4.16	
C1-Naphthobenzothiophenes	6.00	
C2-Naphthobenzothiophenes	6.44	
C3-Naphthobenzothiophenes	4.45	
C4-Naphthobenzothiophenes	1.59	
Benz(a)anthracene	0.69	
Chrysene/Triphenylene	5.01	
C1-Chrysenes	7.00	
C2-Chrysenes	5.59	
C3-Chrysenes	3.71	
C4-Chrysenes	<0.2	U
Benzo(b)fluoranthene	3.54	
Benzo(k,j)fluoranthene	0.505	
Benzo(a)fluoranthene	<0.1	U
Benzo(e)pyrene	3.15	
Benzo(a)pyrene	1.34	
Perylene	21.9	
Indeno(1,2,3-c,d)pyrene	0.653	
Dibenzo(a,h)anthracene	0.307	
C1-Dibenzo(a,h)anthracenes	<0.1	U
C2-Dibenzo(a,h)anthracenes	<0.1	U
C3-Dibenzo(a,h)anthracenes	<0.1	U
Benzo(g,h,i)perylene	2.04	
Total PAHs	275	

Kinnetic Labs - Harrison Bay
Polycyclic Aromatic Hydrocarbon Data
Client Submitted Samples

Laboratory ID	RCA1047.D
Sample ID	HB18-PAM-S4-1
Matrix	Sediment
Collection Date	08/06/18
Received Date	08/14/18
Extraction Date	08/30/18
Extraction Batch	ENV3865
Date Acquired	9/5/18 14:57
Method	B&B SOP1006
Sample Dry Weight (g)	15.01
Sample Wet Weight (g)	21.60
% Dry	69
% Moisture	31
% Lipid (dry)	NA
% Lipid (wet)	NA
Dilution	1X

Target Compounds	Su. Corrected Conc. (ng/dry g)	Q
Individual Alkyl Isomers and Hopa		
2-Methylnaphthalene	5.82	
1-Methylnaphthalene	3.78	
2,6-Dimethylnaphthalene	1.51	
1,6,7-Trimethylnaphthalene	1.39	
1-Methylfluorene	1.37	
4-Methyldibenzothiophene	1.96	
2/3-Methyldibenzothiophene	0.987	
1-Methyldibenzothiophene	0.414	
3-Methylphenanthrene	2.77	
2-Methylphenanthrene	3.75	
2-Methylanthracene	0.180	
4/9-Methylphenanthrene	4.25	
1-Methylphenanthrene	7.82	
3,6-Dimethylphenanthrene	0.892	
Retene	15.1	
2-Methylfluoranthene	1.08	
Benzo(b)fluorene	1.48	
C29-Hopane	3.55	
18a-Oleanane	<0.6	U
C30-Hopane	5.43	
C20-TAS	0.624	
C21-TAS	0.640	
C26(20S)-TAS	0.415	J
C26(20R)/C27(20S)-TAS	1.85	
C28(20S)-TAS	1.57	
C27(20R)-TAS	1.86	
C28(20R)-TAS	1.23	

Surrogate Recovery (%)	
Naphthalene-d8	81
Acenaphthene-d10	89
Phenanthrene-d10	90
Chrysene-d12	94
Perylene-d12	92

Kinnetic Labs - Harrison Bay
Polycyclic Aromatic Hydrocarbon Data
Method Blank Report

Laboratory ID	ENV3865A.D
Sample ID	Method Blank
Matrix	Sediment
Collection Date	NA
Received Date	NA
Extraction Date	08/30/18
Extraction Batch	ENV3865
Date Acquired	9/4/18 23:56
Method	B&B SOP1006
Sample Dry Weight (g)	15.04
Sample Wet Weight (g)	NA
% Dry	NA
% Moisture	NA
% Lipid (dry)	NA
% Lipid (wet)	NA
Dilution	1X

Target Compounds	Su. Corrected Conc. (ng/dry g)	Q	3X MDL	Actual MDL
cis/trans Decalin	<0.1	U	0.395	0.132
C1-Decalins	<0.3	U	0.790	0.263
C2-Decalins	<0.3	U	0.790	0.263
C3-Decalins	<0.3	U	0.790	0.263
C4-Decalins	<0.3	U	0.790	0.263
Naphthalene	<0.3	U	1.03	0.342
C1-Naphthalenes	<1	U	3.09	1.03
C2-Naphthalenes	<0.7	U	2.05	0.684
C3-Naphthalenes	<0.7	U	2.05	0.684
C4-Naphthalenes	<0.7	U	2.05	0.684
Benzothiophene	<0.1	U	0.270	0.090
C1-Benzothiophenes	<0.2	U	0.540	0.180
C2-Benzothiophenes	<0.2	U	0.540	0.180
C3-Benzothiophenes	<0.2	U	0.540	0.180
C4-Benzothiophenes	<0.2	U	0.540	0.180
Biphenyl	<0.3	U	0.881	0.294
Acenaphthylene	<0	U	0.122	0.041
Acenaphthene	<0.1	U	0.308	0.103
Dibenzofuran	<0.2	U	0.613	0.204
Fluorene	<0.2	U	0.550	0.183
C1-Fluorenes	<0.4	U	1.10	0.367
C2-Fluorenes	<0.4	U	1.10	0.367
C3-Fluorenes	<0.4	U	1.10	0.367
Carbazole	<0.1	U	0.449	0.150
Anthracene	<0.1	U	0.346	0.115
Phenanthrene	0.072	J	0.624	0.208
C1-Phenanthrenes/Anthracenes	<0.1	U	0.232	0.077
C2-Phenanthrenes/Anthracenes	<0.3	U	0.855	0.285
C3-Phenanthrenes/Anthracenes	<0.3	U	0.855	0.285
C4-Phenanthrenes/Anthracenes	<0.3	U	0.855	0.285
Dibenzothiophene	<0.1	U	0.348	0.116
C1-Dibenzothiophenes	<0.1	U	0.191	0.064
C2-Dibenzothiophenes	<0.2	U	0.696	0.232
C3-Dibenzothiophenes	<0.2	U	0.696	0.232
C4-Dibenzothiophenes	<0.2	U	0.696	0.232
Fluoranthene	<0.3	U	0.998	0.333
Pyrene	<0.1	U	0.408	0.136
C1-Fluoranthenes/Pyrenes	<0.5	U	1.41	0.469
C2-Fluoranthenes/Pyrenes	<0.5	U	1.41	0.469
C3-Fluoranthenes/Pyrenes	<0.5	U	1.41	0.469
C4-Fluoranthenes/Pyrenes	<0.5	U	1.41	0.469
Naphthobenzothiophene	<0.1	U	0.383	0.128
C1-Naphthobenzothiophenes	<0.3	U	0.767	0.256
C2-Naphthobenzothiophenes	<0.3	U	0.767	0.256
C3-Naphthobenzothiophenes	<0.3	U	0.767	0.256
C4-Naphthobenzothiophenes	<0.3	U	0.767	0.256
Benz(a)anthracene	<0.2	U	0.577	0.192
Chrysene/Triphenylene	<0.1	U	0.347	0.116
C1-Chrysenes	<0.2	U	0.695	0.232
C2-Chrysenes	<0.2	U	0.695	0.232
C3-Chrysenes	<0.2	U	0.695	0.232
C4-Chrysenes	<0.2	U	0.695	0.232
Benzo(b)fluoranthene	<0.2	U	0.609	0.203
Benzo(k,j)fluoranthene	<0.1	U	0.294	0.098
Benzo(a)fluoranthene	<0.1	U	0.294	0.098
Benzo(e)pyrene	<0.2	U	0.530	0.177
Benzo(a)pyrene	<0.1	U	0.304	0.101
Perylene	<1.3	U	3.80	1.27
Indeno(1,2,3-c,d)pyrene	<0.1	U	0.151	0.050
Dibenzo(a,h)anthracene	<0.1	U	0.193	0.064
C1-Dibenzo(a,h)anthracenes	<0.1	U	0.386	0.129
C2-Dibenzo(a,h)anthracenes	<0.1	U	0.386	0.129
C3-Dibenzo(a,h)anthracenes	<0.1	U	0.386	0.129
Benzo(g,h,i)perylene	<0.1	U	0.264	0.088
Total PAHs	0.072			

Kinnetic Labs - Harrison Bay
Polycyclic Aromatic Hydrocarbon Data
Method Blank Report

Laboratory ID	ENV3865A.D
Sample ID	Method Blank
Matrix	Sediment
Collection Date	NA
Received Date	NA
Extraction Date	08/30/18
Extraction Batch	ENV3865
Date Acquired	9/4/18 23:56
Method	B&B SOP1006
Sample Dry Weight (g)	15.04
Sample Wet Weight (g)	NA
% Dry	NA
% Moisture	NA
% Lipid (dry)	NA
% Lipid (wet)	NA
Dilution	1X

Target Compounds	Su. Corrected Conc. (ng/dry g)	Q	3X MDL	Actual MDL
Individual Alkyl Isomers and Hopanes				
2-Methylnaphthalene	<1.3	U	3.89	1.30
1-Methylnaphthalene	<0.5	U	1.64	0.546
2,6-Dimethylnaphthalene	<0.3	U	0.782	0.261
1,6,7-Trimethylnaphthalene	<0.1	U	0.382	0.127
1-Methylfluorene	<0.2	U	0.574	0.191
4-Methyldibenzothiophene	<0.1	U	0.274	0.091
2/3-Methyldibenzothiophene	<0.1	U	0.274	0.091
1-Methyldibenzothiophene	<0.1	U	0.274	0.091
3-Methylphenanthrene	<0.1	U	0.291	0.097
2-Methylphenanthrene	<0.1	U	0.291	0.097
2-Methylanthracene	<0.1	U	0.291	0.097
4/9-Methylphenanthrene	<0.1	U	0.291	0.097
1-Methylphenanthrene	<0.1	U	0.291	0.097
3,6-Dimethylphenanthrene	<0.1	U	0.329	0.110
Retene	<0.2	U	0.694	0.231
2-Methylfluoranthene	<0.2	U	0.668	0.223
Benzo(b)fluorene	<0.1	U	0.374	0.125
C29-Hopane	<0.6	U	1.72	0.575
18a-Oleanane	<0.6	U	1.72	0.575
C30-Hopane	<0.6	U	1.72	0.575
C20-TAS	<0.6	U	1.72	0.575
C21-TAS	<0.6	U	1.72	0.575
C26(20S)-TAS	<0.6	U	1.72	0.575
C26(20R)/C27(20S)-TAS	<0.6	U	1.72	0.575
C28(20S)-TAS	<0.6	U	1.72	0.575
C27(20R)-TAS	<0.6	U	1.72	0.575
C28(20R)-TAS	<0.6	U	1.72	0.575

Surrogate Recovery (%)	
Naphthalene-d8	89
Acenaphthene-d10	89
Phenanthrene-d10	91
Chrysene-d12	93
Perylene-d12	101

Kinnetic Labs - Harrison Bay
Polycyclic Aromatic Hydrocarbon Data
Blank Spike Report

Laboratory ID	ENV3865C.D
Sample ID	Blank Spike
Matrix	Sediment
Collection Date	NA
Received Date	NA
Extraction Date	08/30/18
Extraction Batch	ENV3865
Date Acquired	9/5/18 2:15
Method	B&B SOP1006
Sample Dry Weight (g)	1.00
Sample Wet Weight (g)	NA
% Dry	NA
% Moisture	NA
% Lipid (dry)	NA
% Lipid (wet)	NA
Dilution	1X

Target Compounds	Su. Corrected Conc. (ng/dry g)	Q	Recovery (%)	Q	Spike amount (ng)
cis/trans Decalin	102		102		100
C1-Decalins	NA				
C2-Decalins	NA				
C3-Decalins	NA				
C4-Decalins	NA				
Naphthalene	94.2		94		100
C1-Naphthalenes	NA				
C2-Naphthalenes	NA				
C3-Naphthalenes	NA				
C4-Naphthalenes	NA				
Benzothiophene	99.0		99		100
C1-Benzothiophenes	NA				
C2-Benzothiophenes	NA				
C3-Benzothiophenes	NA				
C4-Benzothiophenes	NA				
Biphenyl	138		138		100
Acenaphthylene	102		101		100
Acenaphthene	105		104		100
Dibenzofuran	103		102		100
Fluorene	104		104		100
C1-Fluorenes	NA				
C2-Fluorenes	NA				
C3-Fluorenes	NA				
Carbazole	97.0		96		101
Anthracene	99.2		99		100
Phenanthrene	104		104		100
C1-Phenanthrenes/Anthracenes	NA				
C2-Phenanthrenes/Anthracenes	NA				
C3-Phenanthrenes/Anthracenes	NA				
C4-Phenanthrenes/Anthracenes	NA				
Dibenzothiophene	95.3		95		100
C1-Dibenzothiophenes	NA				
C2-Dibenzothiophenes	NA				
C3-Dibenzothiophenes	NA				
C4-Dibenzothiophenes	NA				
Fluoranthene	112		112		100
Pyrene	111		111		100
C1-Fluoranthenes/Pyrenes	NA				
C2-Fluoranthenes/Pyrenes	NA				
C3-Fluoranthenes/Pyrenes	NA				
C4-Fluoranthenes/Pyrenes	NA				
Naphthobenzothiophene	112		112		101
C1-Naphthobenzothiophenes	NA				
C2-Naphthobenzothiophenes	NA				
C3-Naphthobenzothiophenes	NA				
C4-Naphthobenzothiophenes	NA				
Benz(a)anthracene	112		112		100
Chrysene/Triphenylene	110		109		100
C1-Chrysenes	NA				
C2-Chrysenes	NA				
C3-Chrysenes	NA				
C4-Chrysenes	NA				
Benzo(b)fluoranthene	107		107		100
Benzo(k,j)fluoranthene	105		105		100
Benzo(a)fluoranthene	NA				
Benzo(e)pyrene	113		113		100
Benzo(a)pyrene	118		118		100
Perylene	110		110		100
Indeno(1,2,3-c,d)pyrene	116		116		100
Dibenzo(a,h)anthracene	112		112		100
C1-Dibenzo(a,h)anthracenes	NA				
C2-Dibenzo(a,h)anthracenes	NA				
C3-Dibenzo(a,h)anthracenes	NA				
Benzo(g,h,i)perylene	119		119		100
Average Recovery (%)			110		

Kinnetic Labs - Harrison Bay
Polycyclic Aromatic Hydrocarbon Data
Blank Spike Report

Laboratory ID	ENV3865C.D
Sample ID	Blank Spike
Matrix	Sediment
Collection Date	NA
Received Date	NA
Extraction Date	08/30/18
Extraction Batch	ENV3865
Date Acquired	9/5/18 2:15
Method	B&B SOP1006
Sample Dry Weight (g)	1.00
Sample Wet Weight (g)	NA
% Dry	NA
% Moisture	NA
% Lipid (dry)	NA
% Lipid (wet)	NA
Dilution	1X

Target Compounds	Su. Corrected Conc. (ng/dry g)	Q	Recovery (%)	Q	Spike amount (ng)
Individual Alkyl Isomers and Hopanes					
2-Methylnaphthalene	99.2		99		100
1-Methylnaphthalene	101		101		100
2,6-Dimethylnaphthalene	101		100		100
1,6,7-Trimethylnaphthalene	108		108		100
1-Methylfluorene	109		108		100
4-Methyldibenzothiophene	99.3		99		101
2/3-Methyldibenzothiophene	NA				
1-Methyldibenzothiophene	NA				
3-Methylphenanthrene	NA				
2-Methylphenanthrene	NA				
2-Methylanthracene	NA				
4/9-Methylphenanthrene	NA				
1-Methylphenanthrene	187		186	*	100
3,6-Dimethylphenanthrene	113		112		100
Retene	113		113		100
2-Methylfluoranthene	114		113		100
Benzo(b)fluorene	109		108		101
C29-Hopane	NA				
18a-Oleanane	NA				
C30-Hopane	116		116		100
C20-TAS	NA				
C21-TAS	NA				
C26(20S)-TAS	NA				
C26(20R)/C27(20S)-TAS	NA				
C28(20S)-TAS	NA				
C27(20R)-TAS	NA				
C28(20R)-TAS	NA				

Surrogate Recovery (%)	
Naphthalene-d8	88
Acenaphthene-d10	91
Phenanthrene-d10	92
Chrysene-d12	95
Perylene-d12	95

Kinnetic Labs - Harrison Bay
Polycyclic Aromatic Hydrocarbon Data
Matrix Spike Report

Laboratory ID	RCA1041.D	ENV3865D.D	ENV3865E.D
Sample ID	HB18-PAM-S2-1	MS (HB18-PAM-S2-1)	MSD (HB18-PAM-S2-1)
Matrix	Sediment	Sediment	Sediment
Collection Date	08/06/18	08/06/18	08/06/18
Received Date	08/14/18	08/14/18	08/14/18
Extraction Date	08/30/18	08/30/18	08/30/18
Extraction Batch	ENV3865	ENV3865	ENV3865
Date Acquired	9/5/18 6:52	9/5/18 3:24	9/5/18 4:34
Method	B&B SOP1006	B&B SOP1006	B&B SOP1006
Sample Dry Weight (g)	15.05	15.05	15.02
Sample Wet Weight (g)	27.12	27.12	27.07
% Dry	55	55	55
% Moisture	45	45	45
% Lipid (dry)	NA	NA	NA
% Lipid (wet)	NA	NA	NA
Dilution	1X	1X	1X

Target Compounds	Su. Corrected Conc. (ng/dry g)	Q	Su. Corrected Conc. (ng/dry g)	Q	Recovery (%)	Q	Q1	Su. Corrected Conc. (ng/dry g)	Q	Recovery (%)	Q	Q1	RPD (%)	Q	Spike Amount (ng)
cis/trans Decalin	20.1		26.6		98		Y	24.5		66		Y	8		100
C1-Decalins	28.9		NA					NA							
C2-Decalins	34.9		NA					NA							
C3-Decalins	49.8		NA					NA							
C4-Decalins	29.2		NA					NA							
Naphthalene	40.9		48.1		108		Y	45.4		66		Y	6		100
C1-Naphthalenes	120		NA					NA							
C2-Naphthalenes	186		NA					NA							
C3-Naphthalenes	197		NA					NA							
C4-Naphthalenes	122		NA					NA							
Benzothiophene	<0.1	U	6.6		99			6.5		97			2		100
C1-Benzothiophenes	<0.2	U	NA					NA							
C2-Benzothiophenes	<0.2	U	NA					NA							
C3-Benzothiophenes	<0.2	U	NA					NA							
C4-Benzothiophenes	<0.2	U	NA					NA							
Biphenyl	20.1		26.0		88		Y	25.4		80		Y	2		100
Acenaphthylene	1.93		8.89		105			8.7		102			2		100
Acenaphthene	1.86		7.87		90			8.0		92			2		100
Dibenzofuran	25.1		28.9		57		Y	28.7		53		Y	1		100
Fluorene	10.9		16.4		82			16.4		82			0		100
C1-Fluorenes	23.1		NA					NA							
C2-Fluorenes	54.0		NA					NA							
C3-Fluorenes	56.8		NA					NA							
Carbazole	6.27		13.0		100			13.0		100			0		101
Anthracene	2.83		9.26		97			9.32		97			1		100
Phenanthrene	75.0		79.2		63		Y	77.7		38		Y	2		100
C1-Phenanthrenes/Anthracenes	137		NA					NA							
C2-Phenanthrenes/Anthracenes	149		NA					NA							
C3-Phenanthrenes/Anthracenes	126		NA					NA							
C4-Phenanthrenes/Anthracenes	46.4		NA					NA							
Dibenzothiophene	10.3		16.5		93			16.1		88			2		100
C1-Dibenzothiophenes	24.1		NA					NA							
C2-Dibenzothiophenes	39.9		NA					NA							
C3-Dibenzothiophenes	23.7		NA					NA							
C4-Dibenzothiophenes	12.6		NA					NA							
Fluoranthene	23.2		30.6		110		Y	30.1		102		Y	2		100
Pyrene	29.5		36.7		109		Y	36.2		100		Y	1		100
C1-Fluoranthenes/Pyrenes	88.1		NA					NA							
C2-Fluoranthenes/Pyrenes	99.0		NA					NA							
C3-Fluoranthenes/Pyrenes	63.8		NA					NA							
C4-Fluoranthenes/Pyrenes	41.9		NA					NA							
Naphthobenzothiophene	40.2		50.0		146		Y	51.1		161		Y	2		101
C1-Naphthobenzothiophenes	46.3		NA					NA							
C2-Naphthobenzothiophenes	37.7		NA					NA							
C3-Naphthobenzothiophenes	20.6		NA					NA							
C4-Naphthobenzothiophenes	7.26		NA					NA							
Benz(a)anthracene	9.29		15.6		96			15.5		93			1		100
Chrysene/Triphenylene	43.3		47.4		61		Y	47.0		55		Y	1		100
C1-Chrysenes	58.8		NA					NA							
C2-Chrysenes	53.8		NA					NA							
C3-Chrysenes	34.0		NA					NA							
C4-Chrysenes	<0.2	U	NA					NA							
Benzo(b)fluoranthene	32.7		36.4		55		Y	35.3		37		Y	3		100
Benzo(k,j)fluoranthene	5.08		9.28		63			9.3		63			0		100
Benzo(a)fluoranthene	<0.1	U	NA					NA							
Benzo(e)pyrene	26.5		32.0		81		Y	31.0		66		Y	3		100
Benzo(a)pyrene	12.4		18.8		96			18.1		85			4		100
Perylene	229		214		-236		Y	206		-357		Y	4		100
Indeno(1,2,3-c,d)pyrene	6.95		13.5		99			13.1		93			3		100
Dibenzo(a,h)anthracene	2.99		9.91		104			9.37		96			6		100
C1-Dibenzo(a,h)anthracenes	<0.1	U	NA					NA							
C2-Dibenzo(a,h)anthracenes	<0.1	U	NA					NA							
C3-Dibenzo(a,h)anthracenes	<0.1	U	NA					NA							
Benzo(g,h,i)perylene	19.5		26.0		97		Y	26.0		97		Y	0		100
Average Recovery (%)					82					67					

Kinnetic Labs - Harrison Bay
Polycyclic Aromatic Hydrocarbon Data
Matrix Spike Report

Laboratory ID	RCA1041.D	ENV3865D.D	ENV3865E.D
Sample ID	HB18-PAM-S2-1	MS (HB18-PAM-S2-1)	MSD (HB18-PAM-S2-1)
Matrix	Sediment	Sediment	Sediment
Collection Date	08/06/18	08/06/18	08/06/18
Received Date	08/14/18	08/14/18	08/14/18
Extraction Date	08/30/18	08/30/18	08/30/18
Extraction Batch	ENV3865	ENV3865	ENV3865
Date Acquired	9/5/18 6:52	9/5/18 3:24	9/5/18 4:34
Method	B&B SOP1006	B&B SOP1006	B&B SOP1006
Sample Dry Weight (g)	15.05	15.05	15.02
Sample Wet Weight (g)	27.12	27.12	27.07
% Dry	55	55	55
% Moisture	45	45	45
% Lipid (dry)	NA	NA	NA
% Lipid (wet)	NA	NA	NA
Dilution	1X	1X	1X

Target Compounds	Su. Corrected Conc. (ng/dry g)	Q	Su. Corrected Conc. (ng/dry g)	Q	Recovery (%)	Q	Q1	Su. Corrected Conc. (ng/dry g)	Q	Recovery (%)	Q	Q1	RPD (%)	Q	Spike Amount (ng)
Individual Alkyl Isomers and Hopanes															
2-Methylnaphthalene	101		112		169		Y	110		124		Y	3		100
1-Methylnaphthalene	75.9		74.4		-23		Y	72.6		-52		Y	2		100
2,6-Dimethylnaphthalene	28.1		34.8		101		Y	34.5		94		Y	1		100
1,6,7-Trimethylnaphthalene	21.8		26.0		63		Y	27.0		77		Y	4		100
1-Methylfluorene	16.0		21.4		80		Y	21.4		80		Y	0		100
4-Methyldibenzothiophene	17.0		23.7		100		Y	23.3		94		Y	2		101
2/3-Methyldibenzothiophene	9.40		NA					NA							
1-Methyldibenzothiophene	4.65		NA					NA							
3-Methylphenanthrene	32.8		NA					NA							
2-Methylphenanthrene	42.8		NA					NA							
2-Methylanthracene	3.47		NA					NA							
4/9-Methylphenanthrene	50.8		NA					NA							
1-Methylphenanthrene	50.8		NA					NA							
3,6-Dimethylphenanthrene	8.67		16.1		111			16.0		110			0		100
Retene	398		403		70		Y	394		-70		Y	2		100
2-Methylfluoranthene	11.7		19.5		116			19.4		115			0		100
Benzo(b)fluorene	14.3		21.8		112		Y	22.0		115		Y	1		101
C29-Hopane	29.5		NA					NA							
18a-Oleanane	<0.6	U	NA					NA							
C30-Hopane	59.0		NA					NA							
C20-TAS	5.06		NA					NA							
C21-TAS	4.78		NA					NA							
C26(20S)-TAS	5.03		NA					NA							
C26(20R)/C27(20S)-TAS	21.0		NA					NA							
C28(20S)-TAS	17.6		NA					NA							
C27(20R)-TAS	21.0		NA					NA							
C28(20R)-TAS	13.4		NA					NA							

Surrogate Recovery (%)			
Naphthalene-d8	83	85	86
Acenaphthene-d10	98	99	100
Phenanthrene-d10	90	89	90
Chrysene-d12	96	95	97
Perylene-d12	97	98	99

Kinnetic Labs - Harrison Bay
Polycyclic Aromatic Hydrocarbon Data
Laboratory Duplicate Report

Laboratory ID	RCA1042.D	ENV3865F.D
Sample ID	HB18-PAM-S3-1	Dupl. (HB18-PAM-S3-1)
Matrix	Sediment	Sediment
Collection Date	08/06/18	08/06/18
Received Date	08/14/18	08/14/18
Extraction Date	08/30/18	08/30/18
Extraction Batch	ENV3865	ENV3865
Date Acquired	9/5/18 9:10	9/5/18 5:43
Method	B&B SOP1006	B&B SOP1006
Sample Dry Weight (g)	15.01	15.02
Sample Wet Weight (g)	20.56	20.57
% Dry	73	73
% Moisture	27	27
% Lipid (dry)	NA	NA
% Lipid (wet)	NA	NA
Dilution	1X	1X

Target Compounds	Su. Corrected Conc. (ng/dry g)	Q	Su. Corrected Conc. (ng/dry g)	Q	RPD %	Q	Q1	3X MDL	MDL
cis/trans Decalin	4.33		3.69		16			0.395	0.132
C1-Decalins	5.59		4.70		17			0.790	0.263
C2-Decalins	7.24		6.71		8			0.790	0.263
C3-Decalins	18.4		17.6		5			0.790	0.263
C4-Decalins	11.3		10.9		4			0.790	0.263
Naphthalene	4.75		4.89		3			1.03	0.342
C1-Naphthalenes	13.6		13.8		1			3.09	1.03
C2-Naphthalenes	22.6		23.2		3			2.05	0.684
C3-Naphthalenes	25.4		24.8		2			2.05	0.684
C4-Naphthalenes	16.2		16.1		0			2.05	0.684
Benzothiophene	<0.1	U	<0.1	U				0.270	0.090
C1-Benzothiophenes	<0.2	U	<0.2	U				0.540	0.180
C2-Benzothiophenes	<0.2	U	<0.2	U				0.540	0.180
C3-Benzothiophenes	<0.2	U	<0.2	U				0.540	0.180
C4-Benzothiophenes	<0.2	U	<0.2	U				0.540	0.180
Biphenyl	3.17		3.05		4			0.881	0.294
Acenaphthylene	0.252		0.263		4			0.122	0.041
Acenaphthene	0.367		0.384		5			0.308	0.103
Dibenzofuran	3.01		2.88		4			0.613	0.204
Fluorene	1.68		1.65		2			0.550	0.183
C1-Fluorenes	3.11		3.42		9			1.10	0.367
C2-Fluorenes	8.98		8.59		4			1.10	0.367
C3-Fluorenes	15.5		12.4		22			1.10	0.367
Carbazole	0.853		0.831		3			0.449	0.150
Anthracene	0.426		0.380		11			0.346	0.115
Phenanthrene	11.2		10.5		6			0.624	0.208
C1-Phenanthrenes/Anthracenes	23.7		23.0		3			0.232	0.077
C2-Phenanthrenes/Anthracenes	28.3		26.9		5			0.855	0.285
C3-Phenanthrenes/Anthracenes	20.2		21.5		6			0.855	0.285
C4-Phenanthrenes/Anthracenes	28.7		27.4		5			0.855	0.285
Dibenzothiophene	1.80		1.65		9			0.348	0.116
C1-Dibenzothiophenes	4.35		4.07		7			0.191	0.064
C2-Dibenzothiophenes	7.94		7.19		10			0.696	0.232
C3-Dibenzothiophenes	6.80		6.32		7			0.696	0.232
C4-Dibenzothiophenes	3.35		3.27		2			0.696	0.232
Fluoranthene	3.92		3.88		1			0.998	0.333
Pyrene	5.08		5.00		2			0.408	0.136
C1-Fluoranthenes/Pyrenes	15.5		14.7		5			1.41	0.469
C2-Fluoranthenes/Pyrenes	14.2		17.0		18			1.41	0.469
C3-Fluoranthenes/Pyrenes	11.9		12.2		3			1.41	0.469
C4-Fluoranthenes/Pyrenes	8.67		8.26		5			1.41	0.469
Naphthobenzothiophene	6.01		6.30		5			0.383	0.128
C1-Naphthobenzothiophenes	9.01		9.16		2			0.767	0.256
C2-Naphthobenzothiophenes	9.42		9.13		3			0.767	0.256
C3-Naphthobenzothiophenes	5.78		5.86		1			0.767	0.256
C4-Naphthobenzothiophenes	2.29		2.36		3			0.767	0.256
Benz(a)anthracene	1.30		1.31		1			0.577	0.192
Chrysene/Triphenylene	8.35		8.16		2			0.347	0.116
C1-Chrysenes	10.8		12.3		12			0.695	0.232
C2-Chrysenes	10.0		10.4		4			0.695	0.232
C3-Chrysenes	6.61		5.80		13			0.695	0.232
C4-Chrysenes	2.61		2.77		6			0.695	0.232
Benzo(b)fluoranthene	5.65		5.64		0			0.609	0.203
Benzo(k,j)fluoranthene	0.924		0.924		0			0.294	0.098
Benzo(a)fluoranthene	<0.1	U	<0.1	U				0.294	0.098
Benzo(e)pyrene	4.98		5.00		0			0.530	0.177
Benzo(a)pyrene	2.24		2.27		1			0.304	0.101
Perylene	39.9		42.0		5			3.80	1.27
Indeno(1,2,3-c,d)pyrene	1.12		1.11		1			0.151	0.050
Dibenzo(a,h)anthracene	0.225		0.229		2			0.193	0.064
C1-Dibenzo(a,h)anthracenes	<0.1	U	<0.1	U				0.386	0.129
C2-Dibenzo(a,h)anthracenes	<0.1	U	<0.1	U				0.386	0.129
C3-Dibenzo(a,h)anthracenes	<0.1	U	<0.1	U				0.386	0.129
Benzo(g,h,i)perylene	3.39		3.33		2			0.264	0.088
Total PAHs	493		487		1				

Kinnetic Labs - Harrison Bay
Polycyclic Aromatic Hydrocarbon Data
Laboratory Duplicate Report

Laboratory ID	RCA1042.D	ENV3865F.D
Sample ID	HB18-PAM-S3-1	Dupl. (HB18-PAM-S3-1)
Matrix	Sediment	Sediment
Collection Date	08/06/18	08/06/18
Received Date	08/14/18	08/14/18
Extraction Date	08/30/18	08/30/18
Extraction Batch	ENV3865	ENV3865
Date Acquired	9/5/18 9:10	9/5/18 5:43
Method	B&B SOP1006	B&B SOP1006
Sample Dry Weight (g)	15.01	15.02
Sample Wet Weight (g)	20.56	20.57
% Dry	73	73
% Moisture	27	27
% Lipid (dry)	NA	NA
% Lipid (wet)	NA	NA
Dilution	1X	1X

Target Compounds	Su. Corrected Conc. (ng/dry g)	Q	Su. Corrected Conc. (ng/dry g)	Q	RPD %	Q	Q1	3X MDL	MDL
Individual Alkyl Isomers and Hopanes									
2-Methylnaphthalene	11.5		11.7		2			3.89	1.30
1-Methylnaphthalene	8.54		8.62		1			1.64	0.546
2,6-Dimethylnaphthalene	3.30		3.31		0			0.782	0.261
1,6,7-Trimethylnaphthalene	2.63		2.63		0			0.382	0.127
1-Methylfluorene	2.43		2.41		1			0.574	0.191
4-Methyldibenzothiophene	3.23		3.01		7			0.274	0.091
2/3-Methyldibenzothiophene	1.62		1.54		5			0.274	0.091
1-Methyldibenzothiophene	0.753		0.691		9			0.274	0.091
3-Methylphenanthrene	5.01		4.84		3			0.291	0.097
2-Methylphenanthrene	6.61		6.42		3			0.291	0.097
2-Methylanthracene	0.405		0.412		2			0.291	0.097
4/9-Methylphenanthrene	7.93		7.56		5			0.291	0.097
1-Methylphenanthrene	10.9		10.6		2			0.291	0.097
3,6-Dimethylphenanthrene	1.45		1.46		1			0.329	0.110
Retene	40.0		38.7		3			0.694	0.231
2-Methylfluoranthene	1.87		1.88		1			0.668	0.223
Benzo(b)fluorene	2.66		2.68		1			0.374	0.125
C29-Hopane	5.01		5.91		16			1.72	0.575
18a-Oleanane	<0.6	U	<0.6	U				1.72	0.575
C30-Hopane	9.66		8.87		8			1.72	0.575
C20-TAS	1.12		0.965		15		X	1.72	0.575
C21-TAS	1.36		1.00		30		X	1.72	0.575
C26(20S)-TAS	0.992		1.04		5		X	1.72	0.575
C26(20R)/C27(20S)-TAS	3.52		3.51		0			1.72	0.575
C28(20S)-TAS	2.86		2.89		1			1.72	0.575
C27(20R)-TAS	3.11		3.16		2			1.72	0.575
C28(20R)-TAS	2.11		2.01		5			1.72	0.575

Surrogate Recovery (%)		
Naphthalene-d8	81	84
Acenaphthene-d10	91	90
Phenanthrene-d10	91	88
Chrysene-d12	94	92
Perylene-d12	91	90

Kinnetic Labs - Harrison Bay
Polycyclic Aromatic Hydrocarbon Data
Standard Reference Material Report

Laboratory ID	ENV3865B.D
Sample ID	SRM1944
Matrix	Sediment
Collection Date	NA
Received Date	NA
Extraction Date	08/30/18
Extraction Batch	ENV3865
Date Acquired	9/5/18 1:06
Method	B&B SOP1006
Sample Dry Weight (g)	0.54
Sample Wet Weight (g)	0.55
% Dry	99
% Moisture	1
% Lipid (dry)	NA
% Lipid (wet)	NA
Dilution	1X

Target Compounds	Su. Corrected	Q	Q1	RPD (%)	SRM 1944 Certified Value (ng/g)	-30% Certified Value (ng/g)	30% Certified Value (ng/g)
cis/trans Decalin	38.2						
C1-Decalins	39.9						
C2-Decalins	102						
C3-Decalins	276						
C4-Decalins	114						
Naphthalene	1009						
C1-Naphthalenes	628						
C2-Naphthalenes	1462						
C3-Naphthalenes	2079						
C4-Naphthalenes	1961						
Benzothiophene	29.7						
C1-Benzothiophenes	110						
C2-Benzothiophenes	134						
C3-Benzothiophenes	216						
C4-Benzothiophenes	135						
Biphenyl	192						
Acenaphthylene	1418						
Acenaphthene	266						
Dibenzofuran	356						
Fluorene	335						
C1-Fluorenes	417						
C2-Fluorenes	1001						
C3-Fluorenes	1621						
Carbazole	174						
Anthracene	1687						
Phenanthrene	4541			15	5270±220	3535	7137
C1-Phenanthrenes/Anthracenes	5061						
C2-Phenanthrenes/Anthracenes	6178						
C3-Phenanthrenes/Anthracenes	5039						
C4-Phenanthrenes/Anthracenes	2297						
Dibenzothiophene	567						
C1-Dibenzothiophenes	1092						
C2-Dibenzothiophenes	2189						
C3-Dibenzothiophenes	1670						
C4-Dibenzothiophenes	880						
Fluoranthene	7862			13	8920±320	6020	12012
Pyrene	7579			25	9700±420	6496	13156
C1-Fluoranthenes/Pyrenes	5249						
C2-Fluoranthenes/Pyrenes	4299						
C3-Fluoranthenes/Pyrenes	2025						
C4-Fluoranthenes/Pyrenes	1181						
Naphthobenzothiophene	2163						
C1-Naphthobenzothiophenes	1932						
C2-Naphthobenzothiophenes	1600						
C3-Naphthobenzothiophenes	1086						
C4-Naphthobenzothiophenes	370						
Benz(a)anthracene	4024			16	4720±110	3227	6279
Chrysene/Triphenylene	5456			8	5900±370	3871	8151
C1-Chrysenes	4326						
C2-Chrysenes	2668						
C3-Chrysenes	1176						
C4-Chrysenes	519						
Benzo(b)fluoranthene	4467			14	3870±420	2415	5577
Benzo(k,j)fluoranthene	3788			15	4390±640	2625	6539
Benzo(a)fluoranthene	990			24	780±120	462	1170
Benzo(e)pyrene	3334			2	3280±110	2219	4407
Benzo(a)pyrene	3518			20	4300±130	2919	5759
Perylene	900			26	1170±240	651	1833
Indeno(1,2,3-c,d)pyrene	2533			9	2780±100	1876	3744
Dibenzo(a,h)anthracene	594			33	424±69	249	641
C1-Dibenzo(a,h)anthracenes	<3.6	U					
C2-Dibenzo(a,h)anthracenes	<3.6	U					
C3-Dibenzo(a,h)anthracenes	<3.6	U					
Benzo(g,h,i)perylene	3203			12	2840±0.1	1988	3692
Total PAHs	122154						

Kinnetic Labs - Harrison Bay
Polycyclic Aromatic Hydrocarbon Data
Standard Reference Material Report

Laboratory ID	ENV3865B.D
Sample ID	SRM1944
Matrix	Sediment
Collection Date	NA
Received Date	NA
Extraction Date	08/30/18
Extraction Batch	ENV3865
Date Acquired	9/5/18 1:06
Method	B&B SOP1006
Sample Dry Weight (g)	0.54
Sample Wet Weight (g)	0.55
% Dry	99
% Moisture	1
% Lipid (dry)	NA
% Lipid (wet)	NA
Dilution	1X

Target Compounds **Individual Alkyl Isomers and Hopanes**	Su. Corrected	Q	Q1	RPD (%)	SRM 1944 Certified Value (ng/g)	-30% Certified Value (ng/g)	30% Certified Value (ng/g)
2-Methylnaphthalene	586						
1-Methylnaphthalene	341						
2,6-Dimethylnaphthalene	345						
1,6,7-Trimethylnaphthalene	227						
1-Methylfluorene	155						
4-Methyldibenzothiophene	748						
2/3-Methyldibenzothiophene	490						
1-Methyldibenzothiophene	168						
3-Methylphenanthrene	1887						
2-Methylphenanthrene	1557						
2-Methylanthracene	530						
4/9-Methylphenanthrene	1266						
1-Methylphenanthrene	1337						
3,6-Dimethylphenanthrene	603						
Retene	615						
2-Methylfluoranthene	1229						
Benzo(b)fluorene	718						
C29-Hopane	2646						
18a-Oleanane	51.1						
C30-Hopane	3575						
C20-TAS	117						
C21-TAS	82.5						
C26(20S)-TAS	122						
C26(20R)/C27(20S)-TAS	489						
C28(20S)-TAS	353						
C27(20R)-TAS	363						
C28(20R)-TAS	293						

Surrogate Recovery (%)	
Naphthalene-d8	83
Acenaphthene-d10	93
Phenanthrene-d10	90
Chrysene-d12	96
Perylene-d12	95

Kinnetic Labs - Harrison Bay
Polycyclic Aromatic Hydrocarbon Data
Standard Reference Material Report

Laboratory ID	MS70274C.D
Sample ID	PAH-WKSRM2779-4.0-012
Matrix	Gulf of Mexico Crude Oil
Collection Date	NA
Received Date	NA
Extraction Date	NA
Extraction Batch	ENV3865
Date Acquired	9/4/18 22:47
Method	B&B SOP1006
Sample Weight (mg)	4.14

Target Compounds	Su. Corrected Conc. (ng/mg)	Q	Q1	RPD (%)	SRM 2779 Certified Value (ug/g)	-20% Certified Value (ug/g)	+20% Certified Value (ug/g)
cis/trans Decalin	880						
C1-Decalins	1205						
C2-Decalins	1027						
C3-Decalins	861						
C4-Decalins	693						
Naphthalene	844			1	855 ± 46	647	1081
C1-Naphthalenes	1913						
C2-Naphthalenes	2467						
C3-Naphthalenes	1795						
C4-Naphthalenes	835						
Benzothiophene	11.4						
C1-Benzothiophenes	54.1						
C2-Benzothiophenes	51.5						
C3-Benzothiophenes	52.4						
C4-Benzothiophenes	32.4						
Biphenyl	213						
Acenaphthylene	7.16	J					
Acenaphthene	13.5						
Dibenzofuran	30.2						
Fluorene	142						
C1-Fluorenes	337						
C2-Fluorenes	380						
C3-Fluorenes	247						
Carbazole	1.23	J					
Anthracene	3.93	J		14	3.42 ± 0.59	2.26	4.81
Phenanthrene	293			13	258 ± 27	184.8	342
C1-Phenanthrenes/Anthracenes	684						
C2-Phenanthrenes/Anthracenes	799						
C3-Phenanthrenes/Anthracenes	537						
C4-Phenanthrenes/Anthracenes	248						
Dibenzothiophene	45.7			13	51.8 ± 2.1	39.8	64.7
C1-Dibenzothiophenes	152						
C2-Dibenzothiophenes	214						
C3-Dibenzothiophenes	130						
C4-Dibenzothiophenes	68.2						
Fluoranthene	3.83	J		13	4.36 ± 0.40	3.17	5.71
Pyrene	13.3			11	14.81 ± 0.39	11.5	18.2
C1-Fluoranthenes/Pyrenes	87.4						
C2-Fluoranthenes/Pyrenes	118						
C3-Fluoranthenes/Pyrenes	128						
C4-Fluoranthenes/Pyrenes	85.8						
Naphthobenzothiophene	26.1						
C1-Naphthobenzothiophenes	70.7						
C2-Naphthobenzothiophenes	101						
C3-Naphthobenzothiophenes	62.4						
C4-Naphthobenzothiophenes	26.9						
Benz(a)anthracene	8.04	J		13	7.03 ± 0.85	4.94	9.46
Chrysene/Triphenylene	53.0			11	47.4 ± 1.7	36.6	58.9
C1-Chrysenes	133						
C2-Chrysenes	158						
C3-Chrysenes	91.2						
C4-Chrysenes	65.1						
Benzo(b)fluoranthene	5.88	J		5	5.62 ± 0.34	4.22	7.15
Benzo(k,j)fluoranthene	1.18	J					
Benzo(a)fluoranthene	<10	U					
Benzo(e)pyrene	11.0			2	10.78 ± 0.60	8.144	13.7
Benzo(a)pyrene	1.81	J					
Perylene	0.506	J					
Indeno(1,2,3-c,d)pyrene	0.572	J					
Dibenzo(a,h)anthracene	0.464	J		21	0.574 ± 0.091	0.386	0.798
C1-Dibenzo(a,h)anthracenes	<10	U					
C2-Dibenzo(a,h)anthracenes	<10	U					
C3-Dibenzo(a,h)anthracenes	<10	U					
Benzo(g,h,i)perylene	2.05	J		3	2.11 ± 0.26	1.48	2.84
Total PAHs	18521						

Kinnetic Labs - Harrison Bay
Polycyclic Aromatic Hydrocarbon Data
Standard Reference Material Report

Laboratory ID	MS70274C.D
Sample ID	PAH-WKSRM2779-4.0-012
Matrix	Gulf of Mexico Crude Oil
Collection Date	NA
Received Date	NA
Extraction Date	NA
Extraction Batch	ENV3865
Date Acquired	9/4/18 22:47
Method	B&B SOP1006
Sample Weight (mg)	4.14

Target Compounds	Su. Corrected Conc. (ng/mg)	Q	RPD (%)	SRM 2779 Certified Value (ug/g)	-20% Certified Value (ug/g)	+20% Certified Value (ug/g)
Individual Alkyl Isomers and Hopanes						
2-Methylnaphthalene	1712		5	1630 ± 50	1264	2016
1-Methylnaphthalene	957		17	1140 ± 20	896	1392
2,6-Dimethylnaphthalene	535					
1,6,7-Trimethylnaphthalene	228					
1-Methylfluorene	229					
4-Methyldibenzothiophene	111					
2/3-Methyldibenzothiophene	50.2					
1-Methyldibenzothiophene	34.9					
3-Methylphenanthrene	209		2	206 ± 32	139	286
2-Methylphenanthrene	238		4	230 ± 14	173	293
2-Methylanthracene	12.6					
4/9-Methylphenanthrene	261		12	232 ± 19	170	301
1-Methylphenanthrene	168		1	169 ± 10	127	215
3,6-Dimethylphenanthrene	59.4					
Retene	8.11	J				
2-Methylfluoranthene	5.33	J				
Benzo(b)fluorene	17.2					
C29-Hopane	21.2					
18a-Oleanane	<10	U				
C30-Hopane	52.4					
C20-TAS	28.0					
C21-TAS	26.8					
C26(20S)-TAS	18.0					
C26(20R)/C27(20S)-TAS	64.8					
C28(20S)-TAS	45.1					
C27(20R)-TAS	36.9					
C28(20R)-TAS	36.6					

Surrogate Recovery (%)

Naphthalene-d8	99
Acenaphthene-d10	115
Phenanthrene-d10	91
Chrysene-d12	94
Perylene-d12	96

Mass Discrimination (m/z 192)

4/9-Methylphenanthrene from 1-Methylyphenanthrene	91%

Kinnetic Labs - Harrison Bay
Polycyclic Aromatic Hydrocarbon Data
Laboratory Control Material Report

Laboratory ID	MS70273I.D
Sample ID	PAH-WKICV-250-015
Matrix	Solution
Collection Date	NA
Received Date	NA
Extraction Date	NA
Extraction Batch	ENV3865
Date Acquired	8/31/18 5:39
Method	B&B SOP1006
Sample Volume (mL)	1.00

Target Compounds	Concentration (ng/mL)	Q	Recovery (%)	LCM Certified Conc. (ng/mL)	-20% Certified Conc. (ng/mL)	+20% Certified Conc. (ng/mL)
cis/trans Decalin	252		100	250	200	300
C1-Decalins	NA					
C2-Decalins	NA					
C3-Decalins	NA					
C4-Decalins	NA					
Naphthalene	254		101	250	200	300
C1-Naphthalenes	NA					
C2-Naphthalenes	NA					
C3-Naphthalenes	NA					
C4-Naphthalenes	NA					
Benzothiophene	254		101	251	200	301
C1-Benzothiophenes	NA					
C2-Benzothiophenes	NA					
C3-Benzothiophenes	NA					
C4-Benzothiophenes	NA					
Biphenyl	252		101	250	200	300
Acenaphthylene	251		100	250	200	300
Acenaphthene	225		90	250	200	300
Dibenzofuran	249		100	250	200	300
Fluorene	246		98	250	200	300
C1-Fluorenes	NA					
C2-Fluorenes	NA					
C3-Fluorenes	NA					
Carbazole	238		95	250	200	300
Anthracene	249		99	250	200	300
Phenanthrene	258		103	250	200	300
C1-Phenanthrenes/Anthracenes	NA					
C2-Phenanthrenes/Anthracenes	NA					
C3-Phenanthrenes/Anthracenes	NA					
C4-Phenanthrenes/Anthracenes	NA					
Dibenzothiophene	247		99	250	200	300
C1-Dibenzothiophenes	NA					
C2-Dibenzothiophenes	NA					
C3-Dibenzothiophenes	NA					
C4-Dibenzothiophenes	NA					
Fluoranthene	243		97	250	200	300
Pyrene	250		100	250	200	300
C1-Fluoranthenes/Pyrenes	NA					
C2-Fluoranthenes/Pyrenes	NA					
C3-Fluoranthenes/Pyrenes	NA					
C4-Fluoranthenes/Pyrenes	NA					
Naphthobenzothiophene	NA					
C1-Naphthobenzothiophenes	NA					
C2-Naphthobenzothiophenes	NA					
C3-Naphthobenzothiophenes	NA					
C4-Naphthobenzothiophenes	NA					
Benz(a)anthracene	236		94	250	200	300
Chrysene/Triphenylene	240		96	250	200	300
C1-Chrysenes	NA					
C2-Chrysenes	NA					
C3-Chrysenes	NA					
C4-Chrysenes	NA					
Benzo(b)fluoranthene	241		96	250	200	300
Benzo(k,j)fluoranthene	242		97	250	200	300
Benzo(a)fluoranthene	NA					
Benzo(e)pyrene	243		97	250	200	300
Benzo(a)pyrene	241		96	250	200	300
Perylene	241		96	250	200	300
Indeno(1,2,3-c,d)pyrene	243		97	250	200	300
Dibenzo(a,h)anthracene	237		95	250	200	300
C1-Dibenzo(a,h)anthracenes	NA					
C2-Dibenzo(a,h)anthracenes	NA					
C3-Dibenzo(a,h)anthracenes	NA					
Benzo(g,h,i)perylene	260		104	250	200	300

Kinnetic Labs - Harrison Bay
Polycyclic Aromatic Hydrocarbon Data
Laboratory Control Material Report

Laboratory ID	MS70273I.D
Sample ID	PAH-WKICV-250-015
Matrix	Solution
Collection Date	NA
Received Date	NA
Extraction Date	NA
Extraction Batch	ENV3865
Date Acquired	8/31/18 5:39
Method	B&B SOP1006
Sample Volume (mL)	1.00

Target Compounds **Individual Alkyl Isomers and Hopanes**	Concentration (ng/mL)	Q	Recovery (%)	LCM Certified Conc. (ng/mL)	-20% Certified Conc. (ng/mL)	+20% Certified Conc. (ng/mL)
2-Methylnaphthalene	247		98	251	201	301
1-Methylnaphthalene	250		100	250	200	301
2,6-Dimethylnaphthalene	248		99	251	201	301
1,6,7-Trimethylnaphthalene	244		98	250	200	300
1-Methylfluorene	NA					
4-Methyldibenzothiophene	NA					
2/3-Methyldibenzothiophene	NA					
1-Methyldibenzothiophene	NA					
3-Methylphenanthrene	NA					
2-Methylphenanthrene	NA					
2-Methylanthracene	NA					
4/9-Methylphenanthrene	NA					
1-Methylphenanthrene	244		97	251	200	301
3,6-Dimethylphenanthrene	NA					
Retene	NA					
2-Methylfluoranthene	NA					
Benzo(b)fluorene	NA					
C29-Hopane	NA					
18a-Oleanane	NA					
C30-Hopane	NA					
C20-TAS	NA					
C21-TAS	NA					
C26(20S)-TAS	NA					
C26(20R)/C27(20S)-TAS	NA					
C28(20S)-TAS	NA					
C27(20R)-TAS	NA					
C28(20R)-TAS	NA					

Surrogate Recovery (%)

Naphthalene-d8	248		99	250	213	288
Acenaphthene-d10	246		99	250	213	288
Phenanthrene-d10	249		100	250	213	288
Chrysene-d12	233		93	250	213	288
Perylene-d12	235		94	250	213	288

Kinnetic Labs - Harrison Bay
Polycyclic Aromatic Hydrocarbon Data
Laboratory Control Material Report

Laboratory ID	MS70274B.D	MS70274D.D	MS70274E.D
Sample ID	PAH-WKCCV-250-048	PAH-WKCCV-250-048	PAH-WKCCV-250-048
Matrix	Solution	Solution	Solution
Collection Date	NA	NA	NA
Received Date	NA	NA	NA
Extraction Date	NA	NA	NA
Extraction Batch	ENV3865	ENV3865	ENV3865
Date Acquired	9/4/18 21:38	9/5/18 8:01	9/5/18 16:07
Method	B&B SOP1006	B&B SOP1006	B&B SOP1006
Sample Volume (mL)	1.00	1.00	1.00

Target Compounds	PAH-WKCCV-250-048 Certified Conc. (ng/mL)	Concentration (ng/mL)	Q	Recovery (%)	Concentration (ng/mL)	Q	Recovery (%)	Concentration (ng/mL)	Q	Recovery (%)
cis/trans Decalin	250	276		110	277		111	275		110
C1-Decalins		NA			NA			NA		
C2-Decalins		NA			NA			NA		
C3-Decalins		NA			NA			NA		
C4-Decalins		NA			NA			NA		
Naphthalene	250	266		106	276		110	272		109
C1-Naphthalenes		NA			NA			NA		
C2-Naphthalenes		NA			NA			NA		
C3-Naphthalenes		NA			NA			NA		
C4-Naphthalenes		NA			NA			NA		
Benzothiophene	251	261		104	273		109	272		109
C1-Benzothiophenes		NA			NA			NA		
C2-Benzothiophenes		NA			NA			NA		
C3-Benzothiophenes		NA			NA			NA		
C4-Benzothiophenes		NA			NA			NA		
Biphenyl	250	268		107	269		108	269		108
Acenaphthylene	250	274		109	270		108	267		106
Acenaphthene	251	277		110	267		107	266		106
Dibenzofuran	250	267		107	264		106	263		105
Fluorene	250	268		107	262		105	262		105
C1-Fluorenes		NA			NA			NA		
C2-Fluorenes		NA			NA			NA		
C3-Fluorenes		NA			NA			NA		
Carbazole	253	239		95	248		98	251		99
Anthracene	250	245		98	253		101	257		103
Phenanthrene	250	250		100	256		102	259		103
C1-Phenanthrenes/Anthracenes		NA			NA			NA		
C2-Phenanthrenes/Anthracenes		NA			NA			NA		
C3-Phenanthrenes/Anthracenes		NA			NA			NA		
C4-Phenanthrenes/Anthracenes		NA			NA			NA		
Dibenzothiophene	250	249		99	255		102	259		103
C1-Dibenzothiophenes		NA			NA			NA		
C2-Dibenzothiophenes		NA			NA			NA		
C3-Dibenzothiophenes		NA			NA			NA		
C4-Dibenzothiophenes		NA			NA			NA		
Fluoranthene	250	257		103	261		104	258		103
Pyrene	250	257		103	259		104	261		104
C1-Fluoranthenes/Pyrenes		NA			NA			NA		
C2-Fluoranthenes/Pyrenes		NA			NA			NA		
C3-Fluoranthenes/Pyrenes		NA			NA			NA		
C4-Fluoranthenes/Pyrenes		NA			NA			NA		
Naphthobenzothiophene	252	265		105	258		102	257		102
C1-Naphthobenzothiophenes		NA			NA			NA		
C2-Naphthobenzothiophenes		NA			NA			NA		
C3-Naphthobenzothiophenes		NA			NA			NA		
C4-Naphthobenzothiophenes		NA			NA			NA		
Benz(a)anthracene	250	262		105	259		103	252		101
Chrysene/Triphenylene	250	260		104	257		103	253		101
C1-Chrysenes		NA			NA			NA		
C2-Chrysenes		NA			NA			NA		
C3-Chrysenes		NA			NA			NA		
C4-Chrysenes		NA			NA			NA		
Benzo(b)fluoranthene	250	257		103	259		103	257		103
Benzo(k,j)fluoranthene	250	256		102	257		103	257		103
Benzo(a)fluoranthene		NA			NA			NA		
Benzo(e)pyrene	250	263		105	262		104	263		105
Benzo(a)pyrene	250	258		103	256		102	258		103
Perylene	250	260		104	260		104	260		104
Indeno(1,2,3-c,d)pyrene	250	268		107	267		107	269		108
Dibenzo(a,h)anthracene	250	267		107	272		109	272		109
C1-Dibenzo(a,h)anthracenes		NA			NA			NA		
C2-Dibenzo(a,h)anthracenes		NA			NA			NA		
C3-Dibenzo(a,h)anthracenes		NA			NA			NA		
Benzo(g,h,i)perylene	250	280		112	274		109	280		112

Kinnetic Labs - Harrison Bay
Polycyclic Aromatic Hydrocarbon Data
Laboratory Control Material Report

Laboratory ID	MS70274B.D	MS70274D.D	MS70274E.D
Sample ID	PAH-WKCCV-250-048	PAH-WKCCV-250-048	PAH-WKCCV-250-048
Matrix	Solution	Solution	Solution
Collection Date	NA	NA	NA
Received Date	NA	NA	NA
Extraction Date	NA	NA	NA
Extraction Batch	ENV3865	ENV3865	ENV3865
Date Acquired	9/4/18 21:38	9/5/18 8:01	9/5/18 16:07
Method	B&B SOP1006	B&B SOP1006	B&B SOP1006
Sample Volume (mL)	1.00	1.00	1.00

Target Compounds	PAH-WKCCV-250-048 Certified Conc. (ng/mL)	Concentration (ng/mL)	Q	Recovery (%)	Concentration (ng/mL)	Q	Recovery (%)	Concentration (ng/mL)	Q	Recovery (%)
Individual Alkyl Isomers and Hopa										
2-Methylnaphthalene	251	263		105	270		108	267		106
1-Methylnaphthalene	251	270		108	271		108	268		107
2,6-Dimethylnaphthalene	251	270		108	269		107	266		106
1,6,7-Trimethylnaphthalene	251	270		108	265		106	264		105
1-Methylfluorene	250	265		106	263		105	259		104
4-Methyldibenzothiophene	251	251		100	255		102	258		103
2/3-Methyldibenzothiophene		NA			NA			NA		
1-Methyldibenzothiophene		NA			NA			NA		
3-Methylphenanthrene		NA			NA			NA		
2-Methylphenanthrene		NA			NA			NA		
2-Methylanthracene		NA			NA			NA		
4/9-Methylphenanthrene		NA			NA			NA		
1-Methylphenanthrene	251	248		99	256		102	259		103
3,6-Dimethylphenanthrene	251	256		102	258		103	259		103
Retene	251	263		105	255		102	250		100
2-Methylfluoranthene	250	263		105	258		103	258		103
Benzo(b)fluorene	252	254		101	257		102	250		99
C29-Hopane		NA			NA			NA		
18a-Oleanane		NA			NA			NA		
C30-Hopane	250	280		112	283		113	283		113
C20-TAS		NA			NA			NA		
C21-TAS		NA			NA			NA		
C26(20S)-TAS		NA			NA			NA		
C26(20R)/C27(20S)-TAS		NA			NA			NA		
C28(20S)-TAS		NA			NA			NA		
C27(20R)-TAS		NA			NA			NA		
C28(20R)-TAS		NA			NA			NA		
Surrogate Standard										
Naphthalene-d8	250	266		106	275		110	270		108
Acenaphthene-d10	250	272		109	266		106	266		106
Phenanthrene-d10	250	245		98	255		102	259		104
Chrysene-d12	250	259		104	254		101	249		100
Perylene-d12	250	258		103	256		103	257		103

