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2017 Site Recharacterization Phase II

Operable Unit 1

Naval Base Kitsap
Keyport, Washington

Department of the Navy
Naval Facilities Engineering Command Northwest
1101 Tautog Circle
Silverdale, WA 98315

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FINAL
2017 SITE RECHARACTERIZATION, PHASE II
OPERABLE UNIT 1
NAVAL BASE KITSAP, KEYPORT, WASHINGTON

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ABBREVIATIONS AND ACRONYMS

%D	percent difference
%R	percent recovery
bgs	below ground surface
AET	apparent effects threshold
BOD	Biological Oxygen Demand
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CMT	continuous multi-channel tubing
COC	contaminant of concern
COD	chemical oxygen demand
CSL	contaminant screening level
CSM	conceptual site model
cVOC	chlorinated volatile organic compound
DCA	dichloroethane
DCE	dichloroethene
DHC	Dehalococcoides
DL	detection limit
DNA	Deoxyribonucleic Acid
DNAPL	dense, nonaqueous phase liquid
DO	Dissolved Oxygen
DoD	Department of Defense
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FCR	Field Change Request
FS	Feasibility Study
Ft	feet
LCS	laboratory control standard
LOD	limit of detection
LOQ	limit of quantitation (equivalent to PQL)
LTM	long-term monitoring
MIP	Membrane Interface Probe
MNA	monitored natural attenuation
MTCA	State of Washington Model Toxics Control Act
NAPL	nonaqueous phase liquid
NAVD	North American Vertical Datum
NBK	Naval Base Kitsap
ORP	oxidation reduction potential
OU	operable unit

PAL	project action limit
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PED	polyethylene device
PID	Photoionization Detector
PFAS	perfluoroalkyl substances
PQL	practical quantitation limit (equivalent to LOQ)
PRC	performance reference compound
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
RAO	remedial action objective
RG	remediation goal
RI	remedial investigation
ROD	Record of Decision
RPD	relative percent difference
RPM	Remedial Project Manager
SAP	sampling and analysis plan
SCO	sediment cleanup objective
SCUM	Sediment Cleanup User's Manual
SMS	Sediment Management Standards
SOP	standard operating procedure
SVOC	semivolatile organic compound
TCA	trichloroethane
TCE	trichloroethene
TEQ	toxicity equivalence
TOC	total organic carbon
TPH	total petroleum hydrocarbon
USCS	unified soil classification system
USGS	U.S. Geological Survey
VC	vinyl chloride
VOC	volatile organic compound
WAC	Washington Administrative Code
WQS	Water Quality Standards
XSD	halogen specific detector

1.0 INTRODUCTION

This report summarizes the background, scope, field activities, and results of field investigation activities conducted in July through November 2017 at the Area 1 former landfill comprising Operable Unit (OU) 1 of Naval Base Kitsap (NBK) Keyport in Keyport, Washington (Figures 1-1 and 1-2). This report documents the 2017 elements of Phase II of the OU 1 site recharacterization program. The overall objective of the site recharacterization was to collect the data necessary to evaluate remedial alternatives for hotspot treatment to reduce the restoration timeframe at the site. Areas of the site where work was conducted in 2017 are shown on Figure 1-3, and historical sampling locations are shown on Figure 1-4.

The activities documented in this report were conducted in accordance with the project-specific OU 1 sampling and analysis plan (SAP) (U.S. Navy, 2017a). These activities were conducted under Navy Contract No. N39430-16-D-1802, Delivery Order 0010 for Naval Facilities Engineering Command Northwest. As the prime contractor, Battelle performed the field data collection and data usability evaluation/interpretation described herein, and prepared this data report. Subcontractors to Battelle performed utility locating, land surveying, direct-push drilling, auger drilling, well installation, laboratory analyses, and data validation.

Responses to regulatory agency and stakeholder comments received on the draft version of this report will be included in Appendix A once received.

1.1 SITE DESCRIPTION

NBK Keyport occupies 340 acres (including tidelands) adjacent to the town of Keyport in Kitsap County, Washington, on a small peninsula in the central portion of Puget Sound. The Keyport property was acquired by the Navy in 1913, with property acquisition continuing through World War II. The property was first used as a quiet-water range for torpedo testing. The first range facility was located in Port Orchard Inlet southeast of the site (U.S. Navy, 2015b).

During the early 1960s, Keyport’s role was expanded to include manufacturing and fabrication, such as welding, metal plating, carpentry, and sheet metal work. Further expansion in 1966 consisted of a new torpedo shop, and, in 1978, the functions were broadened to include various undersea warfare weapons and systems engineering and development activities. Operations currently include engineering, fabrication, assembly, and testing of underwater weapons systems (U.S. Navy, 2015b).

Marine or brackish water bodies on and near the site consist of Liberty Bay to the east and north, Dogfish Bay to the northwest, tide flats and a marsh to the west, and a shallow lagoon to the southeast (Figure 1-1). Freshwater bodies include two creeks draining into Marsh Pond and two creeks that discharge into the shallow lagoon. The topography of the site rises gently from the shoreline to an average of 25 to 30 feet (ft) above mean sea level and then rises steeply to approximately 130 ft above mean sea level at the southeast corner of the site (U.S. Navy, 2015b).

Area 1, the former base landfill, comprises approximately 9 acres in the western part of the base next to a wetland area and the tide flats that flow into Dogfish Bay (Figure 1-2). Most of the landfill area was formerly part of the wetland that now borders the landfill to the west and south. The former shoreline is shown on Figure 1-2. This wetland area drains northward into the tide flats of Dogfish Bay through a culvert under Keys Road. A tide gate has been installed at this culvert to control tidal inundation of the wetlands and landfill. The tide flats are connected to Dogfish Bay by a narrow channel through structural fill material that forms the foundation of the Highway 308 causeway and bridge. The landfill is unlined at the bottom, and the top is covered with areas of grass, trees, asphalt, and concrete. The remaining wetlands adjacent to the landfill include most of the area bounding the landfill to the west, northwest, southwest, and south (Figure 1-2) (U.S. Navy, 2015b). A small pond is located in the central part of the wetlands, west of the landfill. The pond is drained by a small creek that flows northward to the tide flats. The pond is fed by the remainder of the wetlands located south and southeast of the pond. The entire wetlands area is referred to as “the marsh,” including the pond, the creek that drains the pond, and the wetland areas upstream and downstream of the pond.

Surface water discharges to Marsh Pond via two small freshwater creeks that enter the pond from the south end (U.S. Navy, U.S. Environmental Protection Agency [EPA], and Washington State Department of Ecology [Ecology], 1998). The marsh also receives input from stormwater drainage systems at two outfalls and shallow groundwater flowing toward the marsh from all sides in the shallow aquifer. Marsh Creek drains into the tide flats through the tide gate under Keys Road. This tide gate controls tidal flow into the marsh, regulating the marsh water level.

The surface water bodies near the former landfill constitute a complex, tidally influenced hydrologic system. Tidal fluctuations in Dogfish Bay influence the water levels in the tide flats northwest of the landfill. Although the tide gate controls these effects on Marsh Creek and Marsh Pond. The typical range in tide level of the tide flats at a measuring point close to the southeast side of the Highway 308 bridge is about 10 ft from higher high to lower low tide (U.S. Navy, U.S. EPA, and Ecology, 1998).

Near-surface geology in the Keyport area generally consists of both glacial and non-glacial deposits. Updates to the historical interpretations of geology and hydrogeology are part of the data interpretation presented in this report and are covered in more detail in Section 4. The remainder of this section provides a brief overview.

Most of NBK Keyport and all of the former landfill is underlain by a thick nonglacial silt and clay informally known as the Clover Park Unit. This unit is commonly about 100 ft thick and acts as an aquitard separating the shallow groundwater (including aquifers referred to in the Record of Decision [ROD] as the “upper” and “intermediate” aquifers) from deeper, regional water-bearing units (U.S. Navy, U.S. EPA, and Ecology, 1998). The unconfined shallow water-bearing unit, interpreted in the ROD to include two distinct aquifers, is the primary focus of this report and is present throughout the landfill area. The water table in this shallow water-bearing zone intersects the landfill waste material beneath much of the landfill. That is, roughly 5 ft of landfill material lies above the shallow groundwater surface in the unsaturated zone, and up to about 5 ft lies beneath the water table in the saturated zone (U.S. Navy, U.S. EPA, and Ecology, 1998).

Shallow groundwater flow has consistently been interpreted to flow through the landfill in a westerly direction and discharge into the marsh. Deeper groundwater in this same water-bearing zone (historically considered the “intermediate aquifer”) has been interpreted to flow northwesterly. The depth to first groundwater is typically 4 to 5 ft below the ground surface of the landfill.

Groundwater/surface water tidal interaction and groundwater salinity studies were performed historically, and the results included in the 1997 summary data assessment report (U.S. Navy, 1997b). Additional assessment of tidal influence was performed during phytoremediation monitoring. The 1997 focused feasibility study concluded that groundwater levels at OU 1 are influenced by seasonal and tidal changes, but not enough to change the general groundwater flow patterns. Tidal influence occurs in wells close to the shore, but rapidly attenuates with distance from the tide flats or Dogfish Bay, with a maximum tidal fluctuation in groundwater measured prior to 1997 of 2.5 feet (U.S. Navy, 1997a).

1.2 SITE BACKGROUND

1.2.1 Historical Operations

The landfill was the primary disposal area for domestic and industrial wastes generated by the base from the 1930s until 1973, when the landfill was closed. A burn pile for trash and demolition debris was located at the north end of the landfill from the 1930s to 1960s, and included the burning of polychlorinated biphenyl (PCB) oils. Unburned or partially burned materials from this pile were buried in the landfill or pushed into the marsh. A trash incinerator was operated at the north end of the landfill from the 1930s to 1960s, and incinerator ash was disposed of in the landfill. Burning continued at the landfill until the early 1970s (U.S. Navy, U.S. EPA, and Ecology, 1998).

From the 1930s until the 1970s, waste paint, thinners, and strippers from the paint and stripper shop were poured directly into pits in the southwest area of the landfill (U.S. Navy, 1984). The Navy interviewed over 50 former and current employees, 8 of whom had been directly involved in landfill operations, to learn whether intact drums of liquid wastes were placed in the landfill. One person remembered that 12 or 14 pallets of 5-gallon cans of paint and some 55-gallon drums were buried whole. The remaining people who were interviewed believed that whole drums were not buried intact. Some said that drums were emptied into the landfill or crushed before burial. Overall, the interviews indicated that disposal of liquids in drums was not a common practice, and substantial amounts of drummed liquid wastes are unlikely to be in the landfill (U.S. Navy, U.S. EPA, and Ecology, 1998).

1.2.2 Remedial Investigation

During various site investigation and assessment studies between 1984 and 1988, Area 1 was determined to have possible environmental contamination. In 1989, NBK Keyport was officially listed on the National Priorities List, becoming a Superfund site under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Area 1 was included in a remedial investigation (RI) and feasibility study (FS) that were conducted at NBK Keyport between 1988 and 1993 (U.S. Navy, 1993a, 1993b), and the RI included human health and ecological risk assessments (U.S. Navy, 1993c, 1993d). Based on the risk assessments, two classes of chemicals, chlorinated volatile organic compounds (cVOCs) and PCBs, were identified as contaminants of concern (COCs) at the site; cVOCs are COCs for soil, sediment, tissue, groundwater, and surface water; and PCBs are COCs for sediment and seep water at Area 1.

The RI also identified indoor air risks to workers from vapor intrusion into modular units that were located on the landfill at the time. Shortly after the baseline risk assessment, the Navy removed the modular office buildings from the landfill surface to eliminate these potential risks. In addition, Navy personnel were no longer assigned to work full time in the buildings that remained in the southern portion of the landfill. The vapor intrusion studies did not indicate vapor intrusion as a pathway of concern outside the landfill boundary east of Bradley Road based on the soil gas action levels that were established at the time.

1.2.3 Remedial Action

After the RI was completed, the FS evaluated seven remedial alternatives for Area 1. The Navy, Ecology, and EPA selected a preferred remedial alternative for Area 1, which was described in the 1994 proposed plan (U.S. Navy, 1994). However, because public comment regarding the preferred remedial alternative was not favorable, the proposed plan was withdrawn, and Area 1 was separated from the remaining areas assessed during the RI to become OU 1.

To address the public's concerns, the Navy, Ecology, and EPA conducted further site characterization to collect data to supplement the RI. Beginning in 1995 and ending in September 1996, five quarterly rounds of sampling were conducted. The additional data were used to evaluate the potential risks from three key COC pathways at OU 1 (U.S. Navy, EPA, and Ecology, 1998):

- Drinking water pathway (human health risk)
- Seafood ingestion pathway (human health risk)
- Ecological pathway (risk to aquatic organisms)

The environmental media identified as those that could potentially result in future receptor exposures to contaminants were groundwater, surface water, and sediment downgradient of OU 1. The new data obtained from the site characterizations were discussed and evaluated in a summary data assessment report (U.S. Navy, 1997b), which supplemented the RI. Several additional alternatives were then evaluated in a supplemental focused feasibility study (U.S. Navy, 1997a), from which a new preferred remedial alternative was selected and eventually accepted, based on public comment. The ROD for OU 1 was executed in September 1998 (U.S. Navy, EPA, and Ecology, 1998). COCs and remediation goals (RGs) established in the ROD are listed in Table 1-1.

To achieve the remedial action objectives (RAOs), the remedial action components specified in the OU 1 ROD included the following:

- Treat volatile organic compound (VOC) hotspots in the landfill using phytoremediation by poplar trees in concert with natural attenuation.
- Remove PCB-contaminated sediments from around the seep area, which have the highest documented concentrations of PCBs.
- Upgrade the tide gate to protect the landfill from flooding and erosion during extreme tide events.
- Upgrade and maintain the landfill cover.
- Conduct long-term monitoring (LTM), including phytoremediation monitoring, intrinsic biodegradation monitoring, and risk and compliance monitoring.
- Take contingent actions for off-base domestic wells, if necessary.
- Implement institutional controls.

The OU 1 ROD also included an RAO to prevent human exposure to vapors from the landfill. As part of the selected remedy, all of the remaining occupied buildings were removed from the landfill, and institutional controls were established to prohibit construction of occupied structures on the landfill that could result in vapor exposure.

The Navy performs routine LTM of groundwater and surface water on an annual basis at OU 1. The specific LTM requirements have been defined and updated in sampling plans developed by the Navy and approved by Ecology, EPA, and the Suquamish Tribe.

Up through 2015 the U.S. Geological Survey (USGS) performed annual monitoring of natural biodegradation conditions beneath and near the former landfill. The results of these investigations indicated that natural reductive biodegradation processes were operating very effectively at the site.

The LTM results have indicated no need for the implementation of contingent actions for off-base domestic wells. All of the components of the selected remedy have been implemented, the most recent being the upgrade of the landfill cover completed in 2003. The upgrade included regrading of the landfill material and modification and construction of a stormwater conveyance system that includes catch basins and an oil/water separator that discharges to the marsh on the western edge of the landfill cover. The phytoremediation component of the remedy was implemented in 1999 and consisted of planting two plantations of hybrid poplar trees (referred to as the “North Plantation” and the “South Plantation”) (Figure 1-2). The area between the north and South Plantations is referred to as the “Central Landfill.”

In spite of the high degree of biodegradation identified by the USGS and the reductions in cVOC mass over time implied by the LTM results, the concentrations of cVOCs beneath the South Plantation remain very high (trichloroethene [TCE] concentrations up to 33,800 micrograms per liter [µg/L] and a cis-1,2-dichloroethene [DCE] concentration of 55,700 µg/L in 2014), and cVOC concentrations in surface water adjacent to the South Plantation consistently exceed the surface water RGs.

1.2.4 Supplementary Investigation

Based on concerns that the phytoremediation component of the selected remedy was not performing as expected in the South Plantation, the third five-year review (U.S. Navy, 2010) recommended that the Navy perform an evaluation of natural attenuation as a stand-alone remedy, as called for in the ROD. The Navy performed this evaluation in 2011 and 2012 (U.S. Navy, 2012) and concluded that the RG for discharge to surface water adjacent to the South Plantation would not be met within a reasonable restoration timeframe. The evaluation recommended that additional investigation of the South Plantation be performed to identify cVOC hotspots. In addition, trend analysis of the LTM results from well MW1-17, screened in the shallow groundwater and located in the Central Landfill, indicated the potential presence of a source area upgradient of well MW1-17, between the two plantations. Although contaminant concentrations in MW1-17 remain less than the RGs, LTM data from 2009 to the present indicate increasing trends of three cVOCs that are TCE degradation products in this well.

The project team (consisting of the Navy, regulators, and stakeholders) agreed on a two-phased approach for a site recharacterization program designed to collect the data necessary to evaluate remedial alternatives for hotspot treatment to reduce the restoration timeframe. Phase I, which consisted of the collection of screening-level data, was completed in 2014 (U.S. Navy, 2015a). The Phase I investigation included the collection of tree core samples for analysis of cVOCs to identify potential contaminant hotspots in groundwater in the vicinity of the South Plantation and west or downgradient of the Central Landfill. Given the location (in the Central Landfill between the two plantations and at the edge of the paved portion of the landfill), it was not possible to collect tree core samples upgradient of MW1-17. Geophysical surveys were also conducted in the south plantation and a portion of the Central Landfill to identify the presence or absence of subsurface anomalies that could represent potential contaminant sources and pose health risks for workers during future intrusive investigations.

1.2.5 Phase I Results at the South Plantation

An evaluation of the tree core and geophysical data resulted in a refined understanding of COC distribution, which was then used to guide sampling for Phase II. The highest concentrations of cVOCs, especially TCE, appeared to be located south of former Building 884 and along the southern edge of the landfill (Figure 1-5). In addition, the reported detections of 1,1,1-trichloroethane (TCA) in a tree adjacent to a stormwater outfall indicated a possible association with transport through damaged stormwater piping. Phase I concluded that identified geophysical anomalies were not collocated with high COC concentrations in tree cores or groundwater. Therefore, the contaminant source was not expected to be a buried primary source (such as a drum-containing product). Instead, the evidence suggested the presence of a residual source (contaminants adsorbed to soil).

1.2.6 Phase I Results in the Central Landfill

The area upgradient of well MW1-17 was included in the geophysical survey performed under Phase I to guide the Phase II investigation of this area. Within the Central Landfill area upgradient of well MW1-17, there was a significant variation in geophysical response. The northern portion of the area appeared to have more anomalies than the southern portion. The data suggested that areas of voids and metal debris exist within the Central Landfill. The areas of geophysical anomalies were targeted for investigation under Phase II as potential source areas.

Tree core samples were collected from four native trees located downgradient of well MW1-17. Tetrachloroethene (PCE) and TCE were detected in all four trees. However, daughter products of PCE and TCE were not reported in any of the tree core samples. In contrast, PCE and TCE were not reported in groundwater samples collected from well MW1-17 in 2014 while daughter products (1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride [VC]) were reported in 2014 groundwater samples at concentrations greater than the RGs for all constituents except trans-1,2-DCE. Since 2006, a general increase of daughter products has been reported in samples from MW1-17.

1.2.7 Recommendations of Fourth Five-Year Review

In the same timeframe that the Phase I investigation was finalized, the fourth five-year review was completed (U.S. Navy, 2015b). This review included two sampling recommendations that were incorporated into the Phase II investigation.

Based on the increasing trend of PCB concentrations in surface water at seep location SP1-1, the five-year review evaluated the overall and last 5 years of sampling trends (2004 to 2009) of total PCB concentrations at sediment sampling locations with historical detections above the PCB RG, including MA-09, MA-14, and TF-21 (located between the North Plantation and Tide Gate on Figure 1-2). Overall, the PCB trends at these three sediment sampling locations have decreased from the initial sampling event in 1996 (MA-09 and TF-21) and in 2000 (MA-14). However, over the last 5 years (between 2004 and 2009), total PCB concentrations at MA-09 decreased (from 2.68 milligrams per kilogram of organic carbon [mg/kg OC] to 1.36 mg/kg OC) while concentrations increased at MA-14 (from 0.6 to 3.45 mg/kg OC) and at TF-21 (from 1.16 to 6.2 mg/kg OC). Although concentrations remained below the RG, the five-year review recommended that PCB analysis of sediment be conducted at and around monitoring locations MA-09, MA-14, and TF-21 to establish current baseline conditions for future trend evaluations. In addition, collection of sediment samples at and around seep SP1-1 for PCB analysis was recommended to assess whether there is a correlation between the concentrations of PCBs in seep water and sediment and to evaluate if recontamination, as specified in the Sediment Management Standards (SMS) regulation (Ecology, 2013), is occurring.

This recommendation for sediment sampling and analysis was discussed and refined during the January 20, 2016 workgroup meeting. The workgroup included members from the Navy, EPA, Ecology and the Suquamish tribe. The workgroup agreed that the data from the planned sediment sampling should be adequate to support potential review of the ROD risk assumptions in light of the 2013 promulgation of Ecology's revised SMS. This is captured in recommendation number 6 from the fourth five-year review, "collect additional sediment samples at and in the vicinity of seep SP1-1 during the Phase II investigation and use the data to assess whether expanded, ongoing PCB monitoring should be initiated, and risk assumptions reviewed."

The five-year review also noted that the vapor intrusion evaluation performed east of Bradley Road (this road is shown on Figure 1-2) during the RI did not meet current Ecology action levels. Although COCs were not detected in groundwater at the two wells east of Bradley Road, historically high soil gas concentrations were found at location GM1-2 near Building 893 (this building is shown on Figure 1-2). An evaluation of the vapor intrusion pathway was recommended based on limited current VOC data for groundwater and soil gas east of Bradley Road, VOC detections in groundwater at the adjacent landfill, and the lack of definition of the eastern extent of the TCE plume.

1.2.8 2016 Phase II Investigation Results

Phase II of the additional investigation was designed to follow-up on the findings of Phase I, and to address the recommendations of the fourth five-year review report. As part of scoping meetings, the Navy and regulator/stakeholder group (referred to hereafter as the “project team.”) developed the following investigation objectives:

1. Refine the understanding of contamination in groundwater in the shallow aquifer beneath the central portion of the landfill and the South Plantation and in sediment and surface water present in watercourses immediately adjacent to the South Plantation and upstream of station MA-12.

2. Refine the understanding of transport pathways for cVOC contamination from the South Plantation to the adjacent wetlands.

3. Assess the presence or absence of a source or sources of cVOC contamination in groundwater in the shallow aquifer beneath the central portion of the landfill, upgradient of monitoring well MW1-17.

4. If one or more source or sources of cVOCs are found upgradient of well MW1-17, attempt to assess the lateral and vertical extent of the source(s).

5. Assess the presence or absence of the middle aquitard in the area of MW1-17.

6. Collect data necessary to allow screening of remedial technologies that could potentially be incorporated into hotspot cleanup alternatives for remedy optimization.

7. Identify any data gaps based on the Phase II investigation data, including the location of additional monitoring wells, if warranted.

8. Establish current concentrations of PCBs in sediment at seep SP1-1 and at downstream sampling stations.
9. Investigate the vapor intrusion pathway by collecting soil gas samples along the east side of Bradley Road.

The first part of the Phase II investigation was implemented in 2016, and consisted of a membrane interface probe (MIP) investigation and a soil vapor survey along Bradley Road (U.S. Navy, 2017b). During the field investigation, 62 MIP borings were completed in the South Plantation, and 7 MIP borings were completed in the Central Landfill. Throughout the investigation, the boring locations were refined in the field based on MIP results obtained.

The MIP results were used to refine the conceptual site model (CSM). A distinguishable aquitard between the upper aquifer and intermediate aquifer, as described in the ROD, was not evident based on the MIP responses in the South Plantation.

The MIP responses indicated that contamination extends to a minimum of 30 ft below ground surface (bgs) in the eastern portion of the South Plantation, which is deeper than the existing well network. The most significant source observed during the MIP investigation was located on the east side of the landfill adjacent to Bradley Road, south of the former Hazardous Waste Building (Building 884). The distribution pattern exhibits characteristics consistent with dense, nonaqueous phase liquid (DNAPL) or residual DNAPL.

In the Central Landfill, the MIP responses were interpreted at the time to show a distinction between the upper and intermediate aquifers described in the ROD. The MIP responses indicated that contamination extends to approximately 32 ft bgs in the western portion of the Central Landfill, which is deeper than the existing well network.

The following recommendations were made based on the results of the MIP investigation:

- Collect quantitative soil and groundwater data to verify the halogen-specific detector (XSD) results of the MIP investigation and to estimate the extent of hotspots in the South Plantation and the Central Landfill.
- Visually log soils and collect physical soil samples for geotechnical analysis to verify the results of the MIP investigation and to refine the hydrogeologic units at OU 1.
- Install a network of deeper monitoring wells and collect quantitative groundwater data to further assess the extent of groundwater contamination and confirm the groundwater flow patterns within the intermediate aquifer beneath the South Plantation and the Central Landfill.

Soil vapor sampling was completed at 9 of the planned 13 locations along Bradley Road. Because detected concentrations of TCE and VC in soil vapor exceeded the screening criteria at multiple sampling locations, further investigation of potential vapor intrusion at buildings east of Bradley Road was recommended.

1.3 2017 INVESTIGATION APPROACH

The elements of the Phase II additional investigation that were not completed in 2016 were completed in July-November 2017 and are discussed in this report. This section describes the approach used for the 2017 investigation, and the work areas are shown on Figure 1-3. In describing the work performed and the results, this report refers to the project action limits (PALs) established in the SAP. The PALs were established based on the ROD RGs for COCs and based on current promulgated standards for other chemicals of interest.

1.3.1 Direct-Push Drilling and Sampling Approach

Beginning in July 2017, direct-push drilling was used to collect grab soil and groundwater samples from the South Plantation and Central Landfill for comparison against the 2016 MIP results. Continuous soil cores were retrieved at each direct-push drilling location, the soil lithology was logged, and the cores were screened using a hand-held photoionization detector (PID) in an attempt to identify the areas of highest cVOC concentrations along the length of each core. Where nearby MIP data were available, the hand-held PID results were compared to the MIP results. In general, the hand-held PID and MIP were found to correlate well, with the PID indicating high cVOC concentrations at the same locations and depths as were found using the MIP. Based on these findings, grab soil and groundwater samples were preferentially collected at the locations and depths exhibiting the highest readings on the hand-held PID, to allow for correlation of measured cVOC concentrations in grab soil and groundwater to the MIP results. Samples were also collected at locations and depths expected to be representative of low cVOC concentrations to enable assessment of the lateral and vertical extent of cVOCs exceeding the PALs. Direct-push boring locations were also selected to provide lithologic data representative of the entire Central Landfill and South Plantation, for the purpose of updating the geology and hydrogeology elements of the CSM. The placement of the direct-push borings was selected through consultation between the field team and the Navy Remedial Project Manager (RPM), with the results from each day of work used to plan the locations for subsequent investigation.

Where unusual contaminants (such as oily substances in soil samples) were observed during direct-push drilling, additional laboratory analyses, beyond those planned in the SAP, were performed (see discussion in Section 2).

1.3.2 Auger Drilling and Well Installation and Sampling Approach

Following laboratory analysis of the grab soil and groundwater samples collected during the direct-push drilling program, draft isoconcentration contour maps were prepared for the maximum concentrations of three key cVOCs, regardless of depth. These maps, along with exhibits comparing the analytical results to MIP data, lithologic cross sections, and an export of the direct-push laboratory analytical data set, were used during project team meetings on August 30, 2017 and September 28, 2017 to discuss the ramifications and initial interpretations of the data and agree on the locations and screened intervals for permanent groundwater monitoring wells. Auger drilling and monitoring well installation began following these meetings on October 2, 2017.

Soil samples were collected during auger drilling within the screened intervals of each well, to provide cVOC concentrations in soil at the time of well installation. Additionally, relatively undisturbed soil samples were collected from hotspot locations and analyzed for physical characteristics data including grain size, dry bulk density, hydraulic conductivity, effective porosity, and total organic carbon (TOC). Once the new wells had been developed to ensure connectivity with the aquifer and had been allowed to rest, groundwater samples were collected from October 23, 2017 to November 15, 2017.

1.3.3 Surface Water, Porewater, and Stormwater Sampling Approach

Sampling of surface water, porewater, and stormwater was performed following sufficient seasonal precipitation to ensure typical flow conditions in the marsh area. Porewater samples were collected to assess the lateral extent of cVOCs in groundwater prior to daylighting to surface water at locations not previously investigated by the USGS. Surface water samples were collected adjacent to the South Plantation to assess cVOC concentrations in surface water and provide additional information regarding the groundwater-to-surface water transport pathway.

Stormwater samples were collected from an outfall and manhole structure at the South Plantation to assess the potential for cVOC transport to the marsh via stormwater.

1.3.4 Sediment Sampling Approach

As planned in the SAP, sediment samples were collected at, and downstream of, seep SP1-1 to assess current PCB concentrations in sediment. In addition to these planned sediment samples, PCBs were also measured in surface water and porewater upstream and downstream of seep SP1-1, and in groundwater in the northern part of the North Plantation using a passive sampling technique. These additional sample media and locations were added to provide additional lines of evidence regarding exposure point concentrations and evaluate potential PCB sources and transport pathways.

1.4 SCOPE OF FIELD INVESTIGATION

The objectives for the Phase II work, which are discussed in Section 1.2.4, pertain to both the Phase II elements performed in 2016 (MIP and soil vapor investigation) and the work elements performed in 2017 and reported herein. The objective regarding soil vapor sampling (item 9 in Section 1.2 above) was fully addressed by the 2016 investigation work and is not discussed further in this report.

The 2017 Phase II investigation included the collection of additional samples to meet the remaining Phase II objectives and the scope of this sampling is summarized below.

- Soil and groundwater samples were obtained from 69 continuous-core, direct-push borings, with the samples analyzed for target VOCs. Forty-one borings were located in the Central Landfill area, including deeper exploratory borings near well MW1-15 to reassess the historical interpretation of an interconnection between the shallow and intermediate aquifers in this area. A total of 34 soil borings were advanced in the South Plantation area to target the hotspots identified by the MIP investigation. As discussed in Section 1.3.1, above, additional analyses, beyond the list of target VOCs, were performed on a small subset of samples based on field observations of oily residue.

- VOCs were analyzed in soil and groundwater samples collected from auger borings associated with 18 new groundwater monitoring wells: 10 in the South Plantation, 7 in the Central Landfill area, and one boring located on the fence-line west of the South Plantation. In addition to installation, development, and sampling of these new wells, the existing irrigation well in the center of the South Plantation, Well IW1-S, was sampled to provide another repeatable data point. All groundwater samples from the installed monitoring wells were analyzed for VOCs, field parameters, conventional chemistry parameters, and oxygen demand (see Section 2 for the details of these analyses). Wells located in apparent hotspots that were expected to be the focus of potential future remedial action were additionally analyzed for microbial population, perfluoroalkyl substances (PFAS), and 1,4-dioxane.

- Eleven soil samples from the screened interval of wells located in apparent hotspots were also analyzed for physical characteristics data (grain size, dry bulk density, hydraulic conductivity, effective porosity, and TOC).

- Six sediment samples and 10 passive samplers were analyzed for PCB congeners and PCB Aroclors.

- Two stormwater samples, 10 porewater samples (four porewater samples from south of the South Plantation and six porewater samples from west of the Central Landfill area) and 12 surface water samples in the waterways upstream of existing sampling station MA12 were analyzed for VOCs.

- Horizontal locations and top of casing elevations for newly installed groundwater monitoring wells and peeper sampling tubes were surveyed by a licensed land surveyor. Depth-to-groundwater in newly installed groundwater monitoring wells, a subset of historical groundwater monitoring wells, and the USGS peeper tubes were then measured to allow preparation of a groundwater elevation contour map.

1.5 DECISION RULES

The following decision rules were established in the Phase II investigation SAP for evaluating the data generated. Whether the decision was previously made based on data generated in 2016, or is being made based on data collected during the 2017 sampling event is specified under each decision rule subsection below.

1.5.1 Decision 1a – Establish the locations (horizontally and vertically) of the highest concentrations of COCs beneath the South Plantation and in the adjacent wetlands

1. Acquire MIP screening level data from locations within and around the apparent hotspots as identified during the Phase I investigation (MIP data were collected and analyzed in 2016 and are evaluated in combination with the 2017 data to derive the conclusions in this report [U.S. Navy, 2017b]).
2. Make field interpretations of the results from the initial MIP locations to identify where relatively higher concentrations are present, vertically and horizontally, compared to other MIP locations. Adjust the planned MIP locations, or add/subtract planned MIP locations as needed (adjustment to planned MIP locations was part of the 2016 work [U.S. Navy, 2017b]).
3. Select locations for quantitative sampling by identifying both focus areas that appear to exhibit relatively higher COC concentrations and the expected lateral/vertical extent of contamination based on the results of MIP screening, tree core sampling, groundwater sampling from monitoring wells and peeper samplers, surface water sampling, and sediment porewater sampling (selection of locations for quantitative sampling was part of development of the SAP [U.S. Navy, 2017a]).
4. At the quantitative sampling locations, obtain continuous soil cores, to the extent practicable, for logging of soil types, PID screening, non-aqueous phase liquid (NAPL)

screening, and grab soil sampling. Select up to three depths for grab soil sampling, as identified through field screening methods (MIP and PID readings of the soil core) to calibrate the upper and lower vertical bounds of the high COC concentrations and the highest COC concentration at each location against the MIP results, (this work was performed in 2017 and is reported herein).

5. At the quantitative sampling locations, select up to three depths for grab groundwater sampling, as identified through field screening methods (MIP and PID readings of the soil core) to calibrate the upper and lower vertical bounds of the high COC concentrations and the highest COC concentration at each location against the MIP results (this work was performed in 2017 and is reported herein).
6. Within the limitations of laboratory turn-around times, assess the degree of correlation between the MIP data and the initial grab groundwater and soil data. Based on the degree of correlation, consider adjusting the number of grab soil and groundwater samples needed at subsequent quantitative sampling stations to meet the project objectives (this work was performed in 2017 and is reported herein).
7. Based on the MIP data and grab groundwater and soil data, select locations for auger drilling and groundwater monitoring well installation (this work was performed in 2017 and is reported herein).
8. Select the four quantitative sampling locations known or expected to exhibit the highest COC concentrations, and collect relatively undisturbed soil samples (driven ring samples) for analysis of soil physical properties during auger drilling for new monitoring wells (this work was performed in 2017 and is reported herein).
9. Interpret the data gathered in Steps 1 through 8 under this decision rule, along with historical data, to make Decision 1a (reported in Section 5, below).

1.5.2 Decision 1b – Identify the likeliest transport pathways from the high concentration COC areas at the South Plantation to the adjacent wetlands

1. Determine top of casing elevations for new monitoring wells and peeper sample casings and gather time-coincident depth to groundwater measurements within the South Plantation at all wells, piezometers, and peeper sample stations, as well as the elevation of surface water within the adjacent wetland throughout one tide cycle (this work was performed in 2017 and is reported herein).
2. Interpret the data gathered in Steps 1 through 6 under Decision Rule 1a, along with the groundwater flow conditions based on the depth to groundwater data collected, to make Decision 1b (reported in Section 5, below).

1.5.3 Decision 1c – Decide whether a vapor intrusion study of buildings east of Bradley Road is warranted (this decision was made based on data collected in 2016, and a separate vapor intrusion study is underway)

1. Sample soil vapor from locations along the east side of Bradley Road and analyze the samples for cVOCs (data collected in 2016 [U.S. Navy, 2017b]).
2. Compare the cVOC results to the current Ecology soil vapor screening values (Ecology, 2015) and EPA's screening values (EPA, 2015) (completed in 2016 [U.S. Navy, 2017b]).
3. If any cVOCs related to the landfill exceed the lower of Ecology or EPA's screening criteria, recommend further investigation of potential vapor intrusion at buildings east of Bradley Road (recommended in 2016 [U.S. Navy, 2017b]).

1.5.4 Decision 2 – Conclude whether a cVOC source exists upgradient of well MW1-17, and if one or more sources do exist, delimit their location and extents

1. Acquire MIP screening level data from locations along the western edge of pavement in the vicinity of well MW1-17, and down the apparent groundwater gradient from former Building 884 (MIP data were collected and analyzed in 2016 and are used in combination with the 2017 data to draw conclusions in this report [U.S. Navy, 2017b]).
2. Make field interpretations of the results from the initial MIP locations to identify where relatively higher concentrations are present, vertically and horizontally, compared to other MIP locations. Adjust the planned MIP locations, or add/subtract planned MIP locations as needed to identify the highest concentrations of cVOCs upgradient of well MW1-17. Place additional MIP locations around geophysical anomalies identified in the Phase I investigation based on the results at the initial MIP locations, if warranted (adjustment to planned MIP locations was part of the 2016 work [U.S. Navy, 2017b]).
3. Select locations for quantitative sampling based on the plume location and shape, as established by the MIP results (selection of locations for quantitative sampling was part of development of the SAP [U.S. Navy, 2017a]).
4. At the quantitative sampling locations, obtain continuous soil cores, to the extent practicable, for logging of soil types, PID screening, NAPL screening, and grab soil sampling. At each location, select up to three depths for grab soil sampling, as identified through field screening methods (MIP and PID readings of the soil core), to calibrate the results of the upper and lower vertical bounds of the high COC concentrations and the highest COC concentration from initial sampling locations within the South Plantation with the MIP results. Adjust the number of grab soil samples at future sampling locations based on the degree of correlation observed between grab groundwater sample results and MIP probe results (this work was performed in 2017 and is reported herein).

5. At each quantitative sampling location, select up to three depths for grab groundwater sampling, as identified through field screening methods (MIP and PID readings of the soil core), to calibrate the upper and lower vertical bounds of the high COC concentrations and the highest COC concentration from initial sampling locations within the South Plantation against the MIP results. Adjust the number of grab groundwater samples at future sampling locations based on the degree of correlation observed between grab groundwater sample results and MIP probe results at the South Plantation area (this work was performed in 2017 and is reported herein).
6. Based on the MIP data and grab groundwater and soil data, select locations for groundwater monitoring well installation (this work was performed in 2017 and is reported herein).
7. Select the three quantitative sampling locations expected to exhibit the highest COC concentrations, and collect relatively undisturbed soil samples (driven ring samples) for analysis of soil physical properties, during auger drilling for new monitoring wells (this work was performed in 2017 and is reported herein).
8. Interpret the data gathered in Steps 1 through 7 under this decision rule, along with historical data, to make Decision 2 (reported in Section 5, below).

1.5.5 Decision 3 – Conclude whether an aquitard exists between the shallow and intermediate aquifers in the central portion of the landfill, upgradient of well MW1-17

1. Acquire continuous soil lithology data from a minimum of one deep exploratory boring near well MW1-15 to reassess the historical interpretation of an interconnection (“window”) between the shallow and intermediate aquifers in this area (this work was performed in 2017 and is reported herein).
2. Make field interpretations of the results from the initial boring location to identify if additional data are required to conclude whether an aquitard exists between the shallow and intermediate aquifers in this area and add additional boring locations, if needed (this work was performed in 2017 and is reported herein).
3. Use soil lithology data obtained from deep boring locations to develop fence diagrams that illustrate the presence or absence of an aquitard and make Decision 3 (reported in Section 5, below).

1.5.6 Decision 4 – Establish current conditions with regard to PCB concentrations in sediment at, and downstream of seep SP1-1

1. Analyze PCB concentrations in sediment in the vicinity of historical monitoring locations MA-09, MA-14, and TF-21; at the location of seep SP1-1; and at a location just upstream

of seep SP1-1 (to account for tidal inflow transport of seep water) and evaluate data to make Decision 4 (this work was performed in 2017 and is reported herein).

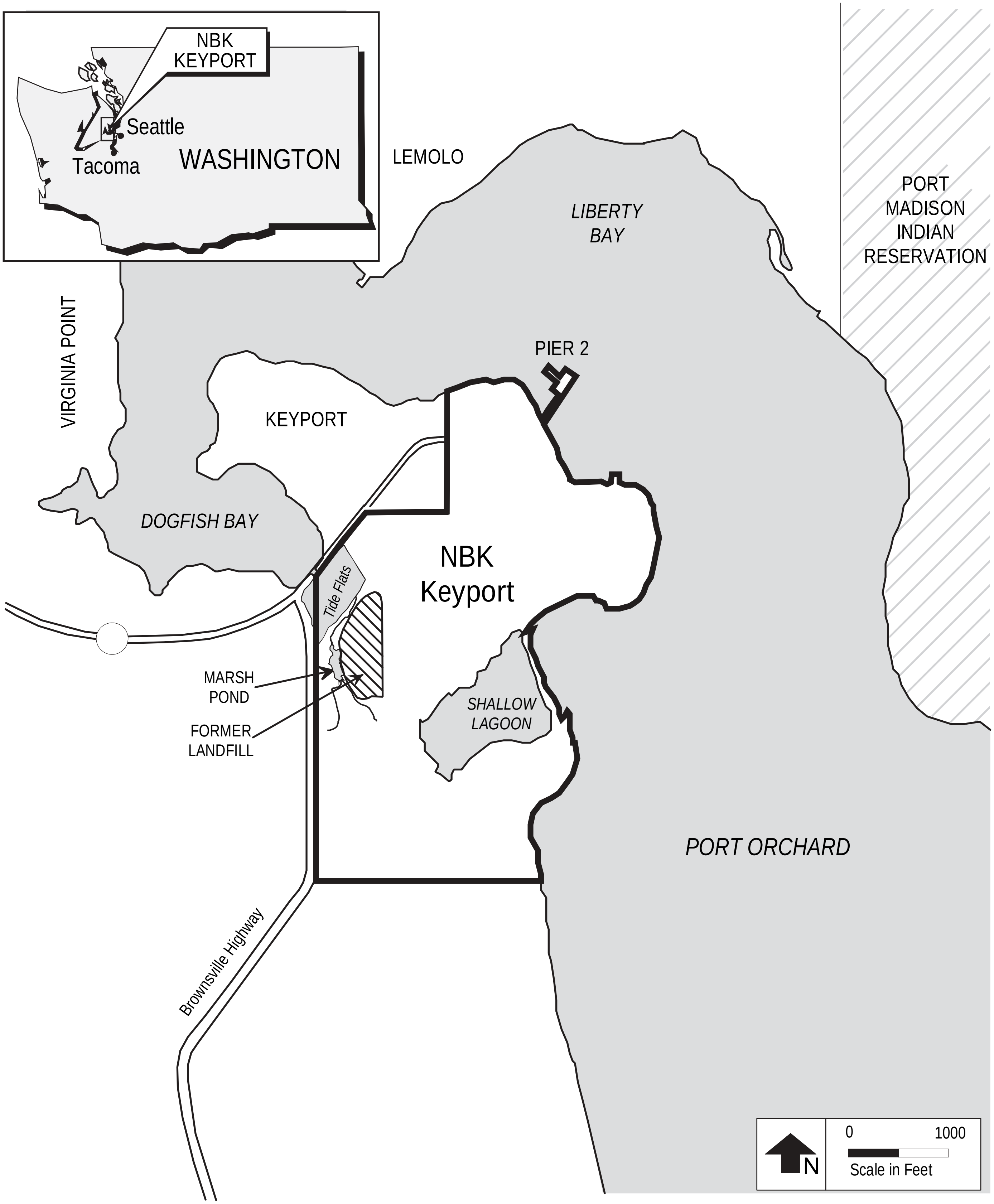
2. Sum the 209 PCB congeners to achieve a roughly comparable total PCB value for general comparison to historical data. Use the 12 dioxin-like congeners to estimate the representative exposure concentrations (toxicity equivalence [TEQ] sums), based on the updated SMS framework (Washington Administrative Code [WAC] 173-204 and Sediment Cleanup User's Manual II [SCUM II]), for evaluating compliance with cleanup standards for PCBs. Use the procedure in Appendix F of SCUM II when non-detects are present in the dataset to estimate the TEQ sums. Continue to collaborate with the regulator/stakeholder group to concur on the precise approach for evaluating PCB exposures using the congener data (this work was performed in 2017 and is reported herein).
3. Compare the results of the 209 PCB congeners to the promulgated benthic standards in order to assess direct toxicity to benthic dwelling organisms. Compare area-weighted average TEQ to assess the potential for toxicity to higher level ecological receptors (this work was performed in 2017 and is reported herein).
4. Based on comparison with the SMS standards identified in Steps 2 and 3 above, assess whether expanded, ongoing PCB sediment monitoring should be initiated prior to the next five-year data review period (this work was performed in 2017 and is reported herein).
5. Based on comparison with the SMS standards identified in Steps 2 and 3 above, and discussion with the regulator/stakeholder group, conclude whether re-evaluation of ROD assumptions regarding potential human health and ecological risks is warranted (this work was performed in 2017 and is reported herein).
6. Compare current concentrations to historical concentrations of PCBs in sediment to conclude whether PCB recontamination of sediment, as specified in the SMS regulation (Ecology, 2013), is occurring (this work was performed in 2017 and is reported herein).

1.5.7 Decision 5 – Conclude whether the existing CSM is accurate or needs refinement and refine, as necessary for accuracy

1. Use soil lithology data obtained from MIP probe and sonic drill locations in the Central Landfill and South Plantation to develop fence diagrams that illustrate contaminant pathways and potential receptors (this work was performed in 2017 and is reported herein).
2. Compare the existing CSM to the fence diagrams to determine if refinement of the CSM is warranted and if so, refine the CSM to make Decision 5 (reported in Section 5, below).