Polycyclic Aromatic Hydrocarbon Total Ion Chromatograms

```
File        :P:\2018\J18346 Kinnetic Harrison Bay\PAH\ENV3865\MS70274-ENV
...          3865\RCA1041.D
Operator    : ECM(YMIAO)
Instrument  :    GCMS 7
Acquired    :   5 Sep 2018    6:52     using AcqMethod PAH-2018.M
Sample Name: HB18-PAM-S2-1
Misc Info   :
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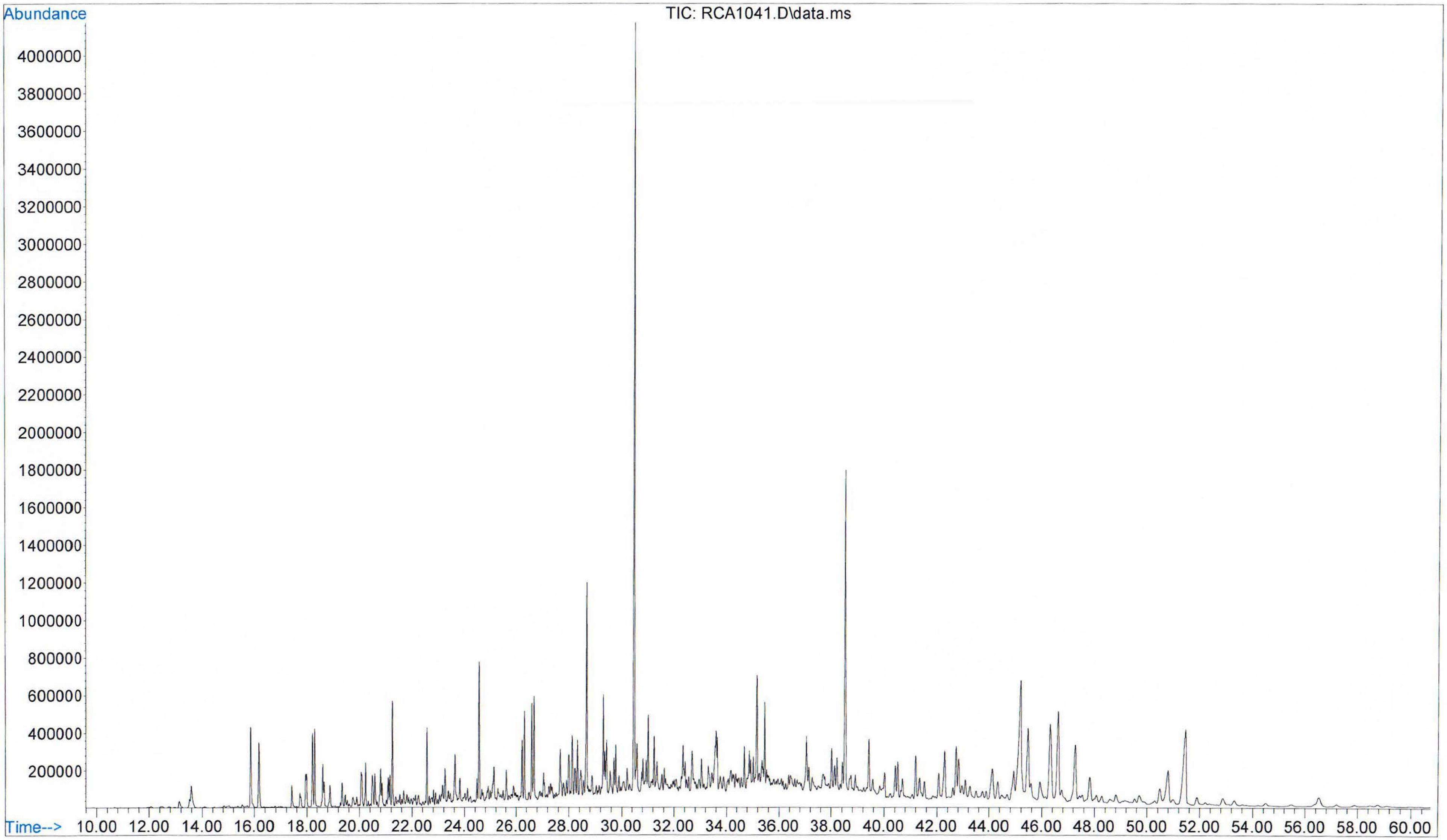

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File        :P:\2018\J18346 Kinnetic Harrison Bay\PAH\ENV3865\MS70274-ENV
...          3865\RCA1042.D
Operator    : ECM(YMIAO)
Instrument  :   GCMS 7
Acquired    :  5 Sep 2018   9:10     using AcqMethod PAH-2018.M
Sample Name: HB18-PAM-S3-1
Misc Info   :
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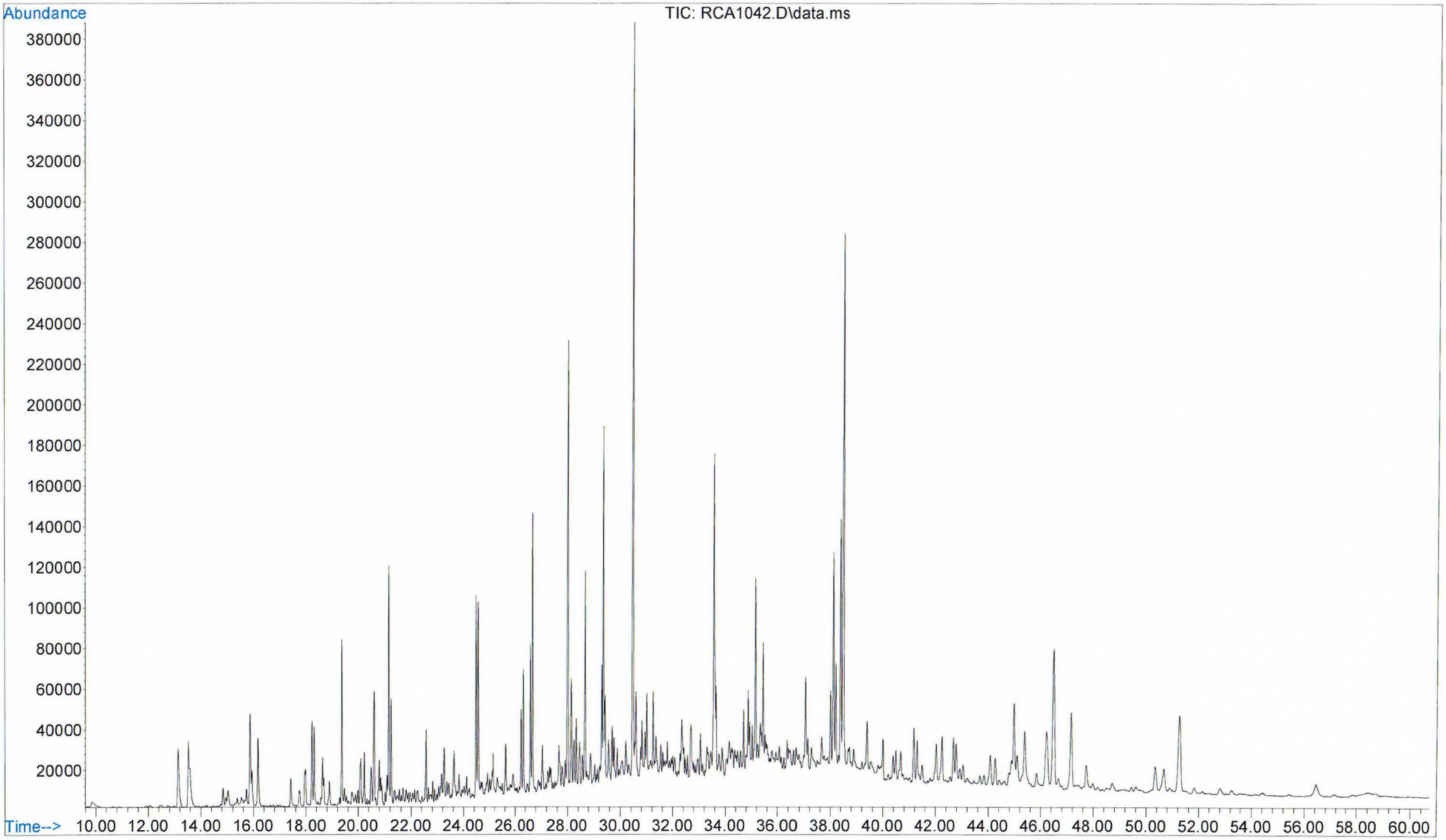

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File        :P:\2018\J18346 Kinnetic Harrison Bay\PAH\ENV3865\MS70274-ENV
...          3865\RCA1043.D
Operator    : ECM(YMIAO)
Instrument  :   GCMS 7
Acquired    :  5 Sep 2018   10:19     using AcqMethod PAH-2018.M
Sample Name: HB18-PAM-S3-2
Misc Info   :
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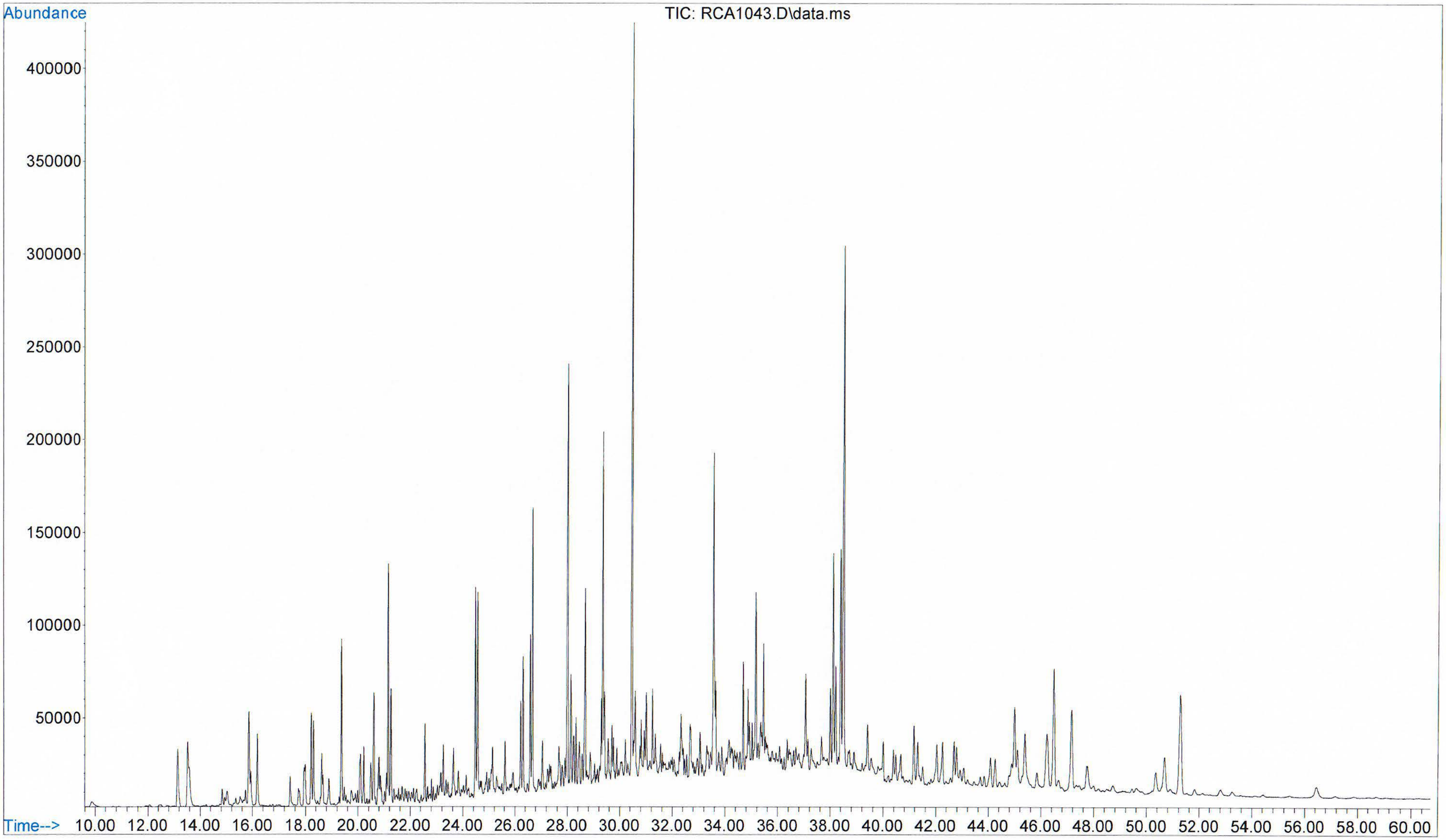

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...          3865\RCA1044.D
Operator    : ECM(YMIAO)
Instrument  :    GCMS 7
Acquired    :  5 Sep 2018   11:29      using AcqMethod PAH-2018.M
Sample Name: HB18-PAM-S6-1
Misc Info   :
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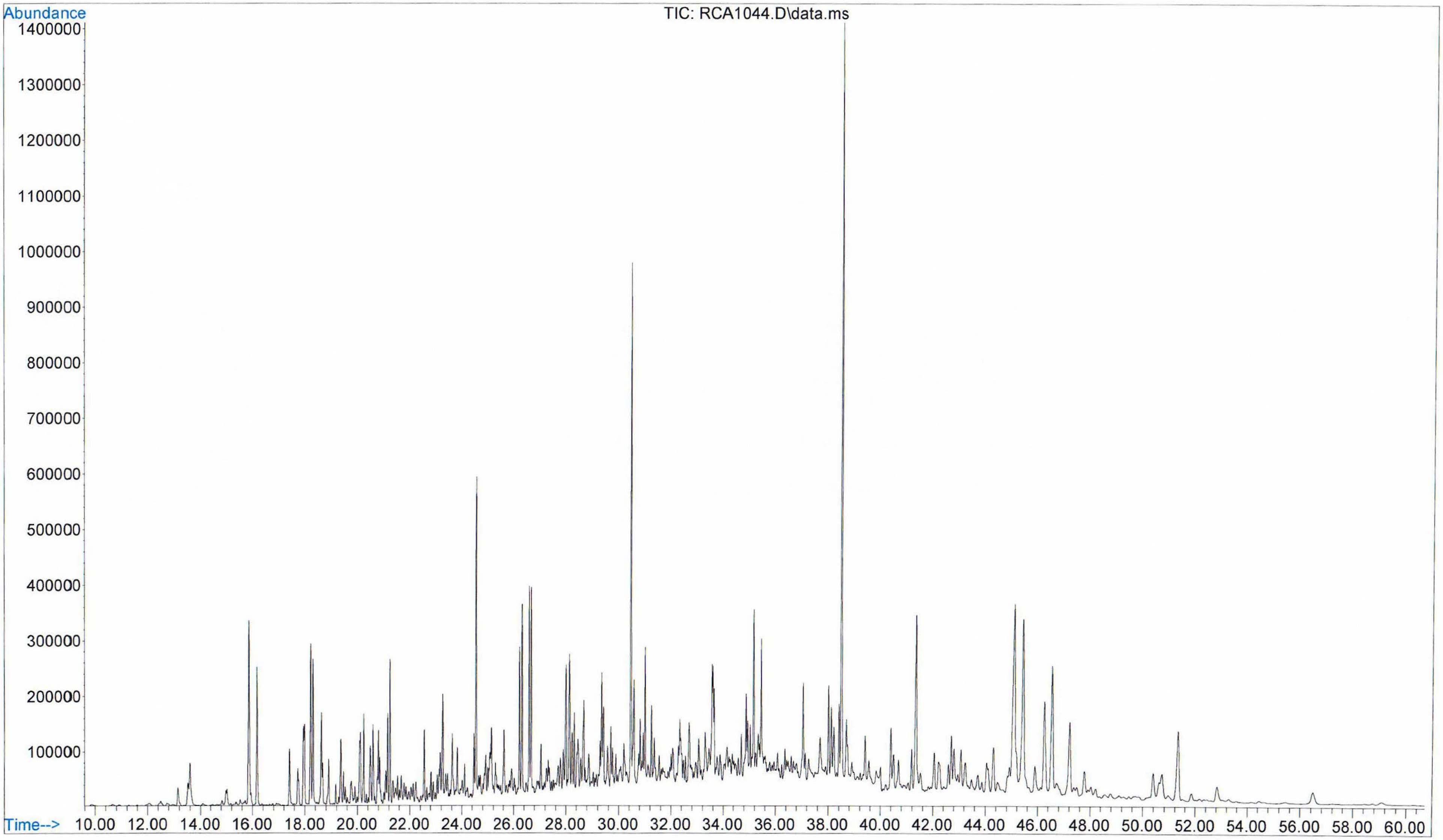

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File        :P:\2018\J18346 Kinnetic Harrison Bay\PAH\ENV3865\MS70274-ENV
...          3865\RCA1045.D
Operator    : ECM(YMIAO)
Instrument  :    GCMS 7
Acquired    :   5 Sep 2018   12:38      using AcqMethod PAH-2018.M
Sample Name: HB18-PAM-S8-1
Misc Info   :
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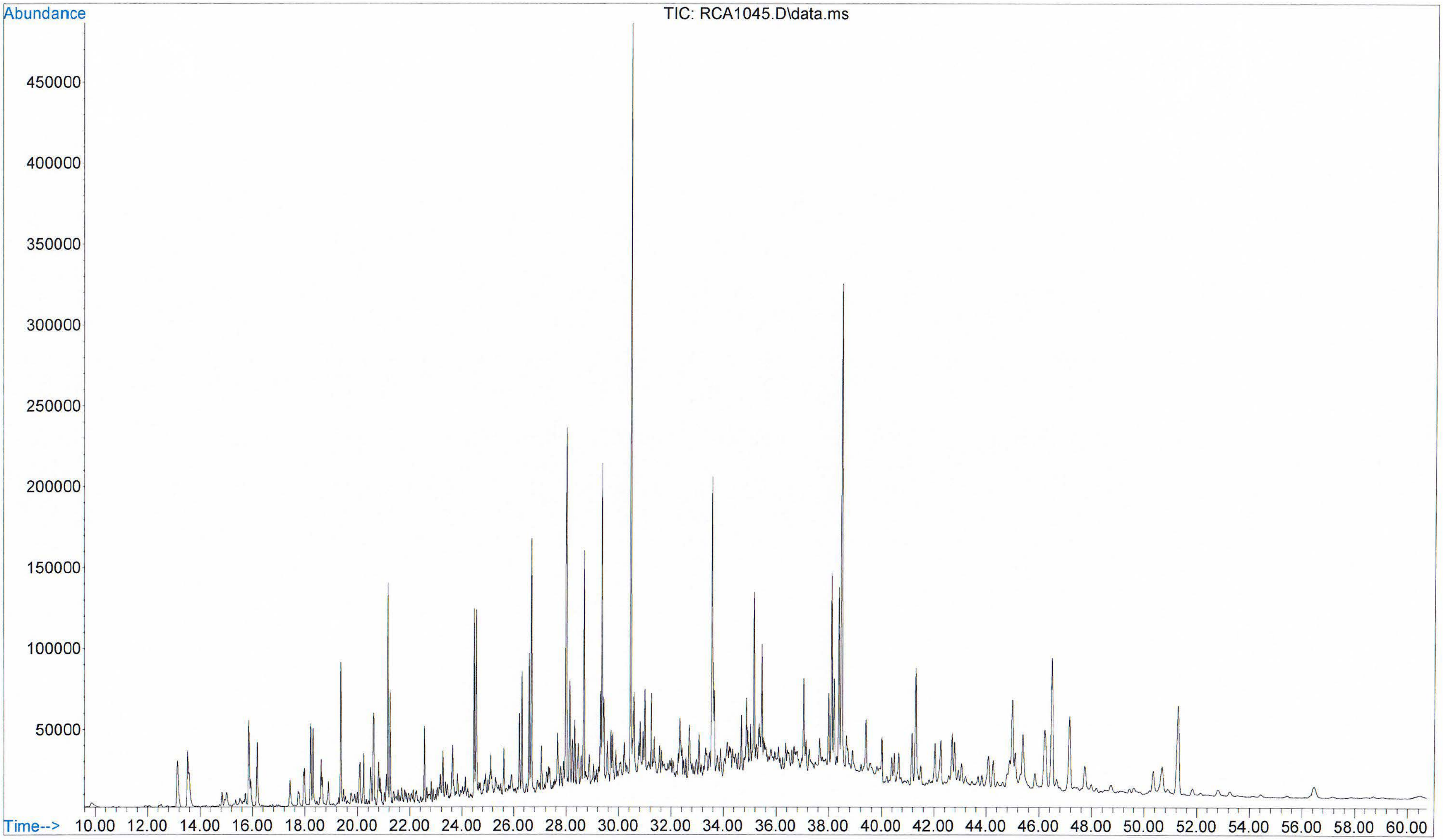

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...          3865\RCA1046.D
Operator    : ECM(YMIAO)
Instrument  :    GCMS 7
Acquired    :   5 Sep 2018   13:48      using AcqMethod PAH-2018.M
Sample Name: HB18-PAM-S11-1
Misc Info   :
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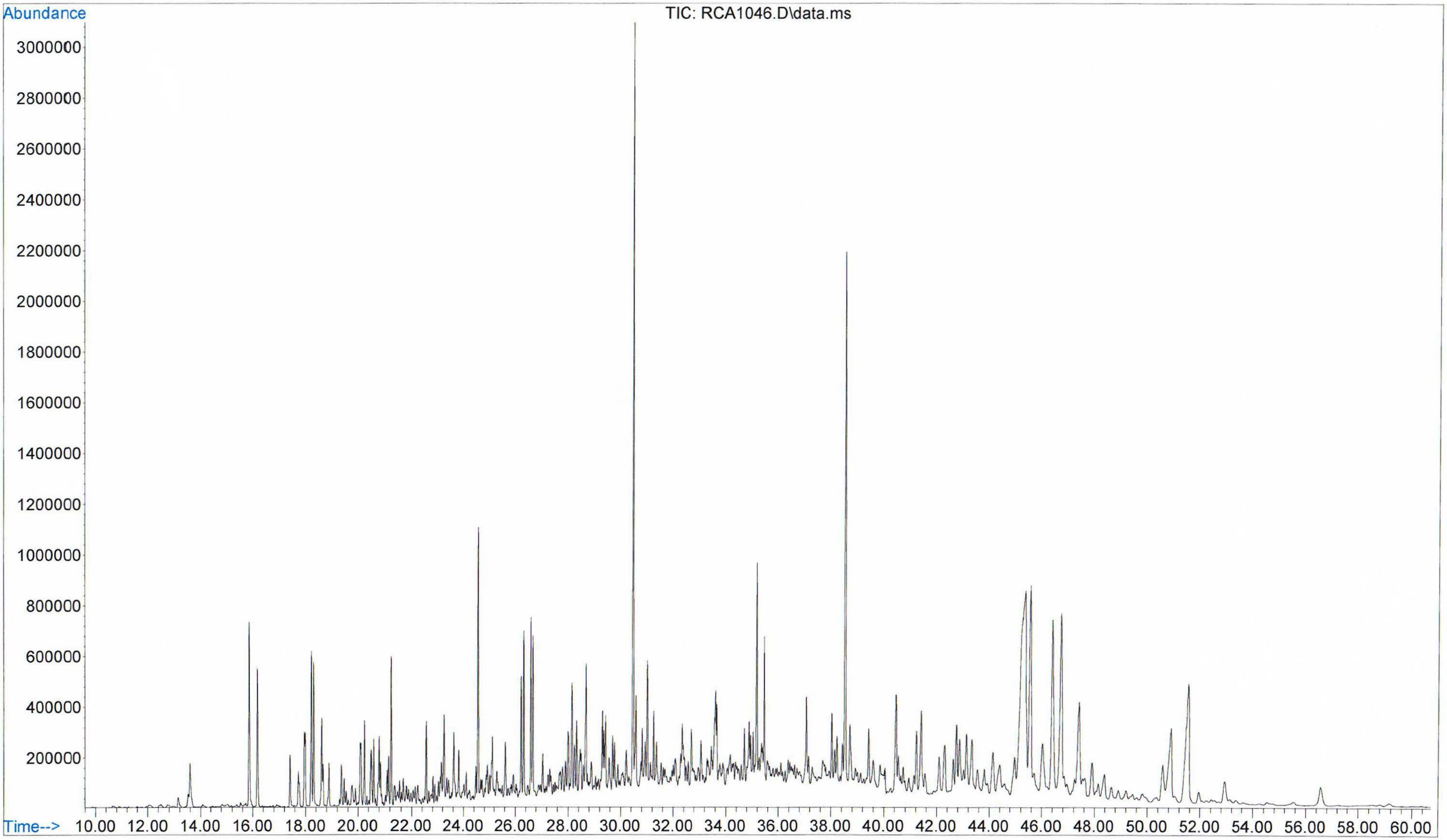

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...           3865\RCA1047.D
Operator     : ECM(YMIAO)
Instrument   :   GCMS 7
Acquired     :  5 Sep 2018   14:57      using AcqMethod PAH-2018.M
Sample Name: HB18-PAM-S4-1
Misc Info    :
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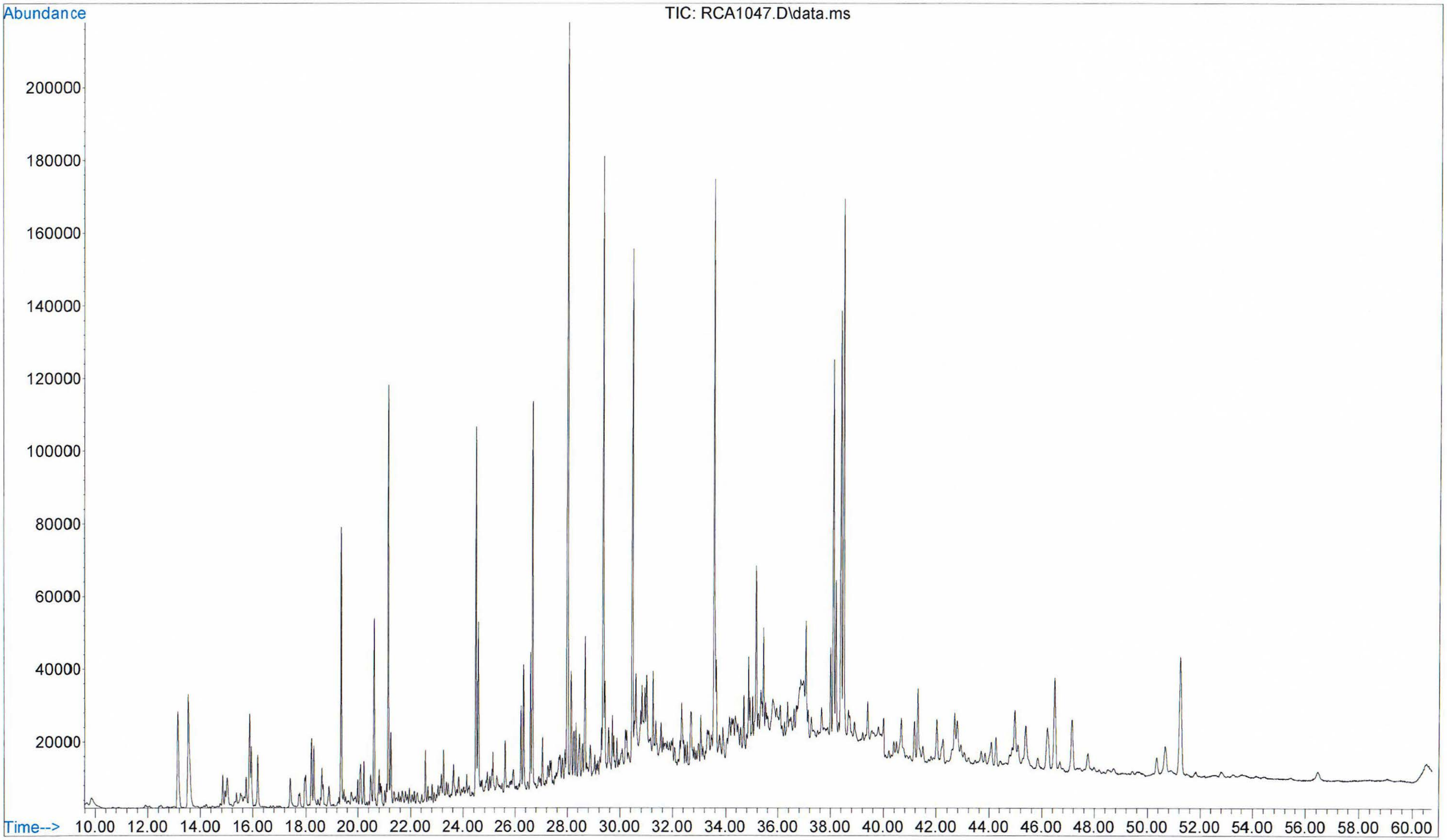


PAH Mass Discrimination Ratio

Kinnetic Labs - Harrison Bay
Polycyclic Aromatic Hydrocarbon Data
Mass Discrimination Sheet

Laboratory ID	Sample ID	Benzo(g,h,i)perylene Concentration (ng/mL)	Phenanthrene Concentration (ng/mL)	Benzo(g,h,i)perylene/ Phenanthrene ratio	Q
MS70273B.D	PAH-WKC1-020-041	20.5	19.0	1.08	
MS70273C.D	PAH-WKC2-100-041	96.3	103	0.94	
MS70273D.D	PAH-WKC3-250-041	257	275	0.93	
MS70273E.D	PAH-WKC4-500-041	490	524	0.94	
MS70273F.D	PAH-WKC5-1000-041	1011	1057	0.96	
MS70273G.D	PAH-WKC6-5000-041	4809	4618	1.04	
MS70273I.D	PAH-WKICV-250-015	260	258	1.01	
MS70274B.D	PAH-WKCCV-250-048	280	250	1.12	
MS70274D.D	PAH-WKCCV-250-048	274	256	1.07	
MS70274E.D	PAH-WKCCV-250-048	280	259	1.08	

Qualifiers (Q): Ratio of Benzo(g,h,i)perylene to Phenanthrene needs to be ≥ 0.70

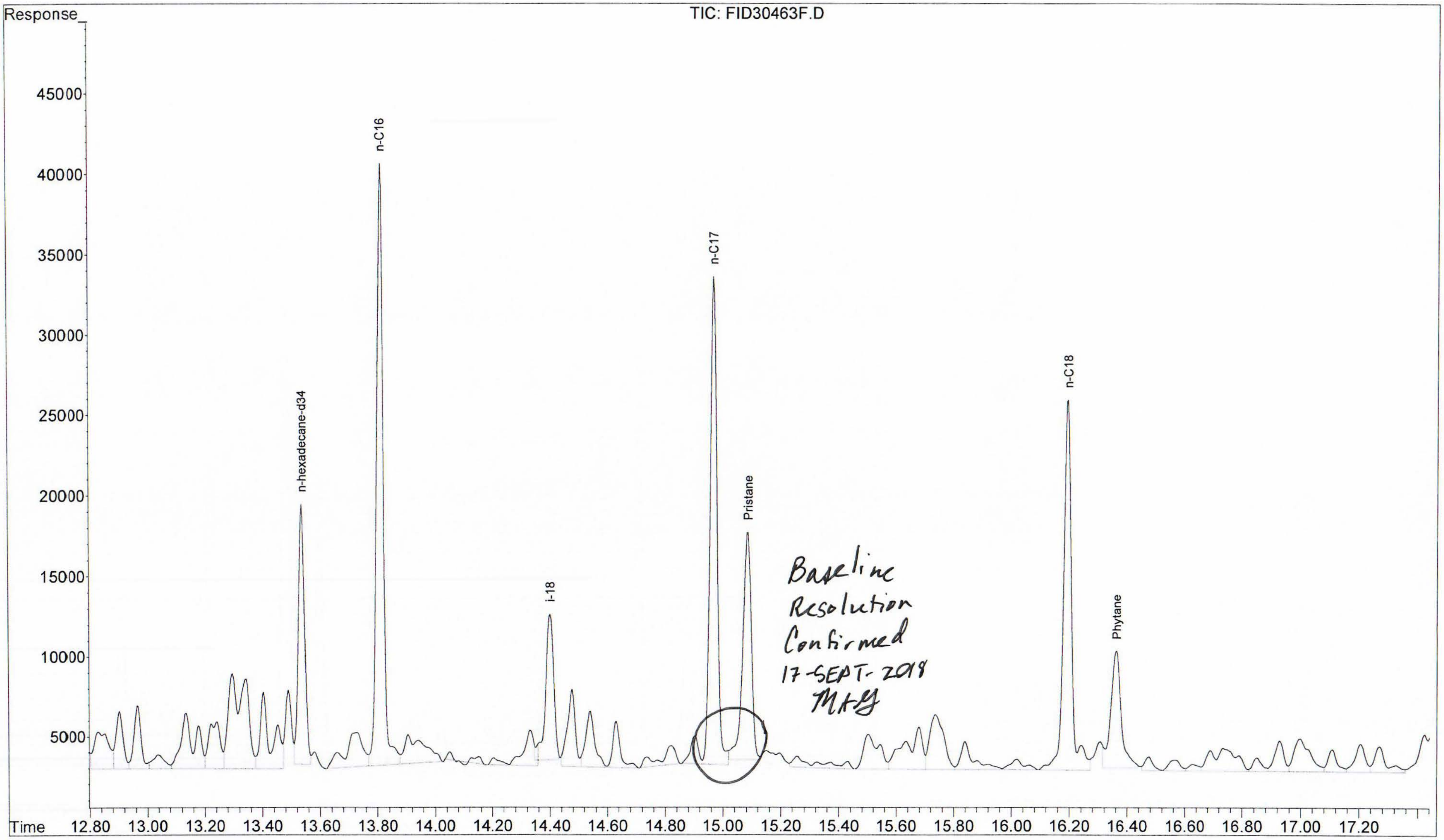
PAH Internal Standard Area Data

Kinnetic Labs - Harrison Bay
Polycyclic Aromatic Hydrocarbon Data
The Area of the Internal Standards in the Associated Calibration Standard

		Internal Standard 1 Fluorene-d10				Internal Standard 2 Pyrene-d10				Internal Standard 3 Benzo(a)pyrene-d12			
Laboratory ID	Sample ID	Response (Area)	50% (Area)	200% (Area)	Q	Response (Area)	50% (Area)	200% (Area)	Q	Response (Area)	50% (Area)	200% (Area)	Q
MS70273D.D	**PAH-WKC3-250-041**	**150870**	**75435**	**301740**		**295501**	**147751**	**591002**		**241239**	**120620**	**482478**	
MS70273I.D	PAH-WKICV-250-015	143458				269374				218093			
MS70273H.D	PAH-WKSUIS-250-014	130385				258550				201216			
MS70274B.D	PAH-WKCCV-250-048	119785				249906				221710			
MS70274C.D	PAH-WKSRM2779-4.0-012	148287				307025				278942			
ENV3865A.D	Method Blank	116333				233809				191340			
ENV3865B.D	SRM1944	132285				282774				251199			
ENV3865C.D	Blank Spike	126546				257747				223917			
ENV3865D.D	MS (HB18-PAM-S2-1)	129902				282914				242677			
ENV3865E.D	MSD (HB18-PAM-S2-1)	128581				282375				242608			
ENV3865F.D	Dupl. (HB18-PAM-S3-1)	119849				255049				223038			
RCA1041.D	HB18-PAM-S2-1	126024				273804				233922			
MS70274D.D	PAH-WKCCV-250-048	120828				243741				207672			
RCA1042.D	HB18-PAM-S3-1	114042				234698				202414			
RCA1043.D	HB18-PAM-S3-2	125831				258346				221846			
RCA1044.D	HB18-PAM-S6-1	125296				261302				219248			
RCA1045.D	HB18-PAM-S8-1	127624				262935				225024			
RCA1046.D	HB18-PAM-S11-1	133719				283100				234845			
RCA1047.D	HB18-PAM-S4-1	113018				235647				200928			
MS70274E.D	PAH-WKCCV-250-048	125190				246237				200978			

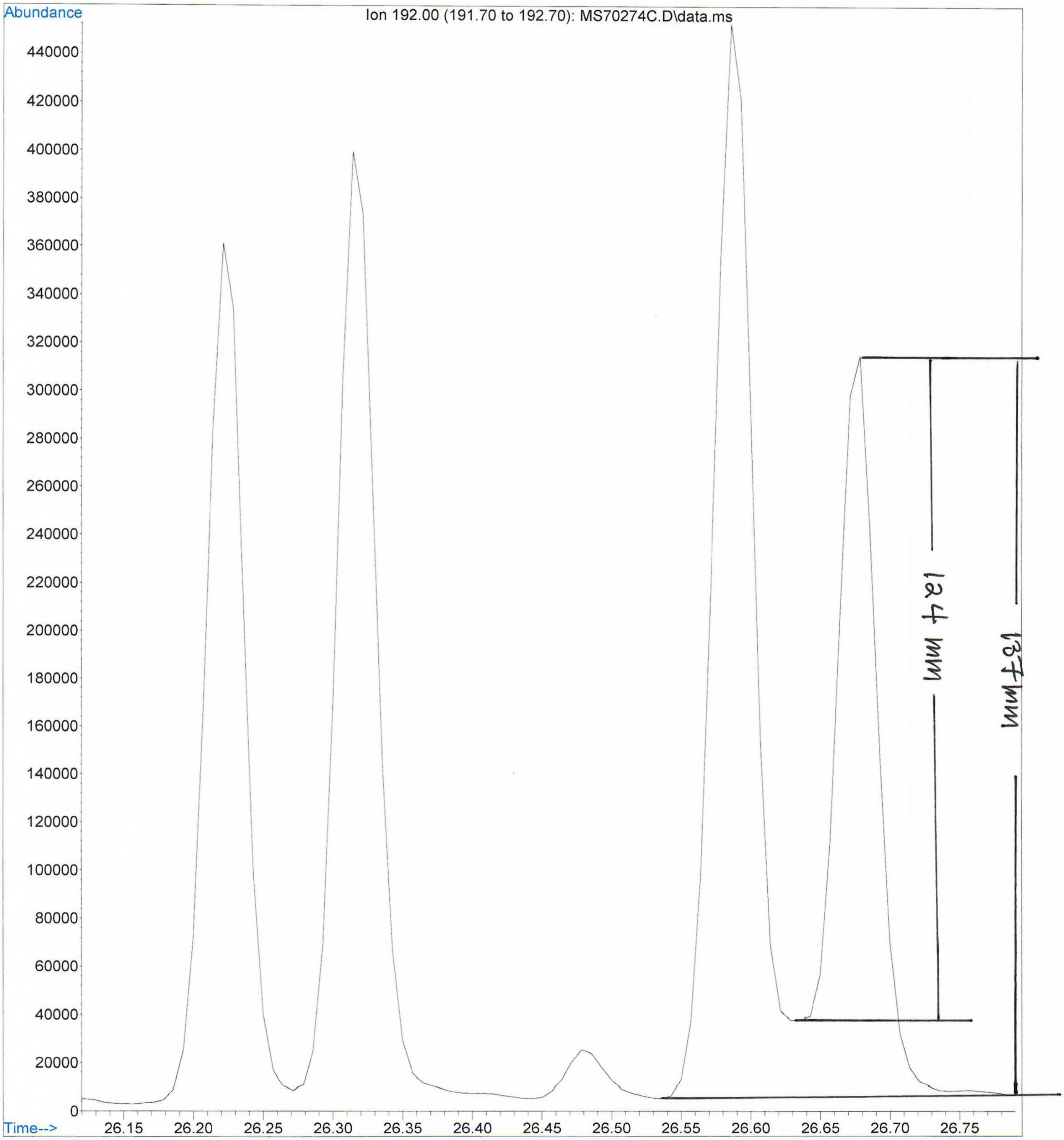
SRM-2779 Reference Oil Aliphatic and PAH Resolution Check