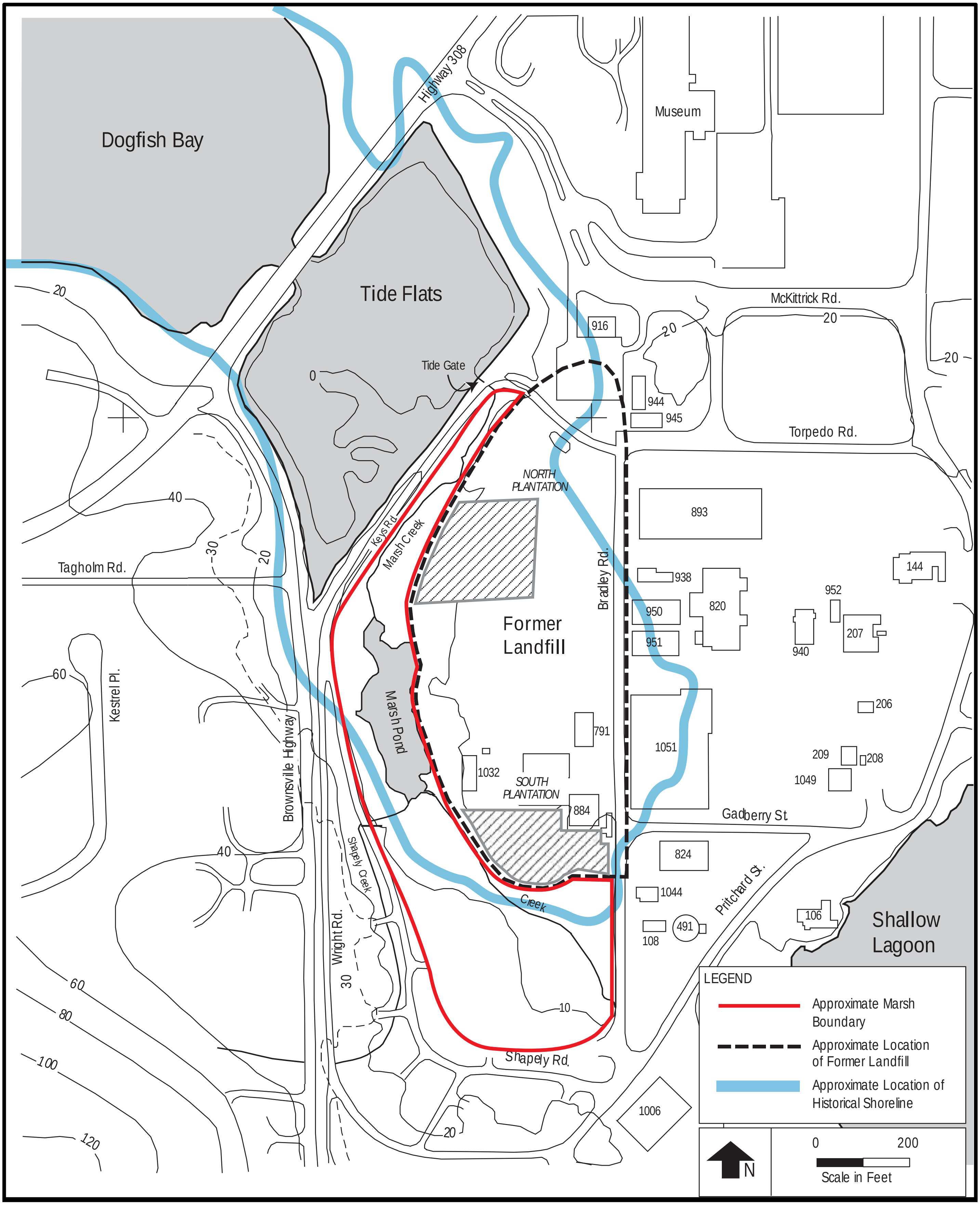
1.5.8 Decision 6 – Develop a shortlist of technologies that could be used to optimize the remedy

1. Incorporate the data generated in support of Decisions 1 through 4, including the soil physical characteristics data and microbial population results, to further screen the technologies identified during the workgroup meetings and make Decision 6 (reported in Section 5, below).



File Name: Figure 1-1_NBK Keyport Vicinity Map

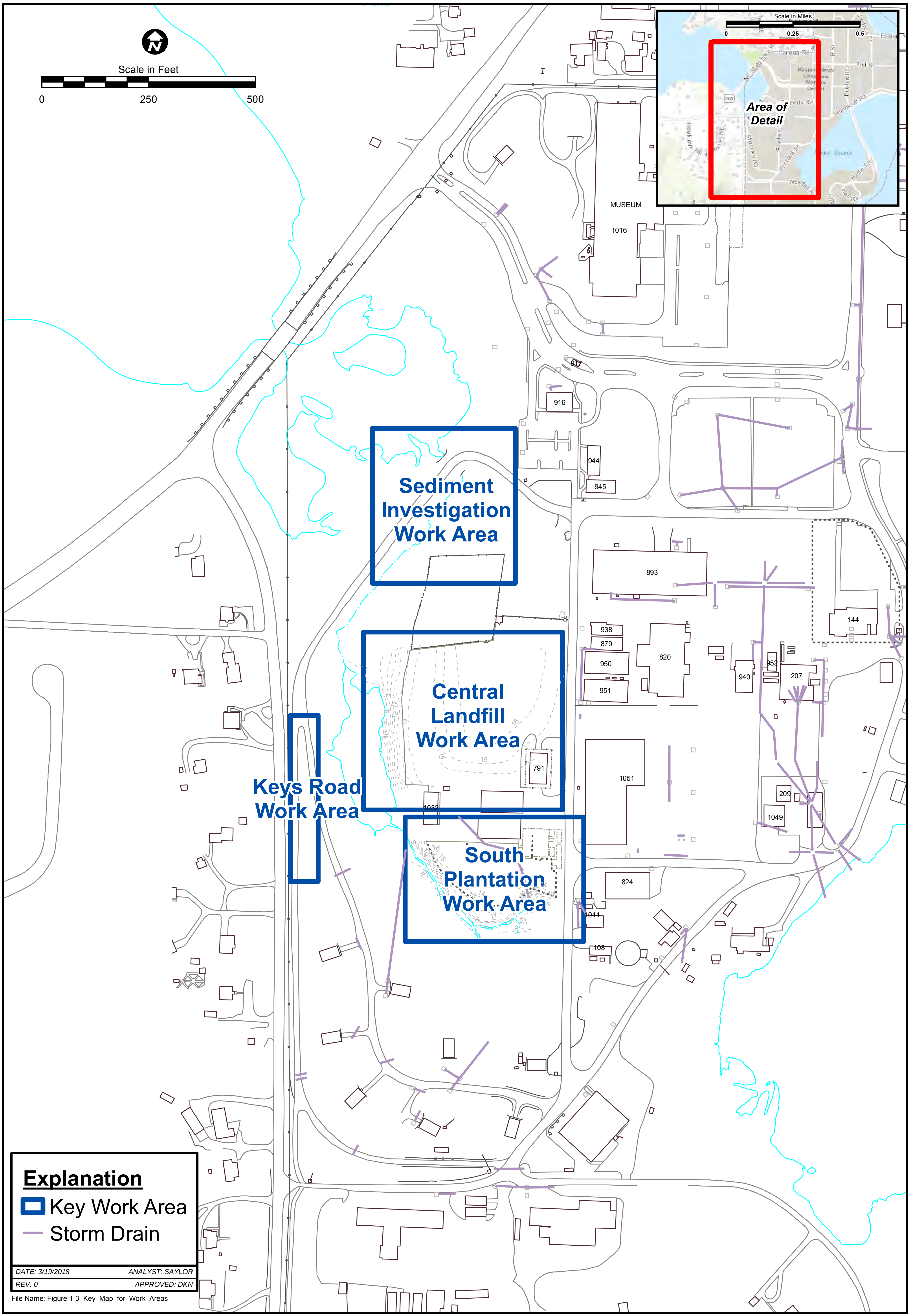
U.S. NAVY	**Figure 1-1** **NBK Keyport Vicinity Map**	Naval Base Kitsap Keyport



U.S. NAVY

Figure 1-2
Operable Unit 1

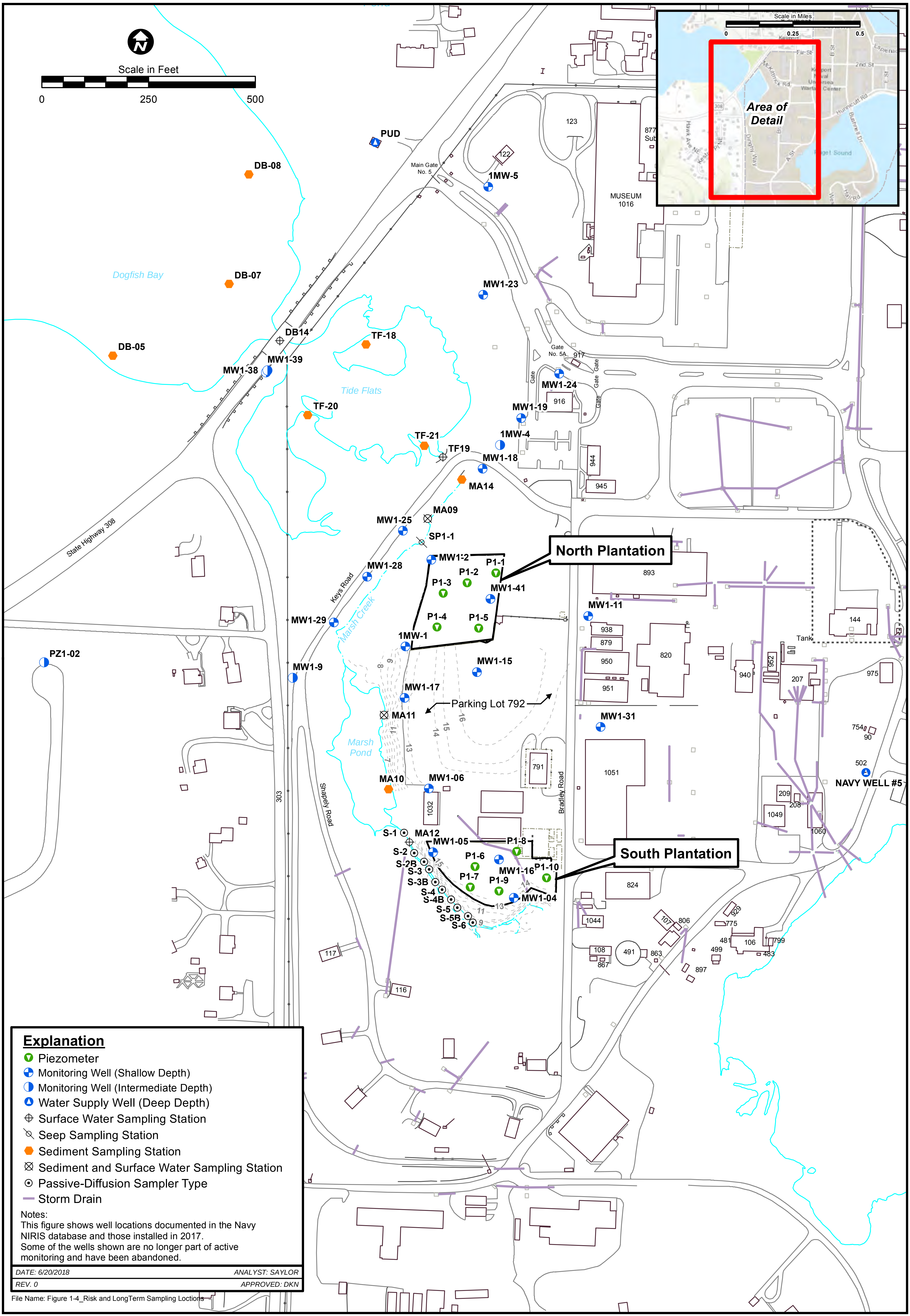
Naval Base Kitsap
Keyport



DATE: 3/19/2018 ANALYST: SAYLOR
REV. 0 APPROVED: DKN

File Name: Figure 1-3_Key_Map_for_Work_Areas

U.S. NAVY	Figure 1-3 Key Map for Work Areas	Naval Base Kitsap Keyport



Notes:
This figure shows well locations documented in the Navy NIRIS database and those installed in 2017.
Some of the wells shown are no longer part of active monitoring and have been abandoned.

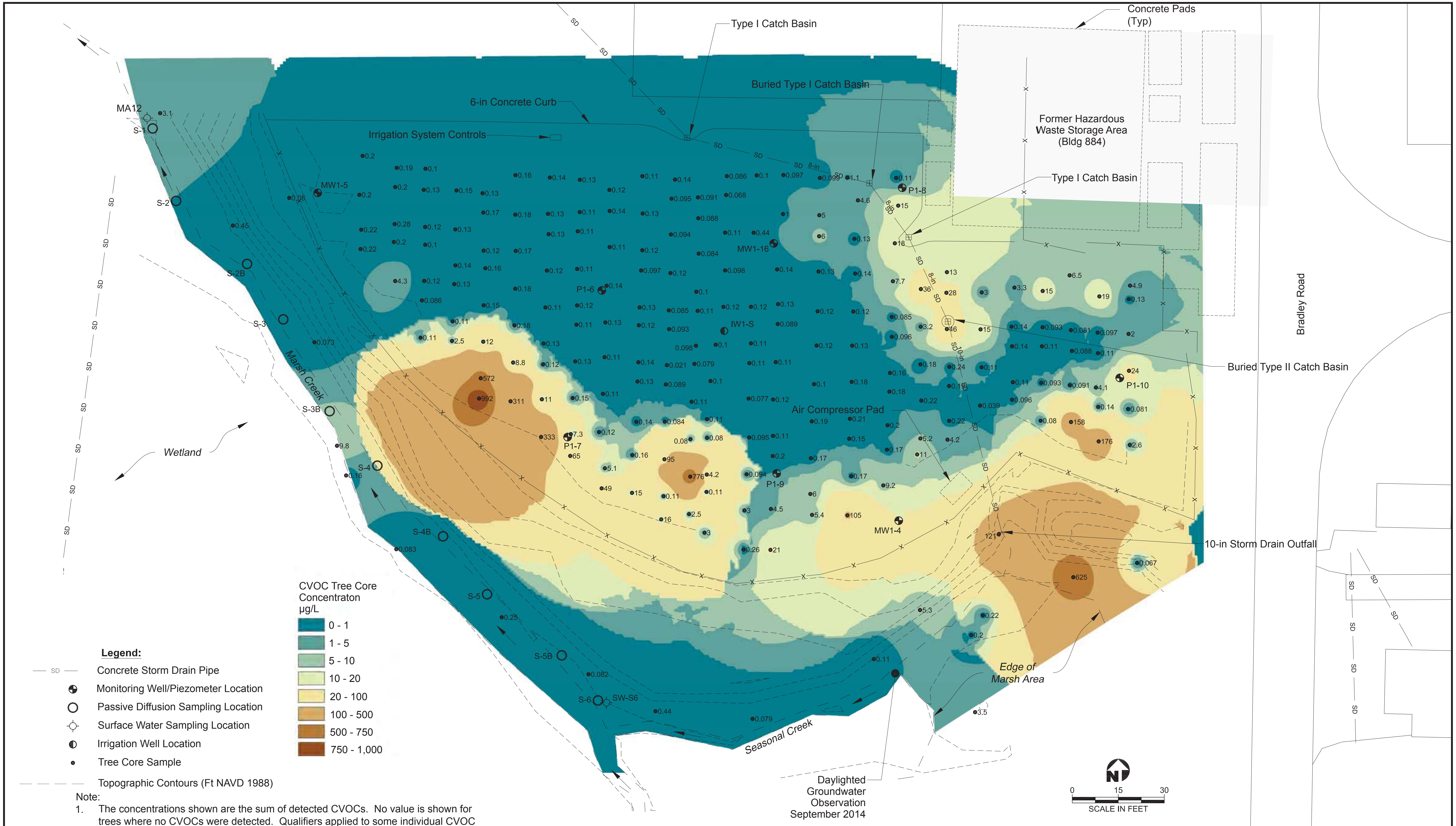
DATE: 6/20/2018 ANALYST: SAYLOR
REV. 0 APPROVED: DKN

File Name: Figure 1-4_Risk and LongTerm Sampling Loctions

U.S. NAVY

Figure 1-4
Risk and Long-Term Monitoring Sampling Locations at OU 1

Naval Base Kitsap
Keyport



Note:
1. The concentrations shown are the sum of detected CVOCs. No value is shown for trees where no CVOCs were detected. Qualifiers applied to some individual CVOC values are not shown. For details, see Appendix A, Table 3 in U.S. Navy 2015a.

U.S. NAVY

Figure 1-5
Phase 1 Investigation Results – South Plantation

Naval Base Kitsap
Keyport

Table 1-1. Chemicals of Concern Established in OU 1 ROD

Chemical of Concern	Remediation Goal
Groundwater (µg/L)	
Tetrachloroethene (PCE)	5
Trichloroethene (TCE)	5
1,1-Dichloroethene	0.5
cis-1,2-Dichloroethene	70
trans-1,2-Dichloroethene	100
Vinyl chloride	0.5
1,1,1-Trichloroethane	200
1,1-Dichloroethane	800
1,2-Dichloroethane	5
Total PCB Aroclors	0.04
Surface Water (µg/L)	
Tetrachloroethene (PCE)	4.2
Trichloroethene (TCE)	56
1,1-Dichloroethene	1.9
cis-1,2-Dichloroethene	NE
trans-1,2-Dichloroethene	33,000
Vinyl chloride	2.9
1,1,1-Trichloroethane	41,700
1,1-Dichloroethane	NE
1,2-Dichloroethane	59
Total PCB Aroclors	0.04
Sediment (mg/kg)	
Total PCB Aroclors	12

Notes:
Values shown are the lowest for either the drinking water or protection of surface water pathways
The OU 1 ROD did not establish numeric cleanup levels for soil or soil vapor beneath the landfill.
NE – not established

2.0 INVESTIGATION ACTIVITIES

This section describes the investigation activities performed during the 2017 Phase II site recharacterization field season. Deviations from the SAP are discussed by work element in the subsections below, and listed in Table 2-1. Approved Field Change Request (FCR) forms are included in Appendix B. Daily reports of the field work performed are included in Appendix C.

2.1 SAMPLE LOCATION SELECTION

The SAP showed the expected distribution of direct-push borings in the South Plantation and expected initial direct-push locations in the Central Landfill. The SAP also listed expected sample quantities of direct-push borings based on the MIP results, historical data from tree cores, groundwater samples from monitoring wells and peeper samplers, and surface water. The approach to select actual direct-push boring locations is discussed in Section 1.3. The project team had access to a SharePoint site where daily reports of the drilling activity, field observations, and working maps were posted, allowing for team input on decisions regarding the locations. Figures 2-1 and 2-2 show the locations of the 69 direct-push borings in the Central Landfill and South Plantation (“Geoprobe 2017” locations on Figures 2-1 and 2-2). Continuous cores were obtained out of 69 direct-push borings. A 70th location was attempted near the former building foundations west of location SP-B62 (Figure 2-2), but a buried concrete slab prevented drilling.

As discussed in Section 1.3.2, draft isoconcentration contour maps were prepared for the maximum concentration of three key VOCs, regardless of depth based on the results of the direct-push sampling. These maps, along with exhibits comparing the analytical results to MIP data, lithologic cross sections, and an export of the direct-push laboratory analytical data set, were used during project team meetings on August 30, 2017 and September 28, 2017. During these meetings the project team discussed the ramifications and initial interpretations of the data and agreed on the locations and screened intervals for permanent groundwater monitoring wells.

2.2 DIRECT-PUSH SOIL AND GROUNDWATER SAMPLING

Direct-push soil and groundwater sampling was performed in accordance with the approved SAP, except where deviations from the SAP are identified in this section and Table 2-1.

Utility locating was performed in advance of direct-push drilling on June 27, 2017, and the Navy issued excavation permit 17-EP110 on July 11, 2017. Direct-push drilling was performed between July 11, 2017 and August 7, 2017. Holt Services, of Puyallup, Washington provided a

Geoprobe Model 7822DT track-mounted direct-push drilling rig operated by a driller licensed in Washington State.

Direct-push drilling was performed at 70 locations and continuous cores were successfully obtained using a 5-foot-long, Macro-Core split-spoon sampler at 69 of these locations (see Appendix D for boring logs). Refusal was met during the initial attempt at 10 borings, with one or more nearby step-outs (typically within 1 foot) necessary to avoid buried obstructions. At one location (SP-B70), a buried concrete slab encountered at approximately 4 feet bgs prevented drilling. At location SP-B58, an attempt was made to push directly to the target sampling depth (20 ft bgs based on the nearest MIP), without continuously coring from ground surface. The intent was to increase the drilling rate, and thereby allow collection of more data at the target depths within the time scheduled for drilling. However, the drill rig was not able to push deeper than 15 ft using a solid drill rod. The continuous coring method was found to allow deeper drill penetration, because soil was removed from each 5-foot interval. After this single attempt, continuous coring was used at all remaining locations.

The continuous soil cores were screened using a hand-held PID, with readings collected at a minimum of every 12 inches along the length of each core. Where relatively higher PID readings were observed, additional screening was conducted at closer intervals (as close together as approximately 1 inch). This technique revealed that small-scale changes in lithology strongly affected the PID results. For example, finer-grained silt interbeds within sandier units were often observed to exhibit much higher hand-held PID readings. These silt interbeds were frequently only 1 to 2 inches thick. Grab soil and groundwater sample depths were selected based on these hand-held PID readings and comparison to nearby MIP results (when available).

The observation of finer-grained interbeds exhibiting higher PID readings compared to adjacent coarser-grained zones indirectly indicates that matrix diffusion is important at the site. At legacy chlorinated solvent release sites where cVOCs have been present in the subsurface for decades, it is commonly observed that cVOC diffusion into the lower permeability zones results in an on-going slow release of cVOCs through back-diffusion long after cVOCs have been removed from the coarser-grained zones (Chapman and Parker, 2005). This observation also indicates that groundwater samples taken in the area will not reflect the higher cVOC concentrations in the lower permeability zones, but rather will represent an integrated sample with preferential flow from the more transmissive zones within the wells screened interval.

Grab soil samples were collected by subsampling the soil cores using single-use Terra Core samplers to transfer soil to laboratory-supplied vials. Grab groundwater samples were collected using one of two methods depending on the depth of the sample. The Geoprobe Screen Point 22 sampler (which has a 4-foot screened interval) was generally used for deeper sample collection when the direct-push rig was needed to advance the sampler to the target depth. For shallower samples, a 5-foot section of polyvinyl chloride (PVC) well screen attached to blank PVC casing was hand-installed to the target depth. Using either method, a peristaltic pump was used to purge groundwater at the target depth until the water visibly cleared, at which time a sample was pumped directly into the laboratory-supplied vials. The SAP anticipated the need to use a check-valve sampling device because of the planned depth of some samples. However, use of the peristaltic pump was successful because of the shallow hydraulic head in the aquifer.

Table 2-2 summarizes the grab soil and grab groundwater samples collected from each direct-push boring, along with the laboratory analyses performed on each sample. At a minimum, all samples were analyzed for the target cVOCs listed in the SAP, consisting of the nine cVOC COCs identified in the ROD and chloroethane as a final breakdown product of 1,1,1-TCA.

2.2.1 South Plantation

Direct-push soil borings were drilled at 32 locations in the South Plantation to target the hotspots identified by the MIP investigation (Figure 2-2). Boring SP-B01 was the first direct-push boring drilled at the site and was located adjacent to one of the MIP locations exhibiting the highest cVOC concentrations, to allow for correlation between hand-held PID readings and MIP results. The hand-held PID readings were found to indicate high cVOC concentrations at depths similar to the MIP, and the lithology observed in continuous cores was found to correlate well to the MIP electrical conductance (EC) log. Following this initial boring in the South Plantation, the direct-push investigation moved to the Central Landfill. The investigation in the South Plantation resumed on July 26, 2017 with location SP-B40. Subsequent locations were placed generally following the locations planned in the SAP.

Between one and four grab soil samples and one to three grab groundwater samples were collected from each boring, based on field observations of highest VOC concentrations.

At two locations in the South Plantation (SP-B01 and SP-B62), soil and groundwater samples were analyzed for additional constituents as a means of characterizing the nature of “oily” NAPL observed at these locations (see Table 2-2). These additional constituents consisted of the following (see Table 2-2 for a summary of which analysis were performed on each specific soil or groundwater sample):

- PCB Aroclors
- Petroleum hydrocarbons
- VOCs (full Method 8260 list)
- SVOCs (semivolatile organics)
- Otto fuel

2.2.2 Central Landfill

Direct-push soil borings were drilled and sampled at 38 locations in the Central Landfill (Figure 2-1). The initial boring locations (CL-B02, CL-B03, CL-B04) were placed adjacent to MIP borings, to allow comparison of hand-held PID readings to MIP results. Continuous exploratory cores were then placed near well MW1-15 (CL-B05), and across the Central Landfill, to reassess the historical interpretation of an interconnection between the shallow and intermediate aquifers in this area. After a sufficient distribution of borings across the Central Landfill was available to provide an overall understanding of the shallow geology, subsequent borings were placed as step-out locations from borings showing elevated hand-held PID results, and to roughly complete the conceptual grid pattern of borings envisioned in the SAP.

Between one and five grab soil samples and one or two grab groundwater samples were collected from each boring, based on field observations of highest cVOC concentrations.

At two locations in the Central Landfill (CL-B18 and CL-B21), soil and groundwater samples were analyzed for additional constituents as a means of characterizing the nature of “oily” NAPL observed at these locations (see Table 2-2). These additional constituents consisted of the following (see Table 2-2 for a summary of which analysis were performed on each specific soil or groundwater sample):

- PCB Aroclors
- Petroleum hydrocarbons
- SVOCs
- Otto fuel

In addition, samples from locations CL-B02, CL-B03, and CL-B04 were run by the laboratory for the full standard list of VOCs by EPA Method 8260C (Table 2-2) to assess the presence or absence of significant concentrations of VOCs other than the site COCs specified in the ROD.

2.3 AUGER DRILLING SOIL SAMPLING AND WELL INSTALLATION

Auger drilling, groundwater monitoring well installation, and monitoring well development were performed in accordance with the approved SAP, except where deviations from the SAP are identified in this section and Table 2-1.

Utility locating was performed in advance of auger drilling on September 14, 2017, and the Navy issued excavation permit 17-EP148 on September 29, 2017. Auger drilling was performed between October 2, 2017 and November 1, 2017. Holt Services, of Puyallup, Washington provided a Landa Drilling Services L-10-T track-mounted auger drilling rig operated by a driller licensed in Washington State.

2.3.1 Auger Drilling

Auger drilling was used following direct-push sampling to allow for groundwater monitoring well installation and relatively undisturbed soil sampling using a Modified California split-spoon sampler driven by a 140-pound autohammer. This sampler type and hammer weight is a deviation from the SAP, which anticipated the use of a Dames and Moore sampler driven with a 300-pound hammer. The use of the slightly smaller sampler and lighter hammer did not affect the ability to obtain representative samples. The locations of auger drilling and groundwater monitoring well installation were selected based on the results of the direct-push sampling in collaboration with the project team (see Section 1.3.2 for further discussion).

Ten auger borings were located in the South Plantation and seven borings were located in the Central Landfill. Two auger borings were located along the base perimeter road (Keys Road) west/northwest of the South Plantation.

Relatively undisturbed samples were collected from the auger borings within the planned screened interval for each well. These samples were analyzed for the cVOC COCs and chloroethane. At seven key well locations selected by the project team (Table 2-3) samples were collected in brass sleeves and submitted for physical characteristics analysis, including porosity, bulk density, hydraulic conductivity, grain size distribution, and TOC.

2.3.2 Groundwater Monitoring Well Installation

A total of 18 monitoring wells were installed at the site, 10 at the South Plantation, 7 in the Central Landfill, and 1 along Keys Road. A well was not installed in the second boring drilled along Keys Road (B85), because silt and clay was logged from ground surface to 46.5 ft bgs, with no groundwater observed. Figures 2-1 through 2-3 show the locations of all groundwater monitoring wells installed at the site in 2017. Wells installed in 2017 continued the historical naming conventions for OU 1 wells, beginning with the next well number in series (MW1-42). No well named “MW1-59” was installed.

As discussed in Section 1.3.2, the screened intervals for groundwater monitoring wells were selected along with the well locations in consultation with the project team. Screened intervals were selected based on the results of the MIP and direct-push investigation to target the highest concentrations of cVOC COCs, and locations downgradient of where the highest concentrations were observed. Table 2-4 summarizes the well construction details for wells installed in 2017.

All but three of the wells were installed as planned in the SAP, using 2-inch-diameter, schedule 40 PVC well screen with 0.01-inch slots. Based on discussions with the project team, three wells were installed using continuous multi-channel tubing (CMT), with three screened intervals per location. The use of CMT wells in the eastern portion of the South Plantation was chosen based on the apparent complexity of the vertical distribution of VOCs in this area observed during the MIP and direct-push investigations. The CMT wells provide a means of evaluating the nature of apparently separate disposal events and repeatably sampling multiple vertical intervals in the aquifer to track VOC trends vertically in the aquifer over time. Because the CMT well construction methodology does not comply with Washington State well construction standards, a well construction variance was obtained from Ecology in advance of CMT well installation (Appendix D).

Eight of the nine (three per well) screened intervals installed in the CMT wells were found to produce sufficient groundwater flow for purging and sampling. However, the deepest screened interval in MW1-56 was found to not produce sufficient groundwater flow for purging and sampling, even following multiple purging attempts and efforts to develop the well using a micro surge block. This deepest screened interval was installed based on the soil lithology observed in the samples collected during auger drilling, which indicated sand and gravel to 37 ft bgs, underlain by the Lawton Clay from 37 ft bgs to the total depth of the boring, 40 ft bgs. The lowest screen in MW1-56 was therefore set at 33 ft bgs, with 2 ft of sand below the screen opening, and 2 ft above. It is possible that the clay below this lowest screened interval was smeared upward in the borehole during auger removal and has occluded the screen.

2.3.3 Monitoring Well Development

Newly installed wells were allowed to rest a minimum of 24 hours following installation, with well development beginning on October 6, 2017. Well development was completed on October 19, 2017. It was performed in accordance with the SAP using surging and bailing followed by high flow pumping while monitoring water quality parameters. As expected, water quality parameters (especially turbidity) did not fully stabilize during development of most wells because of the fine-grained nature of the formation. However, development achieved substantial reductions in turbidity at all wells.

The three CMT wells (MW1-56, MW1-57, and MW1-58) were not developed. It is generally not practical to develop CMT wells using the small diameter tubing available for each port. As stated by the manufacturer, development of CMT wells is generally not necessary to achieve acceptable sampling results. During purging prior to sampling the CMT wells, low turbidity and stabilization of water quality parameters was achieved prior to sampling.

2.4 GROUNDWATER SAMPLING FROM MONITORING WELLS

Groundwater sampling was performed at least 72 hours after well development, using low-flow techniques in accordance with the SAP and NAVFAC NW SOP I-C-5 (U.S. Navy, 2017a). Samples for PFAS from the 10 wells selected for this analysis were collected according to the procedures listed in the SAP (U.S. Navy, 2017a).

Groundwater samples were collected from the wells installed in 2017, except well MW1-58, and existing irrigation well IW1-S between October 23, 2017 and October 26, 2017. Well MW1-58 was sampled on November 15, 2017. Table 2-3 summarizes the samples collected and the analyses performed.

All of the groundwater samples from monitoring wells were analyzed for the nine cVOC COCs and the suite of monitored natural attenuation parameters selected in the SAP (including both field and laboratory analysis). The SAP anticipated that these samples would also be analyzed for chloroethane, however this breakdown compound was inadvertently omitted from the analytical suite. Extensive data regarding chloroethane concentrations in groundwater are available from the grab groundwater sampling (Section 2.2), and this omission does not impact overall data evaluation. Samples from 10 of the 18 newly installed wells were collected for microbial analysis to support remedial technology screening (Table 2-3). These wells were selected by the project team for microbial analysis based on their location within apparent hotspots where future remedial actions may be selected. Samples from a slightly different set of 10 wells were analyzed for PFAS and 1,4-dioxane either to assess whether these contaminants were present, whether an apparent hotspot area was the source of 1,4-dioxane (e.g., MW1-57) and to assess whether these contaminants were present in groundwater near the base property line (e.g., MW1-60).

One groundwater sample was collected from existing monitoring well MW1-17 during the direct-push sampling mobilization. This sample was collected based on a field decision because results from this well were time-coincident with nearby grab groundwater samples and could provide a useful comparison. This sample was analyzed for the nine cVOC COCs and chloroethane.

Depth to groundwater measurements were collected from the wells installed in 2017 (Table 2-4) as well as a representative subset of the existing wells and peeper tubes present at OU 1 (see Section 4.3). Depth to groundwater measurements were made on October 23, 2017, except for the three CMT wells MW1-56, MW1-57, and MW1-58, in which depth to water was measured at the time of well sampling on October 25, 2018 (MW1-56 and MW1-57) and November 15, 2018 (MW1-58) because of the date of installation and the need for a specialized, small-diameter water level indicator.

2.5 POREWATER SAMPLING

A total of four porewater samples were collected adjacent to the South Plantation (Figure 2-2), and six porewater samples were collected adjacent to the Central Landfill (Figure 2-1) on September 7 and 8, 2017. Samples were collected using a PushPoint sampler as planned in the SAP and analyzed for the nine cVOC COCs by EPA Method 8260C. As with groundwater, the SAP anticipated that these samples would also be analyzed for chloroethane, however, this breakdown compound was inadvertently omitted from the analytical suite.

Sampling locations and sample names are summarized in Table 2-5. Sampling of porewater was performed following sufficient seasonal precipitation to ensure typical flow conditions in the marsh area. Access to the sampling stations through dense vegetation was extremely difficult, and the total number of accessible sampling stations (10) was fewer than planned in the SAP (14). The spatial coverage of the 10 samples collected was sufficient to meet the project objectives relative to porewater.

Data from porewater samples are used in Section 4, below, to assess the lateral extent of cVOCs in groundwater prior to water daylighting to surface water at the edge of the marsh (South Plantation) and in Marsh Pond (Central Landfill). South plantation porewater samples are located southeast of the plantation in the vicinity of tree core samples that exhibited elevated cVOCs, and near the highest cVOC concentrations observed in groundwater in the eastern portion of the South Plantation. Central landfill samples are located downgradient from well MW1-17, where increasing trends of cVOC concentrations have been observed.

2.6 SURFACE WATER AND STORMWATER SAMPLING

Twelve surface water samples were collected (Figure 2-2) in the waterways upstream of existing sampling station MA12, south of the South Plantation, within both Marsh Creek and the seasonal tributary creek that flows from the southeast corner of Bradley Road and Shapely Road to the confluence with Marsh Creek, using the procedures specified in the SAP, on October 26, 2017. Two stormwater samples were collected from an outfall and manhole structure within the South Plantation on November 15, 2017. Sampling of surface water and stormwater was performed following sufficient seasonal precipitation to ensure typical flow conditions in the marsh area. Surface water and stormwater samples were analyzed for cVOC COCs by EPA Method 8260C. As with groundwater and porewater, the SAP anticipated that these samples would also be analyzed for chloroethane, however this breakdown compound was inadvertently omitted from the analytical suite. Chloroethane is unlikely to be present in stormwater, considering that none of the cVOC COCs were detected in the two stormwater samples.

The SAP anticipated collecting stormwater samples by direct-filling laboratory glassware. However, the outfall location was not directly accessible because of extensive standing water, and the second stormwater sample was collected from within a manhole structure. Because of these access issues, the stormwater samples were collected using a decontaminated polyethylene dipper.

The SAP planned for collection of a stormwater sample from an outfall shown on facility maps to the southwest of MA12, west of the South Plantation. However, this outfall was not found and may not exist.

Surface water and stormwater samples are summarized in Tables 2-6 and 2-7, respectively.

2.7 SEDIMENT SAMPLING

Five sediment samples were collected on September 6 and 7, 2017 to assess PCB concentrations at historical sediment sample locations SP1-1, MA-09, MA-14, TF-21, and at one new location (MA19) as shown on Figure 2-4. Sediment samples were collected at and around seep SP1-1 to assess whether there is a correlation between the concentrations of PCBs in seep water and sediment and to evaluate if recontamination is occurring, as specified in the SMS regulation (Ecology, 2013). PCB sediment results are used in Section 4 to assess whether expanded, ongoing PCB monitoring should be initiated, and risk assumptions reviewed in the future. A new sample location (MA19) was added upstream of seep SP1-1 to determine if PCB contamination from this seep is migrating upstream during high tides as shown in Figure 2-4. Sediment samples were collected in accordance with the SAP and NAVFAC NW SOP I-B-8 (U.S. Navy, 2017a) and analyzed for PCB congeners in accordance with the SAP. At Ecology’s request, the sediment samples were also analyzed for PCB Aroclors.

Sediment samples are summarized in Table 2-8.

2.8 PASSIVE SAMPLING

Passive samplers, more specifically polyethylene devices (PEDs), were used to measure freely dissolved PCB concentrations in groundwater, porewater, and surface water. The samplers consist of 25 µm-thick low-density polyethylene sheets that, due to their hydrophobic properties, accumulate hydrophobic contaminants such as PCBs. Passive sampling was added as a technique for assessing PCBs at the site after finalization of the SAP, through the FCR process. Passive sampling was discussed with the project team during the meeting on August 30, 2017.

Prior to deployment, PEDs are spiked with performance reference compounds (PRCs), which are compounds not expected to be present in the environment but that show similar properties to the targeted analytes. PRCs assess if the PEDs reached equilibrium with the sampled water during the deployment period (typically about one month), and if not, allow correction of the results for lack of equilibration during data processing. Chemical analyses of the PEDs retrieved from field deployments determine analyte concentration in the PED (nanograms per gram [µg/kg] PED), followed by calculation of the water concentrations (ng/liter [L] water) of the measured analytes using the known polyethylene-water partition coefficients and PRC-based disequilibrium correction, if necessary. For coeluting congeners, the lowest polyethylene-water partition coefficient within each coeluting group was used in the calculation, which resulted in the more conservative (higher) result.[1]When PEDs are deployed across the sediment-water interface to sample both porewater and surface water, calculation of diffusive flux of the contaminant between porewater and surface water can be conducted. Following Fick's First Law of diffusion, the diffusive flux is proportional to the concentration gradient.

During the 2017 Phase II investigation, four PEDs were deployed on September 6 and 7, 2017 to measure dissolved PCBs in groundwater within the landfill at a depth of 10 to 15 ft bgs in the northern part of the North Plantation. Two PEDs were deployed in monitoring wells (MW1-2 and MW1-14) and two in piezometers (P1-1 and P1-2; Figure 2-4).

Six PEDs were deployed across the sediment-water interface to sample freely dissolved PCBs in sediment porewater and surface water and to allow flux calculations (Figure 2-5). Five of the PEDs were deployed in Marsh Creek. Three of these PEDs were placed near the historical sampling locations, at stations MA19, SP1-1, MA-09, MA-14. One PED was collocated with the new sediment location, MA19, that was established in the 2017 event to measure PCB concentrations just upstream of the seep at SP1-1. Another PED was placed further upstream. The final PED was deployed in the Tide Flats near the historical station TF-21 (Figure 2-4). All sediment porewater PEDs were successfully recovered following a 28- or 29-day deployment period on October 5, 2017. Following recovery, each PED was split into portions from above and below the mudline. These portions were analyzed separately to provide a sediment porewater concentration and a surface water concentration at the same location. However, at two of the Marsh Creek PED locations, the surface water portion of the polyethylene was missing (stations SP1-1 and MA-09) so the determination of the surface water PCB concentration and therefore flux at these two locations was not possible.

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[1] The impact of this decision on the total PCB was investigated by comparing the results obtained by using the lowest partition coefficient for the group (the conservative approach) with the results obtained when using the average partition coefficient for each group. The difference was between 0 and 8%, with an average of 3%, so the impact was minimal.

Passive samples are summarized in Tables 2-8. At stations where a passive sampler was split into portions above and below the mudline, two samples are shown for a single sampling station in Table 2-8.

2.9 LAND SURVEY

A survey of the 18 new groundwater monitoring wells and the existing peeper sampler tubes was conducted on November 3 and 6, 2017, by a State of Washington-licensed surveyor under the supervision of Battelle. The locations were tied into the existing base map developed for the site. The elevation of the top of the PVC casing for each well and peeper sampler tube was surveyed to a reference point determined in the field and reported to within 0.01 foot. All elevations were referenced to the North American Vertical Datum (NAVD) 1988. The horizontal locations of each point were documented in North American Datum (1983/91) Washington State Plane North Zone with and accuracy of up to 0.1 foot. The survey report is included in Appendix E.