```
File        :P:\2018\J18346 Kinnetic Harrison Bay\ALI\ENV3865\FID30463 20
...          18-09-05.SC\FID30463F.D
Operator    : Mike Gaskins
Instrument  :   HP5890
Acquired    : 06-Sep-2018, 10:18     using AcqMethod ALI2012.M
Sample Name: ALI-SRM2779-20-04
Misc Info   :
```



Baseline
Resolution
Confirmed
17-SEPT-2018
MAG

File   :P:\2018\J18346 Kinnetic Harrison Bay\PAH\ENV3865\MS70274-ENV
...   3865\MS70274C.D
Operator   : ECM(YMIAO)
Instrument :   GCMS 7
Acquired   : 4 Sep 2018 10:47 pm using AcqMethod PAH-2018.M
Sample Name: PAH-WKSRM2779-4.0-012
Misc Info   :



Supporting Documents

Shipping, Sample Receiving, and Project Initiation Documents

B&B Laboratories, Inc.

TDI Brooks

SAMPLE RECEIVING/INTEGRITY REPORT

Job #: J18346 Date Received: 08/14/2018 Time Arrived: 09:33

Received by: Amanda Brewster SDG#: 18081401

Client: Kinnetic Labs - Harrison Bay Sender: Kinnetics: Mark Savoie

Number of Shipping Containers: 1 of 1

Comments:
medium sized blue cooler

Airbill Present: ☑ Yes ☐ No Shipping Company: Fed Ex

Tracking Number:
772962728919

Comments:
priority overnight

Container Secured? ☑ Yes ☐ No Comments: taped shut

Custody Seals? ☑ Yes ☐ No

☑ Custody Seals intact on container

☐ Custody Seals broken on container

Comments: custody seal on top of tape
(see Sample Custody Corrective Action Report)

Chain of Custody Records: ☑ Shipped with samples Notes:

☐ No COCs received

Preservation Conditions: ☐ Ice ☑ Blue ice ☐ Dry ice ☐ None

Comments:

Temperature on receipt (°C): 2.7 Thermometer #: T5

Temperature blank: ☑ Yes (°C): 2.1 ☐ No

(Note: If temperature receipt differs from required conditions, see Sample Custody Corrective Action Report)

Condition of Samples: ☐ Sample containers intact

☑ Sample containers/lids broken/leaking*
**(see Sample Custody Corrective Action Report)*

Sample custody seals intact: ☐ Yes ☐ No ☑ None

Sample Labels: ☑ Sample labels agree with COC

☐ Sample discrepanices *(see Sample Custody Corrective Action Report)*

Number of Samples Received: 7 sediments

Samples Checked in by: Amanda Brewster Date: 08/14/2018 Time: 11:10

Cooler Description: medium blue

SDG: 18081401

Custody seal on cooler? [✓ Yes] No

Cooler 1 of 1

Custody seal intact? [✓ Yes] No N/A
on top of tape

Cooler sealed shut? [✓ Yes] No

Cooler signed for by
Name: amanda
Date: 8/14/18
Time: 9:33

Cooler sealed with what: tape

Ice type: [✓ Blue ice] Wet ice Dry ice None

7 sediments

Thermometer used: T5

one broken jar:
HB18-PAM-S3-2
transferred to
new jar.

Cooler temperature: 2.7°C

Temperature blank: 2.1°C

FedEx
TRK# 0201 7729 6272 8919

TUE – 14 AUG 10:30A
PRIORITY OVERNIGHT
ASR
77845
TX-US IAH

EXP 11/18

XH CLLA

#258164 08/13 552J1/3309/DCA5

CUSTODY SEAL

[redacted]

Signature:

Date/Time: 8/13/18 1330

Rev. 0

Amanda Brewster Kinnetic - MOA

From: TrackingUpdates@fedex.com
Sent: Monday, August 13, 2018 2:49 PM
To: amandabrewster@tdi-bi.com
Subject: FedEx Shipment 772962728919 Notification

Coming 8/14/18

This shipment is scheduled to be sent on 08/13/2018.

See "Preparing for Delivery" for helpful tips

Tracking # 772962728919

Anticipated ship date:
Mon, 8/13/2018

KINNETIC LABORATORIES, INC
KINNETIC LABORATORIES, INC
ANCHORAGE, AK 99501
US

Initiated

Scheduled delivery:
Tue, 8/14/2018 by 10:30 am

Amanda Brewster
B&B Laboratories
14931B South Dowling Road
COLLEGE STATION, TX 77845
US

Shipment Facts

Tracking number:	772962728919
Reference:	MOA 5089
Service type:	FedEx Priority Overnight®
Packaging type:	Your Packaging
Number of pieces:	1
Weight:	20.00 lb.
Special handling/Services:	Adult Signature Required Deliver Weekday

Preparing for Delivery

To help ensure successful delivery of your shipment, please review the below.

Won't be in?

If an adult (age and required identification vary by country) will not

Chain of Custody Record

Page 1 of 1

To:
B&B LABORATORIES, INC.
14391 B South Dowling Rd.
College Station, TX 77845
Phone: (979) 693-3446

Contact: Amanda Brewster

KLI PO #: AK18-1020
Quote #: Q2018-LAB072601
Lab #:

From:
Kinnetic Laboratories, Inc
704 West 2nd Ave.
Anchorage, AK 99501
(907) 276-6178

Contact: Mark Savoie

Project: 2018 HARRISON BAY MMP
Matrix: Sediment
Project #: 5089.03
Complete by: Standard TAT

SampleID	StationID	Sample Date	Sample Time	Sample Type	Analysis	Container	Pres	No. of Bottles	LabID	Condition Upon Receipt
✓ HB18-PAM-S2-1	S2	8/6/18	1036 ✓	Grab	PAH/AHC/METALS	250-mL WMGJ	4° C	1		good
✓ HB18-PAM-S3-1	S3		0929 ✓	Grab	PAH/AHC/METALS	250-mL WMGJ	4° C	1		good
✓ HB18-PAM-S3-2 *	S3		0929 ✓	Grab	PAH/AHC/METALS	250-mL WMGJ	4° C	1		broken
✓ HB18-PAM-S6-1	S6		1358 ✓	Grab	PAH/AHC/METALS	250-mL WMGJ	4° C	1		
✓ HB18-PAM-S8-1	S8		1515 ✓	Grab	PAH/AHC/METALS	250-mL WMGJ	4° C	1		
✓ HB18-PAM-S11-1	S11		1709 ✓	Grab	PAH/AHC/METALS	250-mL WMGJ	4° C	1		
✓ HB18-PAM-S4-1	S4		1207 ✓	Grab	PAH/AHC/METALS	250-mL WMGJ	4° C	1		
										JMS

Data Report MUST include the following: Sample ID, Analytical Method, Detection Limit, Date of Extraction if applicable, Date of Analysis, Analytical Results, and Signature of QA Reviewer. All times on this sheet are military time. Email sample receipt confirmations, PDF reports, and EDDs to msavoie@kinneticlabs.net. EDD REQUIRED.

Special Instructions/Comments: See quote list of analytes and detection limits. Report on a dry weight basis.

Janet M. Savoie JMS

~~Sampled and~~ JMS Relinquished By: Janet M. Savoie
Date/Time: 8/13/2018 1130
Transporter: FEDEX
Received By: amanda Brewster
Date/Time: 8/14/18 11:10

Relinquished By:
Date/Time:
Transporter:
Received By:
Date/Time:

v20020904

GL

B&B Laboratories, Inc.

Agreement for Services

TDI Brooks

Lab Contact: Juan Ramirez, Laboratory Manager
14391B South Dowling Road
College Station,TX 77845
Phone: (979) 693-3446
email: juanramirez@tdi-bi.com

Sample Shipping Contact: Amanda Brewster, Sample Custodian
14391B South Dowling Road
College Station TX 77845
Phone: (979) 693-3446
email: amandabrewster@tdi-bi.com

Contact Information	
Project Manager:	MARK SAVOIE
Phone:	(907) 276-6178
Street Address City, State Zip:	704 W. 2nd AVE. ANCHORAGE, AK 99501
Fax:	—
Email:	MSAVOIE@KINNETICLABS.NET

Description of Work	
Project Name:	HBMMP
Project Number:	5089
Requested Turn-Around (working days)	45 DAYS
Submission Date:	SHIP OFF SLOPE 8/10/18
Purchase Order #:	AK18-1020

Payment Terms: Net 30 from date of invoice

All overdue payments are subject to an additional interest and service charge of one and one-half percent (1.5%) per month, from the due date until the date payment is received.

Billing corrections must be requested within 30 days of the invoice date.

Sample Storage and Disposal:

B&B Laboratories shall dispose of Client's samples 30 days after analytical report is issued, unless instructed to hold samples for an alternate period of time, or, request is made for samples to be returned to the Client. Longer storage periods may be requested (as space allows) for an additional charge.

If sample disposal is requested, it will be at cost to the client or, samples may be returned to client, at client's cost.

Billing Information	
Attention to:	BRENDA GUMMINGER
Company:	KINNETIC LABORATORIES, INC.
Street Address City, State, Zip:	704 W. 2nd AVE. ANCHORAGE, AK 99501
Phone:	(907) 276-6178
Email:	BGUMMINGER@KINNETICLABS.NET

8/10/18

Signature Date/Time

**Signature indicates agreement with these terms and conditions*

Report # 18-3808 Report Level IV

B&B LABORATORIES SAMPLE INITIATION FORM-ENV

Job #: J18346

SDG: 18081401

Client: Kinnetic Labs - Harrison Bay

Initiation Date: 8/14/18

Number of Samples: 7

Matrix: sediment

Due Date: 45 days: 9/28/18

Comments: aliquot for TM

Analyses Report in: ☑ dry weight ☐ wet weight

☑ PAHs	☐ OCs/PCBs	☑ Aliphatics/TPH	☑ EOM
☑ %Dry Wt.	☐ %Lipid	☐ Biomarkers	☐ _____
☑ Short Columns	☐ Long Columns	☐ _____	☐ _____

Requested QC ☐ SRM 1941b ☑ SRM 1944 ☐ SRM 1945 ☐ SRM 1974c ☐ CARP-2 ☐ SRM 2585 ☐ SRM 2974a

☑ Blank ☐ SRM/LCS_____ ☑ Blank Spike

☐ Blank Spike Duplicate ☑ Matrix Spike _____

☑ Matrix Spike Duplicate _____ ☑ Duplicate _____

EXTRACTION STANDARDS - SEE BACK FOR SPECIFIC STANDARDS

Surrogate(s): PAH, ALI Volume(s): 100 ul

Spike Standard(s): PAH, ALI Volume(s): 100 ul

Internal Standard(s): PAH, ALI Volume(s): 100 ul

Final Extract Volume (ml): 1.0 Final Solvent: DCM

Laboratory Notes:
SOP:1012, 1003

Instrument Notes:
SOP:1006, 1016

Sample Custodian Signature: amanda Brewster Date: 8/15/18

Laboratory Manager Signature: Date: 8/15/18

Sample Initiaiton - General Rev 6
Rev 6: 1/15/2018

cc: COC File
Extraction Lab

Environmental Sample Inventory

Job #	CLIENT NAME	LAB ID	SAMPLE ID	COL. DATE	REC DATE	Analysis	MATRIX	COMMENTS	B&B SDG	Project #
J18346	Kinnetic Labs - Harrison Bay	RCA1041	HB18-PAM-S2-1	08/06/18	08/14/18	PAH, ALI, TM	SED		18081401	5089.03
J18346	Kinnetic Labs - Harrison Bay	RCA1042	HB18-PAM-S3-1	08/06/18	08/14/18	PAH, ALI, TM	SED		18081401	5089.03
J18346	Kinnetic Labs - Harrison Bay	RCA1043	HB18-PAM-S3-2	08/06/18	08/14/18	PAH, ALI, TM	SED	received broken	18081401	5089.03
J18346	Kinnetic Labs - Harrison Bay	RCA1044	HB18-PAM-S6-1	08/06/18	08/14/18	PAH, ALI, TM	SED		18081401	5089.03
J18346	Kinnetic Labs - Harrison Bay	RCA1045	HB18-PAM-S8-1	08/06/18	08/14/18	PAH, ALI, TM	SED		18081401	5089.03
J18346	Kinnetic Labs - Harrison Bay	RCA1046	HB18-PAM-S11-1	08/06/18	08/14/18	PAH, ALI, TM	SED		18081401	5089.03
J18346	Kinnetic Labs - Harrison Bay	RCA1047	HB18-PAM-S4-1	08/06/18	08/14/18	PAH, ALI, TM	SED		18081401	5089.03

B&B
B&B Laboratories, Inc.

TDI Brooks

SAMPLE CUSTODY CORRECTIVE ACTION REPORT

Job #: J18346 Date/Time Received: 08/14/2018, 9:33 SCCAR-109

Client: Kinnetic Labs - Harrison Bay SDG #: 18081401

Description of Discrepancy:	Explanation:
sediment sample received broken: HB18-PAM-53-2	transferred to new container upon receipt

Documentation of client and laboratory manager notification by sample custodian.

Sample Custodian: Amanda Brewster Date/Time: 08/14/2018, 15:19

Client contacted by: ☑ E-mail (see attached) ☐ Phone ☐ Not Contacted

Laboratory Manager: Juan Ramirez

Resolution of Discrepancy: Can be completed by Client, Sample Custodian or Lab Manager

Client:______ Date:______ Time:______

Sample Custodian: Amanda Brewster Date: 08/14/2018 Time: 15:19

Lab Manager:______ Date:______ Time:______

notified client via email

Amanda Brewster

From:	Amanda Brewster <amandabrewster@tdi-bi.com>
Sent:	Tuesday, August 14, 2018 3:19 PM
To:	'msavoie@kinneticlabs.net'
Subject:	RE: samples received 8/14/18

Hi Mark,

Sorry I forgot to mention...

Sample HB18-PAM-S3-2 arrived broken, but frozen solid.
We were able to transfer this to a new jar upon receipt.

Regards,
Amanda

From: Amanda Brewster [mailto:amandabrewster@tdi-bi.com]
Sent: Tuesday, August 14, 2018 3:18 PM
To: 'msavoie@kinneticlabs.net'
Subject: samples received 8/14/18

Hi Mark,

We received your samples this morning in good condition.
The internal temperature of the cooler was 2.7ºC, and the temp blank was 2.1ºC.
A PDF of the signed COC is attached for your records.

Would you like the cooler and ice returned? If so, could I please have a Fed Ex acct # to use for the return shipment?

Regards,
Amanda

Amanda Brewster
Sample Custodian

B&B
B&B Laboratories, Inc.

B&B Laboratories
14391B South Dowling Road
College Station, Texas 77845

Phone: (979) 693-3446
Email: amandabrewster@tdi-bi.com

Amanda Brewster

From: Juan Ramirez <juanramirez@tdi-bi.com>
Sent: Wednesday, August 15, 2018 9:05 AM
To: 'Amanda Brewster'; 'Donell Frank'
Cc: msavoie@kinneticlabs.com
Subject: RE: samples received 8/14/18

Hello Mark,

We're ok on samples since everything was frozen.

Thanks,

Juan

Juan Ramirez
Environmental Laboratory Manager

B&B Laboratories, Inc.

TDI-Brooks International, Inc.
14391 South Dowling Rd.
College Station, Texas 77845

Office: 979.693.3446
Cell: 979.777.0793

juanramirez@tdi-bi.com

http://tdi-bi.com/

Could you please take a moment and answer a quick survey? We would like to know how we can improve our services.

From: Amanda Brewster [mailto:amandabrewster@tdi-bi.com]
Sent: Wednesday, August 15, 2018 8:18 AM
To: 'Juan Ramirez'; 'Donell Frank'
Subject: FW: samples received 8/14/18

Juan,

Do you think they need to send the backup sample for the jar that arrived broken?
It was frozen solid and inside a bubble wrap envelope so the lab was able to transfer it into a new jar upon receipt.

Regards,
Amanda

From: Mark Savoie [mailto:msavoie@kinneticlabs.net] **On Behalf Of** Mark Savoie
Sent: Tuesday, August 14, 2018 5:47 PM
To: 'Amanda Brewster'; msavoie@kinneticlabs.net
Cc: jsavoie@kinneticlabs.net; 'Gary Lawley'
Subject: RE: samples received 8/14/18

Amanda –

Thanks for the update. If you think the broken sample is an issue, let us know, as we do have a backup/archive sample that we could send as a replacement.

You can keep the cooler and ice as they aren't worth the return shipping costs to Alaska.

Regards,

Mark

From: Amanda Brewster [mailto:amandabrewster@tdi-bi.com]
Sent: Tuesday, August 14, 2018 12:19 PM
To: msavoie@kinneticlabs.net
Subject: RE: samples received 8/14/18

Hi Mark,

Sorry I forgot to mention...

Sample HB18-PAM-S3-2 arrived broken, but frozen solid.
We were able to transfer this to a new jar upon receipt.

Regards,
Amanda

From: Amanda Brewster [mailto:amandabrewster@tdi-bi.com]
Sent: Tuesday, August 14, 2018 3:18 PM
To: 'msavoie@kinneticlabs.net'
Subject: samples received 8/14/18

Hi Mark,

We received your samples this morning in good condition.
The internal temperature of the cooler was 2.7ºC, and the temp blank was 2.1ºC.
A PDF of the signed COC is attached for your records.

Would you like the cooler and ice returned? If so, could I please have a Fed Ex acct # to use for the return shipment?

Regards,
Amanda

Laboratory Bench Sheet Logs

B&B LABORATORIES ENVIRONMENTAL EXTRACTION LOG

MATRIX
☐ OTHER
☐ WATER
☒ SEDIMENT
☐ TISSUE

Job #: J18346 SDG #: 1808 1401
Client: Kinnetic Labs ~~2018~~ 8/30/18 HA Harrison Bay
Analysis: ☑ PAH ☐ PESTS ☐ PCB ☑ ALI
Other : TPH
Extraction Solvent: DCM
Final Solvent : DCM Final Volume: 1.0 mL

Lipids Y / [✓ N]
Dry Wt. [✓ Y] / N
Copper [✓ Y] / N
EOM [✓ Y] / N
Columns [✓ Y] / N
Long / [✓ Short]

Surrogate: 100 µL
PAH: PAH-WKSU-2500-016 Bottle 1 of 3
Pest/PCB: — Bottle ___ of ___
Aliphatic: ALI-WKSU-200-003 Bottle 4 of 7
Other: — Bottle ___ of ___

Spike: 100 µL
PAH: PAH-WKSK-1000-035 Bottle 1 of 2
Pest/PCB: — Bottle ___ of ___
Aliphatic: ALI-WKSK-100-029 Bottle ___ of ___
Other: — Bottle ___ of ___

GC Int Std: 100 µL
PAH: PAH-WKIS-2500-016 Bottle 1 of 3
Pest/PCB: — Bottle ___ of ___
Aliphatic: ALI-WKIS-500-003 Bottle 4 of 7
Other: — Bottle ___ of ___

Turbo Vap
Bath T (C): ___
Pressure (>20psi): ___
Check Water Level: ___
Turbo Vap Date: ___
HA 8/30/2018

General Comments:
Report # 18-3808
pH < 2 ☐ NA

Pipet #	Standard	Added	Witness
MP10	Surrogate:	8/30/2018 HA	8-30-18
MP10	Spike:	8/30/2018 HA	8-30-18
MP10	Internal:	9/4/2018 HA	9-4-18

	Sample Name	Client ID	Wet Wt. (g or L)	Dry Wt. %	Dry Wt. (g)	wet wt. Extraction Comments
1	ENV3865A	Method Blank	15.04	–	15.04	15.04
2	ENV3865B	SRM 1944	① 0.54	98.75	0.54	0.55
3	ENV3865C	Blank Spike	15.01	–	15.01	15.01
4	ENV3865D	Matrix Spike (RCA1041)	15.05	55.49	15.05	27.12
5	ENV3865E	Matrix Spike Dup (RCA1041)	15.02 HA	55.49	15.02	27.07
6	ENV3865F	Duplicate (RCA1042)	15.02	~~70.0~~ 73.01 ②	15.02	20.57
7	RCA1041	HB18-PAM-S2-1	15.05	55.49	15.05	27.12
8	RCA1042	HB18-PAM-S3-1	15.01	73.01	15.01	20.56
9	RCA1043	HB18-PAM-S3-2	15.02	75.63	15.02	19.86
10	RCA1044	HB18-PAM-S6-1	15.01	50.86	15.01	29.51
11	RCA1045	HB18-PAM-S8-1	15.02	72.38	15.02	20.75
12	RCA1046	HB18-PAM-S11-1	15.00	51.50	15.00	29.13

Internal Chain of Custody

	Date:	Initials:	Date:	Initials:
Extraction Prep	8-30-18		8-30-18	
Extraction	8-30-18		8-30-18	
Concentration	8-31-18		8-31-18	
Short Columns	8-31-18		8-31-18	

① 8/30/2018 HA
② 8/31/2018 HA

ENVIROLOG Rev 5: 4/17/2018

ENV 3865
Page 1 of 2

B&B LABORATORIES ENVIRONMENTAL EXTRACTION LOG

	Sample Name	Client ID	Wet Wt. (g or L)	Dry Wt. %	Dry Wt. (g)	Wet wt Extraction Comments
13	RCA1047	HB18-PAM-S4-1	① ~~15.01~~	69.49	15.01	21.60
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						

Internal Chain of Custody

Concentration Short Columns	
Date: 9-4-18	Date: 9-4-18
Initials: EW	Initials: EW
Columns SA1	
Date:	Date:
Initials:	Initials:
Concentration SA1	
Date:	Date:
Initials:	Initials:
Columns SA2	
Date:	Date:
Initials:	Initials:
Concentration SA2	
Date:	Date:
Initials:	Initials:
Transfer for HPLC	
Date:	Date:
Initials:	Initials:
HPLC	
Date:	Date:
Initials:	Initials:
Post-HPLC Concentration	
Date:	Date:
Initials:	Initials:
Final Extract Transfer	
Date: 9-4-18	Initials: EW

HA 8/30/2018

Dry Weight Page

DRY1594

Lipid/EOM Page

EOM1433

Clean-up/Separation/Other Columns

HA 8/30/2018

Sample Storage Box #

#503

HPLC Storage Box #

HA 8/30/2018

QC Review

Date	Initials
9/5/18	

Lot Numbers

DCM: 57027

Hexane: —

Hydromatrix: —

Water: ~~58422~~ 58122 9/4/2018 HA

Silica: BCBW 3799

Alumina: 17J115206

Sodium Sulfate: 17C235208

Pentane: —

Copper: 811260-BF

Hydrochloric Acid: —

Other: —

Equipment Used

☒ ASE2 ☐ ____ ☐ HPLC1

☐ ASE4 ☐ ____ ☐ HPLC2

Copied to Folders

① 8/30/2018 HA

B&B LABORATORIES % DRY WEIGHT LOGBOOK

MATRIX

☐ OTHER

☒ SEDIMENT

☐ TISSUE Type

Job #: J18346 SDG #: 18081401

Client: Kinnetic Labs - Harrison Bay

General comments:

Lab Mananger
Date: 9/5/18
Init:

Date/Init: ☑ Bal. Cal.
8/20/2018 HA

Beaker + Dry Smpl (g)
Date/Init: 8/21/18 HA ☒ Bal. Cal.
Date/Init: 8/22/2018 HA ☑ Bal. Cal.

Date/Init: 8/23/2018 HA

	Sample Name	Client ID	Beaker Wt (g)	Beaker + Wet Smpl (g)	1	2	(%) Dry Weight	Comments
1	RCA1041	HB18-PAM-S2-1	1.27	3.00	2.23	2.23	55.49	
2	RCA1042	HB18-PAM-~~S2~~ S3-1 8/20/18 HA	1.29	2.92	2.48	2.48	73.01	HB18-PAM-S3-1
3	RCA1043	HB18-PAM-S3-2	1.30	3.27	2.80	2.79	75.63	
4	RCA1044	HB18-PAM-S6-1	1.28	3.03	2.16	2.17	50.86	
5	RCA1045	HB18-PAM-S8-1	1.29	3.10	2.59	2.60	72.38	
6	RCA1046	HB18-PAM-S11-1	1.28	2.95	2.16	2.14	51.50	
7	RCA1047	HB18-PAM-S4-1	1.28	3.05	2.52	2.51	69.49	
8	RCA1045 Dup	Duplicate	1.30	3.13	2.62	2.61	71.58	
9								
10								
11								
12								
13								
14								
15								
16								

DRY 1594

Page 1 of 2

DRYWT LOG Rev 0

B&B LABORATORIES % DRY WEIGHT LOGBOOK

					Beaker + Dry Smpl (g) Date/Init: ☐Bal. Cal.	Date/Init: ☐Bal. Cal.		
	Sample Name	Client ID	Beaker Wt (g)	Beaker + Wet Smpl (g)	1	2	(%) Dry Weight	Comments
17								
18				HA 8/20/18				
19								
20								
21								
22								
23								
24								

$$\% \text{ Dry Weight} = \frac{[\text{Beaker + Dry SMPL (g)}] - [\text{Beaker Weight (g)}]}{[\text{Beaker + Wet SMPL (g)}] - [\text{Beaker Weight (g)}]} \times 100$$

$$\text{RPD} = \frac{[\text{Original \% Dry Weight Value} - \text{Duplicate \% Dry Weight Value}]}{[\text{Original \% Dry Weight Value} + \text{Duplicate \% Dry Weight Value}] \times 0.5} \times 100$$

The Relative Percent Difference (RPD) between duplicates must be ≤ 25%.

Date / Init.	RPD
8/23/18 HA	3.0%

Sample # RCA1047

Duplicate # RCA1047 DUP

B&B LABORATORIES EOM LOGBOOK

MATRIX
OTHER
[✓ SEDIMENT]
WATER

Job #: J18346
SDG #: 18081401
Client: Kinnetic Labs Harrison Bay

General comments:
Pipet #: MP2

QC Review
Date/Int: 9/5/18

Transferred by Date/Int: 8/31/2018 HA
From ENV Pg: ENV3865
From DRY Pg: DRY1594

Date/Int: 8-31-18 EN

Bal. Cal.

Date/Int: 9/3/2018 HA

Circle one
[✓ µg/g]
µg/L

	Sample Name	Client ID	Smpl Wt./Vol ([✓ g]/L) Wet Wt. [✓ Dry Wt.]	Dry Wt. (%)	Final Extract Vol (mL)	Initial Filter Wt (mg)	Filter & Sample Wt (mg)	Wt. of 100 µl EOM Wt. (mg)	EOM (Wet Wt. Basis)	EOM (Dry Wt. Basis)	Comments	Scale #
1	ENV3865A	Method Blank	15.04	–	3	21.004	21.004	0.000	–	–		6
2	ENV3865B	SRM1944	0.54	98.75	3	21.195	21.339	0.144	7900	8000		10
3	ENV3865C	Blank Spike	15.01	–	3	20.623	20.635	0.012	–	24		6
4	ENV3865D	Matrix Spike (RCA1041)	15.05	55.49	3	20.866	21.297 ~~208~~ 8-31-18 EN	0.431	477	859		10
5	ENV3865E	Matrix Spike Dup (RCA1041)	15.02	55.49	3	21.156	21.569	0.413	458	825		6
6	ENV3865F	Duplicate (RCA1042)	15.02	73.01	3	20.962	20.992	0.030	44	60		10
7	RCA1041	HB18-PAM-S2-1	15.05	55.49	3	20.601	20.978	0.377	417	751		6
8	RCA1042	HB18-PAM-S3-1	15.01	73.01	3	21.205	21.236	0.031	45	62		10
9	RCA1043	HB18-PAM-~~S2-2~~ S3-2 9/14/18 HA	15.02	75.63	3	20.610	20.640	0.036	45	60		6
10	RCA1044	HB18-PAM-S6-1	15.01	50.86	3	20.707	21.031	0.324	329	648		10
11	RCA1045	HB18-PAM-S8-1	15.02	72.38	3	20.838	20.875	0.037	53	74		6
12	RCA1046	HB18-PAM-S11-1	15.00	51.50	3	21.083	22.062	0.979	1008	1958		10

EOM 1433
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EOM Rev 7: 4/17/2018

B&B LABORATORIES EOM LOGBOOK

	Sample Name	Client ID	Smpl Wt./Vol (g/L) Wet Wt. [✓ Dry Wt]	Dry Wt. (%)	Final Extract Vol (mL)	Initial Filter Wt (mg)	Filter & Sample Wt (mg)	Wt. of 100 µl EOM Wt. (mg)	EOM (Wet Wt. Basis)	EOM (Dry Wt. Basis)	Comments	Scale #
13	RCA1047	HB18-PAM-S4-1	15.01	69.49	3	20.758	20.777	0.019	26	38		6
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												

$$\text{EOM} = \frac{(\text{EOM Wt. (mg)})(\text{Final Extract Vol. (ml)})}{(\text{Smpl Wt/Vol. (g/L)})(0.10\ \text{ml})} \times 1000$$

$$\%\text{RPD} = \frac{(\text{EOM}_1 - \text{EOM}_2)}{(\text{EOM}_1 + \text{EOM}_2) \times 0.5} \times 100\%$$

Thermometer #	Oven Temperature (40°C ± 2°C)	Initial Filter Wt (mg)	Filter & Sample Wt (mg)	Scale #	Wt. of 100 µl EOM Wt. (mg)
1	41.6°C				
	Solvent Blank	20.667	20.667	6	0.000
		20.923	20.923	10	0.000
	Corn Oil Standard:	21.053	30.841	6	9.788
	EOM-WKLC-10-008	20.797	30.614	10	9.817

Standard weight must be between 9.50-10.50 mg

The Relative Percent Difference (RPD) between duplicates must be ≤ 25%.

Date/Int:	RPD
9/3/2018	3.345 %

Sample: RCA1042

Duplicate: ENV3865F

EOM 1433

Page 2 of 2

EOM Rev 7: 4/17/2018

TDI Brooks

TDI-Brooks International, Inc.

"Providing Scientific Services On A Global Basis"

B&B Client Number: J18346

Client Address: Kinnetic Laboratories Inc.
704 West 2nd Avenue
Anchorage, AK 99501

Contact Juan Ramirez for questions concerning these data.

B&B
B&B Laboratories, Inc.

Proprietary Information

Kinnetic Laboratories, Inc.
Project #5089.03

Determination of:

Trace Metals (TM)
in Sediment Samples

November 2, 2018

Technical Report 18-3808 TM

Please take a moment and answer a
quick survey. We would like to know how
we can improve our services.

Narrative

Case Narrative

Sample Receipt and Storage

B&B Laboratories received a shipment of one (1) ice chest on August 14, 2018 in College Station, Texas. The ice chest arrived sealed and in good condition.

Cooler Number	Temperature	Samples Received	Sample Custody Corrective Action Report (SCCAR)
1	2.7 °C 2.1°C Temperature Blank	Seven (7) sediment samples in 250 mL jars.	109

The sediment samples were logged in according to B&B Laboratories standard operating procedure (B&B 1009) and stored in an access-controlled freezer (<-16.0°C) prior to analysis. See Supporting Documents for the information related to the sample received broken during shipping.

The sediment samples were analyzed for trace metals using inductively coupled plasma-optical emission spectroscopy (ICP-OES), inductively coupled plasma-mass spectroscopy (ICP-MS), and combustion-trapping-atomic absorption (C-T-AA) spectroscopy by Trace Environmental Labs (TERL, Texas A&M University), College Station, Texas.

The analytical results for trace elements in the sediment samples are included in this report.

Sample Preparation and Digestion

Digestion (TERL)

Sediment samples were digested in polypropylene vessels in a block digester with ultrapure nitric acid, hydrochloric acid, and hydrofluoric acid. The latter acid was necessary in order to solubilize the alumino-silicate mineral lattice in order to achieve a “total” sediment analysis. Following digestion, samples were diluted to volume with deionized water and stored in screw cap high density polyethylene bottles until analysis.

Determination of Percent Moisture in Tissues, Soils and Sediment (B&B Labs)

Percent moisture (weight/weight basis) is determined in samples by measuring the loss in mass of the sample due to drying at 104 °C to a constant weight. Typically, between one and two grams of sample are used for the determination. Wet and dried samples are weighed to the nearest milligram. This procedure is documented in B&B SOP 1012, *Preparation of Tissue, Water, Soils, and Sediment for Extraction*.

Analytical Methods (TERL)

Samples were analyzed by inductively coupled plasma-optical emission spectroscopy (ICP-OES), inductively coupled plasma-mass spectroscopy (ICP-MS), and combustion-trapping-atomic absorption spectroscopy (C-T-AAS for Hg).

Most analytes were determined by using the multi-element inductively coupled plasma instruments. Digested samples were diluted as necessary and analyzed using external calibration and internal standards to compensate for slight matrix differences. Off-peak baseline correction and interelement corrections were utilized in ICP-OES, while reaction cell technology was used to remove molecular ion interferences in ICP-MS. Mercury was determined by direct analysis (C-T-AAS) via sample combustion in a stream of oxygen, trapping of Hg^0 on gold, and measurement of Hg vapor by AAS following heating of the gold trap.

All instrumental methods utilized calibration with a blank and at least three standards that bracket the sample concentrations. Calibration check standards (CCVs) and calibration check blanks (CCBs) were analyzed immediately after calibration and following every 10 samples in order to evaluate instrument performance throughout the run.

Data Reporting

The reporting units for each analyte are listed in Table 1. Data Qualifier Definitions are listed in Table 2. The method detection limits (MDL) for each analyte are listed in Table 3. Refer to Table 4 for Method Performance Criteria for Trace Metals.

Table 1. Analytical reporting units.

Matrix	Trace Metals
Sediment	ug/dry g

Table 2. Data Qualifier Definitions.

Qualifier	Definition
B	Analyte detected in the method blank greater than 3X MDL
D	Diluted Value
E	Analyte concentration exceeds the calibration range of the GC/MS for that specific analysis.
I	Analytical interference
J	Analyte detected below the method detection limit
L	Loss due to matrix effect
NA	Not Applicable
U	Analyte not detected
X	Analyte <3X MDL
Y	Spiked level of analyte <50% of the native concentration
*	Outside QA limits, refer to narrative

Table 3. Method Detection Limits

Metals	**Sediment**
Sample Size (g)	1.00
Unit of Measure	Total µg
Ag	0.00986
Al	0.99
As	0.0246
Ba	0.049
Cd	0.00986
Cr	0.099
Cu	0.197
Fe	0.246
Hg	0.00005
Ni	0.246
Pb	0.0493
Sb	0.00493
Se	0.0197
V	0.099
Zn	0.099

Quality Assurance/Quality Control Variances – Sediment

Trace Metals

Blank

Observation

- No variances are reported.

Laboratory Control Sample (Blank Spike)

Observation

- No variances are reported.

Matrix Spike

Observation

- No variances are reported.

Laboratory Duplicate

Observation

- The %RPD for Se exceeded the QC criteria of 30% for RCA1041 (client ID HB18-PAM-S2-1) and duplicate T8038-001D.

Comments

- Results for Se were <3XMDL; this variance does not impact the overall data quality.

Standard Reference Materials

Observation

- No variances are reported.

Table 4. Method Performance Criteria for Trace Metals

Trace Metals		
Sample Type	Minimum Frequency	Acceptance Criteria
Method Blank	One per batch/every 20 samples	No analytes exceed 2X the method detection limits. Higher blank levels are acceptable as long as the observed sample concentrations are not significantly impacted by blank concentrations
Matrix Spike Blank Spike	One per batch/every 20 samples	The recovery for all analytes is between 80-120% for valid spikes. As long as the spiking level is “valid”, or at least as high as the concentration of the analyte in the unspiked sample
Laboratory Duplicate	One per batch/every 20 samples	The QC criterion for valid duplicates and spiked duplicates is ± 30%. Where concentrations are greater than 3x the MDL
Reference Materials NIST SRM	One per batch/every 20 samples	± 20% the certified limit. Where concentrations are greater than 3x the MDL

B&B Laboratories makes no representation or certifications as to the method of sample collection, sample identification, or transporting/handling procedure used prior to the receipt of samples by B&B Laboratories. To the best of my knowledge, the information contained in this report in accurate and complete.

We appreciate the opportunity to serve your analytical needs and please do not hesitate to contact us should you have any questions.

11/2/2018

Juan A. Ramirez
Laboratory Manager

Date

Sediment Samples

Sample/Analyses Description

TERL/B&B Laboratories
Project J18346
Report 18-3808 TM

Kinnetic Labs - Harrison Bay
Sample Inventory

#	Laboratory ID	Sample ID	Collection Date	Receive Date	Analysis	Matrix	Comments	B&B SDG	Client Project #
1	RCA1041	HB18-PAM-S2-1	08/06/18	08/14/18	TM	Sediment		18081401	5089.03
2	RCA1042	HB18-PAM-S3-1	08/06/18	08/14/18	TM	Sediment		18081401	5089.03
3	RCA1043	HB18-PAM-S3-2	08/06/18	08/14/18	TM	Sediment	received broken	18081401	5089.03
4	RCA1044	HB18-PAM-S6-1	08/06/18	08/14/18	TM	Sediment		18081401	5089.03
5	RCA1045	HB18-PAM-S8-1	08/06/18	08/14/18	TM	Sediment		18081401	5089.03
6	RCA1046	HB18-PAM-S11-1	08/06/18	08/14/18	TM	Sediment		18081401	5089.03
7	RCA1047	HB18-PAM-S4-1	08/06/18	08/14/18	TM	Sediment		18081401	5089.03

Trace Metal Concentrations

TERL/B&B Laboratories
Project J18346
Report 18-3808 TM

Kinnetic Labs - Harrison Bay
Trace Element Data
Client Submitted Samples

Client Project #5089.03

SEQ								
LAB ID	T8038-001		T8038-002		T8038-003		T8038-004	
SampleID	RCA1041		RCA1042		RCA1043		RCA1044	
Site	HB18-PAM-S2-1		HB18-PAM-S3-1		HB18-PAM-S3-2		HB18-PAM-S6-1	
Collection date	08/06/18		08/06/18		08/06/18		08/06/18	
Receipt Date	08/14/18		08/14/18		08/14/18		08/14/18	
Matrix	Sediment		Sediment		Sediment		Sediment	
% DRY	55		73		76		51	
% MOISTURE	45		27		24		49	
Method	ICP		ICP		ICP		ICP	
Batch	9468		9468		9468		9468	
Prep Date	09/24/18		09/24/18		09/24/18		09/24/18	
Analysis Date	09/24/18		09/24/18		09/24/18		09/24/18	
Weight	0.103		0.188		0.109		0.112	
UNITS	ppm	Q	ppm	Q	ppm	Q	ppm	Q
Al	45400		29200		29100		49700	
Ba	900		692		683		572	
Cr	63.9		39.1		38		65.5	
Cu	27.3		8.39		8.37		24.3	
Fe	36900		23600		22400		32400	
Ni	37.4		22.2		22.3		30.5	
V	113		66.3		66.8		121	
Zn	91.2		58.9		68.8		90.9	

Method	ICP-MS		ICP-MS		ICP-MS		ICP-MS	
Batch	9448		9448		9448		9448	
Prep Date	09/24/18		09/24/18		09/24/18		09/24/18	
Analysis Date	9/27/2018- 10/17/2018		9/27/2018- 10/17/2018		9/27/2018- 10/17/2018		9/27/2018- 10/17/2018	
Weight	0.103		0.188		0.109		0.112	
UNITS	ppm	Q	ppm	Q	ppm	Q	ppm	Q
Ag	0.188		0.0838		0.0997		0.144	
As	37.8		15.1		13		15.7	
Cd	0.209		0.0617		0.0906		0.16	
Pb	19.8		7.89		7.36		13.1	
Sb	1.08		0.467		0.477		0.535	
Se	0.394		0.103		0.181		0.365	

Method	C-T-AA		C-T-AA		C-T-AA		C-T-AA	
Batch	9442		9442		9442		9442	
Prep Date	09/17/18		09/17/18		09/17/18		09/17/18	
Analysis Date	09/17/18		09/17/18		09/17/18		09/17/18	
Weight	0.036		0.043		0.063		0.037	
UNITS	ppm	Q	ppm	Q	ppm	Q	ppm	Q
Hg	0.0844		0.0152		0.0173		0.0497	

TERL/B&B Laboratories
Project J18346
Report 18-3808 TM

Kinnetic Labs - Harrison Bay
Trace Element Data
Client Submitted Samples

Client Project #5089.03

SEQ						
LAB ID	T8038-005		T8038-006		T8038-007	
SampleID	RCA1045		RCA1046		RCA1047	
Site	HB18-PAM-S8-1		HB18-PAM-S11-1		HB18-PAM-S4-1	
Collection date	08/06/18		08/06/18		08/06/18	
Receipt Date	08/14/18		08/14/18		08/14/18	
Matrix	Sediment		Sediment		Sediment	
% DRY	72		51		69	
% MOISTURE	28		49		31	
Method	ICP		ICP		ICP	
Batch	9468		9468		9468	
Prep Date	09/24/18		09/24/18		09/24/18	
Analysis Date	09/24/18		09/24/18		09/24/18	
Weight	0.145		0.104		0.107	
UNITS	ppm	Q	ppm	Q	ppm	Q
Al	29300		63200		27200	
Ba	668		733		697	
Cr	38.2		83.5		38.9	
Cu	9.22		42		6.59	
Fe	22900		40900		20500	
Ni	23.7		45.1		20.9	
V	68.7		148		62.3	
Zn	59.8		119		52.8	
Method	ICP-MS		ICP-MS		ICP-MS	
Batch	9448		9448		9448	
Prep Date	09/24/18		09/24/18		09/24/18	
Analysis Date	9/27/2018- 10/17/2018		9/27/2018- 10/17/2018		9/27/2018- 10/17/2018	
Weight	0.145		0.104		0.107	
UNITS	ppm	Q	ppm	Q	ppm	Q
Ag	0.084		0.238		0.101	
As	14.2		17.4		11.2	
Cd	0.0711		0.211		0.0917	
Pb	9.21		17.1		6.24	
Sb	0.474		0.722		0.403	
Se	0.134		0.34		0.183	
Method	C-T-AA		C-T-AA		C-T-AA	
Batch	9442		9442		9442	
Prep Date	09/17/18		09/17/18		09/17/18	
Analysis Date	09/17/18		09/17/18		09/17/18	
Weight	0.053		0.021		0.071	
UNITS	ppm	Q	ppm	Q	ppm	Q
Hg	0.0202		0.098		0.0119	

TERL/B&B Laboratories
Project J18346
Report 18-3808 TM

Kinnetic Labs - Harrison Bay
Trace Element Data
Blank Report

Client Project #5089.03

SEQ	
LAB ID	Blank45099
SampleID	Blank
Site	NA
Collection date	NA
Receipt Date	NA
Matrix	Sediment
% DRY	NA
% MOISTURE	NA

Method	ICP				
Batch	9468				
Prep Date	09/24/18				
Analysis Date	09/24/18				
Weight	1				
UNITS	Total micrograms	Q	2X MDL	Q	Actual MDL
Al	0	U	1.98		0.99
Ba	0	U	0.098		0.049
Cr	0	U	0.198		0.099
Cu	0	U	0.394		0.197
Fe	0.258		0.492		0.246
Ni	0	U	0.492		0.246
V	0	U	0.198		0.099
Zn	0	U	0.198		0.099

Method	NA
Batch	NA
Prep Date	NA
Analysis Date	NA
Weight	NA
UNITS	NA
Ag	NA
As	NA
Cd	NA
Pb	NA
Sb	NA
Se	NA

Method	NA
Batch	NA
Prep Date	NA
Analysis Date	NA
Weight	NA
UNITS	NA
Hg	NA

TERL/B&B Laboratories
Project J18346
Report 18-3808 TM

Kinnetic Labs - Harrison Bay
Trace Element Data
Blank Report

Client Project #5089.03

SEQ	
LAB ID	Blank44995
SampleID	Blank
Site	NA
Collection date	NA
Receipt Date	NA
Matrix	Sediment
% DRY	NA
% MOISTURE	NA

Method	NA
Batch	NA
Prep Date	NA
Analysis Date	NA
Weight	NA
UNITS	NA
Al	NA
Ba	NA
Cr	NA
Cu	NA
Fe	NA
Ni	NA
V	NA
Zn	NA

Method	ICP-MS				
Batch	9448				
Prep Date	09/24/18				
Analysis Date	9/27/2018- 10/17/2018				
Weight	1				
UNITS	Total micrograms	Q	2X MDL	Q	Actual MDL
Ag	0.0171		0.01972		0.00986
As	0	U	0.0492		0.0246
Cd	0	U	0.01972		0.00986
Pb	0	U	0.0986		0.0493
Sb	0	U	0.00986		0.00493
Se	0	U	0.0394		0.0197

Method	NA
Batch	NA
Prep Date	NA
Analysis Date	NA
Weight	NA
UNITS	NA
Hg	NA

Kinnetic Labs - Harrison Bay
Trace Element Data
Blank Report

SEQ	
LAB ID	Blank44966
SampleID	Blank
Site	NA
Collection date	NA
Receipt Date	NA
Matrix	Sediment
% DRY	NA
% MOISTURE	NA

Method	NA
Batch	NA
Prep Date	NA
Analysis Date	NA
Weight	NA
UNITS	NA
Al	NA
Ba	NA
Cr	NA
Cu	NA
Fe	NA
Ni	NA
V	NA
Zn	NA

Method	NA
Batch	NA
Prep Date	NA
Analysis Date	NA
Weight	NA
UNITS	NA
Ag	NA
As	NA
Cd	NA
Pb	NA
Sb	NA
Se	NA

Method	C-T-AA				
Batch	9442				
Prep Date	09/17/18				
Analysis Date	09/17/18				
Weight	1				
UNITS	Total micrograms	Q	2X MDL	Q	Actual MDL
Hg	0	U	0.0001		0.00005

Kinnetic Labs - Harrison Bay
Trace Element Data
Blank Spike Report

SEQ						
LAB ID	LCS45100					
SampleID	BS-s2004					
Site	NA					
Collection date	NA					
Receipt Date	NA					
Matrix	Sediment					
% DRY	NA					
% MOISTURE	NA					
Method	ICP					
Batch	9468					
Prep Date	09/24/18					
Analysis Date	09/24/18					
Weight	1					
UNITS	Total micrograms	Q	% REC	Q	MDL	SPIKE AMT
Al	916		92		0.98	1000
Ba	20.2		101		0.049	20
Cr	5.04		101		0.098	5
Cu	5.06		101		0.196	5
Fe	1010		101		0.245	1000
Ni	10.1		101		0.245	10
V	5.08		102		0.098	5
Zn	20.9		105		0.098	20

Method	NA
Batch	NA
Prep Date	NA
Analysis Date	NA
Weight	NA
UNITS	NA
Ag	NA
As	NA
Cd	NA
Pb	NA
Sb	NA
Se	NA

Method	NA
Batch	NA
Prep Date	NA
Analysis Date	NA
Weight	NA
UNITS	NA
Hg	NA

Kinnetic Labs - Harrison Bay
Trace Element Data
Blank Spike Report

SEQ	
LAB ID	LCS44996
SampleID	BS-t2004
Site	NA
Collection date	NA
Receipt Date	NA
Matrix	Sediment
% DRY	NA
% MOISTURE	NA

Method	NA
Batch	NA
Prep Date	NA
Analysis Date	NA
Weight	NA
UNITS	NA
Al	NA
Ba	NA
Cr	NA
Cu	NA
Fe	NA
Ni	NA
V	NA
Zn	NA

Method	ICP-MS					
Batch	9448					
Prep Date	09/24/18					
Analysis Date	9/27/2018- 10/17/2018					
Weight	1					
UNITS	Total micrograms	Q	% REC	Q	MDL	SPIKE AMT
Ag	0.159		106		0.0098	0.15
As	0.519		104		0.0245	0.5
Cd	0.515		103		0.0098	0.5
Pb	4.83		97		0.0489	5
Sb	0.522		104		0.0049	0.5
Se	0.477		95		0.0196	0.5

Method	NA
Batch	NA
Prep Date	NA
Analysis Date	NA
Weight	NA
UNITS	NA
Hg	NA

TERL/B&B Laboratories
Project J18346
Report 18-3808 TM

Kinnetic Labs - Harrison Bay
Trace Element Data
Matrix Spike Report

Client Project #5089.03

SEQ		
LAB ID	T8038-007	T8038-007S
SampleID	RCA1047	RCA1047
Site	HB18-PAM-S4-1	HB18-PAM-S4-1
Collection date	08/06/18	08/06/18
Receipt Date	08/14/18	08/14/18
Matrix	Sediment	Sediment
% DRY	69	69
% MOISTURE	31	31

Method	ICP		ICP					
Batch	9468		9468					
Prep Date	09/24/18		09/24/18					
Analysis Date	09/24/18		09/24/18					
Weight	0.107		0.103					
UNITS	ppm	Q	ppm	Q	% REC	Q	MDL	SPIKE AMT
Al	27200		36600		97		9.5	9727.626
Ba	697		876		92		0.475	194.553
Cr	38.9		91.2		108		0.95	48.638
Cu	6.59		55.1		100		1.9	48.638
Fe	20500		31800		116		2.37	9727.626
Ni	20.9		123		105		2.37	97.276
V	62.3		113		104		0.95	48.638
Zn	52.8		265		109		0.95	194.553

Method	ICP-MS		ICP-MS					
Batch	9448		9448					
Prep Date	09/24/18		09/24/18					
Analysis Date	/27/2018- 10/17/201		9/27/2018- 10/17/2018					
Weight	0.107		0.103					
UNITS	ppm	Q	ppm	Q	% REC	Q	MDL	SPIKE AMT
Ag	0.101		1.5		96		0.095	1.459
As	11.2		16.1		101		0.237	4.864
Cd	0.0917		5.18		105		0.095	4.864
Pb	6.24		56.4		103		0.475	48.638
Sb	0.403		5.44		104		0.0475	4.864
Se	0.183		4.99		99		0.19	4.864

Method	NA	NA
Batch	NA	NA
Prep Date	NA	NA
Analysis Date	NA	NA
Weight	NA	NA
UNITS	NA	NA
Hg	NA	NA

TERL/B&B Laboratories
Project J18346
Report 18-3808 TM

Kinnetic Labs - Harrison Bay
Trace Element Data
Matrix Spike Report

Client Project #5089.03

SEQ		
LAB ID	T8038-006	T8038-006S
SampleID	RCA1046	RCA1046
Site	HB18-PAM-S11-1	HB18-PAM-S11-1
Collection date	08/06/18	08/06/18
Receipt Date	08/14/18	08/14/18
Matrix	Sediment	Sediment
% DRY	51	51
% MOISTURE	49	49

Method	NA	NA
Batch	NA	NA
Prep Date	NA	NA
Analysis Date	NA	NA
Weight	NA	NA
UNITS	NA	NA
Al	NA	NA
Ba	NA	NA
Cr	NA	NA
Cu	NA	NA
Fe	NA	NA
Ni	NA	NA
V	NA	NA
Zn	NA	NA

Method	NA	NA
Batch	NA	NA
Prep Date	NA	NA
Analysis Date	NA	NA
Weight	NA	NA
UNITS	NA	NA
Ag	NA	NA
As	NA	NA
Cd	NA	NA
Pb	NA	NA
Sb	NA	NA
Se	NA	NA

Method	C-T-AA		C-T-AA					
Batch	9442		9442					
Prep Date	09/17/18		09/17/18					
Analysis Date	09/17/18		09/17/18					
Weight	0.021		0.0209					
UNITS	ppm	Q	ppm	Q	% REC	Q	MDL	SPIKE AMT
Hg	0.098		0.368		102		0.00239	0.264

TERL/B&B Laboratories
Project J18346
Report 18-3808 TM

Kinnetic Labs - Harrison Bay
Trace Element Data
Laboratory Duplicate Report

Client Project #5089.03

SEQ		
LAB ID	T8038-001	T8038-001D
SampleID	RCA1041	RCA1041
Site	HB18-PAM-S2-1	HB18-PAM-S2-1
Collection date	08/06/18	08/06/18
Receipt Date	08/14/18	08/14/18
Matrix	Sediment	Sediment
% DRY	55	55
% MOISTURE	45	45

Method	ICP		ICP					
Batch	9468		9468					
Prep Date	09/24/18		09/24/18					
Analysis Date	09/24/18		09/24/18					
Weight	0.103		0.107					
UNITS	ppm	Q	ppm	Q	% RPD	Q	MDL	3XMDL
Al	45400		44600		2		9.15	27.45
Ba	900		909		1		0.458	1.374
Cr	63.9		61.2		4		0.915	2.745
Cu	27.3		26.4		3		1.83	5.49
Fe	36900		35500		4		2.29	6.87
Ni	37.4		35.5		5		2.29	6.87
V	113		111		2		0.915	2.745
Zn	91.2		91		0		0.915	2.745

Method	ICP-MS		ICP-MS					
Batch	9448		9448					
Prep Date	09/24/18		09/24/18					
Analysis Date	9/27/2018- 10/17/2018		9/27/2018- 10/17/2018					
Weight	0.103		0.107					
UNITS	ppm	Q	ppm	Q	% RPD	Q	MDL	3XMDL
Ag	0.188		0.168		11		0.0915	0.2745
As	37.8		33.1		13		0.229	0.687
Cd	0.209		0.21		0		0.0915	0.2745
Pb	19.8		19.8		0		0.458	1.374
Sb	1.08		0.961		12		0.0458	0.1374
Se	0.394		0.183		73	X	0.183	0.549

Method	C-T-AA		C-T-AA					
Batch	9442		9442					
Prep Date	09/17/18		09/17/18					
Analysis Date	09/17/18		09/17/18					
Weight	0.036		0.046					
UNITS	ppm	Q	ppm	Q	% RPD	Q	MDL	3XMDL
Hg	0.0844		0.0844		0		0.00088	0.00109

Kinnetic Labs - Harrison Bay
Trace Element Data
Standard Reference Material Report

SEQ	
LAB ID	SRM45101
SampleID	MESS-3
Site	NA
Collection date	NA
Receipt Date	NA
Matrix	Sediment
% DRY	NA
% MOISTURE	NA

Method	ICP						
Batch	9468						
Prep Date	09/24/18						
Analysis Date	09/24/18						
Weight	0.128		MESS-3	-20%	+20%		
UNITS	ppm	Q	Certified Conc.	Conc.	Conc.	MDL	3XMDL
Al	81800					7.56	22.7
Ba	999					0.378	1.13
Cr	100		105 ± 4	80.8	130.8	0.756	2.27
Cu	32.8		33.9 ± 1.6	25.84	42.6	1.51	4.53
Fe	44300					1.89	5.67
Ni	40		46.9 ± 2.2	35.8	58.9	1.89	5.67
V	240		243 ± 10	186	304	0.756	2.27
Zn	150		159 ± 8	121	200	0.756	2.27

Method	NA
Batch	NA
Prep Date	NA
Analysis Date	NA
Weight	NA
UNITS	NA
Ag	NA
As	NA
Cd	NA
Pb	NA
Sb	NA
Se	NA

Method	NA
Batch	NA
Prep Date	NA
Analysis Date	NA
Weight	NA
UNITS	NA
Hg	NA

Kinnetic Labs - Harrison Bay
Trace Element Data
Standard Reference Material Report

SEQ	
LAB ID	SRM44997
SampleID	MESS-3
Site	NA
Collection date	NA
Receipt Date	NA
Matrix	Sediment
% DRY	NA
% MOISTURE	NA

Method	NA
Batch	NA
Prep Date	NA
Analysis Date	NA
Weight	NA
UNITS	NA
Al	NA
Ba	NA
Cr	NA
Cu	NA
Fe	NA
Ni	NA
V	NA
Zn	NA

Method	ICP-MS						
Batch	9448						
Prep Date	09/24/18						
Analysis Date	9/27/2018- 10/17/2018						
Weight	0.128		MESS-3	-20%	+20%		
UNITS	ppm	Q	Certified Conc.	Conc.	Conc.	MDL	3XMDL
Ag	0.189					0.0756	0.227
As	23		21.2 ± 1.1	16.1	26.8	0.189	0.567
Cd	0.237		.024 ± 0.01	0.011	0.041	0.0756	0.227
Pb	21.9		21.2 ± .07	16.9	25.52	0.378	1.13
Sb	1.11		1.02 ± 0.09	0.74	1.33	0.0378	0.113
Se	0.72		0.72 ± 0.05	0.54	0.92	0.151	0.453

Method	NA
Batch	NA
Prep Date	NA
Analysis Date	NA
Weight	NA
UNITS	NA
Hg	NA

TERL/B&B Laboratories
Project J18346
Report 18-3808 TM

Kinnetic Labs - Harrison Bay
Trace Element Data
Standard Reference Material Report

Client Project #5089.03

SEQ	
LAB ID	SRM44967
SampleID	MESS-3
Site	NA
Collection date	NA
Receipt Date	NA
Matrix	Sediment
% DRY	NA
% MOISTURE	NA

Method	NA
Batch	NA
Prep Date	NA
Analysis Date	NA
Weight	NA
UNITS	NA
Al	NA
Ba	NA
Cr	NA
Cu	NA
Fe	NA
Ni	NA
V	NA
Zn	NA

Method	NA
Batch	NA
Prep Date	NA
Analysis Date	NA
Weight	NA
UNITS	NA
Ag	NA
As	NA
Cd	NA
Pb	NA
Sb	NA
Se	NA

Method	C-T-AA						
Batch	9442						
Prep Date	09/17/18						
Analysis Date	09/17/18						
Weight	0.024		MESS-3	-20%	+20%		
UNITS	ppm	Q	Certified Conc.	Conc.	Conc.	MDL	3XMDL
Hg	0.0919		0.091 ± 0.009	0.066	0.120	0.0021	0.0062

Supporting Documents

Shipping, Sample Receiving, and Project Initiation Documents

B&B Laboratories, Inc.

TDI Brooks

SAMPLE RECEIVING/INTEGRITY REPORT

Job #: J18346 Date Received: 08/14/2018 Time Arrived: 09:33

Received by: Amanda Brewster SDG#: 18081401

Client: Kinnetic Labs - Harrison Bay Sender: Kinnetics: Mark Savoie

Number of Shipping Containers: 1 of 1

Comments:
medium sized blue cooler

Airbill Present: ☑ Yes ☐ No Shipping Company: Fed Ex

Tracking Number: 772962728919

Comments: priority overnight

Container Secured? ☑ Yes ☐ No Comments: taped shut

Custody Seals? ☑ Yes ☐ No

☑ Custody Seals intact on container

☐ Custody Seals broken on container

Comments: custody seal on top of tape
(see Sample Custody Corrective Action Report)

Chain of Custody Records: ☑ Shipped with samples Notes:

☐ No COCs received

Preservation Conditions: ☐ Ice ☑ Blue ice ☐ Dry ice ☐ None

Comments:

Temperature on receipt (°C): 2.7 Thermometer #: T5

Temperature blank: ☑ Yes (°C): 2.1 ☐ No

(Note: If temperature receipt differs from required conditions, see Sample Custody Corrective Action Report)

Condition of Samples: ☐ Sample containers intact

☑ Sample containers/lids broken/leaking*
**(see Sample Custody Corrective Action Report)*

Sample custody seals intact: ☐ Yes ☐ No ☑ None

Sample Labels: ☑ Sample labels agree with COC

☐ Sample discrepanices *(see Sample Custody Corrective Action Report)*

Number of Samples Received: 7 sediments

Samples Checked in by: Amanda Brewster Date: 08/14/2018 Time: 11:10

Cooler Description: medium blue

SDG: 18081401

Custody seal on cooler? [✓ Yes] No

Cooler 1 of 1

Custody seal intact? [✓ Yes] No N/A
on top of tape

Cooler signed for by
Name: amanda
Date: 8/14/18
Time: 9:33

Cooler sealed shut? [✓ Yes] No

Cooler sealed with what: tape

Ice type: [✓ Blue ice] Wet ice Dry ice None

7 sediments

Thermometer used: T5

Cooler temperature: 2.7°C

Temperature blank: 2.1°C

one broken jar:
HB18-PAM-S3-2
transferred to
new jar.

FedEx
TRK# 0201 7729 6272 8919

TUE – 14 AUG 10:30A
PRIORITY OVERNIGHT
ASR
77845
TX-US **IAH**

XH CLLA

EXP 11/18

#258164 08/13 552J1/3309/DCA5

[redacted]

CUSTODY SEAL

Signature: ______ Date/Time: 8/13/18 1330

Rev. 0

Amanda Brewster

Kinnetic - MOA

From: TrackingUpdates@fedex.com
Sent: Monday, August 13, 2018 2:49 PM
To: amandabrewster@tdi-bi.com
Subject: FedEx Shipment 772962728919 Notification

Coming 8/14/18

This shipment is scheduled to be sent on 08/13/2018.

See "Preparing for Delivery" for helpful tips

Tracking # 772962728919

Anticipated ship date:
Mon, 8/13/2018

KINNETIC LABORATORIES, INC
KINNETIC LABORATORIES, INC
ANCHORAGE, AK 99501
US

Initiated

Scheduled delivery:
Tue, 8/14/2018 by 10:30 am

Amanda Brewster
B&B Laboratories
14931B South Dowling Road
COLLEGE STATION, TX
77845
US

Shipment Facts

Tracking number:	772962728919
Reference:	MOA 5089
Service type:	FedEx Priority Overnight®
Packaging type:	Your Packaging
Number of pieces:	1
Weight:	20.00 lb.
Special handling/Services:	Adult Signature Required Deliver Weekday

Preparing for Delivery

To help ensure successful delivery of your shipment, please review the below.

Won't be in?

If an adult (age and required identification vary by country) will not

Chain of Custody Record

Page 1 of 1

To: **B&B LABORATORIES, INC.** 14391 B South Dowling Rd. College Station, TX 77845 Phone: (979) 693-3446 Contact: Amanda Brewster	KLI PO #: AK18-1020 Quote #: Q2018-LAB072601 Lab #:	From: Kinnetic Laboratories, Inc 704 West 2nd Ave. Anchorage, AK 99501 (907) 276-6178 Contact: Mark Savoie

Project: 2018 HARRISON BAY MMP **Matrix:** Sediment **Project #:** 5089.03

Complete by: Standard TAT

SampleID	StationID	Sample Date	Sample Time	Sample Type	Analysis	Container	Pres	No. of Bottles	LabID	Condition Upon Receipt
✓ HB18-PAM-S2-1	S2	8/6/18	1036 ✓	Grab	PAH/AHC/METALS	250-mL WMGJ	4° C	1		good
✓ HB18-PAM-S3-1	S3		0929 ✓	Grab	PAH/AHC/METALS	250-mL WMGJ	4° C	1		good
✓ HB18-PAM-S3-2 *	S3		0929 ✓	Grab	PAH/AHC/METALS	250-mL WMGJ	4° C	1		broken
✓ HB18-PAM-S6-1	S6		1358 ✓	Grab	PAH/AHC/METALS	250-mL WMGJ	4° C	1		
✓ HB18-PAM-S8-1	S8		1515 ✓	Grab	PAH/AHC/METALS	250-mL WMGJ	4° C	1		
✓ HB18-PAM-S11-1	S11		1709 ✓	Grab	PAH/AHC/METALS	250-mL WMGJ	4° C	1		
✓ HB18-PAM-S4-1	S4	↓	1207 ✓	Grab	PAH/AHC/METALS	250-mL WMGJ	4° C	1		
										JMS

Data Report MUST include the following: Sample ID, Analytical Method, Detection Limit, Date of Extraction if applicable, Date of Analysis, Analytical Results, and Signature of QA Reviewer. All times on this sheet are military time. Email sample receipt confirmations, PDF reports, and EDDs to msavoie@kinneticlabs.net. EDD REQUIRED.

Special Instructions/Comments: See quote list of analytes and detection limits. Report on a dry weight basis.

Janet M. Savoie JMS

JMS

~~Sampled and~~ Relinquished By:	Date/Time:	Transporter	Received By:	Date/Time:
Janet M. Savoie	8/13/2018 1130	FEDEX	amanda Brewster	8/14/18 11:10
Relinquished By:	**Date/Time:**	**Transporter**	**Received By:**	**Date/Time:**

v20020904

GL

B&B
B&B Laboratories, Inc.

Agreement for Services

TDI Brooks

Lab Contact: Juan Ramirez, Laboratory Manager
14391B South Dowling Road
College Station,TX 77845
Phone: (979) 693-3446
email: juanramirez@tdi-bi.com

Sample Shipping Contact: Amanda Brewster, Sample Custodian
14391B South Dowling Road
College Station TX 77845
Phone: (979) 693-3446
email: amandabrewster@tdi-bi.com

Contact Information	
Project Manager:	MARK SAVOIE
Phone:	(907) 276-6178
Street Address City, State Zip:	704 W. 2nd AVE. ANCHORAGE, AK 99501
Fax:	—
Email:	MSAVOIE@KINNETICLABS.NET

Description of Work	
Project Name:	HBMMP
Project Number:	5089
Requested Turn-Around (working days)	45 DAYS
Submission Date:	SHIP OFF SLOPE 8/10/18
Purchase Order #:	AK18-1020

Payment Terms: Net 30 from date of invoice

All overdue payments are subject to an additional interest and service charge of one and one-half percent (1.5%) per month, from the due date until the date payment is received.

Billing corrections must be requested within 30 days of the invoice date.

Billing Information	
Attention to:	BRENDA GUMMINGER
Company:	KINNETIC LABORATORIES, INC.
Street Address City, State, Zip:	704 W. 2nd AVE. ANCHORAGE, AK 99501
Phone:	(907) 276-6178
Email:	BGUMMINGER@KINNETICLABS.NET

Sample Storage and Disposal:

B&B Laboratories shall dispose of Client's samples 30 days after analytical report is issued, unless instructed to hold samples for an alternate period of time, or, request is made for samples to be returned to the Client. Longer storage periods may be requested (as space allows) for an additional charge.

If sample disposal is requested, it will be at cost to the client or, samples may be returned to client, at client's cost.

8/10/18

Signature Date/Time

**Signature indicates agreement with these terms and conditions*

Rev 1: 05/28/2015

SAMPLE CUSTODY CORRECTIVE ACTION REPORT

Job #: J18346 Date/Time Received: 08/14/2018, 9:33 SCCAR-109

Client: Kinnetic Labs - Harrison Bay SDG #: 18081401

Description of Discrepancy:	Explanation:
sediment sample received broken: HB18-PAM-53-2	transferred to new container upon receipt

Documentation of client and laboratory manager notification by sample custodian.

Sample Custodian: Amanda Brewster Date/Time: 08/14/2018, 15:19

Client contacted by: ☑ E-mail (see attached) ☐ Phone ☐ Not Contacted

Laboratory Manager: Juan Ramirez

Resolution of Discrepancy: Can be completed by Client, Sample Custodian or Lab Manager

Client: Date: Time:

Sample Custodian: Amanda Brewster Date: 08/14/2018 Time: 15:19

Lab Manager: Date: Time:

notified client via email

From: Amanda Brewster <amandabrewster@tdi-bi.com>
Sent: Tuesday, August 14, 2018 3:19 PM
To: 'msavoie@kinneticlabs.net'
Subject: RE: samples received 8/14/18

Hi Mark,

Sorry I forgot to mention...

Sample HB18-PAM-S3-2 arrived broken, but frozen solid.
We were able to transfer this to a new jar upon receipt.

Regards,
Amanda

From: Amanda Brewster [mailto:amandabrewster@tdi-bi.com]
Sent: Tuesday, August 14, 2018 3:18 PM
To: 'msavoie@kinneticlabs.net'
Subject: samples received 8/14/18

Hi Mark,

We received your samples this morning in good condition.
The internal temperature of the cooler was 2.7ºC, and the temp blank was 2.1ºC.
A PDF of the signed COC is attached for your records.

Would you like the cooler and ice returned? If so, could I please have a Fed Ex acct # to use for the return shipment?

Regards,
Amanda

Amanda Brewster
Sample Custodian

B&B
B&B Laboratories, Inc.

B&B Laboratories
14391B South Dowling Road
College Station, Texas 77845

Phone: (979) 693-3446
Email: amandabrewster@tdi-bi.com

Amanda Brewster

From: Juan Ramirez <juanramirez@tdi-bi.com>
Sent: Wednesday, August 15, 2018 9:05 AM
To: 'Amanda Brewster'; 'Donell Frank'
Cc: msavoie@kinneticlabs.com
Subject: RE: samples received 8/14/18

Hello Mark,

We're ok on samples since everything was frozen.

Thanks,

Juan

Juan Ramirez
Environmental Laboratory Manager

B&B Laboratories, Inc.

TDI-Brooks International, Inc.
14391 South Dowling Rd.
College Station, Texas 77845

Office: 979.693.3446
Cell: 979.777.0793

juanramirez@tdi-bi.com

http://tdi-bi.com/

Could you please take a moment and answer a quick survey? We would like to know how we can improve our services.

From: Amanda Brewster [mailto:amandabrewster@tdi-bi.com]
Sent: Wednesday, August 15, 2018 8:18 AM
To: 'Juan Ramirez'; 'Donell Frank'
Subject: FW: samples received 8/14/18

Juan,

Do you think they need to send the backup sample for the jar that arrived broken?
It was frozen solid and inside a bubble wrap envelope so the lab was able to transfer it into a new jar upon receipt.

Regards,
Amanda

From: Mark Savoie [mailto:msavoie@kinneticlabs.net] **On Behalf Of** Mark Savoie
Sent: Tuesday, August 14, 2018 5:47 PM
To: 'Amanda Brewster'; msavoie@kinneticlabs.net
Cc: jsavoie@kinneticlabs.net; 'Gary Lawley'
Subject: RE: samples received 8/14/18

Amanda –

Thanks for the update. If you think the broken sample is an issue, let us know, as we do have a backup/archive sample that we could send as a replacement.

You can keep the cooler and ice as they aren't worth the return shipping costs to Alaska.

Regards,

Mark

From: Amanda Brewster [mailto:amandabrewster@tdi-bi.com]
Sent: Tuesday, August 14, 2018 12:19 PM
To: msavoie@kinneticlabs.net
Subject: RE: samples received 8/14/18

Hi Mark,

Sorry I forgot to mention…

Sample HB18-PAM-S3-2 arrived broken, but frozen solid.
We were able to transfer this to a new jar upon receipt.

Regards,
Amanda

From: Amanda Brewster [mailto:amandabrewster@tdi-bi.com]
Sent: Tuesday, August 14, 2018 3:18 PM
To: 'msavoie@kinneticlabs.net'
Subject: samples received 8/14/18

Hi Mark,

We received your samples this morning in good condition.
The internal temperature of the cooler was 2.7ºC, and the temp blank was 2.1ºC.
A PDF of the signed COC is attached for your records.

Would you like the cooler and ice returned? If so, could I please have a Fed Ex acct # to use for the return shipment?

Regards,
Amanda

TERL Copy

B&B Laboratories
Chain of Custody
Project: J18346 Kinnetic Labs - Harrison Bay sediments to TERL for TM analysis

PO2018-LAB082903

sent: 9/14/18

#	Client Name	Lab ID	Sample ID	Collection Date	Receive Date	Matrix	Comments	SDG	Client Project #
1	Kinnetic Labs - Harrison Bay	RCA1041	HB18-PAM-S2-1	08/06/18	08/14/18	SED		18081401	5089.03
2	Kinnetic Labs - Harrison Bay	RCA1042	HB18-PAM-S3-1	08/06/18	08/14/18	SED		18081401	5089.03
3	Kinnetic Labs - Harrison Bay	RCA1043	HB18-PAM-S3-2	08/06/18	08/14/18	SED		18081401	5089.03
4	Kinnetic Labs - Harrison Bay	RCA1044	HB18-PAM-S6-1	08/06/18	08/14/18	SED		18081401	5089.03
5	Kinnetic Labs - Harrison Bay	RCA1045	HB18-PAM-S8-1	08/06/18	08/14/18	SED		18081401	5089.03
6	Kinnetic Labs - Harrison Bay	RCA1046	HB18-PAM-S11-1	08/06/18	08/14/18	SED		18081401	5089.03
7	Kinnetic Labs - Harrison Bay	RCA1047	HB18-PAM-S4-1	08/06/18	08/14/18	SED		18081401	5089.03

B&B Signature 9-14-18 Date 10:10 Time

TERL Signature Bob Taylor 9-14-18 Date 10:10 Time

Appendix B

Willow Marine Monitoring Program
Benthic Infauna Results

November 2018

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Annelid Identifications by Leslie Harris

Family	Taxon	Harrison Bay 6 Aug 2018	Taxonomist comments & notes
Capitellidae	Amastigos sp Beaufort 1	x	Capitellid genus with only hooks, no capillaries, and very distinct. Only 3 species in the genus, from southern California, Pacific Panama, and Virginia. However, the shape is very similar to the Beaufort Capitella capitata complex & the specimens are smaller than the C. capitata complex specimens so I wonder if these are aberrant or juvenile C. c.c.
Ampharetidae	Ampharete sp Beaufort 1	x	The Harrison Bay specimens which key to A. vega don't match the descriptions or figures in Holthe 1986 & Jirkov 1989 in several characters. The differences are : length of branchiae (those shown in the orig. illustration by Wiren 1883 are easily 3X the length of the Harrison Bay branchiae), arrangement of the branchiae (all in single transverse line with no gap between the two groups while HB worms are arranged in 2 rows [3+1] and there is a slight gap), length of paleae (reaching anterior margin, but shorter in HB worms), number of teeth in uncini (3 teeth in each row, thoracic in 2 rows, abdominal in 3 but HB worms have 4-5 teeth per row & both abdominal & thoracic appear to have 2 rows), pygidium (small papillae but HB have 2 long lateral cirri). These are likely to belong to a similar, undescribed species which I have called Ampharete sp Beaufort 1.
Paraonidae	Aricidea (Aricidea) sp Beaufort 1	x	Similar to A. (A.) pseudoarticulata from southern California; might have been identified as A. (A.) minuta in the past
Nephtyidae	Bipalponepthys cornuta	x	
Capitellidae	Capitella capitata Cmplx	x	
Cirratulidae	Chaetozone ruffi	x	
Sabellidae	Chone sp Beaufort 1	x	different staining pattern than others, very small specimen
Phyllodocidae	Eteone longa_flava Cmplx	x	My terminology, following comments by F. Pleijel 1993; the problems have not yet been resolved
	Euclymeninae	x	
Orbiniidae	Leitoscoloplos sp	x	Probably what the others called L. acutus
Spionidae	Marenzellaria arctia	x	
Oligochaeta	Oligochaeta UI	x	
Orbiniidae	Orbinia sp	x	
Spionidae	Prionospio cirrifera	x	I used Prionospio, changed to Minuspio in report
Spionidae	Pygospio elegans	x	
Orbiniidae	Scoloplos armiger Cmplx	x	
Sphaerodoridae	Sphaerodoridium sp Beaufort 1	x	This species has probably been identified as Sphaerodoropsis minuta in the past however it does not match the redescription by Capa et al 2016 and is smaller, with a different pattern of macrotubercles & parapodial papillae than sp 1.
Sphaerodoridae	Sphaerodoridium sp Beaufort 2	x	This species has probably been identified as Sphaerodoropsis minuta in the past however it does not match the redescription by Capa et al 2016.
Trichobranchidae	Terebellides sp Beaufort 1	x	Differs in several respects from the neotype description of T. stroemi by Parapar & Hutchings 2014: stain pattern, number of rows of thoracic uncini, shape of geniculate hooks. In light of the recent paper by Nygren et al 2018 that found 15 species, most of them cryptic, in the NE Atlantic I feel keeping the Harrison Bay specimens separate as a provisional species is warranted.
Cirratulidae	Tharyx alaskensis	x	
Travisiidae	Travisia cf forbesi	x	

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Appendix C

Willow Marine Monitoring Program
Trawl Results

November 2018

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2018 Harrison Bay - Trawl Data

Station	Rep #	Trawl Distance (m)	Trawl Area (m^2)	SampID	Date Collected	Analysis Type	ID_Type	Group	Taxon	Common Name	Catch/ 100 m^2	Count	Length	Length_ Unit	Stage	Dispostion
T0	1	848	2120		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	75	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	78	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	82	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	96	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	92	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	78	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	101	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	74	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	78	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	80	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	99	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	83	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	80	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	68	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	81	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	82	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	76	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	90	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	78	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	73	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	69	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	85	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	67	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Coregonus autumnalis	Arctic cisco	0.05	1	168	mm	adult	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Coregonus autumnalis	Arctic cisco	0.05	1	125	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Coregonus autumnalis	Arctic cisco	0.05	1	116	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Coregonus autumnalis	Arctic cisco	0.05	1	121	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Myoxocephalus quadricornis	Fourhorn sculpin	0.05	1	149	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Myoxocephalus quadricornis	Fourhorn sculpin	0.05	1	144	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Myoxocephalus quadricornis	Fourhorn sculpin	0.05	1	86	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Myoxocephalus quadricornis	Fourhorn sculpin	0.05	1	74	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Myoxocephalus quadricornis	Fourhorn sculpin	0.05	1	97	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Myoxocephalus quadricornis	Fourhorn sculpin	0.05	1	78	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Myoxocephalus quadricornis	Fourhorn sculpin	0.05	1	88	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Myoxocephalus quadricornis	Fourhorn sculpin	0.05	1	66	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Myoxocephalus quadricornis	Fourhorn sculpin	0.05	1	63	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Osmerus mordax	Rainbow smelt	0.05	1	94	mm	juv	Release
T0	1	848	2120		08/08/2018	ID	Field	Fish	Pleuronectes glacialis	Arctic flounder	0.05	1	186	mm	adult	Release
T0	1	848	2120	HB18-TWL-T0-1	08/08/2018	ID	Lab	Amphipoda	Gammarus setosus	Amphipod	0.05	1				Voucher
T0	1	848	2120	HB18-TWL-T0-1	08/08/2018	ID	Lab	Mysida	Neomysis rayii	Mysid	0.09	2	>40	mm	Brood	Voucher
T0	1	848	2120	HB18-TWL-T0-1	08/08/2018	ID	Lab	Hydrozoa	Tubularia indivisa		P	P	colonial			Voucher
T0	1	848	2120	HB18-TWL-T0-1	08/08/2018	ID	Lab	Ascidiacea	Rhizomolgula globularis	tunicate	0.05	1				Voucher

2018 Harrison Bay - Trawl Data

Station	Rep #	Trawl Distance (m)	Trawl Area (m^2)	SampID	Date Collected	Analysis Type	ID_Type	Group	Taxon	Common Name	Catch/ 100 m^2	Count	Length	Length_ Unit	Stage	Dispostion
T1	1	807	2018		08/07/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	82	mm	juv	Release
T1	1	807	2018		08/07/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	79	mm	juv	Release
T1	1	807	2018		08/07/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	86	mm	juv	Release
T1	1	807	2018		08/07/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	83	mm	juv	Release
T1	1	807	2018		08/07/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	75	mm	juv	Release
T1	1	807	2018		08/07/2018	ID	Field	Fish	Myoxocephalus quadricornis	Fourhorn sculpin	0.05	1	152	mm	adult	Release
T1	1	807	2018		08/07/2018	ID	Field	Fish	Myoxocephalus quadricornis	Fourhorn sculpin	0.05	1	112	mm	juv	Release
T1	1	807	2018		08/07/2018	ID	Field	Fish	Myoxocephalus quadricornis	Fourhorn sculpin	0.05	1	104	mm	juv	Release
T1	1	807	2018		08/07/2018	ID	Field	Mysida	Mysida	Mysid	0.35	7				Release
T1	1	807	2018		08/07/2018	ID	Field	Isopoda	Saduria spp.	Isopod	0.25	5				Release
T2	1	989	2473		08/07/2018	ID	Field	Isopoda	Saduria spp.	Isopod	0.24	6				Release
T2	1	989	2473	HB18-TWL-T2-1	08/07/2018	ID	Lab	Gastropoda	Cryptonatia affinis	Arctic moon snail	0.08	2				Voucher
T2	1	989	2473	HB18-TWL-T2-1	08/07/2018	ID	Lab	Jelly	Cnidaria, unid.	Jelly (pelagic)	0.04	1				Voucher
T3	1	842	2105		08/07/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	81	mm	juv	Release Mort
T3	1	842	2105		08/07/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	71	mm	juv	Release
T3	1	842	2105		08/07/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	72	mm	juv	Release
T3	1	842	2105	HB18-TWL-T3-1	08/07/2018	ID	Lab	Amphipoda	Gammaracanthus loricatus	Amphipod	0.05	1				Voucher
T3	1	842	2105		08/07/2018	ID	Field	Mysida	Mysida	Mysid	0.71	15				Release
T3	1	842	2105	HB18-TWL-T3-1	08/07/2018	ID	Lab	Mysida	Mysis segerstralei	Mysid	0.05	1				Voucher
T3	1	842	2105	HB18-TWL-T3-1	08/07/2018	ID	Lab	Mysida	Neomysis rayii	Mysid	0.05	1				Voucher
T3	1	842	2105		08/07/2018	ID	Field	Isopoda	Saduria spp.	Isopod	2.14	45	various			Release
T3	1	842	2105	HB18-TWL-T3-1	08/07/2018	ID	Lab	Gastropoda	Cryptonatia affinis	Arctic moon snail	0.10	2				Voucher
T3	1	842	2105		08/07/2018	ID	Field	Jelly	Cnidaria, unid.	Jelly (pelagic)	0.19	4				Release
T3	2	1021	2553		08/07/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.04	1	70	mm	juv	Release
T3	2	1021	2553		08/07/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.04	1	82	mm	juv	Release
T3	2	1021	2553		08/07/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.04	1	88	mm	juv	Release
T3	2	1021	2553	HB18-TWL-T3-2	08/07/2018	ID	Lab	Euphausiidae	Thysanoessa inermis	Pelagic euphausiid	0.43	11				Voucher
T3	2	1021	2553		08/07/2018	ID	Field	Euphausiidae	Thysanoessa inermis	Pelagic euphausiid						Release
T3	2	1021	2553	HB18-TWL-T3-2	08/07/2018	ID	Lab	Mysida	Mysis segerstralei	Mysid	0.16	4				Voucher
T3	2	1021	2553		08/07/2018	ID	Field	Mysida	Mysis segerstralei	Mysid						Release
T3	2	1021	2553		08/07/2018	ID	Field	Isopoda	Saduria spp.	Isopod	1.21	31	various			Release
T3	2	1021	2553		08/07/2018	ID	Field	Gastropoda	Cryptonatia affinis	Arctic moon snail	0.08	2				Release
T3	2	1021	2553		08/07/2018	ID	Field	Algae (Dead)	Algae	Drift (dead)						Release
T3	2	1021	2553	HB18-TWL-T3-2	08/07/2018	ID	Lab	Polychaeta Tube	Polychaete tubes, empty	Worm tubes, empty		numerous				Voucher
T4	1	893	2233		08/07/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.04	1	60	mm	juv	Release
T4	1	893	2233		08/07/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.04	1	78	mm	juv	Release
T4	1	893	2233		08/07/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.04	1	67	mm	juv	Release
T4	1	893	2233		08/07/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.04	1	80	mm	juv	Release
T4	1	893	2233		08/07/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.04	1	84	mm	juv	Release
T4	1	893	2233		08/07/2018	ID	Field	Mysida	Mysida	Mysid	1.61	36				Release
T4	1	893	2233		08/07/2018	ID	Field	Isopoda	Saduria spp.	Isopod	2.73	61	various			Release
T4	1	893	2233		08/07/2018	ID	Field	Gastropoda	Cryptonatia affinis	Arctic moon snail	0.04	1				Release
T4	1	893	2233		08/07/2018	ID	Field	Algae (Dead)	Algae	Drift (dead)						Release

2018 Harrison Bay - Trawl Data

Station	Rep #	Trawl Distance (m)	Trawl Area (m^2)	SampID	Date Collected	Analysis Type	ID_Type	Group	Taxon	Common Name	Catch/ 100 m^2	Count	Length	Length_ Unit	Stage	Dispostion
T4	1	893	2233	HB18-TWL-T4-1	08/07/2018	ID	Lab	Bivalve	Portlandia spp.	Clam	0.04	1	55	mm		Voucher
T4	1	893	2233		08/07/2018	ID	Field	Jelly	Cnidaria, unid.	Jelly (pelagic)	0.04	1				Release
T4	1	893	2233		08/07/2018	ID	Field	Polychaeta Tube	Polychaete tubes, empty	Worm tubes, empty		numerous				Release
T5	1	852	2130		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	75	mm	juv	Release
T5	1	852	2130		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	94	mm	juv	Release
T5	1	852	2130		08/08/2018	ID	Field	Fish	Liparis tunicatus	Kelp snailfish	0.05	1	54	mm	juv	Release
T5	1	852	2130	HB18-TWL-T5-1	08/08/2018	ID	Lab	Amphipoda	Gammaracanthus loricatus	Amphipod	0.05	1				Voucher
T5	1	852	2130		08/08/2018	ID	Field	Mysida	Mysida	Mysid	0.56	12				Release
T5	1	852	2130		08/08/2018	ID	Field	Isopoda	Saduria spp.	Isopod	13.85	295	various			Release
T5	1	852	2130	HB18-TWL-T5-1	08/08/2018	ID	Lab	Polychaeta	Phyllodocida, unid.	Worm	0.05	1				Voucher
T5	1	852	2130		08/08/2018	ID	Field	Polychaeta	Phyllodocida, unid.	Worm		P				Release
T5	1	852	2130		08/08/2018	ID	Field	Polychaeta Tube	Polychaete tubes, empty	Worm tubes, empty		numerous				Release
T6	1	958	2395		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.04	1	77	mm	juv	Release
T6	1	958	2395		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.04	1	89	mm	juv	Release
T6	1	958	2395	HB18-TWL-T6-1	08/08/2018	ID	Lab	Amphipoda	Acanthostepheia behringiensis	amphipod	0.08	2				Voucher
T6	1	958	2395	HB18-TWL-T6-1	08/08/2018	ID	Lab	Amphipoda	Atylus carinatus	amphipod	0.04	1				Voucher
T6	1	958	2395	HB18-TWL-T6-1	08/08/2018	ID	Lab	Amphipoda	Onisimis affinis	amphipod	0.08	2	12-14	mm		Voucher
T6	1	958	2395		08/08/2018	ID	Field	Mysida	Mysida	Mysid	0.58	14				Release
T6	1	958	2395		08/08/2018	ID	Field	Isopoda	Saduria spp.	Isopod	4.84	116	various			Release
T6	1	958	2395		08/08/2018	ID	Field	Gastropoda	Cryptonatia affinis	Arctic moon snail	0.04	1				Release
T6	1	958	2395		08/08/2018	ID	Field	Gastropoda	Gastopoda egg case	Moon snail egg cas	0.04	1				Release
T6	1	958	2395	HB18-TWL-T6-1	08/08/2018	ID	Lab	Gastropoda	Volutopsius castaneus?	Whelk	0.04	1				Voucher
T7	1	954	2385		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.04	1	85	mm	juv	Release
T7	1	954	2385	HB18-TWL-T7-1	08/08/2018	ID	Lab	Isopoda	Saduria entomon	Isopod	0.04	1	75	mm		Voucher
T7	1	954	2385		08/08/2018	ID	Field	Isopoda	Saduria spp.	Isopod	5.24	125	various			Release
T7	1	954	2385	HB18-TWL-T7-1	08/08/2018	ID	Lab	Hydrozoa	Tubularia indivisa		P	P	colonial			Voucher
T7	1	954	2385		08/08/2018	ID	Field	Jelly	Cnidaria, unid.	Jelly (pelagic)	0.92	22				Release
T7	1	954	2385		08/08/2018	ID	Field	Polychaeta Tube	Polychaete tubes, empty	Worm tubes, empty		numerous				Release
T8	1	922	2305		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.04	1	102	mm	juv	Release
T8	1	922	2305		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.04	1	76	mm	juv	Release
T8	1	922	2305		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.04	1	79	mm	juv	Release
T8	1	922	2305		08/08/2018	ID	Field	Mysida	Mysida	Mysid	0.04	1				Release
T8	1	922	2305		08/08/2018	ID	Field	Isopoda	Saduria spp.	Isopod	0.43	10	various			Release
T8	1	922	2305		08/08/2018	ID	Field	Gastropoda	Cryptonatia affinis	Arctic moon snail	0.17	4				Release
T8	1	922	2305		08/08/2018	ID	Field	Jelly	Cnidaria, unid.	Jelly (pelagic)	0.30	7				Release
T8	1	922	2305		08/08/2018	ID	Field	Polychaeta Tube	Polychaete tubes, empty	Worm tubes, empty		numerous				Release
T9	1	827	2068		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	66	mm	juv	Release
T9	1	827	2068		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	76	mm	juv	Release
T9	1	827	2068		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	74	mm	juv	Release
T9	1	827	2068		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	76	mm	juv	Release
T9	1	827	2068		08/08/2018	ID	Field	Fish	Liparis tunicatus	Kelp snailfish	0.05	1	66	mm	juv	Release
T9	1	827	2068		08/08/2018	ID	Field	Mysida	Mysida	Mysid	0.92	19				Release
T9	1	827	2068		08/08/2018	ID	Field	Isopoda	Saduria spp.	Isopod	0.63	13	various			Release

2018 Harrison Bay - Trawl Data

Station	Rep #	Trawl Distance (m)	Trawl Area (m^2)	SampID	Date Collected	Analysis Type	ID_Type	Group	Taxon	Common Name	Catch/ 100 m^2	Count	Length	Length_ Unit	Stage	Dispostion
T9	1	827	2068		08/08/2018	ID	Field	Gastropoda	Cryptonatia affinis	Arctic moon snail	0.15	3				Release
T9	1	827	2068		08/08/2018	ID	Field	Gastropoda	Gastopoda egg case	Moon snail egg cas	0.05	1				Release
T10	1	792	1980		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	91	mm	juv	Release
T10	1	792	1980		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	76	mm	juv	Release
T10	1	792	1980		08/08/2018	ID	Field	Fish	Coregonus autumnalis	Arctic cisco	0.05	1	148	mm	juv	Release Mort
T10	1	792	1980		08/08/2018	ID	Field	Fish	Myoxocephalus quadricornis	Fourhorn sculpin	0.05	1	99	mm	juv	Release
T10	1	792	1980		08/08/2018	ID	Field	Fish	Myoxocephalus quadricornis	Fourhorn sculpin	0.05	1	92	mm	juv	Release
T10	1	792	1980		08/08/2018	ID	Field	Fish	Myoxocephalus quadricornis	Fourhorn sculpin	0.05	1	124	mm	juv	Release
T10	1	792	1980		08/08/2018	ID	Field	Fish	Myoxocephalus quadricornis	Fourhorn sculpin	0.05	1	76	mm	juv	Release