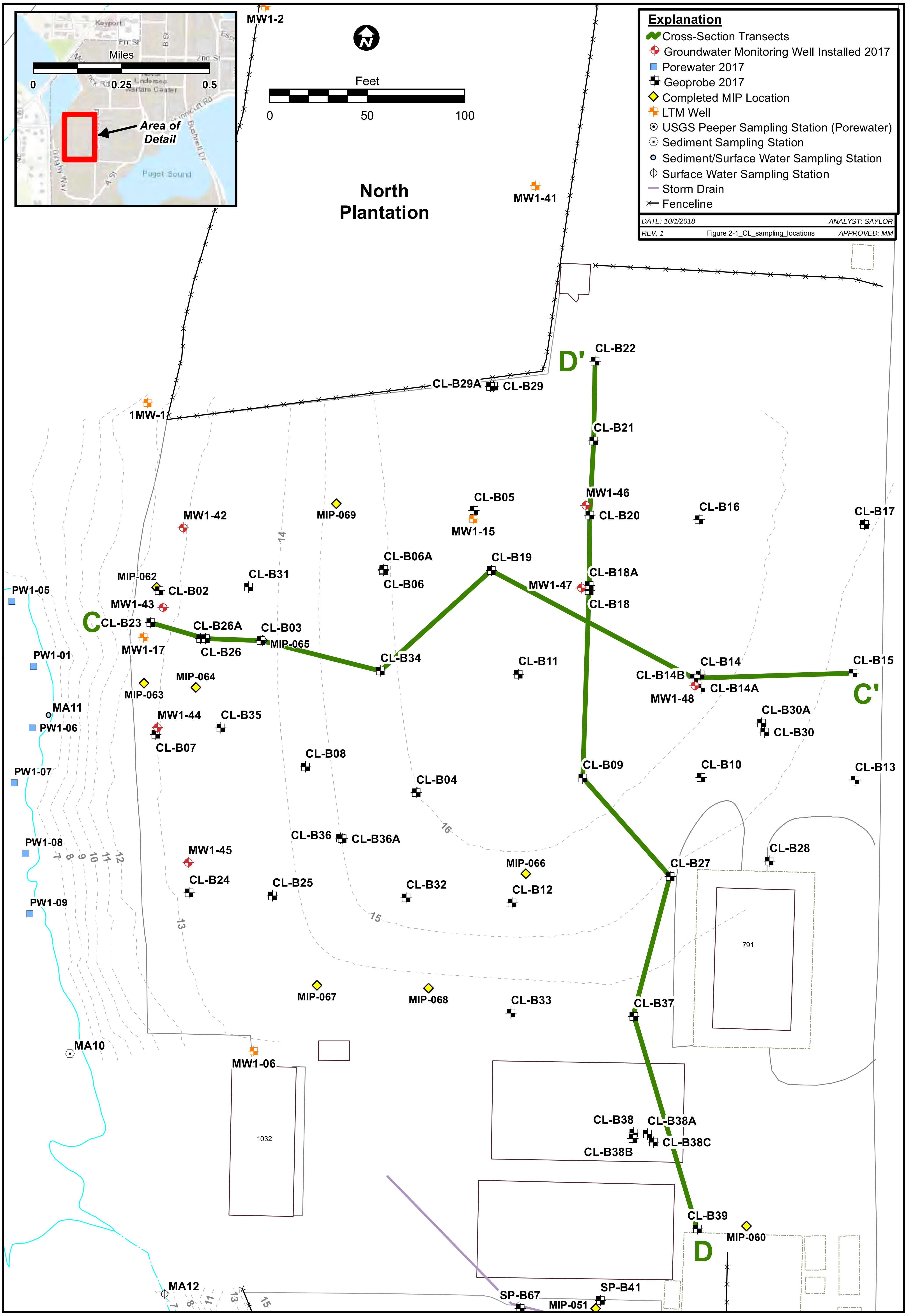

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Figure 2-1
Central Landfill Sampling Locations

Naval Base Kitsap
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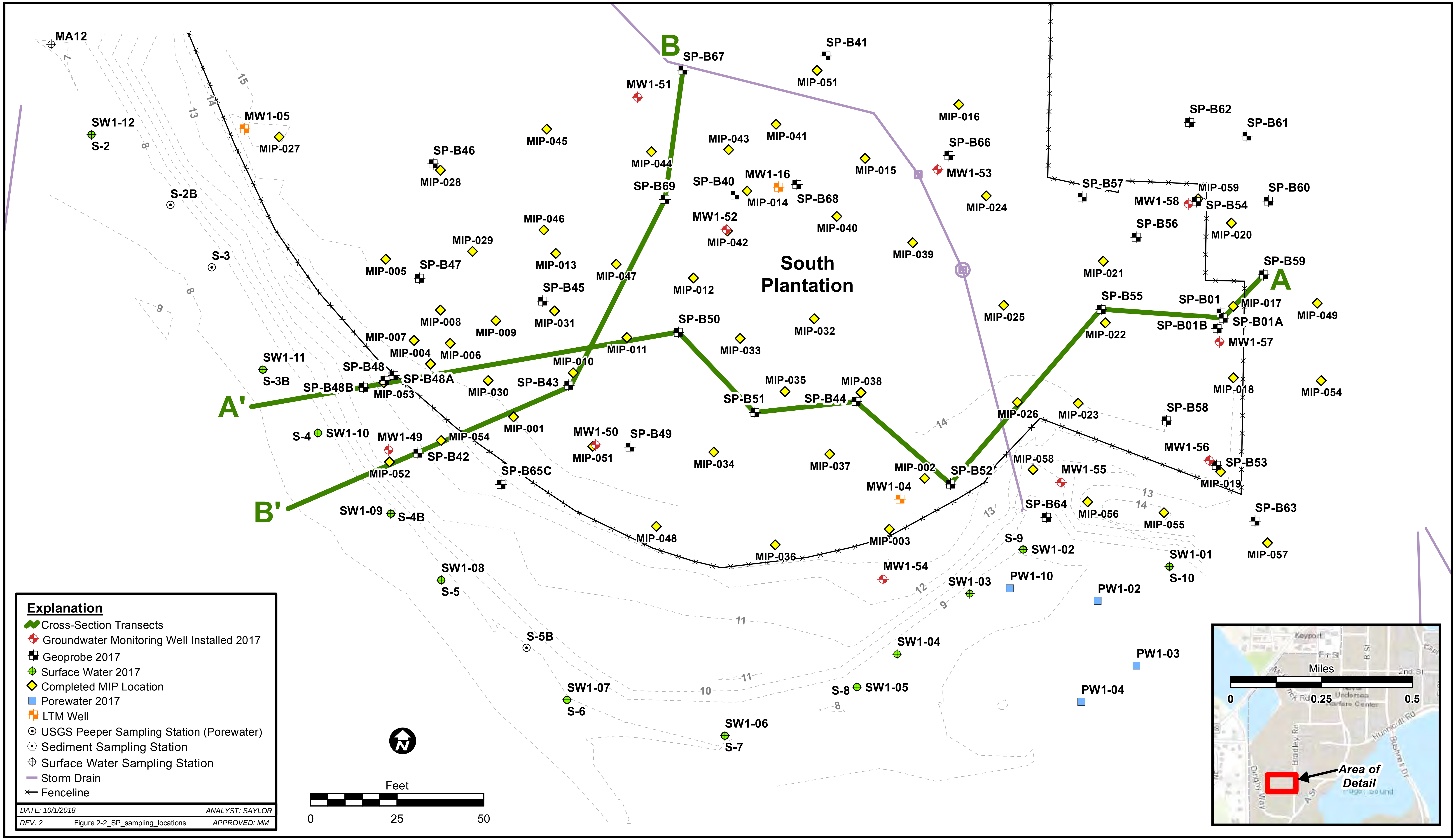

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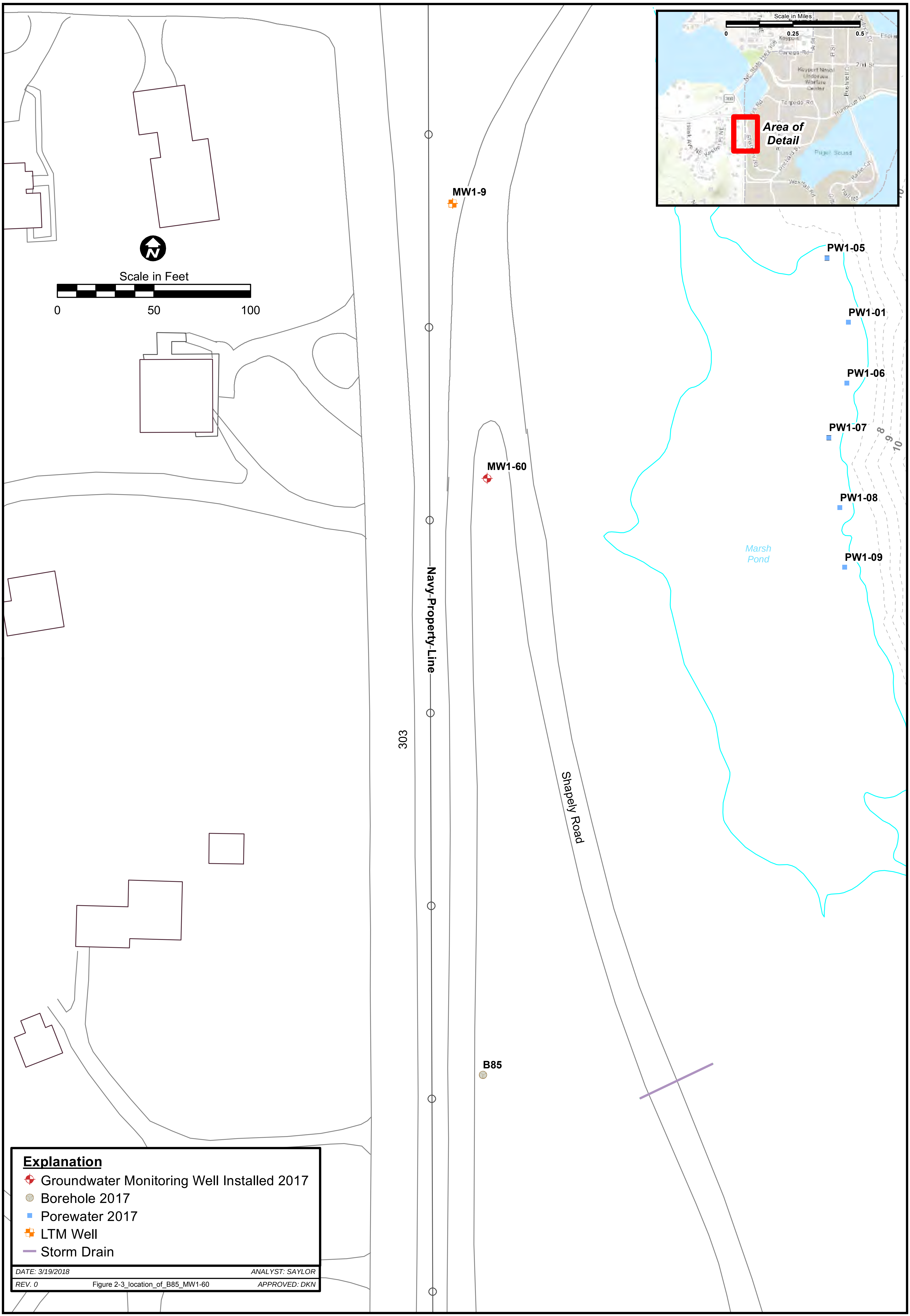
Figure 2-2
South Plantation Sampling Locations

Naval Base Kitsap
Keyport



DATE: 3/19/2018 ANALYST: SAYLOR
REV. 0 Figure 2-3_location_of_B85_MW1-60 APPROVED: DKN

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Figure 2-3
Location of B85 and MW1-60

Naval Base Kitsap
Keyport

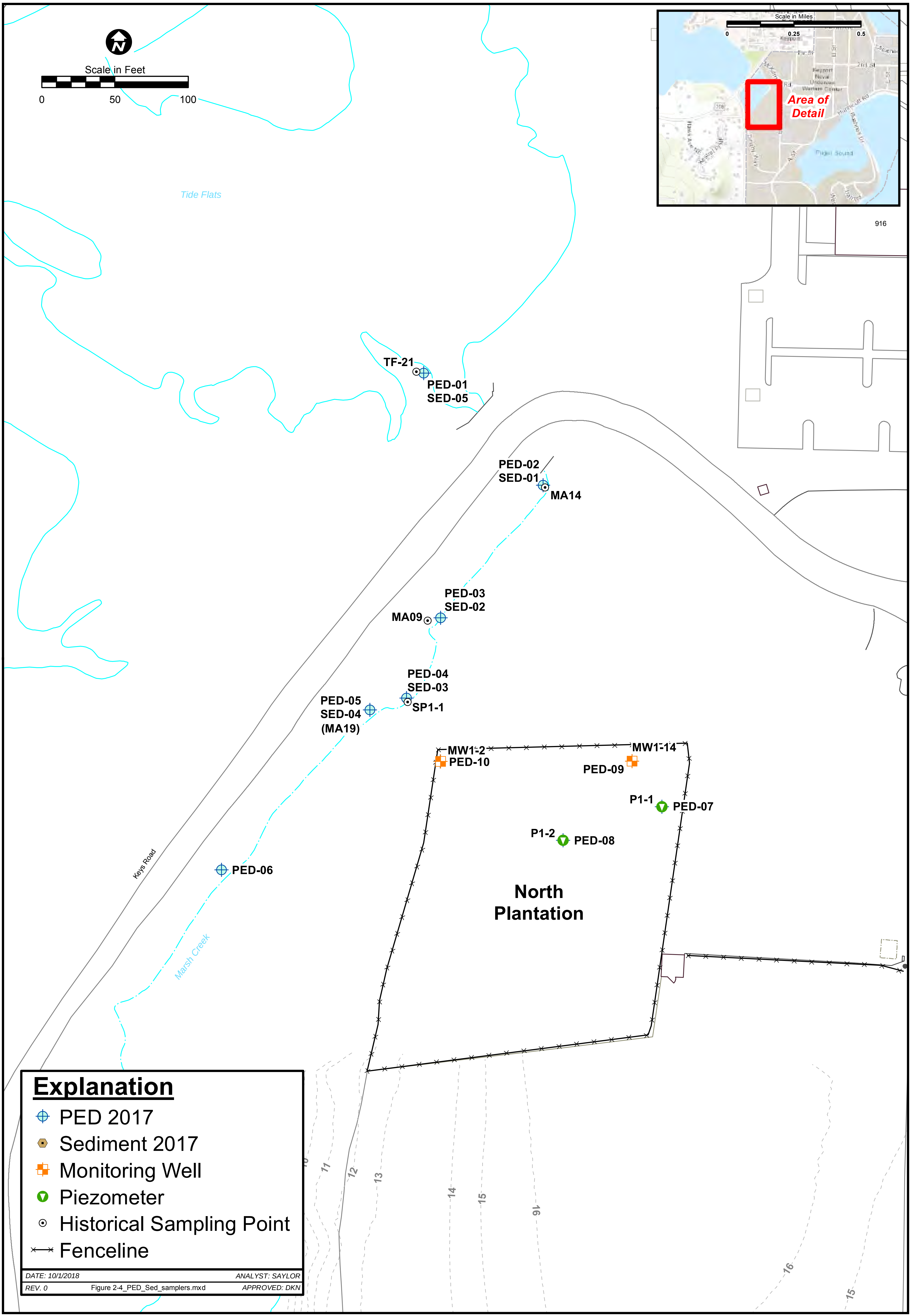

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Figure 2-4
Sediment and PED Sampling Locations

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Monitoring Well

PED in Place

PED Retrieved

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Figure 2-5
Photographs of PEDs

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Table 2-1. Deviations from the Sampling and Analysis Plan

Deviation	Description	Rationale	Effective Date	Samples Affected	FCR No.	SAP Section(s) Affected
Shorten sample analysis turnaround times and add analyses for soil samples exhibiting free product.	Submit initial soil samples on a 5-day TAT to allow correlation of field observations (including PID readings) to VOC concentrations measured in the laboratory. Initial soil samples to include three collected from boring SP-B01 (collected on July 12, 2017), three from CL-B02 (collected on July 12, 2017), and three from CL-B03 (collected on July 11, 2017). In addition, because of the observation of dark brown oily free product lining selected sampler sleeves collected from direct-push boring SP-B01 on July 11, add the following analyses to one soil sample collected from the area with the highest PID concentration to assess the product observed: - NWTPH - HCID - Follow-on NWTPH-Dx analysis (if warranted) - Full 8260C analyte list - PCB Aroclors by EPA Method 8082 (if RRO is identified in the HCID) - Note that there will be insufficient sample for NWTPH-G (if warranted based on the HCID analysis); however, the primary risk drivers benzene, ethylbenzene, toluene and xylenes will be captured by the full 8260C analyte list. No field duplicates, equipment blanks, or other QC samples are proposed for the additional analyses. To allow for timely data interpretation in advance of Mobilization 2, analyze all grab soil and groundwater samples collected during the last week of mobilization (August 7 through 11, 2017) on a 14-day TAT.	Earlier data return from the laboratory is warranted to allow correlation of field observations (including PID readings) to VOC concentrations measured in the laboratory. Also, conditions observed in soil boring SP-B01 were different than anticipated, warranting additional analyses on one sample to assess the product encountered and early data return from the laboratory to ensure additional samples collected from the hot spot area at soil boring SP-B01 are analyzed appropriately. Earlier data return from the laboratory is also warranted for data collected near the end of Mobilization 1 to allow planning for Mobilization 2.	07/13/17	Initial grab soil samples, final grab soil and groundwater samples, and soil samples exhibiting free product.	1	WS#14,15-8,18,19,20, and #23-6
Allow for targeted coring and alternate method of groundwater sample collection.	To allow more efficient use of time, continuous core select borings as determined in collaboration with the RPM to continue to correlate between MIP EC logs and lithology observed in soil cores and correlate between hand-held PID and MIP PID/XSD results. For borings not selected for continuous coring, drive to selected depths based on data obtained from nearby MIP and other direct-push borings, and core discrete ranges to allow collection of soil samples from target contaminated zones. Allow the use of an alternate collection method for grab groundwater, to consist of a hand-placed, clean, temporary PVC well screen at the target depth, which is removed after groundwater sample collection.	Lithology is found to correlate well to the MIP EC log, and continuous coring to establish lithology at each boring location is not necessary. More samples can be collected in the time available if not all of the direct-push borings are continuously cored. The hand-placed temporary well screen is a more efficient way to collect a shallow grab groundwater under some site conditions in some borings. Allowing the use of multiple methods for collecting grab groundwater samples provides flexibility and increases efficiency, allowing data collection to be maximized within the time available.	07/13/17	Grab groundwater samples from continuous core soil borings	2	N/A

Table 2-1. Deviations from the Sampling and Analysis Plan (continued)

Deviation	Description	Rationale	Effective Date	Samples Affected	FCR No.	SAP Section(s) Affected
Add additional analyses of soil samples when unexpected conditions occur, shorten holding time.	Because of the observation of an oily free product in direct-push boring CL-B18A at a depth of 18 ft on July 18, and the previous observation of black stained soil at SP-B01, allow for the following additional analyses of soil samples when unexpected conditions are observed: - NWTPH - HCID - Follow-on NWTPH-Gx, -Dx analyses (if warranted) - PCB Aroclors by EPA Method 8082 (if RRO is identified) - Full 8260C analyte list - SVOCs via EPA Method 8270 Request a 21 day TAT for these additional analyses. Request the laboratory standard limits of detection (LODs) and limits of quantitation [LOQs; which are equivalent to practical quantitation limits (PQLs)] for these additional analyses, and develop and compare to PALs in the project report. No field duplicates, equipment blanks, or other QC samples are proposed for the additional analyses. The laboratory no longer provides preserved soil sample vials as called for in the SAP. The holding time using unpreserved soil sample vials is 48 hrs. Ship samples more frequently, or use a courier, to meet the 48-hr holding time.	Conditions observed in soil boring CL-B18A and previous soil boring SP-B01 were different than anticipated, warranting the flexibility to add additional analyses to select soil samples at the discretion of the field team in consultation with the RPM. Based on changes in the laboratory procedures, the hold time for grab soil samples analyzed for VOCs needs to be reduced to 48 hours.	07/20/17	Grab soil samples analyzed for VOCs	4	SAP Worksheet #14,15-8,18,19,20, and #23-6
Add Aroclor analysis to sediments and add passive sampling; adjust timing of surface water sample collection.	Add PCB aroclor analysis to sediment samples with the same turn-around-time as PCB congeners. Request the laboratory standard LODs and LOQs for this additional analysis, and develop and compare to PALs in the project report. Also run sediment field duplicates, equipment blanks, and other QC samples for PCB aroclors. Collect surface water samples during Mobilization 2 instead of Mobilization 1. Also deploy, retrieve, and analyze passive sediment samplers at sediment stations and in select monitoring wells and piezometers.	The Washington State Department of Ecology requested the additional of PCB aroclor analysis to allow comparison to historical results at these sediment stations. Because of record-setting dry weather during Mobilization 1, no surface water was present at nearly half of the planned surface water sample stations. Cost savings during work plan preparation can be used to optimize the sediment sampling approach (as documented in an approved Concurrence Letter between Battelle and the Navy). The planned optimization using passive samplers will provide direct measurement of PCB concentrations in pore water that can be used as a line of evidence in the risk assessments.	08/17/17	Sediment samples analyzed for PCB congeners	5	Worksheet #12-1, 14, 15-1, 18, 19, 20, 23-5, 24, 25, 28-1, and 30

Table 2-1. Deviations from the Sampling and Analysis Plan (continued)

Deviation	Description	Rationale	Effective Date	Samples Affected	FCR No.	SAP Section(s) Affected
Use of CMT well construction at select locations.	At selected well locations (3 to 5 locations), install wells using Continuous Multi-Channel Tubing (CMT). Ports will be cut in each CMT tubing channel at the depths selected based on the geology observed in adjacent continuous core direct-push borings, and based on the vertical contaminant distribution observed. Following positioning of the CMT tubing in the bore hole, 4 ft of filter pack, consisting of 10/20 Colorado silica sand, will be placed at the depth of each open port (2 ft of sand above and below each port). Each interval of filter pack will be separated from each other filter pack interval with a minimum of 2 ft of hydrated bentonite chips. The CMT will be sealed at ground surface with a minimum of 2 ft of hydrated bentonite chips and finished with a locking well monument set in concrete.	During the direct-push continuous coring investigation, the vertical distribution of COCs in the eastern portion of the South Plantation was found to be complex, with high COC concentrations found at multiple depths separated by relatively lower concentrations. Installation of CMT wells will allow sampling of discrete vertical intervals within one well bore, to help understand the nature of the vertical distribution of COCs in this area.	09/19/17	MW1-56, MW1-57, and MW1-58.	6	WS#14, 17, 18, 19, and 20
Revise microbial analytical method	Revise microbial analysis to include a full quantitative array of reductase genes (Microbial Insights analysis "Quantitative Array Chlor").	The Navy Subject Matter Expert recommends the expanded analysis to better meet the project objectives.	10/11/17	samples analyzed for Microbial qPCR	8	Worksheet #12-7, 14, 15-7, 18, 19, 20, 23-4, 24, 25, 28-18, and 30
Change laboratory analyzing groundwater samples for PFAS	Change analysis of groundwater samples for PFAS compounds in groundwater samples to the Battelle Norwell Laboratory instead of ALS, subcontracted to Empirical, under contract to Battelle.	The Navy has issued a clarification that analysis of PFAS compounds must be performed by laboratories who are DOD QSM 5.1 certified. Certification to DOD QSM 5.0 is not sufficient. ALS is in the process of obtaining DOD QSM 5.1 certification, but is not yet certified. The Battelle Norwell Laboratory is DOD QSM 5.1 certified for PFAS compounds in groundwater, drinking water, and tissue.	11/06/17	All PFAS samples	9	SAP Worksheet #3, 4, 7, 14, 15-5, 23-2, 28-7, and 30.
Location of direct-push borings SP-B59 and SP-B60.	Locations SP-B59 and SP-B60 were placed slightly further west than shown in the SAP, west of Bradley Road.	The MIP locations in Bradley Road did not show evidence of contamination, and the intent of moving the locations to the west was to more closely constrain the eastward lateral extent of contamination observed at MIP-17, MIP-18, and MIP-59.	08/02/17	None.	None.	Worksheet #17; Figure 3
Location of direct-push borings SP-B63 and SP-B64.	Borings SP-B63 and SP-B64 were relocated from the prescribed locations in the SAP as follows: SP-B63 was placed 5 ft. northwest of MIP-057; SP-B64 was relocated to be adjacent to the outfall pipe south of MIP-058 and west of MIP-056.	SP-B63 was relocated to help delineate the contamination observed in SP-B53 (adjacent to MIP-019) to the northwest; SP-B64 was relocated to combine the proposed points near the MIP locations mentioned and to delineate this area.	08/04/17	None.	None.	Worksheet #17; Figure 3
Location of direct-push boring SP-B67.	SP-B67 was relocated to combine two proposed locations into one to delineate the northern extent of the plume area surrounding well MW1-16.	More efficient use of the time available with the direct-push probe on site to characterize the area.	08/06/17	None.	None.	Worksheet #17; Figure 3

Table 2-1. Deviations from the Sampling and Analysis Plan (continued)

Deviation	Description	Rationale	Effective Date	Samples Affected	FCR No.	SAP Section(s) Affected
Locations of planned sediment samples shifted.	Locations of composite sediment samples SED-02 and SED-04 were each shifted approximately 10 ft from the planned coordinates.	Locations of the sediment samples were shifted to align with actual surface water flow.	09/06/17	None.	None.	Worksheet #17-2.4
Porewater samples not collected at all planned stations, water quality parameters not collected.	Porewater sample locations were moved from planned waypoints (<10 ft horizontally). Three porewater sample locations south of the South Plantation were abandoned. One additional location south of the South Plantation was abandoned. Water quality parameters were not collected from porewater samples.	Porewater sample locations were moved due to access issues and to guarantee production of porewater. Three porewater sample locations were abandoned because they (and the surrounding area) were dry. The additional location was abandoned because the waypoint was situated immediately within the root structure of a thick section of woody undergrowth. Water quality parameters were not collected from porewater samples due to the low production rates of porewater at these locations.	09/08/17	None.	None.	Worksheet #17-2.7, 17-4.7; Figure 3, Figure 4
No well installed at planned location MW1-61.	The planned second monitoring well at location MW1-61 (B85) along the property line was not installed.	Continuous silt and clay was logged from ground surface to 46.5 ft bgs, with no groundwater observed.	10/13/17	None.	None.	Worksheet #17, Figure 3, Figure 4
Number of surface water samples.	Twelve surface water samples were collected.	The Plan specifies 11 surface water samples, but 12 locations were indicated on the South Plantation figure within the Plan, and so 12 samples were collected.	10/26/17	None.	None.	Worksheet #17-2.8, Figure 3
Peristaltic pump used to collect grab groundwater samples.	Rather than the check-valve sampling device anticipated by the SAP, a peristaltic pump was used to collect grab groundwater samples.	The SAP anticipated the need to use a check-valve sampling device because of the planned depth of some samples. However, use of the peristaltic pump was successful because of the shallow hydraulic head in the aquifer.	07/10/17	Grab groundwater samples	None.	Worksheet 17.
Undisturbed soil sample collection method.	Relatively undisturbed soil samples were collected using a Modified California split-spoon sampler driven by a 140-pound autohammer, rather than a Dames and Moore sampler driven with a 300-pound hammer.	The heavier autohammer could not be readily mounted on the drill rig. The use of the slightly smaller sampler and lighter hammer did not affect the ability to obtain representative samples.	10/02/17	Undisturbed soil samples.	None.	Worksheet 17.
Chloroethane not sampled in groundwater from monitoring wells, surface water, and porewater.	The planned 9 VOC COCs were analyzed in groundwater, surface water, and porewater, but the breakdown compound chloroethane was inadvertently omitted from the analysis.	Extensive data regarding chloroethane concentrations in groundwater are available from the grab groundwater sampling, and this omission does not impact overall data evaluation.	09/07/17	Groundwater from monitoring wells, porewater, and surface water.	None.	Worksheet 15.

Table 2-1. Deviations from the Sampling and Analysis Plan (continued)

Deviation	Description	Rationale	Effective Date	Samples Affected	FCR No.	SAP Section(s) Affected
Stormwater samples collected using a dipper.	Stormwater samples were collected using a decontaminated polyethylene dipper rather than direct-filling laboratory glassware.	The outfall location was not directly accessible because of extensive standing water, and the second stormwater sample was collected from within a manhole structure.	11/15/17	Stormwater samples.	None.	Worksheet 17.

Table 2-2. Sampling Performed during Direct-Push Drilling

Location ID	Soil Sample ID	Soil Analyses	GW Sample ID	GW Sample Analyses
South Plantation				
SP-B01	SP-B01-S-13.5-170711	Full List VOCs	SP-B01-GW-13.5-170711	Target VOCs
	SP-B01-S-17.5-170711	PCB Aroclors, Full List VOCs and Petroleum	SP-B01-GW-17.5-170711	Target VOCs
	SP-B01-S-28.0-170711	Full list VOCs		
SP-B01a			SP-B01a-GW-28.0-170711	Target VOCs
SP-B01b	SP-B01b-S-8.0-170807	Target VOCs, SVOCs, Otto Fuel	SP-B01b-GW-10.0-170807	Target VOCs, Otto Fuel
			SP-B01b-GW-15.0-170809	Target VOCs, Otto Fuel
SP-B40	SP-B40-S-7.0-170726	Target VOCs	SP-B40-GW-11.0-170726	Target VOCs
	SP-B40-S-13.0-170726	Target VOCs	SP-B40-GW-16.0-170726	Target VOCs
	SP-B40-S-20.0-170726	Target VOCs		
SP-B41	SP-B41-S-8.0-170726	Target VOCs	SP-B41-GW-10.0-170726	Target VOCs
SP-B42	SP-B42-S-7.5-170727	Target VOCs	SP-B42-GW-10.0-170727	Target VOCs
	SP-B42-S-16.0-170727	Target VOCs	SP-B42-GW-18.0-170727	Target VOCs
	SP-B42-S-20.0-170727	Target VOCs		
SP-B43	SP-B43-S-10.0-170727	Target VOCs		
	SP-B43-S-12.0-170727	Target VOCs		
SP-B43a			SP-B43a-GW-13.0-170807	Target VOCs
SP-B44	SP-B44-S-10.5-170727	Target VOCs	SP-B44-GW-12.0-170727	Target VOCs
SP-B45	SP-B45-S-13.5-170727	Target VOCs	SP-B45-GW-18.0-170727	Target VOCs
	SP-B45-S-18.0-170727	Target VOCs		

Table 2-2. Sampling Performed during Direct-Push Drilling (continued)

Location ID	Soil Sample ID	Soil Analyses	GW Sample ID	GW Sample Analyses
SP-B46	SP-B46-S-13.0-170728	Target VOCs	SP-B46-GW-15.0-170728	Target VOCs
SP-B47	SP-B47-S-14.0-170728	Target VOCs	SP-B47-GW-15.0-170728	Target VOCs
SP-B48b	SP-B48b-S-6.0-170728	Target VOCs	SP-B48b-GW-10.0-170728	Target VOCs
	SP-B48b-S-11.0-170728	Target VOCs		
SP-B49	SP-B49-S-9.5-170728	Target VOCs	SP-B49-GW-10.0-170728	Target VOCs
			SP-B49-GW-20.0-170728	Target VOCs
SP-B50	SP-B50-S-12.0-170731	Target VOCs	SP-B50-GW-14.0-170731	Target VOCs
	SP-B50-S-16.5-170731	Target VOCs		
SP-B51	SP-B51-S-13.0-170731	Target VOCs	SP-B51-GW-14.0-170731	Target VOCs
	SP-B51-S-17.0-170731	Target VOCs		
SP-B52	SP-B52-S-9.0-170731	Target VOCs	SP-B52-GW-11.0-170731	Target VOCs
	SP-B52-S-12.0-170731	Target VOCs	SP-B52-GW-20.0-170731	Target VOCs
SP-B53	SP-B53-S-10.0-170731	Target VOCs	SP-B53-GW-23.0-170731	Target VOCs
	SP-B53-S-24.0-170731	Target VOCs	SP-B53-GW-33.0-170731	Target VOCs
	SP-B53-S-32.0-170731	Target VOCs		
	SP-B53-S-33.5-170731	Target VOCs		
SP-B54	SP-B54-S-7.0-170801	Target VOCs	SP-B54-GW-7.0-170801	Target VOCs
	SP-B54-S-17.0-170801	Target VOCs	SP-B54-GW-35.0-170801	Target VOCs
	SP-B54-S-35.0-170801	Target VOCs		
SP-B55	SP-B55-S-9.0-170801	Target VOCs	SP-B55-GW-10.0-170801	Target VOCs
	SP-B55-S-33.0-170801	Target VOCs	SP-B55-GW-33.0-170801	Target VOCs
SP-B56	SP-B56-S-10.0-170801	Target VOCs	SP-B56-GW-10.0-170801	Target VOCs
	SP-B56-S-27.0-170801	Target VOCs	SP-B56-GW-27.0-170801	Target VOCs

Table 2-2. Sampling Performed during Direct-Push Drilling (continued)

Location ID	Soil Sample ID	Soil Analyses	GW Sample ID	GW Sample Analyses
SP-B57	SP-B57-S-10.0-170802	Target VOCs	SP-B57-GW-10.0-170802	Target VOCs
	SP-B57-S-29.0-170802	Target VOCs	SP-B57-GW-29.0-170802	Target VOCs
SP-B58	SP-B58-S-21.0-170802	Target VOCs	SP-B58-GW-39.0-170802	Target VOCs
	SP-B58-S-37.0-170802	Target VOCs		
	SP-B58-S-39.5-170802	Target VOCs		
SP-B59	SP-B59-S-5.0-170802	Target VOCs	SP-B59-GW-30.0-170802	Target VOCs
	SP-B59-S-21.0-170802	Target VOCs		
	SP-B59-S-29.8-170802	Target VOCs		
SP-B60	SP-B60-S-7.5-170802	Target VOCs	SP-B60-GW-9.0-170802	Target VOCs
	SP-B60-S-17.0-170802	Target VOCs	SP-B60-GW-24.0-170802	Target VOCs
	SP-B60-S-23.5-170802	Target VOCs		
SP-B61	SP-B61-S-18.0-170803	Target VOCs	SP-B61-GW-25.0-170803	Target VOCs
	SP-B61-S-23.5-170803	Target VOCs		
SP-B62	SP-B62-S-7.0-170803	Full list VOCs, SVOCs, Petroleum, PCB Aroclors	SP-B62-GW-26.0-170804	Target VOCs
	SP-B62-S-16.0-170803	Target VOCs		
	SP-B62-S-24.0-170803	Target VOCs		
	SP-B62-S-26.0-170804	Target VOCs		
SP-B62a	SP-B62-S-6.5-170807	Otto Fuel		
SP-B63	SP-B63-S-18.5-170804	Target VOCs	SP-B63-GW-24.0-170804	Target VOCs
	SP-B63-S-24.0-170804	Target VOCs		
SP-B64	SP-B64-S-5.5-170804	Target VOCs	SP-B64-GW-10.0-170804	Target VOCs
	SP-B64-S-12.0-170804	Target VOCs		
SP-B65C	SP-B65-S-8.0-170806	Target VOCs	SP-B65-GW-9.0-170806	Target VOCs

Table 2-2. Sampling Performed during Direct-Push Drilling (continued)

Location ID	Soil Sample ID	Soil Analyses	GW Sample ID	GW Sample Analyses
SP-B66	SP-B66-S-9.0-170806	Target VOCs	SP-B66-GW-10.0-170806	Target VOCs
	SP-B66-S-10.5-170806	Target VOCs		
SP-B67	SP-B67-S-12.5-170806	Target VOCs	SP-B67-GW-14.0-170806	Target VOCs
	SP-B67-S-24.0-170806	Target VOCs		
SP-B68	SP-B68-S-0.5-170806	Target VOCs	SP-B68-GW-13.0-170806	Target VOCs
	SP-B68-S-9.5-170806	Target VOCs		
	SP-B68-S-12.5-170806	Target VOCs		
SP-B69	SP-B69-S-11.5-170806	Target VOCs	SP-B69-GW-12.0-170806	Target VOCs
	SP-B69-S-15.0-170806	Target VOCs		
Central Landfill				
CL-B02	CL-B02-S-14.0-170711	Full List VOCs	CL-B02-GW-20.0-170711	Target VOCs
	CL-B02-S-20.0-170711	Full List VOCs		
	CL-B02-S-29.0-170711	Full List VOCs		
CL-B03	CL-B03-S-18.0-170712	Full List VOCs	CL-B03-GW-22.0-170712	Target VOCs
	CL-B03-S-19.4-170712	Full List VOCs		
	CL-B03-S-37.0-170712	Full List VOCs		
CL-B04	CL-B04-S-11.5-170712	Full List VOCs	CL-B04-GW-20.0-170712	Target VOCs
	CL-B04-S-19.5-170712	Full List VOCs		
	CL-B04-S-29.0-170712	Full List VOCs		
CL-B05	CL-B05-S-18.3-170712	Target VOCs	CL-B05-GW-19.0-170712	Target VOCs
CL-B06A	CL-B06a-S-16.0-170713	Target VOCs	CL-B06a-GW-16.0-170713	Target VOCs
	CL-B06a-S-33.0-170713	Target VOCs		
CL-B07	CL-B07-S-4.0-170713	Target VOCs	CL-B07-GW-29.0-170713	Target VOCs

Table 2-2. Sampling Performed during Direct-Push Drilling (continued)

Location ID	Soil Sample ID	Soil Analyses	GW Sample ID	GW Sample Analyses
	CL-B07-S-20.0-170713	Target VOCs		
	CL-B07-S-28.5-170713	Target VOCs		
CL-B08	CL-B08-S-17.5-170713	Target VOCs	CL-B08-GW-18.0-170713	Target VOCs
	CL-B08-S-27.0-170713	Target VOCs		
CL-B09	CL-B09-S-13.0-170713	Target VOCs	CL-B09-GW-14.0-170713	Target VOCs
CL-B10	CL-B10-S-10.0-170714	Target VOCs	CL-B10-GW-12.0-170714	Target VOCs
	CL-B10-S-21.0-170714	Target VOCs		
CL-B11	CL-B11-S-7.0-170714	Target VOCs	CL-B11-GW-12.0-170714	Target VOCs
CL-B12	CL-B12-S-17.5-170714	Target VOCs	CL-B12-GW-21.0-170714	Target VOCs
	CL-B12-S-20.5-170714	Target VOCs		
	CL-B12-S-31.5-170714	Target VOCs		
CL-B13	CL-B13-S-11.5-170717	Target VOCs	CL-B13-GW-12.0-170717	Target VOCs
CL-B14b	CL-B14b-S-4.0-170717	Target VOCs	CL-B14b-GW-22.0-170717	Target VOCs
	CL-B14b-S-9.0-170717	Target VOCs		
	CL-B14b-S-18.0-170717	Target VOCs		
	CL-B14b-S-21.0-170717	Target VOCs		
CL-B15	CL-B15-S-23.0-170717	Target VOCs	CL-B15-GW-23.0-170717	Target VOCs
CL-B16	CL-B16-S-12.5-170718	Target VOCs	CL-B16-GW-13.0-170718	Target VOCs
CL-B17	CL-B17-S-20.0-170718	Target VOCs	CL-B17-GW-19.5-170718	Target VOCs
CL-B18a	CL-B18a-S-14.5-170718	Target VOCs	CL-B18a-GW-14.5-170718	Target VOCs
	CL-B18a-S-18.0-170718	PCB Aroclors, Petroleum, Target VOCs and SVOCs	CL-B18a-GW-33.0-170719	Target VOCs

Table 2-2. Sampling Performed during Direct-Push Drilling (continued)

Location ID	Soil Sample ID	Soil Analyses	GW Sample ID	GW Sample Analyses
	CL-B18a-S-21.5-170718	Target VOCs		
	CL-B18a-S-22.3-170718	Target VOCs		
	CL-B18a-S-33.0-170718	Target VOCs		
CL-B18b			CL-B18b-GW-20.0-170807	Target VOCs, Otto Fuel
CL-B19	CL-B19-S-23.0-170719	Target VOCs	CL-B19-GW-23.0-170719	Target VOCs
	CL-B19-S-38.0-170719	Target VOCs		
CL-B20	CL-B20-S-25.0-170719	Target VOCs	CL-B20-GW-26.5-170719	Target VOCs
	CL-B20-S-28.3-170719	Target VOCs	CL-B20-GW-32.0-170719	Target VOCs
	CL-B20-S-31.5-170719	Target VOCs		
CL-B21	CL-B21-S-12.0-170720	PCB Aroclors, Petroleum, Target VOCs and full list SVOCs	CL-B21-GW-12.5-170720	Target VOCs
	CL-B21-S-21.5-170720	Target VOCs		
CL-B21a			CL-B21a-GW-20.0-170807	Target VOCs, Otto Fuel
CL-B22	CL-B22-S-18.5-170720	Target VOCs	CL-B22-GW-19.0-170720	Target VOCs
CL-B23	CL-B23-S-13.5-170720	Target VOCs	CL-B23-GW-14.0-170720	Target VOCs
	CL-B23-S-18.0-170720	Target VOCs	CL-B23-GW-18.0-170720	Target VOCs
CL-B24	CL-B24-S-15.5-170720	Target VOCs	CL-B24-GW-16.0-170720	Target VOCs
CL-B25	CL-B25-S-14.0-170720	Target VOCs	CL-B25-GW-29.0-170720	Target VOCs
	CL-B25-S-29.0-170720	Target VOCs		
CL-B26a	CL-B26a-S-9.0-170721	Target VOCs	CL-B26a-GW-10.0-170721	Target VOCs
	CL-B26a-S-19.0-170721	Target VOCs		

Table 2-2. Sampling Performed during Direct-Push Drilling (continued)

Location ID	Soil Sample ID	Soil Analyses	GW Sample ID	GW Sample Analyses
	CL-B26a-S-26.0-170721	Target VOCs		
CL-B27	CL-B27-S-10.0-170721	Target VOCs	CL-B27-GW-10.0-170721	Target VOCs
CL-B28	CL-B28-S-9.0-170721	Target VOCs	CL-B28-GW-10.0-170721	Target VOCs
CL-B29a	CL-B29a-S-7.0-170724	Target VOCs	CL-B29a-GW-21.0-170724	Target VOCs
	CL-B29a-S-21.0-170724	Target VOCs		
CL-B30a	CL-B30a-S-10.5-170724	Target VOCs	CL-B30a-GW-21.0-170724	Target VOCs
	CL-B30a-S-21.0-170724	Target VOCs		
CL-B31	CL-B31-S-11.5-170724	Target VOCs	CL-B31-GW-12.0-170724	Target VOCs
	CL-B31-S-19.0-170724	Target VOCs		
CL-B32	CL-B32-S-15.0-170724	Target VOCs	CL-B32-GW-16.0-170724	Target VOCs
CL-B33	CL-B33-S-3.5-170724	Target VOCs	CL-B33-GW-13.0-170724	Target VOCs
CL-B34	CL-B34-S-18.0-170725	Target VOCs	CL-B34-GW-20.0-170725	Target VOCs
CL-B35	CL-B35-S-18.0-170725	Target VOCs	CL-B35-GW-21.0-170725	Target VOCs
	CL-B35-S-20.5-170725	Target VOCs		
CL-B36	CL-B36-S-15.5-170725	Target VOCs		
CL-B36A			CL-B36a-GW-17.0-170725	Target VOCs
CL-B37	CL-B37-S-15.0-170726	Target VOCs	CL-B37-GW-15.0-170726	Target VOCs
CL-B38C			CL-B38C-S-4.0-170726	Target VOCs
CL-B39	CL-B39-S-7.0-170726	Target VOCs	CL-B39-GW-10.0-170726	Target VOCs

Full List VOCs - Samples analyzed using EPA Method 8260C for the full standard list of VOCs associated with this method.
Petroleum - Samples were screened using NWTPH- HCID and analyzed for one or more of the methods TPH-Diesel Range (NWTPH-Dx), TPH-Motor oil C24-C36 (NWTPH-Dx) or TPH-total unknown Gasoline (NWTPH-Gx) based on screening results
Otto Fuel - Samples analyzed for Otto Fuel by the Navy’s Keyport Laboratory.

Table 2-2. Sampling Performed during Direct-Push Drilling (continued)

PCB Aroclors - Samples analyzed for PCBs using EPA Method 8082A
SVOCs - Samples analyzed for the full standard list of semi-volatile organic compounds using EPA Method 8270D.
Target VOCs - Samples analyzed using EPA Method 8260C for the 9 VOC COCs: 1,2-dichloroethane, tetrachloroethylene (PCE), cis-1,2-dichloroethylene, trans-1,2-dichloroethylene, 1,1,1-trichloroethane, vinyl chloride, 1,1-dichloroethane, 1,1-dichloroethylene, and trichloroethylene (TCE) plus the degradation compound chloroethane.
Physical Characteristics - Samples analyzed for porosity, bulk density, hydraulic conductivity, grain size distribution, and TOC.

Table 2-3. Sampling Performed during Auger Drilling and from Groundwater Monitoring Wells

Location ID	Soil Sample ID	Soil Analyses	GW Sample ID	GW Sample Analyses
IW1-S			IW1-S-171026	MNA, VOC COCs
MW1-42/CL-B76	CL-B76-S-19.0-171006	Target VOCs	MW1-42-171023	MNA, VOC COCs
MW1-43/CL-B77	CL-B77-S-18.0-171006	Target VOCs	MW1-43-171023	MNA, PFAS, 1,4-dioxane, VOC COCs
MW1-44/CL-B75	CL-B75-S-26.0-171005	Target VOCs	MW1-44-171023	MNA, VOC COCs
MW1-45/CL-B74	CL-B74-S-18.5-171005	Target VOCs	MW1-45-171023	MNA, VOC COCs
MW1-46/CL-B78	CL-B78-S-28.5-171007	Target VOCs, Physical Characteristics	MW1-46-171023	MNA, Microbial, PFAS, 1,4-dioxane, VOC COCs
MW1-47/CL-B79	CL-B79-S-21.5-171009	Target VOCs, Physical Characteristics	MW1-47-171023	MNA, Microbial, PFAS, 1,4-dioxane, VOC COCs
MW1-48/CL-B83	CL-B83-S-18.5-171012	Target VOCs, Physical Characteristics	MW1-48-171024	MNA, Microbial, PFAS, 1,4-dioxane, VOC COCs
MW1-49/SP-B80	SP-B80-S-7.5-171010	Target VOCs	MW1-49-171024	MNA, VOC COCs
MW1-50/SP-B73	SP-B73-S-9.0-171004	Target VOCs, Physical Characteristics	MW1-50-171024	MNA, Microbial, PFAS, 1,4-dioxane, VOC COCs
MW1-51/SP-B71	SP-B71-S-13.5-171002	Target VOCs,	MW1-51-171024	MNA, VOC COCs
MW1-52/SP-B72	SP-B72-S-12.0-171003	Target VOCs, Physical Characteristics	MW1-52-171024	MNA, Microbial, PFAS, 1,4-dioxane, VOC COCs
MW1-53/SP-B82	SP-B82-S-10.0-171011	Target VOCs	MW1-53-171026	MNA, VOC COCs
MW1-54/SP-B81	SP-B81-S-38.5-171011	Target VOCs	MW1-54-171024	MNA, VOC COCs
MW1-55/SP-B86	SP-B86-S-35.0-171016	Target VOCs	MW1-55-171024	MNA, VOC COCs
MW1-56/SP-B87	SP-B87-S-9.0-171017	Target VOCs, Physical Characteristics	MW1-56-12.0-171025	MNA, Microbial, PFAS, 1,4-dioxane, VOC COCs
	SP-B87-S-29.0-171017	Target VOCs, Physical Characteristics	MW1-56-24.0-171025	MNA, Microbial, VOC COCs

Table 2-3. Sampling Performed during Auger Drilling and from Groundwater Monitoring Wells (continued)

Location ID	Soil Sample ID	Soil Analyses	GW Sample ID	GW Sample Analyses
	SP-B87-S-37.5-171017	Target VOCs, Physical Characteristics		
MW1-57/SP-B88	SP-B88-S-9.0-171018	Target VOCs	MW1-57-10.0-171025	PFAS, VOC COCs, MNA, 1,4-dioxane, Microbial
	SP-B88-S-31.0-171018	Target VOCs		
			MW1-57-16.0-171025	Microbial, VOC COCs, MNA
			MW1-57-34.0-171025[a]	Microbial, VOC COCs, MNA
MW1-58/SP-B89	SP-B89-S-6.5-171101	Target VOCs, Physical Characteristics	MW1-58-9.0-171115	PFAS, VOC COCs, MNA, 1,4-dioxane
	SP-B89-S-24.0-171101	Target VOCs, Physical Characteristics	MW1-58-19.0-171115	VOC COCs, MNA
	SP-B89-S-34.0-171101	Target VOCs, Physical Characteristics	MW1-58-35.0-171115	VOC COCs, MNA
MW1-60/SP-B84	SP-B84-S-20.0-171012	Target VOCs	MW1-60-171026	PFAS, VOC COCs, MNA, 1,4-dioxane

[a] – The sample ID incorrectly indicates the depth of this sample as 34 feet bgs. The actual depth was 31 feet bgs.
VOC COCs - Samples analyzed using EPA Method 8260C for 1,2-dichloroethane, tetrachloroethylene (PCE), cis-1,2-dichloroethylene, trans-1,2-dichloroethylene, 1,1,1-trichloroethane, vinyl chloride, 1,1-dichloroethane, 1,1-dichloroethylene, and trichloroethylene (TCE).
Target VOCs - Samples analyzed using EPA Method SW8260/8260C/8260B/8260 SIM for 10 VOCs: 1,2-dichloroethane, tetrachloroethylene (PCE), cis-1,2-dichloroethylene, trans-1,2-dichloroethylene, 1,1,1-trichloroethane, ethyl chloride (chloroethane), vinyl chloride, 1,1-dichloroethane, 1,1-dichloroethylene, and trichloroethylene (TCE).
PFAS - Samples analyzed for PFAS using EPA Method 537-Mod.
1,4-Dioxane - Samples analyzed for 1,4-Dioxane using EPA Method 8270D.
Microbial - Samples analyzed for microbes using Microbial qPCR (groundwater filters).
Physical Characteristics - Samples analyzed for porosity, bulk density, hydraulic conductivity, grain size distribution, and TOC.
MNA - Laboratory samples analyzed for BOD (EPA Method 5210B), COD (EPA Method 410.4), and anions (EPA Method 300).
Field samples analyzed for sulfite, ferrous iron, dissolved oxygen, oxidation/reduction potential, and pH.