T10	1	792	1980		08/08/2018	ID	Field	Fish	Myoxocephalus quadricornis	Fourhorn sculpin	0.05	1	74	mm	juv	Release
T10	1	792	1980		08/08/2018	ID	Field	Fish	Myoxocephalus quadricornis	Fourhorn sculpin	0.05	1	149	mm	juv	Release
T10	1	792	1980		08/08/2018	ID	Field	Fish	Myoxocephalus quadricornis	Fourhorn sculpin	0.05	1	85	mm	juv	Release
T10	1	792	1980		08/08/2018	ID	Field	Amphipoda	Gammarida		0.05	1				Release
T10	1	792	1980		08/08/2018	ID	Field	Isopoda	Saduria spp.	Isopod	0.05	1				Release
T11	1	827	2068		08/08/2018	ID	Field	Amphipoda	Gammarida		0.05	1				Release
T11	1	827	2068		08/08/2018	ID	Field	Mysida	Mysida	Mysid	0.10	2				Release
T11	1	827	2068		08/08/2018	ID	Field	Isopoda	Saduria spp.	Isopod	2.37	49	various			Release
T11	1	827	2068		08/08/2018	ID	Field	Gastropoda	Cryptonatia affinis	Arctic moon snail	0.05	1				Release
T11	1	827	2068		08/08/2018	ID	Field	Jelly	Cnidaria, unid.	Jelly (pelagic)	0.24	5				Release
T12	1	854	2135		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	84	mm	juv	Release
T12	1	854	2135		08/08/2018	ID	Field	Fish	Boreogadus saida	Arctic cod	0.05	1	73	mm	juv	Release
T12	1	854	2135		08/08/2018	ID	Field	Fish	Liparis tunicatus	Kelp snailfish	0.05	1	82	mm	juv	Release
T12	1	854	2135		08/08/2018	ID	Field	Amphipoda	Gammarida		0.14	3				Release
T12	1	854	2135		08/08/2018	ID	Field	Mysida	Mysida	Mysid	0.09	2				Release
T12	1	854	2135		08/08/2018	ID	Field	Isopoda	Saduria spp.	Isopod	2.20	47	various			Release
T12	1	854	2135		08/08/2018	ID	Field	Gastropoda	Cryptonatia affinis	Arctic moon snail	0.05	1				Release
T12	1	854	2135		08/08/2018	ID	Field	Gastropoda	Gastopoda egg case	Moon snail egg cas	0.05	1				Release

Appendix D

Willow Marine Monitoring Program
Hydrographic & Water Quality Results

November 2018

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August 24, 2018 Service Request No K1807594

Mark Savoie
Kinnetic Laboratories, Incorporated
704 . 2nd Ave
Anchorage, AK 99501

Laboratory Results for: 2018 Harrison Bay MMP

Dear Mark,

Enclosed are the results of the sample(s) submitted to our laboratory August 11, 2018
For your reference, these analyses have been assigned our service request number **K1807594.**

Analyses were performed according to our laboratory s NELAP-approved quality assurance program. The test results meet requirements of the current NELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP-accredited analytes, refer to the certifications section at www.alsglobal.com. All results are intended to be considered in their entirety, and ALS Group USA Corp. dba ALS Environmental (ALS) is not responsible for use of less than the complete report. Results apply only to the items submitted to the laboratory for analysis and individual items (samples) analyzed, as listed in the report.

Please contact me if you have any questions. My extension is 3364. ou may also contact me via email at howard.holmes alsglobal.com.

Respectfully submitted,

ALS Group USA, Corp. dba ALS Environmental

for Howard Holmes
Project Manager

ADDRESS 1317 S. 13th Avenue, Kelso, A 98626
PHONE +1 360 577 7222 **FAX** +1 360 636 1068
ALS Group USA, Corp.
dba ALS Environmental

Narrative Documents

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
Phone (360) 577-7222 Fax (360) 425-9096
www.alsglobal.com

1317 South 13th Ave, Kelso, WA 98626 | 1-360-577-7222 | www.alsglobal.com

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP	**Date Received:**	08/11/2018
Sample Matrix:	Ocean Water		

CASE NARRATIVE

All analyses were performed consistent with the quality assurance program of ALS Environmental. This report contains analytical results for samples designated for Tier II data deliverables. When appropriate to the method, method blank results have been reported with each analytical test. Surrogate recoveries have been reported for all applicable organic analyses. Additional quality control analyses reported herein include: Laboratory Duplicate (DUP), Matrix Spike (MS), Matrix/Duplicate Matrix Spike (MS/DMS), Laboratory Control Sample (LCS), and Laboratory/Duplicate Laboratory Control Sample (LCS/DLCS).

Sample Receipt:

Forty four ocean water samples were received for analysis at ALS Environmental on 08/11/2018. The samples were received in good condition and consistent with the accompanying chain of custody form. The samples were stored in a refrigerator at 4ºC upon receipt at the laboratory.

General Chemistry:

No significant anomalies were noted with this analysis.

Approved by

Date 08/24/2018

SAMPLE DETECTION SUMMARY

CLIENT ID: HB18-TSS-W1-SUR **Lab ID: K1807594-001**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	6.0			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W1-BOT **Lab ID: K1807594-002**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	12.4			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W3-SUR **Lab ID: K1807594-003**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	6.0			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W3-BOT **Lab ID: K1807594-004**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	6.6			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W5-SUR **Lab ID: K1807594-005**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	9.4			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W5-BOT **Lab ID: K1807594-006**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	9.2			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W7-SUR **Lab ID: K1807594-007**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	10.0			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W7-BOT **Lab ID: K1807594-008**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	10.6			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W7-SD **Lab ID: K1807594-009**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	11.0			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W8-SUR **Lab ID: K1807594-010**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	19.4			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W8-BOT **Lab ID: K1807594-011**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	22.6			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W10-SUR **Lab ID: K1807594-012**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	10.2			2.0	mg/L	SM 2540 D

SAMPLE DETECTION SUMMARY

CLIENT ID: HB18-TSS-W10-BOT **Lab ID: K1807594-013**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	8.6			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W12-SUR **Lab ID: K1807594-014**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	6.2			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W12-BOT **Lab ID: K1807594-015**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	6.6			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W16-SUR **Lab ID: K1807594-016**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	7.2			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W16-BOT **Lab ID: K1807594-017**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	6.8			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W18-SUR **Lab ID: K1807594-018**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	10.2			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W18-BOT **Lab ID: K1807594-019**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	12.8			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W18-SD **Lab ID: K1807594-020**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	13.8			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W19-SUR **Lab ID: K1807594-021**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	16.4			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W19-BOT **Lab ID: K1807594-022**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	12.8			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W20-SUR **Lab ID: K1807594-023**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	11.8			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W20-BOT **Lab ID: K1807594-024**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	9.6			2.0	mg/L	SM 2540 D

SAMPLE DETECTION SUMMARY

CLIENT ID: HB18-TSS-W21-SUR **Lab ID: K1807594-025**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	7.2			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W21-BOT **Lab ID: K1807594-026**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	9.0			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W22-SUR **Lab ID: K1807594-027**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	8.6			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W22-BOT **Lab ID: K1807594-028**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	7.8			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W22-SD **Lab ID: K1807594-029**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	7.2			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W23-SUR **Lab ID: K1807594-030**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	6.8			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W23-BOT **Lab ID: K1807594-031**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	7.8			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W29-SUR **Lab ID: K1807594-032**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	6.8			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W29-BOT **Lab ID: K1807594-033**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	8.8			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W30-SUR **Lab ID: K1807594-034**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	9.2			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W30-BOT **Lab ID: K1807594-035**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	9.0			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W31-SUR **Lab ID: K1807594-036**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	27.6			2.0	mg/L	SM 2540 D

SAMPLE DETECTION SUMMARY

CLIENT ID: HB18-TSS-W31-BOT **Lab ID: K1807594-037**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	32.8			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W31-SD **Lab ID: K1807594-038**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	30.8			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W32-SUR **Lab ID: K1807594-039**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	12.2			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W32-BOT **Lab ID: K1807594-040**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	11.2			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W33-SUR **Lab ID: K1807594-041**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	8.2			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W33-BOT **Lab ID: K1807594-042**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	11.6			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W43-SUR **Lab ID: K1807594-043**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	13.8			2.0	mg/L	SM 2540 D

CLIENT ID: HB18-TSS-W43-BOT **Lab ID: K1807594-044**

Analyte	Results	Flag	MDL	MRL	Units	Method
Solids, Total Suspended (TSS)	13.8			2.0	mg/L	SM 2540 D

Sample Receipt Information

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
Phone (360) 577-7222 Fax (360) 425-9096
www.alsglobal.com

Client: Kinnetic Laboratories, Incorporated **Service Request:** K1807594

Project: 2018 Harrison Bay MMP/5089.03

SAMPLE CROSS-REFERENCE

SAMPLE	CLIENT SAMPLE ID	DATE	TIME
K1807594-001	HB18-TSS- 1-SUR	8/8/2018	1701
K1807594-002	HB18-TSS- 1-BOT	8/8/2018	1701
K1807594-003	HB18-TSS- 3-SUR	8/8/2018	1741
K1807594-004	HB18-TSS- 3-BOT	8/8/2018	1741
K1807594-005	HB18-TSS- 5-SUR	8/8/2018	1805
K1807594-006	HB18-TSS- 5-BOT	8/8/2018	1805
K1807594-007	HB18-TSS- 7-SUR	8/8/2018	1848
K1807594-008	HB18-TSS- 7-BOT	8/8/2018	1848
K1807594-009	HB18-TSS- 7-SD	8/8/2018	1848
K1807594-010	HB18-TSS- 8-SUR	8/9/2018	0928
K1807594-011	HB18-TSS- 8-BOT	8/9/2018	0928
K1807594-012	HB18-TSS- 10-SUR	8/9/2018	0959
K1807594-013	HB18-TSS- 10-BOT	8/9/2018	0959
K1807594-014	HB18-TSS- 12-SUR	8/9/2018	1016
K1807594-015	HB18-TSS- 12-BOT	8/9/2018	1016
K1807594-016	HB18-TSS- 16-SUR	8/9/2018	1103
K1807594-017	HB18-TSS- 16-BOT	8/9/2018	1103
K1807594-018	HB18-TSS- 18-SUR	8/9/2018	1123
K1807594-019	HB18-TSS- 18-BOT	8/9/2018	1123
K1807594-020	HB18-TSS- 18-SD	8/9/2018	1123
K1807594-021	HB18-TSS- 19-SUR	8/9/2018	1144
K1807594-022	HB18-TSS- 19-BOT	8/9/2018	1144
K1807594-023	HB18-TSS- 20-SUR	8/9/2018	1154
K1807594-024	HB18-TSS- 20-BOT	8/9/2018	1154
K1807594-025	HB18-TSS- 21-SUR	8/9/2018	1205
K1807594-026	HB18-TSS- 21-BOT	8/9/2018	1205
K1807594-027	HB18-TSS- 22-SUR	8/9/2018	1217
K1807594-028	HB18-TSS- 22-BOT	8/9/2018	1217
K1807594-029	HB18-TSS- 22-SD	8/9/2018	1217
K1807594-030	HB18-TSS- 23-SUR	8/9/2018	1230
K1807594-031	HB18-TSS- 23-BOT	8/9/2018	1230
K1807594-032	HB18-TSS- 29-SUR	8/9/2018	1405
K1807594-033	HB18-TSS- 29-BOT	8/9/2018	1405
K1807594-034	HB18-TSS- 30-SUR	8/9/2018	1419
K1807594-035	HB18-TSS- 30-BOT	8/9/2018	1419
K1807594-036	HB18-TSS- 31-SUR	8/9/2018	1428
K1807594-037	HB18-TSS- 31-BOT	8/9/2018	1428
K1807594-038	HB18-TSS- 31-SD	8/9/2018	1428
K1807594-039	HB18-TSS- 32-SUR	8/9/2018	1512
K1807594-040	HB18-TSS- 32-BOT	8/9/2018	1512
K1807594-041	HB18-TSS- 33-SUR	8/9/2018	1528
K1807594-042	HB18-TSS- 33-BOT	8/9/2018	1528

Client: Kinnetic Laboratories, Incorporated

Service Request: K1807594

Project: 2018 Harrison Bay MMP/5089.03

SAMPLE CROSS-REFERENCE

SAMPLE	CLIENT SAMPLE ID	DATE	TIME
K1807594-043	HB18-TSS- 43-SUR	8/9/2018	1806
K1807594-044	HB18-TSS- 43-BOT	8/9/2018	1806

K1807594

Chain of Custody Record

Page 1 of 4

To: **ALS Environmental** **1317 South 13th Avenue** **Kelso, WA 98626** **(360) 577-7222** **1-800-695-7222** **Contact: Howard Holmes (Howard.Holmes@alsglobal.com)**	KLI PO #: AK18-1619 **Quote #: 91641** **Lab #:**	**From:** **Kinnetic Laboratories, Inc** **704 West 2nd Ave.** **Anchorage, AK 99501** **(907) 276-6178** **Contact: Mark Savoie**

Project: **2018 HARRISON BAY MMP** **Matrix:** **Water** **Project #: 5089.03**

Complete by: Standard TAT

SampleID	StationID	Sample Date	Sample Time	Sample Type	Analysis	Container	Pres	No. of Bottles	LabID	Condition Upon Receipt
HB18-TSS-W1-SUR	W1	8/8/18	1701	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W1-BOT	W1		1701	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W3-SUR	W3		1741	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W3-BOT	W3		1741	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W5-SUR	W5		1805	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W5-BOT	W5		1805	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W7-SUR	W7		1848	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W7-BOT	W7		1848	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W7-SD	W7		1848	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W8-SUR	W8	8/9/18	0928	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W8-BOT	W8		0928	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W10-SUR	W10		0959	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		

Data Report MUST include the following: Sample ID, Analytical Method, Detection Limit, Date of Extraction if applicable, Date of Analysis, Analytical Results, and Signature of QA Reviewer. All times on this sheet are military time. Email sample receipt confirmations, PDF reports, and EDDs to msavoie@kinneticlabs.net. EDD REQUIRED.

Special Instructions/Comments: **See quote list of analytes and detection limits.**

Sampled and Relinquished By:	Date/Time:	Transporter	Received By:	Date/Time:
	8/10/18 1005	AK Goldstreak		8/11/18 1000
Relinquished By:	**Date/Time:**	**Transporter**	**Received By:**	**Date/Time:**

v20020904

K1807594

Chain of Custody Record

Page 2 of 4

To: **ALS Environmental** **1317 South 13th Avenue** **Kelso, WA 98626** **(360) 577-7222** **1-800-695-7222** **Contact: Howard Holmes (Howard.Holmes@alsglobal.com)**	KLI PO #: AK18-1019 **Quote #: 91641** **Lab #:**	**From:** **Kinnetic Laboratories, Inc** **704 West 2nd Ave.** **Anchorage, AK 99501** **(907) 276-6178** **Contact: Mark Savoie**

Project: **2018 HARRISON BAY MMP** **Matrix:** **Water** **Project #:** **5089.03**

Complete by: **Standard TAT**

SampleID	StationID	Sample Date	Sample Time	Sample Type	Analysis	Container	Pres	No. of Bottles	LabID	Condition Upon Receipt
HB18-TSS-W10-BOT	W10	8/9/18	0959	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W12-SUR	W12	↓	1016	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W12-BOT	W12	↓	1016	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W16-SUR	W16	↓	1103	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W16-BOT	W16	↓	1103	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W18-SUR	W18	↓	1123	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W18-BOT	W18	↓	1123	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W18-SD	W18	↓	1123	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W19-SUR	W19	↓	1144	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W19-BOT	W19	↓	1144	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W20-SUR	W20	↓	1154	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W20-BOT	W20	↓	1154	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		

Data Report MUST include the following: Sample ID, Analytical Method, Detection Limit, Date of Extraction if applicable, Date of Analysis, Analytical Results, and Signature of QA Reviewer. All times on this sheet are military time. Email sample receipt confirmations, PDF reports, and EDDs to msavoie@kinneticlabs.net. EDD REQUIRED.

Special Instructions/Comments: **See quote list of analytes and detection limits.**

Sampled and Relinquished By:	Date/Time:	Transporter	Received By:	Date/Time:
	8/10/18 1005	AK Goldstreak		8-11-18 1020
Relinquished By:	**Date/Time:**	**Transporter**	**Received By:**	**Date/Time:**

v20020904

K1807594

Chain of Custody Record

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To:
ALS Environmental
1317 South 13th Avenue
Kelso, WA 98626
(360) 577-7222
1-800-695-7222
Contact: Howard Holmes (Howard.Holmes@alsglobal.com)

KLI PO #: AK18-1019
Quote #: 91641
Lab #:

From:
Kinnetic Laboratories, Inc
704 West 2nd Ave.
Anchorage, AK 99501
(907) 276-6178
Contact: Mark Savoie

Project: 2018 HARRISON BAY MMP **Matrix:** Water **Project #: 5089.03**
Complete by: Standard TAT

SampleID	StationID	Sample Date	Sample Time	Sample Type	Analysis	Container	Pres	No. of Bottles	LabID	Condition Upon Receipt
HB18-TSS-W 21-SUR	W21	8/9/18	1205	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W 21-BOT	W21		1205	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W 22-SUR	W22		1217	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W 22-BOT	W22		1217	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W 22-SD	W22		1217	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W 23-SUR	W23		1230	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W 23-BOT	W23		1230	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W 29-SUR	W29		1405	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W 29-BOT	W29		1405	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W 30-SUR	W30		1419	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W 30-BOT	W30		1419	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W 31-SUR	W31	↓	1428	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		

Data Report MUST include the following: Sample ID, Analytical Method, Detection Limit, Date of Extraction if applicable, Date of Analysis, Analytical Results, and Signature of QA Reviewer. All times on this sheet are military time. Email sample receipt confirmations, PDF reports, and EDDs to msavoie@kinneticlabs.net. EDD REQUIRED.

Special Instructions/Comments: See quote list of analytes and detection limits.

Sampled and Relinquished By:	Date/Time:	Transporter	Received By:	Date/Time:
	8/10/18 1005	AK Goldstreak		8/11/18 1005
Relinquished By:	**Date/Time:**	**Transporter**	**Received By:**	**Date/Time:**

v20020904

K1807594

Chain of Custody Record

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To: **ALS Environmental** **1317 South 13th Avenue** **Kelso, WA 98626** **(360) 577-7222** **1-800-695-7222** **Contact: Howard Holmes (Howard.Holmes@alsglobal.com)**	KLI PO #: AK18-1019 **Quote #: 91641** **Lab #:**	**From:** **Kinnetic Laboratories, Inc** **704 West 2nd Ave.** **Anchorage, AK 99501** **(907) 276-6178** **Contact: Mark Savoie**

Project: **2018 HARRISON BAY MMP** **Matrix:** **Water** **Project #:** **5089.03**

Complete by: **Standard TAT**

SampleID	StationID	Sample Date	Sample Time	Sample Type	Analysis	Container	Pres	No. of Bottles	LabID	Condition Upon Receipt
HB18-TSS-W31-BOT	W31	8/9/18	1428	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W31-SD	W31		1428	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W32-SUR	W32		1512	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W32-BOT	W32		1512	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W33-SUR	W33		1528	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W33-BOT	W33		1528	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W43-SUR	W43		1806	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W43-BOT	W43		1806	Grab	TSS/SM 2540D	0.5-L HDPE	4° C	1		
HB18-TSS-W				Grab	~~TSS/SM 2540D~~	~~0.5-L HDPE~~	~~4° C~~	~~1~~	gms	
~~HB18-TSS-W~~				Grab	~~TSS/SM 2540D~~	~~0.5-L HDPE~~	~~4° C~~	~~1~~	gms	
~~HB18-TSS-W~~				Grab	~~TSS/SM 2540D~~	~~0.5-L HDPE~~	~~4° C~~	~~1~~	gms	
~~HB18-TSS-W~~				Grab	~~TSS/SM 2540D~~	~~0.5-L HDPE~~	~~4° C~~	~~1~~	gms	

Data Report MUST include the following: Sample ID, Analytical Method, Detection Limit, Date of Extraction if applicable, Date of Analysis, Analytical Results, and Signature of QA Reviewer. All times on this sheet are military time. Email sample receipt confirmations, PDF reports, and EDDs to msavoie@kinneticlabs.net. EDD REQUIRED.

Special Instructions/Comments: **See quote list of analytes and detection limits.**

Sampled and Relinquished By:	Date/Time:	Transporter	Received By:	Date/Time:
M. [illegible]	8/10/18 1005	AK Goldstreak	Dawn [illegible]	8-11-18 1000
Relinquished By:	**Date/Time:**	**Transporter**	**Received By:**	**Date/Time:**

v20020904

GL

ALS

PC H2

Cooler Receipt and Preservation Form

ient KINNETIC LABS Service Request *K18* 0754

eceived: 8-11-18 Opened: 8-11-18 By: JSP Unloaded: 8-11-18 By: JSP

Samples were received via? *USPS* *Fed Ex* *UPS* *DHL* *PDX* [✓ *Courier*] *Hand Delivered*

Samples were received in: (circle) [✓ *Cooler*] *Box* *Envelope* *Other*__________ *NA*

. Were custody seals on coolers? NA Y [✓ N] If yes, how many and where?__________

If present, were custody seals intact? Y N If present, were they signed and dated? Y N

Raw Cooler Temp	Corrected. Cooler Temp	Raw Temp Blank	Corrected Temp Blank	Corr. Factor	Thermometer ID	Cooler/COC ID [✓ NA]	Tracking Number [✓ NA]	Filed
5.3	5.3	2.1	2.1	0.0	390			
6.0	5.9	5.3	5.2	-0.1	371			

4. Packing material: *Inserts* *Baggies* [✓ *Bubble Wrap*] [✓ *Gel Packs*] *Wet Ice* *Dry Ice* *Sleeves* __________
5. Were custody papers properly filled out (ink, signed, etc.)? NA [✓ Y] N
6. Were samples received in good condition (temperature, unbroken)? *Indicate in the table below.* NA [✓ Y] N
   If applicable, tissue samples were received: *Frozen* *Partially Thawed* *Thawed*
7. Were all sample labels complete (i.e analysis, preservation, etc.)? NA [✓ Y] N
8. Did all sample labels and tags agree with custody papers? *Indicate major discrepancies in the table on page 2.* NA [✓ Y] N
9. Were appropriate bottles/containers and volumes received for the tests indicated? NA [✓ Y] N
10. Were the pH-preserved bottles (*see SMO GEN SOP*) received at the appropriate pH? *Indicate in the table below* [✓ NA] Y N
11. Were VOA vials received without headspace? *Indicate in the table below.* [✓ NA] Y N
12. Was C12/Res negative? [✓ NA] Y N

Sample ID on Bottle	Sample ID on COC	Identified by:

Sample ID	Bottle Count Bottle Type	Out of Temp	Head-space	Broke	pH	Reagent	Volume added	Reagent Lot Number	Initials	Time

*otes, Discrepancies, & Resolutions:*__________

Miscellaneous Forms

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
Phone (360) 577-7222 Fax (360) 425-9096
www.alsglobal.com

Inorganic Data Qualifiers

*	The result is an outlier. See case narrative.
#	The control limit criteria is not applicable. See case narrative.
B	The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
E	The result is an estimate amount because the value exceeded the instrument calibration range.
J	The result is an estimated value.
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
i	The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
X	See case narrative.
Q	See case narrative. One or more quality control criteria was outside the limits.
H	The holding time for this test is immediately following sample collection. The samples were analyzed as soon as possible after receipt by the laboratory.

Metals Data Qualifiers

#	The control limit criteria is not applicable. See case narrative.
J	The result is an estimated value.
E	The percent difference for the serial dilution was greater than 10%, indicating a possible matrix interference in the sample.
M	The duplicate injection precision was not met.
N	The Matrix Spike sample recovery is not within control limits. See case narrative.
S	The reported value was determined by the Method of Standard Additions (MSA).
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
W	The post-digestion spike for furnace AA analysis is out of control limits, while sample absorbance is less than 50% of spike absorbance.
i	The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
X	See case narrative.
+	The correlation coefficient for the MSA is less than 0.995.
Q	See case narrative. One or more quality control criteria was outside the limits.

Organic Data Qualifiers

*	The result is an outlier. See case narrative.
#	The control limit criteria is not applicable. See case narrative.
A	A tentatively identified compound, a suspected aldol-condensation product.
B	The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
C	The analyte was qualitatively confirmed using GC/MS techniques, pattern recognition, or by comparing to historical data.
D	The reported result is from a dilution.
E	The result is an estimated value.
J	The result is an estimated value.
N	The result is presumptive. The analyte was tentatively identified, but a confirmation analysis was not performed.
P	The GC or HPLC confirmation criteria was exceeded. The relative percent difference is greater than 40% between the two analytical results.
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
i	The MRL/MDL or LOQ/LOD is elevated due to a chromatographic interference.
X	See case narrative.
Q	See case narrative. One or more quality control criteria was outside the limits.

Additional Petroleum Hydrocarbon Specific Qualifiers

F	The chromatographic fingerprint of the sample matches the elution pattern of the calibration standard.
L	The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of lighter molecular weight constituents than the calibration standard.
H	The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of heavier molecular weight constituents than the calibration standard.
O	The chromatographic fingerprint of the sample resembles an oil, but does not match the calibration standard.
Y	The chromatographic fingerprint of the sample resembles a petroleum product eluting in approximately the correct carbon range, but the elution pattern does not match the calibration standard.
Z	The chromatographic fingerprint does not resemble a petroleum product.

ALS Group USA Corp. dba ALS Environmental (ALS) - Kelso
State Certifications, Accreditations, and Licenses

Agency	Web Site	Number
Alaska DEH	http://dec.alaska.gov/eh/lab/cs/csapproval.htm	UST-040
Arizona DHS	http://www.azdhs.gov/lab/license/env.htm	AZ0339
Arkansas - DEQ	http://www.adeq.state.ar.us/techsvs/labcert.htm	88-0637
California DHS (ELAP)	http://www.cdph.ca.gov/certlic/labs/Pages/ELAP.aspx	2795
DOD ELAP	http://www.denix.osd.mil/edqw/Accreditation/AccreditedLabs.cfm	L16-58-R4
Florida DOH	http://www.doh.state.fl.us/lab/EnvLabCert/WaterCert.htm	E87412
Hawaii DOH	http://health.hawaii.gov/	-
ISO 17025	http://www.pjlabs.com/	L16-57
Louisiana DEQ	http://www.deq.louisiana.gov/page/la-lab-accreditation	03016
Maine DHS	http://www.maine.gov/dhhs/	WA01276
Minnesota DOH	http://www.health.state.mn.us/accreditation	053-999-457
Nevada DEP	http://ndep.nv.gov/bsdw/labservice.htm	WA01276
New Jersey DEP	http://www.nj.gov/dep/enforcement/oqa.html	WA005
New York - DOH	https://www.wadsworth.org/regulatory/elap	12060
North Carolina DEQ	https://deq.nc.gov/about/divisions/water-resources/water-resources-data/water-sciences-home-page/laboratory-certification-branch/non-field-lab-certification	605
Oklahoma DEQ	http://www.deq.state.ok.us/CSDnew/labcert.htm	9801
Oregon – DEQ (NELAP)	http://public.health.oregon.gov/LaboratoryServices/EnvironmentalLaboratoryAccreditation/Pages/index.aspx	WA100010
South Carolina DHEC	http://www.scdhec.gov/environment/EnvironmentalLabCertification/	61002
Texas CEQ	http://www.tceq.texas.gov/field/qa/env_lab_accreditation.html	T104704427
Washington DOE	http://www.ecy.wa.gov/programs/eap/labs/lab-accreditation.html	C544
Wyoming (EPA Region 8)	https://www.epa.gov/region8-waterops/epa-region-8-certified-drinking-water	-
Kelso Laboratory Website	www.alsglobal.com	NA

Analyses were performed according to our laboratory’s NELAP-approved quality assurance program. A complete listing of specific NELAP-certified analytes, can be found in the certification section at www.ALSGlobal.com or at the accreditation bodies web site.

Please refer to the certification and/or accreditation body's web site if samples are submitted for compliance purposes. The states highlighted above, require the analysis be listed on the state certification if used for compliance purposes and if the method/anlayte is offered by that state.

Acronyms

ASTM	American Society for Testing and Materials
A2LA	American Association for Laboratory Accreditation
CARB	California Air Resources Board
CAS Number	Chemical Abstract Service registry Number
CFC	Chlorofluorocarbon
CFU	Colony-Forming Unit
DEC	Department of Environmental Conservation
DEQ	Department of Environmental Quality
DHS	Department of Health Services
DOE	Department of Ecology
DOH	Department of Health
EPA	U. S. Environmental Protection Agency
ELAP	Environmental Laboratory Accreditation Program
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
LOD	Limit of Detection
LOQ	Limit of Quantitation
LUFT	Leaking Underground Fuel Tank
M	Modified
MCL	Maximum Contaminant Level is the highest permissible concentration of a substance allowed in drinking water as established by the USEPA.
MDL	Method Detection Limit
MPN	Most Probable Number
MRL	Method Reporting Limit
NA	Not Applicable
NC	Not Calculated
NCASI	National Council of the Paper Industry for Air and Stream Improvement
ND	Not Detected
NIOSH	National Institute for Occupational Safety and Health
PQL	Practical Quantitation Limit
RCRA	Resource Conservation and Recovery Act
SIM	Selected Ion Monitoring
TPH	Total Petroleum Hydrocarbons
tr	Trace level is the concentration of an analyte that is less than the PQL but greater than or equal to the MDL.

Analyst Summary report

Client: Kinnetic Laboratories, Incorporated
Service Request: K1807594
Project: 2018 Harrison Bay MMP/5089.03

Sample Name: HB18-TSS-W1-SUR
Date Collected: 08/8/18
Lab Code: K1807594-001
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Name: HB18-TSS-W1-BOT
Date Collected: 08/8/18
Lab Code: K1807594-002
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Name: HB18-TSS-W3-SUR
Date Collected: 08/8/18
Lab Code: K1807594-003
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Name: HB18-TSS-W3-BOT
Date Collected: 08/8/18
Lab Code: K1807594-004
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Name: HB18-TSS-W5-SUR
Date Collected: 08/8/18
Lab Code: K1807594-005
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Client: Kinnetic Laboratories, Incorporated
Service Request: K1807594
Project: 2018 Harrison Bay MMP/5089.03

Sample Name: HB18-TSS-W5-BOT
Date Collected: 08/8/18
Lab Code: K1807594-006
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Name: HB18-TSS-W7-SUR
Date Collected: 08/8/18
Lab Code: K1807594-007
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Name: HB18-TSS-W7-BOT
Date Collected: 08/8/18
Lab Code: K1807594-008
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Name: HB18-TSS-W7-SD
Date Collected: 08/8/18
Lab Code: K1807594-009
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Name: HB18-TSS-W8-SUR
Date Collected: 08/9/18
Lab Code: K1807594-010
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Client: Kinnetic Laboratories, Incorporated
Service Request: K1807594
Project: 2018 Harrison Bay MMP/5089.03

Sample Name: HB18-TSS-W8-BOT
Date Collected: 08/9/18
Lab Code: K1807594-011
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Name: HB18-TSS-W10-SUR
Date Collected: 08/9/18
Lab Code: K1807594-012
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Name: HB18-TSS-W10-BOT
Date Collected: 08/9/18
Lab Code: K1807594-013
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Name: HB18-TSS-W12-SUR
Date Collected: 08/9/18
Lab Code: K1807594-014
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Name: HB18-TSS-W12-BOT
Date Collected: 08/9/18
Lab Code: K1807594-015
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Client: Kinnetic Laboratories, Incorporated
Service Request: K1807594
Project: 2018 Harrison Bay MMP/5089.03

Sample Name: HB18-TSS-W16-SUR
Date Collected: 08/9/18
Lab Code: K1807594-016
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Name: HB18-TSS-W16-BOT
Date Collected: 08/9/18
Lab Code: K1807594-017
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Name: HB18-TSS-W18-SUR
Date Collected: 08/9/18
Lab Code: K1807594-018
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Name: HB18-TSS-W18-BOT
Date Collected: 08/9/18
Lab Code: K1807594-019
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Name: HB18-TSS-W18-SD
Date Collected: 08/9/18
Lab Code: K1807594-020
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Client: Kinnetic Laboratories, Incorporated
Service Request: K1807594
Project: 2018 Harrison Bay MMP/5089.03

Sample Name: HB18-TSS-W19-SUR
Date Collected: 08/9/18
Lab Code: K1807594-021
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Name: HB18-TSS-W19-BOT
Date Collected: 08/9/18
Lab Code: K1807594-022
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Name: HB18-TSS-W20-SUR
Date Collected: 08/9/18
Lab Code: K1807594-023
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Name: HB18-TSS-W20-BOT
Date Collected: 08/9/18
Lab Code: K1807594-024
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Name: HB18-TSS-W21-SUR
Date Collected: 08/9/18
Lab Code: K1807594-025
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Client: Kinnetic Laboratories, Incorporated
Service Request: K1807594
Project: 2018 Harrison Bay MMP/5089.03

Sample Name: HB18-TSS-W21-BOT
Date Collected: 08/9/18
Lab Code: K1807594-026
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Name: HB18-TSS-W22-SUR
Date Collected: 08/9/18
Lab Code: K1807594-027
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Name: HB18-TSS-W22-BOT
Date Collected: 08/9/18
Lab Code: K1807594-028
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Name: HB18-TSS-W22-SD
Date Collected: 08/9/18
Lab Code: K1807594-029
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Name: HB18-TSS-W23-SUR
Date Collected: 08/9/18
Lab Code: K1807594-030
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Client: Kinnetic Laboratories, Incorporated **Service Request:** K1807594
Project: 2018 Harrison Bay MMP/5089.03

Sample Name: HB18-TSS-W23-BOT **Date Collected:** 08/9/18
Lab Code: K1807594-031 **Date Received:** 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Name: HB18-TSS-W29-SUR **Date Collected:** 08/9/18
Lab Code: K1807594-032 **Date Received:** 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Name: HB18-TSS-W29-BOT **Date Collected:** 08/9/18
Lab Code: K1807594-033 **Date Received:** 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Name: HB18-TSS-W30-SUR **Date Collected:** 08/9/18
Lab Code: K1807594-034 **Date Received:** 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Name: HB18-TSS-W30-BOT **Date Collected:** 08/9/18
Lab Code: K1807594-035 **Date Received:** 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Client: Kinnetic Laboratories, Incorporated
Service Request: K1807594
Project: 2018 Harrison Bay MMP/5089.03

Sample Name: HB18-TSS-W31-SUR
Date Collected: 08/9/18
Lab Code: K1807594-036
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Name: HB18-TSS-W31-BOT
Date Collected: 08/9/18
Lab Code: K1807594-037
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Name: HB18-TSS-W31-SD
Date Collected: 08/9/18
Lab Code: K1807594-038
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Name: HB18-TSS-W32-SUR
Date Collected: 08/9/18
Lab Code: K1807594-039
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Name: HB18-TSS-W32-BOT
Date Collected: 08/9/18
Lab Code: K1807594-040
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Analyst Summary report

Client: Kinnetic Laboratories, Incorporated
Service Request: K1807594
Project: 2018 Harrison Bay MMP/5089.03

Sample Name: HB18-TSS-W33-SUR
Date Collected: 08/9/18
Lab Code: K1807594-041
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Name: HB18-TSS-W33-BOT
Date Collected: 08/9/18
Lab Code: K1807594-042
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Name: HB18-TSS-W43-SUR
Date Collected: 08/9/18
Lab Code: K1807594-043
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Name: HB18-TSS-W43-BOT
Date Collected: 08/9/18
Lab Code: K1807594-044
Date Received: 08/11/18
Sample Matrix: Ocean Water

Analysis Method	**Extracted/Digested By**	**Analyzed By**
SM 2540 D		JMADISON

Sample Results

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
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General Chemistry

ALS Environmental—Kelso Laboratory
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www.alsglobal.com

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Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/08/18 17:01
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W1-SUR	**Basis:**	NA
Lab Code:	K1807594-001		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**6.0**	mg/L	2.0	1	08/14/18 10:10	

Analytical Report

Client: Kinnetic Laboratories, Incorporated
Project: 2018 Harrison Bay MMP/5089.03
Sample Matrix: Ocean Water

Service Request: K1807594
Date Collected: 08/08/18 17:01
Date Received: 08/11/18 10:00

Sample Name: HB18-TSS-W1-BOT
Lab Code: K1807594-002

Basis: NA

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**12.4**	mg/L	2.0	1	08/14/18 10:10	

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/08/18 17:41
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W3-SUR	**Basis:**	NA
Lab Code:	K1807594-003		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**6.0**	mg/L	2.0	1	08/14/18 10:10	

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/08/18 17:41
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W3-BOT	**Basis:**	NA
Lab Code:	K1807594-004		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**6.6**	mg/L	2.0	1	08/14/18 10:10	

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/08/18 18:05
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W5-SUR	**Basis:**	NA
Lab Code:	K1807594-005		

General Chemistry Parameters

Analyte Name	**Analysis Method**	**Result**	**Units**	**MRL**	**Dil.**	**Date Analyzed**	**Q**
Solids, Total Suspended (TSS)	SM 2540 D	**9.4**	mg/L	2.0	1	08/14/18 10:10	

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/08/18 18:05
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W5-BOT	**Basis:**	NA
Lab Code:	K1807594-006		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**9.2**	mg/L	2.0	1	08/14/18 10:10	

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/08/18 18:48
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W7-SUR	**Basis:**	NA
Lab Code:	K1807594-007		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**10.0**	mg/L	2.0	1	08/14/18 10:10	

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/08/18 18:48
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W7-BOT	**Basis:**	NA
Lab Code:	K1807594-008		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**10.6**	mg/L	2.0	1	08/14/18 10:10	

Client: Kinnetic Laboratories, Incorporated
Service Request: K1807594
Project: 2018 Harrison Bay MMP/5089.03
Date Collected: 08/08/18 18:48
Sample Matrix: Ocean Water
Date Received: 08/11/18 10:00

Sample Name: HB18-TSS-W7-SD
Basis: NA
Lab Code: K1807594-009

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**11.0**	mg/L	2.0	1	08/14/18 10:10	

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/09/18 09:28
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W8-SUR	**Basis:**	NA
Lab Code:	K1807594-010		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**19.4**	mg/L	2.0	1	08/14/18 12:10	

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/09/18 09:28
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W8-BOT	**Basis:**	NA
Lab Code:	K1807594-011		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**22.6**	mg/L	2.0	1	08/14/18 12:10	

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Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/09/18 09:59
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W10-SUR	**Basis:**	NA
Lab Code:	K1807594-012		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**10.2**	mg/L	2.0	1	08/14/18 12:10	

ALS Group USA, Corp.

dba ALS Environmental

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/09/18 09:59
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W10-BOT	**Basis:**	NA
Lab Code:	K1807594-013		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**8.6**	mg/L	2.0	1	08/14/18 12:10	

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/09/18 10:16
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W12-SUR	**Basis:**	NA
Lab Code:	K1807594-014		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**6.2**	mg/L	2.0	1	08/14/18 12:10	

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/09/18 10:16
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W12-BOT	**Basis:**	NA
Lab Code:	K1807594-015		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**6.6**	mg/L	2.0	1	08/14/18 12:10	

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/09/18 11:03
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W16-SUR	**Basis:**	NA
Lab Code:	K1807594-016		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**7.2**	mg/L	2.0	1	08/14/18 12:10	

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/09/18 11:03
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W16-BOT	**Basis:**	NA
Lab Code:	K1807594-017		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**6.8**	mg/L	2.0	1	08/14/18 12:10	

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/09/18 11:23
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W18-SUR	**Basis:**	NA
Lab Code:	K1807594-018		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**10.2**	mg/L	2.0	1	08/14/18 12:10	

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/09/18 11:23
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W18-BOT	**Basis:**	NA
Lab Code:	K1807594-019		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**12.8**	mg/L	2.0	1	08/14/18 12:10	

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/09/18 11:23
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W18-SD	**Basis:**	NA
Lab Code:	K1807594-020		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**13.8**	mg/L	2.0	1	08/14/18 12:10	

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/09/18 11:44
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W19-SUR	**Basis:**	NA
Lab Code:	K1807594-021		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**16.4**	mg/L	2.0	1	08/14/18 12:10	

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/09/18 11:44
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W19-BOT	**Basis:**	NA
Lab Code:	K1807594-022		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**12.8**	mg/L	2.0	1	08/14/18 12:10	

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/09/18 11:54
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W20-SUR	**Basis:**	NA
Lab Code:	K1807594-023		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**11.8**	mg/L	2.0	1	08/14/18 12:10	

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/09/18 11:54
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W20-BOT	**Basis:**	NA
Lab Code:	K1807594-024		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**9.6**	mg/L	2.0	1	08/14/18 12:10	

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/09/18 12:05
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W21-SUR	**Basis:**	NA
Lab Code:	K1807594-025		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**7.2**	mg/L	2.0	1	08/14/18 12:10	

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/09/18 12:05
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W21-BOT	**Basis:**	NA
Lab Code:	K1807594-026		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**9.0**	mg/L	2.0	1	08/14/18 12:10	

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/09/18 12:17
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W22-SUR	**Basis:**	NA
Lab Code:	K1807594-027		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**8.6**	mg/L	2.0	1	08/14/18 12:10	

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/09/18 12:17
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W22-BOT	**Basis:**	NA
Lab Code:	K1807594-028		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**7.8**	mg/L	2.0	1	08/14/18 12:10	

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/09/18 12:17
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W22-SD	**Basis:**	NA
Lab Code:	K1807594-029		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**7.2**	mg/L	2.0	1	08/14/18 12:10	

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Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/09/18 12:30
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W23-SUR	**Basis:**	NA
Lab Code:	K1807594-030		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**6.8**	mg/L	2.0	1	08/14/18 15:06	

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/09/18 12:30
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W23-BOT	**Basis:**	NA
Lab Code:	K1807594-031		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**7.8**	mg/L	2.0	1	08/14/18 15:06	

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/09/18 14:05
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W29-SUR	**Basis:**	NA
Lab Code:	K1807594-032		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**6.8**	mg/L	2.0	1	08/14/18 15:06	

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/09/18 14:05
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W29-BOT	**Basis:**	NA
Lab Code:	K1807594-033		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**8.8**	mg/L	2.0	1	08/14/18 15:06	

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/09/18 14:19
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W30-SUR	**Basis:**	NA
Lab Code:	K1807594-034		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**9.2**	mg/L	2.0	1	08/14/18 15:06	

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/09/18 14:19
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W30-BOT	**Basis:**	NA
Lab Code:	K1807594-035		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**9.0**	mg/L	2.0	1	08/14/18 15:06	

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/09/18 14:28
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W31-SUR	**Basis:**	NA
Lab Code:	K1807594-036		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**27.6**	mg/L	2.0	1	08/14/18 15:06	

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/09/18 14:28
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W31-BOT	**Basis:**	NA
Lab Code:	K1807594-037		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**32.8**	mg/L	2.0	1	08/14/18 15:06	

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/09/18 14:28
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W31-SD	**Basis:**	NA
Lab Code:	K1807594-038		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**30.8**	mg/L	2.0	1	08/14/18 15:06	

Client: Kinnetic Laboratories, Incorporated
Project: 2018 Harrison Bay MMP/5089.03
Sample Matrix: Ocean Water

Service Request: K1807594
Date Collected: 08/09/18 15:12
Date Received: 08/11/18 10:00

Sample Name: HB18-TSS-W32-SUR
Lab Code: K1807594-039

Basis: NA

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**12.2**	mg/L	2.0	1	08/14/18 15:06	

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/09/18 15:12
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W32-BOT	**Basis:**	NA
Lab Code:	K1807594-040		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**11.2**	mg/L	2.0	1	08/14/18 15:06	

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/09/18 15:28
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W33-SUR	**Basis:**	NA
Lab Code:	K1807594-041		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**8.2**	mg/L	2.0	1	08/14/18 15:06	

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/09/18 15:28
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W33-BOT	**Basis:**	NA
Lab Code:	K1807594-042		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**11.6**	mg/L	2.0	1	08/14/18 15:06	

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Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/09/18 18:06
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W43-SUR	**Basis:**	NA
Lab Code:	K1807594-043		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**13.8**	mg/L	2.0	1	08/15/18 15:21	

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	08/09/18 18:06
Sample Matrix:	Ocean Water	**Date Received:**	08/11/18 10:00
Sample Name:	HB18-TSS-W43-BOT	**Basis:**	NA
Lab Code:	K1807594-044		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	**13.8**	mg/L	2.0	1	08/15/18 15:21	

QC Summary Forms

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
Phone (360) 577-7222 Fax (360) 425-9096
www.alsglobal.com

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General Chemistry

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
Phone (360) 577-7222 Fax (360) 425-9096
www.alsglobal.com

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	NA
Sample Matrix:	Ocean Water	**Date Received:**	NA
Sample Name:	Method Blank	**Basis:**	NA
Lab Code:	K1807594-MB1		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	ND U	mg/L	2.0	1	08/14/18 10:10	

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	NA
Sample Matrix:	Ocean Water	**Date Received:**	NA
Sample Name:	Method Blank	**Basis:**	NA
Lab Code:	K1807594-MB2		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	ND U	mg/L	2.0	1	08/14/18 10:10	

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	NA
Sample Matrix:	Ocean Water	**Date Received:**	NA
Sample Name:	Method Blank	**Basis:**	NA
Lab Code:	K1807594-MB3		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	ND U	mg/L	2.0	1	08/14/18 12:10	

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	NA
Sample Matrix:	Ocean Water	**Date Received:**	NA
Sample Name:	Method Blank	**Basis:**	NA
Lab Code:	K1807594-MB4		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	ND U	mg/L	2.0	1	08/14/18 12:10	

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	NA
Sample Matrix:	Ocean Water	**Date Received:**	NA
Sample Name:	Method Blank	**Basis:**	NA
Lab Code:	K1807594-MB5		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	ND U	mg/L	2.0	1	08/14/18 15:06	

Client: Kinnetic Laboratories, Incorporated
Service Request: K1807594
Project: 2018 Harrison Bay MMP/5089.03
Date Collected: NA
Sample Matrix: Ocean Water
Date Received: NA

Sample Name: Method Blank
Basis: NA
Lab Code: K1807594-MB6

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	ND U	mg/L	2.0	1	08/14/18 15:06	

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	NA
Sample Matrix:	Ocean Water	**Date Received:**	NA
Sample Name:	Method Blank	**Basis:**	NA
Lab Code:	K1807594-MB7		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	ND U	mg/L	2.0	1	08/15/18 15:21	

Analytical Report

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Collected:**	NA
Sample Matrix:	Ocean Water	**Date Received:**	NA
Sample Name:	Method Blank	**Basis:**	NA
Lab Code:	K1807594-MB8		

General Chemistry Parameters

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Q
Solids, Total Suspended (TSS)	SM 2540 D	ND U	mg/L	2.0	1	08/15/18 15:21	

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Analyzed:**	08/14/18
Sample Matrix:	Ocean Water	**Date Extracted:**	NA

Lab Control Sample Summary
Solids, Total Suspended (TSS)

Analysis Method:	SM 2540 D	**Units:**	mg/L
Prep Method:	None	**Basis:**	NA
		Analysis Lot:	602409

Sample Name	Lab Code	Result	Spike Amount	% Rec	% Rec Limits
Lab Control Sample	K1807594-LCS1	306	306	100	85-115

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Analyzed:**	08/14/18
Sample Matrix:	Ocean Water	**Date Extracted:**	NA

Lab Control Sample Summary
Solids, Total Suspended (TSS)

Analysis Method:	SM 2540 D	**Units:**	mg/L
Prep Method:	None	**Basis:**	NA
		Analysis Lot:	602393

Sample Name	Lab Code	Result	Spike Amount	% Rec	% Rec Limits
Lab Control Sample	K1807594-LCS2	294	306	96	85-115

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Analyzed:**	08/14/18
Sample Matrix:	Ocean Water	**Date Extracted:**	NA

Lab Control Sample Summary
Solids, Total Suspended (TSS)

Analysis Method:	SM 2540 D	**Units:**	mg/L
Prep Method:	None	**Basis:**	NA
		Analysis Lot:	602453

Sample Name	Lab Code	Result	Spike Amount	% Rec	% Rec Limits
Lab Control Sample	K1807594-LCS3	304	306	99	85-115

Client:	Kinnetic Laboratories, Incorporated	**Service Request:**	K1807594
Project:	2018 Harrison Bay MMP/5089.03	**Date Analyzed:**	08/14/18
Sample Matrix:	Ocean Water	**Date Extracted:**	NA

Duplicate Lab Control Sample Summary
General Chemistry Parameters

Analysis Method:	SM 2540 D	**Units:**	mg/L
Prep Method:	None	**Basis:**	NA
		Analysis Lot:	602409

	Lab Control Sample K1807594-LCS1			Duplicate Lab Control Sample K1807594-DLCS1					
Analyte Name	**Result**	**Spike Amount**	**% Rec**	**Result**	**Spike Amount**	**% Rec**	**% Rec Limits**	**RPD**	**RPD Limit**
Solids, Total Suspended (TSS)	306	306	100	306	306	100	85-115	<1	5

Willow - 2018 Water Quality Data

Sample	Station	Depth	Rep	Lab Code	Sample Type	Date Collected	Date Received	Date Analyzed	Method	Matrix	Units	Component	Reporting Limit	Detection Limit	Result	Result Notes
HB18-TSS-W1-SUR	W1	SUR	1	K1807594-001	SMPL	08/08/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		6.0	
HB18-TSS-W1-BOT	W1	BOT	1	K1807594-002	SMPL	08/08/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		12.4	
HB18-TSS-W3-SUR	W3	SUR	1	K1807594-003	SMPL	08/08/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		6.0	
HB18-TSS-W3-BOT	W3	BOT	1	K1807594-004	SMPL	08/08/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		6.6	
HB18-TSS-W5-SUR	W5	SUR	1	K1807594-005	SMPL	08/08/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		9.4	
HB18-TSS-W5-BOT	W5	BOT	1	K1807594-006	SMPL	08/08/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		9.2	
HB18-TSS-W7-SUR	W7	SUR	1	K1807594-007	SMPL	08/08/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		10.0	
HB18-TSS-W7-BOT	W7	BOT	1	K1807594-008	SMPL	08/08/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		10.6	
HB18-TSS-W7-SD	W7	SUR	SD	K1807594-009	FIELD DUPE	08/08/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		11.0	
HB18-TSS-W8-SUR	W8	SUR	1	K1807594-010	SMPL	08/09/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		19.4	
HB18-TSS-W8-BOT	W8	BOT	1	K1807594-011	SMPL	08/09/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		22.6	
HB18-TSS-W10-SUR	W10	SUR	1	K1807594-012	SMPL	08/09/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		10.2	
HB18-TSS-W10-BOT	W10	BOT	1	K1807594-013	SMPL	08/09/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		8.6	
HB18-TSS-W12-SUR	W12	SUR	1	K1807594-014	SMPL	08/09/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		6.2	
HB18-TSS-W12-BOT	W12	BOT	1	K1807594-015	SMPL	08/09/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		6.6	
HB18-TSS-W16-SUR	W16	SUR	1	K1807594-016	SMPL	08/09/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		7.2	
HB18-TSS-W16-BOT	W16	BOT	1	K1807594-017	SMPL	08/09/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		6.8	
HB18-TSS-W18-SUR	W18	SUR	1	K1807594-018	SMPL	08/09/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		10.2	
HB18-TSS-W18-BOT	W18	BOT	1	K1807594-019	SMPL	08/09/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		12.8	
HB18-TSS-W18-SD	W18	SUR	SD	K1807594-020	FIELD DUPE	08/09/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		13.8	
HB18-TSS-W19-SUR	W19	SUR	1	K1807594-021	SMPL	08/09/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		16.4	
HB18-TSS-W19-BOT	W19	BOT	1	K1807594-022	SMPL	08/09/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		12.8	
HB18-TSS-W20-SUR	W20	SUR	1	K1807594-023	SMPL	08/09/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		11.8	
HB18-TSS-W20-BOT	W20	BOT	1	K1807594-024	SMPL	08/09/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		9.6	
HB18-TSS-W21-SUR	W21	SUR	1	K1807594-025	SMPL	08/09/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		7.2	
HB18-TSS-W21-BOT	W21	BOT	1	K1807594-026	SMPL	08/09/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		9.0	
HB18-TSS-W22-SUR	W22	SUR	1	K1807594-027	SMPL	08/09/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		8.6	
HB18-TSS-W22-BOT	W22	BOT	1	K1807594-028	SMPL	08/09/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		7.8	
HB18-TSS-W22-SD	W22	SUR	SD	K1807594-029	FIELD DUPE	08/09/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		7.2	
HB18-TSS-W23-SUR	W23	SUR	1	K1807594-030	SMPL	08/09/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		6.8	
HB18-TSS-W23-BOT	W23	BOT	1	K1807594-031	SMPL	08/09/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		7.8	
HB18-TSS-W29-SUR	W29	SUR	1	K1807594-032	SMPL	08/09/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		6.8	
HB18-TSS-W29-BOT	W29	BOT	1	K1807594-033	SMPL	08/09/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		8.8	
HB18-TSS-W30-SUR	W30	SUR	1	K1807594-034	SMPL	08/09/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		9.2	
HB18-TSS-W30-BOT	W30	BOT	1	K1807594-035	SMPL	08/09/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		9.0	
HB18-TSS-W31-SUR	W31	SUR	1	K1807594-036	SMPL	08/09/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		27.6	
HB18-TSS-W31-BOT	W31	BOT	1	K1807594-037	SMPL	08/09/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		32.8	
HB18-TSS-W31-SD	W31	SUR	SD	K1807594-038	FIELD DUPE	08/09/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		30.8	
HB18-TSS-W32-SUR	W32	SUR	1	K1807594-039	SMPL	08/09/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		12.2	
HB18-TSS-W32-BOT	W32	BOT	1	K1807594-040	SMPL	08/09/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		11.2	
HB18-TSS-W33-SUR	W33	SUR	1	K1807594-041	SMPL	08/09/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		8.2	
HB18-TSS-W33-BOT	W33	BOT	1	K1807594-042	SMPL	08/09/18	08/11/18	08/14/18	SM 2540 D	Ocean Water	mg/L	TSS	2		11.6	
HB18-TSS-W43-SUR	W43	SUR	1	K1807594-043	SMPL	08/09/18	08/11/18	08/15/18	SM 2540 D	Ocean Water	mg/L	TSS	2		13.8	
HB18-TSS-W43-BOT	W43	BOT	1	K1807594-044	SMPL	08/09/18	08/11/18	08/15/18	SM 2540 D	Ocean Water	mg/L	TSS	2		13.8	
Method Blank				K1807594-MB1	MB1	NA	NA	08/14/18	SM 2540 D	Water	mg/L	TSS	2		ND	ND
Method Blank				K1807594-MB2	MB2	NA	NA	08/14/18	SM 2540 D	Water	mg/L	TSS	2		ND	ND
Method Blank				K1807594-MB3	MB3	NA	NA	08/14/18	SM 2540 D	Water	mg/L	TSS	2		ND	ND
Method Blank				K1807594-MB4	MB1	NA	NA	08/14/18	SM 2540 D	Water	mg/L	TSS	2		ND	ND
Method Blank				K1807594-MB5	MB1	NA	NA	08/14/18	SM 2540 D	Water	mg/L	TSS	2		ND	ND
Method Blank				K1807594-MB6	MB1	NA	NA	08/14/18	SM 2540 D	Water	mg/L	TSS	2		ND	ND
Method Blank				K1807594-MB7	MB1	NA	NA	08/15/18	SM 2540 D	Water	mg/L	TSS	2		ND	ND
Method Blank				K1807594-MB8	MB1	NA	NA	08/15/18	SM 2540 D	Water	mg/L	TSS	2		ND	ND
Lab Control Sample				K1807594-LCS1	LCS1	NA	NA	08/14/18	SM 2540 D	Water	mg/L	TSS	20		306	
Lab Control Sample				K1807594-LCS2	LCS2	NA	NA	08/14/18	SM 2540 D	Water	mg/L	TSS	20		294	
Lab Control Sample				K1807594-LCS3	LCS3	NA	NA	08/14/18	SM 2540 D	Water	mg/L	TSS	20		304	
Lab Control Sample				K1807594-LCS4	LCS4	NA	NA	08/15/18	SM 2540 D	Water	mg/L	TSS	20		308	
Duplicate Lab Control Sample				K1807594-DLCS1	DLCS1	NA	NA	08/14/18	SM 2540 D	Water	mg/L	TSS	20		306	

Willow - 2018 Water Quality Data

Sample	Station	Depth	Rep	Lab Code	Sample Type	Date Collected	Date Received	Date Analyzed	Method	Matrix	Units	Component	Reporting Limit	Detection Limit	Result	Result Notes
HB18-TUR-W1-SUR	W1	SUR	1	HB18-TUR-W1-SUR	SMPL	08/08/18	NA	08/08/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	1.89	
HB18-TUR-W1-BOT	W1	BOT	1	HB18-TUR-W1-BOT	SMPL	08/08/18	NA	08/08/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	3.00	
HB18-TUR-W1-BD	W1	BOT	BD	HB18-TUR-W1-BD	FIELD DUPE	08/08/18	NA	08/08/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	3.06	
HB18-TUR-W3-SUR	W3	SUR	1	HB18-TUR-W3-SUR	SMPL	08/08/18	NA	08/08/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	2.29	
HB18-TUR-W3-SD	W3	SUR	SD	HB18-TUR-W3-SD	FIELD DUPE	08/08/18	NA	08/08/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	2.27	
HB18-TUR-W3-BOT	W3	BOT	1	HB18-TUR-W3-BOT	SMPL	08/08/18	NA	08/08/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	2.51	
HB18-TUR-W5-SUR	W5	SUR	1	HB18-TUR-W5-SUR	SMPL	08/08/18	NA	08/08/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	6.80	
HB18-TUR-W5-BOT	W5	BOT	1	HB18-TUR-W5-BOT	SMPL	08/08/18	NA	08/08/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	6.62	
HB18-TUR-W5-BOT-2	W5	BOT	2	HB18-TUR-W5-BOT-2	INSTR DUPE	08/08/18	NA	08/08/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	6.74	
HB18-TUR-W5-BD	W5	BOT	BD	HB18-TUR-W5-BD	FIELD DUPE	08/08/18	NA	08/08/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	7.39	
HB18-TUR-W7-SUR	W7	SUR	1	HB18-TUR-W7-SUR	SMPL	08/08/18	NA	08/08/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	8.13	
HB18-TUR-W7-SD	W7	SUR	SD	HB18-TUR-W7-SD	FIELD DUPE	08/08/18	NA	08/08/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	7.95	
HB18-TUR-W7-BOT	W7	BOT	1	HB18-TUR-W7-BOT	SMPL	08/08/18	NA	08/08/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	8.02	
HB18-TUR-W8-SUR	W8	SUR	1	HB18-TUR-W8-SUR	SMPL	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	8.51	
HB18-TUR-W8-SD	W8	SUR	SD	HB18-TUR-W8-SD	FIELD DUPE	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	7.89	
HB18-TUR-W8-BOT	W8	BOT	1	HB18-TUR-W8-BOT	SMPL	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	8.15	
HB18-TUR-W8-BOT-2	W8	BOT	2	HB18-TUR-W8-BOT-2	INSTR DUPE	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	7.90	
HB18-TUR-W10-SUR	W10	SUR	1	HB18-TUR-W10-SUR	SMPL	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	5.37	
HB18-TUR-W10-BOT	W10	BOT	1	HB18-TUR-W10-BOT	SMPL	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	5.17	
HB18-TUR-W12-SUR	W12	SUR	1	HB18-TUR-W12-SUR	SMPL	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	2.36	
HB18-TUR-W12-SD	W12	SUR	SD	HB18-TUR-W12-SD	FIELD DUPE	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	1.87	
HB18-TUR-W12-BOT	W12	BOT	1	HB18-TUR-W12-BOT	SMPL	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	1.74	
HB18-TUR-W16-SUR	W16	SUR	1	HB18-TUR-W16-SUR	SMPL	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	2.08	
HB18-TUR-W16-SD	W16	SUR	SD	HB18-TUR-W16-SD	FIELD DUPE	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	2.07	
HB18-TUR-W16-BOT	W16	BOT	1	HB18-TUR-W16-BOT	SMPL	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	2.19	
HB18-TUR-W18-SUR	W18	SUR	1	HB18-TUR-W18-SUR	SMPL	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	8.58	
HB18-TUR-W18-SD	W18	SUR	SD	HB18-TUR-W18-SD	FIELD DUPE	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	8.74	
HB18-TUR-W18-BOT	W18	BOT	1	HB18-TUR-W18-BOT	SMPL	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	8.58	
HB18-TUR-W19-SUR	W19	SUR	1	HB18-TUR-W19-SUR	SMPL	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	12.40	
HB18-TUR-W19-SUR-2	W19	SUR	2	HB18-TUR-W19-SUR-2	INSTR DUPE	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	12.10	
HB18-TUR-W19-BOT	W19	BOT	1	HB18-TUR-W19-BOT	SMPL	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	11.70	
HB18-TUR-W19-BOT-2	W19	BOT	2	HB18-TUR-W19-BOT-2	INSTR DUPE	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	12.30	
HB18-TUR-W20-SUR	W20	SUR	1	HB18-TUR-W20-SUR	SMPL	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	6.92	
HB18-TUR-W20-SD	W20	SUR	SD	HB18-TUR-W20-SD	FIELD DUPE	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	7.02	
HB18-TUR-W20-BOT	W20	BOT	1	HB18-TUR-W20-BOT	SMPL	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	6.21	
HB18-TUR-W20-BOT-2	W20	BOT	2	HB18-TUR-W20-BOT-2	INSTR DUPE	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	6.54	
HB18-TUR-W21-SUR	W21	SUR	1	HB18-TUR-W21-SUR	SMPL	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	2.81	
HB18-TUR-W21-SUR-2	W21	SUR	2	HB18-TUR-W21-SUR-2	INSTR DUPE	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	2.81	
HB18-TUR-W21-BOT	W21	BOT	1	HB18-TUR-W21-BOT	SMPL	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	2.45	
HB18-TUR-W21-BOT-2	W21	BOT	2	HB18-TUR-W21-BOT-2	INSTR DUPE	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	2.60	
HB18-TUR-W22-SUR	W22	SUR	1	HB18-TUR-W22-SUR	SMPL	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	2.75	
HB18-TUR-W22-SUR-2	W22	SUR	2	HB18-TUR-W22-SUR-2	INSTR DUPE	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	2.58	
HB18-TUR-W22-BOT	W22	BOT	1	HB18-TUR-W22-BOT	SMPL	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	3.10	
HB18-TUR-W22-BOT-2	W22	BOT	2	HB18-TUR-W22-BOT-2	INSTR DUPE	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	3.11	
HB18-TUR-W23-SUR	W23	SUR	1	HB18-TUR-W23-SUR	SMPL	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	2.11	
HB18-TUR-W23-SUR-2	W23	SUR	2	HB18-TUR-W23-SUR-2	INSTR DUPE	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	2.15	
HB18-TUR-W23-BOT	W23	BOT	1	HB18-TUR-W23-BOT	SMPL	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	3.58	
HB18-TUR-W29-SUR	W29	SUR	1	HB18-TUR-W29-SUR	SMPL	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	2.07	
HB18-TUR-W29-SUR-2	W29	SUR	2	HB18-TUR-W29-SUR-2	INSTR DUPE	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	2.09	
HB18-TUR-W29-BOT	W29	BOT	1	HB18-TUR-W29-BOT	SMPL	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	3.48	
HB18-TUR-W30-SUR	W30	SUR	1	HB18-TUR-W30-SUR	SMPL	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	5.53	
HB18-TUR-W30-SD	W30	SUR	SD	HB18-TUR-W30-SD	FIELD DUPE	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	5.53	
HB18-TUR-W30-BOT	W30	BOT	1	HB18-TUR-W30-BOT	SMPL	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	5.59	
HB18-TUR-W31-SUR	W31	SUR	1	HB18-TUR-W31-SUR	SMPL	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	19.90	
HB18-TUR-W31-SUR-2	W31	SUR	2	HB18-TUR-W31-SUR-2	INSTR DUPE	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	20.30	
HB18-TUR-W31-BOT	W31	BOT	1	HB18-TUR-W31-BOT	SMPL	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	21.40	
HB18-TUR-W31-SD	W31	SUR	SD	HB18-TUR-W31-SD	FIELD DUPE	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	19.70	
HB18-TUR-W32-SUR	W32	SUR	1	HB18-TUR-W32-SUR	SMPL	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	7.81	
HB18-TUR-W32-SD	W32	SUR	SD	HB18-TUR-W32-SD	FIELD DUPE	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	7.68	
HB18-TUR-W32-BOT	W32	BOT	1	HB18-TUR-W32-BOT	SMPL	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	7.44	
HB18-TUR-W32-BOT-2	W32	BOT	2	HB18-TUR-W32-BOT-2	INSTR DUPE	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	7.73	
HB18-TUR-W33-SUR	W33	SUR	1	HB18-TUR-W33-SUR	SMPL	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	4.58	
HB18-TUR-W33-SUR-2	W33	SUR	2	HB18-TUR-W33-SUR-2	INSTR DUPE	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	4.66	
HB18-TUR-W33-BOT	W33	BOT	1	HB18-TUR-W33-BOT	SMPL	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	6.77	
HB18-TUR-W43-SUR	W43	SUR	1	HB18-TUR-W43-SUR	SMPL	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	7.18	
HB18-TUR-W43-SD	W43	SUR	SD	HB18-TUR-W43-SD	FIELD DUPE	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	7.80	
HB18-TUR-W43-BOT	W43	BOT	1	HB18-TUR-W43-BOT	SMPL	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	7.19	
HB18-TUR-W43-BOT-2	W43	BOT	2	HB18-TUR-W43-BOT-2	INSTR DUPE	08/09/18	NA	08/09/18	SM 2130 B	Ocean Water	ntu	Turbidity		0.05	7.08	

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Station	Depth (m)	Cond (S/m)	Temp (deg C)	Salinity (psu)	pH	OBS (ntu)	DO (mg/L)	Sigma-t
S1	0.50	1.531	6.015	14.443	8.08	7.98	10.48	11.350
S1	0.75	1.732	5.300	16.861	8.02	7.55	10.45	13.307
S1	1.00	2.034	4.137	20.815	7.94	7.11	10.70	16.514
S1	1.25	2.290	3.058	24.459	7.90	6.03	11.18	19.478
S1	1.50	2.348	2.713	25.409	7.89	5.45	11.24	20.256
S1	1.75	2.350	2.697	25.447	7.88	5.94	11.02	20.287
S2	0.50	2.309	3.721	24.186	8.00	4.13	10.83	19.216
S2	0.75	2.325	3.563	24.480	8.00	2.78	10.84	19.461
S2	1.00	2.332	3.430	24.663	7.99	2.22	10.88	19.615
S2	1.25	2.344	3.181	24.993	7.99	1.89	10.95	19.895
S2	1.50	2.355	2.873	25.368	7.99	1.77	11.06	20.213
S2	1.75	2.362	2.701	25.581	7.98	1.67	11.18	20.394
S2	2.00	2.361	2.708	25.571	7.98	1.63	11.19	20.386
S2	2.25	2.366	2.651	25.668	7.97	1.58	11.15	20.467
S2	2.50	2.378	2.429	25.996	7.97	1.64	11.19	20.742
S3	0.50	2.297	3.645	24.106	7.99	2.21	10.80	19.158
S3	0.75	2.314	3.387	24.488	7.99	2.21	10.90	19.480
S3	1.00	2.321	3.236	24.681	7.99	2.20	10.99	19.643
S3	1.25	2.323	3.171	24.762	7.99	2.18	11.00	19.712
S3	1.50	2.328	2.932	25.004	7.99	2.18	11.09	19.920
S3	1.75	2.334	2.772	25.198	7.98	2.19	11.16	20.084
S3	2.00	2.338	2.682	25.314	7.98	2.17	11.16	20.182
S3	2.25	2.350	2.517	25.589	7.98	2.14	11.17	20.412
S3	2.50	2.368	2.316	25.962	7.98	2.21	11.19	20.721
S4	0.50	2.201	2.891	23.536	8.02	0.81	11.29	18.753
S4	0.75	2.219	2.857	23.783	8.01	0.76	11.30	18.952
S4	1.00	2.257	2.828	24.243	8.01	0.72	11.27	19.320
S4	1.25	2.296	2.744	24.771	8.00	0.68	11.25	19.746
S4	1.50	2.319	2.660	25.110	8.00	0.62	11.25	20.021
S4	1.75	2.323	2.611	25.195	7.99	0.61	11.23	20.092
S4	2.00	2.337	2.356	25.564	7.98	0.61	11.30	20.401
S4	2.25	2.347	2.232	25.782	7.98	0.74	11.33	20.582
S4	2.50	2.353	2.168	25.909	7.98	0.91	11.32	20.687
S4	2.75	2.359	2.127	26.008	7.98	1.15	11.29	20.768
S4	3.00	2.363	2.116	26.066	7.98	1.52	11.28	20.815
S4	3.25	2.368	2.102	26.142	7.98	1.96	11.26	20.877
S5	0.50	2.001	3.201	21.016	8.04	0.90	11.23	16.730
S5	0.75	2.042	2.942	21.660	8.02	0.97	11.30	17.256
S5	1.00	2.098	2.628	22.522	8.01	1.00	11.42	17.959
S5	1.25	2.141	2.350	23.235	8.00	0.95	11.50	18.543
S5	1.50	2.197	1.997	24.164	8.00	0.81	11.60	19.302
S5	1.75	2.226	1.821	24.651	7.99	0.69	11.69	19.699
S5	2.00	2.254	1.759	25.031	7.99	0.67	11.69	20.006