Table 2-4. Well Construction Details

							Well Screen Information				
Well Name	**Ground Elevation (ft, NAVD 88)**	**TOC Elevation (ft, NAVD 88)**	**Easting**	**Northing**	**Static Depth to Water (ft BTOC)**	**Groundwater Elevation**	**Top (ft BTOC)**	**Bottom (ft BTOC)**	**ID (in)**	**OD (in)**	**Slot Size (in)**
MW1-42	13.62	12.77	1198819.7671	259497.0165	4.69	8.08	14.15	24.15	2	2.375	0.01
MW1-43	13.05	12.69	1198809.4138	259456.2297	4.51	8.18	14.64	24.64	2	2.375	0.01
MW1-44	12.89	12.24	1198806.4999	259394.5155	4.1	8.14	17.35	27.35	2	2.375	0.01
MW1-45	13.34	12.99	1198822.3192	259325.2582	5.45	7.54	14.65	24.65	2	2.375	0.01
MW1-46	17.07	16.71	1199026.2707	259508.6036	7.24	9.47	23.64	33.64	2	2.375	0.01
MW1-47	16.78	16.44	1199023.8478	259466.2485	6.91	9.53	14.66	24.66	2	2.375	0.01
MW1-48	16.09	15.80	1199082.0107	259416.0288	6.1	9.70	14.71	24.71	2	2.375	0.01
MW1-49	10.88	14.17	1198907.6253	258986.9134	6.01	8.16	8.29	18.29	2	2.375	0.01
MW1-50	14.21	16.75	1198967.2777	258988.4697	8.11	8.64	7.54	17.54	2	2.375	0.01
MW1-51	14.44	17.23	1198979.3721	259088.5398	8.35	8.88	12.79	22.79	2	2.375	0.01
MW1-52	14.13	17.11	1199004.9317	259050.3482	8.18	8.93	9.98	19.98	2	2.375	0.01
MW1-53	13.33	13.40	1199065.8429	259067.6984	4.29	9.11	5.07	15.07	2	2.375	0.01
MW1-54	12.69	15.57	1199050.1607	258949.7909	5.58	9.99	31.88	41.88	2	2.375	0.01
MW1-55	12.18	15.60	1199101.4660	258977.6776	5.72	9.88	29.92	39.92	2	2.375	0.01
MW1-56	13.16	15.82	1199144.3017	258984.0502	6.08	9.74	10.66	14.66	0.4	1.7	0.01
					6.02	9.80	22.66	26.66	0.4	1.7	0.01
					18.5[a]	-2.68	34.66	38.66	0.4	1.7	0.01
MW1-57	12.96	15.62	1199147.1727	259018.1379	5.7	9.92	8.66	13.16	0.4	1.7	0.01
					5.71	9.91	14.66	18.66	0.4	1.7	0.01
					5.72	9.90	28.66	33.66	0.4	1.7	0.01
MW1-58	14.03	16.84	1199138.2103	259057.7906	5.98	10.86	7.81	11.81	0.4	1.7	0.01
					5.24	11.60	17.81	21.81	0.4	1.7	0.01
					5.89	10.95	33.81	37.81	0.4	1.7	0.01
MW1-60	14.85	18.01	1198555.9076	259345.1140	10.26	7.75	18.16	28.16	2	2.375	0.01

Notes:

Static depth to water shown for all wells except CMT wells MW1-56, MW1-57, and MW1-58 measured on October 23, 2017. Depth to groundwater in CMT wells from purge logs.

Northing and easting coordinates based on Washington State Plan Coordinate System, North Zone, US Survey feet.

[a] - The bottom screened interval in well MW1-56 was found to not produce water, even with repeated development.

BTOC - below top of casing
ft - feet
ID - inside diameter
in - inches
NAVD 88 - North American Vertical Datum of 1988
OD - outside diameter
TOC - top of casing

Table 2-5. Porewater Samples

Location ID	Location at Site	Porewater Sample ID	Porewater Analyses
PW1-01	Central Landfill	PW1-01-170907	VOC COCs
PW1-02	South Plantation	PW1-02-170907	VOC COCs
PW1-03	South Plantation	PW1-03-170907	VOC COCs
PW1-04	South Plantation	PW1-04-170907	VOC COCs
PW1-05	Central Landfill	PW1-05-170908	VOC COCs
PW1-06	Central Landfill	PW1-06-170908	VOC COCs
PW1-07	Central Landfill	PW1-07-170908	VOC COCs
PW1-08	Central Landfill	PW1-08-170908	VOC COCs
PW1-09	Central Landfill	PW1-09-170908	VOC COCs
PW1-10	South Plantation	PW1-10-170908	VOC COCs

VOC COCs - Samples analyzed using EPA Method 8260C for 1,2-dichloroethane, tetrachloroethylene (PCE), cis-1,2-dichloroethylene, trans-1,2-dichloroethylene, 1,1,1-trichloroethane, vinyl chloride, 1,1-dichloroethane, 1,1-dichloroethylene, and trichloroethylene (TCE).

Table 2-6. Surface Water Samples

Location ID	Surface Water Sample ID	Surface Water Sample Analyses
SW1-01	SW1-01-171026	VOC COCs
SW1-02	SW1-02-171026	VOC COCs
SW1-03	SW1-03-171026	VOC COCs
SW1-04	SW1-04-171026	VOC COCs
SW1-05	SW1-05-171026	VOC COCs
SW1-06	SW1-06-171026	VOC COCs
SW1-07	SW1-07-171026	VOC COCs
SW1-08	SW1-08-171026	VOC COCs
SW1-09	SW1-09-171026	VOC COCs
SW1-10	SW1-10-171026	VOC COCs
SW1-11	SW1-11-171026	VOC COCs
SW1-12	SW1-12-171026	VOC COCs

VOC COCs - Samples analyzed using EPA Method 8260C for 1,2-dichloroethane, tetrachloroethylene (PCE), cis-1,2-dichloroethylene, trans-1,2-dichloroethylene, 1,1,1-trichloroethane, vinyl chloride, 1,1-dichloroethane, 1,1-dichloroethylene, and trichloroethylene (TCE).

Table 2-7. Stormwater Samples

Location ID	Stormwater Sample ID	Stormwater Sample Analyses
Outfall 08-705	08-705-STORMW-171115	VOC COCs
First Manhole Upstream of Outfall	MH-STORMW-171115	VOC COCs

VOC COCs - Samples analyzed using EPA Method 8260C for 1,2-dichloroethane, tetrachloroethylene (PCE), cis-1,2-dichloroethylene, trans-1,2-dichloroethylene, 1,1,1-trichloroethane, vinyl chloride, 1,1-dichloroethane, 1,1-dichloroethylene, and trichloroethylene (TCE).

Table 2-8. Sediment and Passive Samples

Nearest Historical Location ID	Sediment Sample ID	Sediment Analyses
MA-14	SED01-10-170906	PCB Congeners; PCB Aroclors; TOC
MA-09	SED02-10-170906	PCB Congeners; PCB Aroclors; TOC
SP1-1	SED03-10-170906	PCB Congeners; PCB Aroclors; TOC
MA19	SED04-10-170906	PCB Congeners; PCB Aroclors; TOC
TF-21	SED05-10-170907	PCB Congeners; PCB Aroclors; TOC
TF-21	PED-01-171005-PW	PCB Congeners
	PED-01-171005-SW	PCB Congeners
MA-14	PED-02-171005-PW	PCB Congeners
	PED-02-171005-SW	PCB Congeners
MA-09	PED-03-171005-PW	PCB Congeners
SP1-1	PED-04-171005-PW	PCB Congeners
MA19	PED-05-171005-PW	PCB Congeners
	PED-05-171005-SW	PCB Congeners
South of MW1-28	PED-06-171005-PW	PCB Congeners
	PED-06-171005-SW	PCB Congeners
P1-1	PED-07-171005	PCB Congeners
P1-2	PED-08-171005	PCB Congeners
MW1-14	PED-09-171005	PCB Congeners
MW1-2	PED-10-171005	PCB Congeners

PCB Congeners - Samples analyzed for PCBs using EPA Method 1668A/209 congeners and 10 homologues.
PCB Aroclors - Samples analyzed for PCBs using EPA Method 8082A
TOC- Sample analyzed for TOC using EPA Method 9060

3.0 LABORATORY AND FIELD ANALYTICAL RESULTS

3.1 QUALITY ASSURANCE/QUALITY CONTROL

All samples were collected and analyzed in accordance with EPA methods stated in the *Final Sampling and Analysis Plan (SAP) for Operable Unit 1 Site Recharacterization, Naval Base Kitsap Keyport, Washington* (U.S. Navy, 2017a) and FCRs 1 through 9 (Appendix B). Samples were shipped via overnight courier under chain-of-custody documentation to the designated analytical laboratories for analysis. The analytical laboratories were required to maintain certification from Department of Defense Environmental Laboratory Accreditation Program for the analytical methods performed on the samples with the exception of Microbial Insights (microbial populations and functional genes) and PTS Laboratories, Inc. (geotechnical analyses). Laboratories used to perform the analyses were also state-accredited for analyses accredited by the State of Washington.

Laboratory quality assurance (QA) oversight involved the performance of a first-level screening of the data and an indication of any deviations from their precision, accuracy, detection limit, or laboratory QA/quality control (QC) criteria. A representative from each laboratory signed the data sheets, ensuring that the screening described above had been completed. Subsequently, Battelle completed a completeness review of the data by comparing the analyses requested for each sample on the chain-of-custody form with the database results for that sample. Additionally, the analytical data, along with the associated laboratory QC information, were forwarded to an independent, third-party data validation service. An EPA Stage IV data validation was performed on 100% of the soil and groundwater samples for all analytes. Third-party data validation was not performed on the microbial population, functional genes and geotechnical data in accordance with the SAP.

Results from the sampling event indicated that the data generally met analytical criteria. However, there were exceptions to the analytical criteria noted in the laboratory data validation reports. Exceptions to the analytical criteria are detailed in the sections below by matrix (e.g. soil, sediment, grab groundwater, groundwater from monitoring wells, porewater, PEDs) and analytical group. The soil and grab groundwater data had the most analytical exceptions as detailed below. One laboratory (Test America, Seattle) experienced instrument issues due to contaminant saturation of some samples which caused delays in sample analysis beyond the method-required holding times for volatile analysis.

Exceptions to the analytical criteria resulted in the assignment of “J” qualifiers to the data. The “J” qualifier indicates that the result is considered an estimated value.

During sampling, field duplicate QC samples were collected to evaluate reproducibility and ensure that a meaningful and representative dataset was generated for OU 1 site recharacterization. Field duplicate samples were collected at a rate of 10% of locations sampled. Field duplicate samples were not collected for geotechnical analyses.

Results from the field duplicate samples were generally consistent with the primary samples. Table 3-1 lists all field duplicate pairs analyzed for this project. Where RPDs exceeded SAP criteria, the RPD is bolded in Table 3-1. There were a few exceptions where the RPD exceeded the SAP criteria. Out of 16 field duplicate pairs analyzed for VOCs, 88% of the analytes that were detected above the laboratory limit of detection (LOD) in each pair met relative percent difference (RPD) criteria. Poly and perfluoroalkyl substances (PFAS) analysis in 2 field duplicate pairs collected from monitoring wells exhibited 3 analytes outside the RPD control limit (≤50%) out of 14 analytes detected above the LOD in each pair (79% compliant). PCB congener analysis in one sediment field duplicate pair exhibited only 2 analytes outside the RPD control limit (≤100%) out of 161 analytes detected above the LOD in the pair (99% compliant). Field duplicates for other tests were within control criteria.

Review of the laboratory data and data validation confirmed that the measurement quality objectives were achieved, and data are acceptable for use with the exception of a few instances where results not detected above the laboratory LOD were qualified as rejected (R qualified) by the data validator. Project decision making is focused on areas of high concentrations, rather than concentrations near the limit of detection, and therefore these R-qualified values where contaminants were not detected do not materially impact project decisions made based on the overall data set. Data validation qualifiers used in the data set are in Appendix G. Except where otherwise stated, the data associated with all of the issues identified below were qualified as estimated using either the qualifier “J” where the analyte was detected above the laboratory limit of quantitation [LOQ, which is equivalent to the practical quantitation limit (PQL)], or “UJ” where the analyte was not detected above the laboratory LOD.

3.1.1 Soil

Chlorinated VOCs

- Holding time requirements of 14 days for cVOCs were exceeded for several soil samples. The samples were analyzed 15 to 36 days after collection. If samples were analyzed after more than twice the holding time, results were qualified as rejected with an “R” qualifier, following EPA National Functional Guidelines for Organic Superfund Method Data Review (EPA, 2017) guidance. Of the 2,662 analytical values reported in soil samples, 32 of the values reported as not detected above the laboratory LOD were qualified as rejected (approximately 1.2 percent of data values).

- Percent difference (%D) of the initial calibration verification standards for two cVOCs (VC and dichlorodifluoromethane) was outside of the acceptable range affecting several soil samples.
- Continuing calibration standard %D for a few cVOCs (TCE, chloroethane, cis-1,2-DCE, VC, 1,1-DCE, 1,2-DCA, 1,2-dichloropropane, and dichlorodifluoromethane) were outside of the acceptable range affecting several soil samples.
- Matrix spike/matrix spike duplicate percent recoveries (%R) for a few cVOCs were outside of the acceptable range affecting two soil samples.
- Matrix spike/matrix spike duplicate RPDs for a few cVOCs was outside of the acceptable range affecting one soil sample.
- Surrogate spike %R were outside of the acceptable range, or failed, for between one and 10 soil samples per surrogate.
- Laboratory control sample (LCS) percent recoveries (%R) for a few cVOCs (TCE, trans-1,2-DCE, VC, 1,1-DCA, 1,2-DCA, 1,1-DCE, 1,2-dichloropropane, ethylbenzene, and benzene) were outside of the acceptable range for several soil samples.
- LCS/laboratory control sample duplicate RPDs for a few cVOCs (PCE, chloroethene, VC, and 12 compounds in one LCS pair) were outside of the acceptable range affecting several soil samples.
- cVOCs were detected in the laboratory blank. Sample concentrations were compared to concentrations detected in the laboratory blank. If sample concentrations were not significantly greater (>10X for common contaminants [i.e., methylene chloride], >5X for other listed contaminants) than the blank concentration, the sample concentration was considered to be non-detect. cVOCs identified in the blank were VC, cis-1,2-DCE, and methylene chloride.
- cVOCs were detected in the trip blank. Sample concentrations were compared to concentrations detected in the trip blank. If sample concentrations were not significantly greater (>10X for common contaminants [i.e., methylene chloride], >5X for other listed contaminants) than the blank concentration, the sample concentration was considered to be non-detect. cVOCs identified in the trip blank were PCE, TCE, VC, cis-1,2-DCE, and methylene chloride.

Semivolatiles

- %D initial calibration verification standards for a few semivolatiles (N-nitrosodimethylamine, hexachlorocyclopentadiene, and butylbenzylphthalate) were outside of the acceptable range affecting several soil samples.
- The continuing calibration standard %D for a few semivolvatiles (4,6-dinitro-2-methylphenol, butylbenzylphthalate, 3,3'-dichlorobenzilate, indeno(1,2,3-cd)pyrene, dibenz(a,h)anthracene, benzo(g,h,i)perylene, and fluoranthene) were outside of the acceptable range affecting several soil samples.

PCB Aroclors

- Matrix spike/matrix spike duplicate %R for PCB Aroclors 1016 and 1260 were outside of the acceptable range affecting one soil sample.

TPH-screening

- The surrogate spike %R for total petroleum hydrocarbon (TPH) extractable screening analysis was outside of the acceptable range affecting two soil samples.
- The matrix spike/matrix spike duplicate %R for TPH compounds were outside of the acceptable range affecting one soil sample.

TPH-extractable (TPH-Dx)

- The surrogate spike %R for TPH extractable was outside of the acceptable range affecting one soil sample.

TPH-purgeable (TPH-Gx)

- The holding time requirement of 14 days for TPH-purgeable was exceeded for one soil sample. The sample was analyzed 15 days after collection.
- A surrogate spike %R for TPH purgeable was outside of the acceptable range affecting one soil sample.

3.1.2 Sediment

PCB Aroclors

- The surrogate spike %R for one PCB congener (decachlorobiphenyl) was outside of the acceptable range affecting four sediment samples.
- LCS %R for PCB Aroclor 1260 was outside of the acceptable range affecting four sediment samples.

3.1.3 Grab Groundwater

Chlorinated VOCs

- The holding time requirement of 14 days for cVOCs was exceeded for a several grab groundwater samples. The samples were analyzed 15 to 42 days after collection. If the samples were analyzed after more than twice the holding time, results were qualified as rejected with an "R" qualifier. Of the 1,985 analytical values reported in groundwater samples, 17 of the values reported as not detected above the laboratory LOD were qualified as rejected (approximately 0.9 percent of data values).
- The %D of the initial calibration verification standards for one cVOC (VC) was outside of the acceptable range affecting several grab groundwater samples.
- The continuing calibration standard %D for a few cVOCs (VC, cis-1,2-DCE, and TCE) were outside of the acceptable range affecting several grab groundwater samples.
- The matrix spike/matrix spike duplicate %R for one cVOC (cis-1,2-DCE) were outside of the acceptable range affecting one grab groundwater samples.
- Surrogate spike %R for cVOCs were outside of the acceptable range affecting three grab groundwater samples.
- LCS %R for a few cVOCs (cis-1,2-DCE, TCE, and VC) were outside of the acceptable range affecting several grab groundwater samples.
- LCS/laboratory control sample duplicate RPD for one cVOC (VC) was outside of the acceptable range affecting several grab groundwater samples.
- cVOCs were detected in the laboratory blank. Sample concentrations were compared to concentrations detected in the laboratory blank. If sample concentrations were not significantly greater (>10X for common contaminants [i.e., methylene chloride], >5X for other listed contaminants) than the blank concentration, the sample concentration

was considered to be non-detect. The only cVOC identified in the laboratory blank sample was TCE.

- cVOCs were detected in the field blanks (trip blank and equipment blank). Sample concentrations were compared to concentrations detected in the field blanks. If sample concentrations were not significantly greater (>10X for common contaminants [i.e., methylene chloride], >5X for other listed contaminants) than the blank concentration, the sample concentration was considered to be non-detect. cVOCs identified in the field blanks were TCE and cis-1,2-DCE.

3.1.4 Groundwater from Monitoring Wells

Perfluorinated Compounds

- The holding time requirement of 14 days for perfluorinated (PFAS) compounds was exceeded for several groundwater samples. The samples were analyzed 15 to 16 days after collection.
- Initial calibration %R for a few PFAS compounds (PFDS, NMeFOSAA, PFTrDA, and PFHxA) were outside of the acceptable range affecting several groundwater samples.
- %D between the initial calibration and continuing calibration standards for a few PFAS compounds (NMeFOSAA, PFUnA, PFDoA, PFTrDA, PFTeDA, and NEtFOSAA) were outside of the acceptable range affecting several groundwater samples.
- Internal standard %R were outside of the acceptable range affecting three groundwater samples.
- PFAS compounds (PFOA and PFTeDA) were detected in the laboratory blank. Groundwater sample concentrations were compared to concentrations detected in the source blank. If groundwater sample concentrations were not significantly greater (>5X) than the blank concentration, the sample concentration was considered to be non-detect.
- PFAS compounds (14 compounds) were detected in the equipment blank and source blank. Groundwater sample concentrations were compared to concentrations detected in the equipment blank and source blank. If groundwater sample concentrations were not significantly greater (>5X) than the blank concentration, the sample concentration was considered to be non-detect.

Biochemical Oxygen Demand (BOD)

- Holding time requirements of 48 hours for BOD were exceeded for several groundwater samples. The samples were analyzed 66 to 72 hours after collection.

Nitrate/Nitrite

- Holding time requirements of 48 hours for nitrate/nitrite were exceeded for several groundwater samples. The samples were analyzed 13 to 60 minutes after the holding time expired.
- Nitrate as N was detected in the source blank. Groundwater sample concentrations were compared to concentrations detected in the source blank. If groundwater sample concentrations were not significantly greater (>5X) than the blank concentration, the sample concentration was considered non-detect.

Sulfate

- LCS %R for sulfate were outside of the acceptable range affecting a few groundwater samples.

3.1.5 Porewater

Chlorinated VOCs

- Matrix spike/matrix spike duplicate %R for a cVOC (cis-1,2-DCE) was outside of the acceptable range affecting one porewater sample.
- Matrix spike/matrix spike duplicate relative percent difference (RPD) for a cVOC (vinyl chloride) was outside of the acceptable range affecting one porewater sample.

3.1.6 PEDs

- PCB congeners were detected at trace levels (less than ½ the LOQ) in all three laboratory blanks (method blanks) analyzed with the samples. PED sample concentrations were compared to concentrations detected in the laboratory blanks. If PED sample concentrations were not significantly greater (>5X) than the blank concentration, the sample concentration was considered to be non-detect. In this way, sample results were corrected for the blank contamination. Only the PCB congeners which were detected in one of the laboratory blanks, for which a calculated value was also determined to be present, and that effected an associated sample are listed here: PCB-80, 126, 141, 153, 168, 182, 189, 191, 193, 197, 205, and 207.

- PCB congeners were detected in both the field blank (1) and the source blank (1) collected for PCB congener analyses. PED sample concentrations were compared to concentrations detected in the field blanks. If PED sample concentrations were not significantly greater (>5X) than the blank concentrations, the sample concentration was considered to be non-detect. In this way, sample results were corrected for the blank contamination. The following PCB congeners were detected in field blanks: PCB-1, 11, and 68.

3.2 SOIL ANALYTICAL RESULTS

This subsection presents the results of field and laboratory analysis of grab soil samples collected both from direct push sampling during Mobilization 1 and from auger well bores during Mobilization 2.

3.2.1 Field Analysis of Soil Samples

Field analysis of soil consisted of hand-held PID screening of continuous soil cores from direct-push borings and headspace analysis of grab soil samples collected during auger drilling. The hand-held PID screening results for continuous soil cores were compared real time with the results of nearby historical MIP probe results to assess the correlation between these two screening methods and to select depths for collection of grab soil and groundwater samples. Hand-held PID readings are shown on the boring logs in Appendix D. Representative comparisons of the hand-held PID readings to the MIP probe readings, as well as to the laboratory analytical results discussed in the remainder of this section, are shown on Figures 3-1 through 3-5.

3.2.2 COCs in Soil Samples

Table 3-2 summarizes the frequency of detection in soil samples of each of the nine cVOC COCs, and shows the frequency that each cVOC was found to exceed its PAL. This summary shows that the most frequently detected cVOCs were TCE (73 percent of samples), cis-1,2-DCE (93 percent of samples), and VC (77 percent of samples). The only other cVOC detected in more than 50 percent of samples was trans-1,2-DCE (62 percent of samples).

TCE, cis-1,2-DCE, and VC were also the cVOCs that most frequently exceeded their PAL in soil samples, with samples exhibiting these cVOCs exceeding their PAL in 39 percent, 55 percent, and 64 percent of the samples collected, respectively.

The maximum detected concentrations of cVOCs were very high in a few samples at the site, with the measured concentration of TCE in one soil sample at 8.3 percent (83,000,000 µg/kg). As discussed further in Section 4.4, the highest cVOC concentrations in soil samples were from borings located in the eastern portion of the South Plantation.

Although both chlorinated ethene compounds (e.g., TCE, cis-1,2-DCE) and chlorinated ethane compounds (e.g., 1,1,1-TCA, 1,1-DCA) were detected in soil samples, chlorinated ethenes were detected at concentrations orders of magnitude higher than chlorinated ethanes, as shown in Table 3-2 by comparing the maximum detected concentrations of TCE to 1,1,1-TCA and 1,1-DCE to 1,1-DCA.

The frequency of detection statistics for cVOCs in soil, and the magnitude of exceedances for each cVOC relative to its associated PAL, indicate that the key cVOCs are TCE, cis-1,2-DCE, and VC. This analysis demonstrates that cVOCs other than TCE, cis-1,2-DCE, and VC are collocated with TCE, cis-1,2-DCE, and VC. That is, for every location where one of the other cVOCs exceeds its PAL, either TCE, cis-1,2-DCE, or VC also exceeds its PAL. This conclusion is supported by the results shown in the last two columns of Table 3-2. The penultimate column in Table 3-2 shows that cis-1,2-DCE and TCE exhibited the highest absolute concentration in the vast majority of the soil samples. The last column shows that in samples in which other cVOCs were detected, either TCE, cis-1,2, DCE, or VC were also detected.

Although TCE is a chemical daughter product of PCE, both TCE and PCE can be “parent” compounds released to the environment from industrial operations, and these parent compounds biodegrade to form other “daughter” products with fewer chlorine atoms (see the chlorinated solvent degradation chemistry graph in Appendix F). In soil samples collected in 2017, TCE was detected much more frequently than PCE (TCE in 73 percent of samples compared to PCE in 10 percent of samples). The maximum concentration of TCE detected in soil samples was also substantially higher compared to PCE (83,000,000 µg/kg compared to 69,100 µg/kg). This finding indicates that the PCE released historically has substantially degraded to TCE, or that TCE was more commonly released at the site.

The results of the nine cVOC COCs analyzed in the 162 soil samples collected in 2017 are shown in Tables 3-3 and 3-4. The highest concentrations measured at each direct-push boring location of the key analytes, TCE, cis-1,2-DCE, and vinyl chloride, are shown on Figures 3-6 through 3-11.

3.2.3 Additional Chemical Analysis of Soil Samples

As discussed in Section 2, unexpected oily substances were observed in some direct-push borings, and the nature of these oily substances was assessed using additional laboratory analyses for fuels, PCBs, and a full list of SVOCs in soil samples from borings SP-B01, SP-B18, SP-B21, and SP-B62. The samples from SP-B01 and SP-B62 were also analyzed for a full list of VOCs. Because of the nature of historical operations at NBK Keyport, the on-base laboratory analyzed samples containing the oily substances for Otto fuel, which is used in submarine weapons propulsion.

The results of the additional analyses performed on soil samples are shown in Tables 3-5 through 3-8 and compared to the Washington State Model Toxics Control Act (MTCA) soil cleanup levels as screening levels.

SVOC Results

Table 3-5 shows that SVOC analytes were detected in all four samples analyzed for these constituents. Twenty-two of 68 SVOC analytes were detected in the sample from location CL-B18, while in the sample from nearby Central Landfill location CL-B21, only four SVOC analytes were detected, and similar LODs were achieved. At the South Plantation, 13 SVOC analytes were detected at location SP-B62, while only three SVOC analytes were detected at SP-B01. Because of interferences, the SVOC LODs in the sample from SP-B01 were generally an order of magnitude higher than where achieved for the samples in the Central Landfill, and LODs for the sample from SP-B62 were one to two orders of magnitude higher than SP-B01. The concentrations of detected SVOC analytes, and the LODs for undetected analytes, were generally above the screening levels.

Total Petroleum Hydrocarbon and Otto Fuel Results

The Total Petroleum Hydrocarbons – Hydrocarbon Identification (TPH-HCID) results (Table 3-6) for samples collected in the Central Landfill at locations CL-B18 and CL-B21 identified the presence of diesel and motor oil range petroleum. At South Plantation locations SP-B01 and SP-B62, gasoline, diesel, and motor oil range petroleum were all identified. When quantified using the Northwest Total Petroleum Hydrocarbon (NWTPH) analysis appropriate to the petroleum range identified, the concentrations of diesel and oil range petroleum in the two samples from the Central Landfill did not exceed the MTCA Method A Soil Cleanup Levels. In the South Plantation, concentrations of all petroleum range compounds in both samples exceeded the MTCA Method A Soil Cleanup Levels. Otto fuel was not detected in any of the samples analyzed (Table 3-7).

Full-list VOC Results

In addition to the soil samples from two locations in the South Plantation, the soil samples from three locations in the Central Landfill (CL-B02, CL-B03, and CL-B04) were analyzed for a full VOC list according to EPA Method 8260 (Table 3-8). For these samples in the Central Landfill, the nine cVOC COCs (Table 1-1) were generally detected most frequently and at the highest concentrations. However, the following additional VOCs were detected in the Central Landfill:

- 1,2,4-Trimethylbenzene
- 1,3,5-Trimethylbenzene
- 4-Isopropyltoluene
- *m*- and *p-Xylene*
- N-Butylbenzene
- Naphthalene
- *o*-Xylene
- Propylbenzene
- sec-Butylbenzene
- Toluene

In the South Plantation, the VOCs detected in the highest concentration were the COCs TCE and cis-1,2-DCE. However, a wide range of other VOCs were detected. Many of the detected VOCs are associated with petroleum which was also detected in high concentrations in these samples.

PCBs in Soil

Table 3-9 shows that PCBs were not detected in the soil sample from boring CL-B21 in the Central Landfill. One PCB Aroclor, 1254, was detected in the soil sample from CL-B18a, at a concentration of 0.053 mg/kg. Both Aroclor 1254 and 1260 were detected in the soil sample from South Plantation boring SP-B01, at concentrations of 1.1 mg/kg and 0.34J mg/kg, respectively. Aroclor 1254 was also detected in South Plantation boring SP-B62, at a concentration of 0.32 mg/kg.

Only the detected concentration of Aroclor 1254 in South Plantation boring SP-B01 (1.1 mg/kg) exceeds the MTCA Method B Soil Cleanup Level of 0.5 mg/kg.

3.2.4 Physical Characteristics Analysis of Soil Samples

At seven of the locations selected for installation of permanent monitoring wells, soil samples were collected from within the screened interval(s) of the wells and analyzed for physical characteristics, as described in Section 2.3.1. These data were collected from wells located in areas of the site exhibiting the highest concentrations of COCs in soil to facilitate screening of potential remediation technologies that might be applied in these areas. The results of the physical characteristics analyses are shown in Table 3-10, and key parameters are discussed in the subsections below.

Soil Type

The soil types identified through laboratory analysis ranged from silt to coarse sand, with the predominant soil type according to the USCS classification system being fine sand. The laboratory classification of soil types matched closely with the field descriptions, with a slight variation in description of the coarsest soil type observed. The sample from the well bore of MW1-58 at 6.5 ft bgs was classified in the field as a sandy, silty, gravel, but by the laboratory as a coarse sand, indicating that the largest grain size was in the range of a very fine gravel or a very coarse sand.

Total Organic Carbon

TOC measured in the soil samples ranged from 580 mg/kg to 19,000 mg/kg, with a median value of 950 mg/kg and geometric mean value of 1,473 mg/kg. TOC in the sample from the well bore for MW1-58 at 6.5 ft bgs (19,000 mg/kg) was an order of magnitude higher than the next highest concentration (4,100 mg/kg in the same boring from 34 ft bgs). Other than this very high value, TOC values were within one order of magnitude of one another, between 580 mg/kg and 4,100 mg/kg.

Dry Bulk Density

Dry bulk density of the soils ranged from 0.58 g/cc to 1.98 g/cc, with a median value of 1.68 g/cc and a geometric mean value of 1.53 g/cc. The density of 0.58 g/cc measured in the sample from 6.5 ft bgs in the well bore for well MW1-58 appears anomalously low compared to the other measured values. This measurement is on the low end of the range typical for organic silts and clays, perhaps indicating that a portion of thin marsh bottom silt commonly found at this depth, was collected, despite the overall sample description of “coarse sand.” The median value for all samples of 1.68 g/cc is on the low end of the range typical for glacial soils.

Laboratory Hydraulic Conductivity

Hydraulic conductivity ranged from 5.84×10^{-8} cm/s to 7.18×10^{-3} cm/s, with a median value of 2.47×10^{-5} cm/s and a geometric mean value of 3.93×10^{-5} cm/s. Values in the range of 1×10^{-5} cm/s are typical of the silty fine sand observed at the site. The minimum hydraulic conductivity measured, 5.84×10^{-8} cm/s, is representative of the Lawton Clay, sampled at 37.5 ft bgs in the well bore for well MW1-56. This value is typical of glacial till and marine clays. The hydraulic conductivity reported for the sample from 6.5 ft bgs in the well bore for well MW1-58 (2.93×10^{-7} cm/s) appears incongruous with the overall classification of the sample as "coarse sand." However, this hydraulic conductivity is consistent with the high TOC and low dry bulk density reported for this sample, indicating that the sub-sample tested reflects the thin marsh silt layer within the sampling interval.

3.3 GROUNDWATER ANALYTICAL RESULTS

This section summarizes the results of field and laboratory analysis of groundwater samples. The concentration magnitude of each COC was substantially different between grab groundwater samples collected from direct-push borings and samples collected from monitoring wells. The results from these two sample types are therefore discussed first in separate subsections and then compared in Section 3.3.3.

3.3.1 Grab Groundwater Samples

Table 3-11 summarizes the frequency of detection in grab groundwater samples of each of the nine cVOC COCs, and chloroethane, and shows the frequency that each of these cVOCs was found to exceed its PAL. This summary shows that the most frequently detected cVOCs were TCE (75 percent of samples), cis-1,2-DCE (89 percent of samples), trans-1,2-DCE (80 percent of samples), and VC (77 percent of samples). The only other cVOCs detected in more than 50 percent of samples were 1,1-DCA (57 percent of samples) and 1,1-DCE (57 percent of samples).

TCE, cis-1,2-DCE, and VC were also the cVOCs that most frequently exceeded their PAL in grab groundwater samples, with 59 percent, 77 percent, and 77 percent of samples exhibiting these cVOCs exceeding their PAL, respectively.

The maximum detected concentrations of cVOCs were very high in a few samples at the site, with the measured concentration of TCE in one grab groundwater sample at 540,000 µg/L. As discussed further in Section 4.4, the highest cVOC concentrations in grab groundwater samples were from borings located in the eastern portion of the South Plantation.

Although both chlorinated ethene compounds (e.g., TCE, cis-1,2-DCE) and chlorinated ethane compounds (e.g., 1,1,1-TCA, 1,1-DCA) were detected in grab groundwater samples, chlorinated ethenes, represented by TCE, were detected at a concentration two orders of magnitude higher than chlorinated ethanes, represented by 1,1,1-TCA. The maximum concentration of the breakdown product 1,1-DCA was higher than the maximum concentration of breakdown product 1,1-DCE, but an order of magnitude lower than the maximum concentration of cis-1,2-DCE.

The frequency of detection statistics for cVOCs in grab groundwater, and the magnitude of exceedances for each cVOC relative to its associated PAL, indicate that the key cVOCs are TCE, cis-1,2-DCE, and VC. This analysis demonstrates that cVOCs other than TCE, cis-1,2-DCE, and VC are collocated with TCE, cis-1,2-DCE, and VC. That is, for every location where one of the other cVOCs exceeds its PAL, either TCE, cis-1,2-DCE, or VC also exceeds its PAL. This conclusion is supported by the results shown in the last two columns of Table 3-11. The penultimate column in Table 3-11 shows that cis-1,2-DCE, TCE, and VC exhibited the highest absolute concentration in the vast majority of the grab groundwater samples. The last column shows that in all but two samples in which other cVOCs were detected, either TCE, cis-1,2, DCE, or VC were also detected.

In grab groundwater samples collected in 2017, TCE was detected much more frequently than PCE (TCE in 75 percent of samples compared to PCE in 30 percent of samples). The maximum concentration of TCE detected in grab groundwater samples was also substantially higher compared to PCE (540,000 µg/L compared to 43 µg/L). This finding indicates that PCE has substantially degraded to TCE, or TCE was more commonly released at the site.

The breakdown compound chloroethane, which is not a COC at the site but represents a final breakdown product of the chlorinated ethane pathway (see Appendix F), was detected in 26% of samples, and was the highest concentration analyte detected in 5 of the 87 samples. The presence of measurable chloroethane implies that degradation of the chlorinated ethanes is occurring in at least some areas of the site.

The results of the analysis of the 87 grab groundwater samples collected in 2017 and analyzed for the nine cVOC COCs are shown in Table 3-12. The highest concentrations measured at each direct-push boring location of the key analytes TCE, cis-1,2-DCE, and VC are shown on Figures 3-6 through 3-11.

3.3.2 Groundwater Samples from Monitoring Wells

Table 3-13 summarizes the frequency of detection of each of the nine cVOC COCs in groundwater samples from monitoring wells, and shows the frequency that each cVOC was found to exceed its PAL. This summary shows that the most frequently detected cVOCs were TCE (76 percent of samples), cis-1,2-DCE (92 percent of samples), and VC (76 percent of samples). The only other cVOC detected in more than 50 percent of samples was trans-1,2-DCE (68 percent of samples).

TCE, cis-1,2-DCE, and VC were also the cVOCs that most frequently exceeded their PAL in groundwater monitoring well samples, with 76 percent, 88 percent, and 76 percent of samples exhibiting these cVOCs exceeding their PAL, respectively.

The maximum detected concentrations of cVOCs were very high in a few samples at the site, with the measured concentration of TCE in one groundwater sample at 361,000 µg/L. As discussed further in Section 4.4, the highest cVOC concentrations in groundwater monitoring well samples were from borings located in the eastern portion of the South Plantation. The highest TCE and cis-1,2-DCE concentrations was observed in MW1-57 at the 10-ft screen interval.

Although both chlorinated ethene compounds (e.g., TCE, cis-1,2-DCE) and chlorinated ethane compounds (e.g., 1,1,1-TCA, 1,1-DCA) were detected in grab groundwater samples, chlorinated ethenes were detected at concentrations orders of magnitude higher than chlorinated ethanes in most cases (in Table 3-13, compare the maximum detected concentrations of TCE to 1,1,1-TCA and cis-1,2-DCE and 1,1-DCE to 1,1-DCA).

The frequency of detection statistics for cVOCs in groundwater from monitoring wells, and the magnitude of exceedances for each cVOC relative to its associated PAL, indicate that the key cVOCs are TCE, cis-1,2-DCE, and VC. This analysis demonstrates that cVOCs other than TCE, cis-1,2-DCE, and VC are collocated with TCE, cis-1,2-DCE, and VC. That is, for every location where one of the other cVOCs exceeds its PAL, either TCE, cis-1,2-DCE, or VC also exceeds its PAL. This conclusion is supported by the results shown in the last two columns of Table 3-13. The penultimate column in Table 3-13 shows that cis-1,2-DCE and TCE exhibited the highest absolute concentration in the vast majority of the groundwater samples. The last column shows that in samples in which other cVOCs were detected, either TCE, cis-1,2, DCE, or VC were also detected.

In groundwater monitoring well samples collected in 2017, TCE was detected in 76 percent of samples, whereas PCE was not detected above the laboratory LOD in any of the samples. This implies that PCE has successfully degraded to TCE, or that TCE was more commonly released at the site.

The results of the analysis of the 25 groundwater monitoring samples collected in 2017 and analyzed for the nine cVOC COCs are shown in Table 3-14. The concentrations of detected cVOCs measured at each monitoring well location are shown on Figures 3-12 and 3-13.

PFAS compounds were analyzed in groundwater samples from 10 monitoring wells as shown in Table 3-15. Of the 10 monitoring wells, one or more PFAS compounds were detected in five monitoring wells (MW1-48, MW1-5, MW1-57, MW1-58 and MW1-60). However, none of the detected PFAS compound concentrations exceeded the PAL, and all were much lower than the EPA lifetime health advisory.

1,4-Dioxane was analyzed in groundwater samples from 10 monitoring wells as shown in Table 3-16 and was detected in three monitoring wells (MW1-46, MW1-47 and MW1-48). The detected concentrations all exceeded the PAL of 0.44 µg/L by approximately an order of magnitude, with the highest concentration of 4.94 µg/L at MW1-48. These concentrations of 1,4-dioxane in the Central Landfill are in the same range as, but slightly higher than those detected in 2014 at the base boundary wells MW1-38 and MW1-39 (2.3 µg/L and 1.1 µg/L, respectively; Navy, 2015b). Wells MW1-38 and MW1-39 are downgradient of the Central Landfill, assuming a northwesterly groundwater flow direction.

Analytes indicative of natural attenuation are shown in Tables 3-17 and 3-18. The results of the laboratory analyses for nitrate, nitrite, sulfate, chemical oxidation demand (COD) and BOD are summarized in Table 3-17. Nitrate and nitrite concentrations were below 1 mg/L with 85% of nitrate samples and 92% of nitrite samples below detection. Sulfate concentrations ranged from non-detect to 245D mg/L with 27% of samples requiring dilution. COD was measured to support remedy evaluation, and results ranged from non-detect to 273 mg/L. Similarly, BOD was measured to support remedy evaluation, and results ranged from non-detect to 40 mg/L. Field measured monitored natural attenuation (MNA) parameters are summarized in Table 3-18. Dissolved oxygen concentrations were less than 1 mg/L with the exceptions of MW1-45 and MW1-48 with DO concentrations of 2.89 mg/L and 3.95 mg/L, respectively. Oxidation reduction potential (ORP) ranged from -276 to 284 mV with the average OPR value at -70 mV. Ferrous iron levels were observed throughout the aquifer and concentrations ranged from 0.02 and 2.4 mg/L. pH of the groundwater averaged 7.5, with the exception of 4.74 at MW1-56 at 33.0 ft bgs. Overall, these parameters indicate the reducing environment necessary to support biodegradation of the cVOCs via reductive dechlorination is prevalent in both the Central Landfill and South Planation.

Microbial results at the seven selected monitoring wells are shown on in Table 3-19. Analyses were performed for several different types of bacteria (e.g., sulfate reducers, methanogens, total eubacteria) as well as halorespiring bacteria (e.g., *Dehalococcoides*, *Dehalobacter*, *Dehalogenimonas*, *Desulfitobacterium* spp.) and functional genes (e.g., VC reductases, TCE reductase). Among the seven monitoring wells, two monitoring wells (MW1-56 and MW1-57) have microbial results from multiple screen intervals. The highest concentrations of halorespiring microorganisms were found in MW1-47 and MW1-48 where not only general bacteria but also halorespiring bacteria were detected at levels >10^4 cells/mL which is a threshold for active dechlorination. In monitoring wells MW1-46, MW1-50, MW1-52, and MW1-57 (16 and 31 ft bgs depth), the microbial results for halorespiring bacteria showed levels below the threshold for active reductive dechlorination and the general bacterial types were an order of magnitude lower than at MW1-48. For both depths (12 and 24 ft bgs) at MW1-56 and the 10 ft bgs depth at MW1-57, the microbial results were negligible to non-detect. The functional genes concentrations across the wells sampled were either low (<10^4 cells/mL) to non-detect. Overall, the microbial results indicate reductive dechlorination is occurring at the site but the concentrations of microorganisms and functional genes responsible for halorespiration are negligible to non-detect at locations where high levels of cVOCs are present.

3.3.3 Comparison of Groundwater Sample Results

Table 3-20 shows a comparison of TCE, cis-1,2-DCE, and VC concentrations in samples from groundwater monitoring wells to concentrations in nearest representative grab groundwater sample from the direct-push borings. This comparison shows that concentrations in grab groundwater samples were generally substantially higher than those in monitoring wells. This is a common finding at chlorinated solvent sites, and is generally the result of two primary factors:

1. Screen length – the grab groundwater samples were collected using 4- or 5-ft screens, and so more precisely target the zones of highest concentrations (as compared to the 10-ft screens in monitoring wells).
2. Turbidity – the samples from monitoring wells were collected from screens surrounded by sand-pack following well development, in accordance with low-flow sampling procedures. This reduces the turbidity of the samples compared to the grab-groundwater samples. VOC concentrations sorbed to particles in the turbid grab groundwater samples have the effect of elevating the measured concentrations.

3.4 SEDIMENT AND PASSIVE SAMPLER ANALYTICAL RESULTS

3.4.1 Sediment Sample Results

Sediment samples were collected in accordance with the SAP and NAVFAC NW SOP I-B-8 (U.S. Navy, 2017a) and analyzed for PCB congeners in accordance with the SAP. Table 3-21 shows the PCB congener result for the five sediment locations. The results for the summation of the PCB congeners assumed the non-detect values to be zero.

Table 3-22 shows the total PCBs from the summation of the congeners. For low-salinity (estuarine) sediment chemistry data from instances such as the sediment in Marsh Creek, SCUM II recommends that the concentrations be compared to both the freshwater and marine benthic criteria. The total PCB concentration for MA-09 exceeded both freshwater and marine sediment cleanup objectives (SCOs). The total PCB concentrations at the other Marsh Creek and the tide flats sampling locations did not exceed the SCOs. These results are also shown on Figure 3-14.

At Ecology's request, the sediment samples were also analyzed for PCB Aroclors, and Table 3-23 shows the Aroclor results (for Aroclors 1016, 1221, 1232, 1242, 1248, 1254, 1260, 1262 and 1268). Aroclors were detected in one sediment sample, MA-09. In this sample two Aroclors (1254 and 1260) were detected at concentrations of 350 J µg/kg and 120 J µg/kg, respectively. Aroclors 1254 and 1260 are the two Aroclors that have been typically detected historically as shown in Table 3-24, excerpted and updated from the third five-year review (U.S. Navy, 2010; No new PCB data were reported in the fourth five-year review). For comparison to historical data from earlier sampling events, the 2017 data were normalized to TOC concentrations. The 2017 data for individual Aroclors and total PCBs as a summation of the two detected Aroclors are shown in Table 3-24 following the SCUM II guidance, which recommends normalizing Aroclor data from marine sediment samples with TOC concentrations ranging between 0.5% and 3.5%. Because all of the TOC data for the 2017 sampling data fall within the 0.5% and 3.5% range, all of the data for Aroclors 1254 and 1260 were normalized. In the case where both Aroclors were non-detect, the higher non-detect value between Aroclors 1254 and 1260 was normalized and used as the total PCB LOD. As seen in Table 3-24, the 2017 normalized total PCB result for MA-09 exceeds the SCO of 12 mg/kg OC. The highest total PCB concentration (200 µg/kg) was recorded in June 2000 at MA-09. However, the data for June 2000 were not normalized in Table 3-24 (or in the third five-year review) because there were no TOC data available for this sample. Table 3-25 shows non-normalized data for MA-09 to allow more direct comparison of the historical and 2017 results. Two data points exceed the apparent effects threshold (AET) screening level of 130 µg/kg, June 2000 (200 µg/kg) and September 2017 (470 J µg/kg).

Tables 3-24 and 3-25 show that, with the exception of MA-09, the 2017 results for PCBs in sediment are generally similar to those from 2009. At MA-09, the carbon-normalized total PCB concentrations are an order of magnitude higher than reported in 2002, 2004, and 2009. The non-normalized total PCB result from 2017 at location MA-09 is higher than, but the same order of magnitude as, the result from 2000 (Table 3-25). The 2017 result at MA-09 could indicate a temporal increase in PCBs at location MA-09, or a spatial variation in concentration in sediment in this area. Overall the 2017 data are similar to pre-ROD concentrations. Additional investigation will be conducted in 2019 to evaluate potential sources of PCBs in sediment.

3.4.2 Passive Sampler Results

PEDs were used to determine freely dissolved concentrations of PCBs in four groundwater samples within the landfill. These PEDs were placed in monitoring wells and piezometers located in the northern part of the North Plantation. PEDs were also used to determine PCB concentrations in six porewater and four surface water samples in Marsh Creek and the tide flats area. The results of the calculated total PCB concentrations in the sampled waters are presented in Table 3-26 and Figure 3-14. In calculating total PCB concentrations, all congeners not detected in PED samples were given a value of zero to avoid artificially high totals that would result if the large number of undetected congeners were multiplied by the detection limit or half of the detection limit. Because six environmentally rare PCB congeners (PCB-14, PCB-38, PCB-78, PCB-79, PCB-121 and PCB-186) were used as PRCs and spiked onto the PEDs prior to deployment, these congeners could not be quantified in PED results. Therefore, the total PCB in PED data represents the sum of the remaining 203 congeners.

The highest dissolved PCB concentration (129.2 ng/L) in groundwater was measured in monitoring well MW1-14. The dissolved PCB concentrations in the other three groundwater samples was much lower and ranged from 0.9 to 6.0 ng/L.

PCBs were also measured at marsh stations MA-09 (14.6 ng/L) and MA-14 (8.9 ng/L) located downstream from the seep. The area of the seep itself (station SP1-1) exhibited porewater concentrations of 2.2 ng/L which is similar to those obtained at the MA19 location just upstream of SP1 (3.4 ng/L) and the new location further upstream of location PED-06 (2.6 ng/L). A similar concentration was also measured in the tide flat (station TF-21, 3.3 ng/L). The surface waters displayed a narrow range of concentrations from 0.5 to 0.8 ng/L. However, the surface water portion of PEDs corresponding to two porewater concentrations (MA-09 and SP1-1) were not recovered, and therefore no data are available for these stations.

3.5 PUSHPOINT POREWATER ANALYTICAL RESULTS

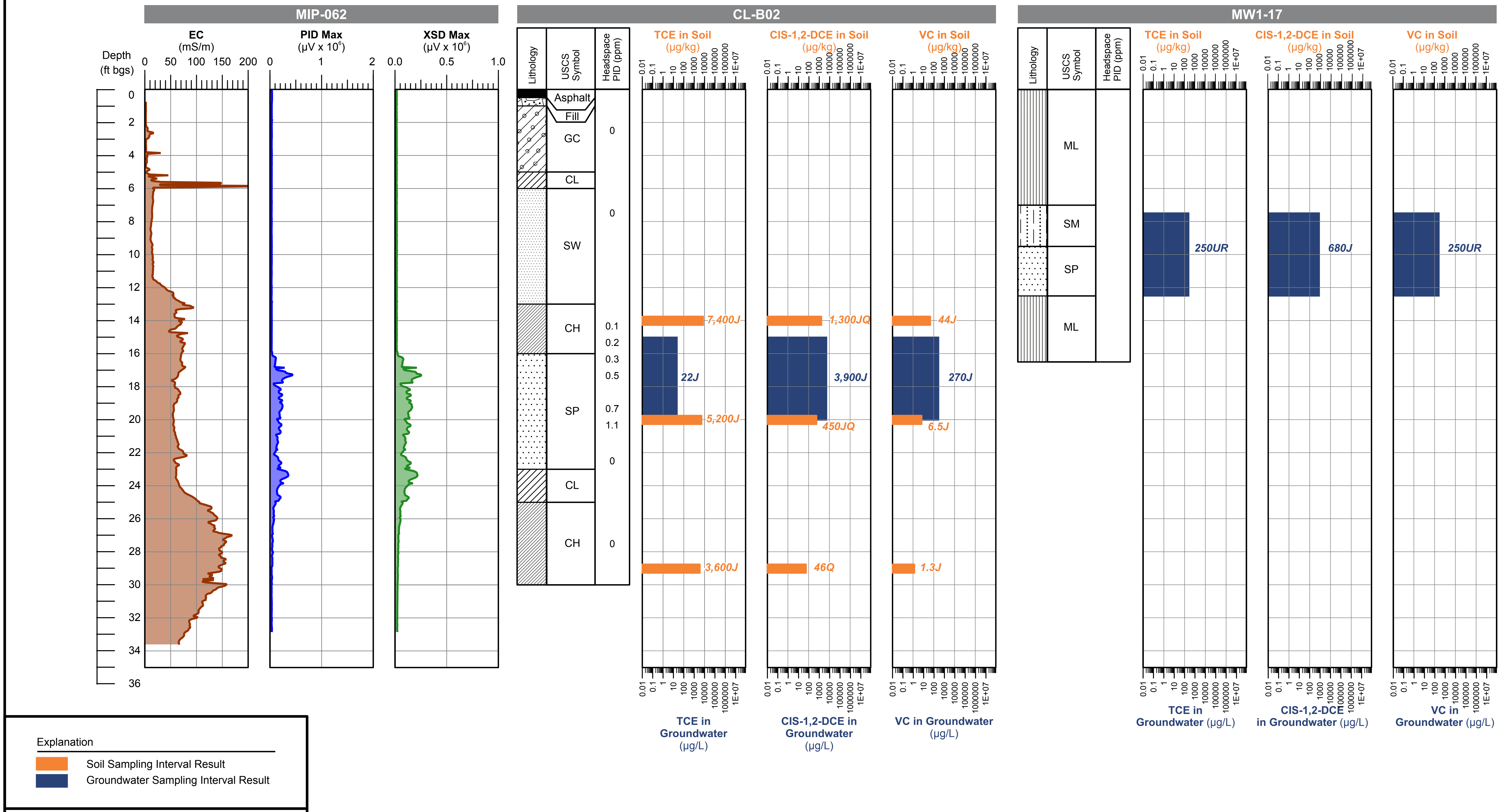
The 2017 sampling results for pushpoint porewater samples are shown on Figure 3-15 and Table 3-27. The frequency of detection of cVOCs in porewater samples is shown in Table 3-28. cVOCs were not detected above the laboratory LOD in porewater samples from any of the sampling locations adjacent to the Central landfill (PW1-01, PW1-05, PW1-06, PW1-07 and PW1-09). In contrast, all the porewater samples collected adjacent to the eastern portion of the South Plantation (PW1-02, PW1-03, PW1-04, PW1-10) exhibited multiple cVOCs exceeding their respective PALs (TCE, cis-1,2-DCE, trans-1,2-DCE, 1,1-DCE, and VC). The highest concentrations were measured at location PW1-03 for TCE (6,520 µg/L), cis-1,2-DCE (26,800 µg/L), trans-1,2-DCE (194 µg/L), 1,1-DCE (108 µg/L), and VC (3,570 µg/L).

3.6 SURFACE WATER AND STORMWATER ANALYTICAL RESULTS

The 2017 sampling results for surface water samples are shown on Figure 3-15 and Table 3-29. The frequency of detection of cVOCs in surface water samples is shown in Table 3-30. Concentrations of two or three of the nine cVOCs COCs exceeded the PALs in each of the surface water samples collected adjacent to the South Plantation. Concentrations of TCE and

VC exceeded their respective PALs in 11 of the 12 surface water samples, while concentrations of cis-1,2-DCE exceeded the PAL in 4 of the 12 samples. The highest cVOC concentrations in surface water were measured immediately adjacent to the eastern portion of the South Plantation, and near peeper stations S-4 and S-4B, where the highest cVOC concentrations in porewater have been measured historically.

Two stormwater samples were collected during the Phase II sampling event. Results are shown in Table 3-31. One COC was detected (cis-1,2 DCE at a concentration of 1.14 µg/L JD) in the sample from the outfall, south of the eastern portion of the South Plantation. No COCs were detected in the sample from the manhole immediately upstream of the outfall.



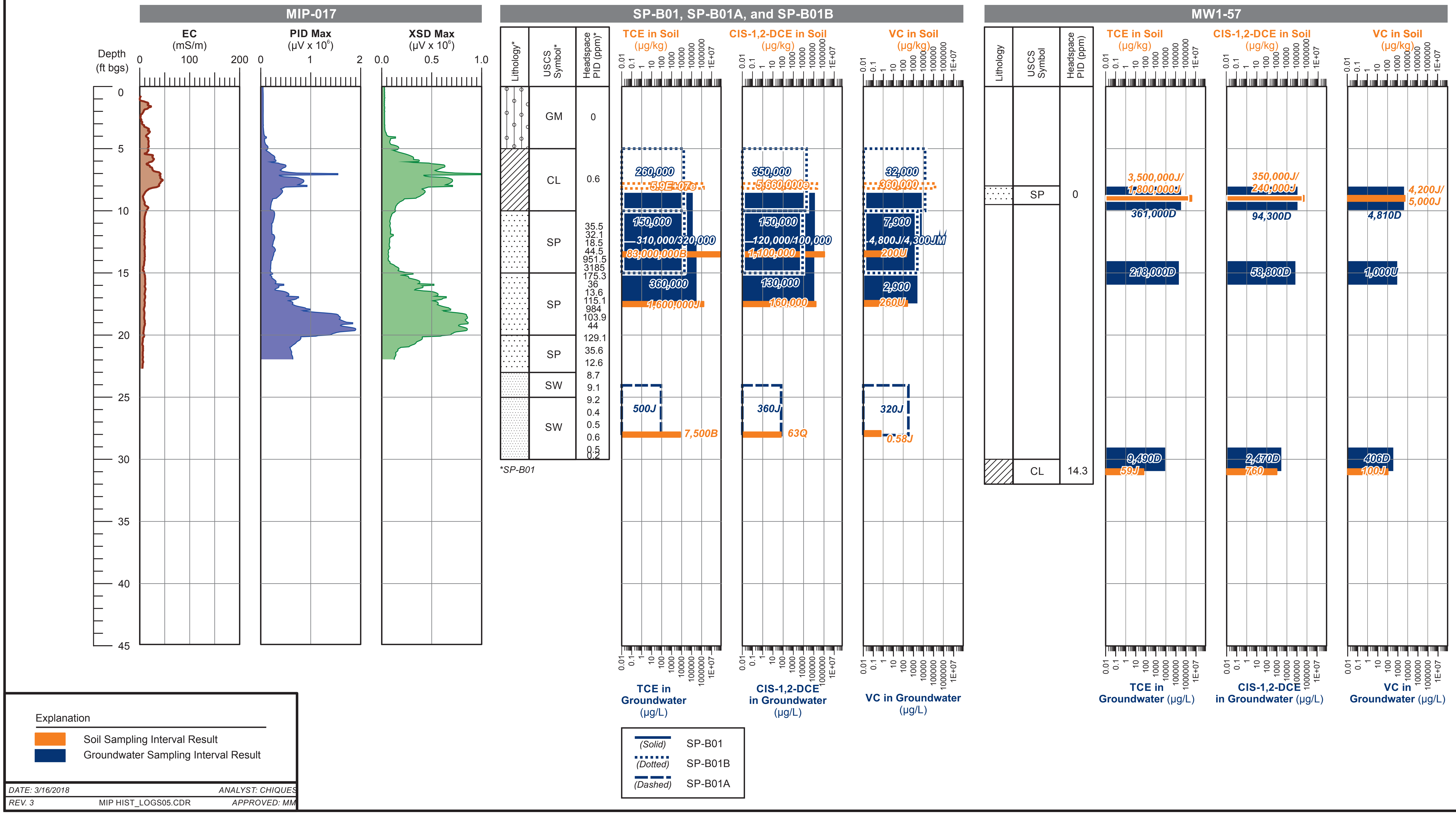
DATE: 3/16/2018 ANALYST: CHIQUES

REV. 3 MIP HIST_LOGS05.CDR APPROVED: MM

U.S. NAVY

Figure 3-1
OU 1 Central Landfill
MIP-062, CL-B02, and MW1-17

Naval Base Kitsap
Keyport



DATE: 3/16/2018 ANALYST: CHIQUES
REV. 3 MIP HIST_LOGS05.CDR APPROVED: MM

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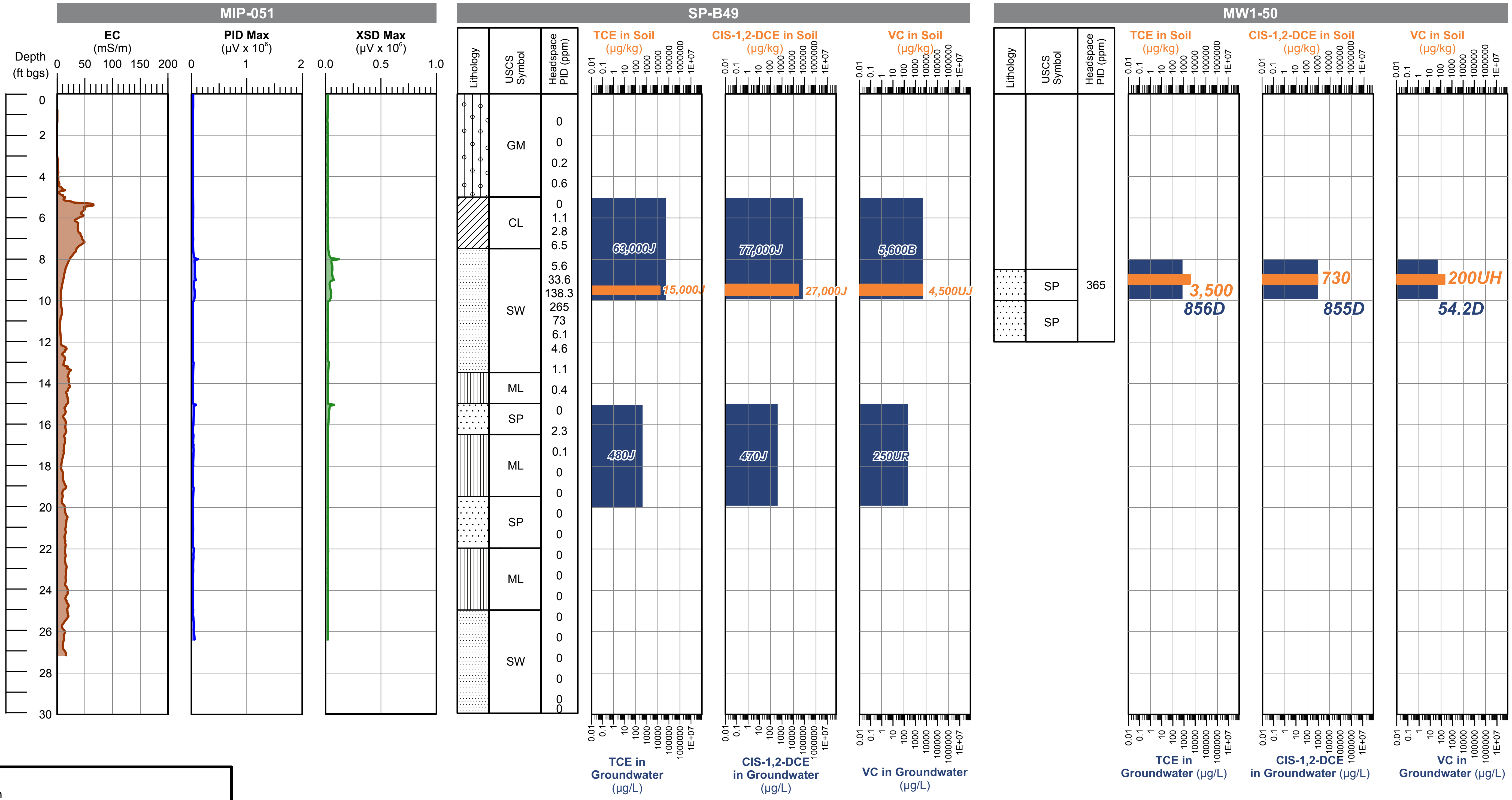
Figure 3-2
OU 1 South Plantation MIP-017, SP-B01, SP-B01A, SP-B01B and MW1-57

Naval Base Kitsap
Keyport



Explanation

🟧 Soil Sampling Interval Result
🟦 Groundwater Sampling Interval Result

DATE: 3/16/2018 ANALYST: CHIQUES
REV. 3 MIP HIST_LOGS05.CDR APPROVED: MM

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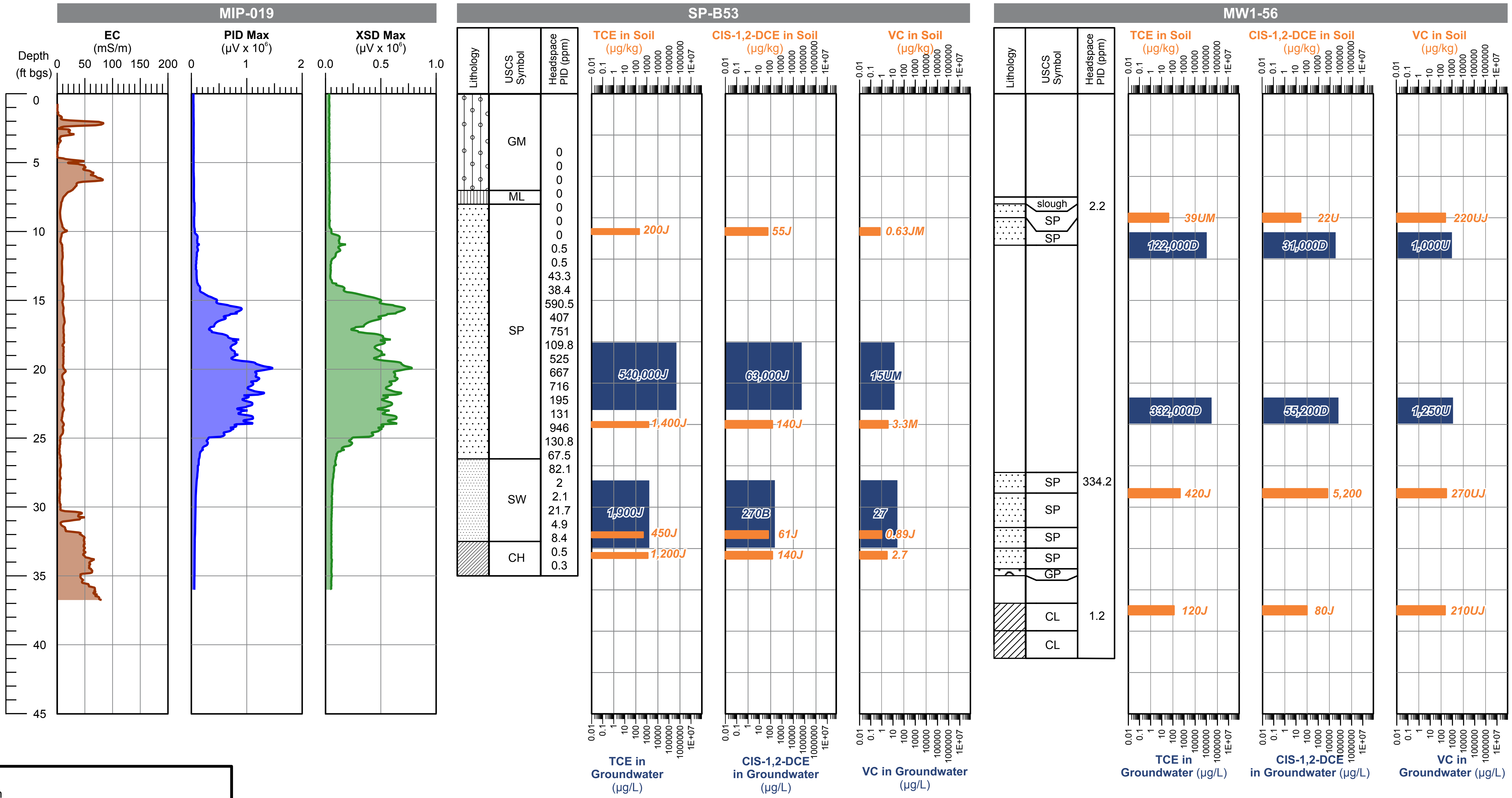
Figure 3-3
OU 1 South Plantation
MIP-051, SP-B49, and MW1-50

Naval Base Kitsap
Keyport



Explanation

🟧	Soil Sampling Interval Result
🟦	Groundwater Sampling Interval Result

DATE: 3/16/2018 ANALYST: CHIQUES

REV. 3 MIP HIST_LOGS05.CDR APPROVED: MM

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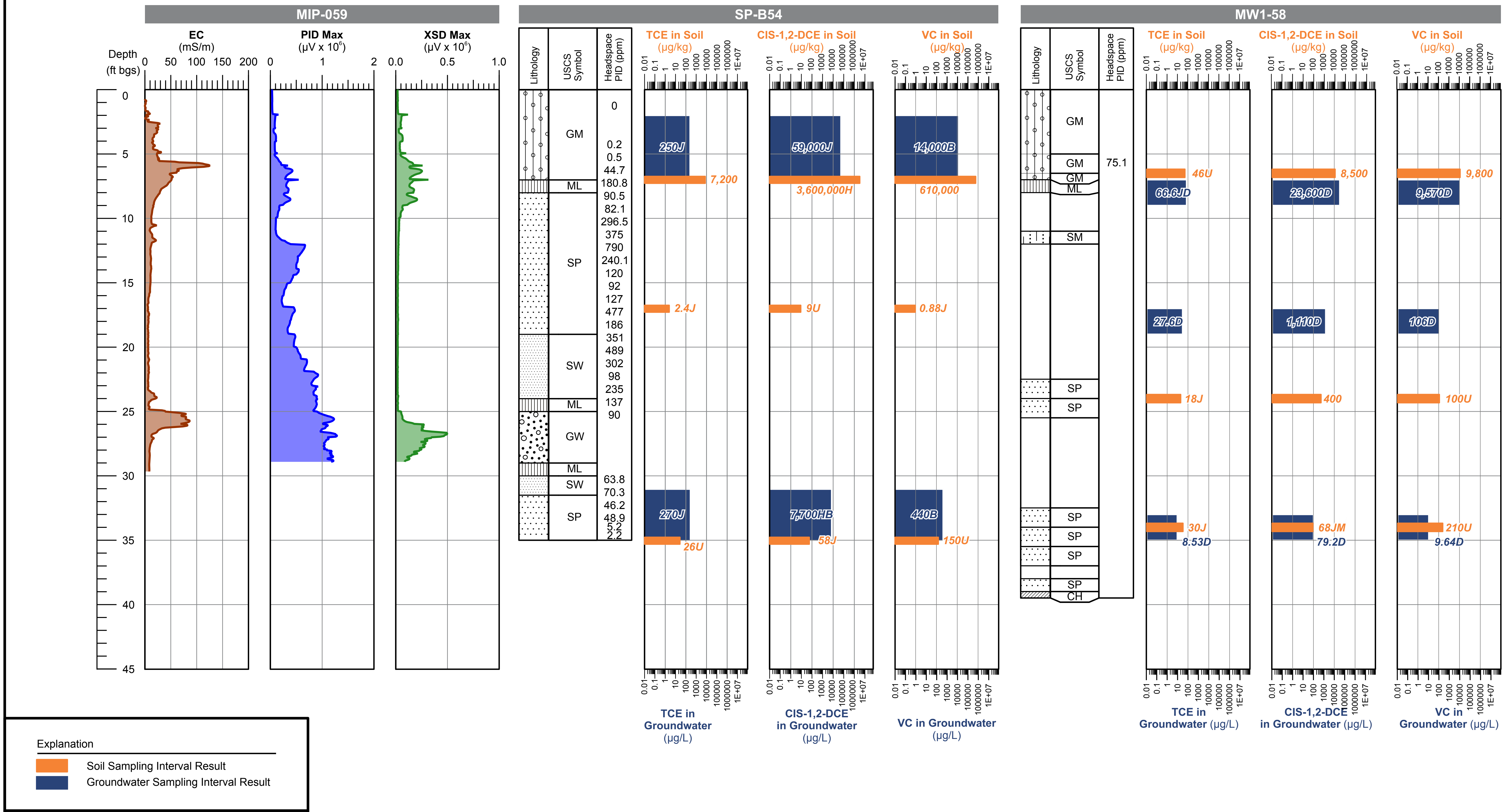
Figure 3-4
OU 1 South Plantation
MIP-019, SP-B53, and MW1-56

Naval Base Kitsap
Keyport



DATE: 3/16/2018 ANALYST: CHIQUES
REV. 3 MIP HIST_LOGS05.CDR APPROVED: MM

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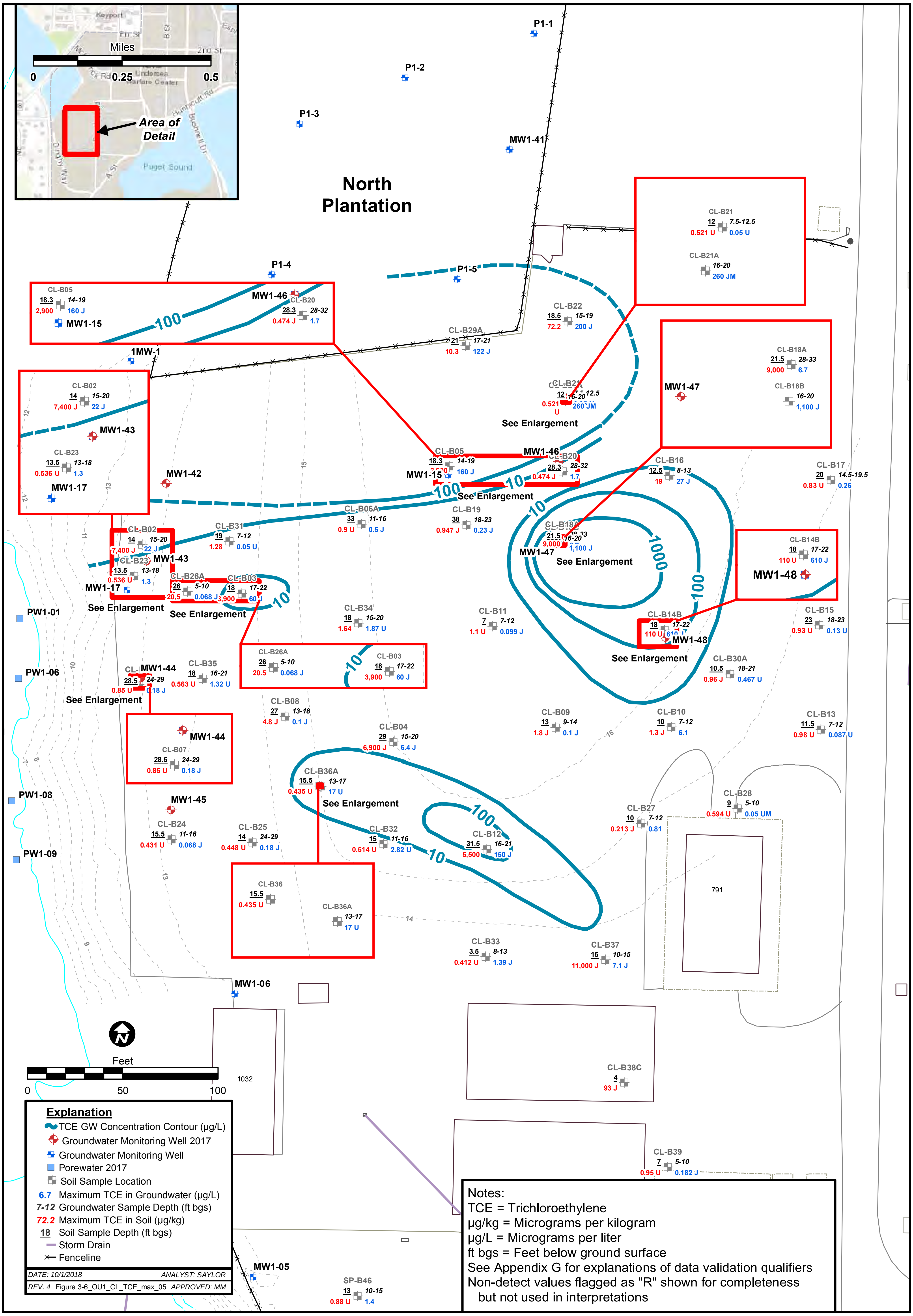
Figure 3-5
OU 1 South Plantation
MIP-059, SP-B54, and MW1-58

Naval Base Kitsap
Keyport



Notes:
TCE = Trichloroethylene
µg/kg = Micrograms per kilogram
µg/L = Micrograms per liter
ft bgs = Feet below ground surface
See Appendix G for explanations of data validation qualifiers
Non-detect values flagged as "R" shown for completeness
but not used in interpretations

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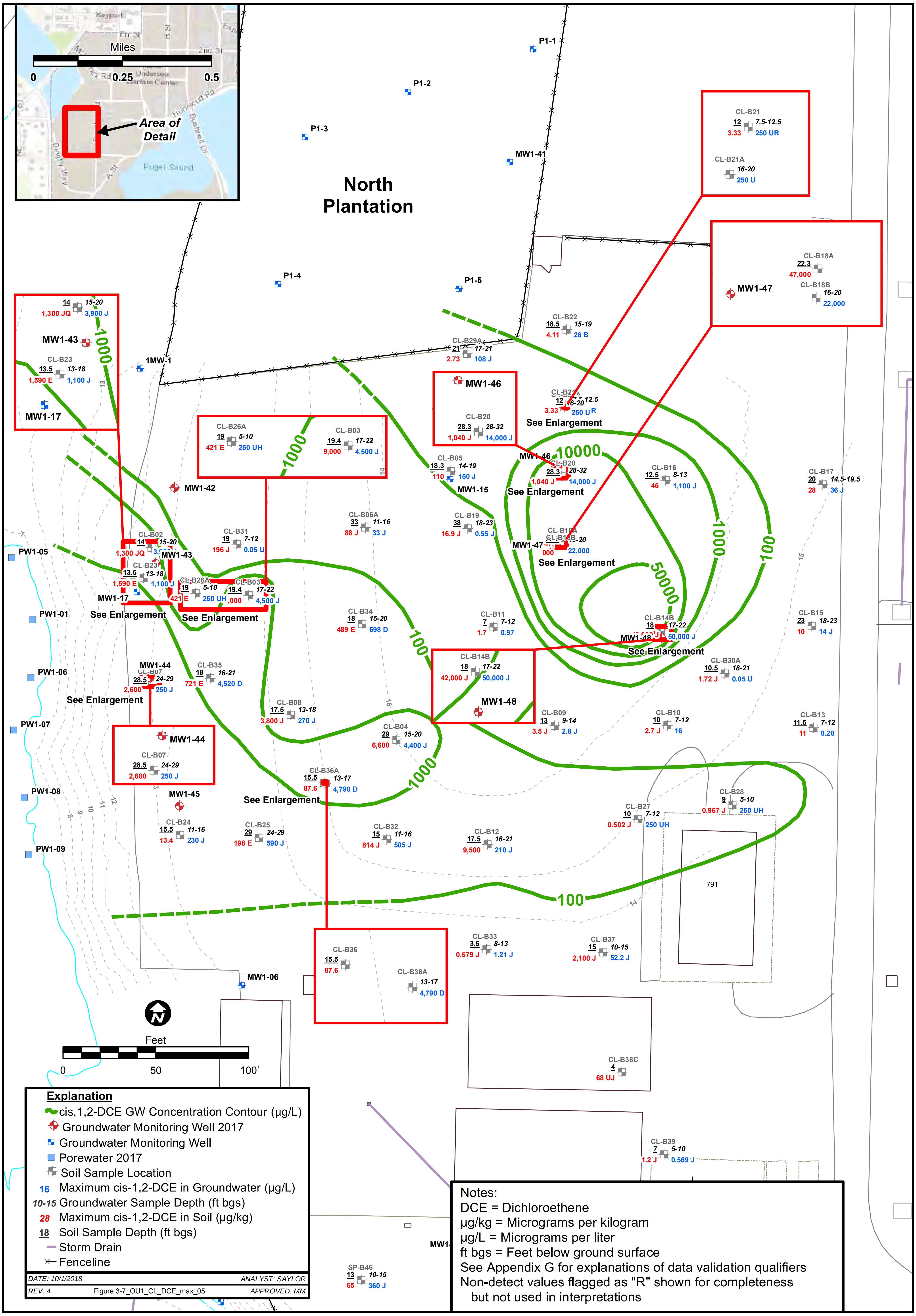
Figure 3-6
Maximum TCE Concentrations in Grab Soil and Groundwater Samples from Direct-Push Borings (Central Landfill)

Naval Base Kitsap
Keyport



Notes:
DCE = Dichloroethene
µg/kg = Micrograms per kilogram
µg/L = Micrograms per liter
ft bgs = Feet below ground surface
See Appendix G for explanations of data validation qualifiers
Non-detect values flagged as "R" shown for completeness
but not used in interpretations

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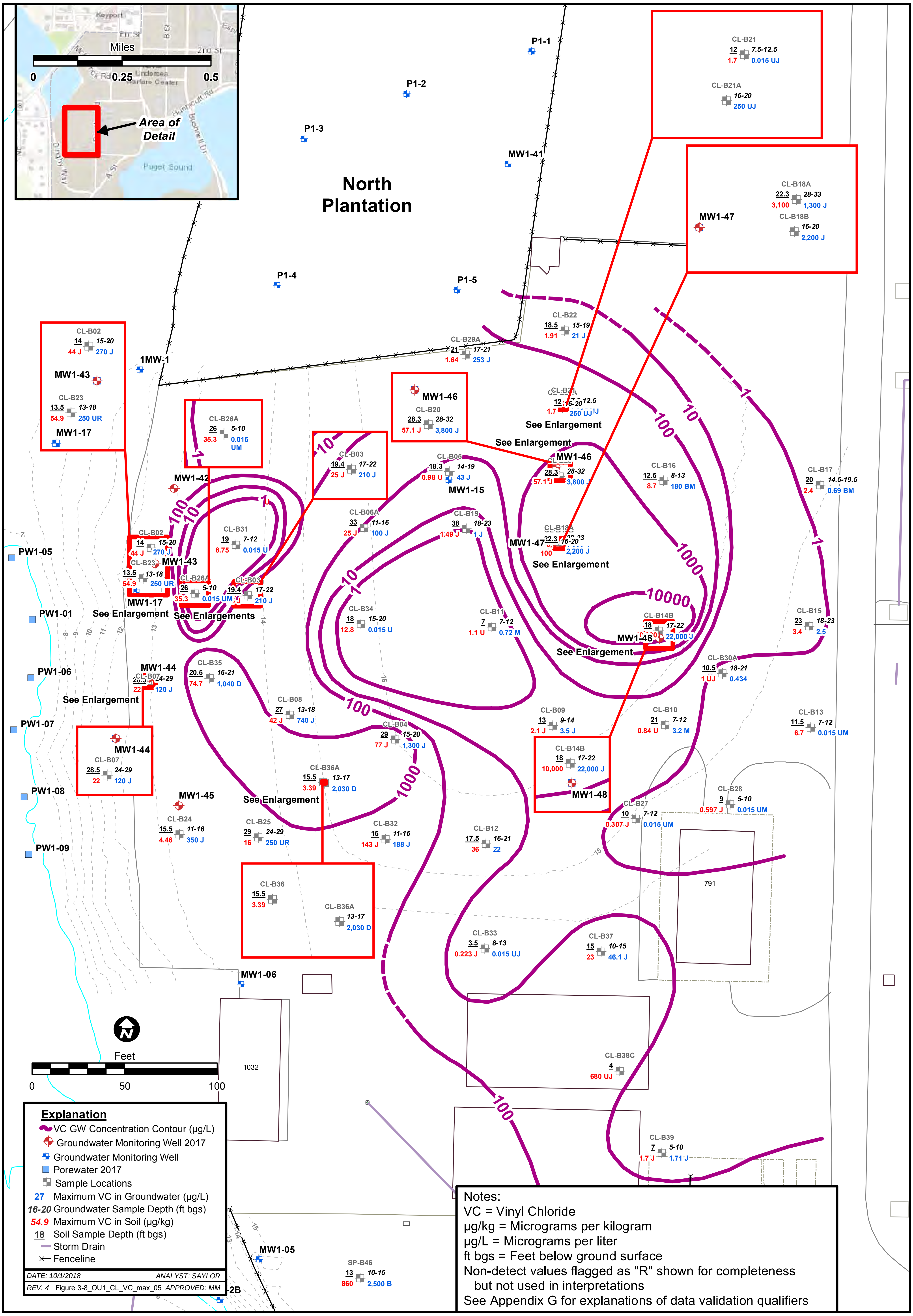
Figure 3-7
Maximum cis-1,2-DCE Concentrations in Grab Soil and Groundwater Samples from Direct-Push Borings (Central Landfill)

Naval Base Kitsap
Keyport



Notes:
VC = Vinyl Chloride
µg/kg = Micrograms per kilogram
µg/L = Micrograms per liter
ft bgs = Feet below ground surface
Non-detect values flagged as "R" shown for completeness but not used in interpretations
See Appendix G for explanations of data validation qualifiers

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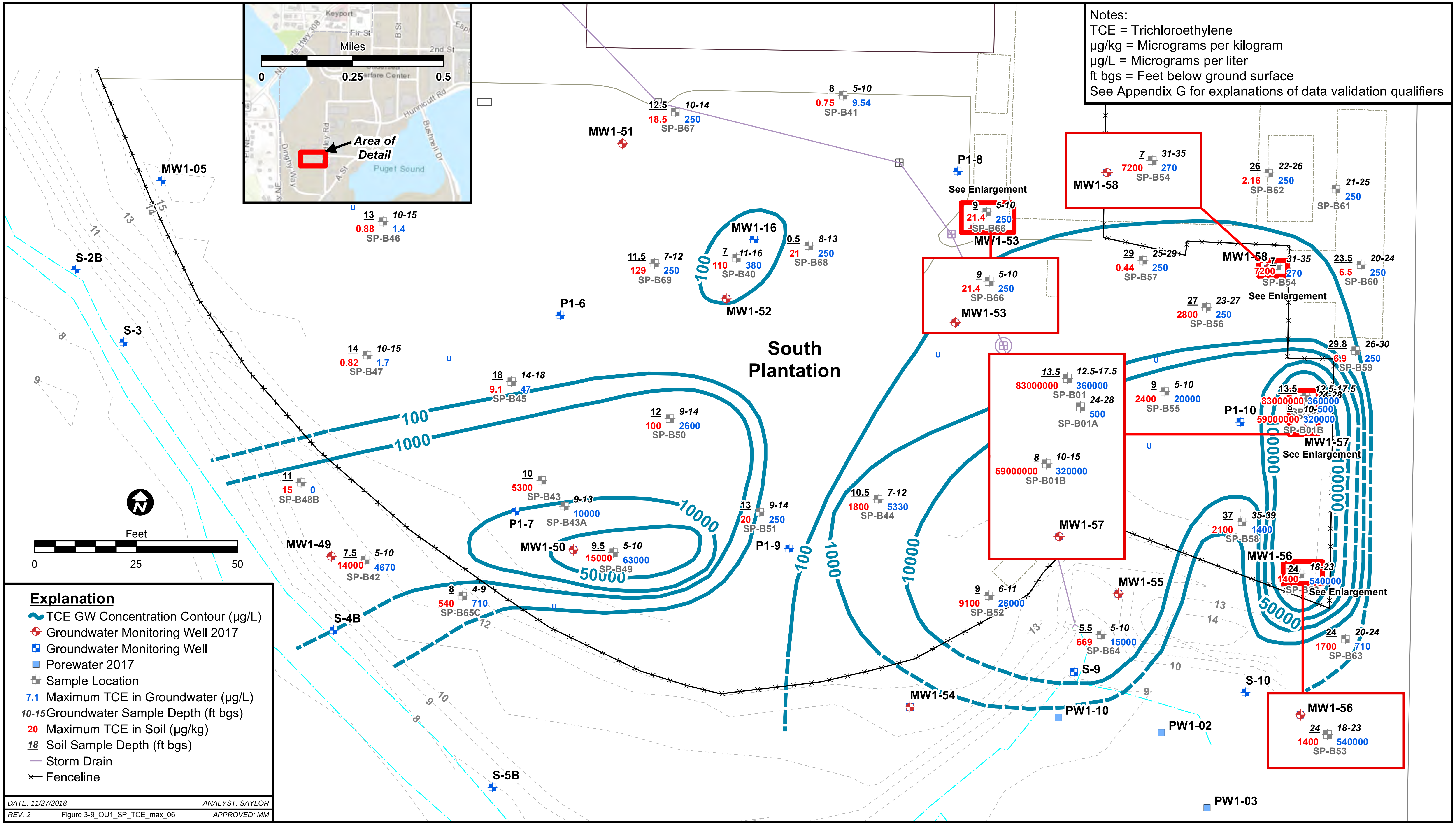
Figure 3-8
Maximum VC Concentrations in Grab Soil and Groundwater Samples from Direct-Push Borings (Central Landfill)

Naval Base Kitsap
Keyport



Notes:
TCE = Trichloroethylene
µg/kg = Micrograms per kilogram
µg/L = Micrograms per liter
ft bgs = Feet below ground surface
See Appendix G for explanations of data validation qualifiers

Explanation

- TCE GW Concentration Contour (µg/L)
- Groundwater Monitoring Well 2017
- Groundwater Monitoring Well
- Porewater 2017
- Sample Location
- 7.1 Maximum TCE in Groundwater (µg/L)
- *10-15* Groundwater Sample Depth (ft bgs)
- 20 Maximum TCE in Soil (µg/kg)
- *18* Soil Sample Depth (ft bgs)
- Storm Drain
- Fenceline

DATE: 11/27/2018 ANALYST: SAYLOR
REV. 2 Figure 3-9_OU1_SP_TCE_max_06 APPROVED: MM

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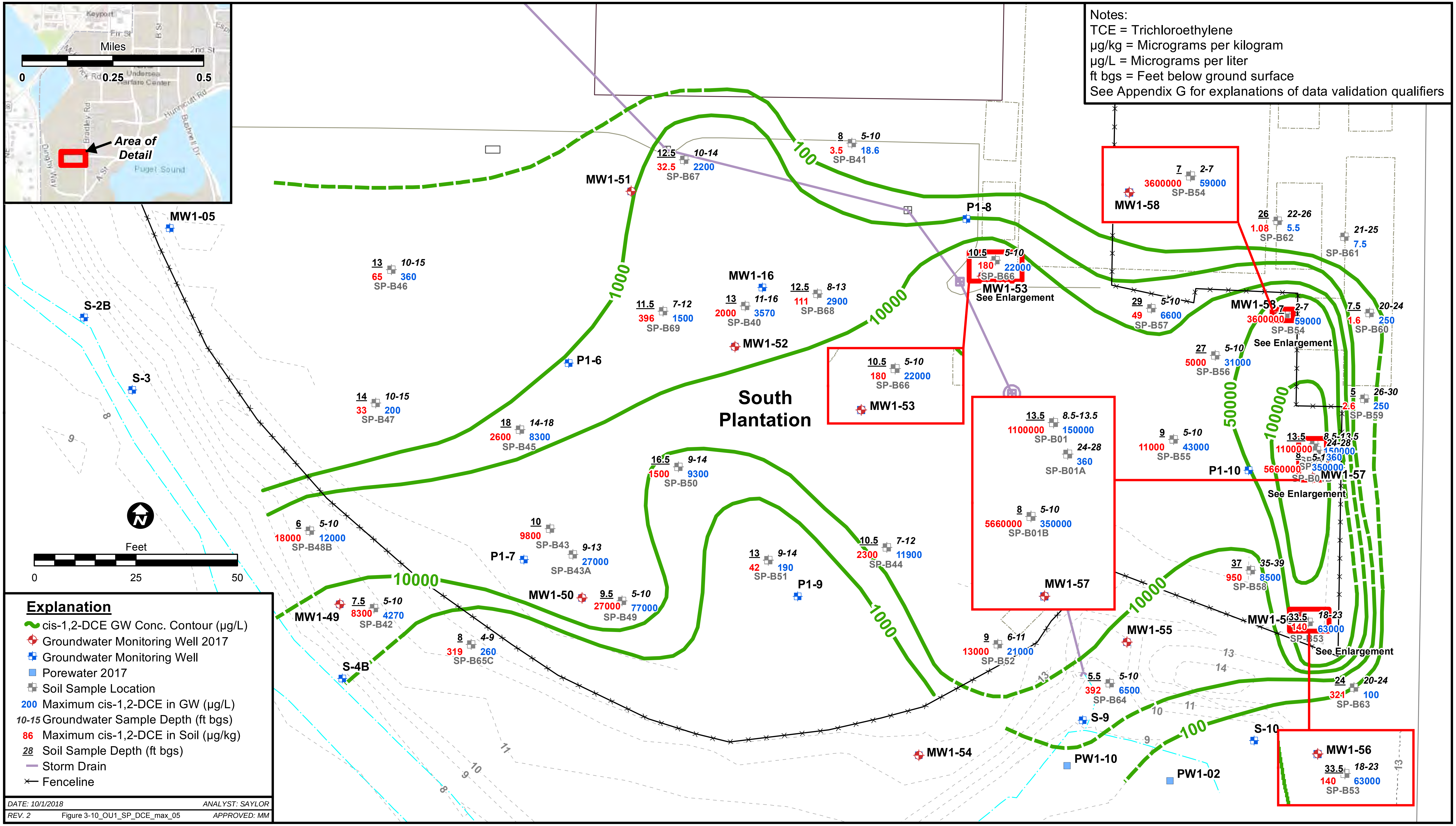
Figure 3-9
Maximum TCE Concentrations in Soil and Groundwater
Samples from Direct-Push Borings (South Plantation)