S5	2.25	2.273	1.786	25.251	7.98	0.65	11.62	20.180
S5	2.50	2.288	1.840	25.386	7.98	0.58	11.56	20.286
S5	2.75	2.302	1.891	25.508	7.98	0.56	11.56	20.381
S5	3.00	2.322	1.997	25.665	7.97	0.51	11.51	20.501
S5	3.25	2.333	2.055	25.753	7.97	0.48	11.45	20.568
S5	3.50	2.344	2.092	25.853	7.97	0.46	11.43	20.646
S5	3.75	2.349	2.065	25.936	7.97	0.43	11.44	20.714
S5	4.00	2.349	1.947	26.040	7.97	0.45	11.50	20.803
S5	4.25	2.351	1.840	26.151	7.96	0.46	11.55	20.897

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Station	Depth (m)	Cond (S/m)	Temp (deg C)	Salinity (psu)	pH	OBS (ntu)	DO (mg/L)	Sigma-t
S6	0.50	1.983	3.012	20.924	8.04	0.98	11.32	16.667
S6	0.75	2.020	2.916	21.425	8.02	1.03	11.32	17.070
S6	1.00	2.085	2.761	22.282	8.01	1.06	11.37	17.761
S6	1.25	2.121	2.643	22.784	8.00	1.00	11.48	18.167
S6	1.50	2.148	2.518	23.196	8.00	0.94	11.56	18.502
S6	1.75	2.171	2.394	23.553	8.00	0.92	11.60	18.794
S6	2.00	2.200	2.216	24.027	7.99	0.91	11.64	19.181
S6	2.25	2.225	2.023	24.483	7.99	0.82	11.66	19.555
S6	2.50	2.239	1.872	24.763	7.99	0.76	11.67	19.786
S6	2.75	2.253	1.813	24.978	7.99	0.72	11.65	19.961
S6	3.00	2.268	1.821	25.158	7.98	0.67	11.60	20.104
S6	3.25	2.277	1.812	25.269	7.98	0.67	11.55	20.193
S6	3.50	2.284	1.759	25.402	7.98	0.73	11.55	20.302
S6	3.75	2.299	1.682	25.642	7.98	0.82	11.55	20.498
S6	4.00	2.304	1.654	25.724	7.97	0.80	11.53	20.565
S6	4.25	2.314	1.665	25.848	7.97	0.81	11.51	20.664
S6	4.50	2.329	1.622	26.056	7.97	0.78	11.52	20.833
S6	4.75	2.339	1.532	26.264	7.96	0.74	11.55	21.003
S6	5.00	2.343	1.469	26.359	7.96	0.74	11.56	21.083
S6	5.25	2.348	1.392	26.484	7.96	0.73	11.56	21.186
S6	5.50	2.354	1.304	26.631	7.96	0.71	11.55	21.308
S6	5.75	2.358	1.228	26.755	7.96	0.63	11.54	21.411
S6	6.00	2.366	1.087	26.976	7.96	0.65	11.48	21.594
S7	0.50	1.891	5.265	18.555	8.07	5.63	10.51	14.646
S7	0.75	2.002	4.699	20.087	8.03	5.47	10.67	15.899
S7	1.00	2.179	3.790	22.652	7.99	5.14	10.93	17.994
S7	1.25	2.322	2.941	24.924	7.96	4.59	11.31	19.856
S7	1.50	2.382	2.508	25.974	7.95	4.04	11.47	20.719
S7	1.75	2.396	2.387	26.245	7.94	3.64	11.28	20.943
S7	2.00	2.400	2.348	26.319	7.94	3.42	11.16	21.004
S7	2.25	2.398	2.314	26.331	7.94	3.46	11.14	21.015
S8	0.50	2.196	4.235	22.537	8.03	3.60	10.87	17.871
S8	0.75	2.223	4.019	22.990	8.02	3.50	10.94	18.246
S8	1.00	2.244	3.780	23.394	8.02	3.20	10.94	18.583
S8	1.25	2.251	3.679	23.542	8.01	3.06	10.94	18.708
S8	1.50	2.264	3.502	23.825	8.01	3.06	10.98	18.945
S8	1.75	2.291	3.185	24.371	8.00	3.14	11.04	19.400
S8	2.00	2.330	3.032	24.950	7.99	3.18	11.07	19.871
S9	0.50	2.251	3.505	23.678	8.02	1.42	11.02	18.827
S9	0.75	2.254	3.348	23.820	8.02	1.26	11.08	18.951
S9	1.00	2.255	3.240	23.917	8.02	1.08	11.14	19.035
S9	1.25	2.258	3.185	23.993	8.02	0.93	11.15	19.099
S9	1.50	2.266	3.108	24.143	8.02	0.84	11.15	19.223
S9	1.75	2.274	3.040	24.286	8.01	0.87	11.13	19.341
S9	2.00	2.284	3.000	24.437	8.01	1.02	11.11	19.464
S9	2.25	2.304	2.963	24.693	8.00	1.42	11.08	19.670
S10	0.50	1.637	6.477	15.312	8.10	9.54	10.45	11.997
S10	0.75	1.874	5.402	18.341	8.05	10.80	10.54	14.468
S10	1.00	2.278	3.482	24.006	7.97	16.32	11.20	19.090
S10	1.25	2.329	3.191	24.816	7.95	27.37	11.13	19.753
S10	1.50	2.343	3.110	25.036	7.94	21.69	11.05	19.934

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Station	Depth (m)	Cond (S/m)	Temp (deg C)	Salinity (psu)	pH	OBS (ntu)	DO (mg/L)	Sigma-t
S11	0.50	2.294	3.655	24.062	7.99	5.73	11.12	19.122
S11	0.75	2.383	2.706	25.832	7.99	3.87	11.54	20.593
S11	1.00	2.399	2.226	26.410	7.98	2.86	11.53	21.084
S11	1.25	2.402	2.108	26.549	7.98	2.50	11.38	21.202
S11	1.50	2.407	1.997	26.696	7.98	2.80	11.37	21.325
S11	1.75	2.417	1.877	26.925	7.97	3.12	11.35	21.515
S11	2.00	2.427	1.813	27.103	7.97	3.77	11.36	21.661
S11	2.25	2.429	1.792	27.149	7.97	4.64	11.34	21.699
S11	2.50	2.430	1.770	27.178	7.97	4.72	11.34	21.723
S11	2.75	2.431	1.726	27.223	7.97	4.88	11.37	21.762
S12	0.50	2.265	2.284	24.763	8.01	0.70	11.57	19.765
S12	0.75	2.268	1.890	25.104	8.01	0.61	11.83	20.058
S12	1.00	2.288	1.755	25.458	8.00	0.50	11.78	20.347
S12	1.25	2.300	1.696	25.642	8.00	0.44	11.74	20.498
S12	1.50	2.308	1.676	25.766	8.00	0.43	11.70	20.598
S12	1.75	2.318	1.693	25.870	7.99	0.42	11.67	20.680
S12	2.00	2.327	1.749	25.937	7.99	0.40	11.63	20.731
S12	2.25	2.339	1.851	25.993	7.99	0.39	11.56	20.771
S12	2.50	2.351	1.964	26.046	7.99	0.45	11.50	20.807
S12	2.75	2.359	2.050	26.081	7.99	0.52	11.45	20.830
S12	3.00	2.367	2.119	26.117	7.99	0.63	11.41	20.855
S12	3.25	2.373	2.159	26.154	7.99	0.81	11.37	20.883
S12	3.50	2.378	2.175	26.199	7.99	1.03	11.35	20.918
S12	3.75	2.379	2.129	26.250	7.99	1.37	11.34	20.961
S12	4.00	2.379	2.083	26.289	7.99	1.66	11.34	20.995
S12	4.25	2.379	2.085	26.290	7.99	1.86	11.33	20.996
T4	0.50	1.997	3.965	20.482	8.06	0.97	11.16	16.261
T4	0.75	1.999	3.964	20.498	8.06	0.95	11.15	16.274
T4	1.00	1.999	3.964	20.502	8.06	0.98	11.16	16.277
T4	1.25	2.005	3.967	20.564	8.06	1.10	11.14	16.326
T4	1.50	2.019	3.978	20.719	8.05	1.10	11.14	16.448
T4	1.75	2.031	3.990	20.840	8.05	1.15	11.15	16.543
T4	2.00	2.085	4.030	21.427	8.03	1.22	11.08	17.006
T4	2.25	2.180	3.835	22.624	8.01	1.39	11.02	17.968
T4	2.50	2.300	3.051	24.584	7.99	1.61	11.23	19.578
T4	2.75	2.331	2.663	25.245	7.99	1.55	11.43	20.128
T4	3.00	2.333	2.612	25.305	7.99	1.44	11.27	20.180
T4	3.25	2.333	2.598	25.315	7.99	1.42	11.22	20.188
W1	0.50	1.515	3.812	15.233	8.15	0.90	11.15	12.106
W1	0.75	1.526	3.846	15.337	8.14	0.95	11.12	12.187
W1	1.00	1.543	3.905	15.497	8.13	1.02	11.06	12.312
W1	1.25	1.580	4.038	15.839	8.12	1.09	10.93	12.576
W1	1.50	1.673	4.298	16.713	8.10	1.22	10.69	13.254
W1	1.75	1.823	4.300	18.350	8.07	1.74	10.49	14.550
W1	2.00	1.944	3.680	20.062	8.05	2.26	10.66	15.945
W1	2.25	2.066	3.347	21.659	8.03	1.62	11.00	17.233
W1	2.50	2.172	3.149	23.020	8.01	1.06	11.19	18.327
W1	2.75	2.260	2.747	24.341	8.00	0.87	11.24	19.403
W1	3.00	2.325	2.230	25.517	7.99	0.82	11.36	20.371
W1	3.25	2.403	1.779	26.845	7.97	0.83	11.41	21.456
W1	3.50	2.505	1.368	28.465	7.94	0.91	11.33	22.776
W1	3.75	2.535	1.214	28.977	7.92	1.18	11.20	23.194
W1	4.00	2.542	1.128	29.143	7.91	1.58	11.04	23.332
W1	4.25	2.542	1.035	29.229	7.91	1.97	10.92	23.406
W1	4.50	2.541	0.895	29.345	7.91	2.21	10.92	23.506

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Station	Depth (m)	Cond (S/m)	Temp (deg C)	Salinity (psu)	pH	OBS (ntu)	DO (mg/L)	Sigma-t
W1	4.75	2.540	0.728	29.496	7.91	2.34	11.02	23.635
W1	5.00	2.536	0.632	29.541	7.90	2.39	11.08	23.675
W2	0.50	1.599	4.027	16.052	8.12	0.78	11.11	12.746
W2	0.75	1.601	4.030	16.066	8.12	0.75	11.10	12.757
W2	1.00	1.603	4.032	16.087	8.12	0.75	11.12	12.773
W2	1.25	1.607	4.036	16.129	8.12	0.76	11.12	12.806
W2	1.50	1.610	4.040	16.164	8.12	0.80	11.10	12.834
W2	1.75	1.622	4.050	16.283	8.12	0.78	11.08	12.927
W2	2.00	1.637	4.064	16.448	8.12	0.78	11.07	13.057
W2	2.25	1.666	4.094	16.741	8.11	0.83	11.05	13.288
W2	2.50	1.776	4.215	17.885	8.08	0.96	10.92	14.187
W2	2.75	1.882	4.367	18.958	8.06	1.12	10.78	15.028
W2	3.00	2.011	4.504	20.296	8.03	1.49	10.68	16.077
W2	3.25	2.078	4.372	21.125	8.01	1.67	10.83	16.743
W3	0.50	1.791	4.525	17.879	8.06	1.23	10.88	14.164
W3	0.75	1.791	4.522	17.882	8.06	1.21	10.89	14.166
W3	1.00	1.791	4.521	17.884	8.06	1.16	10.90	14.168
W3	1.25	1.791	4.519	17.888	8.06	1.16	10.91	14.171
W3	1.50	1.792	4.516	17.894	8.06	1.17	10.91	14.176
W3	1.75	1.792	4.514	17.900	8.06	1.19	10.91	14.181
W3	2.00	1.793	4.515	17.912	8.06	1.19	10.90	14.191
W3	2.25	1.796	4.526	17.938	8.06	1.14	10.88	14.210
W4	0.50	1.806	5.985	17.279	8.05	3.22	10.31	13.584
W4	0.75	1.806	5.981	17.277	8.05	3.21	10.32	13.582
W4	1.00	1.806	5.977	17.274	8.05	3.18	10.30	13.581
W4	1.25	1.806	5.977	17.275	8.05	3.25	10.29	13.582
W4	1.50	1.808	5.987	17.289	8.05	3.18	10.31	13.592
W4	1.75	1.815	6.009	17.359	8.05	3.28	10.28	13.645
W4	2.00	1.838	6.046	17.571	8.05	3.52	10.27	13.809
W5	0.50	1.793	6.525	16.873	8.04	4.76	10.11	13.219
W5	0.75	1.793	6.523	16.873	8.04	4.71	10.12	13.219
W5	1.00	1.793	6.524	16.872	8.05	4.77	10.12	13.219
W5	1.25	1.793	6.524	16.872	8.05	4.77	10.12	13.219
W5	1.50	1.793	6.524	16.872	8.05	4.75	10.13	13.219
W5	1.75	1.793	6.524	16.872	8.05	4.68	10.12	13.219
W6	0.50	1.695	6.889	15.697	8.03	11.02	9.92	12.264
W6	0.75	1.694	6.887	15.697	8.03	8.97	9.92	12.264
W6	1.00	1.694	6.887	15.697	8.03	8.87	9.93	12.264
W6	1.25	1.694	6.887	15.697	8.03	8.96	9.93	12.264
W6	1.50	1.694	6.887	15.697	8.03	8.69	9.95	12.264
W7	0.50	1.676	7.238	15.357	8.03	5.78	9.83	11.966
W7	0.75	1.676	7.234	15.357	8.03	5.42	9.89	11.966
W7	1.00	1.676	7.233	15.357	8.03	5.52	9.88	11.966
W7	1.25	1.676	7.235	15.356	8.03	5.50	9.88	11.965
W7	1.50	1.676	7.237	15.356	8.04	5.60	9.88	11.965
W7	1.75	1.676	7.237	15.356	8.04	5.65	9.88	11.965
W8	0.50	1.474	6.938	13.472	8.02	6.43	9.85	10.514
W8	0.75	1.474	6.938	13.472	8.02	7.31	9.85	10.514
W8	1.00	1.474	6.940	13.473	8.02	7.70	9.86	10.514

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Station	Depth (m)	Cond (S/m)	Temp (deg C)	Salinity (psu)	pH	OBS (ntu)	DO (mg/L)	Sigma-t
W9	0.50	1.673	6.551	15.630	8.05	5.96	9.95	12.241
W9	0.75	1.673	6.543	15.639	8.05	6.03	10.00	12.248
W9	1.00	1.675	6.533	15.657	8.05	6.02	10.02	12.263
W9	1.25	1.676	6.523	15.681	8.05	5.95	10.02	12.283
W9	1.50	1.680	6.506	15.726	8.06	5.88	10.00	12.319
W9	1.75	1.689	6.473	15.830	8.05	5.89	9.93	12.405
W9	2.00	1.699	6.440	15.952	8.05	6.01	9.74	12.503
W10	0.50	1.817	5.905	17.434	8.05	3.37	10.13	13.712
W10	0.75	1.820	5.888	17.469	8.05	3.27	10.19	13.742
W10	1.00	1.826	5.849	17.548	8.04	3.24	10.20	13.807
W10	1.25	1.844	5.752	17.788	8.04	3.24	10.23	14.004
W10	1.50	1.870	5.635	18.126	8.03	3.10	10.27	14.279
W10	1.75	1.888	5.590	18.347	8.03	2.81	10.29	14.457
W10	2.00	1.923	5.544	18.735	8.03	2.62	10.32	14.766
W11	0.50	1.895	4.280	19.155	8.06	0.86	10.88	15.189
W11	0.75	1.894	4.268	19.155	8.06	0.80	10.91	15.190
W11	1.00	1.894	4.265	19.159	8.06	0.76	10.90	15.193
W11	1.25	1.896	4.262	19.178	8.06	0.82	10.91	15.208
W11	1.50	1.899	4.251	19.213	8.06	0.87	10.92	15.237
W11	1.75	1.907	4.248	19.310	8.05	0.92	10.88	15.314
W11	2.00	1.920	4.248	19.449	8.05	0.91	10.85	15.424
W11	2.25	1.926	4.250	19.512	8.05	0.95	10.83	15.474
W12	0.50	1.833	4.228	18.503	8.07	0.92	10.94	14.676
W12	0.75	1.833	4.228	18.507	8.07	0.76	10.97	14.679
W12	1.00	1.834	4.228	18.511	8.07	0.72	10.98	14.682
W12	1.25	1.834	4.229	18.517	8.07	0.72	11.00	14.687
W12	1.50	1.838	4.236	18.553	8.07	0.77	11.00	14.715
W12	1.75	1.852	4.260	18.697	8.06	0.75	10.96	14.827
W12	2.00	1.873	4.290	18.913	8.06	0.74	10.93	14.997
W12	2.25	1.886	4.298	19.043	8.06	0.72	10.94	15.099
W12	2.50	1.918	4.312	19.396	8.06	0.73	10.90	15.378
W13	0.50	1.846	4.152	18.692	8.09	0.82	10.94	14.830
W13	0.75	1.846	4.151	18.689	8.08	0.90	10.96	14.828
W13	1.00	1.846	4.152	18.687	8.08	0.92	10.96	14.827
W13	1.25	1.847	4.154	18.698	8.07	0.88	10.94	14.835
W13	1.50	1.850	4.160	18.729	8.07	0.91	10.98	14.859
W13	1.75	1.847	4.155	18.699	8.07	0.93	10.96	14.836
W13	2.00	1.889	4.225	19.118	8.06	0.93	10.83	15.163
W13	2.25	2.066	4.379	20.988	8.04	0.99	10.62	16.634
W13	2.50	2.243	4.072	23.180	8.00	1.13	11.26	18.393
W14	0.50	1.791	4.155	18.081	8.08	0.81	10.98	14.346
W14	0.75	1.791	4.155	18.080	8.08	0.92	11.00	14.345
W14	1.00	1.791	4.153	18.082	8.08	0.92	11.00	14.347
W14	1.25	1.791	4.153	18.080	8.08	0.84	10.99	14.346
W15	0.50	1.947	3.954	19.927	8.06	0.88	10.92	15.821
W15	0.75	1.993	4.011	20.409	8.06	1.05	10.89	16.200
W15	1.00	2.028	4.025	20.787	8.05	1.56	10.80	16.499
W15	1.25	2.035	4.030	20.869	8.05	1.92	10.78	16.563
W15	1.50	2.045	4.046	20.963	8.04	1.95	10.78	16.637
W15	1.75	2.085	4.039	21.418	8.03	1.92	10.73	16.998
W15	2.00	2.124	4.016	21.875	8.02	2.18	10.69	17.362
W15	2.25	2.185	3.963	22.595	8.01	2.33	10.59	17.937
W15	2.50	2.235	3.915	23.193	8.00	2.21	10.49	18.414

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Station	Depth (m)	Cond (S/m)	Temp (deg C)	Salinity (psu)	pH	OBS (ntu)	DO (mg/L)	Sigma-t
W16	0.50	2.050	4.395	20.799	8.05	1.17	10.71	16.483
W16	0.75	2.050	4.384	20.801	8.05	1.01	10.74	16.485
W16	1.00	2.050	4.384	20.807	8.05	0.94	10.74	16.490
W16	1.25	2.051	4.388	20.818	8.05	0.94	10.71	16.499
W16	1.50	2.053	4.395	20.832	8.05	0.97	10.75	16.509
W16	1.75	2.055	4.404	20.849	8.05	0.97	10.77	16.522
W16	2.00	2.059	4.424	20.883	8.05	1.02	10.73	16.547
W16	2.25	2.065	4.449	20.925	8.05	1.07	10.72	16.579
W17	0.50	1.756	6.176	16.666	8.07	4.53	10.03	13.086
W17	0.75	1.760	6.166	16.709	8.07	4.62	10.06	13.121
W17	1.00	1.766	6.146	16.778	8.07	4.76	10.06	13.176
W17	1.25	1.776	6.091	16.907	8.07	4.86	10.06	13.282
W17	1.50	1.793	5.992	17.137	8.06	4.87	10.06	13.471
W17	1.75	1.831	5.895	17.584	8.05	4.74	10.04	13.831
W17	2.00	1.932	5.767	18.712	8.03	4.47	9.98	14.730
W17	2.25	2.050	5.610	20.052	8.01	3.82	10.11	15.799
W17	2.50	2.097	5.431	20.668	8.00	2.91	10.43	16.300
W18	0.50	1.640	6.380	15.377	8.06	5.81	10.14	12.056
W18	0.75	1.641	6.381	15.381	8.07	5.67	10.13	12.059
W18	1.00	1.641	6.382	15.383	8.07	5.68	10.14	12.060
W18	1.25	1.642	6.384	15.391	8.07	5.77	10.15	12.067
W18	1.50	1.647	6.390	15.437	8.07	5.78	10.12	12.102
W18	1.75	1.653	6.385	15.506	8.07	5.75	10.10	12.157
W18	2.00	1.661	6.363	15.595	8.07	5.85	10.08	12.229
W19	0.50	1.567	6.256	14.685	8.08	8.47	10.24	11.522
W19	0.75	1.568	6.253	14.695	8.08	8.22	10.28	11.530
W19	1.00	1.568	6.251	14.699	8.08	8.36	10.28	11.533
W19	1.25	1.569	6.247	14.708	8.08	8.40	10.26	11.541
W20	0.50	1.665	6.236	15.695	8.07	4.84	10.19	12.318
W20	0.75	1.703	6.205	16.096	8.06	4.74	10.18	12.635
W20	1.00	1.743	6.168	16.529	8.05	4.75	10.17	12.979
W20	1.25	1.751	6.163	16.616	8.05	4.65	10.15	13.048
W20	1.50	1.754	6.144	16.656	8.05	4.45	10.16	13.081
W20	1.75	1.759	6.099	16.729	8.05	4.29	10.13	13.142
W21	0.50	2.071	4.536	20.939	8.04	2.01	10.68	16.584
W21	0.75	2.070	4.527	20.941	8.04	1.39	10.69	16.587
W21	1.00	2.071	4.529	20.952	8.04	1.43	10.69	16.595
W21	1.25	2.074	4.543	20.966	8.04	1.46	10.66	16.604
W21	1.50	2.077	4.566	20.993	8.04	1.48	10.66	16.624
W21	1.75	2.083	4.602	21.028	8.04	1.49	10.67	16.649
W21	2.00	2.091	4.661	21.082	8.04	1.48	10.62	16.687
W21	2.25	2.095	4.692	21.112	8.03	1.56	10.56	16.709
W21	2.50	2.099	4.691	21.149	8.03	1.57	10.53	16.739
W21	2.75	2.101	4.623	21.223	8.03	1.67	10.56	16.802
W22a	0.50	1.995	4.739	19.984	8.05	1.78	10.74	15.814
W22a	0.75	1.997	4.751	19.994	8.05	1.61	10.74	15.821
W22a	1.00	1.999	4.768	20.003	8.05	1.56	10.73	15.827
W22a	1.25	2.007	4.833	20.058	8.05	1.56	10.59	15.866
W22a	1.50	2.053	5.030	20.438	8.05	1.68	10.49	16.151
W22a	1.75	2.113	4.946	21.149	8.04	1.83	10.54	16.719
W22a	2.00	2.167	4.649	21.933	8.02	1.83	10.45	17.362
W22a	2.25	2.188	4.402	22.325	8.02	1.90	10.35	17.691
W22a	2.50	2.213	4.165	22.772	8.01	2.16	10.29	18.063
W22a	2.75	2.243	4.013	23.211	8.00	2.38	10.28	18.422

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Station	Depth (m)	Cond (S/m)	Temp (deg C)	Salinity (psu)	pH	OBS (ntu)	DO (mg/L)	Sigma-t
W22b	0.50	2.003	4.802	20.032	8.06	1.57	10.64	15.847
W22b	0.75	2.010	4.849	20.081	8.06	1.49	10.67	15.882
W22b	1.00	2.017	4.897	20.126	8.06	1.49	10.65	15.914
W22b	1.25	2.031	4.973	20.228	8.06	1.66	10.62	15.990
W22b	1.50	2.061	5.060	20.506	8.05	1.77	10.55	16.202
W22b	1.75	2.107	4.979	21.056	8.04	1.73	10.54	16.643
W22b	2.00	2.172	4.589	22.027	8.02	1.69	10.72	17.441
W22b	2.25	2.192	4.374	22.391	8.02	1.81	10.83	17.745
W22b	2.50	2.215	4.153	22.799	8.01	1.88	10.76	18.085
W22c	0.50	1.999	4.761	20.016	8.06	1.49	10.68	15.837
W22c	0.75	2.007	4.808	20.069	8.06	1.47	10.70	15.876
W22c	1.00	2.015	4.846	20.135	8.06	1.52	10.69	15.925
W22c	1.25	2.031	4.921	20.262	8.05	1.68	10.64	16.020
W22c	1.50	2.099	5.014	20.943	8.04	1.69	10.52	16.551
W22c	1.75	2.156	4.729	21.761	8.03	1.67	10.59	17.219
W22c	2.00	2.185	4.463	22.255	8.02	1.73	10.85	17.631
W22c	2.25	2.201	4.263	22.572	8.01	1.91	10.82	17.897
W22c	2.50	2.228	4.073	23.003	8.01	2.00	10.68	18.252
W23	0.50	1.687	3.783	17.133	8.11	0.75	11.14	13.615
W23	0.75	1.694	3.794	17.208	8.10	0.81	11.18	13.674
W23	1.00	1.703	3.806	17.308	8.09	0.84	11.17	13.753
W23	1.25	1.739	3.846	17.674	8.06	0.87	11.13	14.041
W23	1.50	1.890	4.050	19.240	8.04	0.91	10.95	15.271
W23	1.75	2.026	4.351	20.556	8.02	1.02	10.70	16.294
W23	2.00	2.110	4.572	21.346	8.01	1.28	10.50	16.903
W23	2.25	2.189	4.426	22.319	8.00	1.54	10.48	17.685
W23	2.50	2.257	4.097	23.317	7.99	1.77	10.64	18.499
W23	2.75	2.302	3.821	24.027	7.97	1.93	10.79	19.083
W23	3.00	2.328	3.644	24.461	7.97	1.94	10.86	19.440
W23	3.25	2.343	3.520	24.723	7.96	1.81	10.87	19.657
W23	3.50	2.361	3.417	25.008	7.95	1.90	10.74	19.891
W24	0.50	1.808	3.868	18.435	8.07	2.29	11.02	14.643
W24	0.75	1.998	4.105	20.401	8.04	0.86	10.91	16.188
W24	1.00	2.071	4.200	21.158	8.03	0.77	10.88	16.781
W24	1.25	2.173	4.152	22.331	8.01	0.90	10.85	17.714
W24	1.50	2.254	3.945	23.387	7.99	1.05	11.02	18.566
W24	1.75	2.284	3.775	23.852	7.99	1.10	11.11	18.947
W24	2.00	2.288	3.711	23.951	7.99	1.28	11.02	19.031
W24	2.25	2.289	3.645	24.004	7.99	1.39	10.97	19.077
W24	2.50	2.290	3.594	24.051	7.99	1.41	10.94	19.118
W24	2.75	2.291	3.551	24.103	7.99	1.49	10.93	19.162
W24	3.00	2.294	3.523	24.151	7.99	1.47	10.94	19.202
W24	3.25	2.295	3.512	24.179	7.99	1.48	10.94	19.225
W24	3.50	2.298	3.510	24.209	7.98	1.41	10.92	19.249
W24	3.75	2.302	3.501	24.257	7.98	1.38	10.87	19.288
W24	4.00	2.307	3.483	24.332	7.98	1.38	10.85	19.349
W24	4.25	2.314	3.440	24.442	7.98	1.35	10.78	19.439
W24	4.50	2.312	3.390	24.460	7.97	1.56	10.64	19.457

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Station	Depth (m)	Cond (S/m)	Temp (deg C)	Salinity (psu)	pH	OBS (ntu)	DO (mg/L)	Sigma-t
W25	0.50	1.447	3.568	14.602	8.19	0.86	11.39	11.616
W25	0.75	1.458	3.578	14.717	8.19	0.93	11.37	11.707
W25	1.00	1.482	3.601	14.976	8.19	0.91	11.34	11.912
W25	1.25	1.518	3.635	15.353	8.17	0.92	11.29	12.210
W25	1.50	1.652	3.783	16.757	8.13	0.91	11.11	13.317
W25	1.75	1.831	3.987	18.618	8.09	0.87	10.88	14.781
W25	2.00	1.915	4.048	19.515	8.07	0.82	10.82	15.489
W25	2.25	2.060	3.861	21.255	8.04	0.87	10.91	16.881
W25	2.50	2.142	3.473	22.446	8.02	0.85	11.17	17.851
W25	2.75	2.170	3.048	23.069	8.02	0.74	11.53	18.372
W25	3.00	2.180	2.850	23.320	8.01	0.69	11.68	18.583
W25	3.25	2.183	2.686	23.482	8.01	0.62	11.67	18.722
W25	3.50	2.190	2.497	23.698	8.01	0.52	11.69	18.904
W25	3.75	2.215	2.414	24.065	8.01	0.54	11.66	19.202
W25	4.00	2.241	2.473	24.329	8.00	0.52	11.59	19.409
W25	4.25	2.282	2.659	24.666	7.99	0.53	11.36	19.667
W25	4.50	2.312	2.744	24.960	7.99	0.63	11.15	19.896
W25	4.75	2.327	2.542	25.295	7.99	0.67	11.12	20.176
W25	5.00	2.344	2.184	25.782	7.98	0.71	11.19	20.584
W25	5.25	2.359	1.833	26.255	7.98	0.85	11.17	20.981
W25	5.50	2.394	1.209	27.218	7.97	0.95	11.25	21.783
W25	5.75	2.444	0.417	28.566	7.96	0.91	11.62	22.900
W25	6.00	2.468	-0.246	29.498	7.95	0.74	12.26	23.675
W25	6.25	2.477	-0.561	29.922	7.94	0.77	12.30	24.028
W26	0.50	1.403	3.448	14.179	-	2.70	11.17	11.285
W26	0.75	1.557	3.590	15.799	8.17	1.30	11.10	12.566
W26	1.00	1.819	3.746	18.623	8.10	0.96	10.91	14.799
W26	1.25	2.050	3.656	21.277	8.06	0.81	10.91	16.911
W26	1.50	2.113	3.584	22.038	8.04	0.77	11.14	17.520
W26	1.75	2.149	3.472	22.524	8.04	0.75	11.28	17.913
W26	2.00	2.175	3.425	22.858	8.03	0.74	11.31	18.181
W26	2.25	2.191	3.401	23.057	8.03	0.70	11.29	18.341
W26	2.50	2.203	3.347	23.238	8.03	0.63	11.31	18.488
W26	2.75	2.222	3.240	23.535	8.02	0.64	11.35	18.731
W26	3.00	2.241	3.103	23.857	8.02	0.62	11.33	18.996
W26	3.25	2.253	2.971	24.094	8.02	0.62	11.31	19.193
W26	3.50	2.261	2.878	24.255	8.02	0.63	11.27	19.326
W26	3.75	2.275	2.698	24.558	8.02	0.55	11.25	19.579
W26	4.00	2.288	2.542	24.832	8.01	0.51	11.28	19.806
W26	4.25	2.307	2.328	25.227	8.01	0.49	11.35	20.134
W26	4.50	2.323	2.090	25.605	8.01	0.47	11.42	20.448
W26	4.75	2.340	1.687	26.144	8.01	0.48	11.48	20.900
W26	5.00	2.358	1.287	26.700	8.00	0.52	11.48	21.365
W26	5.25	2.402	0.651	27.808	8.00	0.43	11.46	22.281
W26	5.50	2.444	-0.127	29.077	7.98	0.23	11.87	23.331
W26	5.75	2.461	-0.597	29.746	7.97	0.17	12.39	23.886
W26	6.00	2.468	-0.848	30.094	7.97	0.30	12.48	24.174
W26	6.25	2.471	-0.979	30.266	7.97	0.52	12.41	24.318
W26	6.50	2.471	-1.028	30.318	7.96	0.73	12.32	24.361
W26	6.75	2.471	-1.048	30.332	7.96	0.96	12.21	24.372
W26	7.00	2.473	-1.091	30.407	7.96	1.00	12.19	24.435
W26	7.25	2.475	-1.113	30.451	7.95	1.05	12.18	24.470
W26	7.50	2.476	-1.127	30.476	7.95	1.13	12.16	24.491
W26	7.75	2.475	-1.139	30.481	7.95	1.24	12.13	24.496

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Station	Depth (m)	Cond (S/m)	Temp (deg C)	Salinity (psu)	pH	OBS (ntu)	DO (mg/L)	Sigma-t
W27	0.50	1.238	3.310	12.432	-	1.33	11.57	9.901
W27	0.75	1.286	3.342	12.946	-	1.19	11.51	10.309
W27	1.00	1.303	3.365	13.124	-	1.18	11.48	10.449
W27	1.25	1.378	3.428	13.906	8.18	1.13	11.38	11.069
W27	1.50	1.623	3.574	16.543	8.13	1.08	11.14	13.157
W27	1.75	1.859	3.681	19.111	8.08	1.00	10.94	15.191
W27	2.00	1.995	3.688	20.630	8.06	0.92	10.87	16.395
W27	2.25	2.060	3.672	21.371	8.05	0.84	10.89	16.985
W27	2.50	2.111	3.694	21.940	8.04	0.75	10.96	17.435
W27	2.75	2.150	3.679	22.390	8.04	0.66	11.06	17.793
W27	3.00	2.178	3.581	22.780	8.03	0.60	11.15	18.109
W27	3.25	2.202	3.483	23.129	8.03	0.59	11.20	18.393
W27	3.50	2.220	3.387	23.404	8.02	0.62	11.21	18.618
W27	3.75	2.237	3.282	23.668	8.02	0.65	11.20	18.834
W27	4.00	2.256	3.129	24.003	8.01	0.65	11.21	19.111
W27	4.25	2.268	2.875	24.333	8.00	0.66	11.17	19.389
W27	4.50	2.281	2.445	24.821	7.99	0.70	10.92	19.802
W27	4.75	2.330	1.879	25.870	7.98	0.75	10.62	20.671
W27	5.00	2.409	1.056	27.535	7.97	0.74	10.84	22.045
W27	5.25	2.463	0.241	28.977	7.97	0.45	11.63	23.238
W27	5.50	2.464	-0.417	29.619	7.97	0.19	12.35	23.778
W27	5.75	2.459	-0.891	30.013	7.97	0.10	12.67	24.110
W27	6.00	2.461	-1.106	30.263	7.97	0.06	12.70	24.318
W27	6.25	2.468	-1.200	30.449	7.97	0.01	12.62	24.471
W27	6.50	2.476	-1.253	30.613	7.97	0.02	12.52	24.605
W27	6.75	2.480	-1.280	30.689	7.97	0.04	12.46	24.667
W27	7.00	2.481	-1.295	30.724	7.96	0.11	12.44	24.696
W27	7.25	2.482	-1.304	30.745	7.96	0.18	12.43	24.713
W27	7.50	2.483	-1.306	30.758	7.96	0.22	12.41	24.724
W27	7.75	2.484	-1.302	30.767	7.96	0.24	12.37	24.731
W27	8.00	2.485	-1.297	30.773	7.96	0.31	12.33	24.735
W27	8.25	2.485	-1.298	30.776	7.96	0.43	12.33	24.738
W27	8.50	2.485	-1.304	30.783	7.96	0.63	12.38	24.744
W27	8.75	2.486	-1.309	30.799	7.96	0.82	12.42	24.757
W27	9.00	2.487	-1.313	30.824	7.95	0.91	12.35	24.777
W27	9.25	2.489	-1.298	30.827	7.95	1.00	12.29	24.779
W27	9.50	2.489	-1.299	30.832	7.95	1.16	12.28	24.783
W28	0.50	1.459	3.767	14.645	8.17	0.98	11.39	11.642
W28	0.75	1.482	3.781	14.888	8.16	0.95	11.41	11.834
W28	1.00	1.547	3.806	15.593	8.14	0.98	11.36	12.392
W28	1.25	1.675	3.857	16.964	8.10	0.97	11.24	13.477
W28	1.50	1.820	3.940	18.528	8.07	1.09	11.08	14.713
W28	1.75	1.901	4.212	19.257	8.05	1.38	10.90	15.274
W28	2.00	1.993	4.581	20.054	8.03	1.65	10.58	15.880
W28	2.25	2.076	4.616	20.952	8.02	1.73	10.44	16.588
W28	2.50	2.106	4.370	21.436	8.01	1.61	10.60	16.989
W28	2.75	2.131	4.189	21.834	8.00	1.39	10.78	17.317
W28	3.00	2.203	3.859	22.872	7.98	1.17	10.92	18.164
W28	3.25	2.276	3.492	23.968	7.97	1.03	11.19	19.059
W28	3.50	2.311	3.392	24.454	7.96	0.92	11.38	19.452
W28	3.75	2.322	3.246	24.687	7.95	0.91	11.31	19.647
W28	4.00	2.328	3.082	24.879	7.95	0.89	11.32	19.810
W28	4.25	2.347	3.090	25.099	7.95	0.94	11.24	19.985
W28	4.50	2.362	3.102	25.263	7.94	1.06	11.11	20.115
W28	4.75	2.380	3.051	25.521	7.94	1.18	11.01	20.324

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W28	5.00	2.400	2.921	25.855	7.93	1.35	11.02	20.599
W28	5.25	2.405	2.818	25.992	7.93	1.57	11.04	20.714
W28	5.50	2.404	2.772	26.029	7.93	1.81	10.95	20.746
W29	0.50	1.633	3.945	16.461	8.12	0.92	11.25	13.074
W29	0.75	1.639	3.962	16.518	8.12	0.83	11.29	13.118
W29	1.00	1.673	4.047	16.847	8.11	0.86	11.24	13.375
W29	1.25	1.753	4.234	17.626	8.09	0.89	11.08	13.981
W29	1.50	1.911	4.436	19.242	8.05	1.17	10.76	15.248
W29	1.75	2.002	4.298	20.330	8.03	1.27	10.83	16.118
W29	2.00	2.051	4.504	20.740	8.02	1.19	10.83	16.429
W29	2.25	2.089	4.726	21.016	8.01	1.37	10.64	16.631
W29	2.50	2.102	4.731	21.157	8.01	1.59	10.64	16.742
W29	2.75	2.113	4.673	21.321	8.01	1.75	10.69	16.876
W29	3.00	2.150	4.503	21.838	8.00	1.94	10.65	17.298
W29	3.25	2.208	4.241	22.658	7.99	2.16	10.60	17.966
W29	3.50	2.246	3.930	23.314	7.98	2.21	10.64	18.510
W29	3.75	2.266	3.730	23.679	7.97	2.27	10.74	18.813
W29	4.00	2.279	3.656	23.888	7.96	2.13	10.73	18.984
W30	0.50	1.837	5.877	17.654	8.05	3.68	10.19	13.888
W30	0.75	1.838	5.871	17.663	8.05	3.68	10.21	13.896
W30	1.00	1.839	5.866	17.676	8.06	3.60	10.21	13.906
W30	1.25	1.839	5.864	17.685	8.06	3.58	10.21	13.913
W30	1.50	1.840	5.859	17.699	8.06	3.53	10.20	13.925
W30	1.75	1.842	5.854	17.715	8.06	3.50	10.21	13.938
W30	2.00	1.843	5.848	17.734	8.06	3.43	10.20	13.953
W30	2.25	1.846	5.839	17.762	8.06	3.40	10.20	13.976
W30	2.50	1.850	5.823	17.814	8.06	3.44	10.21	14.018
W30	2.75	1.856	5.797	17.889	8.05	3.50	10.22	14.080
W31	0.50	1.633	6.239	15.369	8.07	15.85	10.24	12.061
W31	0.75	1.642	6.225	15.467	8.07	15.68	10.20	12.139
W31	1.00	1.662	6.195	15.682	8.06	15.71	10.19	12.311
W31	1.25	1.712	6.126	16.228	8.05	14.95	10.21	12.746
W31	1.50	1.777	6.045	16.942	8.04	13.47	10.23	13.314
W32	0.50	1.725	6.223	16.319	8.07	5.23	10.20	12.809
W32	0.75	1.727	6.214	16.339	8.07	5.48	10.22	12.825
W32	1.00	1.730	6.194	16.387	8.07	5.64	10.23	12.865
W32	1.25	1.741	6.146	16.517	8.07	5.76	10.20	12.971
W32	1.50	1.758	6.073	16.732	8.07	5.83	10.20	13.147
W32	1.75	1.769	6.030	16.866	8.07	6.14	10.24	13.256
W33	0.50	1.893	5.819	18.274	8.07	3.20	10.16	14.381
W33	0.75	1.907	5.778	18.440	8.06	3.15	10.22	14.515
W33	1.00	1.927	5.712	18.695	8.06	3.25	10.23	14.721
W33	1.25	1.983	5.534	19.385	8.05	3.32	10.26	15.279
W33	1.50	2.079	5.230	20.602	8.03	3.38	10.33	16.265
W33	1.75	2.205	4.794	22.257	7.99	3.71	10.44	17.607
W33	2.00	2.379	4.167	24.648	7.96	4.55	10.60	19.549
W33	2.25	2.430	4.015	25.347	7.95	6.43	10.59	20.116

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W34	0.50	1.847	5.190	18.124	8.06	2.00	10.56	14.311
W34	0.75	1.868	5.288	18.295	8.06	2.13	10.53	14.439
W34	1.00	1.877	5.305	18.381	8.06	2.17	10.51	14.506
W34	1.25	1.887	5.311	18.481	8.05	2.18	10.51	14.584
W34	1.50	1.902	5.340	18.625	8.05	2.19	10.48	14.695
W34	1.75	1.917	5.389	18.758	8.05	2.22	10.44	14.797
W34	2.00	1.925	5.413	18.837	8.05	2.24	10.38	14.857
W34	2.25	1.929	5.411	18.874	8.05	2.27	10.37	14.887
W34	2.50	1.933	5.405	18.923	8.05	2.31	10.38	14.926
W34	2.75	1.937	5.381	18.984	8.04	2.36	10.38	14.976
W34	3.00	1.953	5.301	19.198	8.04	2.34	10.37	15.151
W34	3.25	1.992	5.156	19.704	8.02	2.28	10.38	15.561
W34	3.50	2.045	4.970	20.392	8.01	2.20	10.43	16.119
W34	3.75	2.129	4.682	21.489	8.00	2.17	10.52	17.008
W34	4.00	2.190	4.347	22.393	7.99	2.12	10.68	17.749
W35	0.50	1.514	3.847	15.212	8.17	1.17	11.38	12.088
W35	0.75	1.524	3.840	15.316	8.17	0.86	11.41	12.171
W35	1.00	1.524	3.835	15.321	8.17	0.84	11.42	12.175
W35	1.25	1.529	3.837	15.379	8.17	0.88	11.40	12.221
W35	1.50	1.556	3.846	15.670	8.17	0.91	11.37	12.451
W35	1.75	1.622	3.854	16.388	8.14	0.98	11.33	13.021
W35	2.00	1.739	3.894	17.658	8.11	1.08	11.25	14.026
W35	2.25	1.891	4.330	19.084	8.07	1.28	10.97	15.129
W35	2.50	2.106	4.792	21.164	8.03	1.56	10.54	16.743
W35	2.75	2.179	4.506	22.162	8.02	1.72	10.49	17.554
W35	3.00	2.225	4.146	22.918	8.01	1.82	10.69	18.179
W35	3.25	2.258	3.818	23.532	8.00	1.78	10.74	18.690
W35	3.50	2.308	3.449	24.375	7.99	1.46	10.88	19.385
W35	3.75	2.330	3.210	24.811	7.98	1.25	11.19	19.748
W35	4.00	2.344	3.161	25.006	7.98	1.08	11.31	19.907
W35	4.25	2.354	3.188	25.107	7.97	0.99	11.32	19.985
W35	4.50	2.358	3.178	25.164	7.97	0.99	11.22	20.031
W35	4.75	2.363	3.095	25.285	7.97	1.08	11.22	20.133
W35	5.00	2.373	2.910	25.547	7.96	1.28	11.22	20.353
W35	5.25	2.381	2.678	25.821	7.96	1.58	11.16	20.587
W35	5.50	2.382	2.638	25.869	7.96	1.80	11.03	20.627
W36	0.50	1.255	3.422	12.579	-	1.22	11.57	10.014
W36	0.75	1.256	3.424	12.582	-	1.07	11.64	10.017
W36	1.00	1.259	3.429	12.617	-	1.04	11.64	10.044
W36	1.25	1.281	3.447	12.847	-	1.02	11.58	10.226
W36	1.50	1.466	3.556	14.817	-	0.99	11.39	11.787
W36	1.75	1.707	3.775	17.368	8.13	0.96	11.12	13.801
W36	2.00	1.913	3.988	19.532	8.07	0.86	10.91	15.506
W36	2.25	1.991	4.025	20.377	8.05	0.82	10.88	16.173
W36	2.50	2.050	3.932	21.098	8.04	0.87	10.95	16.751
W36	2.75	2.091	3.733	21.689	8.02	0.86	11.14	17.233
W36	3.00	2.136	3.361	22.454	8.01	0.76	11.34	17.864
W36	3.25	2.167	2.931	23.114	8.00	0.64	11.52	18.415
W36	3.50	2.185	2.667	23.516	8.00	0.65	11.66	18.750
W36	3.75	2.203	2.543	23.823	8.00	0.64	11.67	19.001
W36	4.00	2.217	2.448	24.057	7.99	0.63	11.64	19.193
W36	4.25	2.228	2.335	24.277	7.99	0.61	11.65	19.375
W36	4.50	2.237	2.226	24.464	7.99	0.60	11.65	19.530
W36	4.75	2.256	2.056	24.831	7.98	0.52	11.65	19.832

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Station	Depth (m)	Cond (S/m)	Temp (deg C)	Salinity (psu)	pH	OBS (ntu)	DO (mg/L)	Sigma-t
W36	5.00	2.276	1.950	25.149	7.98	0.49	11.64	20.091
W36	5.25	2.298	1.882	25.476	7.97	0.49	11.54	20.356
W36	5.50	2.330	1.867	25.873	7.96	0.54	11.33	20.674
W36	5.75	2.371	1.730	26.486	7.95	0.75	11.08	21.171
W36	6.00	2.430	1.007	27.851	7.94	1.21	11.24	22.300
W36	6.25	2.471	0.290	29.031	7.93	1.49	11.80	23.280
W36	6.50	2.482	-0.433	29.864	7.93	1.44	12.46	23.977
W36	6.75	2.489	-0.746	30.269	7.93	1.52	12.58	24.313
W36	7.00	2.489	-0.851	30.380	7.93	1.66	12.43	24.406
W36	7.25	2.488	-0.903	30.413	7.93	1.47	12.30	24.434
W36	7.50	2.488	-0.920	30.426	7.93	1.32	12.27	24.445
W37	0.50	0.990	3.165	9.816	-	1.51	11.84	7.823
W37	0.75	1.125	3.168	11.271	-	1.30	11.73	8.981
W37	1.00	1.526	3.196	15.653	-	1.22	11.37	12.466
W37	1.25	1.928	3.231	20.167	8.14	1.12	11.09	16.053
W37	1.50	2.176	3.247	22.994	8.06	0.92	11.00	18.301
W37	1.75	2.250	3.271	23.837	8.02	0.75	11.05	18.970
W37	2.00	2.292	3.192	24.382	8.00	0.62	11.07	19.408
W37	2.25	2.318	3.094	24.758	8.00	0.51	11.13	19.713
W37	2.50	2.347	2.935	25.216	7.99	0.45	11.25	20.088
W37	2.75	2.391	2.628	25.984	7.98	0.43	11.45	20.720
W37	3.00	2.426	2.226	26.742	7.98	0.36	11.78	21.349
W37	3.25	2.436	1.823	27.203	7.97	0.28	12.02	21.740
W37	3.50	2.440	1.681	27.375	7.97	0.24	12.03	21.886
W37	3.75	2.440	1.568	27.472	7.97	0.24	11.94	21.970
W37	4.00	2.436	1.233	27.724	7.96	0.24	11.98	22.188
W37	4.25	2.439	0.830	28.123	7.96	0.26	12.12	22.527
W37	4.50	2.457	0.523	28.623	7.96	0.24	12.21	22.942
W37	4.75	2.470	0.339	28.964	7.95	0.22	12.18	23.224
W37	5.00	2.484	0.079	29.401	7.94	0.16	12.16	23.586
W37	5.25	2.498	-0.079	29.736	7.94	0.14	12.22	23.862
W37	5.50	2.510	-0.232	30.039	7.93	0.14	12.30	24.112
W37	5.75	2.515	-0.471	30.340	7.93	0.17	12.46	24.362
W37	6.00	2.517	-0.699	30.593	7.93	0.19	12.69	24.574
W37	6.25	2.517	-0.875	30.780	7.93	0.21	12.84	24.731
W37	6.50	2.519	-1.006	30.942	7.93	0.14	12.93	24.866
W37	6.75	2.521	-1.106	31.065	7.93	0.15	12.97	24.968
W37	7.00	2.522	-1.183	31.162	7.93	0.20	12.94	25.049
W37	7.25	2.522	-1.221	31.206	7.92	0.32	12.88	25.085
W37	7.50	2.523	-1.251	31.241	7.92	0.38	12.84	25.114
W37	7.75	2.523	-1.280	31.271	7.92	0.42	12.83	25.139
W37	8.00	2.523	-1.305	31.302	7.92	0.42	12.80	25.165
W37	8.25	2.523	-1.321	31.322	7.92	0.45	12.74	25.181
W37	8.50	2.524	-1.332	31.338	7.92	0.46	12.70	25.195
W37	8.75	2.524	-1.337	31.350	7.92	0.50	12.66	25.205
W37	9.00	2.524	-1.342	31.359	7.92	0.57	12.63	25.212
W37	9.25	2.524	-1.348	31.367	7.92	0.62	12.62	25.218
W37	9.50	2.524	-1.360	31.377	7.92	0.65	12.62	25.227
W37	9.75	2.524	-1.381	31.399	7.91	0.65	12.64	25.245
W37	10.00	2.525	-1.401	31.424	7.91	0.58	12.68	25.266
W37	10.25	2.525	-1.412	31.436	7.91	0.53	12.72	25.276
W37	10.50	2.525	-1.414	31.438	7.91	0.49	12.73	25.278
W37	10.75	2.525	-1.409	31.438	7.91	0.46	12.74	25.277
W37	11.00	2.526	-1.401	31.439	7.91	0.47	12.75	25.278
W37	11.25	2.526	-1.398	31.440	7.91	0.48	12.76	25.279

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W38	0.50	1.377	3.249	13.976	-	1.26	11.52	11.130
W38	0.75	1.693	3.182	17.529	8.15	1.10	11.34	13.958
W38	1.00	2.029	3.042	21.438	8.07	0.97	11.21	17.074
W38	1.25	2.091	2.945	22.217	8.05	0.82	11.31	17.700
W38	1.50	2.131	2.540	22.970	8.05	0.63	11.47	18.321
W38	1.75	2.162	2.101	23.669	8.04	0.56	11.66	18.900
W38	2.00	2.193	1.701	24.346	8.03	0.53	11.77	19.460
W38	2.25	2.207	1.593	24.590	8.03	0.48	11.75	19.660
W38	2.50	2.225	1.517	24.874	8.02	0.44	11.63	19.891
W38	2.75	2.248	1.484	25.185	8.01	0.40	11.58	20.142
W38	3.00	2.276	1.603	25.430	8.00	0.40	11.55	20.333
W38	3.25	2.312	1.787	25.723	7.99	0.38	11.54	20.558
W38	3.50	2.329	1.522	26.143	7.99	0.31	11.77	20.907
W38	3.75	2.319	1.079	26.398	7.98	0.23	12.08	21.131
W38	4.00	2.342	0.793	26.929	7.98	0.21	12.20	21.569
W38	4.25	2.388	0.831	27.469	7.97	0.22	12.07	22.001
W38	4.50	2.431	0.968	27.897	7.97	0.29	11.85	22.340
W38	4.75	2.457	0.932	28.247	7.96	0.34	11.74	22.622
W38	5.00	2.483	0.816	28.688	7.96	0.27	11.76	22.981
W38	5.25	2.489	0.607	28.957	7.96	0.23	11.84	23.207
W38	5.50	2.495	0.432	29.200	7.96	0.21	11.90	23.410
W38	5.75	2.507	0.348	29.437	7.95	0.21	11.88	23.604
W38	6.00	2.508	0.056	29.727	7.95	0.20	11.99	23.849
W38	6.25	2.510	-0.224	30.027	7.95	0.18	12.21	24.102
W38	6.50	2.512	-0.403	30.227	7.95	0.20	12.37	24.269
W38	6.75	2.515	-0.678	30.553	7.95	0.23	12.55	24.541
W38	7.00	2.516	-0.810	30.702	7.94	0.23	12.68	24.666
W38	7.25	2.518	-0.944	30.861	7.94	0.31	12.72	24.798
W38	7.50	2.520	-1.039	30.980	7.94	0.32	12.73	24.897
W38	7.75	2.520	-1.068	31.020	7.94	0.39	12.71	24.930
W38	8.00	2.521	-1.094	31.060	7.93	0.49	12.66	24.963
W38	8.25	2.523	-1.119	31.102	7.93	0.66	12.62	24.998
W38	8.50	2.523	-1.139	31.128	7.93	0.86	12.59	25.020
W38	8.75	2.523	-1.145	31.136	7.93	1.00	12.53	25.026
W38	9.00	2.524	-1.141	31.139	7.93	1.17	12.49	25.029
W38	9.25	2.524	-1.140	31.141	7.93	1.31	12.47	25.030
W38	9.50	2.523	-1.147	31.138	7.93	1.40	12.48	25.028
W39	0.50	1.476	3.382	15.018	-	4.87	11.43	11.954
W39	0.75	1.761	3.209	18.282	-	1.51	11.36	14.556
W39	1.00	1.988	3.021	20.983	8.14	0.97	11.29	16.713
W39	1.25	2.066	2.913	21.953	8.09	0.80	11.30	17.491
W39	1.50	2.086	2.856	22.230	8.06	0.71	11.29	17.715
W39	1.75	2.122	2.807	22.674	8.04	0.67	11.25	18.071
W39	2.00	2.140	2.846	22.865	8.04	0.65	11.22	18.221
W39	2.25	2.169	2.802	23.235	8.03	0.61	11.20	18.518
W39	2.50	2.203	2.696	23.707	8.02	0.59	11.21	18.900
W39	2.75	2.216	2.615	23.917	8.02	0.62	11.30	19.072
W39	3.00	2.240	2.393	24.373	8.01	0.65	11.42	19.448
W39	3.25	2.253	2.307	24.597	8.01	0.64	11.50	19.631
W39	3.50	2.265	2.243	24.791	8.00	0.65	11.58	19.790
W39	3.75	2.286	2.089	25.156	8.00	0.64	11.59	20.089
W39	4.00	2.294	1.987	25.338	8.00	0.66	11.61	20.240
W39	4.25	2.309	1.873	25.614	7.99	0.65	11.59	20.467
W39	4.50	2.316	1.829	25.737	7.99	0.74	11.52	20.567
W39	4.75	2.323	1.781	25.857	7.99	0.79	11.46	20.665

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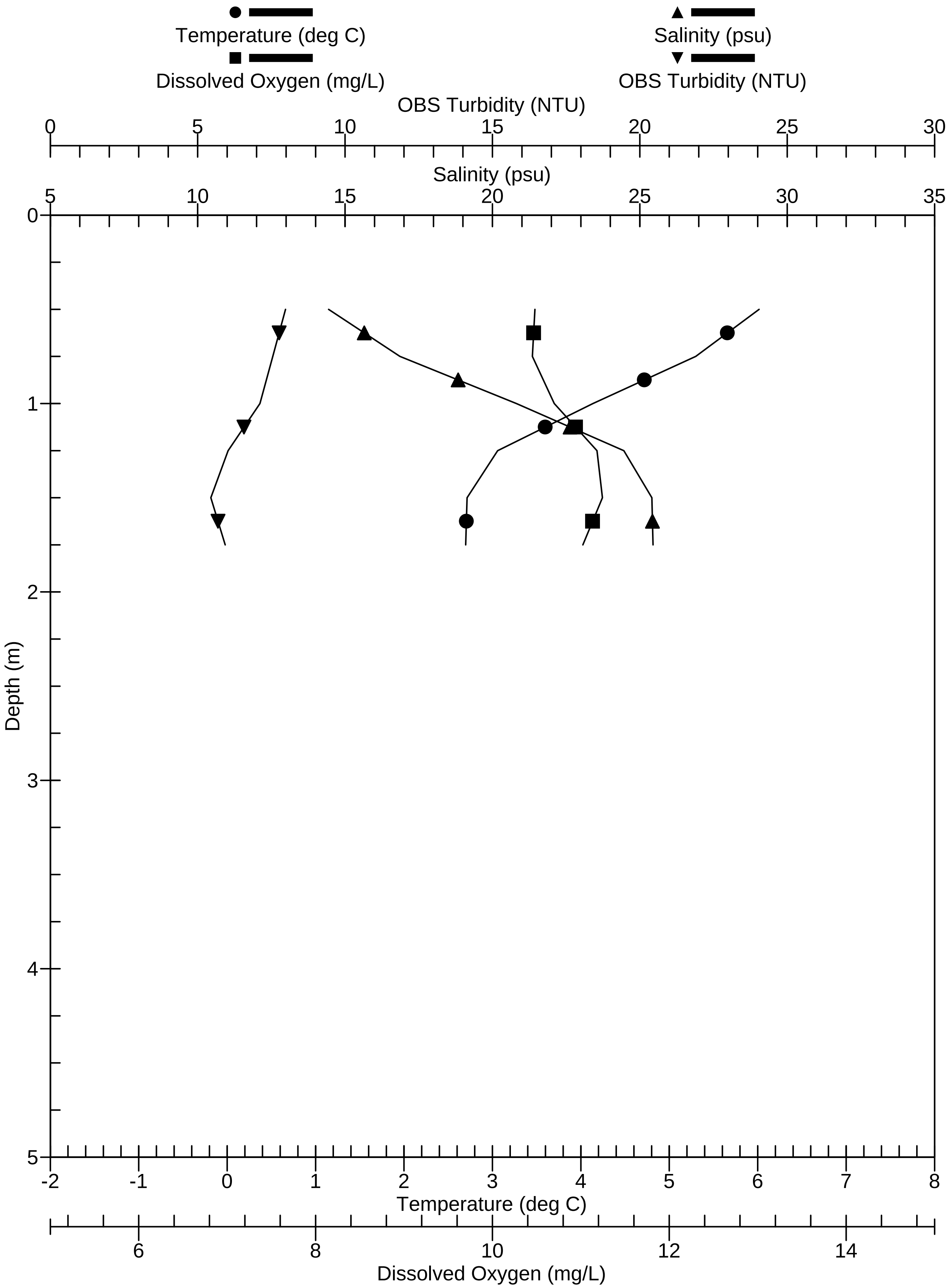
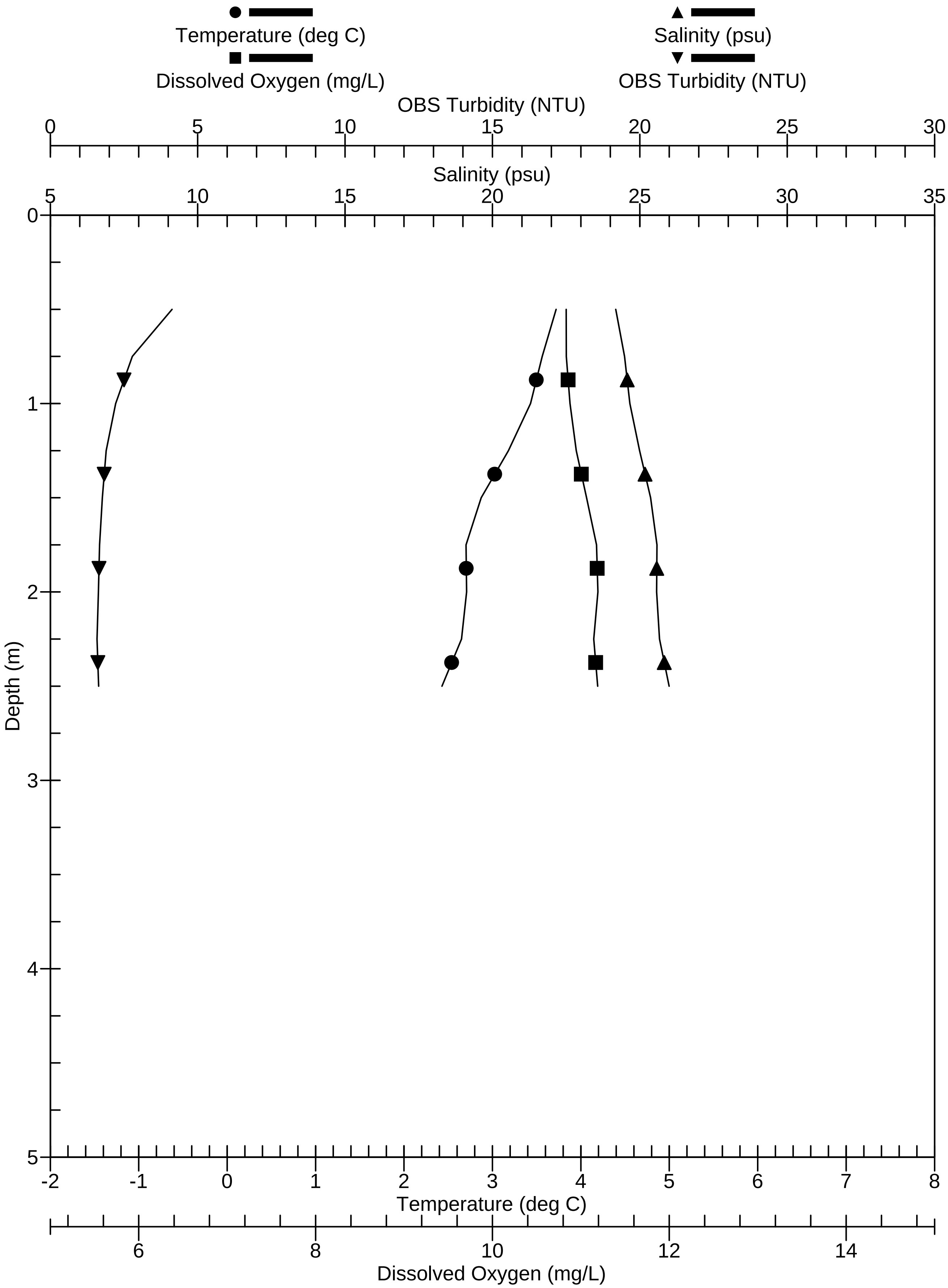
W39	5.00	2.327	1.747	25.939	7.99	0.81	11.44	20.733
W39	5.25	2.335	1.645	26.111	7.99	0.82	11.41	20.876
W39	5.50	2.347	1.635	26.274	7.99	0.84	11.37	21.007
W39	5.75	2.386	1.689	26.705	7.98	0.80	11.29	21.349
W39	6.00	2.415	1.585	27.149	7.98	0.69	11.34	21.710
W39	6.25	2.419	1.040	27.678	7.98	0.71	11.60	22.160
W39	6.50	2.432	0.547	28.285	7.97	0.80	11.75	22.669
W39	6.75	2.469	0.242	29.040	7.96	0.82	11.72	23.288
W39	7.00	2.489	0.048	29.489	7.96	0.71	11.91	23.658
W39	7.25	2.490	-0.270	29.815	7.95	0.69	12.19	23.932
W40	0.50	1.597	3.755	16.161	8.13	1.08	11.33	12.845
W40	0.75	1.606	3.746	16.259	8.14	0.86	11.38	12.924
W40	1.00	1.604	3.738	16.245	8.14	0.82	11.40	12.913
W40	1.25	1.617	3.721	16.393	8.14	0.78	11.39	13.031
W40	1.50	1.669	3.738	16.959	8.12	0.75	11.31	13.480
W40	1.75	1.776	3.813	18.104	8.09	0.69	11.17	14.384
W40	2.00	2.031	3.844	20.934	8.03	0.59	11.06	16.627
W40	2.25	2.092	3.844	21.628	8.02	0.52	11.20	17.178
W40	2.50	2.106	3.845	21.785	8.02	0.49	11.25	17.302
W40	2.75	2.111	3.773	21.882	8.02	0.51	11.28	17.384
W40	3.00	2.118	3.716	22.000	8.02	0.47	11.31	17.481
W40	3.25	2.116	3.634	22.042	8.02	0.46	11.31	17.519
W40	3.50	2.113	3.560	22.051	8.02	0.48	11.33	17.532
W40	3.75	2.114	3.502	22.106	8.02	0.51	11.30	17.579
W40	4.00	2.117	3.475	22.153	8.02	0.48	11.28	17.618