Naval Base Kitsap
Keyport



Notes:
TCE = Trichloroethylene
µg/kg = Micrograms per kilogram
µg/L = Micrograms per liter
ft bgs = Feet below ground surface
See Appendix G for explanations of data validation qualifiers

Explanation

- cis-1,2-DCE GW Conc. Contour (µg/L)
- Groundwater Monitoring Well 2017
- Groundwater Monitoring Well
- Porewater 2017
- Soil Sample Location
- 200 Maximum cis-1,2-DCE in GW (µg/L)
- *10-15* Groundwater Sample Depth (ft bgs)
- 86 Maximum cis-1,2-DCE in Soil (µg/kg)
- 28 Soil Sample Depth (ft bgs)
- Storm Drain
- Fenceline

DATE: 10/1/2018 ANALYST: SAYLOR
REV. 2 Figure 3-10_OU1_SP_DCE_max_05 APPROVED: MM

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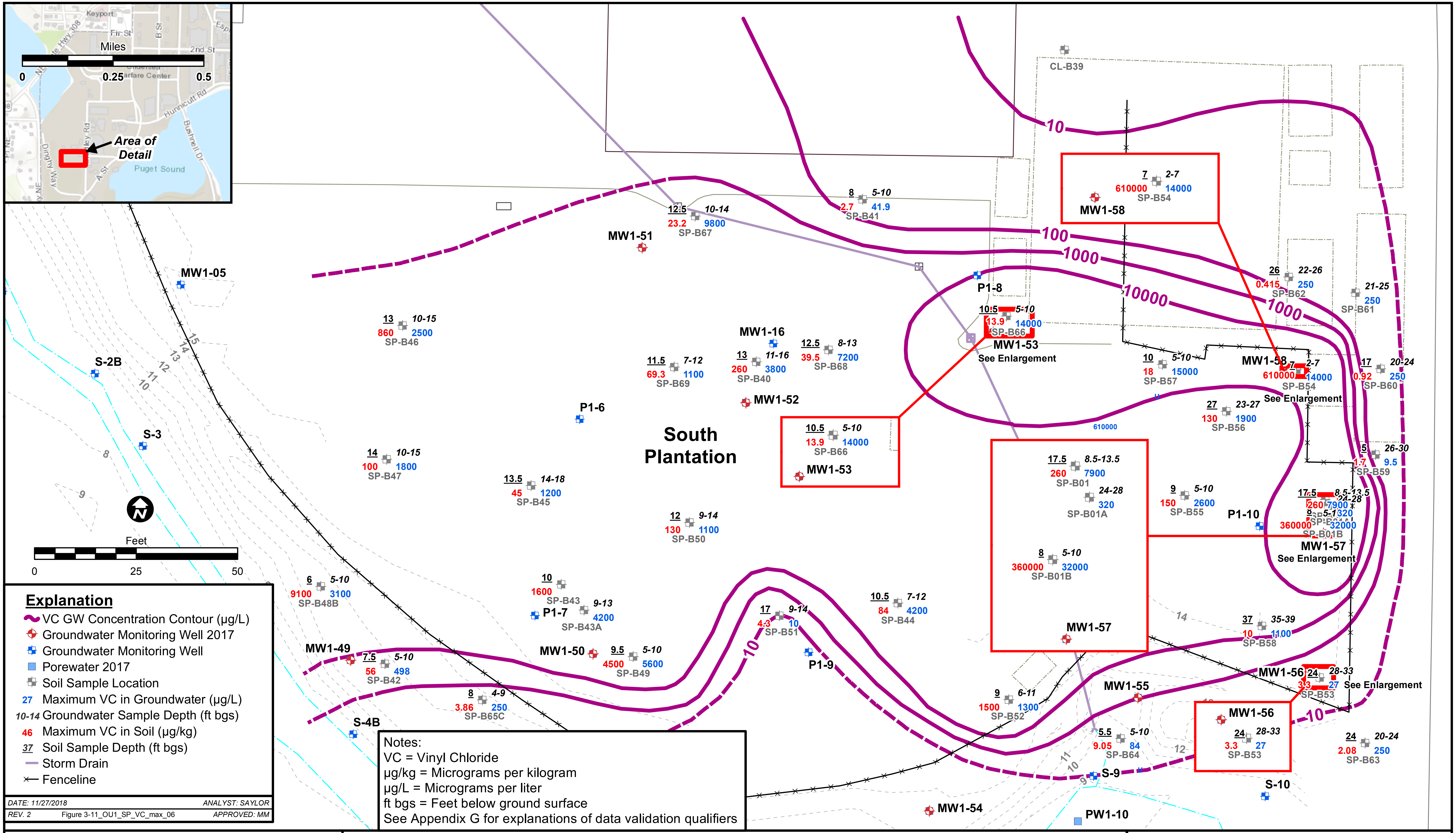
Figure 3-10
Maximum cis-1,2-DCE Concentrations in Soil and Groundwater Samples from Direct-Push Borings (South Plantation)

Naval Base Kitsap
Keyport



Explanation

- VC GW Concentration Contour (µg/L)
- Groundwater Monitoring Well 2017
- Groundwater Monitoring Well
- Porewater 2017
- Soil Sample Location
- 27 Maximum VC in Groundwater (µg/L)
- *10-14* Groundwater Sample Depth (ft bgs)
- 46 Maximum VC in Soil (µg/kg)
- <u>37</u> Soil Sample Depth (ft bgs)
- Storm Drain
- Fenceline

DATE: 11/27/2018 ANALYST: SAYLOR
REV. 2 Figure 3-11_OU1_SP_VC_max_06 APPROVED: MM

Notes:
VC = Vinyl Chloride
µg/kg = Micrograms per kilogram
µg/L = Micrograms per liter
ft bgs = Feet below ground surface
See Appendix G for explanations of data validation qualifiers

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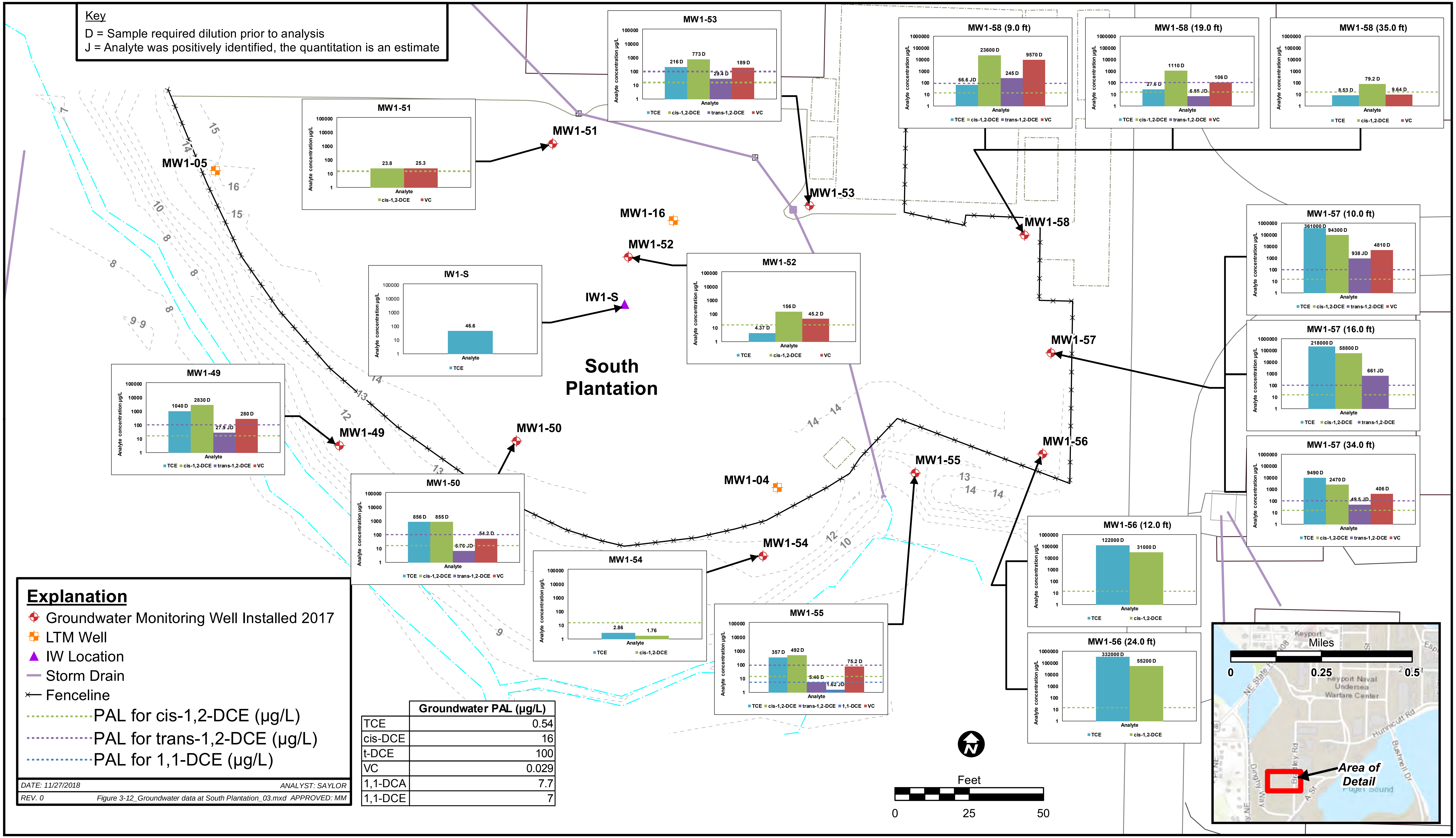
Figure 3-11
Maximum VC Concentrations in Soil and Groundwater Samples from Direct-Push Borings (South Plantation)

Naval Base Kitsap
Keyport



Groundwater PAL (µg/L)	
TCE	0.54
cis-DCE	16
t-DCE	100
VC	0.029
1,1-DCA	7.7
1,1-DCE	7

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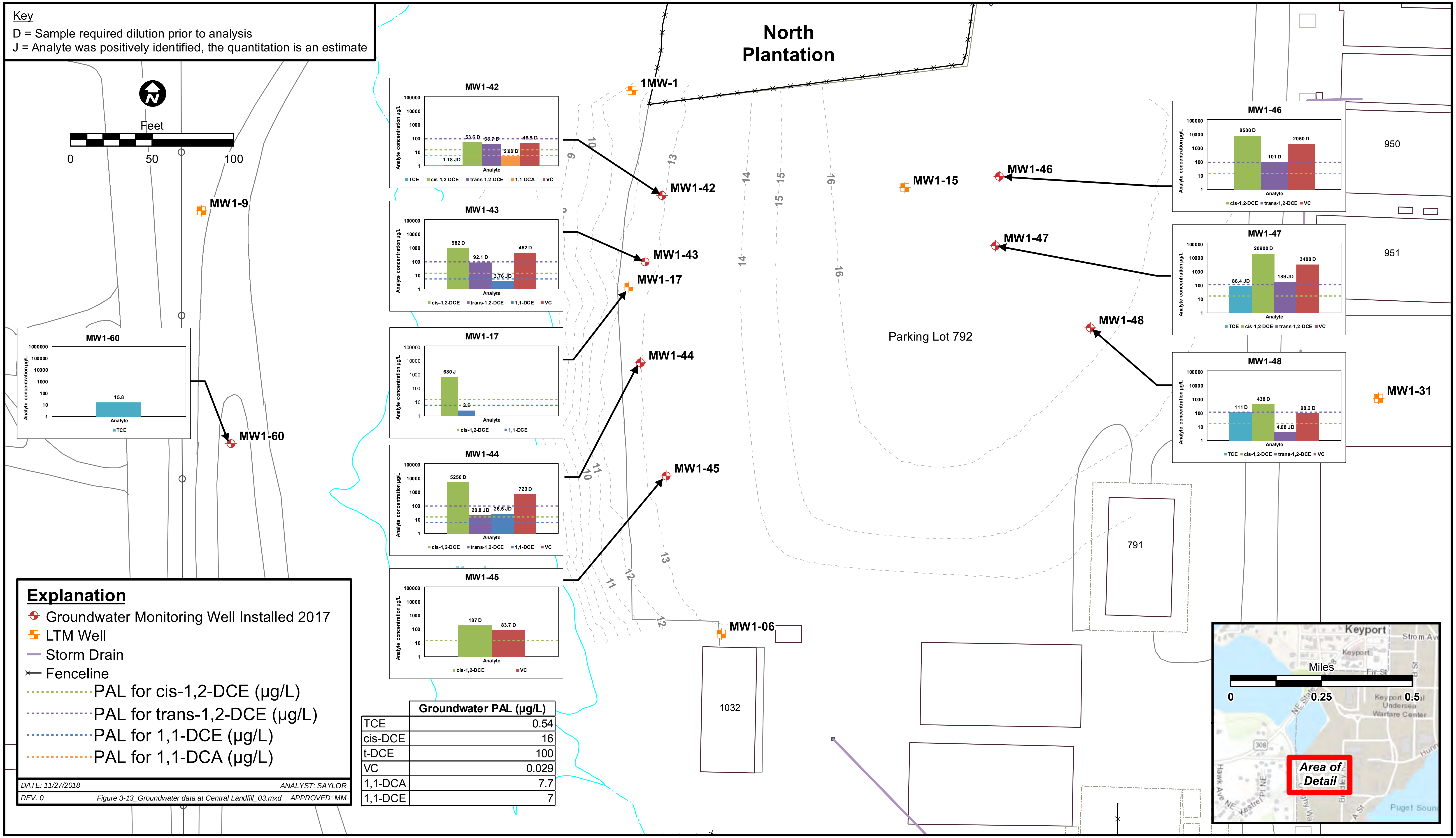
Figure 3-12
Groundwater Data at South Plantation

Naval Base Kitsap
Keyport

Key
D = Sample required dilution prior to analysis
J = Analyte was positively identified, the quantitation is an estimate



Explanation

- ⯐ Groundwater Monitoring Well Installed 2017
- ⯐ LTM Well
- — Storm Drain
- ×— Fenceline
- ------ PAL for cis-1,2-DCE (µg/L)
- ------ PAL for trans-1,2-DCE (µg/L)
- ------ PAL for 1,1-DCE (µg/L)
- ------ PAL for 1,1-DCA (µg/L)

DATE: 11/27/2018 ANALYST: SAYLOR
REV. 0 Figure 3-13_Groundwater data at Central Landfill_03.mxd APPROVED: MM

	Groundwater PAL (µg/L)
TCE	0.54
cis-DCE	16
t-DCE	100
VC	0.029
1,1-DCA	7.7
1,1-DCE	7

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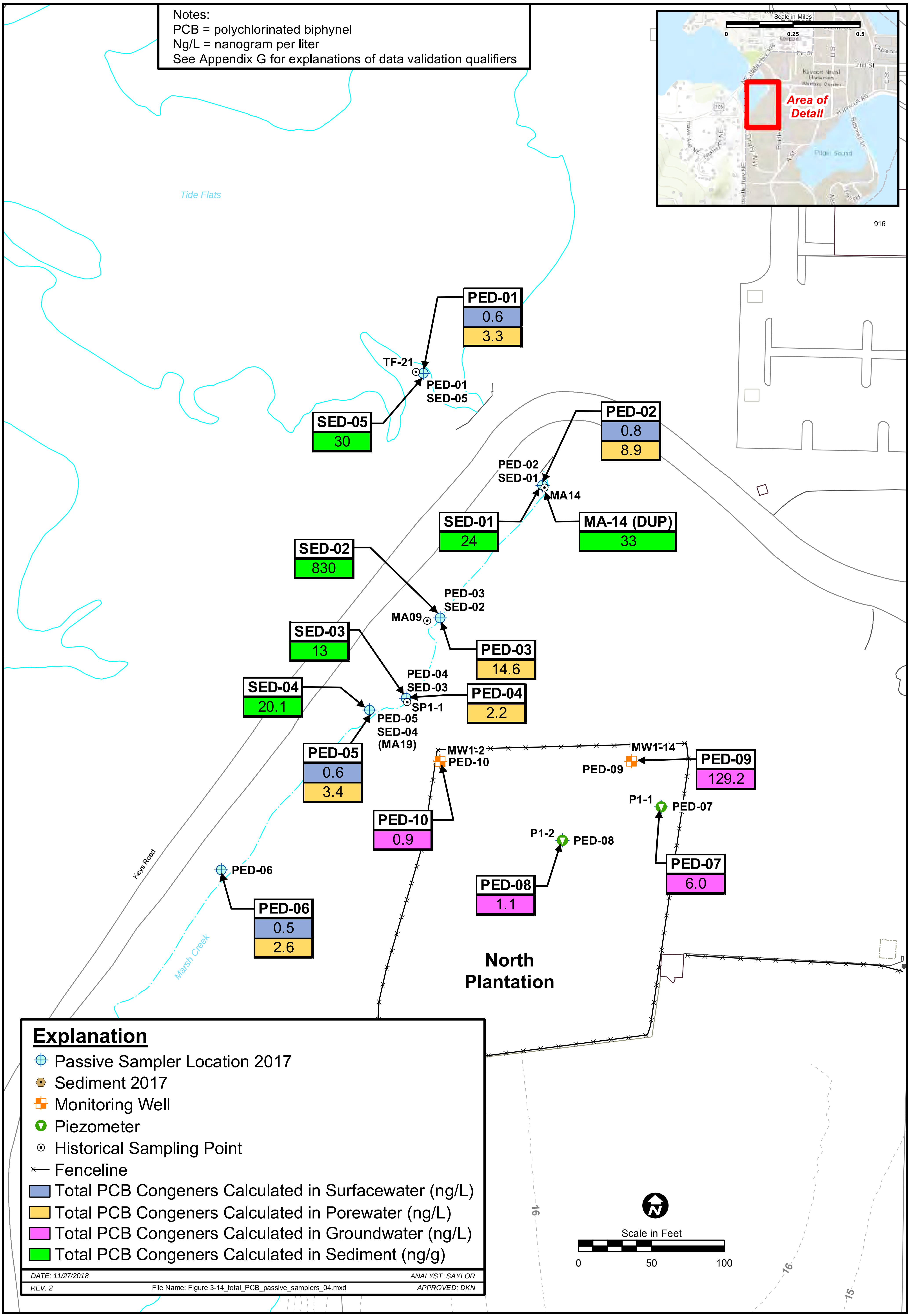
Figure 3-13
Groundwater Data at Central Landfill

Naval Base Kitsap
Keyport



Notes:
PCB = polychlorinated biphynel
Ng/L = nanogram per liter
See Appendix G for explanations of data validation qualifiers

Explanation

- ⊕ Passive Sampler Location 2017
- ⬡ Sediment 2017
- ✚ Monitoring Well
- ▼ Piezometer
- ⊙ Historical Sampling Point
- ×— Fenceline
- 🟦 Total PCB Congeners Calculated in Surfacewater (ng/L)
- 🟨 Total PCB Congeners Calculated in Porewater (ng/L)
- 🟪 Total PCB Congeners Calculated in Groundwater (ng/L)
- 🟩 Total PCB Congeners Calculated in Sediment (ng/g)

DATE: 11/27/2018 ANALYST: SAYLOR
REV. 2 File Name: Figure 3-14_total_PCB_passive_samplers_04.mxd APPROVED: DKN

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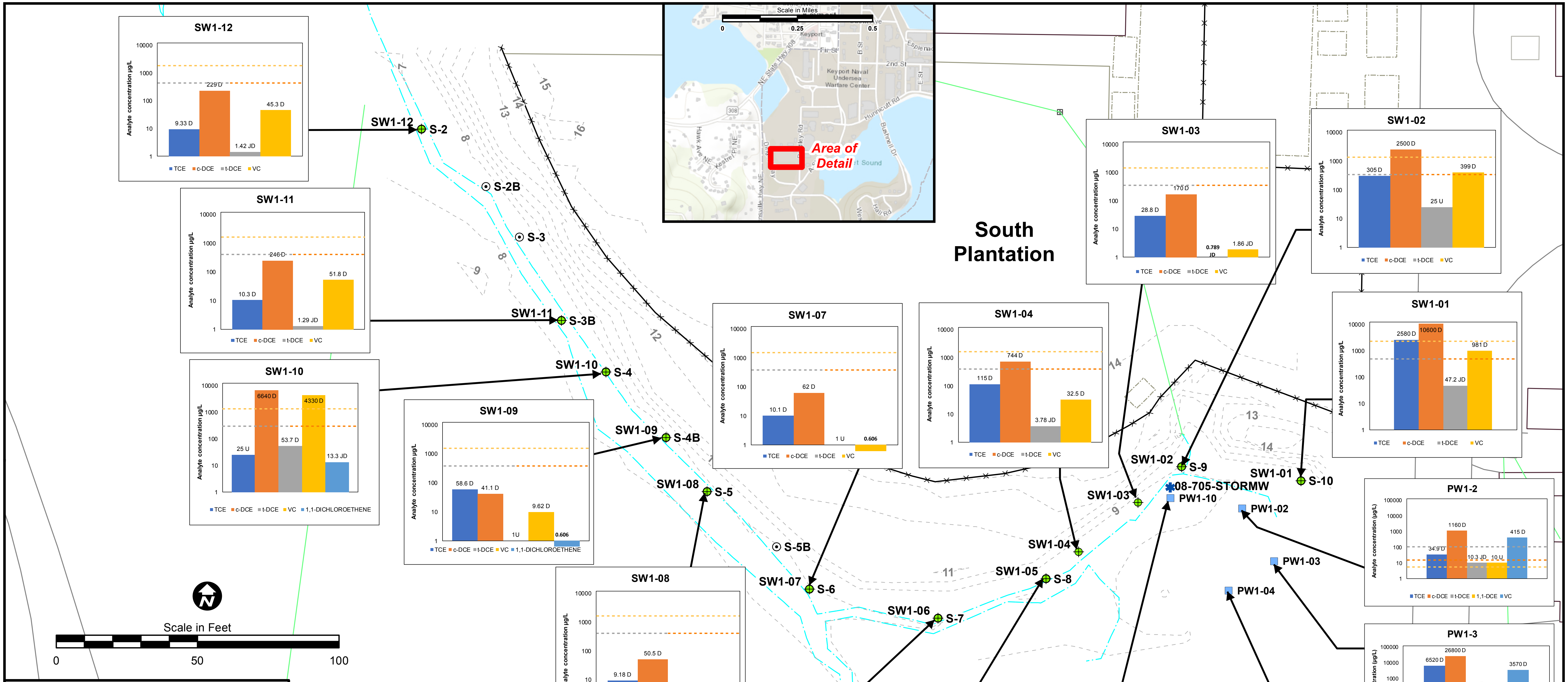
Figure 3-14
PCB Congeners in Sediments and Passive Samplers

Naval Base Kisap
Keyport



Explanation

- 🟦 Porewater 2017
- ⊕ Surface Water 2017
- ✱ Stormwater 2017
- ×— Fenceline
- PAL for cis-DCE (µg/L)
- PAL for t-DCE (µg/L)
- PAL for 1,1-DCE (µg/L)

	Porewater PAL (µg/L)
TCE	0.54
cis-DCE	16
t-DCE	100
vc	0.029
1,1-DCE	7

	Surfacewater PAL (µg/L)
TCE	0.382
cis-DCE	600
t-DCE	600
VC	0.021
1,1-DCE	1200

DATE: 11/27/2018 ANALYST: SAYLOR
REV. 0 Figure 3-15_results_pore_surface_storm_03.mxd APPROVED: DKN

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Figure 3-15
Porewater and Surface Water Data at South Plantation

Naval Base Kitsap
Keyport

Table 3-1. Field Duplicate Analyses Summary

Compound	**Concentration (ug/kg)**		**RPD (Limits)**
	SP-855-S-9.0-170801	**FD-170801-01**	
1,1-Dichloroethene	5.3	19	**113 (≤100)**
cis-1,2-Dichloroethene	11,000	10,000	10 (≤100)
trans-1,2-Dichloroethene	16	31	64 (≤100)
Trichloroethene	1,600	2,400	40 (≤100)
Vinyl chloride	58	150	88 (≤100)
Compound	**Concentration (ug/kg)**		**RPD (Limits)**
	CL-B12-S-31.5-170714	**FD-170714-01**	
1 ,1-Dichloroethene	0.024	0.015	46 (≤100)
cis-1,2-Dichloroethene	2	1.9	5 (≤100)
T richloroethane	5.5	5	10 (≤100)
trans-1,2-Dichloroethene	0.025	0.018	33 (≤100)
Vinyl chloride	0.027	0.017	45 (≤100)
Compound	**Concentration (mg/kg)**		**RPD (Limits)**
	CL-B14b-S-9.0-170717	**FD-170717-01**	
1,1-Dichloroethane	0.0012U	0.0025	not calculable
cis-1 ,2-Dichloroethene	0.032	0.074	79 (≤100)
Trichloroethene	0.0017	0.0026	42 (≤100)
Vinyl chloride	0.011	0.018	48 (≤100)
Compound	**Concentration (ug/kg)**		**RPD (Limits)**
	CL-B26a-S-26.0-170721	**FD-170721-01**	
1,1-Dichloroethene	0.372	0.418	12 (≤100)
1,2-Dichloroethane	0.705	0.485U	not calculable
Chloroethane	0.450	0.485U	not calculable
cis-1,2-Dichloroethene	139	151	8 (≤100)
trans-1,2-Dichloroethene	31.8	30.0	6 (≤100)
Trichloroethene	13.8	20.5	39 (≤100)
Vinyl chloride	35.3	30.2	16 (≤100)
Compound	**Concentration (ug/kg)**		**RPD (Limits)**
	CL-B26a-S-26.0-170721DL	**FD-170721-01DL**	
cis-1,2-Dichloroethene	4,190	4,150	1 (≤100)
trans-1,2-Dichloroethene	951	1,320	32 (≤100)
Trichloroethene	1,740	1,770	2 (≤100)
Vinyl chloride	155	326	71 (≤100)

Table 3-1. Field Duplicate Analyses Summary (continued)

Compound	**Concentration (ug/kg)**		**RPD (Limits)**
	SP-869-S-15.0-170806	**FD-0-170806-02**	
1,1-Dichloroethene	0.549U	0.487	not calculable
Chloroethane	2.29	10.0	**125 (≤100)**
cis-1,2-Dichloroethene	168	395	81 (≤100)
trans-1,2-Dichloroethene	2.93	5.67	64 (≤100)
Trichloroethene	16.3	129	**155 (≤100)**
Vinyl chloride	18.2	69.3	**117(≤100)**

Compound	**Concentration (ug/kg)**		**RPD (Limits)**
	SP-B69-S-15.0-170806DL	**FD-0-170806-02DL**	
Chloroethane	34.3U	49.6	not calculable
cis-1,2-Dichloroethene	1590	1890	17 (≤100)
trans-1 ,2-Dichloroethene	42.2	46.7	10 (≤100)
Trichloroethene	74.6	32.8	78 (≤100)
Vinyl chloride	115	327	96 (≤100)

Compound	**Concentration (ug/kg)**		**RPD (Limits)**
	CL-B78-S-28.5-171007	**FD-171007-01**	
cis-1,2-Dichloroethene	3,500	11,000	**103 (≤100)**
trans-1,2-Dichloroethene	53	240	**128 (≤100)**
Trichloroethene	200	150	29 (≤100)
Vinyl chloride	630	450	33 (≤100)

Compound	**Concentration(ug/kg)**		**RPD (Limits)**
	SP-888-S-9.0-171018	**FD-171018-04**	
1,1-Dichloroethene	540	350	43 (≤100)
cis-1,2-Dichloroethene	350,000	240,000	37 (≤100)
Tetrachloroethene	4,200	2,000	71 (≤100)
trans-1,2-Dichloroethene	5,600	3,500	46 (≤100)
Trichloroethene	3,500,000	1,800,000	64 (≤100)
Vinyl chloride	4,200	5,000	17 (≤100)

Compound	**Concentration (ug/L)**		**RPD (Limits)**
	CL-B14B-GW-22.0-170717	**FD-170717-02**	
1,1-Dichloroethene	210	210	0 (≤30)
cis-1,2-Dichloroethene	50,000	46,000	8 (≤30)
trans-1 ,2-Dichloroethene	1,300	1,300	0 (≤30)
Trichloroethene	610	610	0 (≤30)
Vinyl chloride	22,000	20,000	10 (≤30)

Table 3-1. Field Duplicate Analyses Summary (continued)

Compound	**Concentration (ug/L)**		**RPD (Limits)**
	CL-828-GW-10.0-170721	**FD-170721-02**	
Trichloroethene	0.036	0.050U	not calculable

Compound	**Concentration (ug/L)**		**RPD (Limits)**
	SP-B56-GW-10.0-170801	**FD-170801-02**	
1,1-Dichloroethane	0.16	0.34	**72 (≤30)**
1,1-Dichloroethene	17	18	6 (≤30)
1,2-Dichloroethane	0.72	0.050U	not calculable
cis-1,2-Dichloroethene	29,000	31,000	7 (≤30)
trans-1,2-Dichloroethene	330	370	11 (≤30)
Trichloroethene	5.9	6.8	14 (≤30)

Compound	**Concentration (ug/L)**		**RPD (Limits)**
	SP-868-GW-13.0-170806	**F0-170806-01**	
cis-1,2-Dichloroethene	2,900	2,400	19 (≤30)
Vinyl chloride	6,600	7,200	9 (≤30)

Compound	**Concentration (ug/L)**		**RPD (Limits)**
	SP-801B-GW-15.0-170807	**FD-0170807-01**	
cis-1 ,2-Dichloroethene	120,000	100,000	18 (≤30)
trans-1,2-Dichloroethene	1,100	1,100	0 (≤30)
Trichloroethene	310,000	320,000	3 (≤30)
Vinyl chloride	4,800	4,300	11 (≤30)

Compound	**Concentration (ug/L)**		**RPD (Limits)**
	PW1-02-170907	**FD-170907-01**	
cis-1,2-Dichloroethene	1,000	1,160	15 (≤50)
trans-1,2-Dichloroethene	7.25	10.3	35 (≤50)
Trichloroethene	10.9	34.9	**105 (≤50)**
Vinyl chloride	408	415	2 (≤50)

Compound	**Concentration (ug/L)**		**RPD (Limits)**
	SW1-06-171026	**FD-102617-02**	
cis-1,2-Dichloroethene	293	319	8 (≤50)
trans-1,2-Dichloroethene	1.67	1.84	10 (≤50)
Trichloroethene	44.9	49.1	9 (≤50)
Vinyl chloride	5.89	5.54	6 (≤50)

Table 3-1. Field Duplicate Analyses Summary (continued)

Compound	**Concentration (ug/L)**		**RPD (Limits)**
	MW1-46-171023	**FD-171023-01**	
cis-1,2-Dichloroethene	8,500	8,600	1 (≤50)
trans-1,2-Dichloroethene	101	82.0	21 (≤50)
Vinyl chloride	2050	2070	1 (≤50)

Compound	**Concentration (ug/L)**		**RPD (Limits)**
	MW1-53-171026	**FD-171026-01**	
cis-1,2-Dichloroethene	773	803	4 (≤50)
trans-1,2 -Dichloroethene	29.4	31.1	6 (≤50)
Trichloroethene	216	220	2 (≤50)
Vinyl chloride	189	192	2 (≤50)

Volatile Organic Compound Field Duplicate Summary

Sample Type	**# Compounds with RPDs**	**# RPDs in Control**	**%Compliant**
Solids	35	29	83%
Groundwater	16	15	94%
Surface water	4	3	75%
Porewater	4	4	100%
Monitoring Wells	7	7	100%
Total	66	58	88%

Compound	**Concentration (μg/kg)**		**RPD (Limits)**
	SED01-10-170906	**FD-171906-01**	
PCB-1	0.0065	0.0078	18 (≤100)
PCB-2	0.0020	0.0024	18 (≤100)
PCB-3	0.0031	0.0045	37 (≤100)
PCB-4	0.066	0.063	5 (≤100)
PCB-6	0.091	0.084	8 (≤100)
PCB-7	0.012U	0.0029	Not calculable
PCB-8	0.12	0.14	15 (≤100)
PCB-9	0.012U	0.0047	Not calculable
PCB-11	0.019	0.013	38 (≤100)
PCB-13	0.012	0.012	0 (≤100)
PCB-15	0.088	0.090	2 (≤100)
PCB-16	0.062	0.062	0 (≤100)
PCB-17	0.085	0.086	1 (≤100)
PCB-18	0.21	0.21	0 (≤100)
PCB-19	0.027	0.025	8 (≤100)
PCB-20	0.25	0.27	8 (≤100)

Table 3-1. Field Duplicate Analyses Summary (continued)

Compound	**Concentration (µg/kg)**		**RPD (Limits)**
	SED01-10-170906	**FD-171906-01**	
PCB-21	0.062	0.084	30 (≤100)
PCB-22	0.048	0.057	17(≤100)
PCB-24	0.0027	0.0026	4 (≤100)
PCB-25	0.066	0.070	6 (≤100)
PCB-26	0.13	0.13	0 (≤100)
PCB-27	0.038	0.034	11 (≤100)
PCB-28	0.25	0.27	8 (≤100)
PCB-29	0.13	0.13	0 (≤100)
PCB-30	0.21	0.21	0 (≤100)
PCB-31	0.15	0.018	**157 (≤100)**
PCB-32	0.062	0.067	8 (≤100)
PCB-33	0.062	0.084	30 (≤100)
PCB-35	0.0025	0.0036	36 (≤100)
PCB-37	0.042	0.052	21 (≤100)
PCB-40	0.14	0.15	7 (≤100)
PCB-41	0.14	0.15	7 (≤100)
PCB-42	0.068	0.070	3 (≤100)
PCB-43	0.012	0.0088	31 (≤100)
PCB-44	0.35	0.39	11 (≤100)
PCB-45	0.032	0.032	0 (≤100)
PCB-46	0.016	0.016	0 (≤100)
PCB-47	0.35	0.39	11 (≤100)
PCB-48	0.030	0.032	6 (≤100)
PCB-49	0.34	0.35	3 (≤100)
PCB-50	0.062	0.065	5 (≤100)
PCB-51	0.032	0.032	0 (≤100)
PCB-52	0.80	0.90	12 (≤100)
PCB-53	0.062	0.065	5 (≤100)
PCB-55	0.0095	0.0059	47 (≤100)
PCB-56	0.065	0.077	17 (≤100)
PCB-59	0.047	0.047	0 (≤100)
PCB-60	0.024	0.029	19 (≤100)
PCB-61	0.49	0.57	15 (≤100)
PCB-62	0.047	0.047	0 (≤100)
PCB-63	0.0098	0.012	20 (≤100)

Table 3-1. Field Duplicate Analyses Summary (continued)

Compound	**Concentration** (μg/kg)		**RPD (Limits)**
	SED01-10-170906	**FD-171906-01**	
PCB-64	0.087	0.097	11 (≤100)
PCB-65	0.35	0.39	11 (≤100)
PCB-66	0.29	0.35	19 (≤100)
PCB-67	0.012	0.014	15(≤100)
PCB-68	0.0074	0.0091	21 (≤100)
PCB-69	0.34	0.35	3 (≤100)
PCB-70	0.49	0.57	15 (≤100)
PCB-71	0.14	0.15	7 (≤100)
PCB-72	0.012	0.014	15 (≤100)
PCB-73	0.012	0.0088	31 (≤100)
PCB-74	0.49	0.57	15 (≤100)
PCB-75	0.047	0.047	0 (≤100)
PCB-76	0.490	0.57	15 (≤100)
PCB-77	0.038	0.046	19 (≤100)
PCB-79	0.012	0.015	22 (≤100)
PCB-82	0.15	0.21	33 (≤100)
PCB-83	1.1	1.4	24 (≤100)
PCB-84	0.34	0.43	23 (≤100)
PCB-85	0.28	0.37	28 (≤100)
PCB-86	0.93	1.3	33 (≤100)
PCB-87	0.93	1.3	33 (≤100)
PCB-88	0.21	0.26	21 (≤100)
PCB-90	1.5	2.0	29 (≤100)
PCB-91	0.21	0.26	21 (≤100)
PCB-92	0.28	0.36	25 (≤100)
PCB-93	0.012U	0.0080	Not calculable
PCB-95	1.2	1.6	29 (≤100)
PCB-97	0.93	1.3	33 (≤100)
PCB-98	0.054	0.068	23 (≤100)
PCB-99	1.1	1.4	24 (≤100)
PCB-100	0.012U	0.0080	Not calculable
PCB-101	1.5	2.0	29 (≤100)
PCB-102	0.054	0.068	23 (≤100)
PCB-103	0.013	0.012U	Not calculable
PCB-105	0.48	0.69	36 (≤100)

Table 3-1. Field Duplicate Analyses Summary (continued)

Compound	**Concentration** (μg/kg)		**RPD (Limits)**
	SED01-10-170906	**FD-171906-01**	
PCB-107	0.11	0.18	48 (≤100)
PCB-108	0.041	0.061	39 (≤100)
PCB-109	0.93	1.3	33 (≤100)
PCB-110	1.9	2.6	31 (≤100)
PCB-113	1.5	2.0	29 (≤100)
PCB-114	0.022	0.028	24 (≤100)
PCB-115	1.9	2.6	31 (≤100)
PCB-116	0.28	0.37	28 (≤100)
PCB-117	0.28	0.37	28 (≤100)
PCB-118	1.4	1.9	30 (≤100)
PCB-119	0.93	1.3	33 (≤100)
PCB-120	0.010	0.012U	Not calculable
PCB-122	0.021	0.026	21 (≤100)
PCB-123	0.018	0.036	67 (≤100)
PCB-124	0.041	0.061	39 (≤100)
PCB-125	0.93	1.3	33 (≤100)
PCB-126	0.012U	0.0067	Not calculable
PCB-128	0.37	0.58	44 (≤100)
PCB-129	2.1	3.2	42 (≤100)
PCB-130	0.13	0.21	47 (≤100)
PCB-131	0.026	0.041	45 (≤100)
PCB-132	0.55	0.91	49 (≤100)
PCB-133	0.022	0.039	56 (≤100)
PCB-134	0.11	0.16	37 (≤100)
PCB-135	0.37	0.50	30 (≤100)
PCB-136	0.15	0.21	33 (≤100)
PCB-137	0.11	0.18	48 (≤100)
PCB-138	2.1	3.2	42 (≤100)
PCB-139	0.038	0.061	46 (≤100)
PCB-140	0.038	0.061	46 (≤100)
PCB-141	0.24	0.39	48 (≤100)
PCB-143	0.11	0.16	37 (≤100)
PCB-144	0.049	0.068	32 (≤100)
PCB-146	0.23	0.36	44 (≤100)
PCB-147	1.3	1.9	37 (≤100)

Table 3-1. Field Duplicate Analyses Summary (continued)

Compound	Concentration (µg/kg)		RPD (Limits)
	SED01-10-170906	FD-171906-01	
PCB-148	0.012U	0.0016	Not calculable
PCB-149	1.3	1.9	37 (≤100)
PCB-150	0.0015	0.0017	12 (≤100)
PCB-151	0.37	0.50	30 (≤100)
PCB-152	0.00090	0.012U	Not calculable
PCB -153	1.4	2.0	35 (≤100)
PCB-154	0.012U	0.027	Not calculable
PCB-156	0.20	0.34	52 (≤100)
PCB-157	0.20	0.34	52 (≤100)
PCB-158	0.20	0.33	49 (≤100)
PCB-160	2.1	3.2	42 (≤100)
PCB-163	2.1	3.2	42 (≤100)
PCB-164	0.12	0.19	45 (≤100)
PCB-166	0.37	0.58	44 (≤100)
PCB-167	0.074	0.12	47 (≤100)
PCB-168	1.4	2.0	35 (≤100)
PCB-170	0.18	0.31	53 (≤100)
PCB-171	0.062	0.099	46 (≤100)
PCB-172	0.028	0.042	40 (≤100)
PCB-173	0.062	0.099	46 (≤100)
PCB-174	0.14	0.21	40 (≤100)
PCB-175	0.0080	0.0088	10 (≤100)
PCB-176	0.018	0.029	47 (≤100)
PCB-177	0.095	0.14	38 (≤100)
PCB-178	0.031	0.049	45 (≤100)
PCB-179	0.063	0.086	31 (≤100)
PCB-180	0.30	0.46	42 (≤100)
PCB-181	0.0036	0.0060	50 (≤100)
PCB-182	0.0023	0.012U	Not calculable
PCB-183	0.11	0.17	43 (≤100)
PCB-185	0.11	0.17	43 (≤100)
PCB-187	0.19	0.27	35 (≤100)
PCB-189	0.0081	0.014	53 (≤100)
PCB-190	0.028	0.047	51 (≤100)
PCB-191	0.0024	0.010	**123 (≤100)**

Table 3-1. Field Duplicate Analyses Summary (continued)

Compound	**Concentration** (μg/kg)		**RPD (Limits)**
	SED01-10-170906	**FD-171906-01**	
PCB-193	0.30	0.46	42 (≤100)
PCB-194	0.051	0.071	33 (≤100)
PCB-195	0.018	0.028	43 (≤100)
PCB-196	0.023	0.028	20 (≤100)
PCB-197	0.0013	0.0023	56 (≤100)
PCB-198	0.052	0.069	28 (≤100)
PCB-199	0.052	0.069	28 (≤100)
PCB-200	0.0051	0.0058	13 (≤100)
PCB-201	0.0062	0.0081	27 (≤100)
PCB-202	0.016	0.013	21 (≤100)
PCB-203	0.028	0.038	30 (≤100)
PCB-205	0.0034	0.0030	12 (≤100)
PCB-206	0.043	0.052	19 (≤100)
PCB-207	0.0048	0.0068	34 (≤100)
PCB-208	0.016	0.022	32 (≤100)
PCB-209	0.055	0.068	21 (≤100)
Total Monochioroblphenyls	0.012	0.015	22 (≤100)
Total Dichlorobipheniys	0.40	0.41	2 (≤100)
Total Trichlorobiphenyls	1.2	1.3	8 (≤100)
Total Tetrachlorobiphenyis	3.0	3.3	10 (≤100)
Total Pentachlorobiphenyls	10	13	26 (≤100)
Total Hexachlorobiphenyls	7.7	12	44 (≤100)
Total Heptachlorobiphenyls	1.3	2.0	42 (≤100)
Total Octachlorobiphenyls	0.20	0.27	30 (≤100)
Total Nonachloroblphenyls	0.064	0.081	23 (≤100)
Polychlorinated biphenyls, Total	24	33	32 (≤100)

PCB Congener Field Duplicate Summary

Sample Type	**# Compounds with RPDs**	**# RPDs in Control**	**%Compliant**
Solid	161	159	99%

Compound	**Concentration (ng/L)**		**RPD (Limits)**
	MW1-58-9.0-171115	**FD-171115-02**	
PFNA	0.63 J	0.52 J	19 (≤50)
PFDA	0.44 J	0.39 J	12 (≤50)
PFDoA	0.22 U	0.12 J	Not calculable

Table 3-1. Field Duplicate Analyses Summary (continued)

PFTrDA	0.22 U	0.34 J	Not calculable
PFOS	1.95 J	1.71 J	13 (≤50)
PFHxA	3.50 J	1.57 J	**76 (≤50)**
PFHpA	3.29 J	2.36 J	33 (≤50)
Compound	**Concentration (ug/L)**		**RPD (Limits)**
	MW1-46-171023	**FD-171023-01**	
1,4-Dioxane	4.04	3.32	20 (≤50)
Analyte	**Concentration (mg/kg)**		**RPD (Limits)**
	SED01-10-170906	**FD-170906-01**	
Total organic carbon	9300	7100	27 (≤100)
Analvte	**Concentration (mg/kg)**		**RPD (Limits)**
	SED01-10-170906	**FD-171906-01**	
Total organic carbon	5100	5300	4 (≤100)
Analyte	**Concentration (mg/kg)**		**RPD (Limits)**
	SED01-10-170906	**FD-170906-01**	
Total organic carbon	9300	7100	27 (≤100)
Analyte	**Concentration (mg/L)**		**RPD (Limits)**
	MW1-46-171023	**FD-171023-01**	
Chemical oxygen demand	40.8	36.4	11 (≤50)
Sulfate	52.5	57.0	8 (≤50)
Analyte	**Concentration (mg/L)**		**RPD (Limits)**
	MW1-53-171026	**FD-171026-01**	
Chemical oxygen demand	40.0U	34.2	not calculable
Biochemical oxygen demand	5.60	4.40	24 (≤50)

Table 3-1. Field Duplicate Analyses Summary (continued)

Miscellaneous Target Analyte Field Duplicate Summary			
Analysis/Sample Type	**# Compounds with RPDs**	**# RPDs in Control**	**%Compliant**
PFAS in MWs	5	4	80%
1,4-Dioxane in MW	1	1	100%
TOC in Sediment	3	3	100%
COD in MWs	1	1	100%
Sulfate in MW	1	1	100%
BOD in MW	1	1	100%
Total	21	18	86%

Field duplicates exceeding RPDs are bolded.

Table 3-2. Frequency of Detection and Exceedance in Grab Soil Samples

Analyte	Number of grab soil samples collected	Number of detections in grab soil	Percent Detection	Minimum detected concentration (µg/kg)	Maximum detected concentration (µg/kg)	Maximum LOD **	PAL (µg/kg)	Number of exceedances above PAL	Percent Exceeding PAL	Number of samples in which each analyte is the highest concentration analyte*	Number of times each analyte that is not TCE, cis-1,2-DCE, or VC is detected in a sample in which none of the key analytes, TCE, cis-1,2-DCE, and VC are detected
cis-1,2-DCE	162	150	93%	0.292	5,560,000	49,000	78.1	89	55%	96	NA
1,1-DCA	162	25	15%	0.21	2,100	95	40.7	2	1%	3	0
1,1-DCE	162	62	38%	0.254	25,600	9,000	45.7	8	5%	0	0
trans-1,2-DCE	162	100	62%	0.258	59,000	9,700	518	7	4%	1	0
TCE	162	118	73%	0.213	83,000,000	530,000	25.2	63	39%	47	NA
VC	162	125	77%	0.223	610,000	36,000	1.67	103	64%	9	NA
PCE	162	16	10%	0.37	69,100	9,000	49.9	4	2%	1	0
1,2-DCA	162	16	10%	0.13	25	3	23.1	1	1%	0	0
1,1,1-TCA	162	3	2%	140	2,000	9,700	1490	1	1%	1	0

Notes:
Samples do not include duplicate samples.
*If a sample had two COCs sharing the highest concentrations, then both of them were counted.
** Maximum LOD was the Laboratory Limit of Detection.
cis-1,2-DCE - cis-1,2-dichloroethene
1,1-DCA - 1,1-dichloroethane
trans-1,2-DCE - trans-1,2-dichloroethene
TCE - trichloroethene
VC - vinyl chloride
PCE - tetrachloroethene
1,2-DCA - 1,2-dichloroethane
1,1,1-TCA - 1,1,1-trichloroethane
PAL - project action limit
ug/L - micrograms per liter
NA - not applicable

Table 3-3. Target VOCs in Auger Boring Soil Samples (µg/kg)

Location Name		MW1-42		MW1-43		MW1-44		MW1-45		MW1-46				MW1-47		MW1-48	
Sample Name		CL-B76-S-19.0-171006		CL-B77-S-18.0-171006		CL-B75-S-26.0-171005		CL-B74-S-18.5-171005		CL-B78-S-28.5-171007		FD-171007-01		CL-B79-S-21.5-171009		CL-B83-S-18.5-171012	
Sample Type		N		N		N		N		P		FD		N		N	
Analyte Name	**PAL**	**Result**		**Result**		**Result**		**Result**		**Result**		**Result**		**Result**		**Result**	
1,1,1-Trichloroethane	1490	23	U	21	U	22	U	23	U	18	U	63	U	21	U	29	U
1,1-Dichloroethane	40.7	23	U	21	U	22	U	23	U	18	U	63	U	21	U	29	U
1,1-Dichloroethene	45.7	23	U	21	U	39	J	23	U	18	U	63	U	**56**		29	U
1,2-Dichloroethane	23.1	39	U	37	U	38	U	40	U	32	U	110	U	37	U	50	U
Chloroethane	40.7	110	U	110	U	110	U	110	U	92	U	320	U	100	U	140	U
Cis-1,2-Dichloroethene	78.1	**110**		**4,000**		**6,600**		23	U	**3,500**		**11,000**		**36,000**	J	**440**	
Tetrachloroethene	49.9	39	U	37	U	38	U	40	U	32	U	110	U	37	U	50	U
Trans-1,2-Dichloroethene	518	190		150		**60**	J	68	U	53	J	240	J	390		86	U
Trichloroethene	25.2	**73**		37	U	38	U	40	U	**200**		**150**	J	**54**		**52**	J
Vinyl Chloride	1.67	230	U	**150**	J	**130**	J	230	U	**630**		**450**	J	**2,400**	J	**440**	

Table 3-3. Target VOCs in Auger Boring Soil Samples (μg/Kg) (continued)

Location Name		MW1-49		MW1-50		MW1-51		MW1-52		MW1-53		MW1-54		MW1-55	
Sample Name		SP-B80-S-7.5-171010		SP-B73-S-9.0-171004		SP-B71-S-13.5-171002		SP-B72-S-12.0-171003		SP-B82-S-10.0-171011		SP-B81-S-38.5-171011		SP-B86-S-35.0-171016	
Sample Type		N		N		N		N		N		N		N	
Analyte Name	**PAL**	**Result**		**Result**		**Result**		**Result**		**Result**		**Result**		**Result**	
1,1,1-Trichloroethane	1490	22	U	20	U	24	UJ	23	U	21	U	20	U	14	U
1,1-Dichloroethane	40.7	22	U	20	U	**140**	J	23	U	21	U	20	U	14	U
1,1-Dichloroethene	45.7	22	U	20	U	45	J	23	U	21	U	20	U	14	U
1,2-Dichloroethane	23.1	38	U	36	U	41	UJ	40	U	37	U	36	U	24	U
Chloroethane	40.7	110	U	100	U	120	UJ	110	U	110	U	100	U	69	U
Cis-1,2-Dichloroethene	78.1	**620**		**730**		**4,000**	J	**3,700**		**5,300**		**93**		**290**	
Tetrachloroethene	49.9	38	U	36	U	41	UJ	40	U	37	U	36	U	24	U
Trans-1,2-Dichloroethene	518	65	U	61	U	220	J	86	J	310		61	U	41	U
Trichloroethene	25.2	**2,200**		**3,500**		**1,600**	J	**52**	J	**3,000**		36	U	**520**	
Vinyl Chloride	1.67	220	U	200	U H	**980**	J	**260**	J	**530**		200	U	140	UJ

Table 3-3. Target VOCs in Auger Boring Soil Samples (µg/Kg) (continued)

Location Name		MW1-56		MW1-56		MW1-56		MW1-57				MW1-57	
Sample Name		SP-B87-S-29.0-171017		SP-B87-S-37.5-171017		SP-B87-S-9.0-171017		FD-171018-01		SP-B88-S-9.0-171018		SP-B88-S-31.0-171018	
Sample Type		N		N		N		FD		P		N	
Analyte Name	**PAL**	**Result**		**Result**		**Result**		**Result**		**Result**		**Result**	
1,1,1-Trichloroethane	1490	27	U	21	U	22	U	19	UJ	21	UJ	27	U
1,1-Dichloroethane	40.7	27	U	21	U	22	U	19	UJ	21	UJ	27	U
1,1-Dichloroethene	45.7	27	U	21	U	22	U	**350**	J	**540**	J	27	U
1,2-Dichloroethane	23.1	47	U	38	U	39	U	34	UJ	37	UJ	47	U
Chloroethane	40.7	130	U	110	U	110	U	96	UJ	110	UJ	130	U
Cis-1,2-Dichloroethene	78.1	**5,200**		**80**	J	22	U	**240,000**	J	**350,000**	J	**760**	
Tetrachloroethene	49.9	47	U	38	U	39	U	**2,000**	J	**4,200**	J	47	U
Trans-1,2-Dichloroethene	518	80	U	64	U	66	U	**3,500**	J	**5,600**	J	61	J
Trichloroethene	25.2	**420**	J	**120**	J	39	U M	**1,800,000**	J	**3,500,000**	J	**59**	J
Vinyl Chloride	1.67	270	UJ	210	UJ	220	UJ	**5,000**	J	**4,200**	J	**100**	J

Table 3-3. Target VOCs in Auger Boring Soil Samples (µg/Kg) (continued)

Location Name		MW1-58		MW1-58		MW1-58		MW1-60	
Sample Name		SP-B89-S-24.0-171101		SP-B89-S-34.0-171101		SP-B89-S-6.5-171101		SP-B84-S-20.0-171012	
Sample Type		N		N		N		N	
Analyte Name	**PAL**	**Result**		**Result**		**Result**		**Result**	
1,1,1-Trichloroethane	1490	10	U	21	U	26	U	23	U
1,1-Dichloroethane	40.7	10	U	21	U	26	U	23	U
1,1-Dichloroethene	45.7	10	U	21	U	26	U	23	U
1,2-Dichloroethane	23.1	18	U	36	U	46	U	41	U
Chloroethane	40.7	51	U	100	U	130	U	120	U
Cis-1,2-Dichloroethene	78.1	**400**		68	J M	**8,500**		23	U
Tetrachloroethene	49.9	18	U Q	36	U Q	46	U Q	41	U
Trans-1,2-Dichloroethene	518	31	U	62	U	**92**	J	70	U
Trichloroethene	25.2	18	J	**30**	J	46	U	41	U
Vinyl Chloride	1.67	100	U	210	U	**9,800**		230	UJ

Samples analyzed using EPA Method 8260C
Underlined values represent analytes not detected at or above the stated limit, which exceeds the PAL
Bolded values indicate that the reported concentration exceeds the PAL.
FD - Field Duplicate
P – Parent sample of field duplicate
N – Sample is not part of a duplicate pair.
PAL - Project Action Limit
U - The analyte was not detected at or above the stated limit. (sometimes validators will elevate the limit due to the "B" qualifier using the 5x/10x rule so this definition is different than the lab description).
J - The reported value is an estimated concentration.
U H - The analyte was not detected at or above the stated limit. (sometimes validators will elevate the limit due to the "B" qualifier using the 5x/10x rule so this definition is different than the lab description). / Sample was prepped or analyzed beyond the specified holding time.
U M - The analyte was not detected at or above the stated limit. (sometimes validators will elevate the limit due to the "B" qualifier using the 5x/10x rule so this definition is different than the lab description). / A matrix effect was present.
UJ - The analyte was not detected at or above the stated sample quantitation limit, which is an estimated value.
µg/kg – micrograms per kilogram

Table 3-4. Target VOCs in Direct Push Soil Samples (µg/kg)

	Location Name	CL-B02			CL-B03		
	Sample Name	CL-B02-S-14.0-170711	CL-B02-S-20.0-170711	CL-B02-S-29.0-170711	CL-B03-S-18.0-170712	CL-B03-S-19.4-170712	CL-B03-S-37.0-170712
	Sample Type	N	N	N	N	N	N
Analyte	**PAL (µg/kg)**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
1,1,1-Trichloroethane	1,490	0.88 UJ	0.88 UJ	0.97 UJ	0.92 UJ	0.89 UJ	1.1 UJ
1,1-Dichloroethane	40.7	0.44 U	0.44 U	0.48 U	0.46 U	0.44 U	0.54 U
1,1-Dichloroethene	45.7	5.2	1 J	0.97 U M	0.92 U M	4.8	1.1 U
1,2-Dichloroethane	23.1	0.44 UJ	0.44 UJ	0.48 UJ	0.46 UJ	0.44 UJ	0.54 UJ
Chloroethane	40.7	0.44 UJ	0.44 UJ	0.48 UJ	0.46 UJ	0.44 UJ	0.54 UJ
Cis-1,2-Dichloroethene	78.1	**1,300** J Q	**450** J Q	46 Q	46 Q	**9,000**	13 Q
Tetrachloroethene	49.9	0.88 U	0.88 U	0.97 U M	0.92 U	0.89 U	1.1 U
Trans-1,2-Dichloroethene	518	2 J	32 J	0.78 J	0.83 J	2 J	1.1 UJ
Trichloroethene	25.2	**7,400** J	**5,200** J	**3,600** J	**3,900**	**83** Q	**92** Q
Vinyl Chloride	1.67	**44** J	**6.5** J	1.3 J	**3.8** J	**25** J	1.1 UJ

Table 3-4. Target VOCs in Direct Push Soil Samples (µg/kg) (continued)

Location Name		CL-B04			CL-B05	CL-B06a	
Sample Name		CL-B04-S-11.5-170712	CL-B04-S-19.5-170712	CL-B04-S-29.0-170712	CL-B05-S-18.3-170712	CL-B06a-S-16.0-170713	CL-B06a-S-33.0-170713
Sample Type		N	N	N	N	N	N
Analyte	**PAL (µg/kg)**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
1,1,1-Trichloroethane	1,490	0.9 UJ	0.88 UJ	1.2 UJ	0.98 U	0.85 U	0.9 U
1,1-Dichloroethane	40.7	0.45 U M	0.44 U	0.59 U	0.98 U	0.85 U	0.9 U
1,1-Dichloroethene	45.7	0.9 U	2.9 J	13	0.98 U	0.85 U	0.9 U
1,2-Dichloroethane	23.1	0.45 UJ	0.44 UJ	0.59 UJ	0.98 U	0.85 U	0.9 U
Chloroethane	40.7	0.45 UJ	0.44 UJ	0.59 UJ	4.9 U	4.3 U	4.5 U
Cis-1,2-Dichloroethene	78.1	8.1 Q	**5,600**	**6,600**	**110**	2	**88** J
Tetrachloroethene	49.9	0.9 U	0.88 U	1.2 U	0.98 U	0.85 U	0.9 U
Trans-1,2-Dichloroethene	518	0.9 UJ	48 J	35 J	2.7	0.85 U	23 J
Trichloroethene	25.2	**51** Q	**3,800** J	**6,900** J	**2,900**	0.85 U	0.9 U
Vinyl Chloride	1.67	0.9 UJ	**5** J	**77** J	0.98 U	0.85 U	**25** J

Table 3-4. Target VOCs in Direct Push Soil Samples (µg/kg) (continued)

Location Name		CL-B07						CL-B08				CL-B09	
Sample Name		CL-B07-S-20.0-170713		CL-B07-S-28.5-170713		CL-B07-S-4.0-170713		CL-B08-S-17.5-170713		CL-B08-S-27.0-170713		CL-B09-S-13.0-170713	
Sample Type		N		N		N		N		N		N	
Analyte	**PAL (µg/kg)**	**Result**		**Result**		**Result**		**Result**		**Result**		**Result**	
1,1,1-Trichloroethane	1,490	0.82	U	0.85	U	0.76	U	0.87	U	0.79	U	1	U
1,1-Dichloroethane	40.7	0.82	U	0.85	U	0.76	U	0.87	U	0.79	U	1	U
1,1-Dichloroethene	45.7	4.8		3.1		0.76	U	2.2	J	1.3	J	1	U
1,2-Dichloroethane	23.1	0.82	U	0.85	U	0.76	U	0.87	U	0.79	U	1	U
Chloroethane	40.7	4.1	U	4.2	U	3.8	U	4.3	U	3.9	U	5.1	U
Cis-1,2-Dichloroethene	78.1	**2,100**		**2,600**		0.76	U	**3,800**	J	**470**	J	3.5	J
Tetrachloroethene	49.9	0.82	U	0.85	U	0.76	U	0.87	U	0.79	U	1	U
Trans-1,2-Dichloroethene	518	6.9		1.4		0.76	U	1.7	J	39	J	3.3	J
Trichloroethene	25.2	0.82	U	0.85	U	0.76	U	0.87	U	4.8	J	1.8	J
Vinyl Chloride	1.67	**14**		**22**		0.76	U	**5.3**	J	**42**	J	**2.1**	J

Table 3-4. Target VOCs in Direct Push Soil Samples (µg/kg) (continued)

Location Name		CL-B10		CL-B11	CL-B12				CL-B13
Sample Name		CL-B10-S-10.0-170714	CL-B10-S-21.0-170714	CL-B11-S-7.0-170714	CL-B12-S-17.5-170714	CL-B12-S-20.5-170714	CL-B12-S-31.5-170714	FD-170714-01	CL-B13-S-11.5-170717
Sample Type		N	N	N	N	N	P	FD	N
Analyte	**PAL (µg/kg)**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
1,1,1-Trichloroethane	1,490	0.75 U	0.84 U	1.1 U	0.95 U	0.88 U	1.6 U	1.5 U	0.98 U
1,1-Dichloroethane	40.7	0.75 U	0.84 U	1.1 U	0.95 U	0.88 U	1.6 U	1.5 U	0.98 U
1,1-Dichloroethene	45.7	0.75 U	0.84 U	1.1 U	19	1.8	24	15	0.98 U
1,2-Dichloroethane	23.1	0.75 U	0.84 U	1.1 U	0.95 U	0.88 U	1.6 U	1.5 U	0.98 U
Chloroethane	40.7	3.8 U	4.2 U	5.3 U	4.8 U	4.4 U	7.9 U	7.7 U	4.9 U
Cis-1,2-Dichloroethene	78.1	2.7 J	1.2	1.7	**9,500**	**690**	**2,000**	**1,900**	11
Tetrachloroethene	49.9	0.75 U	0.84 U	1.1 U	0.95 U	0.88 U	1.6 U	1.5 U	0.98 U
Trans-1,2-Dichloroethene	518	0.75 U	0.84 U	1.1 U	19	81	25	18	0.98 U
Trichloroethene	25.2	1.3 J	0.85	1.1 U	1.7	**1,900**	**5,500**	**5,000**	0.98 U
Vinyl Chloride	1.67	0.75 U	0.84 U	1.1 U	**36**	**5.6**	**27**	**17**	**6.7**

Table 3-4. Target VOCs in Direct Push Soil Samples (µg/kg) (continued)

Location Name		CL-B14b					CL-B15	CL-B16
Sample Name		CL-B14b-S-18.0-170717	CL-B14b-S-21.0-170717	CL-B14b-S-4.0-170717	CL-B14b-S-9.0-170717	FD-170717-01	CL-B15-S-23.0-170717	CL-B16-S-12.5-170718
Sample Type		N	N	N	P	FD	N	N
Analyte	**PAL (µg/kg)**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
1,1,1-Trichloroethane	1,490	110 U	0.86 U	0.87 U	1.2 U	1.7 U	0.93 U	**2,000**
1,1-Dichloroethane	40.7	110 U	0.86 U	0.87 U	1.2 U	2.5	0.93 U	**2,100**
1,1-Dichloroethene	45.7	**120**	16	0.87 U	1.2 U	1.7 U	0.93 U	**110**
1,2-Dichloroethane	23.1	110 U	0.86 U	0.87 U	1.2 U	1.7 U	0.93 U	**25**
Chloroethane	40.7	560 U	4.3 U	4.4 U	6.2 U	8.7 U	4.6 U	**120**
Cis-1,2-Dichloroethene	78.1	**42,000** J	**31,000**	5.1	32	74	10	45
Tetrachloroethene	49.9	110 U	0.86 U	0.87 U	1.2 U	1.7 U	0.93 U	1.1 U
Trans-1,2-Dichloroethene	518	**770**	130	0.87 U	1.2 U	1.7 U	0.93 U	1.1 U
Trichloroethene	25.2	110 U	2.5	1.5	1.7	2.6	0.93 U	19
Vinyl Chloride	1.67	**10,000**	**5,100**	1.1	**11**	**18**	**3.4**	**8.7**

Table 3-4. Target VOCs in Direct Push Soil Samples (µg/kg) (continued)

	Location Name	CL-B17	CL-B18a					CL-B19	
	Sample Name	CL-B17-S-20.0-170718	CL-B18a-S-14.5-170718	CL-B18a-S-18.0-170718	CL-B18a-S-21.5-170718	CL-B18a-S-22.3-170718	CL-B18a-S-33.0-170718	CL-B19-S-23.0-170719	CL-B19-S-38.0-170719
	Sample Type	N	N	N	N	N	N	N	N
Analyte	**PAL (µg/kg)**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
1,1,1-Trichloroethane	1,490	0.83 U	1.3 U	0.9 U	0.99 U	110 U	0.85 U	0.422 UJ	0.402 UJ
1,1-Dichloroethane	40.7	1.6	1.3 U	0.9 U	0.99 U	110 U	0.85 U	0.422 UJ	0.402 UJ
1,1-Dichloroethene	45.7	0.83 U	1.3 U	0.9 U	4.2	110 U	0.85 U	0.422 UJ	0.402 UJ
1,2-Dichloroethane	23.1	0.83 U	1.3 U	0.9 U	0.99 U	110 U	0.85 U	0.422 UJ	0.402 UJ
Chloroethane	40.7	4.1 U	6.5 U	4.5 U	4.9 U	530 U	4.2 U	0.422 UJ	0.402 UJ
Cis-1,2-Dichloroethene	78.1	28	19	15	**27,000**	**47,000**	**1,600**	1.51 J	16.9 J
Tetrachloroethene	49.9	0.83 U	1.3 U	0.9 U	0.99 U	110 U	0.85 U	0.422 UJ	0.402 UJ
Trans-1,2-Dichloroethene	518	0.83 U	1.3 U	0.9 U	37	**550**	4.6	0.422 UJ	2.38 J
Trichloroethene	25.2	0.83 U	1.3 U	0.9 U	**9,000**	**6,000**	1.3	0.422 UJ	0.947 J
Vinyl Chloride	1.67	**2.4**	**5.7**	0.9 U	**76**	**3,100**	**26**	1.19 J	1.49 J

Table 3-4. Target VOCs in Direct Push Soil Samples (µg/kg) (continued)

Location Name		CL-B20			CL-B21		CL-B22	CL-B23	
Sample Name		CL-B20-S-25.0-170719	CL-B20-S-28.3-170719	CL-B20-S-31.5-170719	CL-B21-S-12.0-170720	CL-B21-S-21.5-170720	CL-B22-S-18.5-170720	CL-B23-S-13.5-170720	CL-B23-S-18.0-170720
Sample Type		N	N	N	N	N	N	N	N
Analyte	**PAL (µg/kg)**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
1,1,1-Trichloroethane	1,490	0.381 UJ	0.397 UJ	0.479 UJ	0.521 U	0.452 U	0.467 U	0.536 U	0.38 UJ
1,1-Dichloroethane	40.7	0.381 UJ	0.397 UJ	0.479 UJ	0.521 U	0.594 J	0.467 U	0.536 U	0.38 UJ
1,1-Dichloroethene	45.7	0.343 J	1.64 J	0.479 UJ	0.521 U	0.452 U	0.467 U	6.05	0.598 J
1,2-Dichloroethane	23.1	0.381 UJ	0.397 UJ	0.479 UJ	0.446 J	0.452 U	0.467 U	0.536 U	0.38 UJ
Chloroethane	40.7	0.381 UJ	0.397 UJ	0.479 UJ	9.32	0.452 U	0.467 U	0.536 U	0.38 UJ
Cis-1,2-Dichloroethene	78.1	**282** J	**1,040** J	**261** J	3.33	2.26	4.11	**1,590** E	**244** J
Tetrachloroethene	49.9	0.381 UJ	0.397 UJ	0.479 UJ	0.521 U	0.452 U	2.75	0.536 U	0.38 UJ
Trans-1,2-Dichloroethene	518	3.3 J	16.9 J	3.08 J	0.521 U	0.452 U	3.33	2.16	0.258 J
Trichloroethene	25.2	0.229 J	0.474 J	0.267 J	0.521 U	0.441 J	**72.2**	0.536 U	0.38 UJ
Vinyl Chloride	1.67	**6.81** J	**57.1** J	**9.87** J	**1.7**	0.945	**1.91**	**54.9**	**7.59** J

Table 3-4. Target VOCs in Direct Push Soil Samples (µg/kg) (continued)

Location Name		CL-B24		CL-B25				CL-B26a								CL-B27	
Sample Name		CL-B24-S-15.5-170720		CL-B25-S-14.0-170720		CL-B25-S-29.0-170720		CL-26a-S-19.0-170721		CL-26a-S-26.0-170721		FD-170721-01		CL-26a-S-9.0-170721		CL-B27-S-10.0-170721	
Sample Type		N		N		N		N		P		FD		N		N	
Analyte	**PAL (µg/kg)**	**Result**		**Result**		**Result**		**Result**		**Result**		**Result**		**Result**		**Result**	
1,1,1-Trichloroethane	1,490	0.431	U	0.448	U	0.447	U	0.44	U	0.489	U	0.485	U	0.755	U	0.425	U
1,1-Dichloroethane	40.7	0.431	U	0.448	U	0.447	U	0.44	U	0.489	U	0.485	U	0.755	U	0.425	U
1,1-Dichloroethene	45.7	0.431	U	0.448	U	1.6		0.796	J	0.372	J	0.418	J	0.755	U	0.425	U
1,2-Dichloroethane	23.1	0.431	U	0.26	J	0.403	J	0.309	J	0.705	J	0.485	U	0.603	J	0.425	U
Chloroethane	40.7	0.234	J	0.233	J	0.242	J	0.248	J	0.45	J	0.485	U	0.755	U	0.307	J
Cis-1,2-Dichloroethene	78.1	13.4		1.03	J	**198**	E	**421**	E	**139**	E	**151**	E	1.4	J	0.502	J
Tetrachloroethene	49.9	0.431	U	0.448	U	0.447	U	0.44	U	0.489	U	0.485	U	0.755	U	0.425	U
Trans-1,2-Dichloroethene	518	0.753	J	3.09		21.2		6.36		31.8	J	30		0.755	U	0.425	U
Trichloroethene	25.2	0.431	U	0.448	U	0.447	U	2.8		13.8		20.5		0.755	U	0.213	J
Vinyl Chloride	1.67	**4.46**		**11.9**	J	**16**		**3.17**		**35.3**		**30.2**		0.755	U	0.307	J

Table 3-4. Target VOCs in Direct Push Soil Samples (µg/kg) (continued)

Location Name		CL-B28	CL-B29a		CL-B30a		CL-B31	
Sample Name		CL-B28-S-9.0-170721	CL-B29a-S-2.0-170724	CL-B29a-S-21.0-170724	CL-B30a-S-10.5-170724	CL-B30a-S-21.0-170724	CL-B31-S-11.5-170724	CL-B31-S-19.0-170724
Sample Type		N	N	N	N	N	N	N
Analyte	**PAL (µg/kg)**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
1,1,1-Trichloroethane	1,490	0.594 U	0.591 U	0.453 U	1 UJ	0.427 U	0.697 U	0.41 U
1,1-Dichloroethane	40.7	0.594 U	0.591 U	1.36	0.7 J	0.427 U	0.697 U	0.41 U
1,1-Dichloroethene	45.7	0.594 U	0.591 U	0.254 J	1 UJ	0.427 U	0.697 U	0.383 J
1,2-Dichloroethane	23.1	0.594 U	0.591 U	0.499 J	1 UJ	0.427 U	0.697 U	0.41 U
Chloroethane	40.7	0.43 J	0.591 U	0.453 U	1 UJ	0.427 U	0.697 U	0.41 U
Cis-1,2-Dichloroethene	78.1	0.967 J	0.681 J	2.73	1.72 J	0.292 J	0.967 J	**196** J
Tetrachloroethene	49.9	0.594 U	0.591 U	0.816 J	1 UJ	0.427 U	0.697 U	0.41 U
Trans-1,2-Dichloroethene	518	0.594 U	0.591 U	2.33	0.7 J	0.427 U	0.697 U	10.5
Trichloroethene	25.2	0.594 U	0.591 U	10.3	0.96 J	0.427 U	0.697 U	1.28
Vinyl Chloride	1.67	0.597 J	0.411 J	1.64	1 UJ	0.427 U	0.477 J	**8.75**

Table 3-4. Target VOCs in Direct Push Soil Samples (µg/kg) (continued)

Location Name		CL-B32		CL-B33		CL-B34		CL-B35				CL-B36		CL-B37	
Sample Name		CL-B32-S-15.0-170724		CL-B33-S-3.5-170724		CL-B34-S-18.0-170725		CL-B35-S-18.0-170725		CL-B35-S-20.5-170725		CL-B36-S-15.5-170725		CL-B37-S-15.0-170726	
Sample Type		N		N		N		N		N		N		N	
Analyte	**PAL (µg/kg)**	**Result**		**Result**		**Result**		**Result**		**Result**		**Result**		**Result**	
1,1,1-Trichloroethane	1,490	0.514	U	0.412	U	0.502	U	0.563	U	0.481	U	0.435	U	0.95	U
1,1-Dichloroethane	40.7	0.514	U	0.412	U	0.502	U	0.563	U	0.481	U	0.435	U	0.48	U
1,1-Dichloroethene	45.7	3.4		0.412	U	1.96		3.1		0.481	U	0.313	J	6.3	
1,2-Dichloroethane	23.1	0.514	U	0.412	U	0.502	U	0.563	U	0.481	U	0.435	U	0.48	U
Chloroethane	40.7	0.514	U	0.412	U	0.502	U	0.563	U	0.481	U	0.435	U	0.43	J
Cis-1,2-Dichloroethene	78.1	814	J	0.579	J	489	E	**721**	E	**89.7**		**87.6**		**2,100**	J
Tetrachloroethene	49.9	0.514	U	0.412	U	0.502	U	0.563	U	0.481	U	0.435	U	0.95	U
Trans-1,2-Dichloroethene	518	27.4		0.412	U	49.1		1.23		0.481	U	1.05		99	
Trichloroethene	25.2	0.514	U	0.412	U	1.64		0.563	U	0.481	U	0.435	U	**11,000**	J
Vinyl Chloride	1.67	**143**	J	0.223	J	**12.8**		**22**		**74.7**		**3.39**		**23**	

Table 3-4. Target VOCs in Direct Push Soil Samples (μg/kg) (continued)

Location Name		CL-B38c		CL-B39		SP-B01						SP-B01B	
Sample Name		CL-B38C-S-4.0-170726		CL-B39-S-7.0-170726		SP-B01-S-13.5-170711		SP-B01-S-17.5-170711		SP-B01-S-28.0-170711		SP-B01b-S-8.0-170807	
Sample Type		N		N		N		N		N		N	
Analyte	**PAL (μg/kg)**	**Result**		**Result**		**Result**		**Result**		**Result**		**Result**	
1,1,1-Trichloroethane	1,490	68	UJ	0.95	U	140	J	26	U	0.87	UJ	5,400	U
1,1-Dichloroethane	40.7	68	UJ	0.48	U	20	U	26	U	0.43	U	5,400	U
1,1-Dichloroethene	45.7	68	UJ	0.95	U	**2,300**		160		0.87	U	**25,600**	
1,2-Dichloroethane	23.1	120	UJ	0.48	U	34	U	46	U	0.43	UJ	5,400	U
Chloroethane	40.7	340	UJ	1.7	J	98	U	130	U	0.43	UJ	5,400	U
Cis-1,2-Dichloroethene	78.1	68	UJ	1.2	J	**1,100,000**		**160,000**		63	Q	**5,660,000**	E
Tetrachloroethene	49.9	120	UJ	0.95	U	**17,000**		**2,200**		0.82	J	**69,100**	
Trans-1,2-Dichloroethene	518	210	UJ	0.95	U	**19,000**		**1,800**		0.99	J	**55,900**	
Trichloroethene	25.2	**93**	J	0.95	U	**83,000,000**	B	**1,600,000**	J	**7,500**	B	**59,000,000**	E
Vinyl Chloride	1.67	680	UJ	**1.7**	J	200	U	260	U	0.58	J	**360,000**	

Table 3-4. Target VOCs in Direct Push Soil Samples (μg/kg) (continued)

Location Name		SP-B40			SP-B41	SP-B42		
Sample Name		SP-B40-S-13.0-170726	SP-B40-S-20.0-170726	SP-B40-S-7.0-170726	SP-B41-S-8.0-170726	SP-B42-S-16.0-170727	SP-B42-S-20.0-170727	SP-B42-S-7.5-170727
Sample Type		N	N	N	N	N	N	N
Analyte	**PAL (μg/kg)**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
1,1,1-Trichloroethane	1,490	26 UJ	0.91 U	140 J	0.86 U	0.98 U	0.92 U	1.1 U
1,1-Dichloroethane	40.7	26 UJ	0.49 J	26 UJ	3.5	0.81 J	0.46 U	0.67 J
1,1-Dichloroethene	45.7	26 UJ	0.91 U	7.9 J	0.86 U	2.1 J	0.92 U	2.8 J
1,2-Dichloroethane	23.1	46 UJ	0.46 U	0.54 U	0.43 U	0.49 U	0.46 U	0.54 U
Chloroethane	40.7	**180** J	2.7	**340** J	12	4	0.64 J	3.4
Cis-1,2-Dichloroethene	78.1	**2,000** J	5.7	26 J	3.5	**6,800** H	2.4 J	**8,300** J
Tetrachloroethene	49.9	46 UJ	0.91 U	44 J	0.86 U	0.98 U	0.92 U	1.6 J
Trans-1,2-Dichloroethene	518	79 UJ	0.91 U	1.1 U	0.66 J	9.4	0.92 U	30
Trichloroethene	25.2	46 UJ	0.63 J	**110** J	0.75 J	**6,300** J	2.4 J	**14,000** J
Vinyl Chloride	1.67	260 UJ	**3.4**	**3.3** J	**2.7**	**31**	0.99 J	**56**

Table 3-4. Target VOCs in Direct Push Soil Samples (µg/kg) (continued)

Location Name		SP-B43		SP-B44	SP-B45		SP-B46	SP-B47
Sample Name		SP-B43-S-10.0-170727	SP-B43-S-12.0-170727	SP-B44-S-10.5-170727	SP-B45-S-13.5-170727	SP-B45-S-18.0-170727	SP-B46-S-13.0-170728	SP-B47-S-14.0-170728
Sample Type		N	N	N	N	N	N	N
Analyte	**PAL (µg/kg)**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
1,1,1-Trichloroethane	1,490	0.9 U	1.4 U	0.91 U	0.99 U	1.1 U	0.88 U	0.82 U
1,1-Dichloroethane	40.7	1.1	0.65 J	0.35 J	0.5 J	0.61 J	2.6	2.6
1,1-Dichloroethene	45.7	4.3 J	1.5 J	1.1 J	0.55 J	1.1 U	0.88 U	0.82 U
1,2-Dichloroethane	23.1	0.45 U	0.72 U	0.45 U	0.49 U	0.57 U	0.44 U	0.41 U
Chloroethane	40.7	0.74 J	3.8	1.6 J	3.3	3.8	120 U	37 J
Cis-1,2-Dichloroethene	78.1	**9,800** J	**2,900** J	**2,300** J	**2,400** J	**2,600** J	65	33
Tetrachloroethene	49.9	0.9 U	1.4 U	0.91 U	0.99 U	1.1 U	0.88 U	0.82 U
Trans-1,2-Dichloroethene	518	29	6.5	6.3	7.1	6	4.1	4.1
Trichloroethene	25.2	**5,300** J	**2,800** J	**1,800** J	6.7	9.1	0.88 U	0.82 U
Vinyl Chloride	1.67	**1,600** J	**48**	**84**	**45**	**24**	**860**	**100**

Table 3-4. Target VOCs in Direct Push Soil Samples (µg/kg) (continued)

Location Name		SP-B48b		SP-B49	SP-B50		SP-B51	
Sample Name		SP-B48b-S-11.0-170728	SP-B48b-S-6.0-170728	SP-B49-S-9.5-170728	SP-B50-S-12.0-170731	SP-B50-S-16.5-170731	SP-B51-S-13.0-170731	SP-B51-S-17.0-170731
Sample Type		N	N	N	N	N	N	N
Analyte	**PAL (µg/kg)**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
1,1,1-Trichloroethane	1,490	1 U	0.93 U	0.94 U	0.92 U	0.88 U	0.94 U	0.97 U
1,1-Dichloroethane	40.7	0.77 J M	3.5	4.4	0.21 J M	0.44 U	0.47 U	0.49 U
1,1-Dichloroethene	45.7	1.7 J	5	12	2.7 J	0.88 U	0.94 U	0.97 U
1,2-Dichloroethane	23.1	0.52 U	0.25 J	0.39 J	0.46 U	0.13 J	0.47 U	0.49 U
Chloroethane	40.7	0.52 U Q	0.46 U Q	2,300 UJ	0.46 UJ	0.44 UJ	0.47 UJ	0.49 UJ
Cis-1,2-Dichloroethene	78.1	**11,000** J	**18,000** J	**27,000** J	**1,400** J	**1,500** J	42	2.8
Tetrachloroethene	49.9	1 U	0.93 U	0.66 J	0.92 U	0.88 U	0.94 U	0.97 U
Trans-1,2-Dichloroethene	518	20	74	100	6.9	1.8	0.94 U	0.97 U
Trichloroethene	25.2	15	0.93 U M	**15,000** J	**100**	**46**	20	1.2 J
Vinyl Chloride	1.67	**4,400** J	**9,100** J	4,500 UJ	**130**	**15**	**2.7**	**4.3**

Table 3-4. Target VOCs in Direct Push Soil Samples (µg/kg) (continued)

	Location Name	SP-B52		SP-B53			
	Sample Name	SP-B52-S-12.0-170731	SP-B52-S-9.0-170731	SP-B53-S-10.0-170731	SP-B53-S-24.0-170731	SP-B53-S-32.0-170731	SP-B53-S-33.5-170731
	Sample Type	N	N	N	N	N	N
Analyte	**PAL (µg/kg)**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
1,1,1-Trichloroethane	1,490	0.96 U	0.93 U	0.91 U	0.94 U M	0.73 U	0.99 U
1,1-Dichloroethane	40.7	0.48 U	6.1	0.46 U	0.47 U	0.36 U	0.5 U
1,1-Dichloroethene	45.7	0.93 J	11	0.91 U	1.4 J	0.73 U	0.82 J M
1,2-Dichloroethane	23.1	0.14 J	0.27 J	0.46 U	0.47 U	0.36 U	0.5 U M
Chloroethane	40.7	0.48 UJ	7.8 J	0.46 UJ	0.47 UJ	0.36 UJ	0.5 UJ
Cis-1,2-Dichloroethene	78.1	**480** J	**13,000** J	55 J	140 J	61 J	**140** J
Tetrachloroethene	49.9	0.96 U	0.52 J	0.91 U	11	0.73 U	0.99 U M
Trans-1,2-Dichloroethene	518	8.1	83 J	0.91 U	18	0.73 U M	1.6 J
Trichloroethene	25.2	**1,300** J	**9,100** J	**200** J	**1,400** J	**450** J	**1,200** J
Vinyl Chloride	1.67	**15**	**1,500** J H	0.63 J M	**3.3** M	0.89 J	**2.7**

Table 3-4. Target VOCs in Direct Push Soil Samples (µg/kg) (continued)

Location Name		SP-B54						SP-B55					
Sample Name		SP-B54-S-17.0-170801		SP-B54-S-35.0-170801		SP-B54-S-7.0-170801		FD-170801-01		SP-B55-S-9.0-170801		SP-B55-S-33.0-170801	
Sample Type		N		N		N		FD		P		N	
Analyte	**PAL (µg/kg)**	**Result**		**Result**		**Result**		**Result**		**Result**		**Result**	
1,1,1-Trichloroethane	1,490	0.98	UJ	15	U	2,400	U	140	U	130	U	0.95	U Q
1,1-Dichloroethane	40.7	0.49	UJ	15	U	2,400	U	140	UJ	130	UJ	0.48	U Q
1,1-Dichloroethene	45.7	0.98	UJ	15	U	**9,800**	M	19		5.3		0.95	U
1,2-Dichloroethane	23.1	0.49	UJ	26	U	4,200	U	240	U	220	U	0.48	U Q
Chloroethane	40.7	0.49	UJ	74	UJ	12,000	UJ	0.52	UJ	0.48	UJ	0.48	UJ
Cis-1,2-Dichloroethene	78.1	9	U	58	J	**3,600,000**	H	**10,000**		**11,000**		75	B
Tetrachloroethene	49.9	0.98	UJ	26	U	**4,200**	U	1	UJ	0.95	UJ	0.95	U Q
Trans-1,2-Dichloroethene	518	0.71	J	44	U	**59,000**		31		16		1.2	J
Trichloroethene	25.2	2.4	J	26	U	**7,200**		**2,400**		**1,600**		18	Q
Vinyl Chloride	1.67	0.88	J	150	U	**610,000**		**150**		**58**		**13**	

Table 3-4. Target VOCs in Direct Push Soil Samples (µg/kg) (continued)

Location Name		SP-B56		SP-B57		SP-B58		
Sample Name		SP-B56-S-10.0-170801	SP-B56-S-27.0-170801	SP-B57-S-10.0-170802	SP-B57-S-29.0-170802	SP-B58-S-21.0-170802	SP-B58-S-37.0-170802	SP-B58-S-39.5-170802
Sample Type		N	N	N	N	N	N	N
Analyte	**PAL (µg/kg)**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
1,1,1-Trichloroethane	1,490	140 U	140 U	0.94 U H	0.86 U H	1 U	0.78 U	1.9 U
1,1-Dichloroethane	40.7	140 UJ	140 UJ	0.26 J H	0.43 U H	0.51 U	0.39 U	0.97 U
1,1-Dichloroethene	45.7	1.8 J	9	0.94 UJ	0.72 J	1 UJ	0.91 J	1.9 U
1,2-Dichloroethane	23.1	240 U	250 U	0.16 J	0.43 UJ	0.51 UJ	0.39 UJ	0.97 UJ
Chloroethane	40.7	0.54 UJ	0.52 UJ	0.47 U H	0.43 U H	0.51 U	0.39 U	0.97 U
Cis-1,2-Dichloroethene	78.1	**3,500**	**5,000**	1.9 U	49 H	7.4	**950** J	5.1
Tetrachloroethene	49.9	5.2 J	1 UJ	0.94 U H	0.86 U H	1 U	1.3 J	1.9 U
Trans-1,2-Dichloroethene	518	100 J	60	0.5 J H	2.1 H	1 U	3.6	1.9 U
Trichloroethene	25.2	240 U	**2,800**	0.32 J H	0.44 J H	4.3	**2,100** J	2.5 J
Vinyl Chloride	1.67	**6,600**	**130**	**18** H	**4.8** H	1.4 J M	**10** J	1 J

Table 3-4. Target VOCs in Direct Push Soil Samples (µg/kg) (continued)

Location Name		SP-B59			SP-B60		
Sample Name		SP-B59-S-21.0-170802	SP-B59-S-29.8-170802	SP-B59-S-5.0-170802	SP-B60-S-17.0-170802	SP-B60-S-23.5-170802	SP-B60-S-7.5-170802
Sample Type		N	N	N	N	N	N
Analyte	**PAL (µg/kg)**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
1,1,1-Trichloroethane	1,490	0.86 U	0.9 U	1 UJ	0.92 U	0.8 U	1.4 U
1,1-Dichloroethane	40.7	0.43 U	0.45 U	0.5 UJ	0.46 U	0.4 U	0.72 U
1,1-Dichloroethene	45.7	0.86 U	0.9 U	1 UJ	0.92 U	0.8 U	1.4 U
1,2-Dichloroethane	23.1	0.43 UJ	0.45 UJ	0.5 UJ	0.46 U Q	0.4 U Q	0.72 UJ
Chloroethane	40.7	0.43 U	0.45 U	0.5 UJ	0.46 U	0.4 U	0.72 U
Cis-1,2-Dichloroethene	78.1	0.6 U	1.1 U	2.6 J	1.5 J	1.1 J	1.6 U
Tetrachloroethene	49.9	0.86 U	0.9 U	31 J	0.92 U	0.8 U	1.4 U
Trans-1,2-Dichloroethene	518	0.86 U	0.9 U	8 J	0.92 U	0.8 U	1.4 U M
Trichloroethene	25.2	1.6 J	6.9	2.1 J	1.6 J	6.5	1.4 J
Vinyl Chloride	1.67	0.37 J	0.9 UJ	**1.7** J	0.92 U Q	0.37 J M Q	0.79 J

Table 3-4. Target VOCs in Direct Push Soil Samples (µg/kg) (continued)

Location Name		SP-B61		SP-B62			
Sample Name		SP-B61-S-18.0-170803	SP-B61-S-23.5-170803	SP-B62-S-16.0-170803	SP-B62-S-24.0-170803	SP-B62-S-26.0-170804	SP-B62-S-7.0-170803
Sample Type		N	N	N	N	N	N
Analyte	**PAL (µg/kg)**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
1,1,1-Trichloroethane	1,490	21 U R	18 U R	20 U R	17 U R	0.415 U	3.3 U
1,1-Dichloroethane	40.7	21 U R	18 U R	20 U R	17 U R	0.415 U	0.87 J
1,1-Dichloroethene	45.7	21 U R	18 U R	20 U R	17 U R	0.415 U	3.3 U
1,2-Dichloroethane	23.1	**38** U R	**31** U R	35 U R	**29** U R	0.415 U	0.99 J
Chloroethane	40.7	**110** U R	**89** U R	**100** U R	**84** U R	0.415 U	1.6 U
Cis-1,2-Dichloroethene	78.1	**160** J	18 U R	**260** J	17 U R	1.08	68
Tetrachloroethene	49.9	38 U R	31 U R	35 U R	29 U R	0.415 U	3.3 U
Trans-1,2-Dichloroethene	518	36 J	53 U R	96 J	50 U R	0.415 U	7.4
Trichloroethene	25.2	**35** J	**180** J	**780** J	**230** J	2.16	2.4 J
Vinyl Chloride	1.67	**210** U R	**180** U R	**200** U R	**170** U R	0.415 U	**8.3** J

Table 3-4. Target VOCs in Direct Push Soil Samples (μg/kg) (continued)

Location Name		SP-B63		SP-B64		SP-B65C	SP-B66	
Sample Name		SP-B63-S-18.5-170804	SP-B63-S-24.0-170804	SP-B64-S-12.0-170804	SP-B64-S-5.5-170804	SP-B65c-S-8.0-170806	SP-B66-S-10.5-170806	SP-B66-S-9.0-170806
Sample Type		N	N	N	N	N	N	N
Analyte	**PAL (μg/kg)**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
1,1,1-Trichloroethane	1,490	0.468 U	0.444 U	0.538 U	0.443 U	0.544 U	0.457 U	0.473 U
1,1-Dichloroethane	40.7	0.468 U	0.444 U	0.538 U	0.443 U	0.544 U	0.457 U	0.473 U
1,1-Dichloroethene	45.7	0.468 U	0.573 J	0.538 U	0.346 J	0.294 J	0.457 U	0.473 U
1,2-Dichloroethane	23.1	0.468 U	0.444 U	0.538 U	0.443 U	0.544 U	0.457 U	0.473 U
Chloroethane	40.7	0.468 U	0.444 U	0.538 U	0.443 U	0.544 U	0.229 J	0.473 U
Cis-1,2-Dichloroethene	78.1	9.63	**321** E	**199** E	**392** E	**319** E	**180** E	**84**
Tetrachloroethene	49.9	0.468 U	0.37 J	0.538 U	0.443 U	0.544 U	0.457 U	0.473 U
Trans-1,2-Dichloroethene	518	0.468 U	2.4	1.7	3.18	3.72	1.58	0.95
Trichloroethene	25.2	12.2	**1,700** E	**513** E	**669** E	**540** E	20.2	21.4
Vinyl Chloride	1.67	0.586 J	**2.08**	**1.91**	**9.05**	**3.86**	**13.9**	**6.31**

Table 3-4. Target VOCs in Direct Push Soil Samples (µg/kg) (continued)

Location Name		SP-B67		SP-B68			SP-B69		
Sample Name		SP-B67-S-12.5-170806	SP-B67-S-24.0-170806	SP-B68-S-0.5-170806	SP-B68-S-12.5-170806	SP-B68-S-9.5-170806	FD-0-170806-02	SP-B69-S-11.5-170806	SP-B69-S-15.0-170806
Sample Type		N	N	N	N	N	FD	P	N
Analyte	**PAL (µg/kg)**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
1,1,1-Trichloroethane	1,490	0.473 U	0.523 U	0.777 U	0.468 U	0.504 U	0.478 U	0.526 U	0.549 U
1,1-Dichloroethane	40.7	0.473 U	0.523 U	0.777 U	0.468 U	32.4	0.478 U	0.526 U	0.549 U
1,1-Dichloroethene	45.7	0.473 U	0.523 U	0.777 U	0.468 U	0.504 U	0.487 J	0.326 J	0.549 U
1,2-Dichloroethane	23.1	0.473 U	0.523 U	0.777 U	0.468 U	0.302 J	0.478 U	0.526 U	0.549 U
Chloroethane	40.7	0.958	0.523 U	0.777 U	0.468 U	**90.8**	10	8.38	2.29
Cis-1,2-Dichloroethene	78.1	32.5	3.36	7.19	**111** E	5.45	**395** E	**396** E	**168** E
Tetrachloroethene	49.9	0.473 U	0.523 U	0.777 U	0.468 U	0.504 U	0.478 U	0.526 U	0.549 U
Trans-1,2-Dichloroethene	518	1.13	0.523 U	0.777 U	2.21	3.47	5.67	5.57	2.93
Trichloroethene	25.2	18.5	9.78	21	10.9	11.9	**129** E	11.5	16.3
Vinyl Chloride	1.67	**23.2**	**3.17**	**4.68**	**39.5**	**3.46**	**69.3**	**66.9**	**18.2**

Samples analyzed using EPA Method 8260C
FD - Field Duplicate
PAL - Project Action Limit
µg/kg – micrograms per kilogram
J - The reported value is an estimated concentration.
B - The analyte was found in an associated blank, as well as in the sample.
M - A matrix effect was present.
H - Sample was prepped or analyzed beyond the specified holding time.
Q - One or more quality control criteria failed.
E - The reported value exceeded the instrument calibration range, so the concentration is estimated.
P – Parent sample of field duplicate.
N – Sample is not part of a duplicate pair.
U - The analyte was not detected at or above the stated limit. (sometimes validators will elevate the limit due to the "B" qualifier using the 5x/10x rule, so this definition is different than the lab description).
UJ - The analyte was not detected at the stated sample quantitation limit, which is an estimated value.
J H - The reported value is an estimated concentration. / Sample was prepped or analyzed beyond the specified holding time.
U R - The reported value is unusable, rejected. Analyte may or may not be present.
U H - The analyte was not detected at or above the stated limit. (sometimes validators will elevate the limit due to the "B" qualifier using the 5x/10x rule, so this definition is different than the lab description). / Sample was prepped or analyzed beyond the specified holding time.