W40	4.25	2.118	3.473	22.169	8.02	0.42	11.26	17.631
W40	4.50	2.135	3.508	22.338	8.01	0.48	11.27	17.763
W40	4.75	2.158	3.506	22.605	8.01	0.47	11.27	17.975
W40	5.00	2.245	3.275	23.766	7.99	0.51	11.31	18.913
W40	5.25	2.284	3.155	24.312	7.98	0.61	11.29	19.355
W41	0.50	1.738	3.958	17.607	8.08	1.62	11.18	13.982
W41	0.75	1.738	3.954	17.608	8.08	0.87	11.23	13.982
W41	1.00	1.738	3.954	17.609	8.08	0.77	11.24	13.984
W41	1.25	1.738	3.954	17.609	8.08	0.82	11.25	13.984
W41	1.50	1.738	3.955	17.610	8.09	0.79	11.20	13.984
W41	1.75	1.739	3.954	17.621	8.09	0.77	11.19	13.993
W41	2.00	1.744	3.946	17.685	8.08	0.76	11.20	14.044
W41	2.25	1.779	3.940	18.066	8.08	0.84	11.16	14.347
W41	2.50	1.856	3.961	18.912	8.05	0.95	11.10	15.016
W41	2.75	1.984	3.974	20.329	8.03	1.02	11.06	16.139
W41	3.00	2.012	3.918	20.676	8.02	1.03	11.16	16.418
W41	3.25	2.020	3.877	20.790	8.02	1.06	11.23	16.511
W42	0.50	2.194	5.042	21.969	8.03	2.97	10.46	17.359
W42	0.75	2.194	5.042	21.968	8.03	2.97	10.48	17.359
W42	1.00	2.194	5.043	21.968	8.03	3.04	10.49	17.358
W42	1.25	2.194	5.044	21.969	8.03	3.02	10.50	17.359
W42	1.50	2.194	5.044	21.968	8.03	3.14	10.48	17.358
W43	0.50	2.042	5.556	20.005	8.04	5.34	10.32	15.767
W43	0.75	2.042	5.556	20.006	8.04	5.56	10.37	15.768
W43	1.00	2.042	5.556	20.005	8.04	5.71	10.35	15.766
W43	1.25	2.042	5.556	20.003	8.04	5.81	10.37	15.765

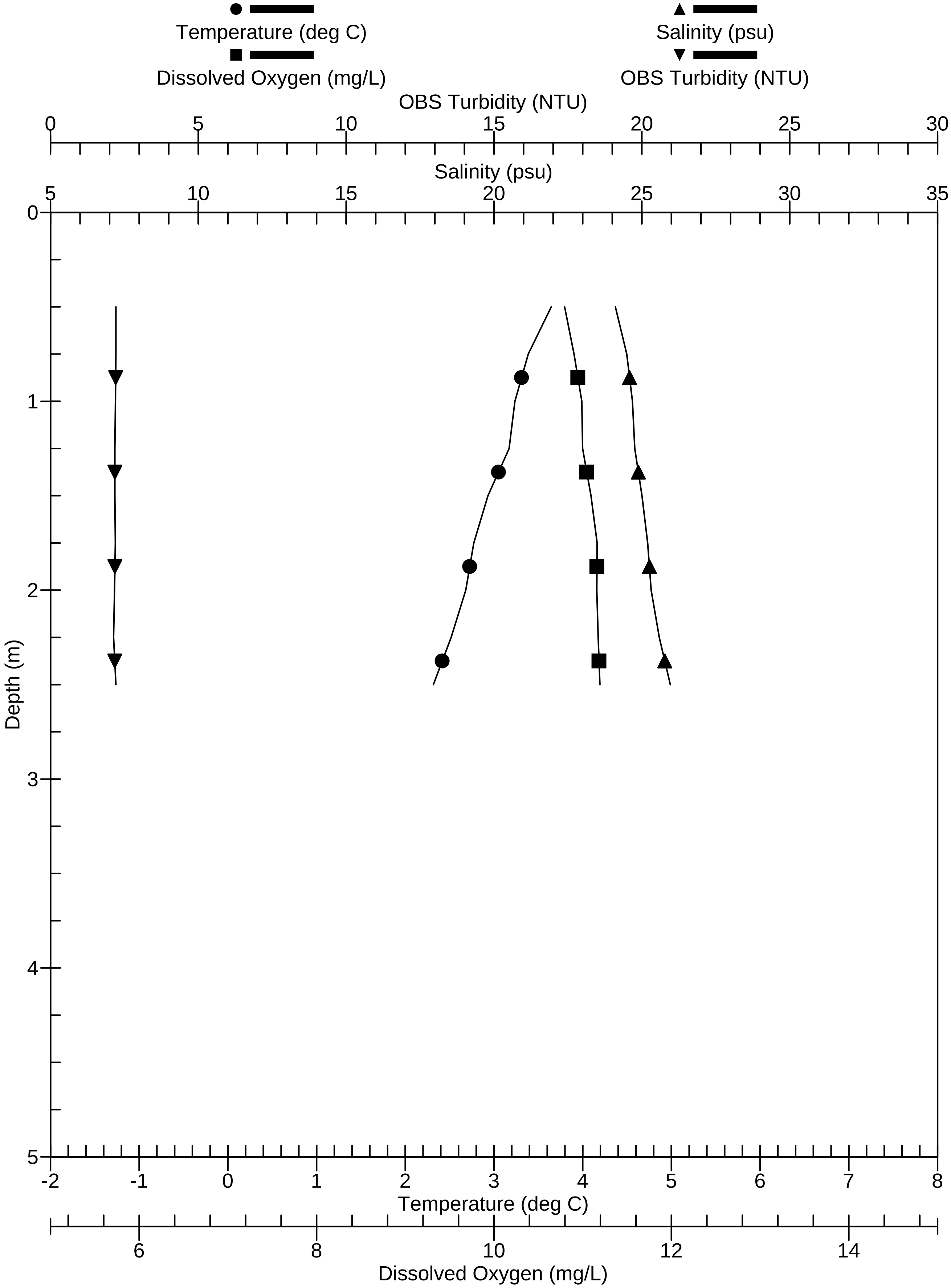
Willow Marine Monitoring Program - 2018 Hydrographic Data, S1.cnv



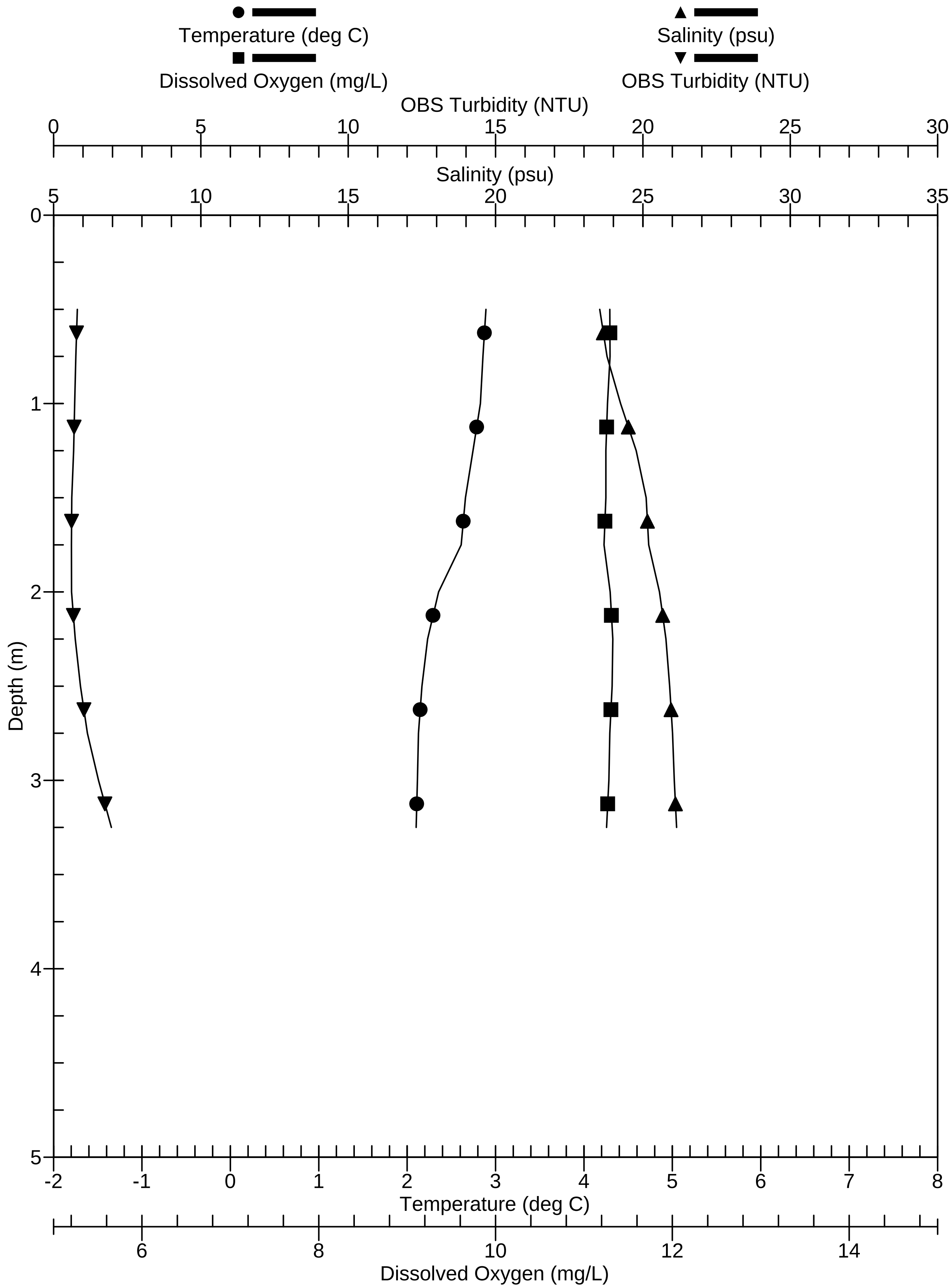
Willow Marine Monitoring Program - 2018 Hydrographic Data, S2.cnv



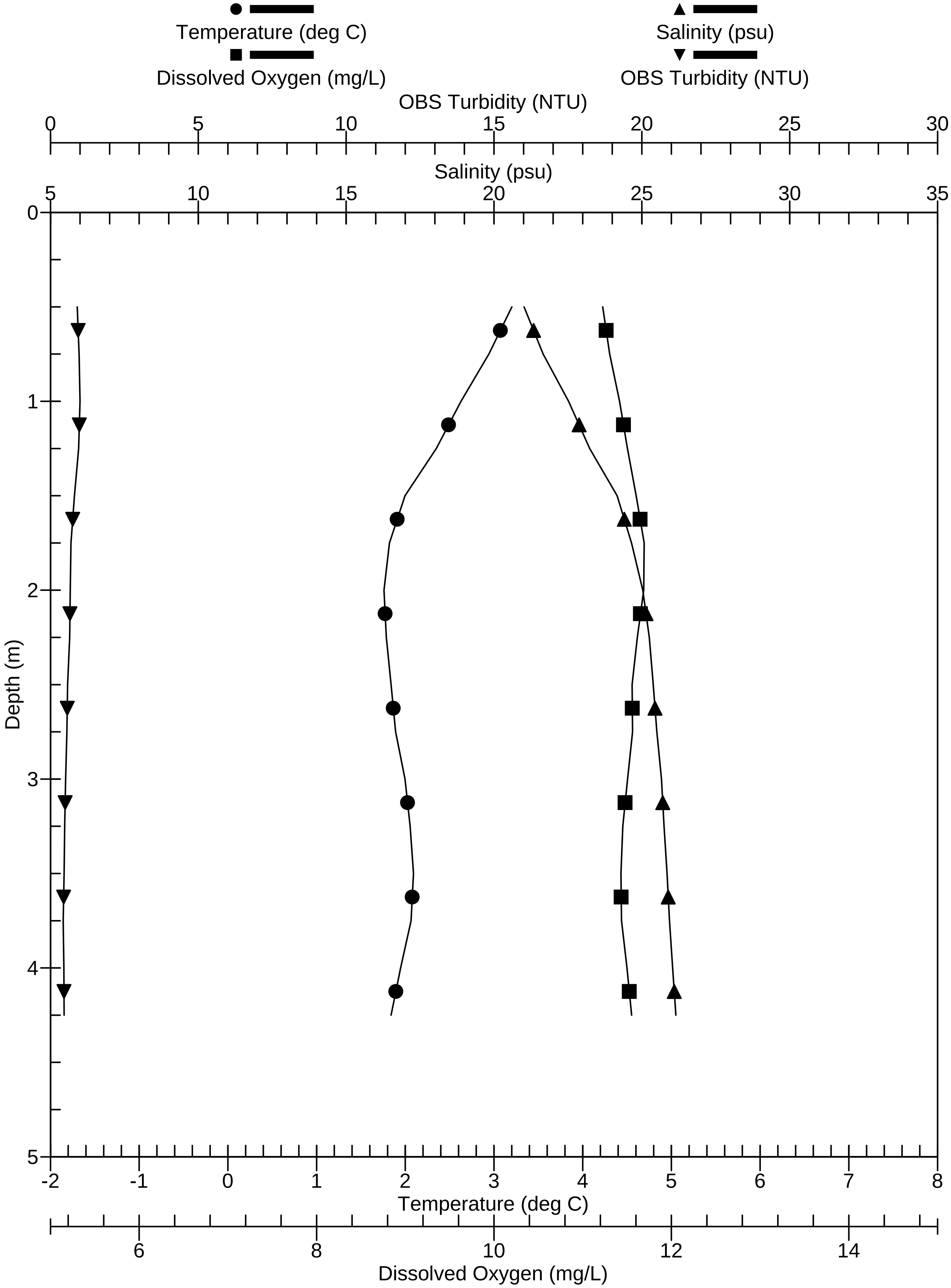
Willow Marine Monitoring Program - 2018 Hydrographic Data, S3.cnv



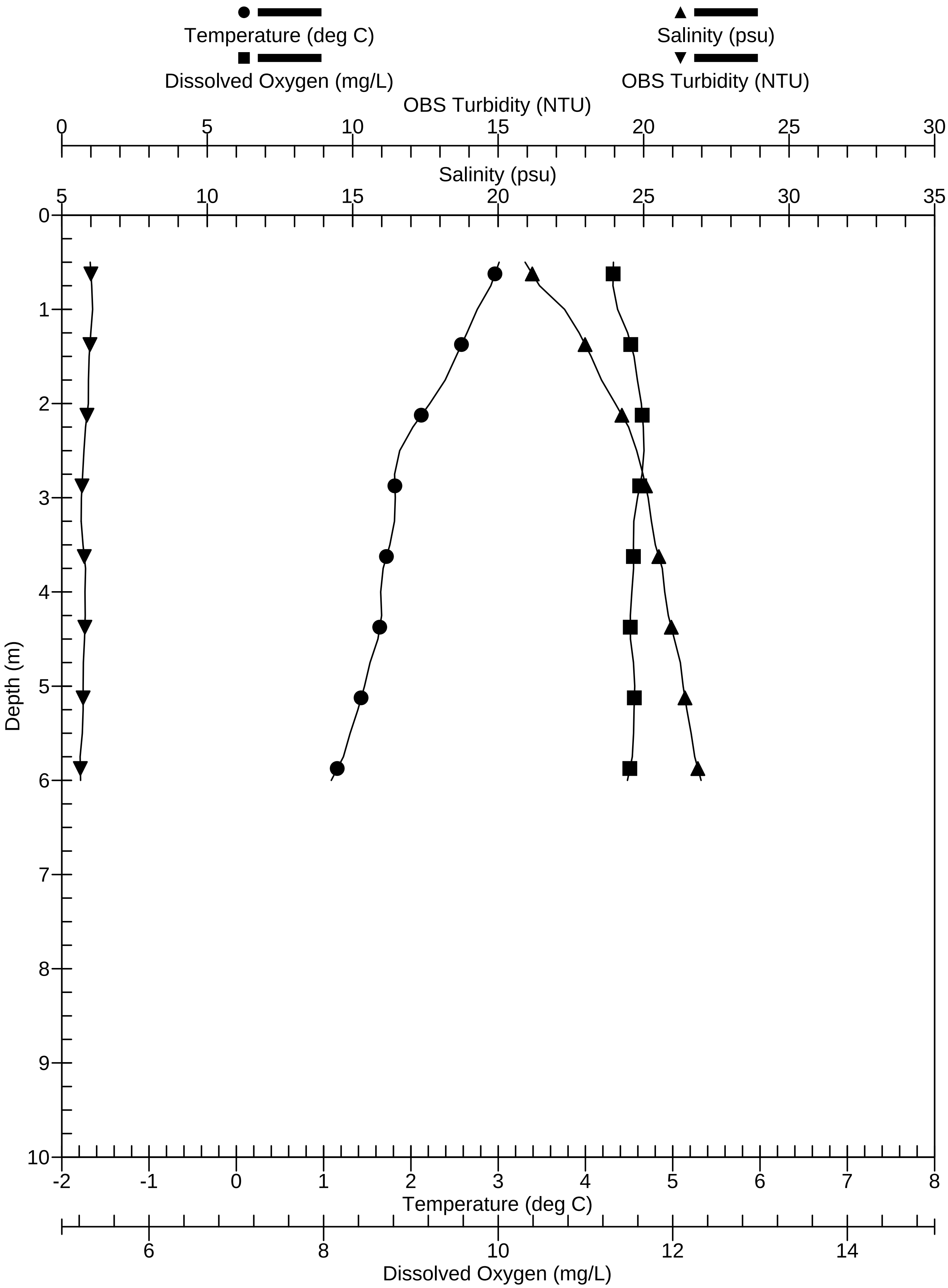
Willow Marine Monitoring Program - 2018 Hydrographic Data, S4.cnv



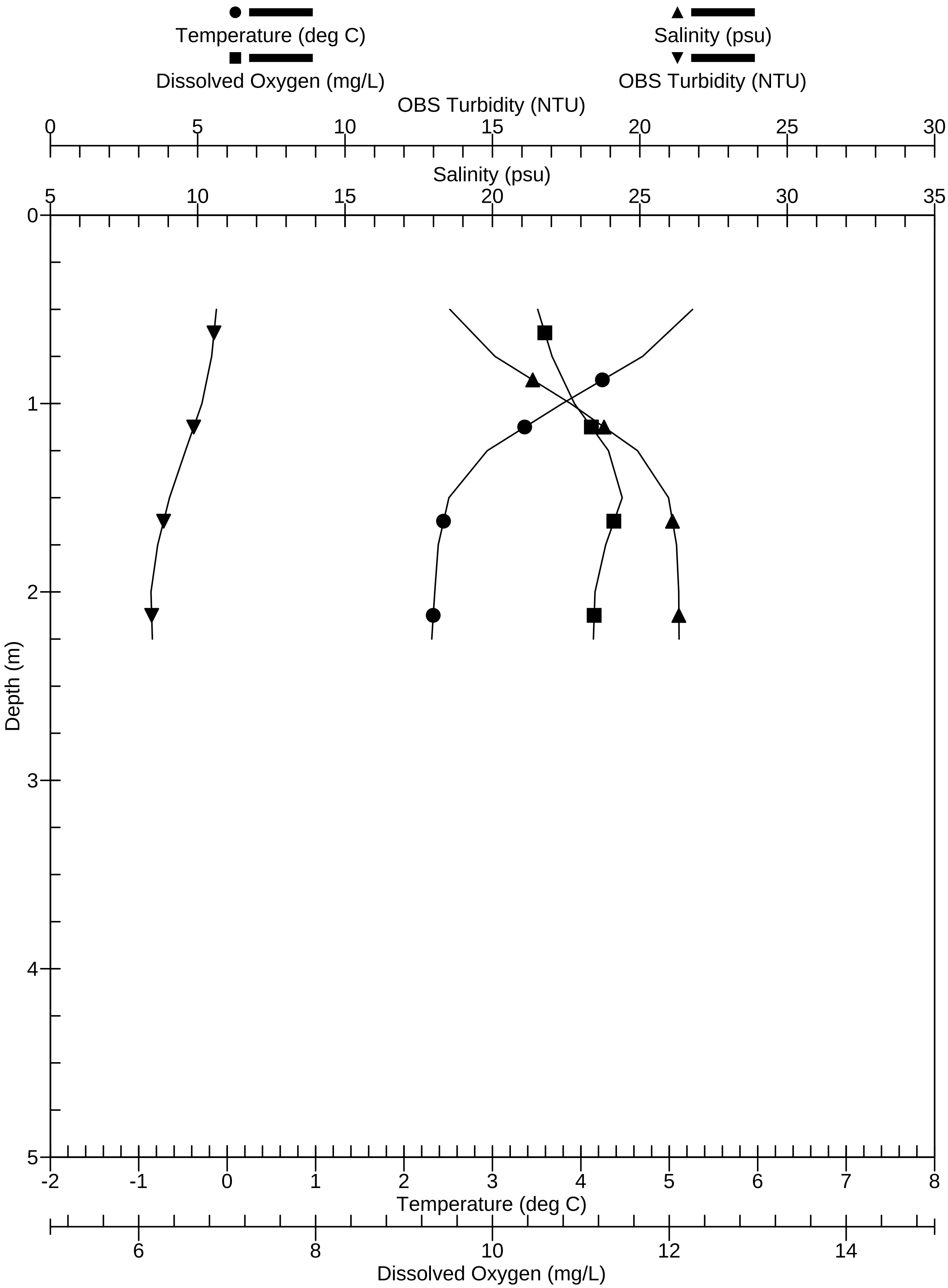
Willow Marine Monitoring Program - 2018 Hydrographic Data, S5.cnv



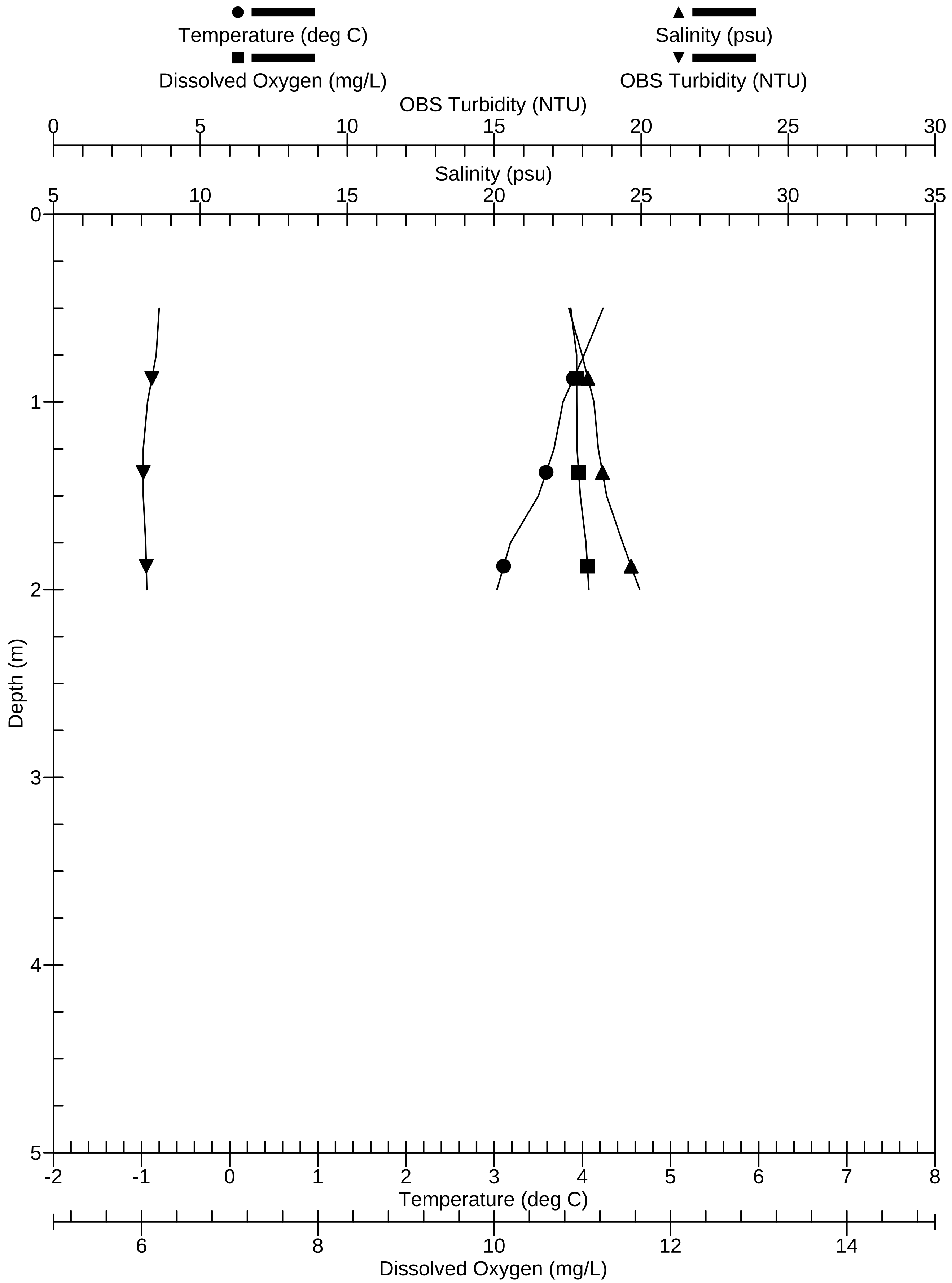
Willow Marine Monitoring Program - 2018 Hydrographic Data, S6.cnv



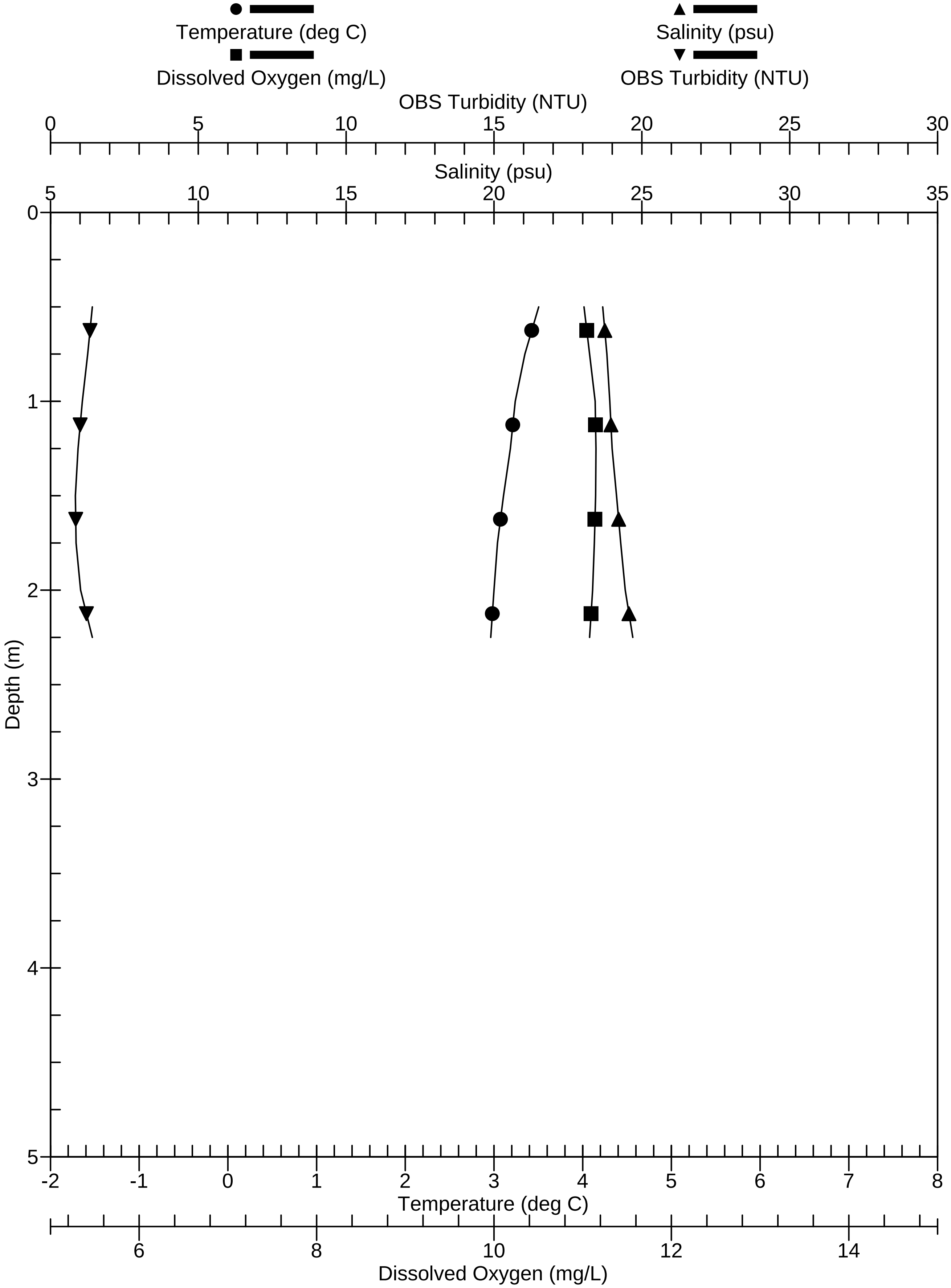
Willow Marine Monitoring Program - 2018 Hydrographic Data, S7.cnv



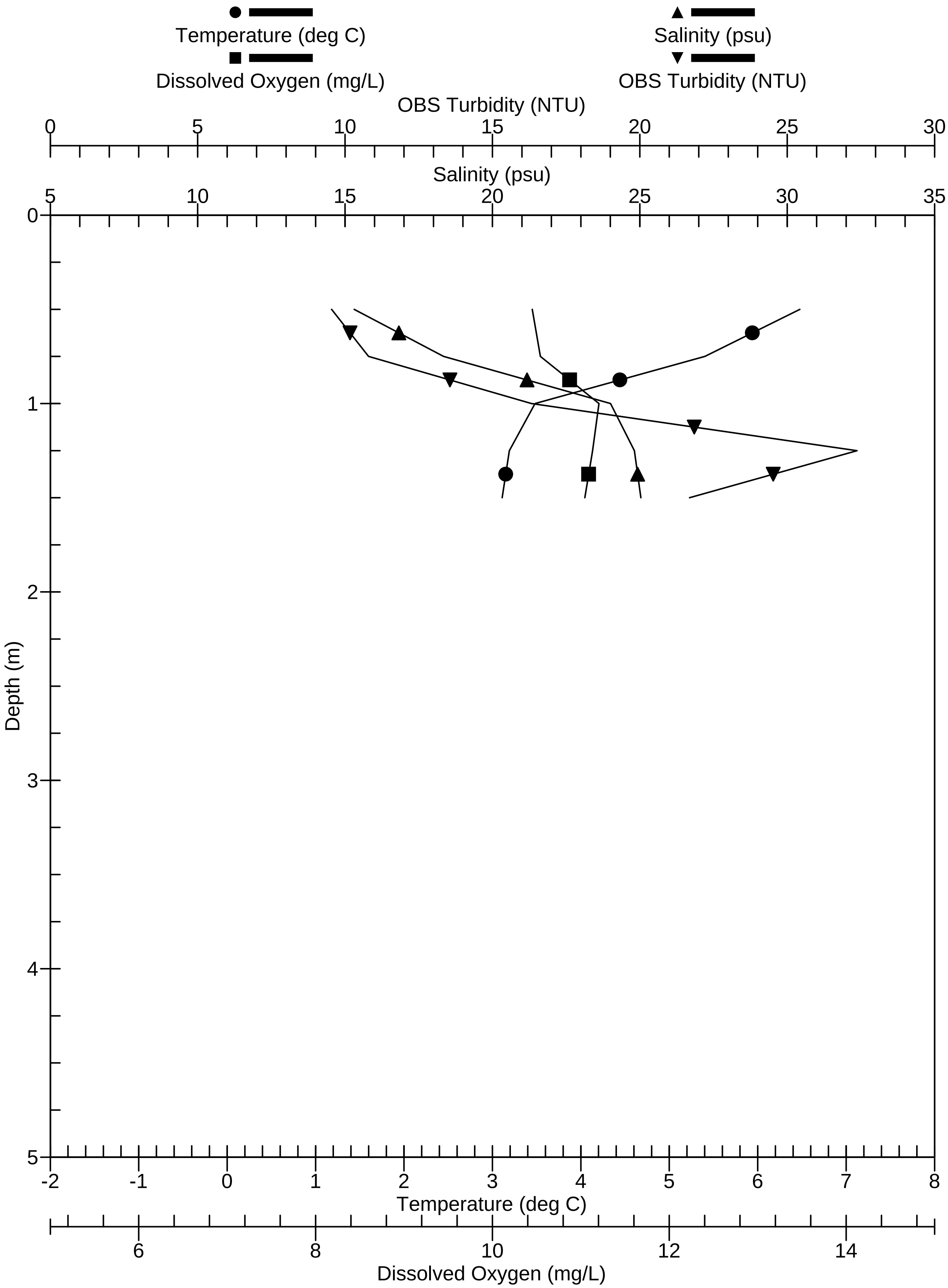
Willow Marine Monitoring Program - 2018 Hydrographic Data, S8.cnv



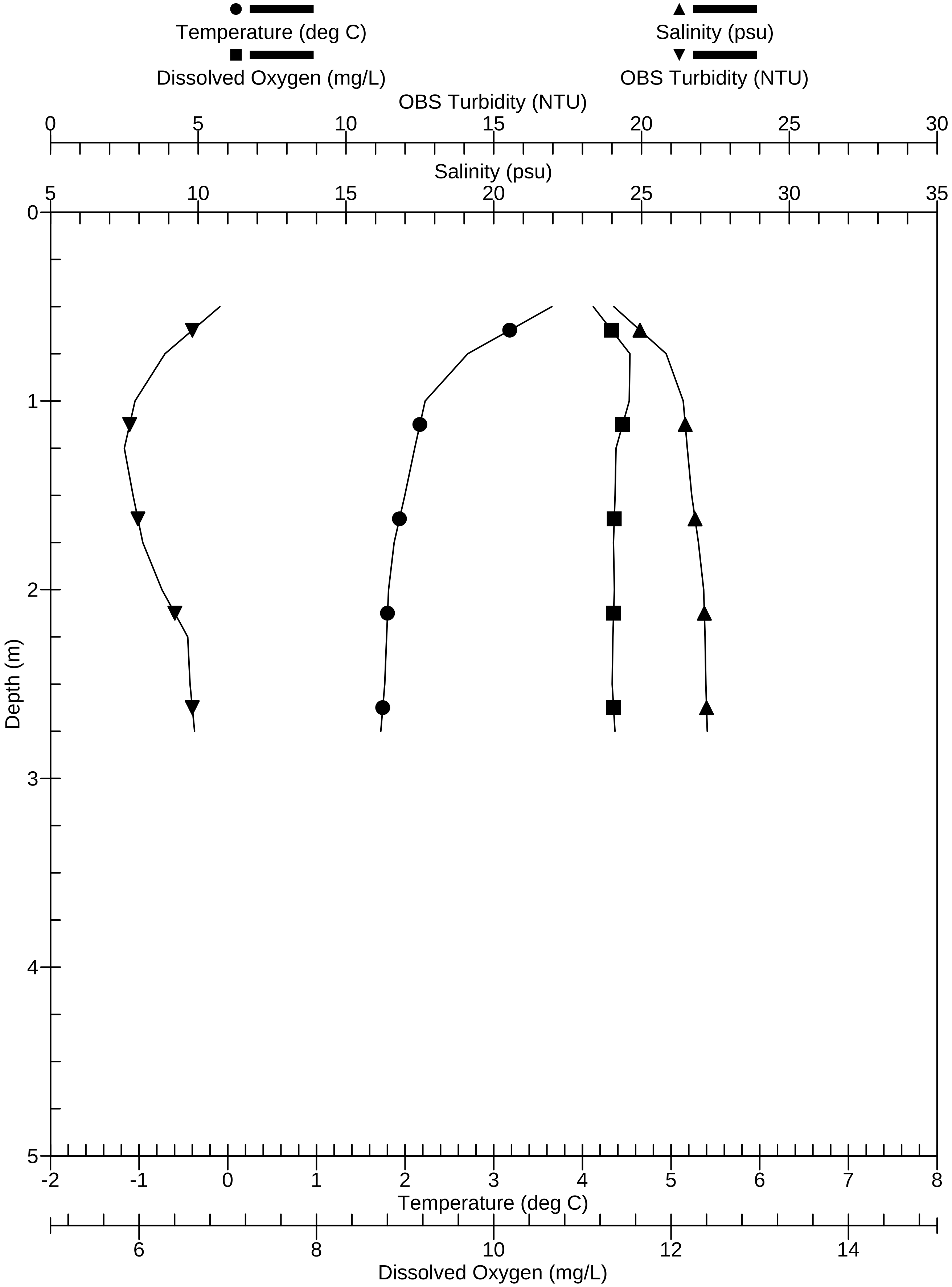
Willow Marine Monitoring Program - 2018 Hydrographic Data, S9.cnv



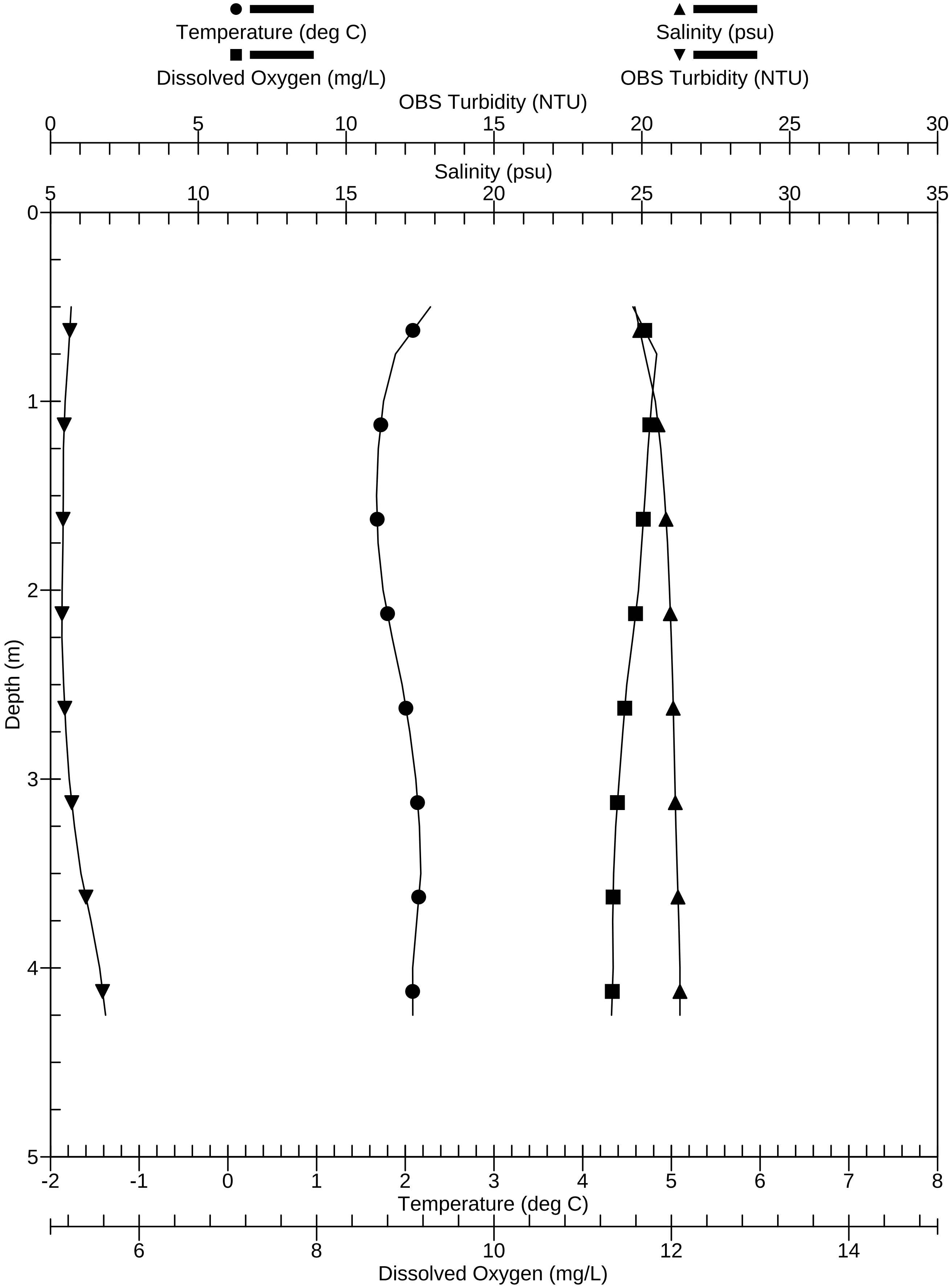
Willow Marine Monitoring Program - 2018 Hydrographic Data, S10.cnv



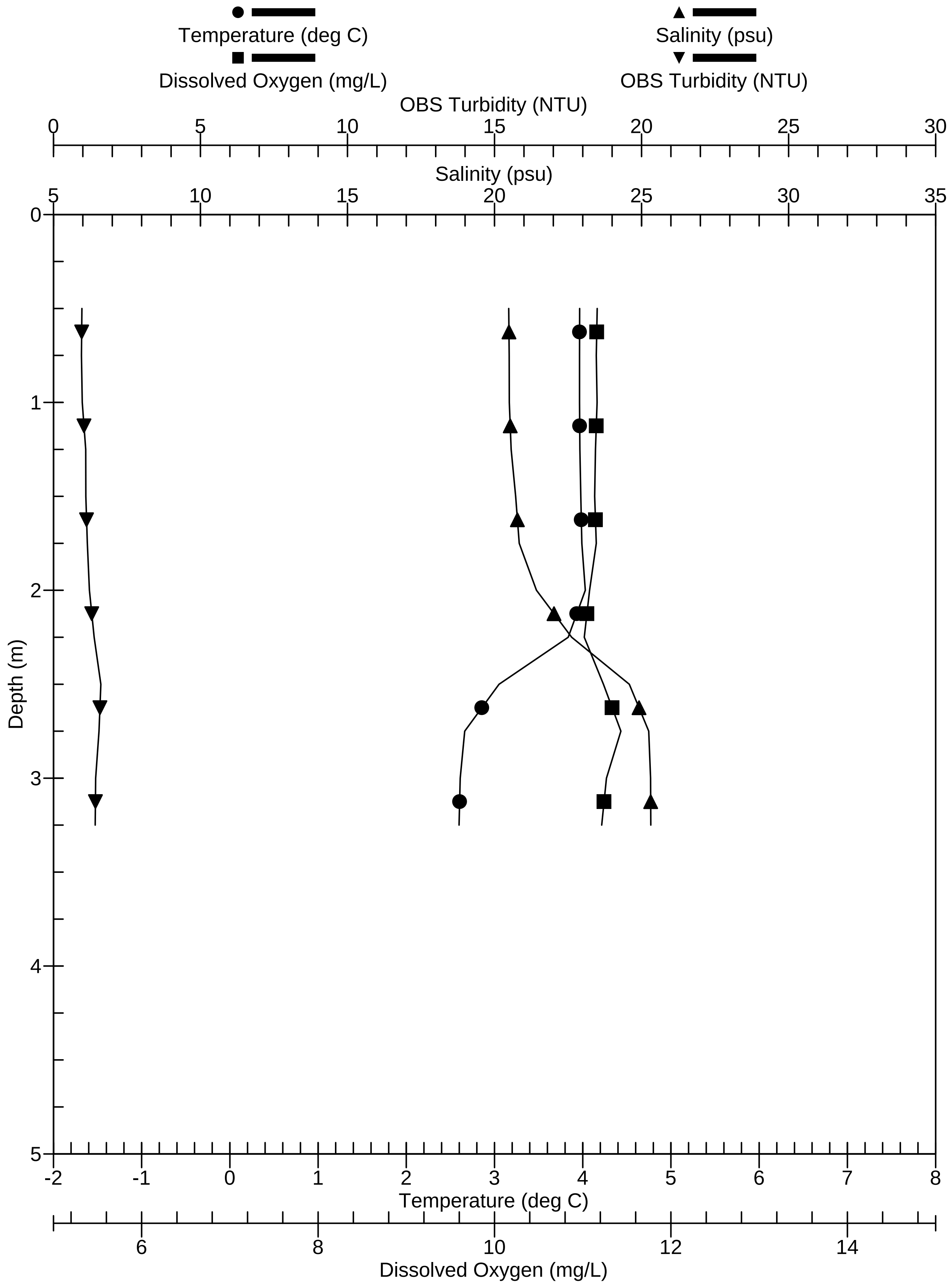
Willow Marine Monitoring Program - 2018 Hydrographic Data, S11.cnv



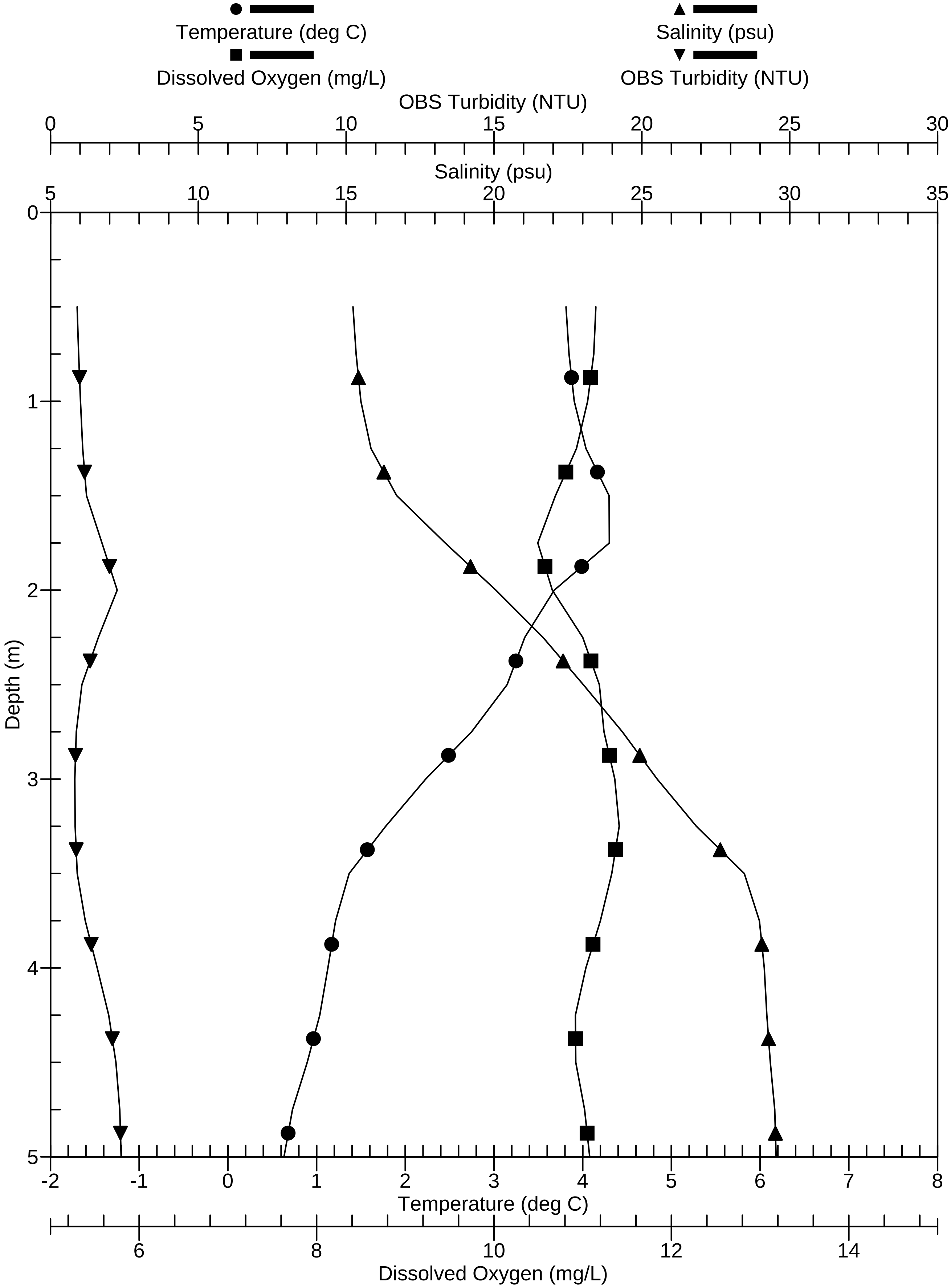
Willow Marine Monitoring Program - 2018 Hydrographic Data, S12.cnv



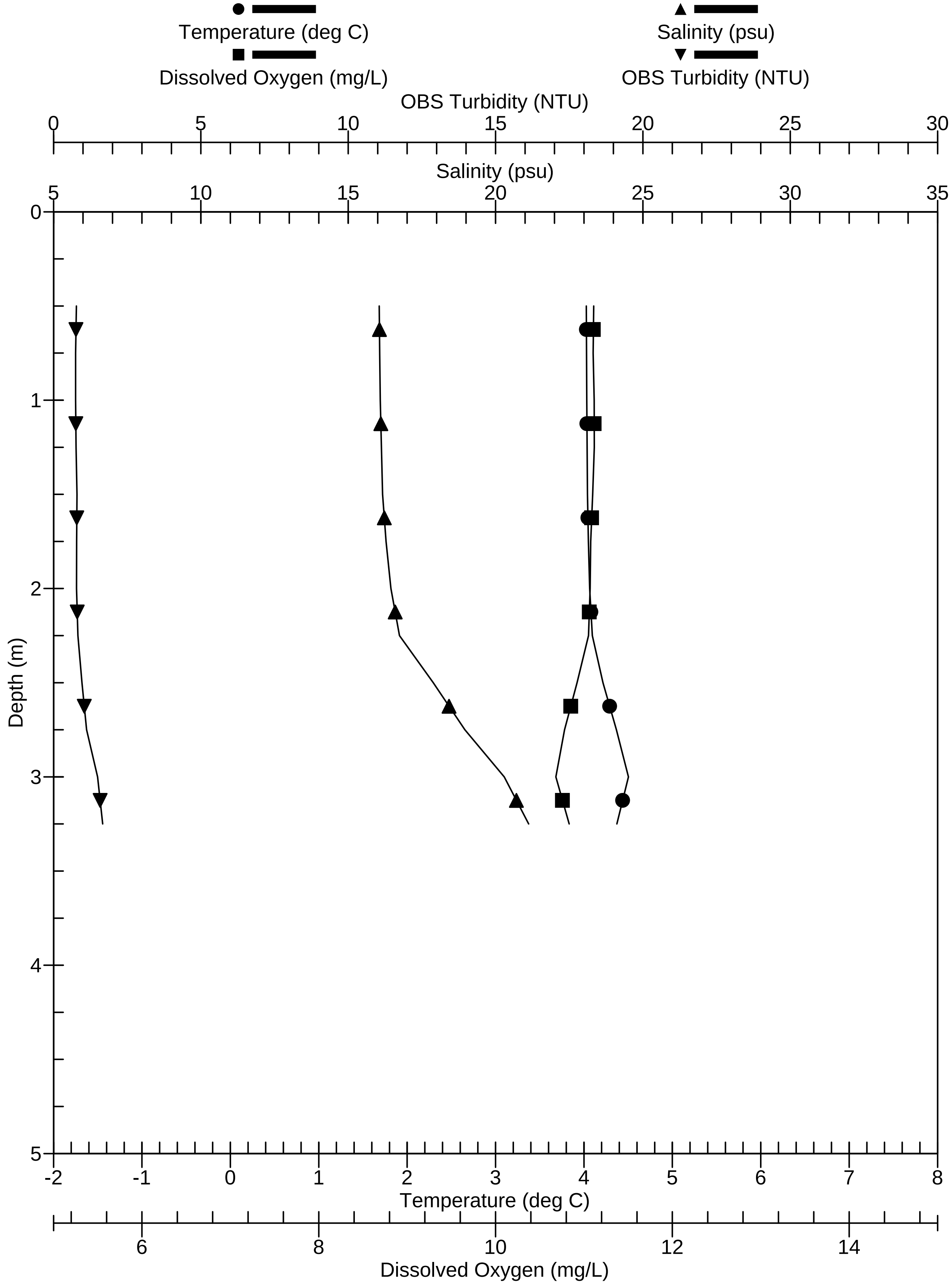
Willow Marine Monitoring Program - 2018 Hydrographic Data, T4.cnv



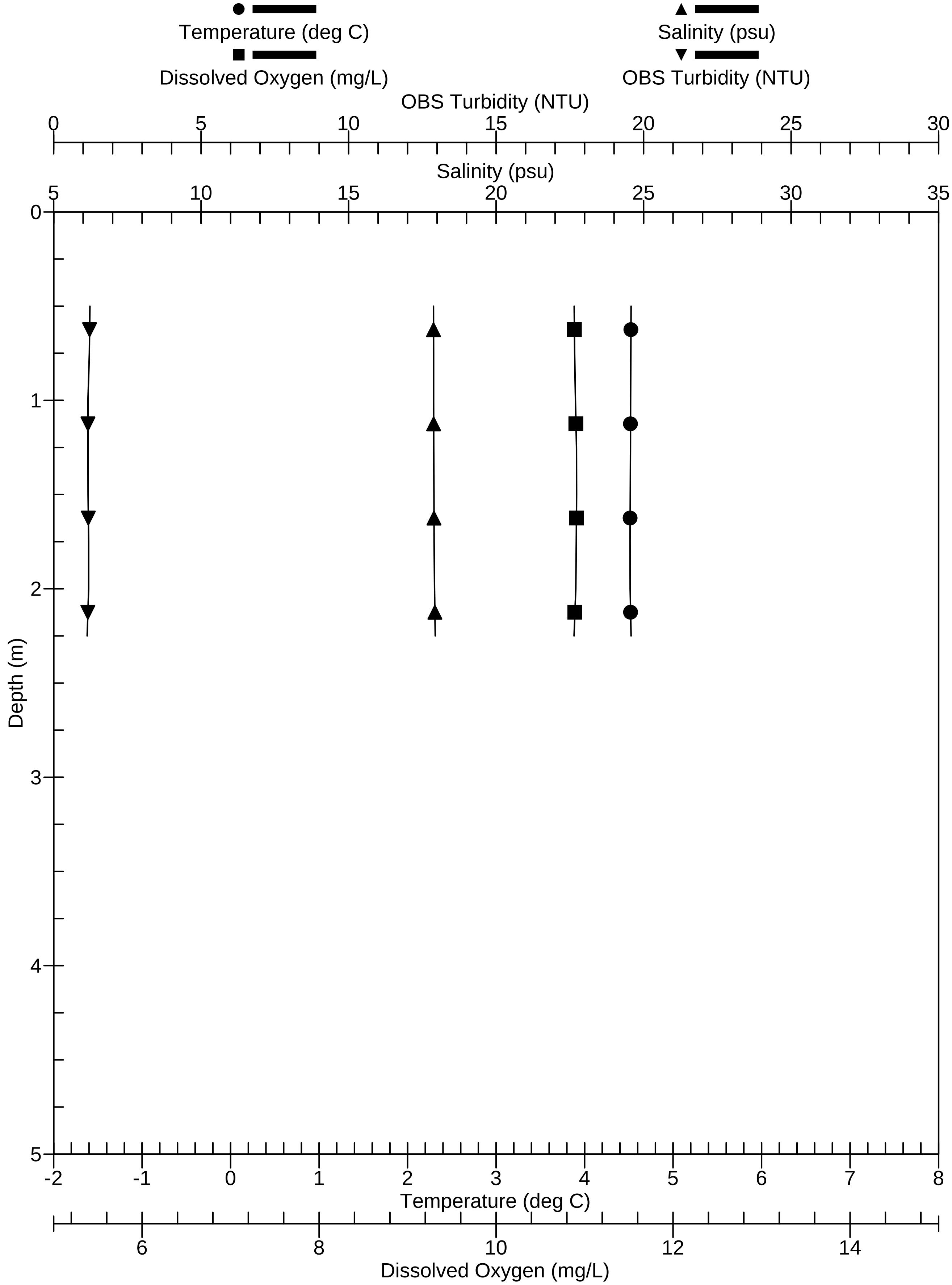
Willow Marine Monitoring Program - 2018 Hydrographic Data, W1.cnv



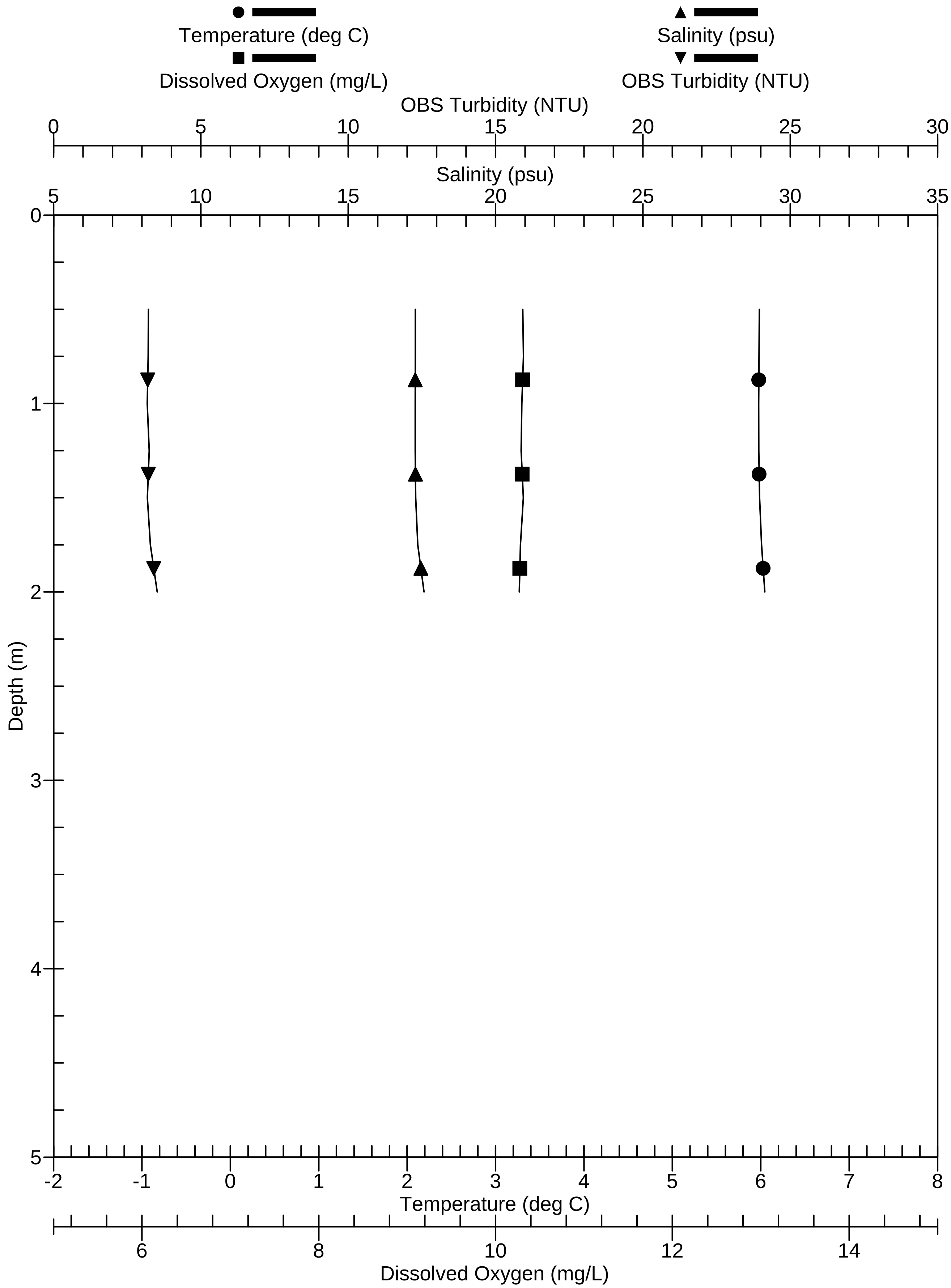
Willow Marine Monitoring Program - 2018 Hydrographic Data, W2.cnv

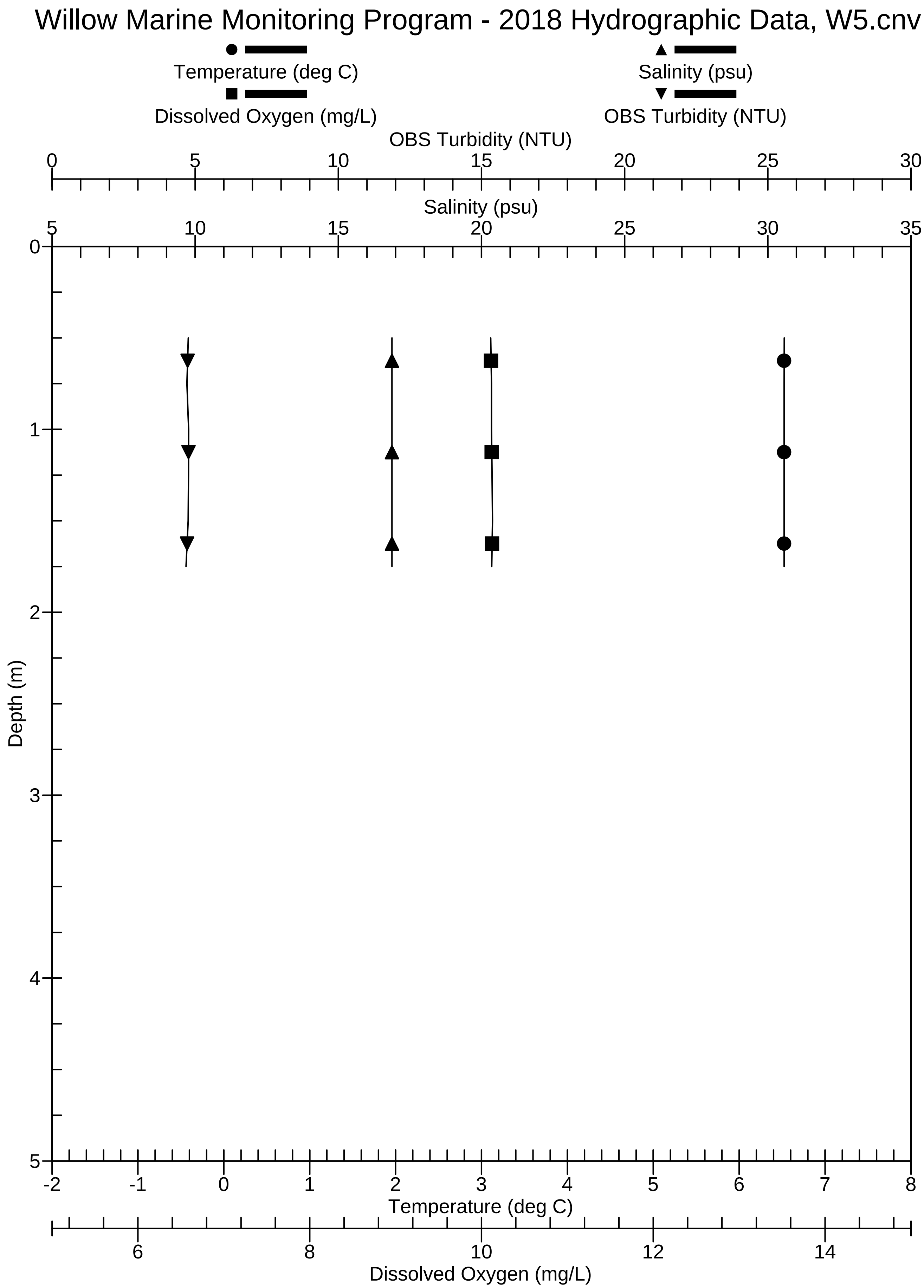


Willow Marine Monitoring Program - 2018 Hydrographic Data, W3.cnv

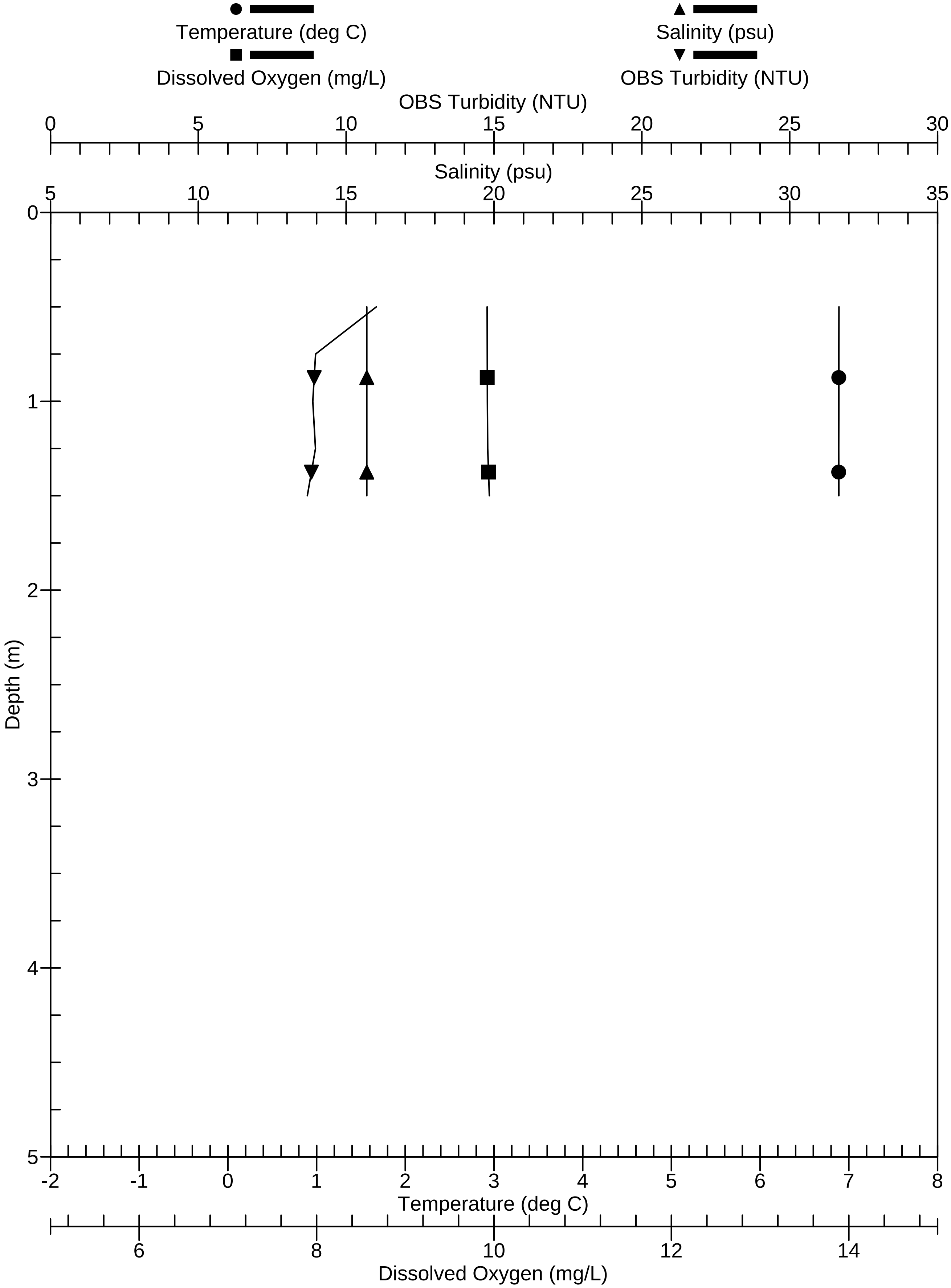


Willow Marine Monitoring Program - 2018 Hydrographic Data, W4.cnv

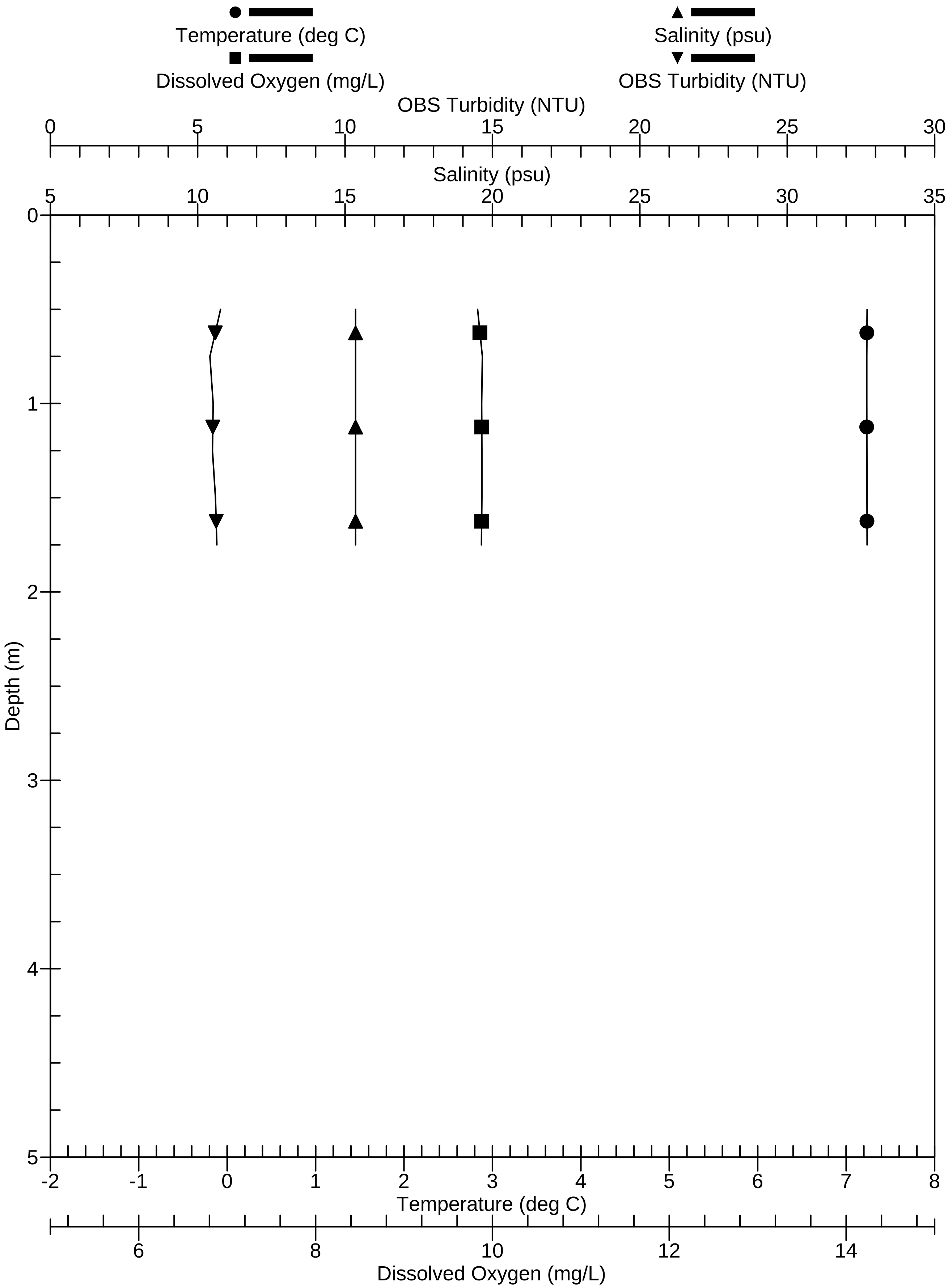



Willow Marine Monitoring Program - 2018 Hydrographic Data, W5.cnv
● Temperature (deg C)
▲ Salinity (psu)
■ Dissolved Oxygen (mg/L)
▼ OBS Turbidity (NTU)
OBS Turbidity (NTU)
0
5
10
15
20
25
30
Salinity (psu)
5
10
15
20
25
30
35
Depth (m)
0
1
2
3
4
5
-2
-1
0
1
2
3
4
5
6
7
8
Temperature (deg C)
6
8
10
12
14
Dissolved Oxygen (mg/L)

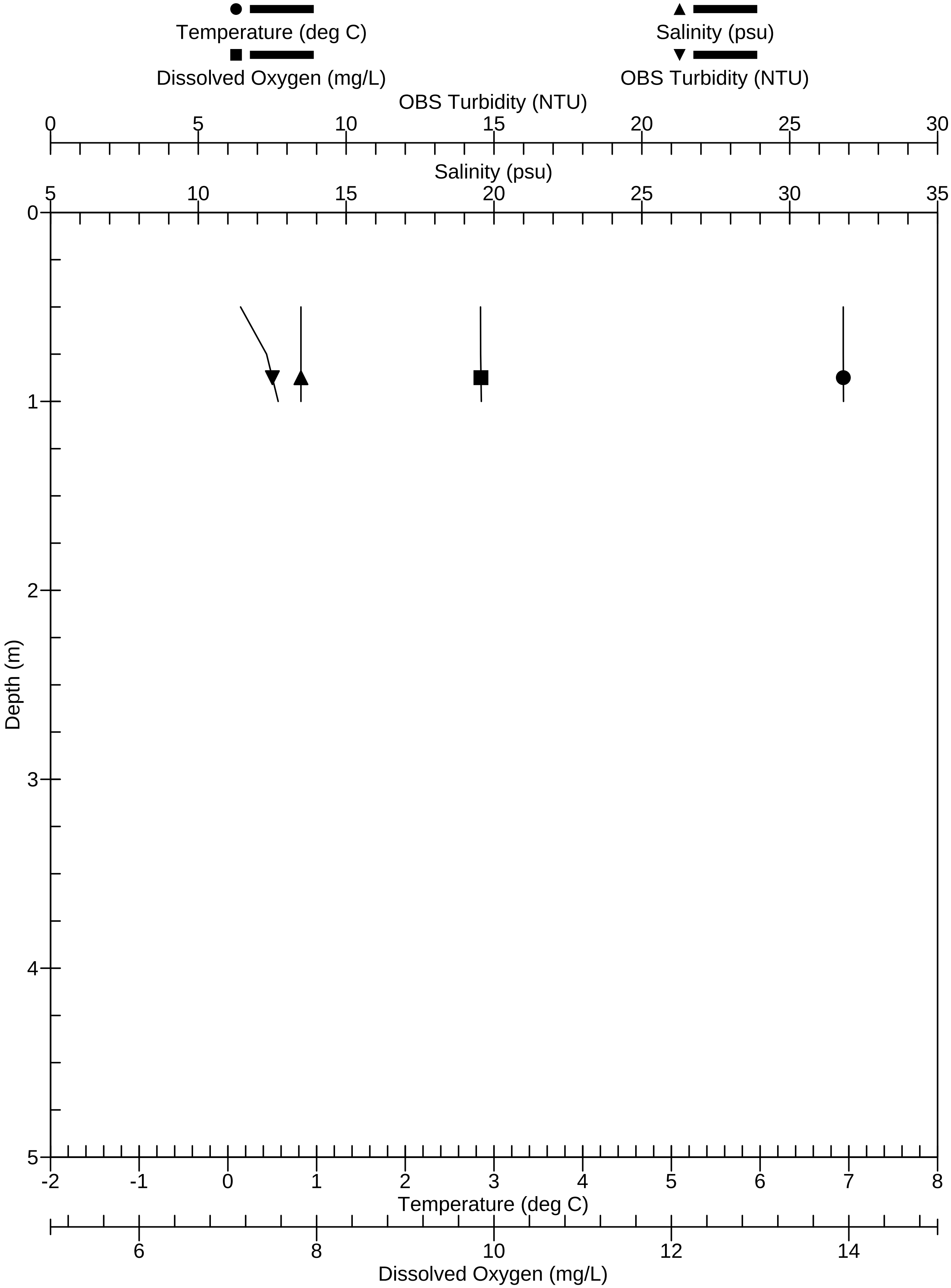
Willow Marine Monitoring Program - 2018 Hydrographic Data, W6.cnv



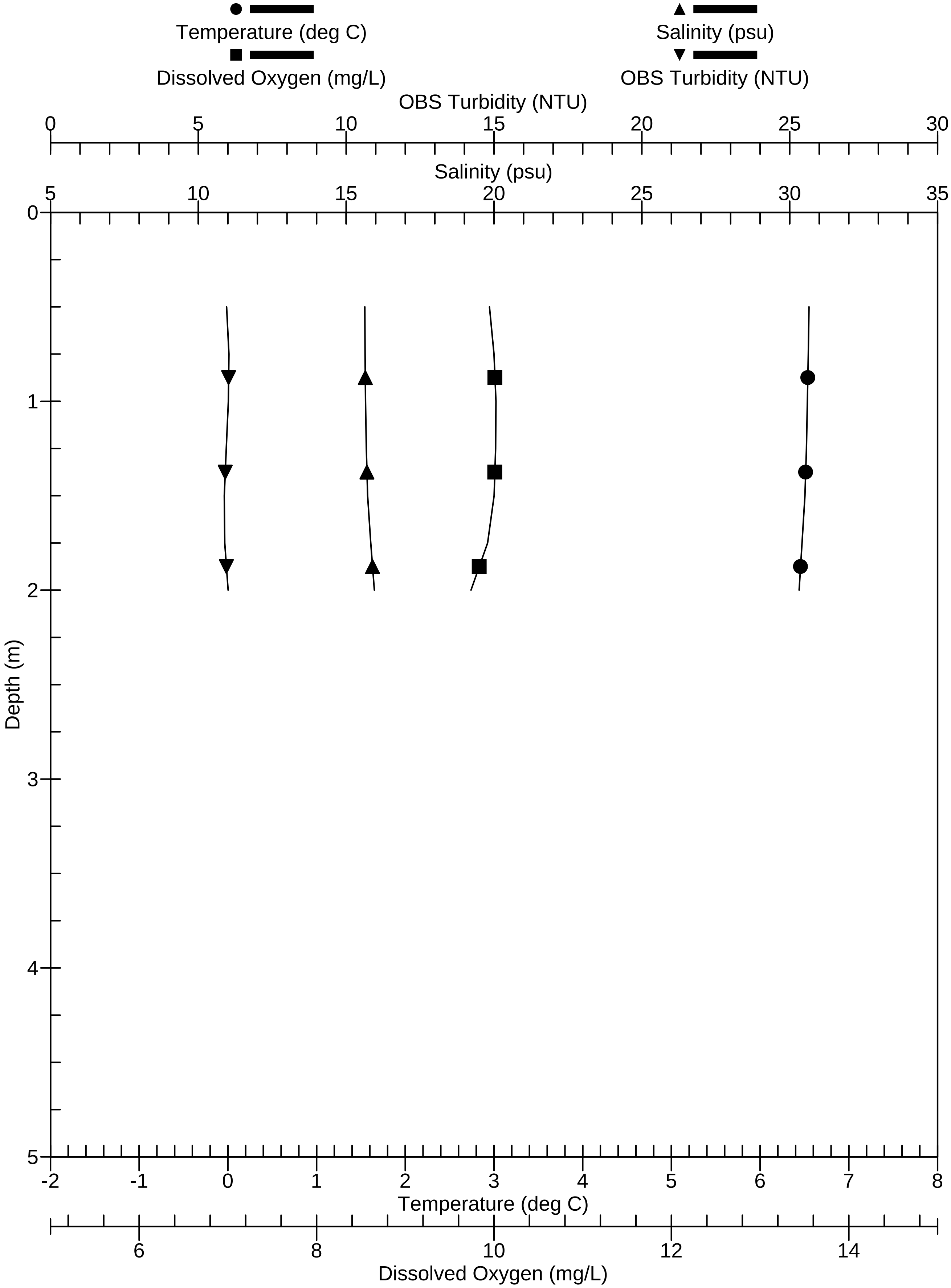
Willow Marine Monitoring Program - 2018 Hydrographic Data, W7.cnv



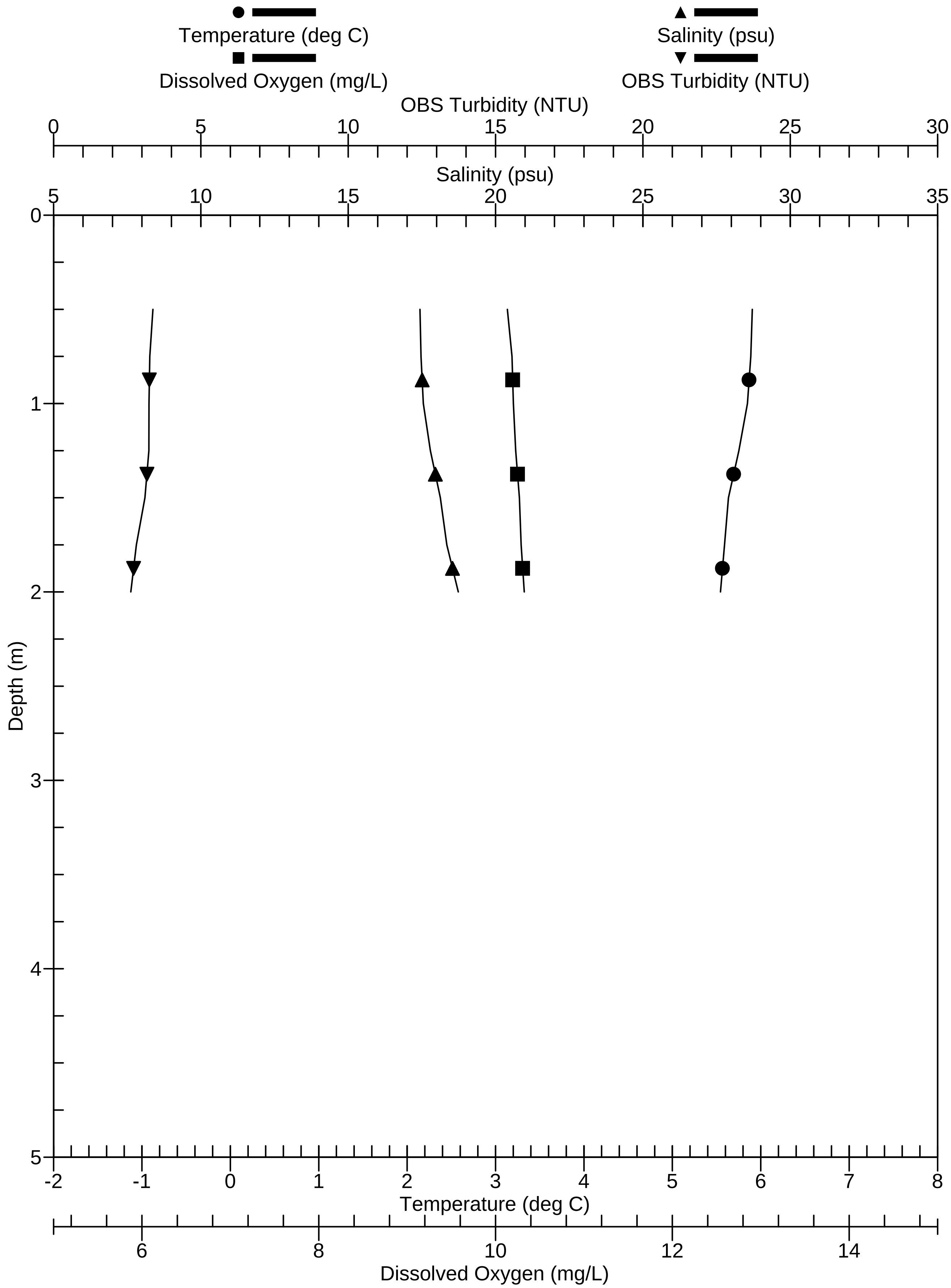
Willow Marine Monitoring Program - 2018 Hydrographic Data, W8.cnv



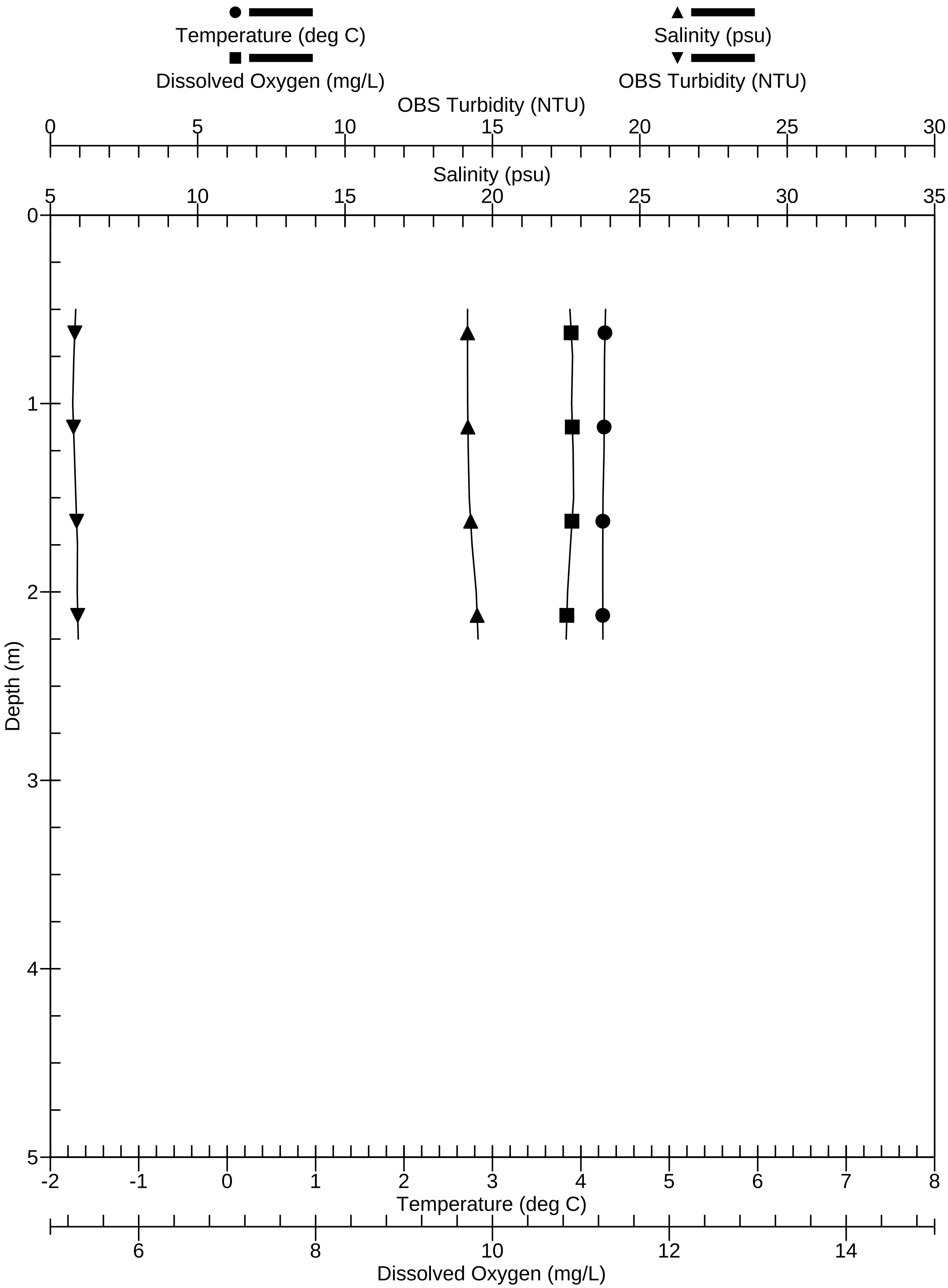
Willow Marine Monitoring Program - 2018 Hydrographic Data, W9.cnv



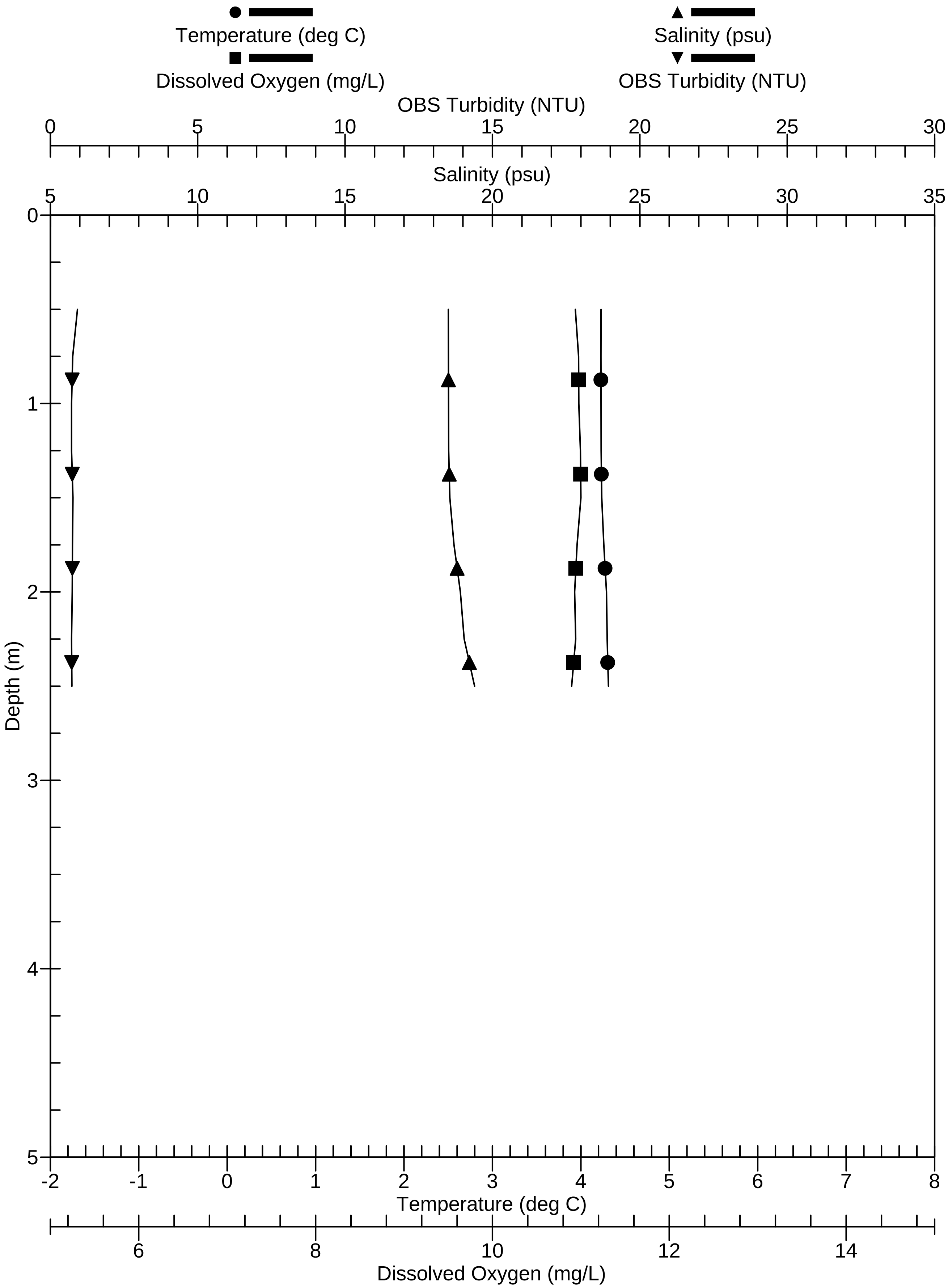
Willow Marine Monitoring Program - 2018 Hydrographic Data, W10.cnv



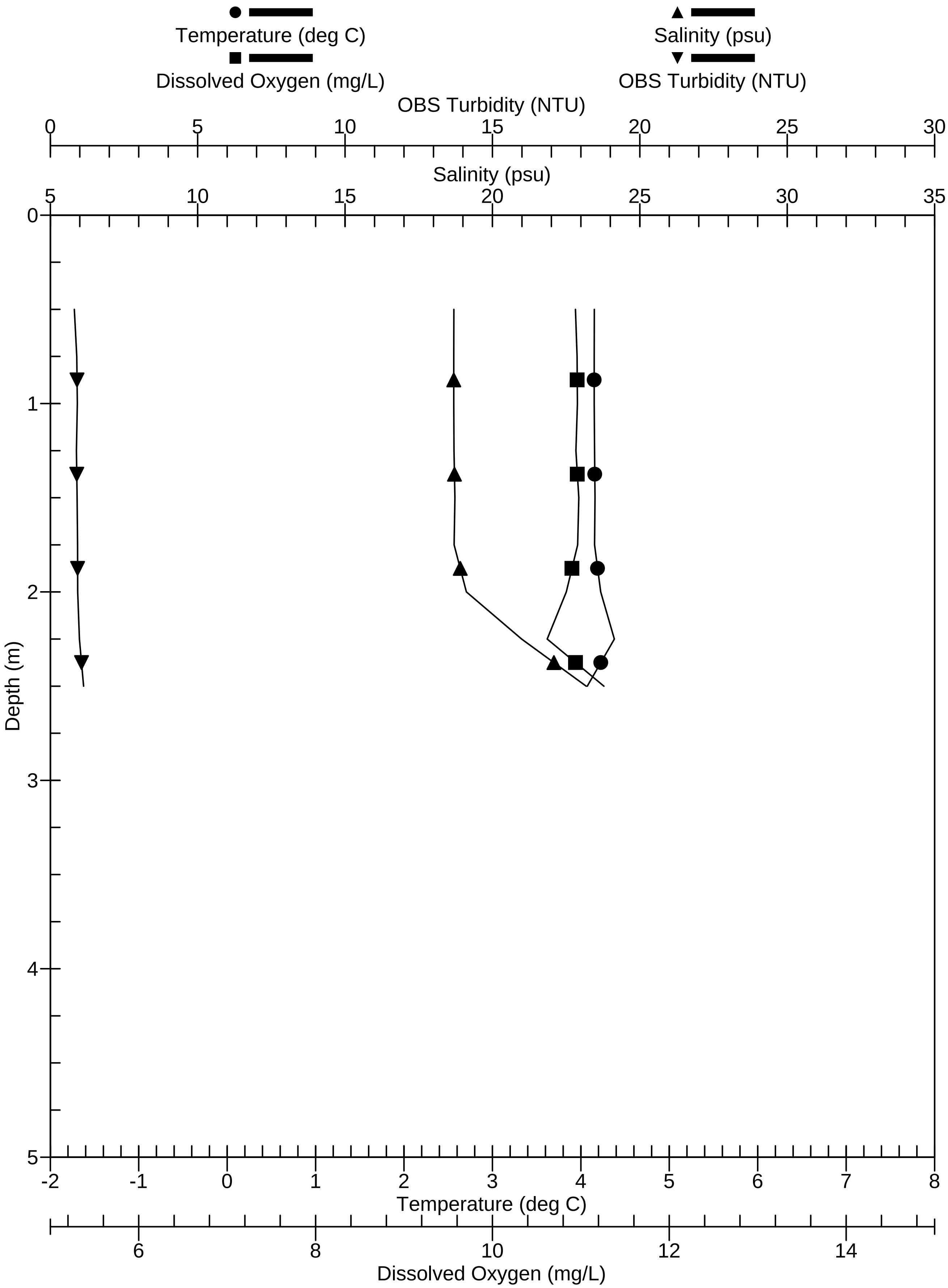
Willow Marine Monitoring Program - 2018 Hydrographic Data, W11.cnv



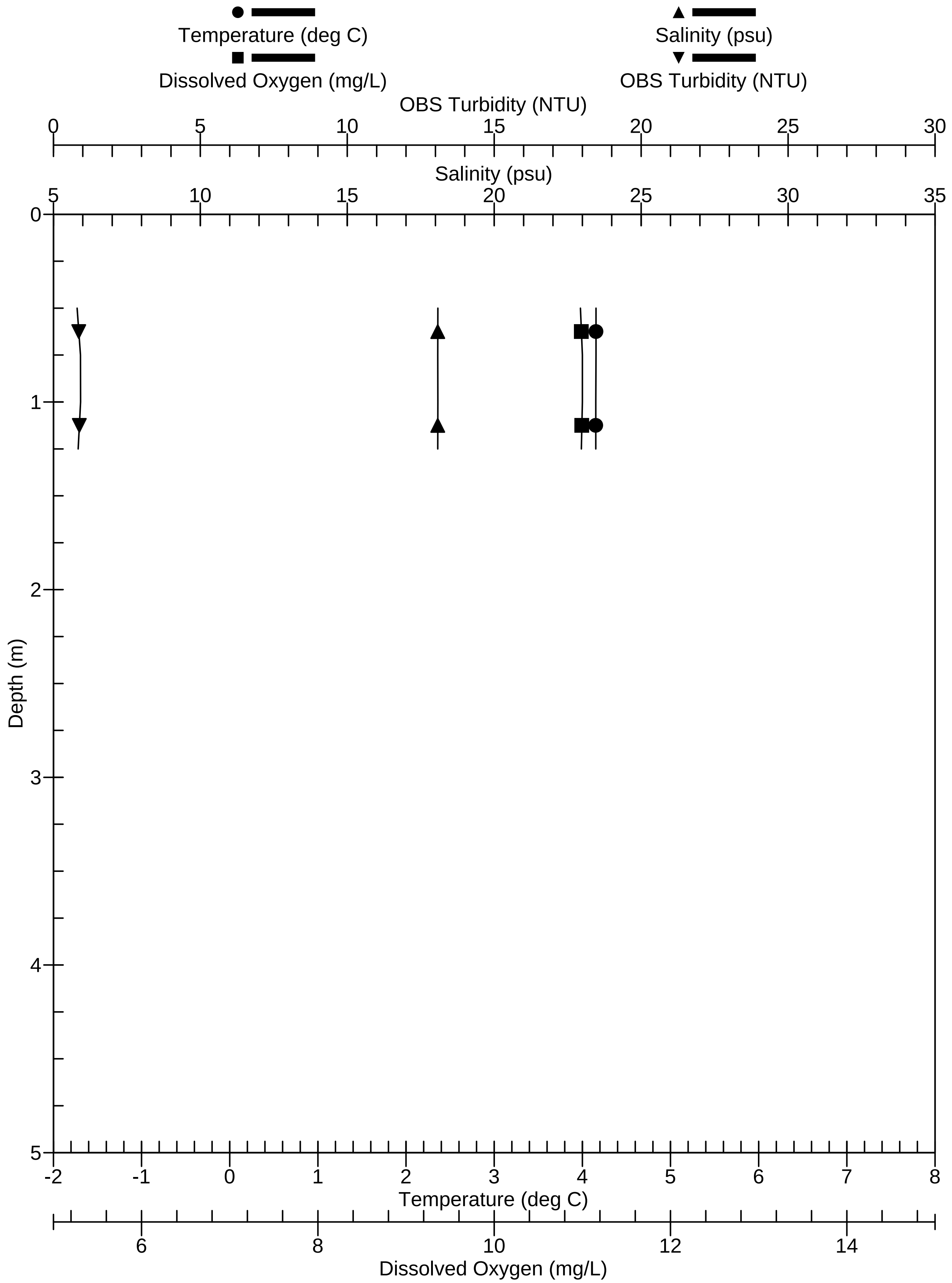
Willow Marine Monitoring Program - 2018 Hydrographic Data, W12.cnv



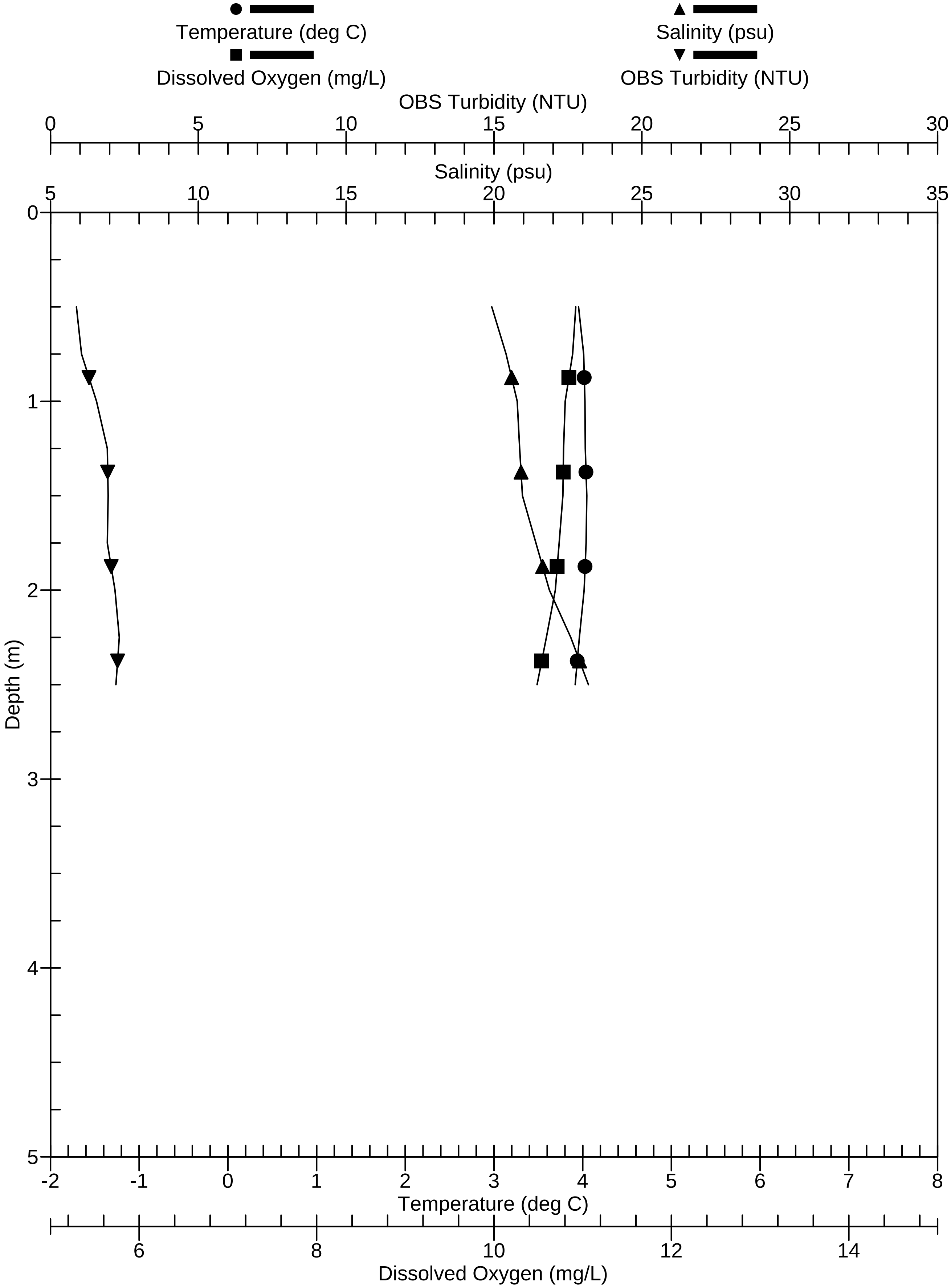
Willow Marine Monitoring Program - 2018 Hydrographic Data, W13.cnv



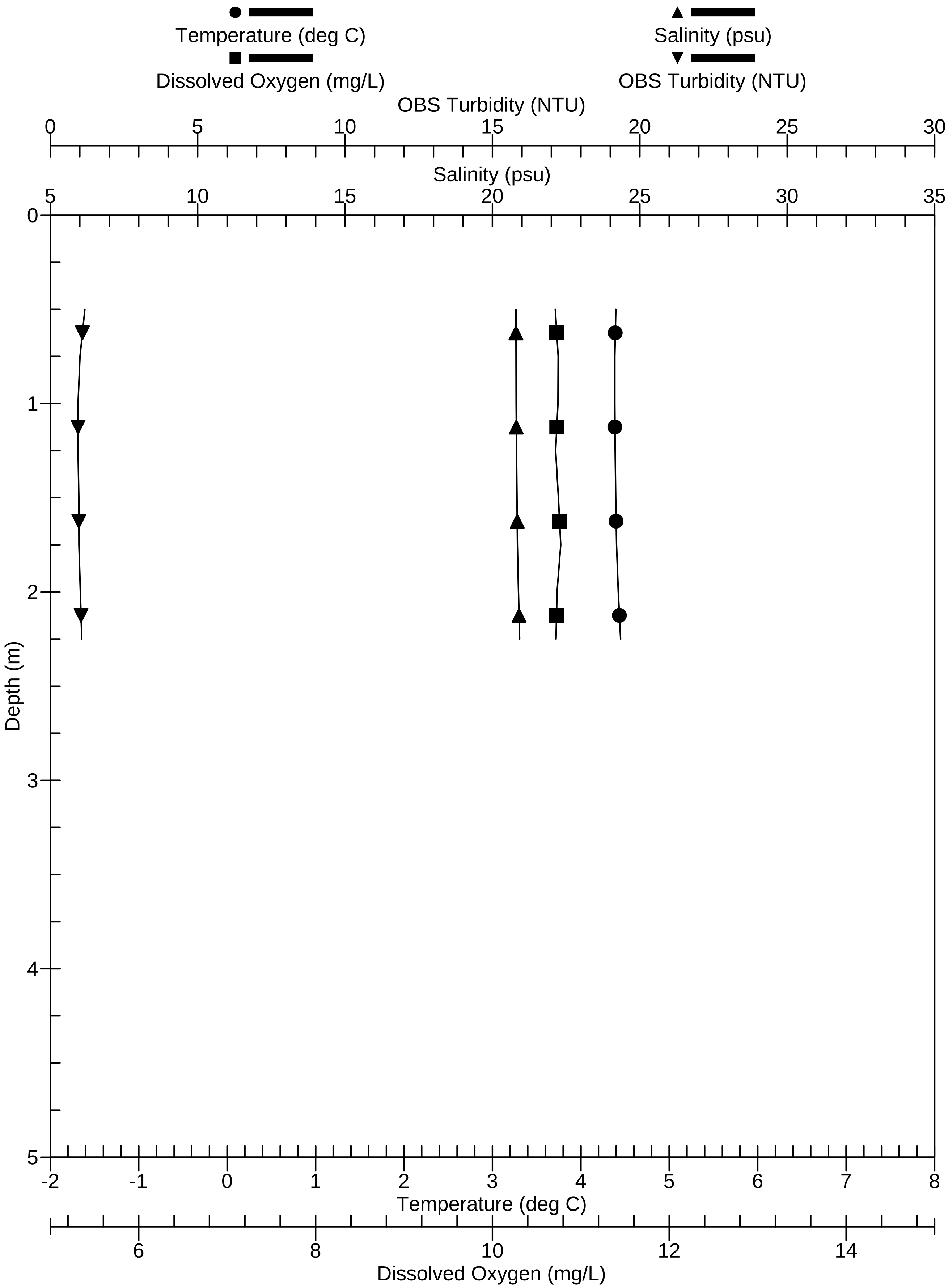
Willow Marine Monitoring Program - 2018 Hydrographic Data, W14.cnv



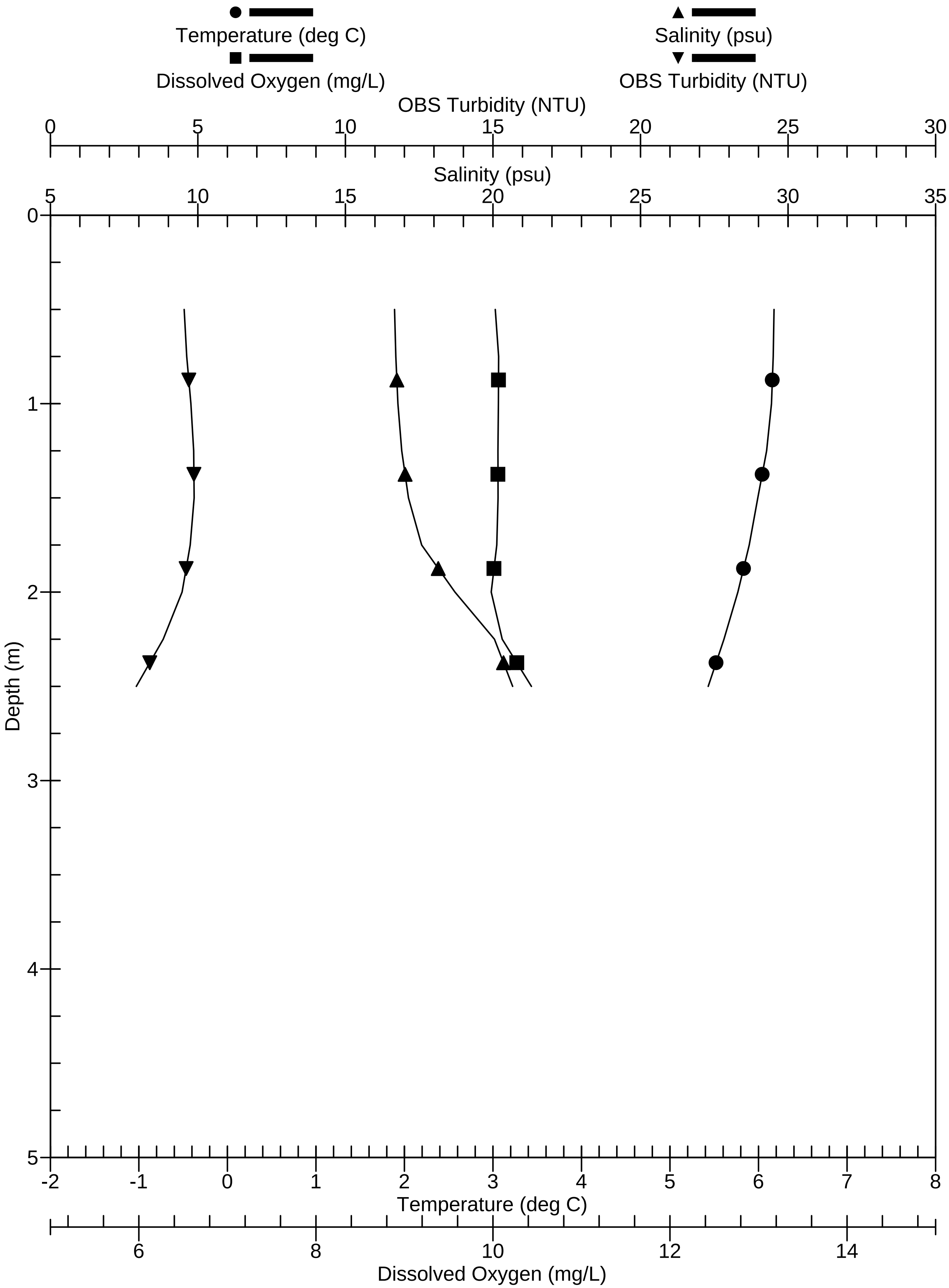
Willow Marine Monitoring Program - 2018 Hydrographic Data, W15.cnv



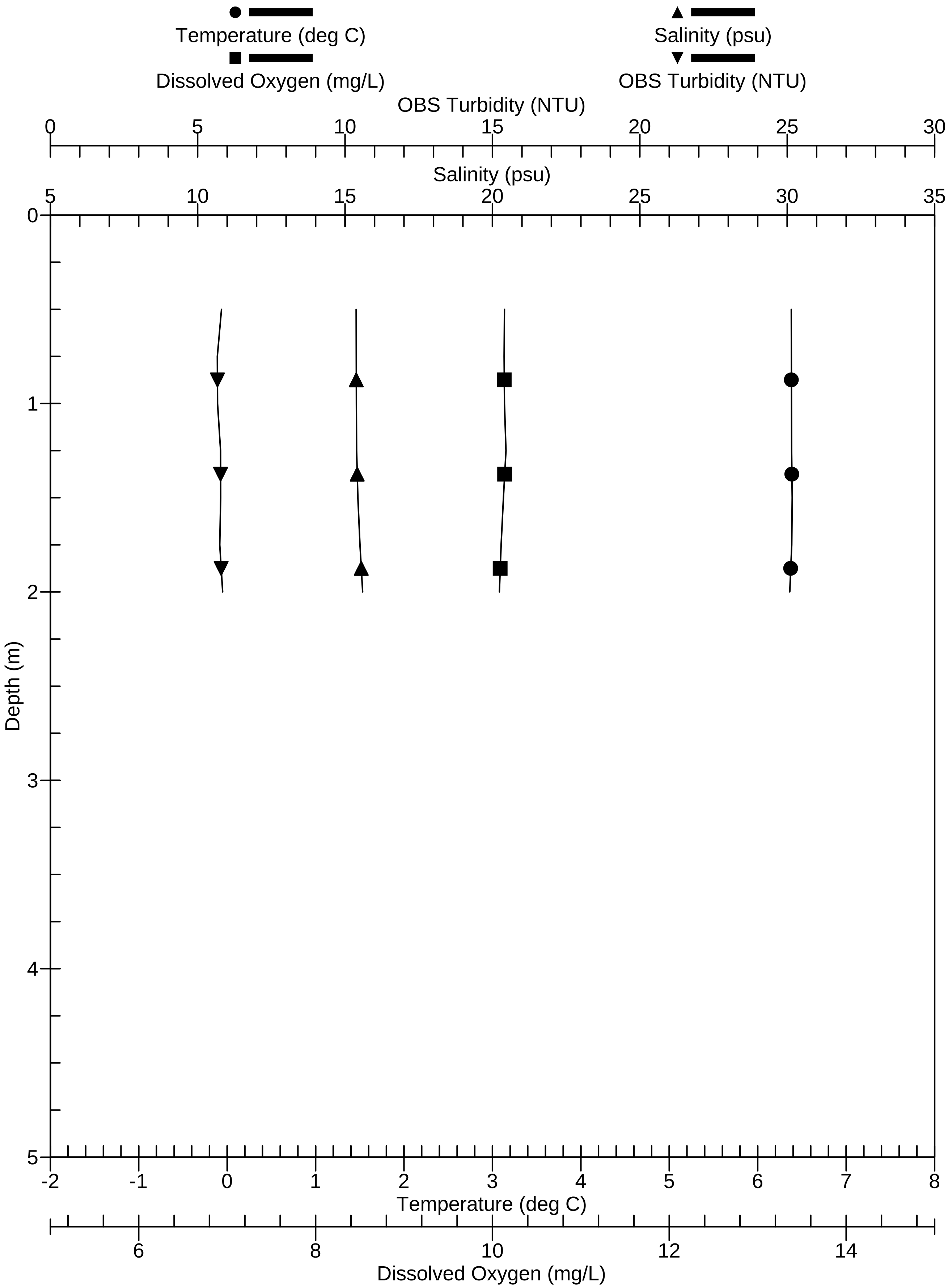
Willow Marine Monitoring Program - 2018 Hydrographic Data, W16.cnv



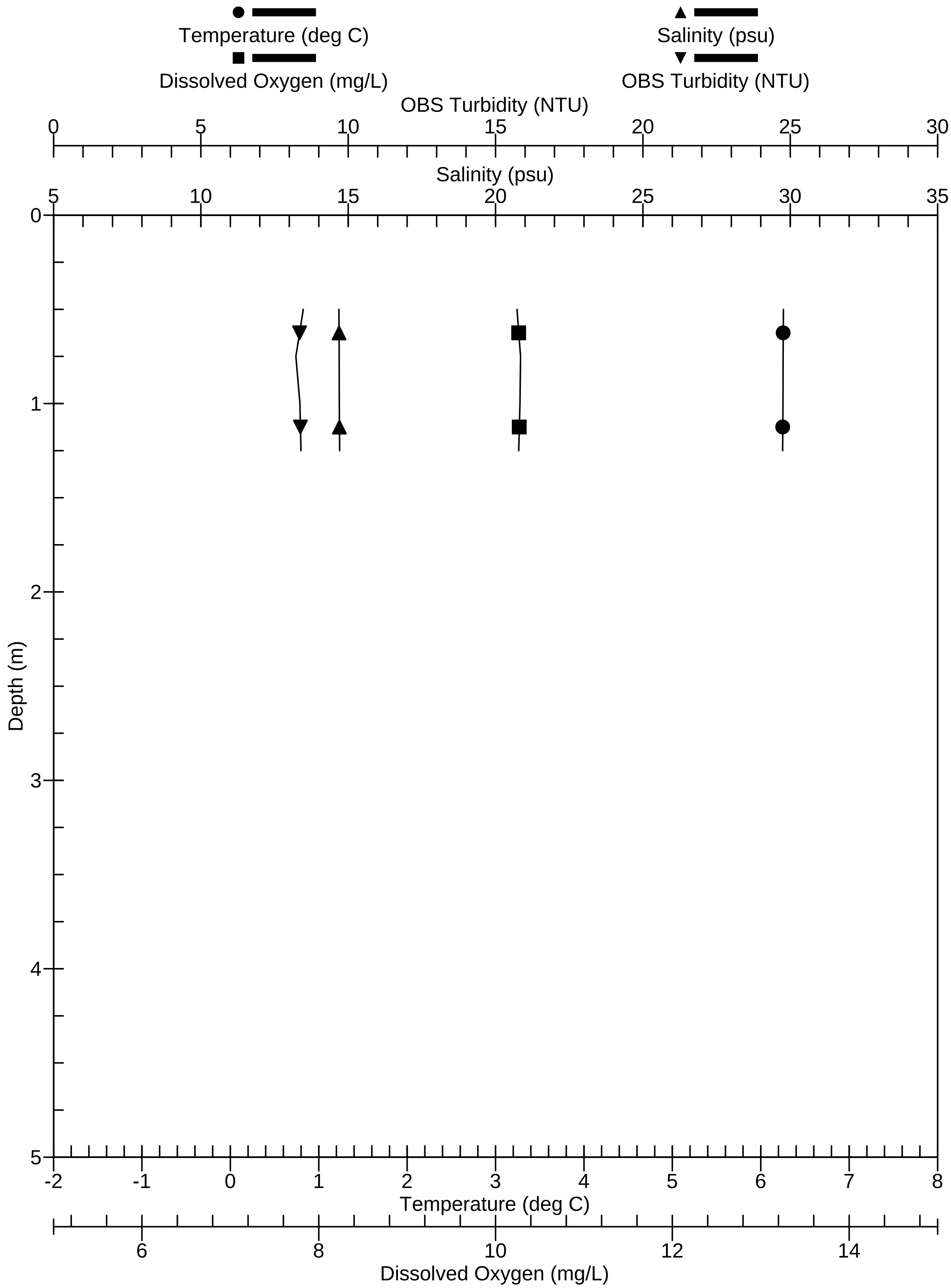
Willow Marine Monitoring Program - 2018 Hydrographic Data, W17.cnv



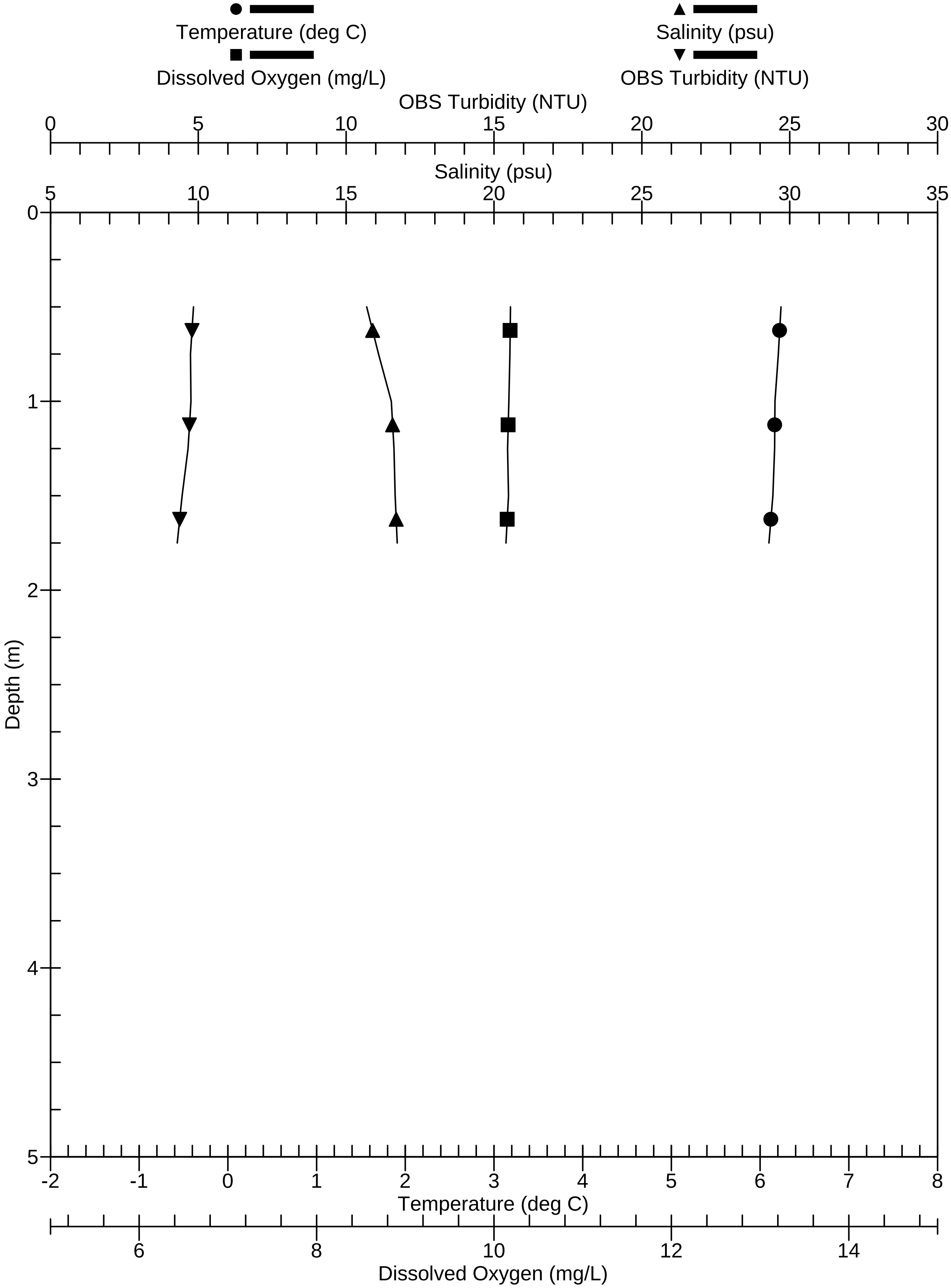
Willow Marine Monitoring Program - 2018 Hydrographic Data, W18.cnv



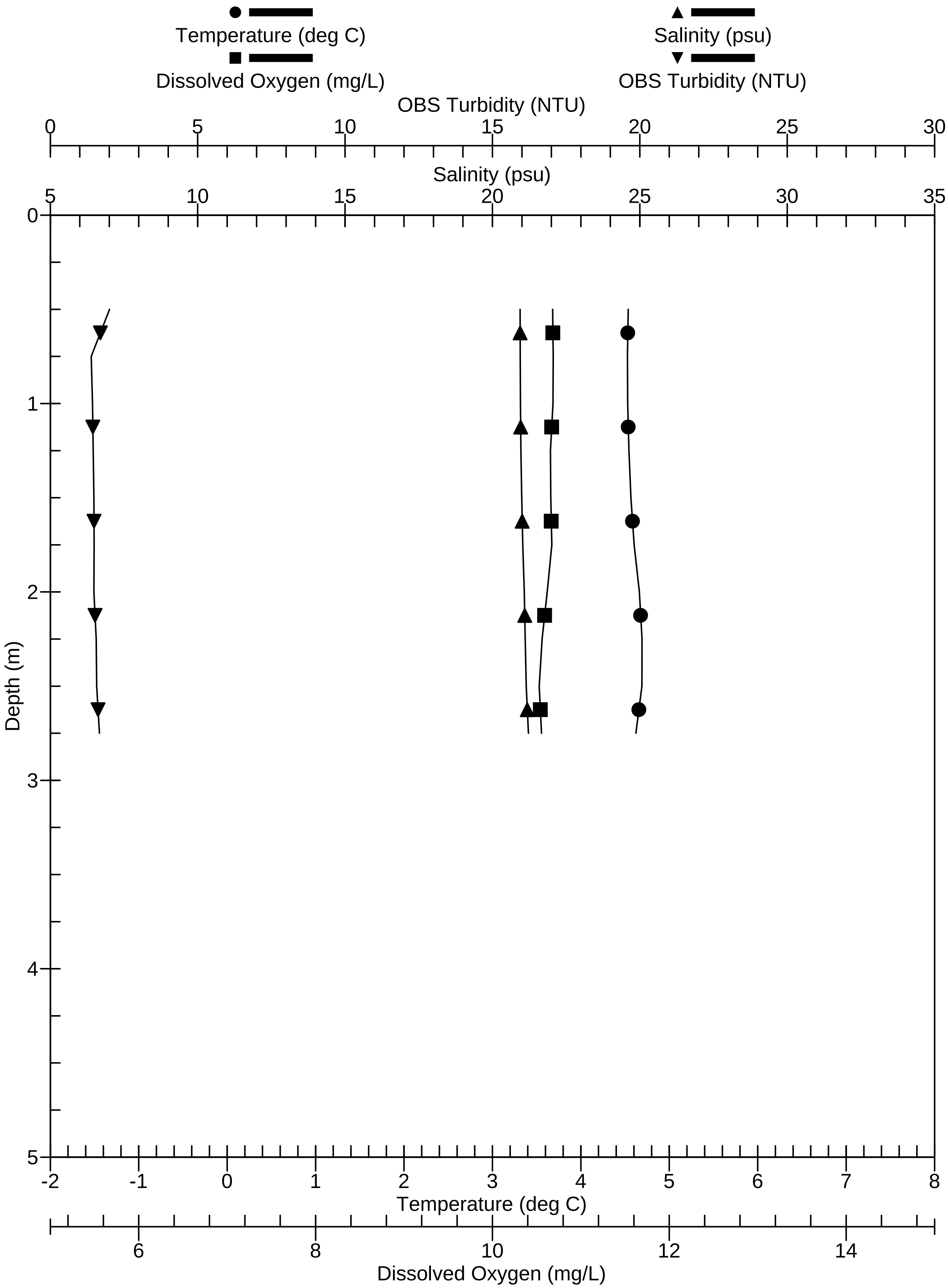
Willow Marine Monitoring Program - 2018 Hydrographic Data, W19.cnv



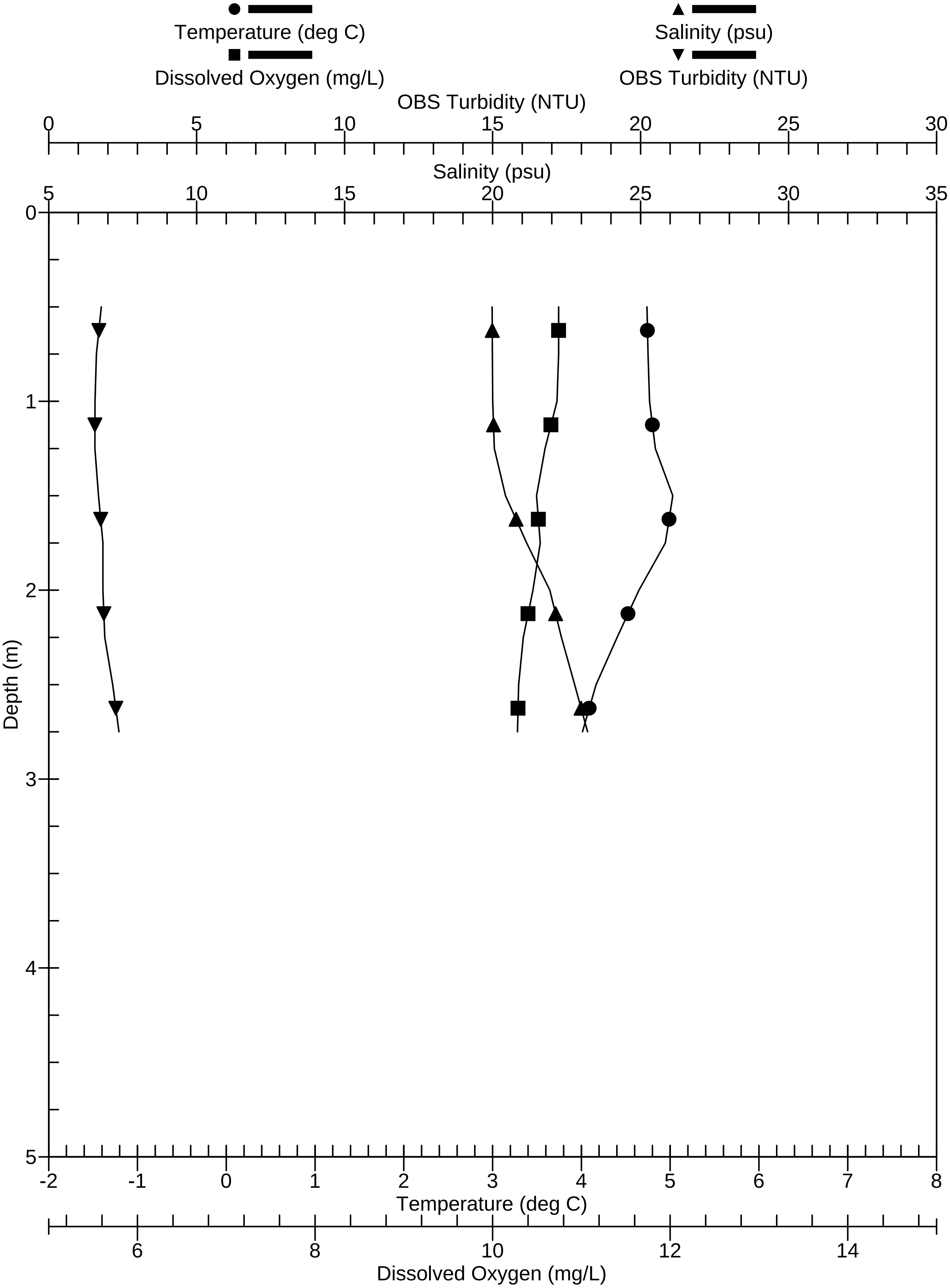
Willow Marine Monitoring Program - 2018 Hydrographic Data, W20.cnv



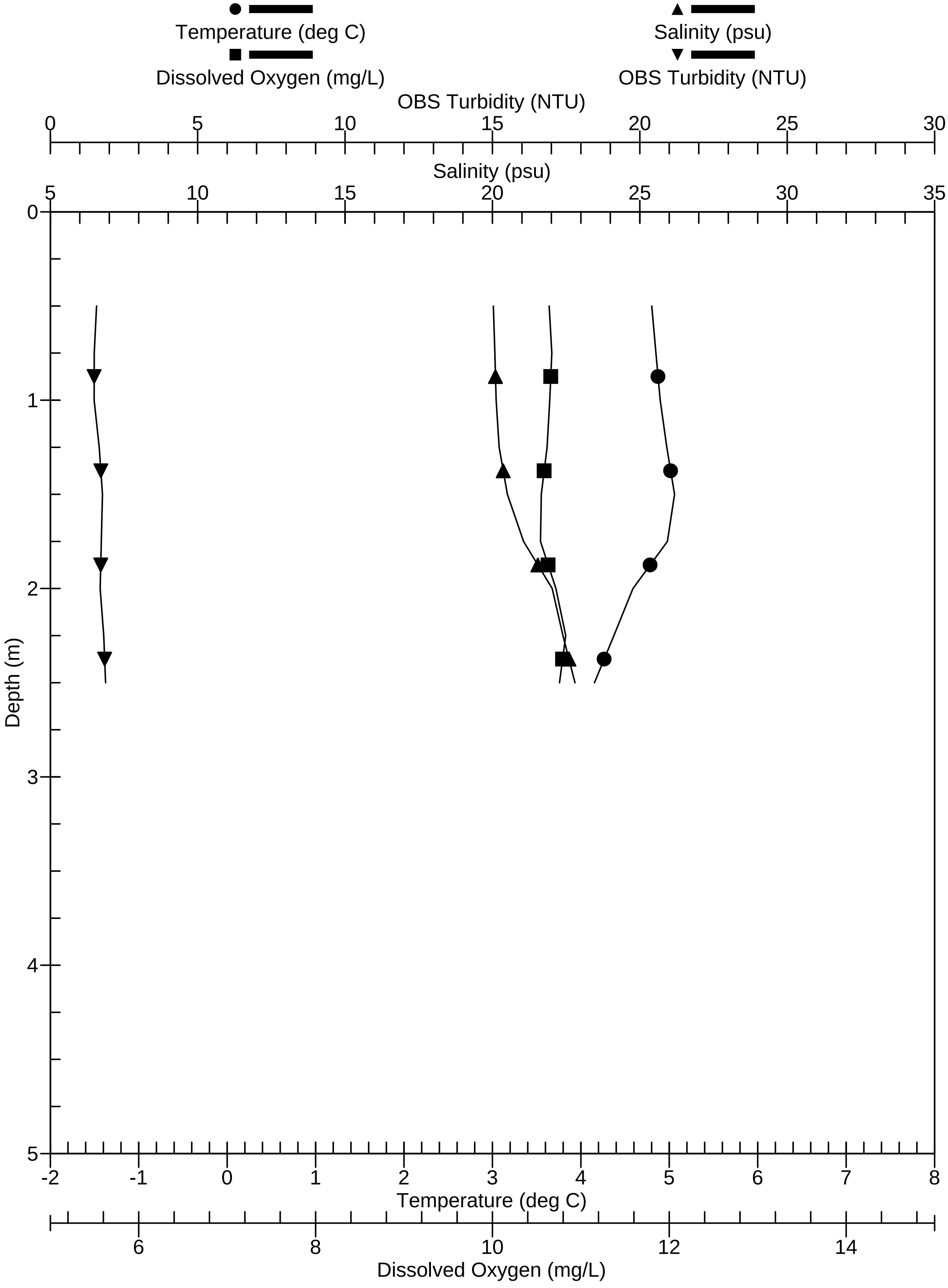
Willow Marine Monitoring Program - 2018 Hydrographic Data, W21.cnv

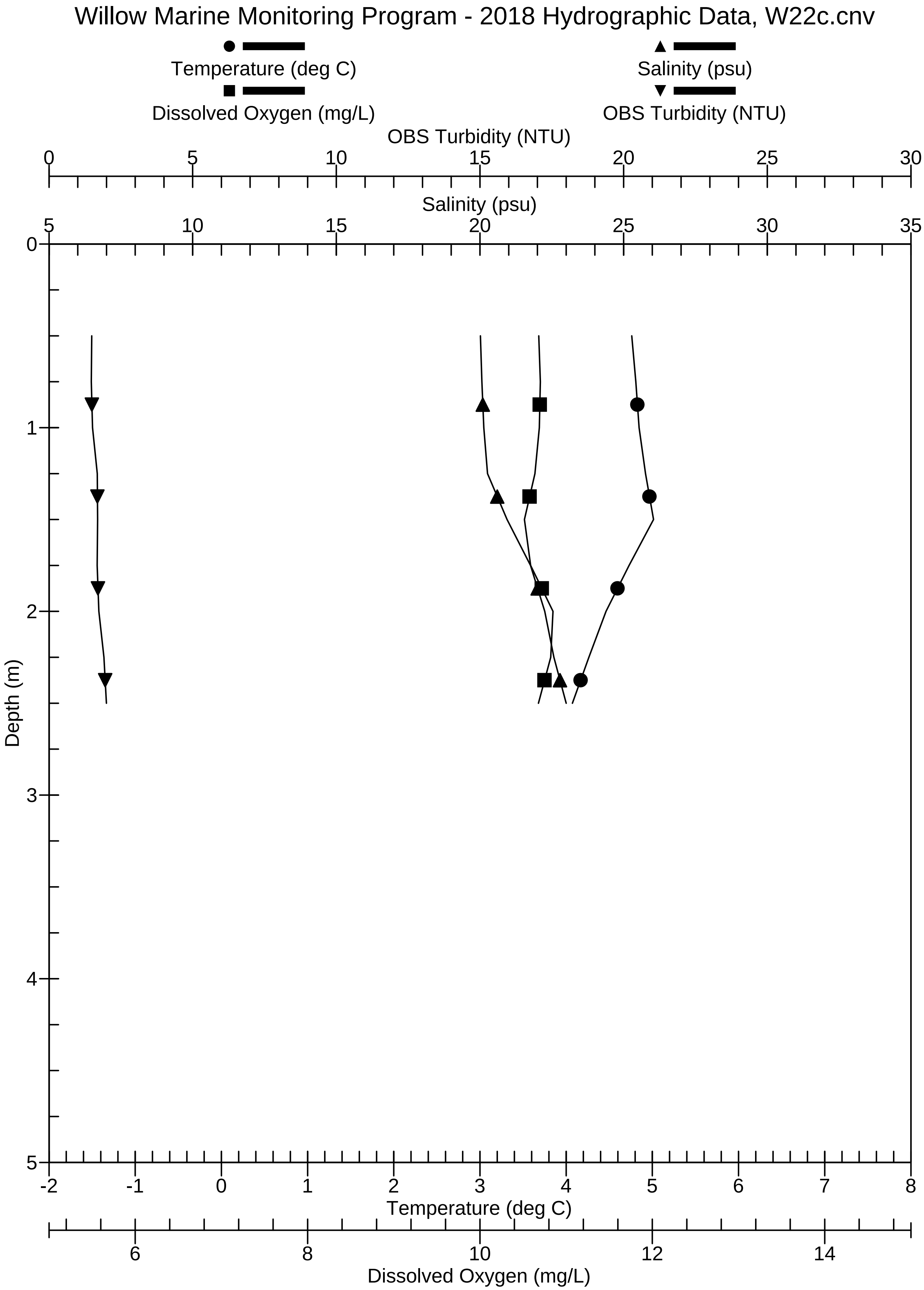


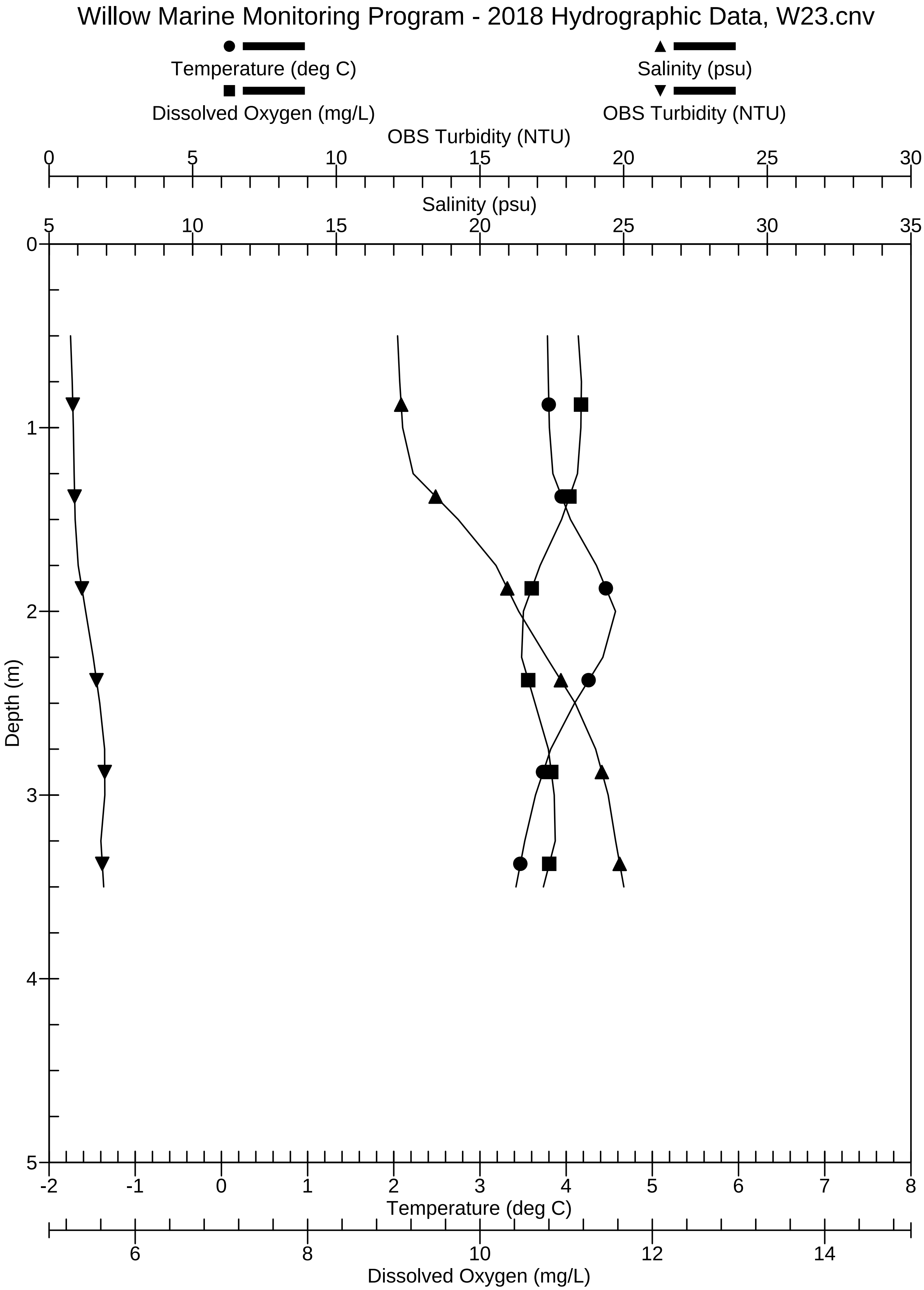
Willow Marine Monitoring Program - 2018 Hydrographic Data, W22.cnv



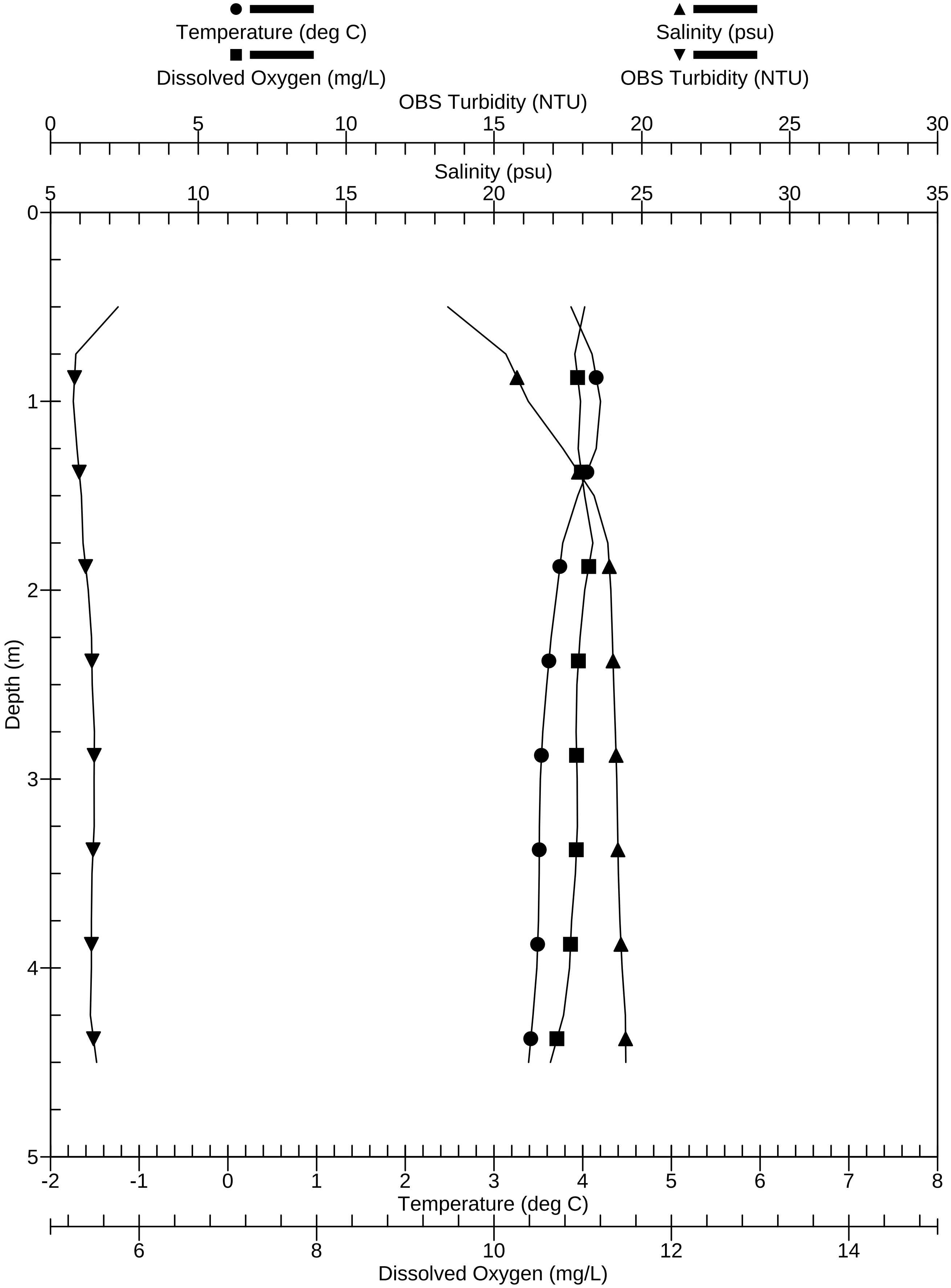
Willow Marine Monitoring Program - 2018 Hydrographic Data, W22b.cnv



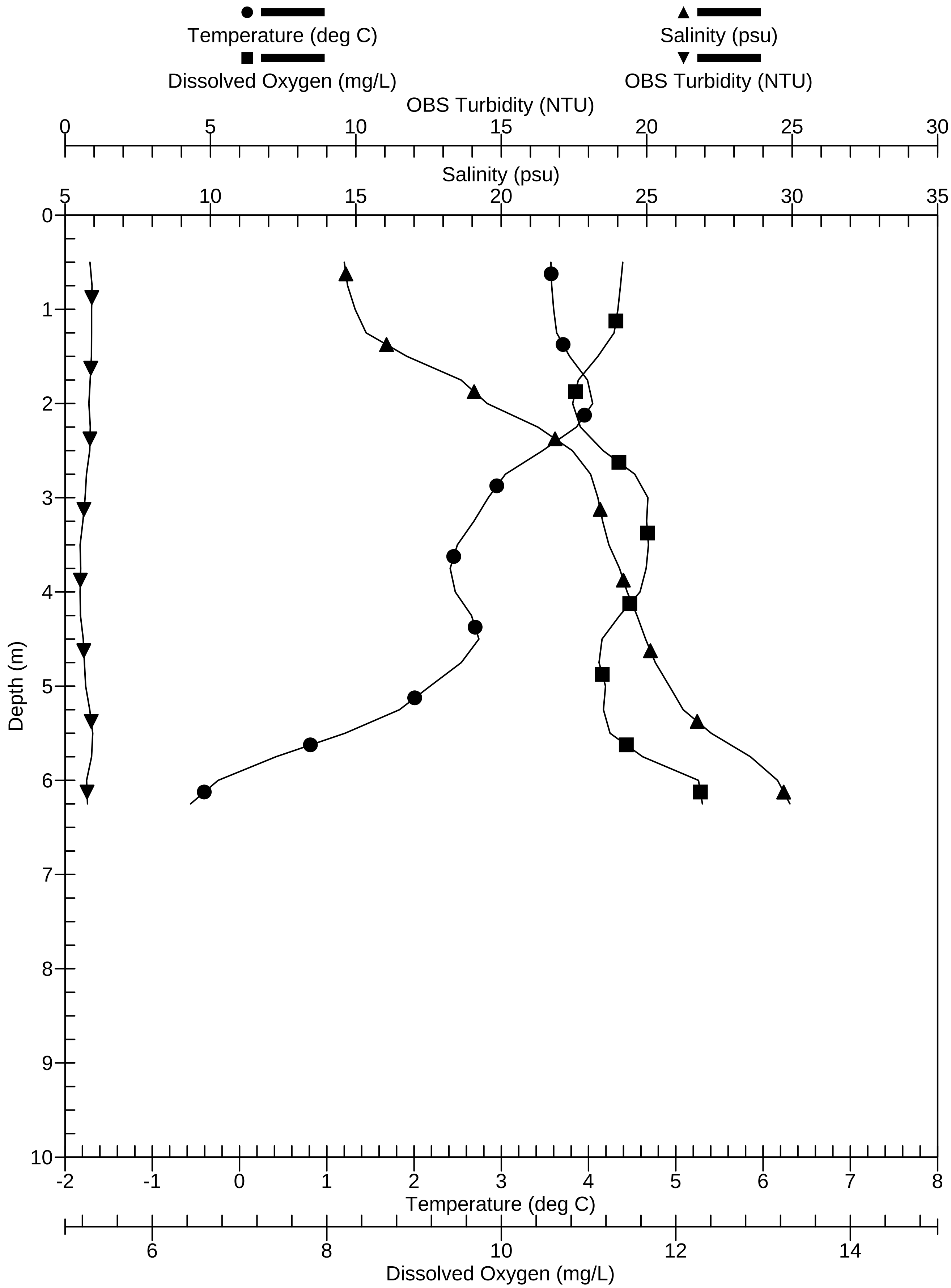

Willow Marine Monitoring Program - 2018 Hydrographic Data, W22c.cnv
● Temperature (deg C)
■ Dissolved Oxygen (mg/L)
▲ Salinity (psu)
▼ OBS Turbidity (NTU)
OBS Turbidity (NTU)
0
5
10
15
20
25
30
Salinity (psu)
5
10
15
20
25
30
35
Depth (m)
0
1
2
3
4
5
-2
-1
0
1
2
3
4
5
6
7
8
Temperature (deg C)
6
8
10
12
14
Dissolved Oxygen (mg/L)


Willow Marine Monitoring Program - 2018 Hydrographic Data, W23.cnv
● Temperature (deg C)
■ Dissolved Oxygen (mg/L)
▲ Salinity (psu)
▼ OBS Turbidity (NTU)
OBS Turbidity (NTU)
0
5
10
15
20
25
30
Salinity (psu)
5
10
15
20
25
30
35
Depth (m)
0
1
2
3
4
5
-2
-1
0
1
2
3
4
5
6
7
8
Temperature (deg C)
6
8
10
12
14
Dissolved Oxygen (mg/L)

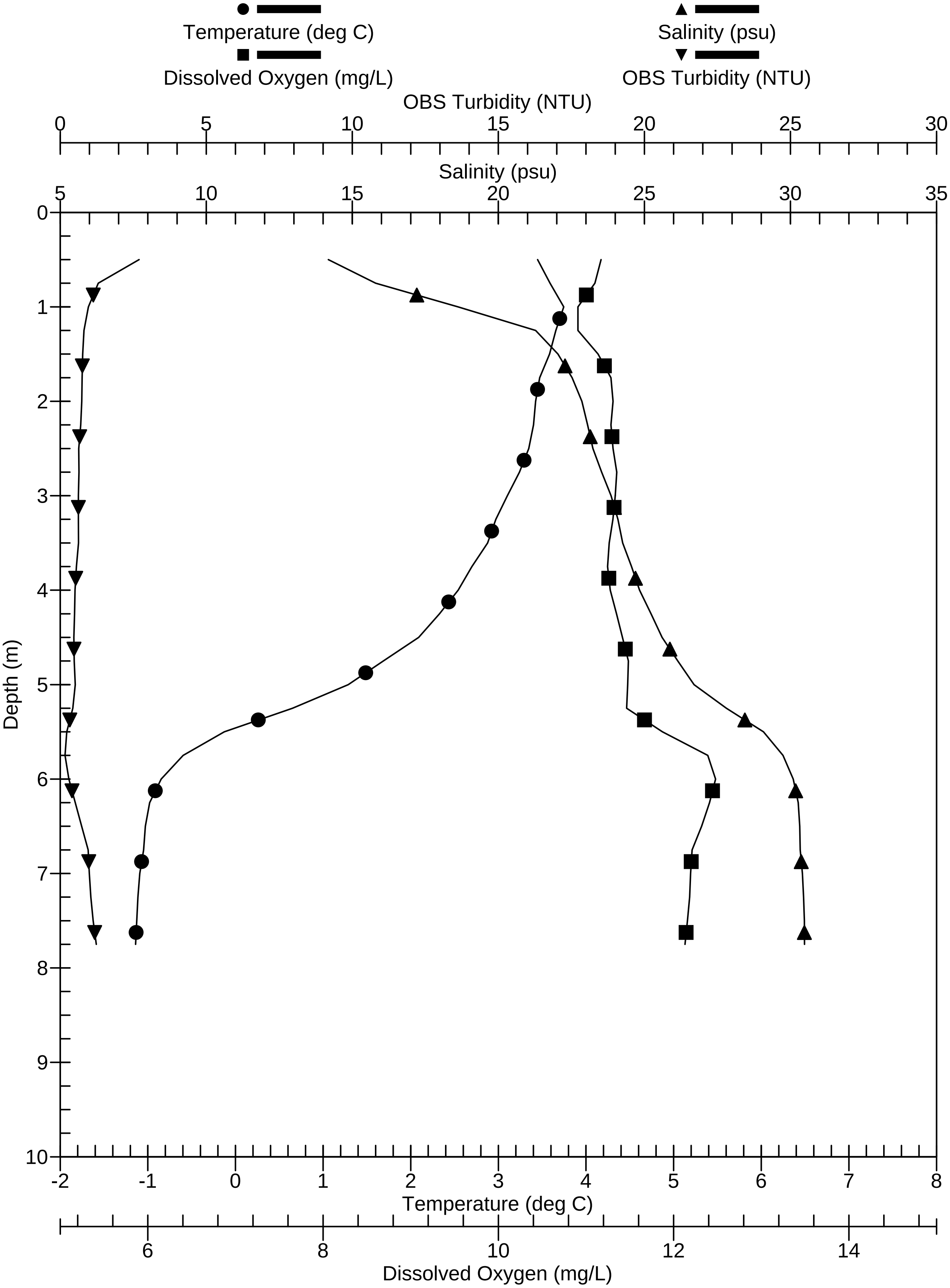
Willow Marine Monitoring Program - 2018 Hydrographic Data, W24.cnv



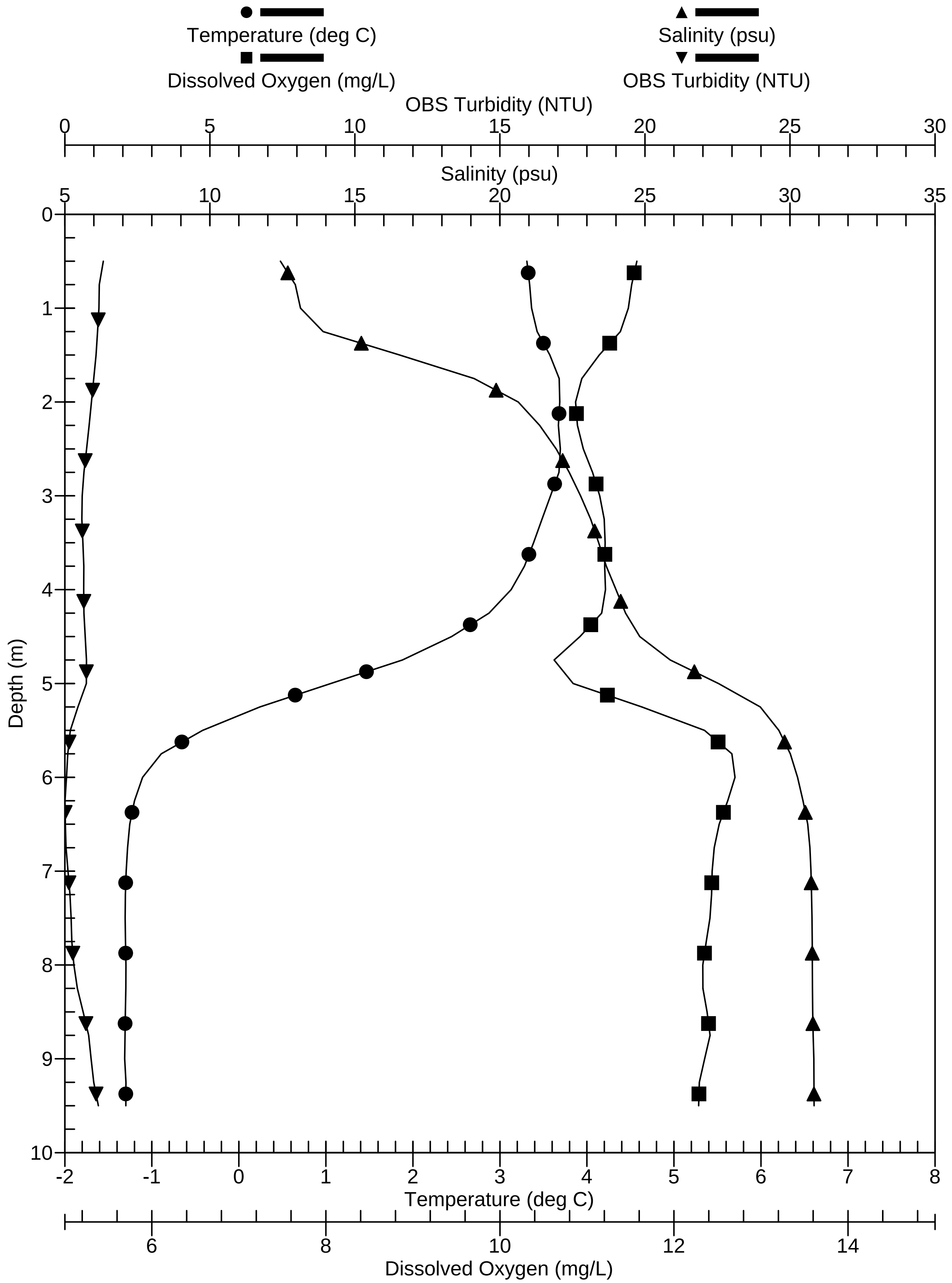
Willow Marine Monitoring Program - 2018 Hydrographic Data, W25.cnv



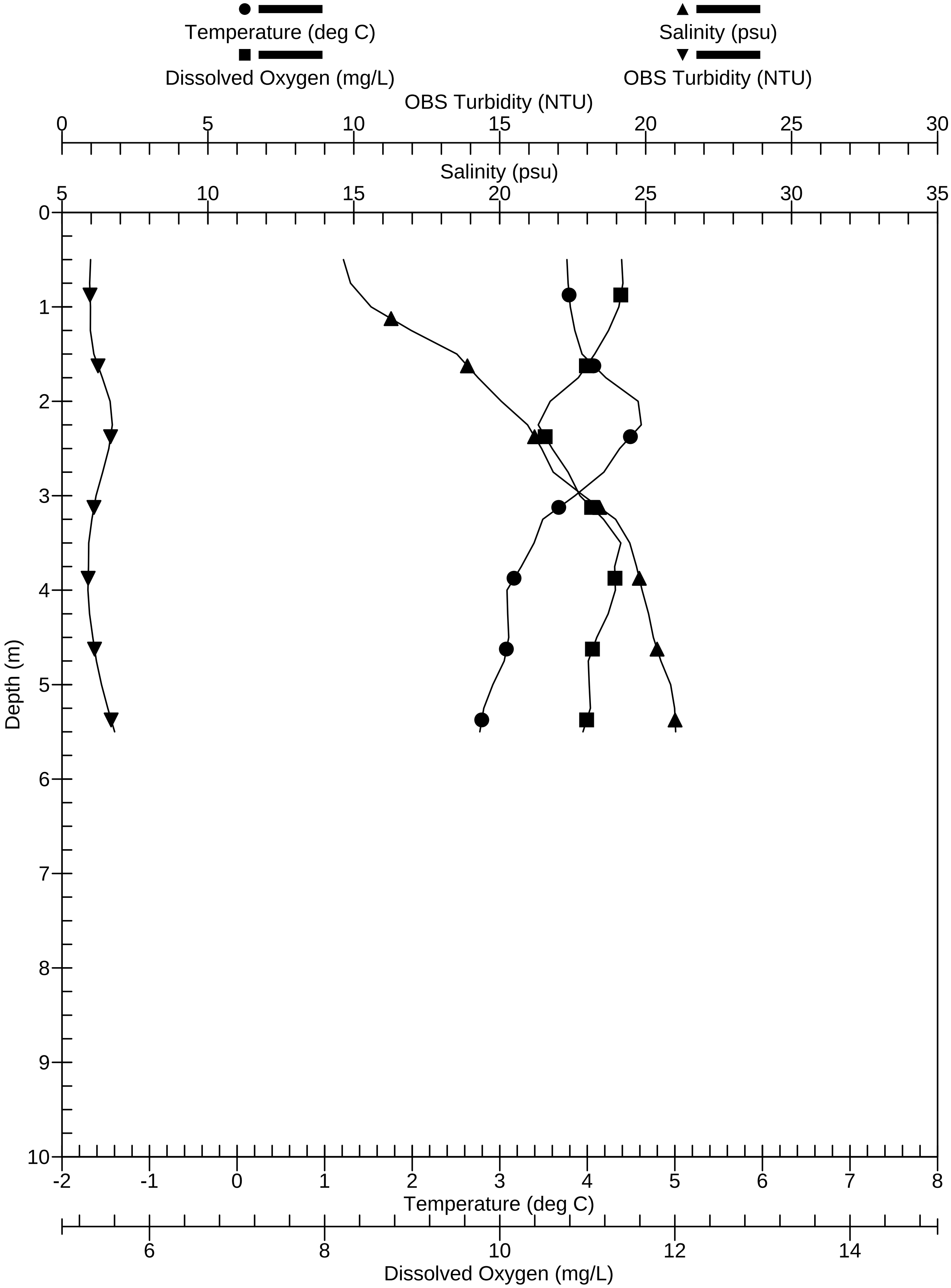
Willow Marine Monitoring Program - 2018 Hydrographic Data, W26.cnv



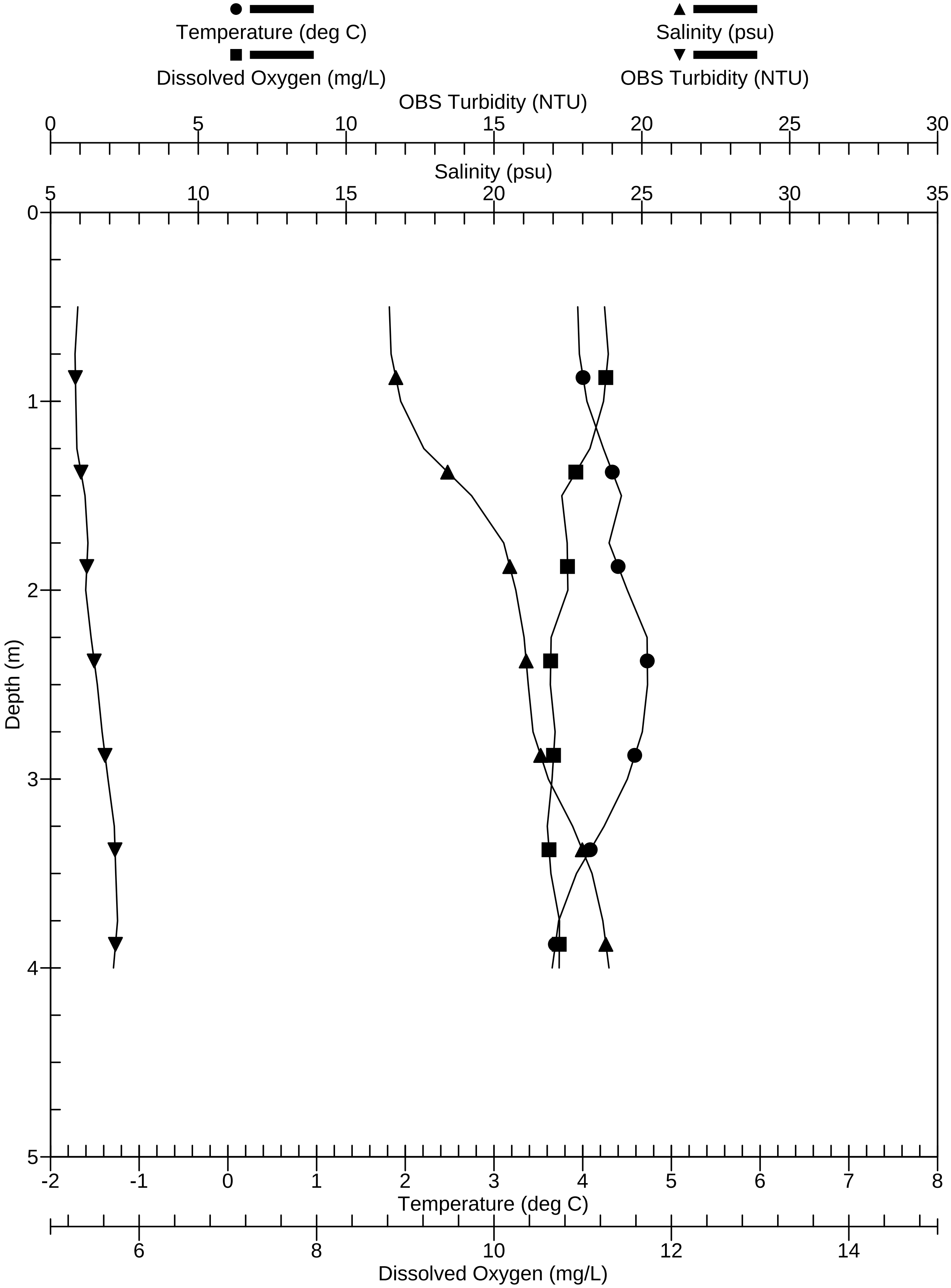
Willow Marine Monitoring Program - 2018 Hydrographic Data, W27.cnv

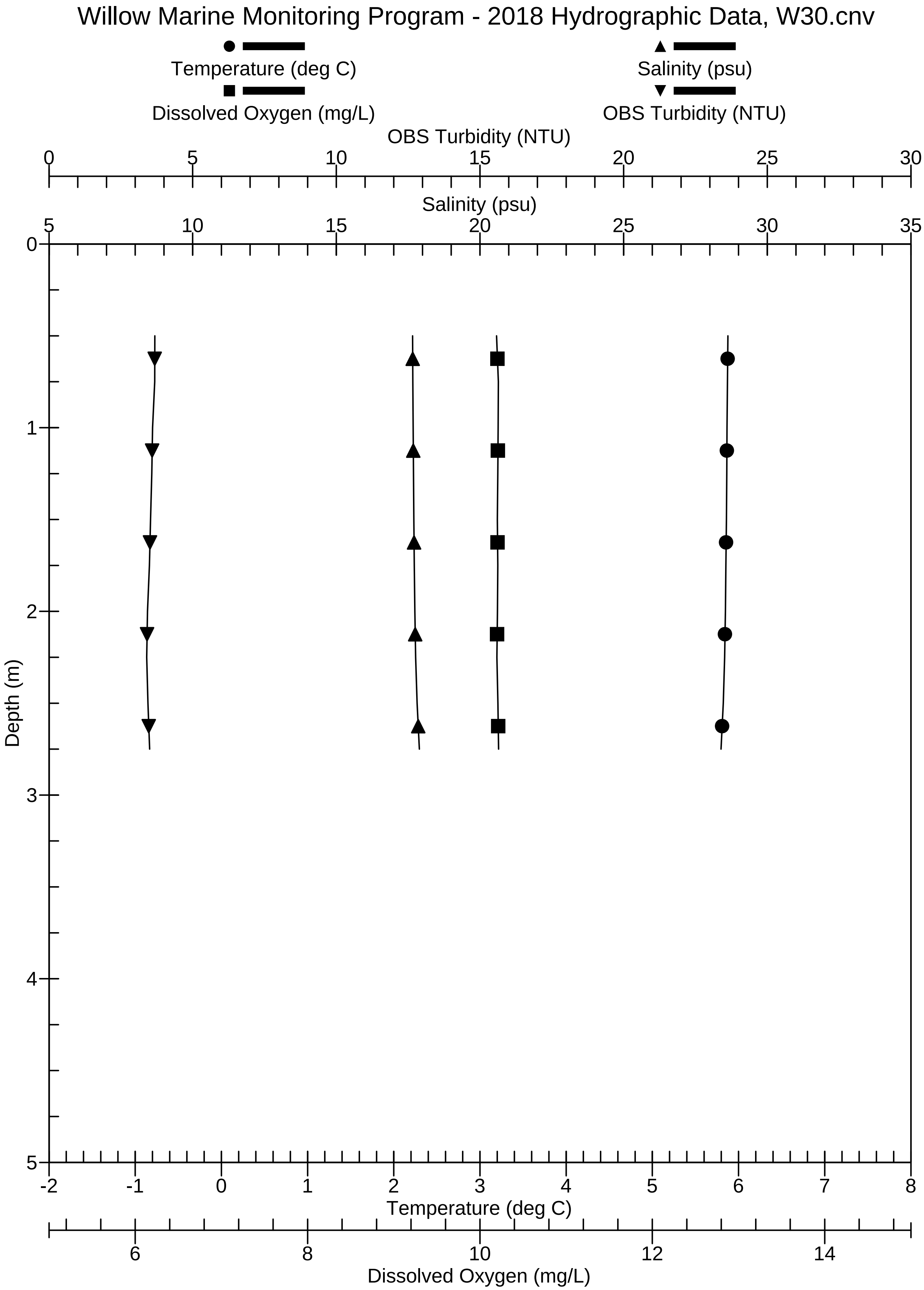


Willow Marine Monitoring Program - 2018 Hydrographic Data, W28.cnv

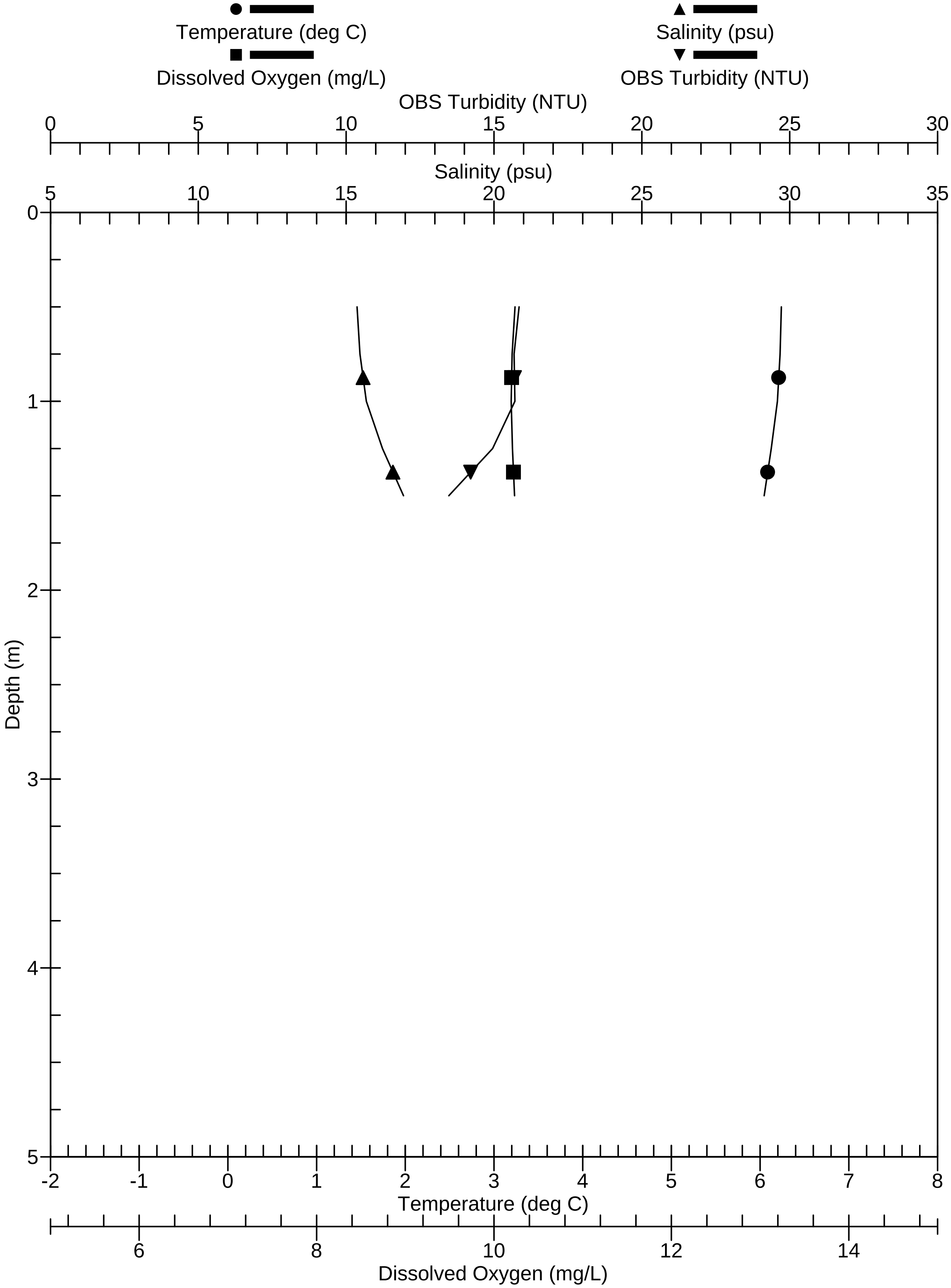


Willow Marine Monitoring Program - 2018 Hydrographic Data, W29.cnv

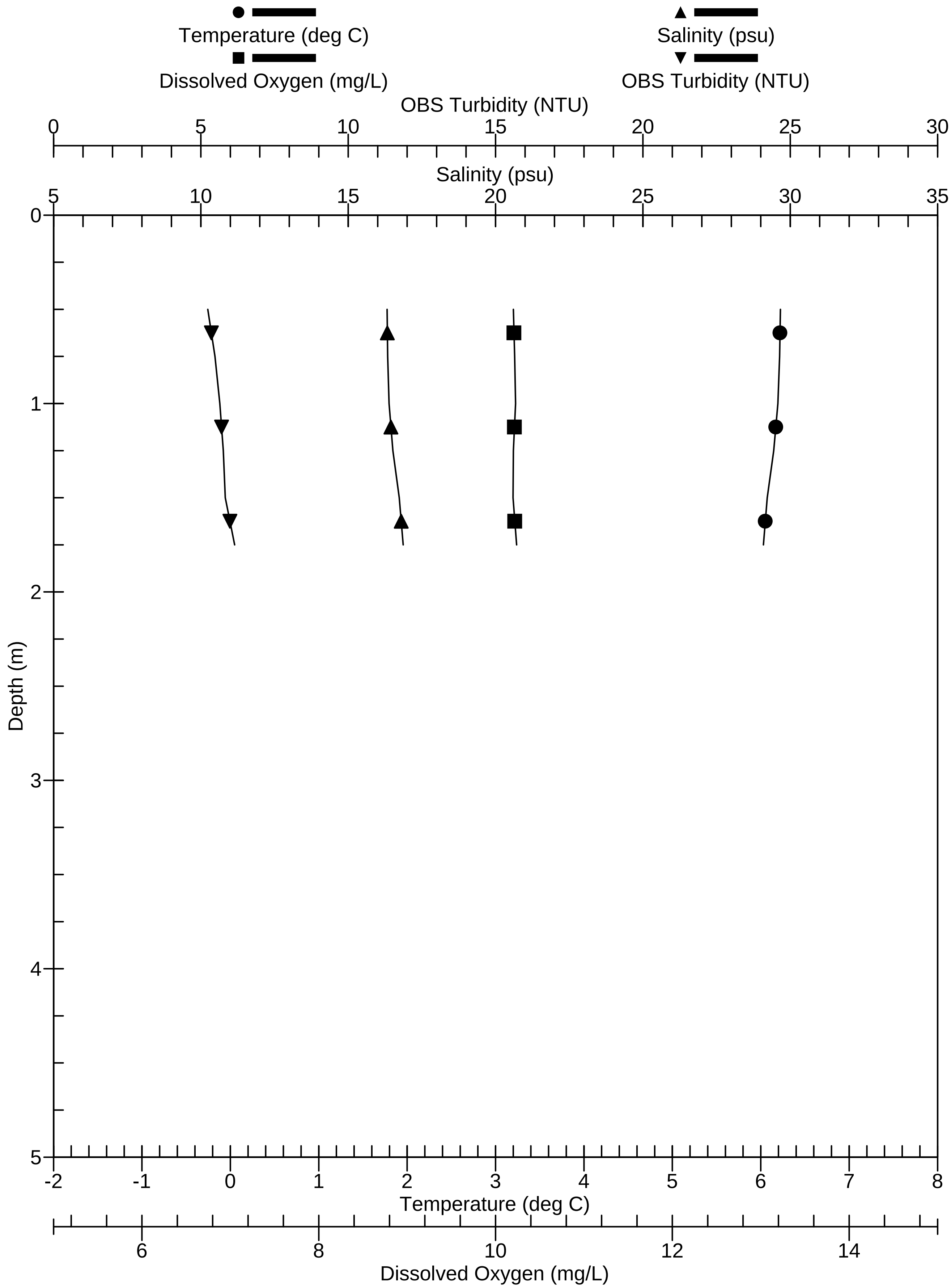


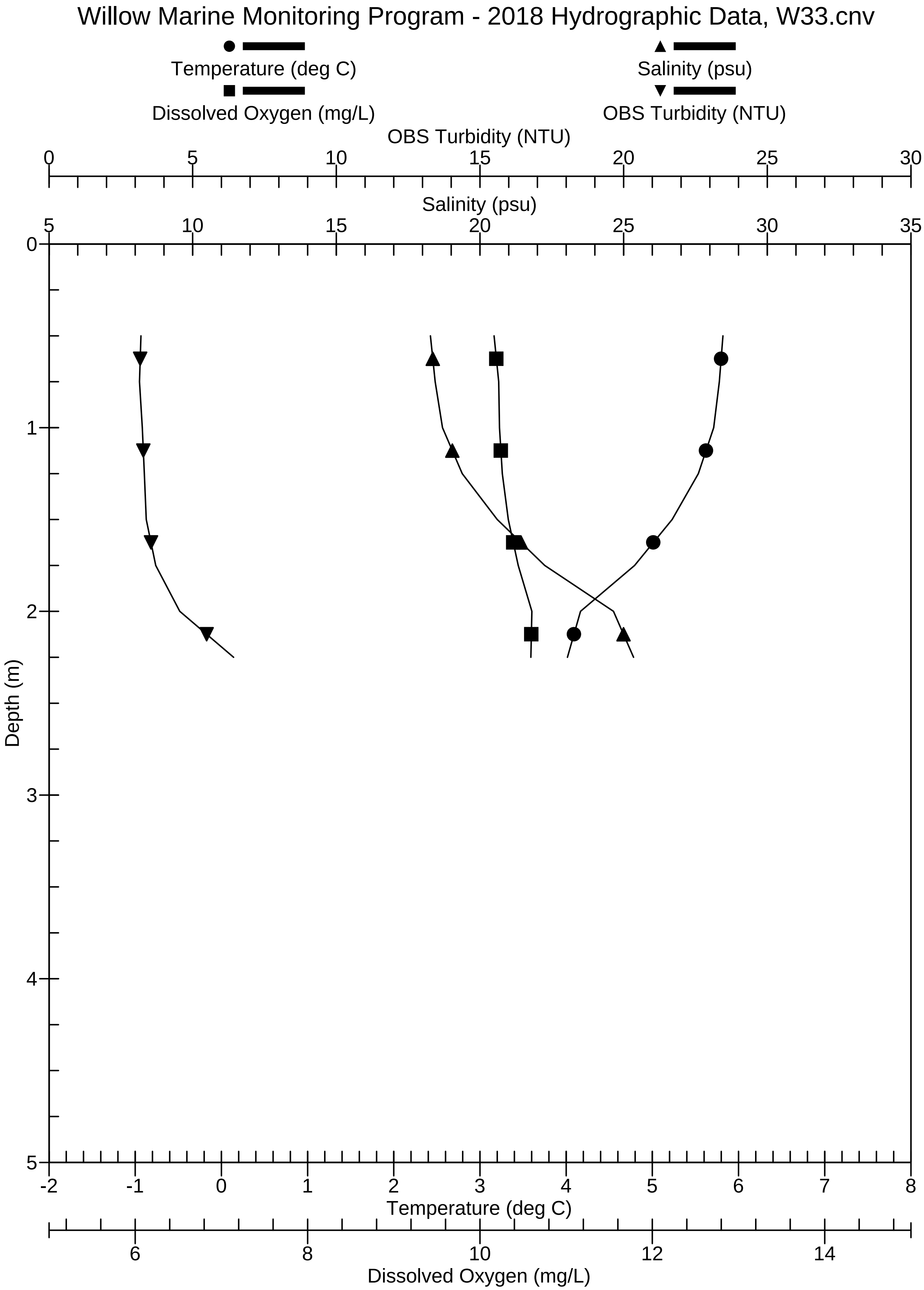

Willow Marine Monitoring Program - 2018 Hydrographic Data, W30.cnv
● Temperature (deg C)
■ Dissolved Oxygen (mg/L)
▲ Salinity (psu)
▼ OBS Turbidity (NTU)
OBS Turbidity (NTU)
0
5
10
15
20
25
30
Salinity (psu)
5
10
15
20
25
30
35
Depth (m)
0
1
2
3
4
5
Temperature (deg C)
-2
-1
0
1
2
3
4
5
6
7
8
Dissolved Oxygen (mg/L)
6
8
10
12
14

Willow Marine Monitoring Program - 2018 Hydrographic Data, W31.cnv

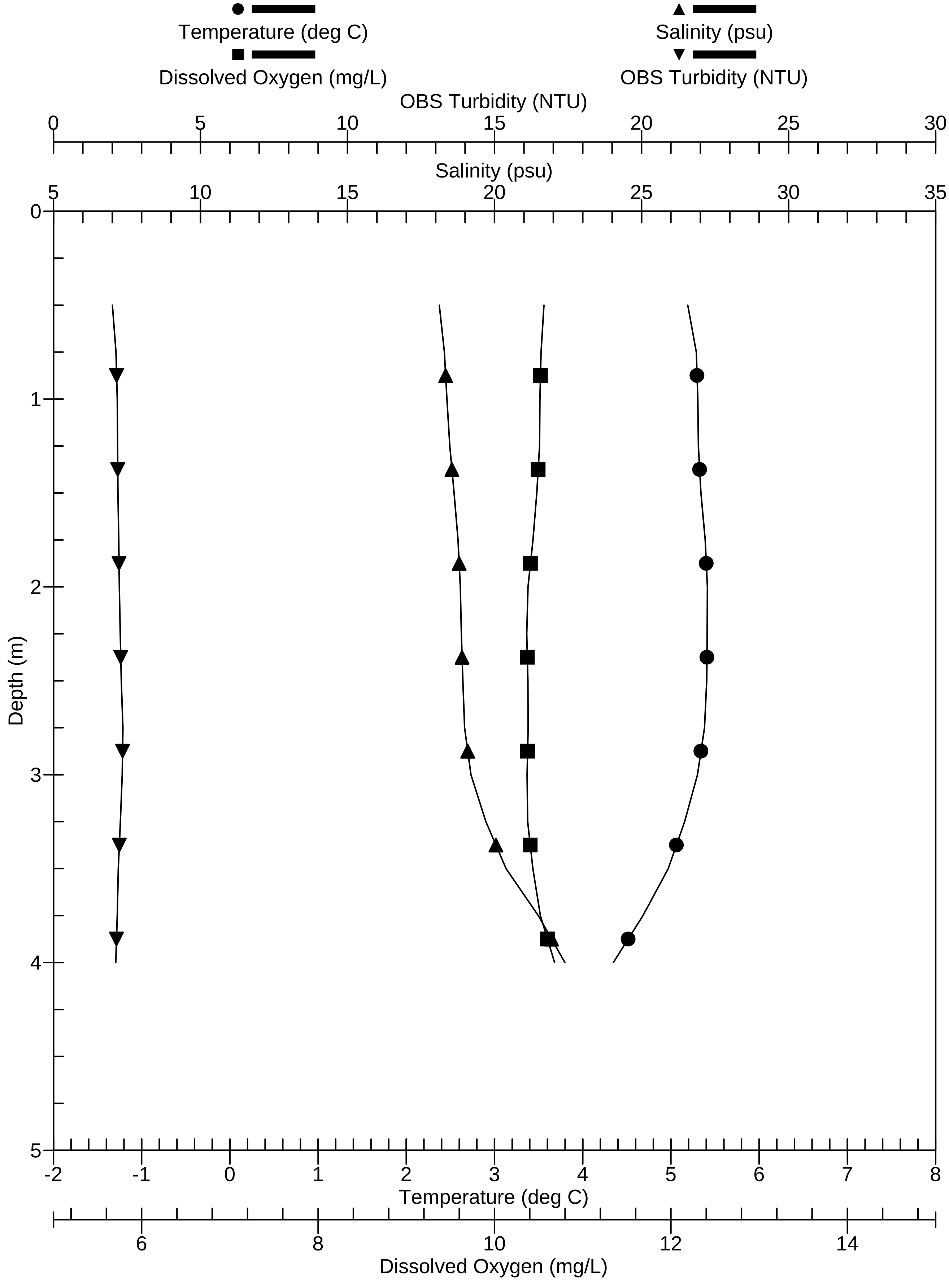


Willow Marine Monitoring Program - 2018 Hydrographic Data, W32.cnv

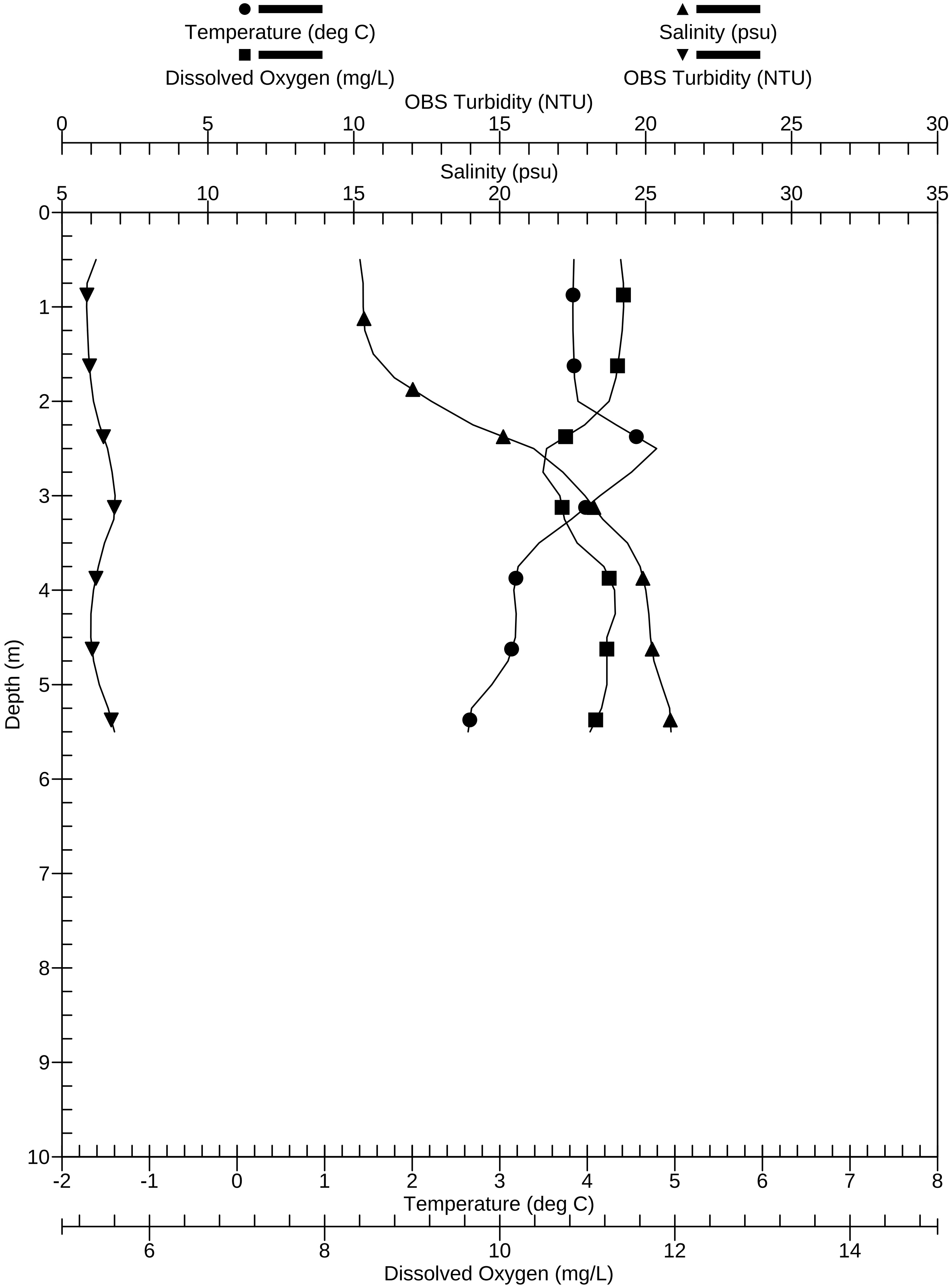



Willow Marine Monitoring Program - 2018 Hydrographic Data, W33.cnv
● Temperature (deg C)
■ Dissolved Oxygen (mg/L)
▲ Salinity (psu)
▼ OBS Turbidity (NTU)
OBS Turbidity (NTU)
0
5
10
15
20
25
30
Salinity (psu)
5
10
15
20
25
30
35
Depth (m)
0
1
2
3
4
5
-2
-1
0
1
2
3
4
5
6
7
8
Temperature (deg C)
6
8
10
12
14
Dissolved Oxygen (mg/L)

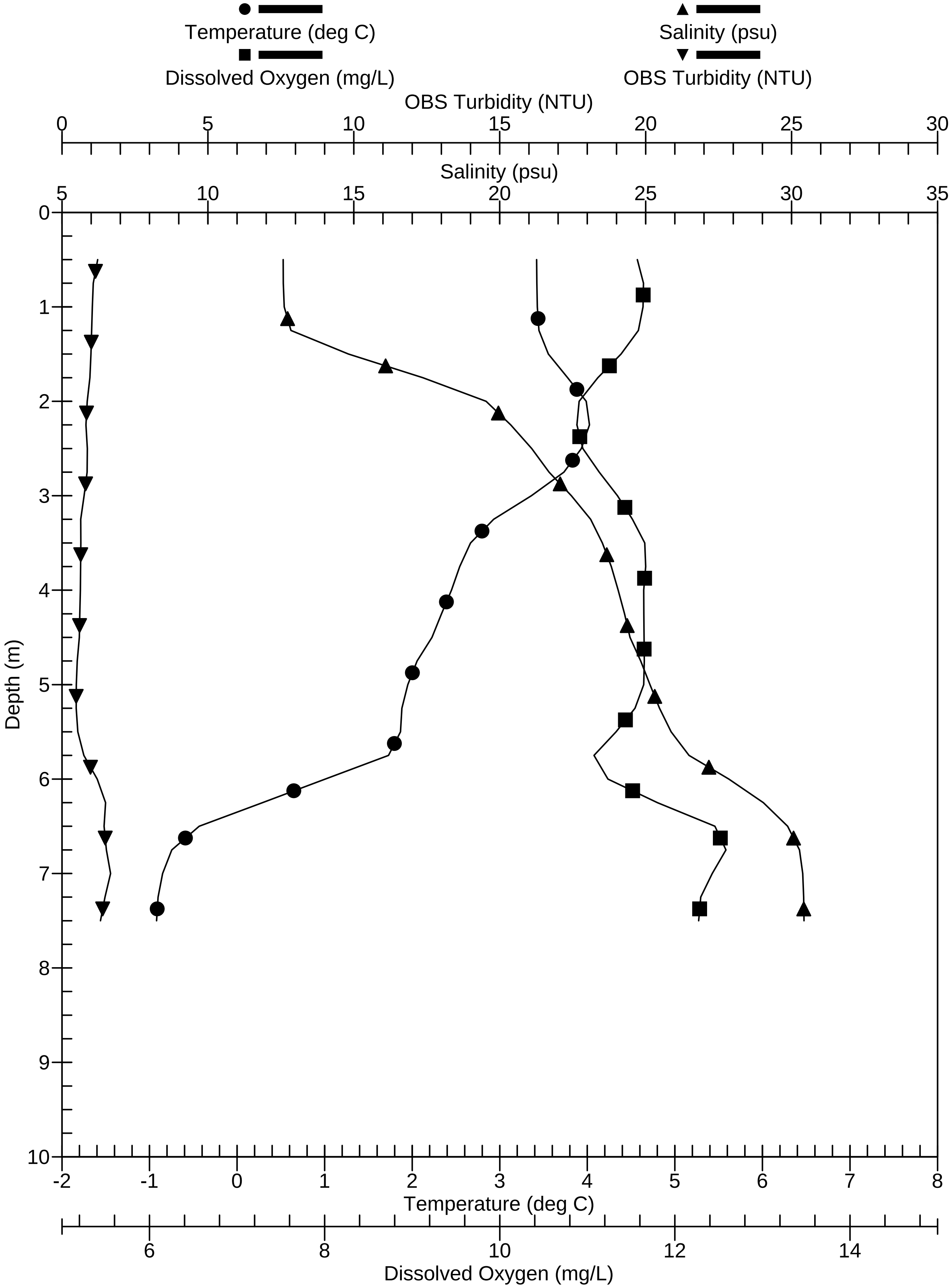
Willow Marine Monitoring Program - 2018 Hydrographic Data, W34.cnv



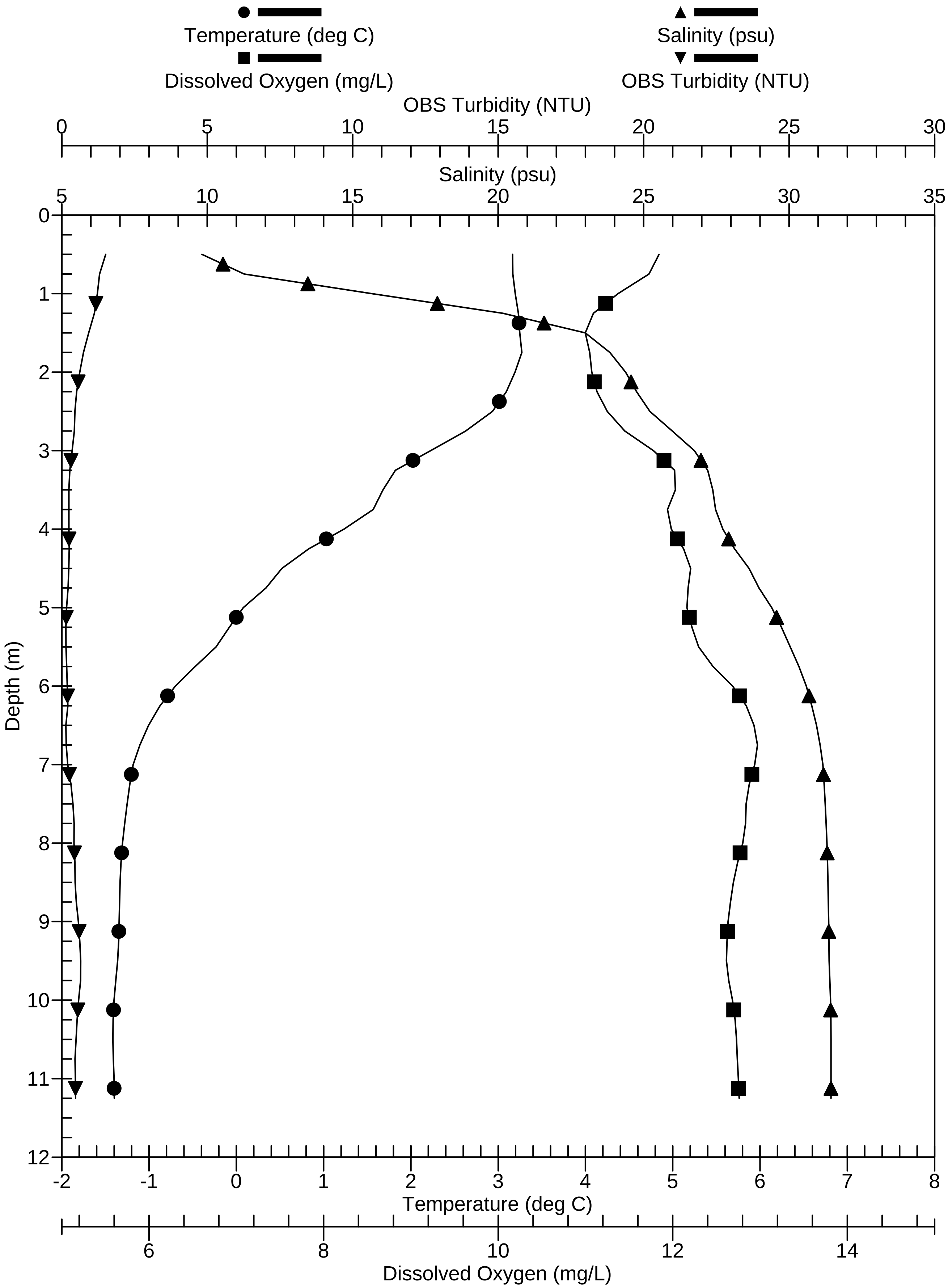
Willow Marine Monitoring Program - 2018 Hydrographic Data, W35.cnv



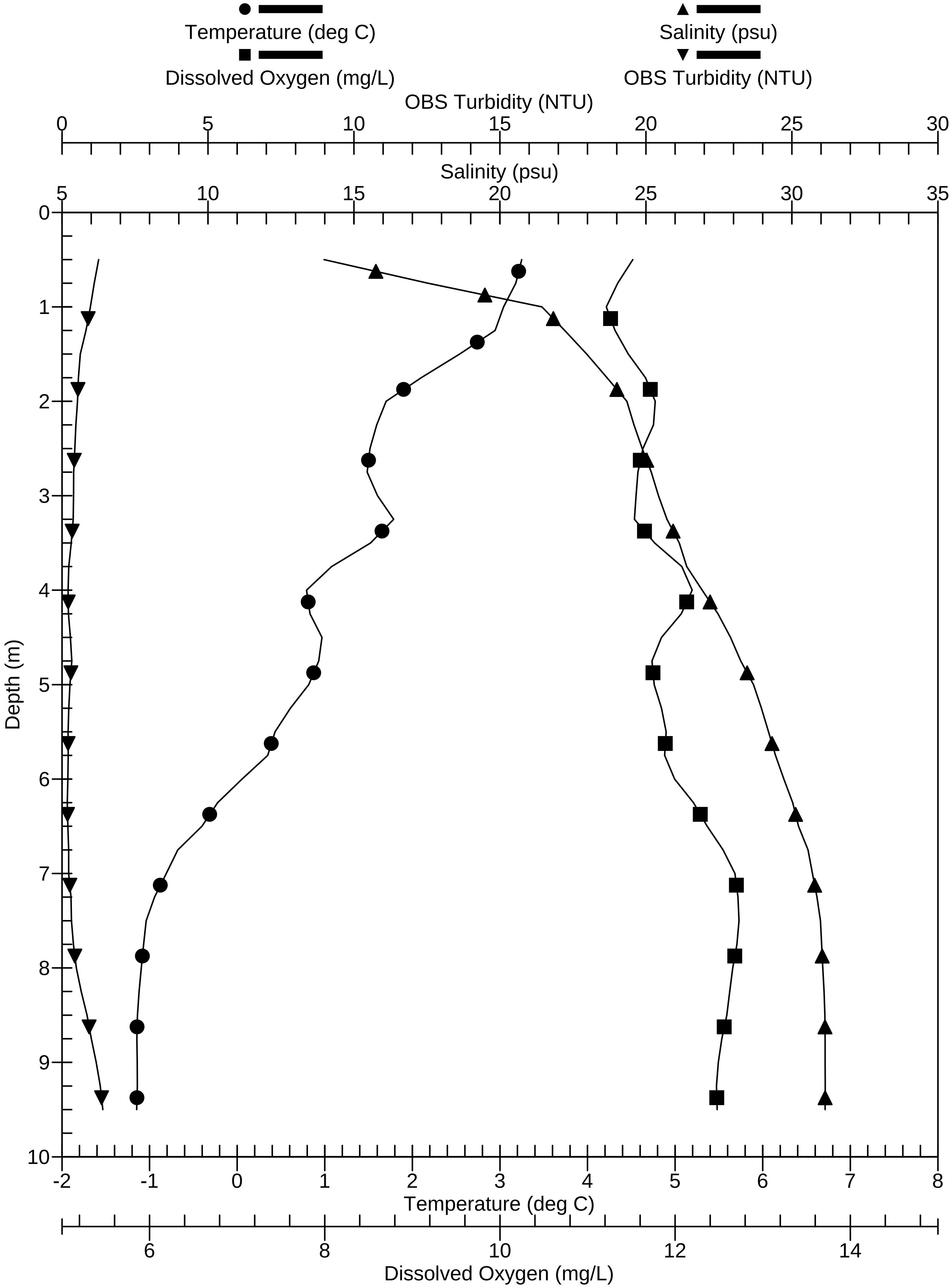
Willow Marine Monitoring Program - 2018 Hydrographic Data, W36.cnv



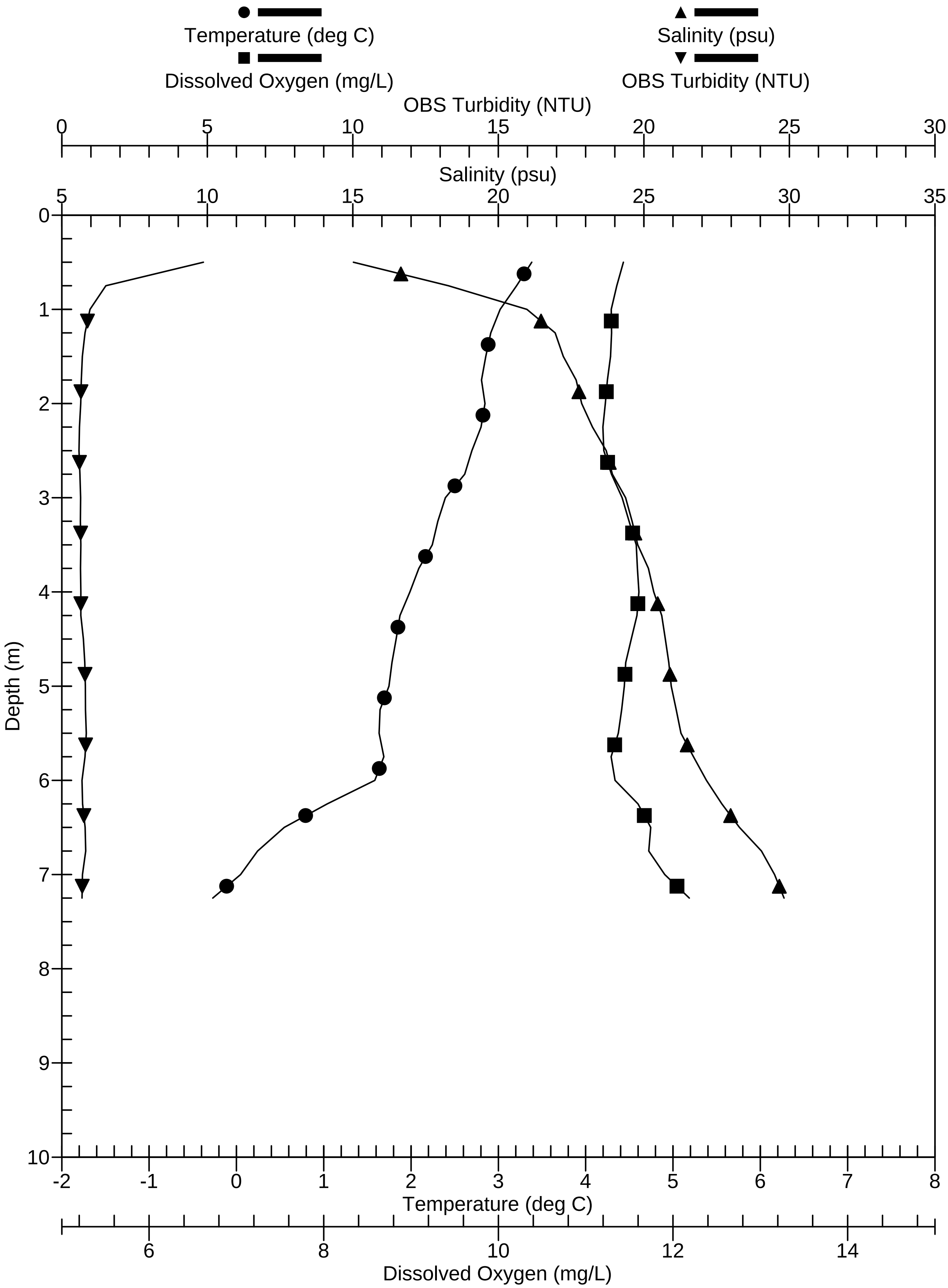
Willow Marine Monitoring Program - 2018 Hydrographic Data, W37.cnv



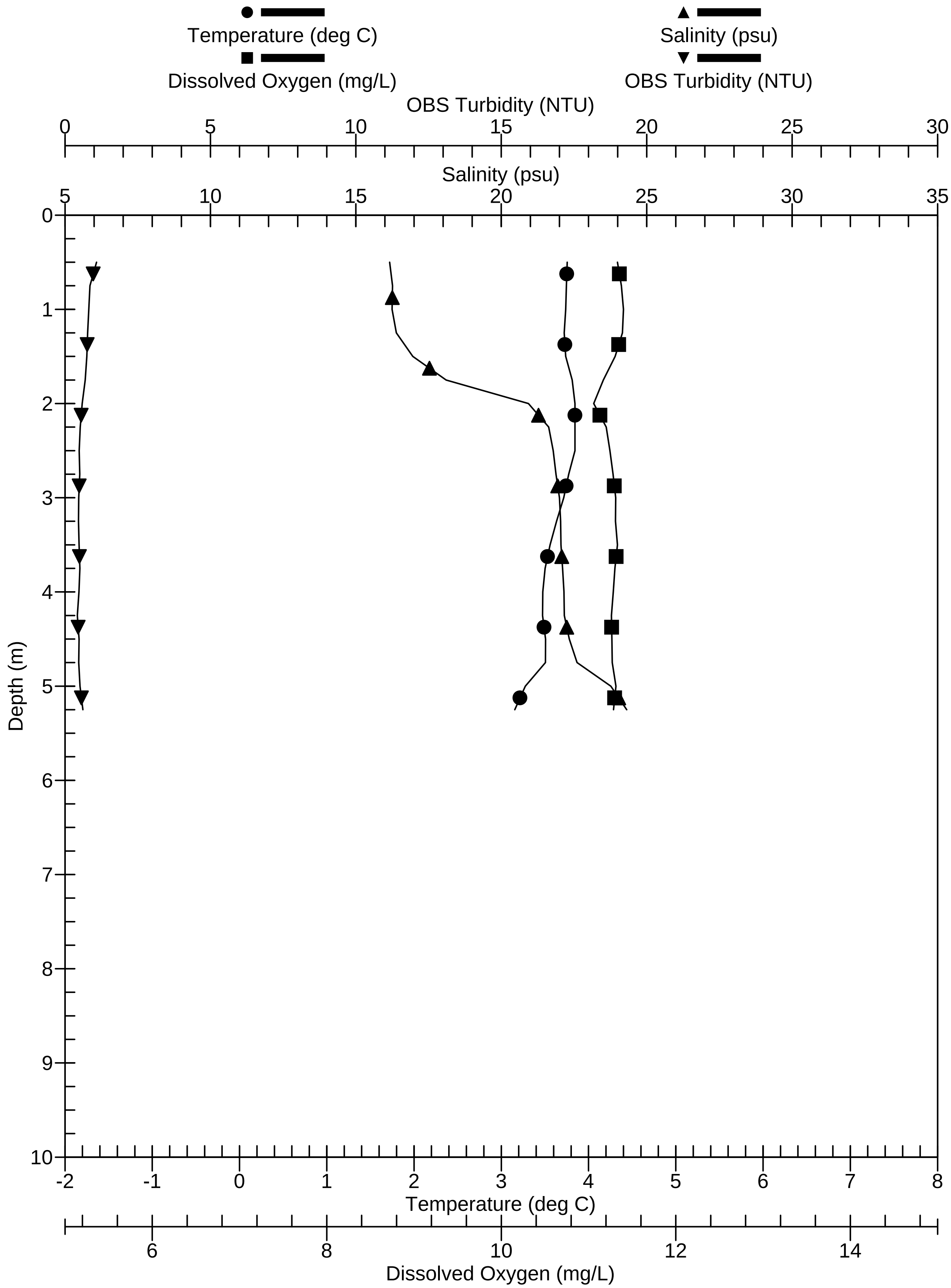
Willow Marine Monitoring Program - 2018 Hydrographic Data, W38.cnv

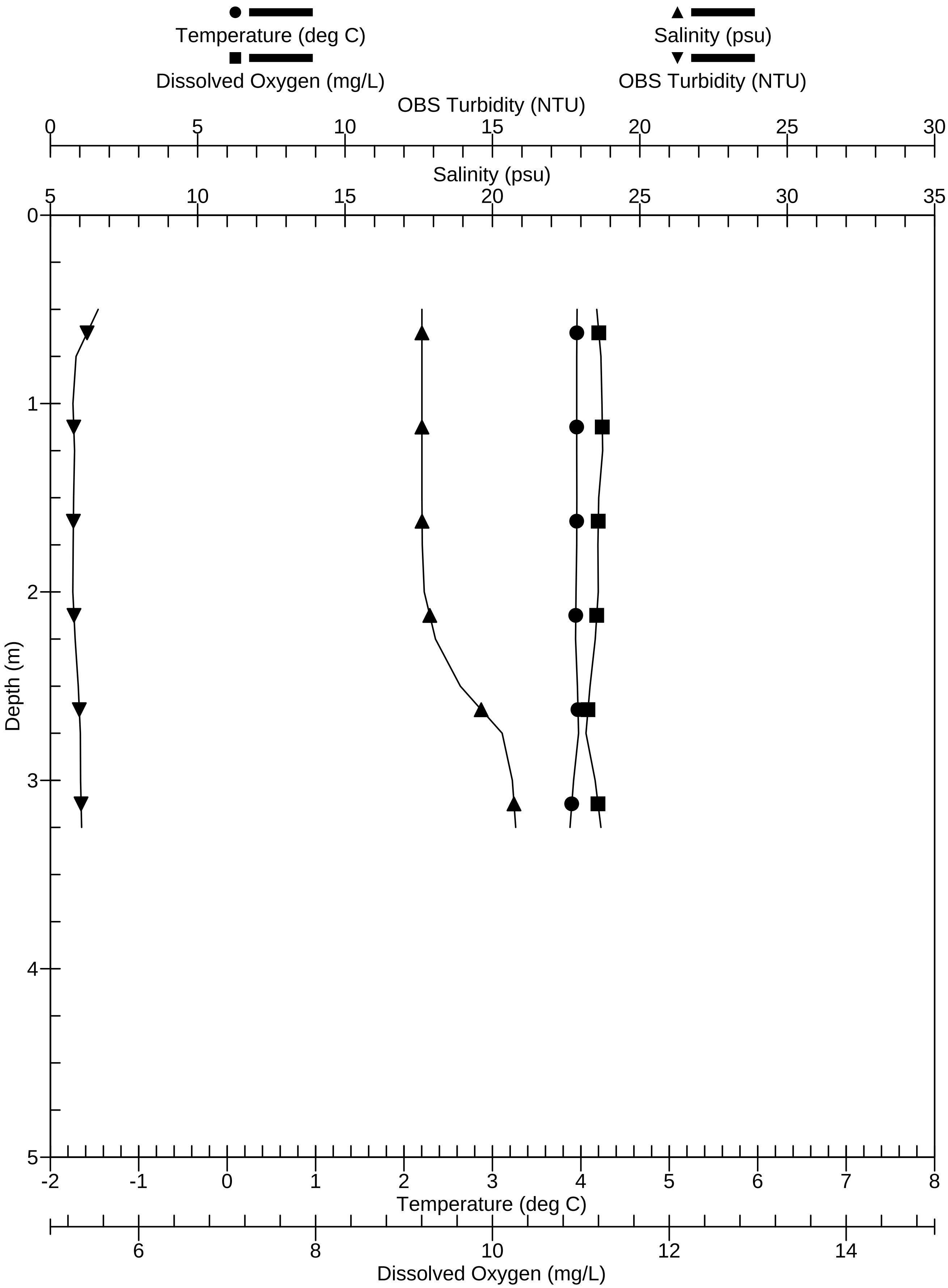


Willow Marine Monitoring Program - 2018 Hydrographic Data, W39.cnv



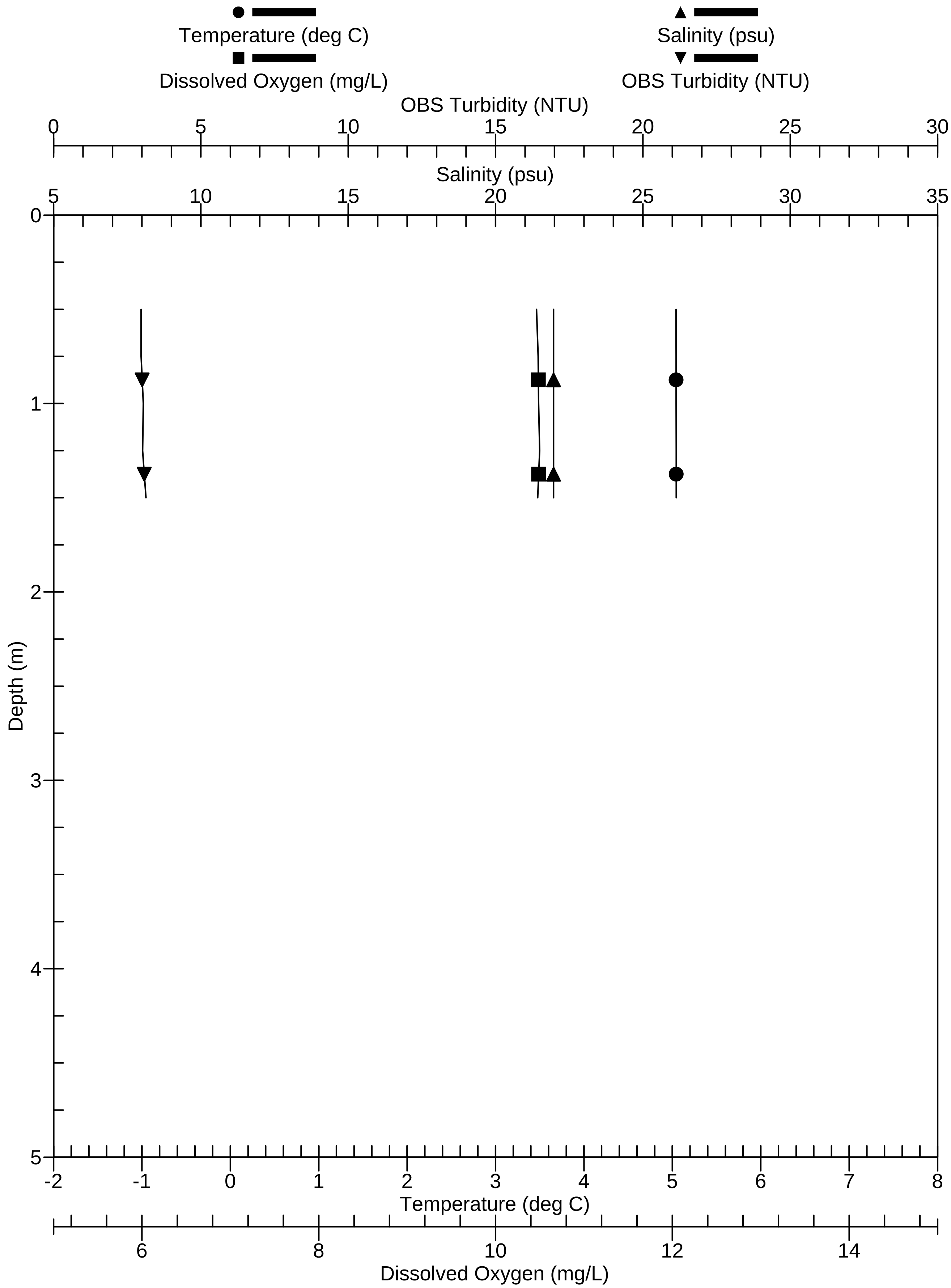
Willow Marine Monitoring Program - 2018 Hydrographic Data, W40.cnv





Willow Marine Monitoring Program - 2018 Hydrographic Data, W41.cnv

Willow Marine Monitoring Program - 2018 Hydrographic Data, W42.cnv



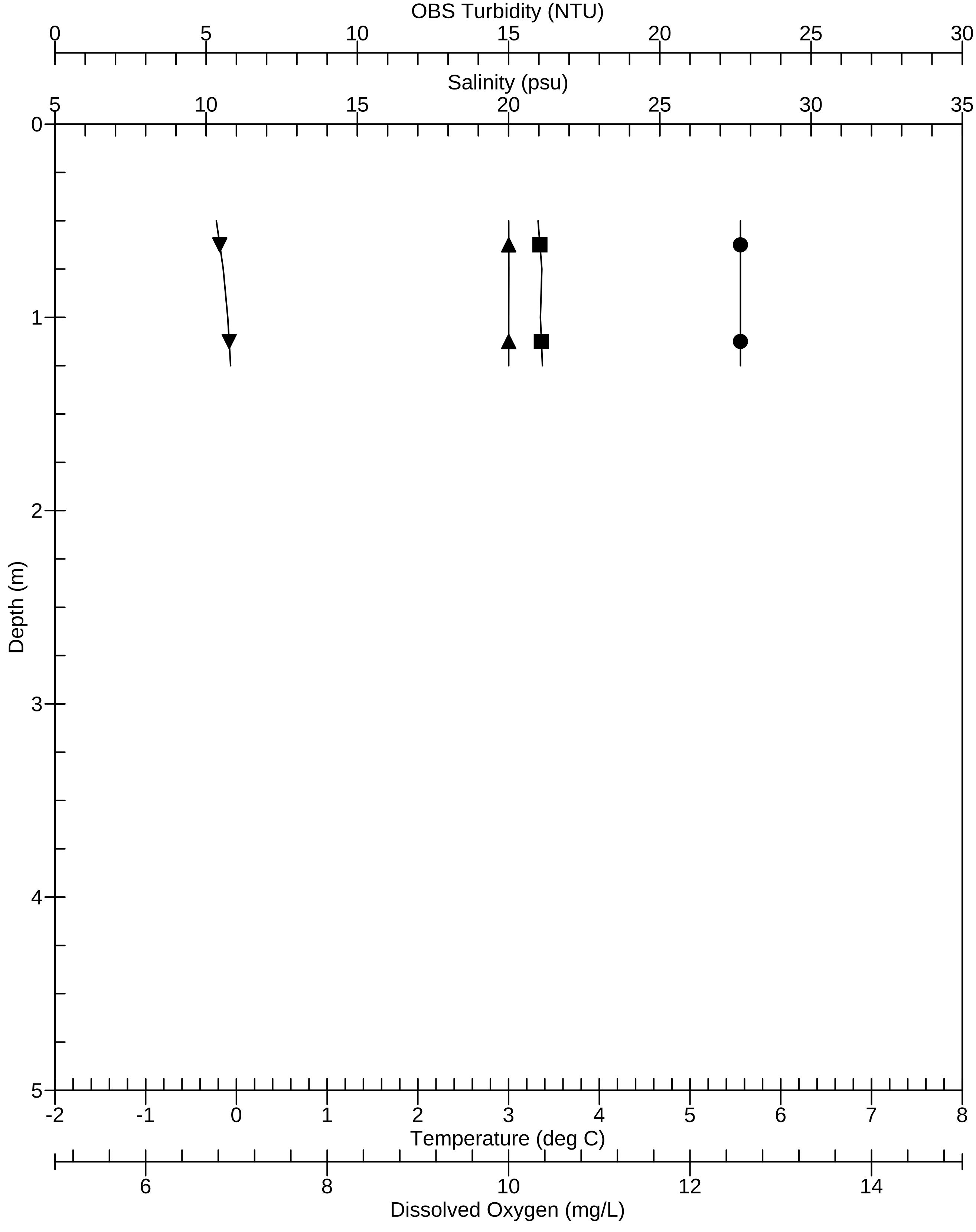
Willow Marine Monitoring Program - 2018 Hydrographic Data, W43.cnv

● Temperature (deg C)

■ Dissolved Oxygen (mg/L)

▲ Salinity (psu)

▼ OBS Turbidity (NTU)



Appendix E

Willow Marine Monitoring Program
QA/QC Evaluation

November 2018

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1.0 INTRODUCTION

Field sampling and analyses conducted for the Willow MMP were performed in accordance with formal quality assurance/quality control (QA/QC) procedures. The objectives of the QA/QC program were to fully document the field and laboratory data collected, to maintain data integrity from the time of field collection to storage at the end of the project, and to produce the highest quality data possible. The program was designed to allow the data to be assessed by the following parameters: Precision, Accuracy, Comparability, Representativeness, and Completeness. These parameters were controlled by adhering to documented methods and standard operating procedures (SOPs) and by the analysis of quality control (QC) samples on a routine basis.

Field QC included the analysis of field duplicate samples, adherence to SOPs, and formal sample documentation and tracking. Analytical chemistry methodology and QC procedures were formalized by EPA and State certification agencies and involve internal QC checks such as method blanks, laboratory control spike/laboratory control spike duplicates (LCS/LCSDs), matrix spike/spike duplicates (MS/MSDs), standard reference material (SRMs), laboratory duplicates (DUPs) or triplicates (TRP), surrogates (SURR), and instrument calibration procedures.

All analytical data collected for this testing program underwent QA/QC evaluation according to EPA National Functional Guidelines for inorganic and organic data review (EPA 2017a and 2017b). A summary of QC analyses that were performed for each type of analyses is provided in Table E-1.

Table E-1. Summary of QC Performed on Sediment and Water Chemistry Samples.

Analyte	Blanks	Lab DUP	LCS	MS/MSD	SRM	Surrogates
Sediments						
% Solids	-	✓	-	-	-	-
TOC	✓	✓	✓	✓	-	-
TVS	✓	✓	-	-	-	-
Grain Size	-	✓	-	-	-	-
Total Metals	✓	✓	✓	✓	✓	-
PAHs	✓	✓	✓	✓	✓✓	✓
AHCs	✓	✓	✓	✓	✓	✓
Steranes/Triterpanes	✓	✓	✓	✓	✓	✓
Water						
Total Suspended Solids	✓	-	✓	-	-	-
Turbidity	✓	✓	-	-	✓	—

2.0 QA/QC METHODS

The overall quality of the dataset was determined to a large degree by the thoroughness, accuracy, and precision of the laboratory QC records. The QC is discussed individually by topic in this evaluation.

2.1 PRECISION

Precision provides an assessment of mutual agreement between repeated measurements. These measures may apply to DUPs, MSDs, and LCSDs. Monitoring of precision through the process allows for the evaluation of the consistency of laboratory analyses.

The Relative Percent Difference (RPD) is used to evaluate duplicative sample results. The RPD is the difference between the two samples divided by their average expressed as percent and is calculated as:

$$RPD = 100 * \left(\frac{|x_1 - x_2|}{\frac{1}{2}(x_1 + x_2)} \right)$$

where:
x_1 = Concentration of sample 1
x_2 = Concentration of sample 2

RPDs can be large when analyzing differences between small numbers, a situation that is common when analyzing DUPs with values near the method reporting limit (MRL) or in sediment matrices where the sample is heterogeneous. When one or both concentrations are less than five times the MRL, replication is assessed by determining if the two values differ by more than one times the MRL. When one or both values are less than the MRL, precision cannot be ascertained.

2.2 ACCURACY

An assessment of the accuracy of measurements is based on determining the difference between measured values and the known or “true” value and is applied to MS/MSDs, LCS/LCSDs, and SRMs.

In general, Percent Recovery is calculated as:

$$\%R = 100 * \left(\frac{Measured\_Value}{True\_Value} \right)$$

Matrix Spike recoveries take into account the concentration of the source sample:

$$\%R_{MS} = 100 * \left(\frac{Measured\_Value - Sample\_Value}{True\_Value} \right)$$

2.3 REPRESENTATIVENESS, COMPARABILITY, AND COMPLETENESS

Representativeness is the degree to which data accurately and precisely represent the natural environment. The objective for representativeness for this program is a function of the initial study design and overall program objectives as described by the SAP. Representativeness was achieved in part through use of the standard sampling and analytical procedures described in this report, the SAP, and associated SOPs.

Comparability is the measure of confidence with which one dataset can be compared to another. The use of standardized methods of chemical analysis and field sampling and processing are ways of assuring comparability. The implementation of thorough QA/QC methods such as laboratory QC is essential.

Completeness is a measure of the percentage of the data judged valid after comparison with specific validation criteria. This includes data lost through accidental breakage of sample containers or other activities that result in irreparable loss of samples. Implementation of standardized chain of custody procedures which track samples as they are transferred between custodians is one method of maintaining a high level of completeness.

A high level of completeness is essential to all phases of this study due to the limited number of samples targeted for collection. Of course, the overall goal is to obtain completeness of 100 percent. However, a realistic data quality objective of 95% for both field and collection analytical data will insure an adequate level of data return.

Close adherence to SOPs assures that the resulting data is representative, complete, and comparable. The results are further assessed with a thorough validation process.

2.4 VALIDATION

Data validation was performed in accordance with the National Functional Guidelines for Inorganic Superfund Methods Data Review (EPA 540-R-2017-001, January 2017) and Organic Review (EPA 540-R-2017-002, January 2017). All laboratory and field data generated under the program were reviewed for accuracy, precision, and completeness. The review included:

- Data package completeness
- Chain of custody information and integrity
- Use of specified analytical methods
- Holding times for extraction and analysis
- Blanking results relative to the MRLs and sample concentrations
- Field duplicate frequency and precision
- Laboratory duplicates, frequency and precision
- Laboratory Control Sample frequency, compounds and recoveries
- Surrogate standard frequency, compounds and recoveries
- Matrix spike frequency, compounds and recoveries
- Matrix spike duplicate frequency and relative percent differences
- MRLs and dilution factors

2.5 DATA QUALIFIER CODES

Where appropriate, data qualifiers were associated with the results using the following standard notations from the EPA guidance documents:

Appropriate Data Review Qualifiers	
<	Not detected above the MDL or MRL. The compound was analyzed for but was not detected above method MDL or MRL. The associated value is the sample MDL or MRL.
UJ	Estimated Non-detect. The compound result was raised to the MRL due to a method blank hit.
J-	Estimated Value. The associated value is a low estimate.
J	Estimated Value. The associate value is an estimated quantity.
J+	Estimated Value. The associated value is a high estimate.
R	Rejected. The data are unusable. The analyte may or may not be present.

EPA guidance documents are clear that data review and qualification rules are to be tempered using best professional judgment. The specific data qualifications as they apply to this program are discussed in the following section.

3.0 QA/QC RESULTS

This project generated a final count of 1,236 analytical results for target analytes including field duplicate results, of which 1,139 were for sediment and 97 were for water matrices. An additional 882 supporting QC records were derived alongside, and the counts of each type per chemical category can be found in Table E-2.

Generally, the laboratory QC was found to be very good and within limits with the exceptions fully noted below. Two sediment sample analyses were found to require additional qualification. No additional water sample results were further qualified as a result of this QC review. The details of the entire review follow with the sediment and water records discussed separately.

Table E-2. Counts of QC Records per Analytical Category

Analyte Group	Blank	Lab DUP	LCS/Blank Spike	MS/MSD	SRM	Surrogate	Total
Sediment							
% Solids		8					8
TOC	1	1	1	2			5
TVS	1	2					3
PGS		14					14
Metals	15	15	14	15	15		74
PAHs	67	70	27	60	138	70	432
AHCs	41	45	35	74	39	39	273
Steranes/Triterpanes	10	10	1		20		41
Sediment Total	**135**	**165**	**78**	**151**	**212**	**109**	**850**
Water							
TSS	8		5				13
Turbidity	2	15			2		19
Water Totals	**10**	**15**	**5**		**2**		**32**

3.1 SEDIMENT QUALITY CONTROL RECORDS

Quality control results for the sediment composite samples are discussed in subsections that follow.

3.1.1 Completeness and Holding Times

All sediment environmental samples and associated QC samples (i.e., field duplicates) were collected as required, resulting in a field completeness value of 100%. With the exception of one sediment sample, all samples were received intact under proper chain of custody procedures at the analytical laboratory within the proper temperature ranges and were analyzed within acceptable EPA holding times. One sediment sample arrived at the laboratory with a cracked jar, but since the sample was frozen and intact, it was deemed acceptable for analysis after discussions between the KLI and the laboratory. In addition, no laboratory data were deemed invalid or were rejected during the data validation process; the analytical completeness was therefore assessed at 100%.

3.1.2 Reporting Limits

Sediment method MRLs and method detection limits (MDLs) were compared to target limits as specified in the program SAP and detailed earlier in this report. All MDLs and MRLs target limits were achieved with no dilutions or matrix interferences that resulted in adjustments to MDLs. For sediments, low percent solids results can sometimes cause MDLs to be elevated once results are dry-weight adjusted; however, the laboratories performing the analyses for this program provided MDLs on a dry weight basis, so this issue was not encountered.

3.1.3 Field Duplicates

Field duplicate results are summarized in Table E-3. Strict criteria are not established for the evaluation of field duplicates since sediment samples by their nature are often very heterogeneous. Rather, sample/field duplicate results are evaluated based upon best professional judgment. RPDs in Table E-3 are highlighted in yellow when greater than 50% and red when greater than 100%; any samples falling outside these values were given closer scrutiny.

Table E-3. Field Duplicate Results for Sediment Samples with RPD > 50%

Sample ID	Analyte	Sample	Field Dup	RPD	Diff	MRL
HB18-PAM-S3-1	i-C15	0.018	0.059	106	0.041	0.016
HB18-PAM-S3-1	i-C18	0.021	ND	200	0.021	0.004
HB18-PAM-S3-1	n-C13	0.04 J	0.067	50	0.027	0.045
HB18-PAM-S3-1	Dibenzo(a,h)anthracene	0.482	0.225	73	0.257	0.064
HB18-PGS-S3-1	Clay, 3.9 um	0.58	0.32	58	0.26	0.01
HB18-PGS-S3-1	Gravel, Fine	0.03	0.01	100	0.02	0.01
HB18-PGS-S3-1	Sand, Very Coarse	0.08	0.03	91	0.05	0.01
Shading Description	**Yellow: 50 < RPD < 100%**		**Red: RPD > 100%**			

As a general rule, KLI considers values to be of concern if they exceed 50% provided both values are greater than five times the MRL. In cases where one or both values are less than five times the MRL, those values are considered to be of potential concern if the difference between the two values is greater than twice the MRL. The excursions from these guidelines are discussed below.

Of the 169 field duplicate analyses performed for the program, 5 were above 50% RPD QC limit, and an additional 2 samples showed RPDs greater than 100%. Two of those (n-C_{13} and Gravel-fine) occurred where both concentrations were < 5xMRL and where the difference between the values was < 2xMRL, so these were dismissed. The two other grain size analyses were also dismissed and were the result of slight natural differences between fractions as the overall difference in the distribution of sand, silt, clay, and %fines was less 20% RPD. The overall differences for the two AHC analyses, i-C_{15} and iC_{18}, were small and near the MRL, so the higher RPDs could just be the result of slight differences in the amount of organic material or peat between the field sample and duplicate. The last analyte, dibenzo(a,h)anthracene, was found at concentrations where the duplicate was < 5xMRL but where the field sample was > 5xMRL with an RPD of 73. This analyte is considered a pyrogenic PAH, but since its overall contribution to TPAH was ~ 0.1%, this deviation was considered minor and well within the natural range expected for heterogeneous sediments.

As a result of these considerations, no final qualifications were made to the field duplicates, and so all results were forwarded without qualifiers, although the results do indicate that some sediment samples have a higher degree of variability due to differences in grain size distribution and TOC content.

3.1.4 Method Blanks

Method blanks were prepared and run alongside all sediment samples. All blanks were evaluated down to the MDL with three constituents being found above the MDL and none recorded above the MRL.

If the method blank result is below the MRL, all sample results estimated between the MDL and MRL and that are less than five times the blank hit are reported as non-detect at the MRL level and flagged with “UJ.” If the method blank is below the MRL and the sample results are above the MRL but below five times the blank hit, results are flagged with a “J+” to indicate that they have a potential high bias. Dry weight results were compared to the method blank hit to allow for easy comparison with the laboratory data and therefore may contain a slight bias due to the dry weight conversion.

There were a total of 3 analytes (iron, silver, and phenanthrene) with method blank hits in the sediment results. Iron and phenanthrene results did not require any additional qualification of the data as they were < 2xMDL (metals) and < 3xMDL (hydrocarbons) with all sample values being greater than ten times the blank concentration. Two results for silver were qualified with a J+ indicating the sample has the potential to be biased high since the analysis result was above the MRL and less than five times the value seen in the blank. A summary of the method blank results are summarized in Table E-4 below.

Table E-4. Sediment Method Blank QC Review Detail

Sediment Analyte	Report No.	Reported Blank Result	MDL	Qualifier	No. of Qualified Samples
Iron	18-3808-TM	0.258	0.246		0
Silver	18-3808-TM	0.0171	0.00986	J+	2
Phenanthrene	K1508007	0.072 J	0.208		0

3.1.5 Laboratory Duplicates

Laboratory duplicates provide a manner of assessing laboratory precision. Because the field-collected samples are split in the laboratory and then analyzed, it is measure of both laboratory precision and the sample homogeneity. When the RPD between the sample and duplicate value is above the QC objective of <30%, it is flagged for further review. Small values below the MRL can lead to large RPDs. If the differences between these values are small (less than the MRL), they are not of concern. All other cases with elevated RPDs are subjected to extended review.

One aliphatic hydrocarbon (i-C_{18}) laboratory duplicate associated with the field samples had an RPD above the laboratory’s QC limit of 30%, thereby requiring review. This resulted from trace levels seen in the duplicate and an ND in the sample, leading to a high RPD. Since no other AHC analytes exceeded QC criteria and since the overall concentration of the analyte was < 0.8% of total AHCs, no further action was deemed necessary. For metals, selenium also exceeded the QC limit of 30% with an RPD of 73; however, since both the sample and laboratory duplicate were < 3xMDL, no further action was warranted. All other laboratory duplicate analyses met QC criteria.

3.1.6 Laboratory Control Samples

Laboratory Control Spikes, including blank spikes and their duplicates (LCS/LCSD), are solutions of known compounds and selected concentrations in clean laboratory water. Precision and accuracy are evaluated in a similar fashion as MS/MSDs with the exception that there is no source sample to subtract and no matrix interference issues.

All sediment LCS/LCSD samples for this program were recovered within acceptance range criteria with the exception of 1-Methylphenanthrene which had a high recovery in a blank spike. Note, this analyte was included in the hydrocarbon analyses but was not on the program’s target analyte list as a pollutant of interest; therefore, no further action was taken.

3.1.7 Matrix Spikes

Matrix Spike and Matrix Spike Duplicate (MS/MSD) percent recoveries were evaluated to determine acceptable accuracy based on method-specific percent recoveries. Precision was evaluated by calculating the RPD of the MS/MSD recovery results. When spikes are reported below the accepted range, they indicate a low bias to the results and when reported above the accepted range, they indicate a high bias.

QA/QC guidelines indicate that no action needs to be taken on MS/MSD data alone. The data reviewer may use the MS/MSD results in conjunction with other QC criteria when determining the need for further qualification. Cases where the spike concentration is less than the source concentration are ignored as the recoveries cannot be calculated.

For this program, nearly all the MS/MSD results were acceptable. Six PAHs had recoveries that were outside of QC limits; however, in all cases, the spike concentrations were found to be low (< 50%) compared to native sediment concentrations. Since other QC sample analyses (blank, duplicate, LCS, and SRM data) were acceptable, no further qualification was necessary.

3.1.8 Standard Reference Material

Standard reference material (SRM) that was analyzed for the program included certified sediment SRMs and Gulf of Mexico reference crude oil. Sediment metals analyses utilized National Research Council of Canada's MESS-3 sediment SRM from the Beaufort Sea. Hydrocarbon analyses for PAHs utilized National Institute of Standards and Technology's (NIST) SRM 1944, a sediment SRM from the New Jersey/New York Waterway. In addition, a Gulf of Mexico crude oil SRM 2779 was run as a reference for both PAH and AHC analyses.

With the exception of i-C_{16} reference oil SRM, all sediment SRMs for both metals and hydrocarbons that were analyzed for this project were recovered within their certified acceptance ranges. The isoprenoid i-C_{16} recovered low with an RPD of 51. The laboratory indicated that this excursion did not affect the overall data quality as there were no other excursions for this analyte.

3.1.9 Surrogates

Surrogate analytes behave similarly to the target analytes. Surrogate spikes are introduced into organic samples (AHC and PAH) at specific concentrations and are used to provide a measure of instrument and method performance and to indicate sample-specific matrix effects. Based upon logic similar to that offered for matrix spikes, no action is required based on surrogate recoveries alone, but surrogate recoveries should be considered in context with other QC records.

All surrogates were recovered well within QC limits.

3.2 HYDROGRAPHIC AND WATER QUALITY CONTROL RECORDS

Quality control results for the background water samples are discussed in subsections that follow.

3.2.1 Completeness and Holding Times

All water samples and field duplicates for this project were collected as required. All samples were received intact and within proper temperature range. All samples were analyzed within EPA holding times. In addition, no data were rejected during the data validation process. One hundred percent completeness was achieved for water analyses for this program. For hydrographic data, 15 near surface pH values were rejected due to anomalously high readings; however, the overall usability of the hydrographic data was not affected.

3.2.2 Reporting Limits

Target MRLs were achieved for all water analyses.

3.2.3 Field Duplicates

No specific RPD limit was set in the SAP for field duplication. This measure is used more as an indication of field variability that may then be compared to laboratory variability that is determined by duplicate laboratory analyses. Four field duplicates were performed for TSS on the forty water samples with RPDs ranging from 9.5 to 30, which is within the typical acceptance range of ≤ 30%. For turbidity, 13 field duplicate analyses were performed which exceeded the 10% number required. The duplicate RPDs for turbidity ranged from 0.0 to 23.2%, which is within the typical acceptance range of ≤ 30%.

3.2.4 Method Blanks

Method blanks were prepared and run alongside all TSS samples. All eight TSS blanks were evaluated down to the MDL, and no blank concentration was reported above the MDL. Laboratory blanks for turbidity consisted of deionized water placed in a sample cuvette; all readings were 0.05 NTU which is considered the MDL as that is the minimum reading found for an air sample.

3.2.5 Laboratory Duplicates

A total of 15 laboratory duplicate samples were run for the turbidity analyses, and all were reported within the 20% acceptance range for RPDs with values ranging from 0.0 to 6.4%. Due to sample size, laboratory duplicates were not performed for TSS analysis.

3.2.6 Laboratory Control Samples

Three LCS and one LCS duplicate were run for TSS; all were reported to be within QC acceptance limits of 85-115%, and the LCS duplicate had an RPD of <1. Turbidity analyses included daily calibrations and periodic checks against three certified formazin standards. Following each calibration, turbidity was further checked against a secondary Gelex standard. All calibrations and field checks were found to be well within acceptance criteria.

3.2.7 Hydrographic Variability Check

Field variability checks of the SeaBird CTD electronic profiler were performed in the field by performing a triplicate profile of temperature, salinity, OBS, pH, and DO at one location. In addition, each profile of the CTD provides duplicate information (down cast versus up cast) for comparison. Results of these variability checks showed that probe variability was low with the coefficient of variation all less than 3% for temperature, salinity, pH, and DO, with the majority of differences being less than 1%. The highest variability was seen in OBS turbidity measurements, where the coefficient of variation ranged from 2.5 to 9.3%, probably the result of the very low turbidities seen overall and the natural variability of the nearshore waters in terms of suspended solids in the water column.

Due to its high precision and accuracy, the SeaBird Electronics CTD requires factory calibration for most sensors. However, it is recommended by SeaBird that the pH sensor be calibrated immediately prior to any field effort and on an ongoing basis as pH sensors tend to have a high degree of drift. Calibration of the pH sensor was performed by KLI immediately prior to the field effort and checked both in the field and again after the survey. Following the completion of the survey, the CTD was sent to SeaBird's facility in Seattle, WA for post-survey calibration to further verify other sensor measurements. Post-survey calibrations indicated a <0.005% difference in conductivity (salinity), temperature, and pressure (depth) measurements; therefore, no post-survey calibration adjustments were made. The post-survey calibration of DO indicated that the sensor was reading approximately 2% high; therefore, the post-survey calibration coefficients were utilized in the processing of data that are presented in this report. Calibration checks were also made in the field against a secondary YSI multi-probe system and calibration standards (pH and conductivity). All final measurements were found to be within acceptance criteria, and no qualification of the data was necessary.

3.3 BENTHIC INFAUNA LABORATORY

All biological samples were collected as required, and all were received intact under proper chain of custody at the biological facilities. QC for benthic infauna included the resorting of a minimum of 30% by volume of each sample sorted by one individual; these samples were then resorted (i.e., again placed under a dissecting microscope to check for remaining organisms) by a different individual. Any samples showing more than 5% of the total number of organisms "missed" fail this sorting check (i.e., if less than 95% of the total number of organisms were removed from the sample during the first sort); these samples were then 100% resorted and again checked for missed organisms against the cumulative total using the 5% criteria. Six samples required 100% resort; no other anomalies were reported.

4.0 QA/QC CONCLUSIONS

A careful review of the program data confirmed that the laboratory and field analyses met most QA/QC requirements. A total of 2 sediment chemistry values were further qualified as part of the QA/QC process; no further qualifications were needed for the water sample analyses. This equated to 0.16% of the analytical data being re-qualified. All qualifications were due to low level method blank contamination in silver and the fact that silver concentrations in the sediment samples were low. Despite these minor QC issues, overall evaluation of the analytical QA/QC data indicates that the chemical data are within established performance criteria. No analytical data were rejected or considered unusable. For hydrographic data, 15 pH values were rejected that equated to 2% of all pH measurements; this did not affect the overall usability of the hydrographic data. One hundred percent of the data described in this report can be used for characterization of sediments and waters for the proposed project area.

5.0 REFERENCES

EPA (U.S. Environmental Protection Agency). 2017a. National Functional Guidelines for Inorganic Superfund Methods Data Review. EPA 540-R-2017-001. January 2017.

EPA. 2017b. National Functional Guidelines for Organic Superfund Methods Data Review. EPA 540-R-2017-002. January 201