Table 3-4. Target VOCs in Direct Push Soil Samples (µg/kg) (continued)

U M - The analyte was not detected at or above the stated limit. (sometimes validators will elevate the limit due to the "B" qualifier using the 5x/10x rule, so this definition is different than the lab description). / A matrix effect was present.

Underlined values represent analytes not detected at or above the stated limit, which exceeds the PAL.

Bolded values indicate that the reported concentration exceeds the PAL.

Table 3-5. Full List of SVOCs in Soil (µg/kg)

Analyte Name	**Screening Level (µg/kg)**	**Screening Level Source**	CL-B18a		CL-B21		SP-B01B		SP-B62	
			CL-B18a-S-18.0-170718		CL-B21-S-12.0-170720		SP-B01b-S-8.0-170807		SP-B62-S-7.0-170803	
			N		N		N		N	
			Result		**Result**		**Result**		**Result**	
1,2,4-Trichlorobenzene	29.4	A	19	U	19	U	190	U J	2,300	U J
1,2-Dichlorobenzene	399.4	A	38	U	38	U	370	U J	4,600	U J
1,3-Dichlorobenzene	NA	NE	19	U	19	U	190	U J	2,300	U J
1,4-Dichlorobenzene	67.7	A	19	U	19	U	190	U J	2,300	U J
1-Methylnaphthalene	34,483	B	2,000		20	J	190	U J	8,600	
2,2'-Oxybis(1-Chloropropane)	14,286	B	150	U	150	U	1,500	U J	18,000	U J
2,4,5-Trichlorophenol	1,507	A	150	U	150	U	1,500	U J	18,000	U J
2,4,6-Trichlorophenol	2.66	A	150	U	150	U	1,500	U J	18,000	U J
2,4-Dichlorophenol	10.4	A	38	U	38	U	370	U J	4,600	U J
2,4-Dimethylphenol	79.3	A	38	U	38	U	370	U J	4,600	U J
2,4-Dinitrophenol	9.17	A	510	U	500	U	5,000	U J	61,000	U J
2,4-Dinitrotoluene	0.11	A	150	U	150	U	1,500	U J	18,000	U
2,6-Dinitrotoluene	0.021	A	150	U	150	U	1,500	U J	18,000	U
2-Chloronaphthalene	6,400,000	C	19	U	19	U	190	U J	2,300	U
2-Chlorophenol	27	A	150	U	150	U	1,500	U J	18,000	U J
2-Methylnaphthalene	320,000	C	2,900		15	J	370	U J	10,000	
2-Methylphenol	151.1	A	150	U	150	U	1,500	U J	18,000	U J
2-Nitroaniline	800,000	C	64	U	63	U	620	U J	7,700	U
2-Nitrophenol	NA	NE	150	U	150	U	1,500	U J	18,000	U J
3,3-Dichlorobenzidine	0.197	A	310	U Q	300	U Q	3,000	U J	37,000	U

Table 3-5. Full List of SVOCs in Soil (µg/Kg) (continued)

Analyte Name	**Screening Level (µg/kg)**	**Screening Level Source**	CL-B18a		CL-B21		SP-B01B		SP-B62	
			CL-B18a-S-18.0-170718		CL-B21-S-12.0-170720		SP-B01b-S-8.0-170807		SP-B62-S-7.0-170803	
			N		N		N		N	
			Result		**Result**		**Result**		**Result**	
3- And 4-Methylphenol	4,000,000	C	24	J	38	U	370	U J	4,600	U J
3-Nitroaniline	NA	NE	150	U	150	U	1,500	U J	18,000	U
4,6-Dinitro-2-Methylphenol	NA	NE	310	U Q	300	U Q	3,000	U J	37,000	U J
4-Bromophenyl-Phenylether	NA	NE	150	U	150	U	1,500	U J	18,000	U
4-Chloro-3-Methylphenol	NA	NE	150	U	150	U	1,500	U J	18,000	U J
4-Chloroaniline	0.0772	A	1,300	U	1,300	U	12,000	U J	150,000	U J
4-Chlorophenyl-Phenylether	NA	NE	150	U	150	U	1,500	U J	18,000	U
4-Nitroaniline	NA	NE	64	U	63	U	620	U J	7,700	U
4-Nitrophenol	NA	NE	1,000	U	1,000	U	10,000	U J	120,000	U J
Acenaphthene	4,977	A	4,700		17	J	190	U J	**8,900**	
Acenaphthylene	NA	NE	110		19	U	190	U J	2,300	U
Anthracene	114,142	A	3,600		19	U	190	U J	8,400	
Benzo[A]Anthracene	42.89	A	**7,500**		19	U	**75**	J	**8,500**	
Benzo[A]Pyrene	116.3	A	**3,400**		38	U	370	U J	**5,100**	J
Benzo[B]Fluoranthene	147.5	A	**6,400**		19	U	190	U J	**4,600**	
Benzo[G,H,I]Perylene	NA	NE	590		38	U	370	U J	4,600	UJ
Benzo[K]Fluoranthene	1,475	A	**2,400**	M	38	U	370	U J	4,600	U M
Benzoic Acid	18,385	A	2,600	U M	2,500	U	25,000	U J	310,000	U J
Benzyl Alcohol	8,000,000	C	150	U	150	U	1,500	U J	18,000	U J
Bis(2-Chloroethoxy)Methane	NA	NE	150	U	150	U	1,500	U J	18,000	U J

Table 3-5. Full List of SVOCs in Soil (µg/Kg) (continued)

Analyte Name	**Screening Level (µg/kg)**	**Screening Level Source**	CL-B18a		CL-B21		SP-B01B		SP-B62	
			CL-B18a-S-18.0-170718		CL-B21-S-12.0-170720		SP-B01b-S-8.0-170807		SP-B62-S-7.0-170803	
			N		N		N		N	
			Result		**Result**		**Result**		**Result**	
Bis(2-Chloroethyl)Ether	0.0144	A	150	U	150	U	1,500	U J	18,000	U J
Bis(2-Ethylhexyl)Phthalate	668.5	A	510	U	500	U	5,000	U J	61,000	U
Butylbenzylphthalate	646	A	150	U Q	150	U Q	1,500	U J	18,000	UJ
Carbazole	NA	NE	1,300		150	U	1,500	U J	18,000	U J
Chrysene	4,774	A	**7,200**		38	U	370	U J	**12,000**	
Di-N-Butylphthalate	2,966	A	150	U	150	U	1,500	U J	18,000	U
Di-N-Octylphthalate	13,312,046	A	770	U	760	U	7,500	U J	92,000	U
Dibenz[A,H]Anthracene	21.4	A	**220**		38	U	370	U J	4,600	UJ
Dibenzofuran	80,000	C	3,600		150	U	1,500	U J	18,000	U
Diethylphthalate	4,719	A	510	U	500	U	5,000	U J	61,000	U
Dimethyl Phthalate	NA	NE	150	U	150	U	1,500	U J	18,000	U
Fluoranthene	31,605	A	**42,000**		19	U	130	J	14,000	
Fluorene	5,116	A	**5,500**		12	J	190	U J	**12,000**	
Hexachlorobenzene	43.9	A	19	U	19	U	190	U J	2,300	U
Hexachlorobutadiene	30.3	A	38	U	38	U	370	U J	4,600	U J
Hexachlorocyclopentadiene	9,613.76	A	64	U	63	U	620	U J	7,700	U J
Hexachloroethane	2.26	A	150	U	150	U	1,500	U J	18,000	U J
Indeno[1,2,3-Cd]Pyrene	416	A	**960**		19	U	190	U J	2,300	U J
Isophorone	15.4	A	150	U	150	U	1,500	U J	18,000	U J
N-Nitrosodimethylamine	19.6	B	1,300	U	1,300	U	12,000	U J	150,000	U J

Table 3-5. Full List of SVOCs in Soil (µg/Kg) (continued)

Analyte Name	**Screening Level (µg/kg)**	**Screening Level Source**	CL-B18a		CL-B21		SP-B01B		SP-B62	
			CL-B18a-S-18.0-170718		CL-B21-S-12.0-170720		SP-B01b-S-8.0-170807		SP-B62-S-7.0-170803	
			N		N		N		N	
			Result		**Result**		**Result**		**Result**	
N-Nitrosodinpropylamine	3.88E-03	A	150	U	150	U	1,500	U J	18,000	U J
N-Nitrosodiphenylamine	28.2	A	38	U	38	U	370	U J	4,600	U
Naphthalene	236.4	A	**1,700**		19	U	190	U J	**21,000**	J
Nitrobenzene	6.49	A	150	U	150	U	1,500	U J	18,000	U J
Pentachlorophenol	0.879	A	310	U	300	U	3,000	U J	37,000	U J
Phenanthrene	NA	NE	34,000		38	U	370	U J	46,000	J
Phenol	757.12	A	71	J	150	U	520	J	18,000	U J
Pyrene	32,774	A	28,000		38	U	370	U J	19,000	J

Notes:
Samples analyzed using EPA Method 8270D.
Screening levels based on the lowest MTCA Method B value shown in Ecology's July 2015 CLARC table. Values used as presented by Ecology without recalculation.
A - Screening level source is "Protective of Groundwater Saturated".
B - Screening level source is "Method B Cancer".
C - Screening level source is "Method B Non Cancer".
N – Sample is not part of a duplicate pair.
Underlined values represent analytes not detected at or above the stated limit, which exceeds the PAL.
Bolded values indicate that the reported concentration exceeds the PAL.
NE - Not established.
U - The analyte was not detected at or above the stated limit. (Sometimes validators will elevate the limit due to the "B" qualifier using the 5x/10x rule so this definition is different than the lab description).
J - The reported value is an estimated concentration.
U J - The analyte was not detected at the stated sample quantitation limit, which is an estimated value.
Q - One or more quality control criteria failed.
M - A matrix effect was present.
U M - The analyte was not detected at or above the stated limit. (sometimes validators will elevate the limit due to the "B" qualifier using the 5x/10x rule so this definition is different than the lab description). / A matrix effect was present.
µg/kg – micrograms per kilogram

Table 3-6. TPH Results in Soil Samples (mg/kg)

		Location Name	CL-B18a	CL-B21	SP-B01	SP-B62
		Sample Name	CL-B18a-S-18.0-170718	CL-B21-S-12.0-170720	SP-B01-S-17.5-170711	SP-B62-S-7.0-170803
		Sample Type	N	N	N	N
Method	**Analyte**	**Screening Level [a]**	**Result**	**Result**	**Result**	**Result**
NWTPH-HCID	TPH-Diesel range C12-C24	NE	300 J	140	4,200 J	80,000 J
NWTPH-HCID	TPH-Motor Oil C24-C36	NE	140 J	310	6,600 J	330,000 J
NWTPH-HCID	TPH-Total Unknown Gasoline Range Organics	NE	28 UJ	27 U	13,000 J	390,000 J
NWTPH-Dx	TPH-Diesel range	2000	950 J	260	**6,900** J	**69,000** J
NWTPH-Dx	TPH-Motor Oil C24-C36	2000	660 J	800	**12,000** J	**240,000** J
NWTPH-Gx	TPH-Total Gasoline Range Organics	100	NA	NA	**6,500** J	**13,000**

Notes:
Samples analyzed using EPA Method NWTPH-HCID, NWTPH-Dx, NWTPH-Gx
EPA Method NWTPH-HCID is a screening method for TPH
N – Sample is not part of a duplicate pair.
U - The analyte was analyzed but not detected at or above the stated limit. (sometimes validators will elevate the limit due to the "B" qualifier using the 5x/10x rule so this definition is different than the lab description).
J - The reported value is an estimated concentration.
UJ - The analyte was analyzed but not detected. the sample quantitation limit is an estimated value.
NA - not analyzed
NE - not established
[a] MTCA Method A Soil Cleanup Levels used as screening levels for reference
Bolded values indicate that the reported concentration exceeds the PAL.
mg/kg - milligrams per kilogram

Table 3-7. Otto Fuel Results in Soil and Water Samples (ppm)

		Location Name	SP-B01B			CL-B18B	CL-B21A	SP-B62A
		Sample Name	SP-B01B-S-8.0-170807	SP-B01B-GW-10.0-170807	SP-B01B-GW-15.0-170807	CL-B18B-GW-20.0-170807	CL-B21A-GW-20.0-170807	SP-B62A-S-6.5-170807
		Matrix Type	Soil	GW	GW	GW	GW	Soil
Method	**Analyte**	**Screening Level** [a]	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Otto Fuel[a]	1,2-propylene glycol dinitrate	NE	1.1 U	0.05 U	0.05 U	0.05 U	0.05 U	1.1 U

Notes:
GW – groundwater.
U - The analyte was analyzed but not detected at or above the stated limit.
NE - not established
[a] By gas chromatography (GC-ECD)
ppm - parts per million

Table 3-8. VOCs in Soil Samples (μg/kg)

		Location Name:	**CL-B02**			**CL-B03**		
		Sample Name	**CL-B02-S-14.0-170711**	**CL-B02-S-20.0-170711**	**CL-B02-S-29.0-170711**	**CL-B03-S-18.0-170712**	**CL-B03-S-19.4-170712**	**CL-B03-S-37.0-170712**
		Sample Type	**N**	**N**	**N**	**N**	**N**	**N**
Analyte	**PAL or Screening level**	**Source**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
1,1,1,2-Tetrachloroethane	38,500	B	0.44 U	0.44 U	0.48 U	0.46 U	0.44 U	0.54 U
1,1,1-Trichloroethane	1,490	SAP	0.88 UJ	0.88 UJ	0.97 UJ	0.92 UJ	0.89 UJ	1.1 UJ
1,1,2,2-Tetrachloroethane	0.080	A	1.8 U	1.8 U	1.9 U	1.8 U	1.8 U	2.2 U
1,1,2-Trichloroethane	1.81	A	0.44 U	0.44 U	0.48 U	0.46 U	0.44 U	0.54 U
1,1-Dichloroethane	40.7	SAP	0.44 U	0.44 U	0.48 U	0.46 U	0.44 U	0.54 U
1,1-Dichloroethene	45.7	SAP	5.2	1 J	0.97 U M	0.92 U M	4.8	1.1 U
1,1-Dichloropropene	NE	NA	0.88 UJ	0.88 UJ	0.97 UJ	0.92 UJ	0.89 UJ	1.1 UJ
1,2,3-Trichlorobenzene	21	D	1.8 U	1.8 U	1.9 U	1.8 U	1.8 U	2.2 U
1,2,3-Trichloropropane	33	B	0.88 U	0.88 U	0.97 U	0.92 U	0.89 U	1.1 U
1,2,4-Trichlorobenzene	29.4	A	0.88 U	0.88 U	0.97 U	0.92 U	0.89 U	1.1 U
1,2,4-Trimethylbenzene	NE	NA	5.9	2.7	1.6 J	1.3 J	0.89 J	1.1 J
1,2-Dibromo-3-Chloropropane	1,250	B	3.5 U M	3.5 U	3.9 U	3.7 U M	3.5 U	4.3 U
1,2-Dibromoethane	NE	NA	0.44 U	0.44 U	0.48 U	0.46 U	0.44 U	0.54 U
1,2-Dichlorobenzene	399	A	0.88 U M	0.88 U M	0.97 U M	0.92 U M	0.89 U	1.1 U M
1,2-Dichloroethane	23.1	SAP	0.44 UJ	0.44 UJ	0.48 UJ	0.46 UJ	0.44 UJ	0.54 UJ
1,2-Dichloropropane	1.67	A	0.88 UJ	0.88 UJ	0.97 UJ	0.92 UJ	0.89 UJ	1.1 UJ
1,3,5-Trimethylbenzene	800,000	C	1.2 J	0.53 J	0.29 J	0.25 J	0.16 J	0.21 J
1,3-Dichlorobenzene	NE	NA	0.88 U	0.88 U M	0.97 U M	0.92 U M	0.89 U M	1.1 U
1,3-Dichloropropane	NE	NA	0.44 U	0.44 U	0.48 U	0.46 U	0.44 U	0.54 U

Table 3-8. VOCs in Soil Samples (µg/Kg) (continued)

		Location Name:	**CL-B02**			**CL-B03**		
		Sample Name	**CL-B02-S-14.0-170711**	**CL-B02-S-20.0-170711**	**CL-B02-S-29.0-170711**	**CL-B03-S-18.0-170712**	**CL-B03-S-19.4-170712**	**CL-B03-S-37.0-170712**
		Sample Type	**N**	**N**	**N**	**N**	**N**	**N**
Analyte	**PAL or Screening level**	**Source**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
1,4-Dichlorobenzene	67.7	A	0.44 U M	0.44 U M	0.48 U M	0.46 U M	0.44 U M	0.54 U M
2,2-Dichloropropane	NE	NA	1.8 U	1.8 U	1.9 U	1.8 U	1.8 U	2.2 U
2-Chlorotoluene	NE	NA	0.44 U	0.44 U	0.48 U	0.46 U	0.44 U	0.54 U
4-Chlorotoluene	NE	NA	0.44 U M	0.44 U M	0.48 U	0.46 U	0.44 U	0.54 U
4-Isopropyltoluene	NE	NA	0.61 J	0.88 U	0.97 U	0.92 U	0.89 U	1.1 U M
Benzene	1.74	A	0.88 U Q	0.88 U Q	0.97 U Q	0.92 U Q	0.89 U Q	1.1 U M Q
Bromobenzene	NE	NA	3.5 U	3.5 U	3.9 U	3.7 U	3.5 U	4.3 U
Bromochloromethane	NE	NA	0.44 U Q	0.44 U Q	0.48 U Q	0.46 U Q	0.44 U Q	0.54 U Q
Bromodichloromethane	2.60	A	0.44 U M Q	0.44 U M Q	0.48 U M Q	0.46 U Q	0.44 U M Q	0.54 U M Q
Bromoform	22.9	A	0.88 U	0.88 U	0.97 U	0.92 U	0.89 U	1.1 U
Bromomethane	3.31	A	0.44 UJ	0.44 UJ	0.48 UJ	0.46 UJ	0.44 UJ	0.54 UJ
Carbon Tetrachloride	2.19	A	0.88 U Q	0.88 U Q	0.97 U Q	0.92 U Q	0.89 U Q	1.1 U Q
Chlorobenzene	51.1	A	0.88 U	0.88 U	0.97 U	0.92 U	0.89 U	1.1 U
Chloroethane	40.7	SAP	0.44 UJ	0.44 UJ	0.48 UJ	0.46 UJ	0.44 UJ	0.54 UJ
Chloroform	4.80	A	0.88 UJ	0.88 UJ	0.97 UJ	0.92 UJ	0.89 UJ	1.1 UJ
Chloromethane	NE	NA	0.44 U	0.44 U	0.48 U	0.46 U	0.44 U	0.54 U
Cis-1,2-Dichloroethene	78.1	SAP	**1,300** J Q	**450** J Q	46 Q	46 Q	**9,000**	13 Q
Cis-1,3-Dichloropropene	0.14	A	0.44 U	0.44 U	0.48 U	0.46 U	0.44 U	0.54 U
Dibromochloromethane	1.82	A	0.88 U	0.88 U	0.97 U	0.92 U	0.89 U	1.1 U

Table 3-8. VOCs in Soil Samples (µg/Kg) (continued)

		Location Name:	**CL-B02**			**CL-B03**		
		Sample Name	**CL-B02-S-14.0-170711**	**CL-B02-S-20.0-170711**	**CL-B02-S-29.0-170711**	**CL-B03-S-18.0-170712**	**CL-B03-S-19.4-170712**	**CL-B03-S-37.0-170712**
		Sample Type	**N**	**N**	**N**	**N**	**N**	**N**
Analyte	**PAL or Screening level**	**Source**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Dibromomethane	NE	NA	0.44 UJ	0.44 UJ	0.48 UJ	0.46 UJ	0.44 UJ	0.54 UJ
Dichlorodifluoromethane	16,000,000	C	0.88 UJ	0.88 UJ	0.97 UJ	0.92 UJ	0.89 UJ	1.1 UJ
Ethylbenzene	343	A	0.88 U	0.88 U	0.97 U M	0.92 U M	0.89 U M	1.1 U
Hexachlorobutadiene	30.3	A	1.8 U	1.8 U	1.9 U	1.8 U	1.8 U	2.2 U
Isopropylbenzene	NE	NA	0.44 U M	0.44 U M	0.48 U	0.46 U	0.44 U	0.54 U
M- and P-Xylene¹	772	A	0.58 J	0.41 J	0.27 J	0.46 U	0.44 U M	0.54 U
Methyl Tert-Butyl Ether	7.23	A	0.88 UJ	0.88 UJ	0.97 UJ	0.92 UJ	0.89 UJ	1.1 UJ
Methylene Chloride	1.48	A	3.9 U	4.7 U	4.5 U	**5.4** J	**3.7** J	**4.2** J
N-Butylbenzene	4,000,000	C	2.4	0.44 U M	0.59 J	0.46 U M	0.44 U M	0.35 J
Naphthalene	236	A	1.8 J	3.5 U	3.9 U	3.7 U	3.5 U	4.3 U
O-Xylene	844	A	0.29 J	0.88 U	0.97 U M	0.92 U	0.89 U	1.1 U
Propylbenzene	8,000,000	C	0.72 J	0.37 J	0.97 U	0.92 U M	0.89 U	1.1 U
Sec-Butylbenzene	8,000,000	C	0.32 J	0.44 U	0.48 U	0.46 U	0.44 U	0.54 U M
Styrene	120	A	0.44 U	0.44 U	0.48 U	0.46 U	0.44 U	0.54 U
Tert-Butylbenzene	8,000,000	A	0.44 U M	0.44 U	0.48 U	0.46 U	0.44 U	0.54 U
Tetrachloroethene	49.9	SAP	0.88 U	0.88 U	0.97 U M	0.92 U	0.89 U	1.1 U
Toluene	273	A	0.3 J	0.27 J	0.35 J	0.28 J	0.89 U	1.1 U
Trans-1,2-Dichloroethene	518	SAP	2 J	32 J	0.78 J	0.83 J	2 J	1.1 UJ
Trans-1,3-Dichloropropene	0.137	A	3.5 U	3.5 U	3.9 U	3.7 U	3.5 U	4.3 U

Table 3-8. VOCs in Soil Samples (µg/Kg) (continued)

		Location Name:	**CL-B02**						**CL-B03**					
		Sample Name	**CL-B02-S-14.0-170711**		**CL-B02-S-20.0-170711**		**CL-B02-S-29.0-170711**		**CL-B03-S-18.0-170712**		**CL-B03-S-19.4-170712**		**CL-B03-S-37.0-170712**	
		Sample Type	**N**		**N**		**N**		**N**		**N**		**N**	
Analyte	**PAL or Screening level**	**Source**	**Result**		**Result**		**Result**		**Result**		**Result**		**Result**	
Trichloroethene	25.2	SAP	**7,400**	J	**5,200**	J	**3,600**	J	**3,900**		**83**	Q	**92**	Q
Trichlorofluoromethane	24,000,000	C	0.88	UJ	0.88	UJ	0.97	UJ	0.92	UJ	0.89	UJ	1.1	UJ
Vinyl Chloride	1.67	SAP	**44**	J	**6.5**	J	1.3	J	**3.8**	J	**25**	J	1.1	UJ

Table 3-8. VOCs in Soil Samples (µg/Kg) (continued)

		Location Name:	**CL-B04**		
		Sample Name	**CL-B04-S-11.5-170712**	**CL-B04-S-19.5-170712**	**CL-B04-S-29.0-170712**
		Sample Type	**N**	**N**	**N**
Analyte	**PAL or Screening level**	**Source**	**Result**	**Result**	**Result**
1,1,1,2-Tetrachloroethane	38,500	B	0.45 U	0.44 U	0.59 U
1,1,1-Trichloroethane	1,490	SAP	0.9 UJ	0.88 UJ	1.2 UJ
1,1,2,2-Tetrachloroethane	0.080	A	1.8 U	1.8 U	2.4 U
1,1,2-Trichloroethane	1.81	A	0.45 U	0.44 U	0.59 U
1,1-Dichloroethane	40.7	SAP	0.45 U M	0.44 U	0.59 U
1,1-Dichloroethene	45.7	SAP	0.9 U	2.9 J	13
1,1-Dichloropropene	NE	NA	0.9 UJ	0.88 UJ	1.2 UJ
1,2,3-Trichlorobenzene	21	D	1.8 U	1.8 U	2.4 U
1,2,3-Trichloropropane	33	B	0.9 U	0.88 U	1.2 U
1,2,4-Trichlorobenzene	29.4	A	0.9 U	0.88 U	1.2 U
1,2,4-Trimethylbenzene	NE	NA	0.59 J	0.72 J	0.71 J
1,2-Dibromo-3-Chloropropane	1,250	B	3.6 U	3.5 U	4.7 U
1,2-Dibromoethane	NE	NA	0.45 U	0.44 U	0.59 U
1,2-Dichlorobenzene	399	A	0.9 U	0.88 U	1.2 U
1,2-Dichloroethane	23.1	SAP	0.45 UJ	0.44 UJ	0.59 UJ
1,2-Dichloropropane	1.67	A	0.9 UJ	0.88 UJ	1.2 UJ
1,3,5-Trimethylbenzene	800,000	C	0.45 U	0.44 U	0.59 U
1,3-Dichlorobenzene	NE	NA	0.9 U M	0.88 U	1.2 U M
1,3-Dichloropropane	NE	NA	0.45 U	0.44 U	0.59 U
1,4-Dichlorobenzene	67.7	A	0.45 U M	0.44 U	0.59 U M
2,2-Dichloropropane	NE	NA	1.8 U	1.8 U	2.4 U

Table 3-8. VOCs in Soil Samples (µg/Kg) (continued)

		Location Name:	**CL-B04**		
		Sample Name	**CL-B04-S-11.5-170712**	**CL-B04-S-19.5-170712**	**CL-B04-S-29.0-170712**
		Sample Type	**N**	**N**	**N**
Analyte	**PAL or Screening level**	**Source**	**Result**	**Result**	**Result**
2-Chlorotoluene	NE	NA	0.45 U	0.44 U	0.59 U
4-Chlorotoluene	NE	NA	0.45 U	0.44 U	0.59 U
4-Isopropyltoluene	NE	NA	0.9 U	0.88 U M	1.2 U
Benzene	1.74	A	0.9 U Q	0.88 U Q	1.2 U Q
Bromobenzene	NE	NA	3.6 U	3.5 U	4.7 U
Bromochloromethane	NE	NA	0.45 U Q	0.44 U Q	0.59 U Q
Bromodichloromethane	2.60	A	0.45 U M Q	0.44 U M Q	0.59 U M Q
Bromoform	22.9	A	0.9 U	0.88 U	1.2 U
Bromomethane	3.31	A	0.45 UJ	0.44 UJ	0.59 UJ
Carbon Tetrachloride	2.19	A	0.9 U Q	0.88 U Q	1.2 U Q
Chlorobenzene	51.1	A	0.9 U	0.88 U	1.2 U
Chloroethane	40.7	SAP	0.45 UJ	0.44 UJ	0.59 UJ
Chloroform	4.80	A	0.9 UJ	0.88 UJ	1.2 UJ
Chloromethane	NE	NA	0.45 U	0.44 U	0.59 U
Cis-1,2-Dichloroethene	78.1	SAP	8.1 Q	**5,600**	**6,600**
Cis-1,3-Dichloropropene	0.14	A	0.45 U	0.44 U	0.59 U
Dibromochloromethane	1.82	A	0.9 U	0.88 U	1.2 U
Dibromomethane	NE	NA	0.45 UJ	0.44 UJ	0.59 UJ
Dichlorodifluoromethane	16,000,000	C	0.9 UJ	0.88 UJ	1.2 UJ
Ethylbenzene	343	A	0.9 U	0.88 U	1.2 U

Table 3-8. VOCs in Soil Samples (μg/Kg) (continued)

		Location Name:	**CL-B04**					
		Sample Name	**CL-B04-S-11.5-170712**		**CL-B04-S-19.5-170712**		**CL-B04-S-29.0-170712**	
		Sample Type	**N**		**N**		**N**	
Analyte	**PAL or Screening level**	**Source**	**Result**		**Result**		**Result**	
Hexachlorobutadiene	30.3	A	1.8	U	1.8	U	2.4	U
Isopropylbenzene	NE	NA	0.45	U	0.44	U	0.59	U
M- and P-Xylene[1]	772	A	0.23	J	0.44	U	0.59	U
Methyl Tert-Butyl Ether	7.23	A	0.9	UJ	0.88	UJ	1.2	UJ
Methylene Chloride	1.48	A	3.3	U	5.4	U	4.3	U
N-Butylbenzene	4,000,000	C	0.45	U	0.22	J	0.59	U
Naphthalene	236	A	3.6	U	3.5	U	4.7	U M
O-Xylene	844	A	0.9	U	0.88	U	1.2	U
Propylbenzene	8,000,000	C	0.9	U	0.88	U	1.2	U
Sec-Butylbenzene	8,000,000	C	0.45	U M	0.44	U	0.59	U M
Styrene	120	A	0.45	U	0.44	U	0.59	U
Tert-Butylbenzene	8,000,000	A	0.45	U	0.44	U	0.59	U
Tetrachloroethene	49.9	SAP	0.9	U	0.88	U	1.2	U
Toluene	273	A	0.27	J	0.28	J	1.2	U
Trans-1,2-Dichloroethene	518	SAP	0.9	UJ	48	J	35	J
Trans-1,3-Dichloropropene	0.137	A	3.6	U	3.5	U	4.7	U
Trichloroethene	25.2	SAP	**51**	Q	**3,800**	J	**6,900**	J
Trichlorofluoromethane	24,000,000	C	0.9	UJ	0.88	UJ	1.2	UJ
Vinyl Chloride	1.67	SAP	0.9	UJ	**5**	J	**77**	J

Table 3-8. VOCs in Soil Samples (µg/Kg) (continued)

		Location Name:	**SP-B01**			**SP-B62**
		Sample Name	**SP-B01-S-13.5-170711**	**SP-B01-S-17.5-170711**	**SP-B01-S-28.0-170711**	**SP-B62-S-7.0-170803**
		Sample Type	**N**	**N**	**N**	**N**
Analyte	**PAL or Screening level**	**Source**	**Result**	**Result**	**Result**	**Result**
1,1,1,2-Tetrachloroethane	38,500	B	210	78 U	0.43 U	1.6 U Q
1,1,1-Trichloroethane	1,490	SAP	140 J	26 U	0.87 UJ	3.3 U
1,1,2,2-Tetrachloroethane	0.080	A	9.8 U	13 U	1.7 U	6.6 U
1,1,2-Trichloroethane	1.81	A	20 U M	26 U	0.43 U	1.6 U
1,1-Dichloroethane	40.7	SAP	20 U	26 U	0.43 U	0.87 J
1,1-Dichloroethene	45.7	SAP	**2,300**	**160**	0.87 U	3.3 U
1,1-Dichloropropene	NE	NA	34 U	46 U	0.87 UJ	3.3 U
1,2,3-Trichlorobenzene	21	D	59 U	78 U	1.7 U	6.6 U M Q
1,2,3-Trichloropropane	33	B	59 U	78 U	0.87 U	**40**
1,2,4-Trichlorobenzene	29.4	A	98 U	130 U	0.87 U	3.3 U M Q
1,2,4-Trimethylbenzene	NE	NA	140,000	97,000	28	370,000 J
1,2-Dibromo-3-Chloropropane	1,250	B	**3,500**	520 U M	3.5 U	13 U Q
1,2-Dibromoethane	NE	NA	20 U Q	26 U Q	0.43 U	1.6 U
1,2-Dichlorobenzene	399	A	20 U	26 U	0.87 U M	3.3 U
1,2-Dichloroethane	23.1	SAP	34 U	46 U	0.43 UJ	0.99 J
1,2-Dichloropropane	1.67	A	19 U Q M	25 U Q	0.87 UJ	3.3 UJ
1,3,5-Trimethylbenzene	800,000	C	45,000	27,000	6.9	140,000 J
1,3-Dichlorobenzene	NE	NA	34 U	46 U	0.87 U M	3.3 U M
1,3-Dichloropropane	NE	NA	34 U Q M	46 U Q	0.43 U	1.6 U
1,4-Dichlorobenzene	67.7	A	59 U Q M	78 U Q	0.43 U M	1.6 U
2,2-Dichloropropane	NE	NA	59 U	78 U	1.7 U	6.6 U

Table 3-8. VOCs in Soil Samples (µg/Kg) (continued)

		Location Name:	**SP-B01**						**SP-B62**	
		Sample Name	**SP-B01-S-13.5-170711**		**SP-B01-S-17.5-170711**		**SP-B01-S-28.0-170711**		**SP-B62-S-7.0-170803**	
		Sample Type	**N**		**N**		**N**		**N**	
Analyte	**PAL or Screening level**	**Source**	**Result**		**Result**		**Result**		**Result**	
2-Chlorotoluene	NE	NA	34	U Q	46	U Q	0.43	U M	1.6	U
4-Chlorotoluene	NE	NA	740		78	U Q M	0.43	U M	3,000	J
4-Isopropyltoluene	NE	NA	20,000		12,000		3.1		62,000	H
Benzene	1.74	A	**390**	J	46	U M	0.87	U Q	**11**	
Bromobenzene	NE	NA	98	U Q	130	U Q	3.5	U	13	U
Bromochloromethane	NE	NA	34	U	46	U	0.43	U Q	1.6	U
Bromodichloromethane	2.60	A	**54,000**	M	26	U M	0.43	U M Q	1.6	U
Bromoform	22.9	A	200	U	260	U	0.87	U	3.3	U
Bromomethane	3.31	A	59	U	78	U	0.43	UJ	1.6	U
Carbon Tetrachloride	2.19	A	20	U	26	U	0.87	U Q	3.3	U Q
Chlorobenzene	51.1	A	**970**		78	U Q	0.87	U M	**100**	
Chloroethane	40.7	SAP	98	U	130	U	0.43	UJ	1.6	U
Chloroform	4.80	A	20	U	26	U	0.87	UJ	3.3	U
Chloromethane	NE	NA	59	U	78	U	0.43	U	1.6	UJ
Cis-1,2-Dichloroethene	78.1	SAP	**1,100,000**		**160,000**		63	Q	68	
Cis-1,3-Dichloropropene	0.14	A	20	U Q	26	U Q	0.43	U	1.6	U
Dibromochloromethane	1.82	A	59	U	78	U	0.87	U	3.3	U
Dibromomethane	NE	NA	34	U M	46	U	0.43	UJ	1.6	U
Dichlorodifluoromethane	16,000,000	C	200	UJ	260	UJ	0.87	UJ	3.3	U
Ethylbenzene	343	A	**4,100**		**2,900**	J	0.71	J	**400**	
Hexachlorobutadiene	30.3	A	98	U	130	U	1.7	U	6.6	U

Table 3-8. VOCs in Soil Samples (µg/Kg) (continued)

		Location Name:	**SP-B01**			**SP-B62**
		Sample Name	**SP-B01-S-13.5-170711**	**SP-B01-S-17.5-170711**	**SP-B01-S-28.0-170711**	**SP-B62-S-7.0-170803**
		Sample Type	**N**	**N**	**N**	**N**
Analyte	**PAL or Screening level**	**Source**	**Result**	**Result**	**Result**	**Result**
Isopropylbenzene	NE	NA	9,300	5,500	1.3 J	39,000 J
M- and P-Xylene¹	772	A	**14,000**	**11,000**	2.9	**40,000** J
Methyl Tert-Butyl Ether	7.23	A	34 U	46 U	0.87 UJ	3.3 U
Methylene Chloride	1.48	A	390 U	520 U	4.2 U	**5.1** J
N-Butylbenzene	4,000,000	C	21,000	12,000	13	68,000 J
Naphthalene	236	A	**460**	**7,300**	6.2 J	**6,700** J
O-Xylene	844	A	**10,000**	**7,400**	1.7	**21,000** J
Propylbenzene	8,000,000	C	22,000	14,000	3.8	73,000 J
Sec-Butylbenzene	8,000,000	C	14,000	8,200	3.5	66,000 J
Styrene	120	A	34 U M	46 U M	0.43 U M	1.6 U M
Tert-Butylbenzene	8,000,000	A	900	2,500 U	0.43 U M	62
Tetrachloroethene	49.9	SAP	**17,000**	**2,200**	0.82 J	3.3 U
Toluene	273	A	2,800	14,000 U	0.37 J	120
Trans-1,2-Dichloroethene	518	SAP	**19,000**	**1,800**	0.99 J	7.4
Trans-1,3-Dichloropropene	0.137	A	34 U Q	46 U Q	3.5 U	13 U
Trichloroethene	25.2	SAP	**83,000,000** B	**1,600,000** J	**7,500** B	2.4 J
Trichlorofluoromethane	24,000,000	C	200 U	260 U	0.87 UJ	3.3 U
Vinyl Chloride	1.67	SAP	200 U	260 U	0.58 J	**8.3** J

Table 3-8. VOCs in Soil Samples (µg/Kg) (continued)

Notes:
Samples analyzed using EPA Method 8260C.
[1]The lowest MTCA Method B value for M-Xylene was chosen to represent M- and P-Xylene, as the M-Xylene value was the lower of the two analytes.
Screening levels based either on the lowest MTCA Method B value show in Ecology's July 2015 CLARC table or the project SAP. Values used as presented by Ecology without recalculation.
A - Screening level source is "Protective of Groundwater Saturated".
B - Screening level source is "Method B Cancer".
C - Screening level source is "Method B Non Cancer".
D - Screening level source is "Protective of Groundwater Vadose at 25 degC"
SAP - The screening level source is the SAP for this project: "Sampling and Analysis Plan Operable Unit 1 Site Recharacterization, June 29, 2017."
NA - Not applicable; NE - Not established.
N – Sample is not part of a field duplicate pair
PAL - Project Action Limit
U - The analyte was analyzed but not detected at or above the stated limit. (sometimes validators will elevate the limit due to the "B" qual using the 5x/10x rule so this definition is different than the lab description).
J - The reported value is an estimated concentration.
E - The reported value exceeded the instrument calibration range, estimated concentration.
UJ - The analyte was analyzed but not detected. the sample quantitation limit is an estimated value.
B - The analyte was found in an associated blank, as well as in the sample.
H - Sample was prepped or analyzed beyond the specified holding time.
J H - The reported value is an estimated concentration./Sample was prepped or analyzed beyond the specified holding time.
M - A matrix effect was present.
Q - One or more quality control criteria failed.
U H - The analyte was analyzed but not detected at or above the stated limit. (sometimes validators will elevate the limit due to the "B" qual using the 5x/10x rule so this definition is different than the lab description)./Sample was prepped or analyzed beyond the specified holding time.
U M - The analyte was analyzed but not detected at or above the stated limit. (sometimes validators will elevate the limit due to the "B" qual using the 5x/10x rule so this definition is different than the lab description)./A matrix effect was present.
Underlined values represent analytes not detected at or above the stated limit, which exceeds the PAL.

Bolded values indicate that the reported concentration exceeds the PAL.

Table 3-9. PCBs in Soil (mg/kg)

	Location Name	CL-B18a		CL-B21		SP-B01		SP-B62	
	Sample Name	CL-B18a-S-18.0-170718		CL-B21-S-12.0-170720		SP-B01-S-17.5-170711		SP-B62-S-7.0-170803	
	Sample Type	N		N		N		N	
Analyte Name	**PAL* (mg/kg)**	**Result**		**Result**		**Result**		**Result**	
Aroclor-1016	0.5	0.029	U	0.025	U	0.023	U J	0.31	U J
Aroclor-1221	0.5	0.014	U	0.012	U	0.012	U	0.15	U J
Aroclor-1232	0.5	0.014	U	0.012	U	0.012	U	0.15	U J
Aroclor-1242	0.5	0.005	U	0.0043	U	0.0041	U	0.054	U J
Aroclor-1248	0.5	0.014	U	0.012	U	0.012	U	0.15	U J
Aroclor-1254	0.5	0.053		0.0062	U	1.1		0.32	J
Aroclor-1260	0.5	0.01	U	0.0087	U	0.34	J	0.11	U J

Notes:
* WAC 173-340-747; Soil Method B cleanup level
Samples analyzed using EPA Method 8082 A
mg/kg - milligram per kilogram
U - The compound was analyzed for, but was not detected ("nondetect") at or above the LOD.
J - The result is an estimated concentration that is less than the LOQ, but greater than or equal to the DL.
U J - The analyte was not detected at the stated sample quantitation limit, which is an estimated value
N – Sample is not part of a field duplicate pair

Table 3-10. Physical Characteristics of Soil

Location Name		MW1-46	MW1-47	MW1-48	MW1-52
Sample Name		CL-B78-SR-28.5-171007	CL-B79-SR-21.5-171009	CL-B83-SR-18.5-171012	SP-B72-S-12.0-171003
Description		Soil	Soil	Soil	Soil
Description	**Units**	**Result**	**Result**	**Result**	**Result**
Mean Grain Size Description USCS/ASTM	NA	Fine Sand	Fine Sand	Fine Sand	Fine Sand
Gravel	wt. percent	0.34	0.26	0.13	0
Coarse Sand Size	wt. percent	0.54	0.61	0.06	0.58
Medium Sand Size	wt. percent	5.07	3.54	5.38	14.23
Fine Sand Size	wt. percent	87.52	84.38	75.5	82.03
Clay	wt. percent				
Silt/Clay	wt. percent	6.53	11.2	18.93	3.16
Silt	wt. percent				
Silt & Clay	wt. percent				
Median Grain Size	mm	0.254	0.14	0.173	0.32
TOC	mg/kg	580	1,350	750	1,141
Fraction Organic Carbon	g/g	0.00058	0.00135	0.00075	0.00115
Dry Bulk Density	g/cc	1.8	1.59	1.68	1.67
Effective Permeability to Water	millidarcy	7155	24.6	23	889
Intrinsic Permeability to Water	cm2	7.06E-08	2.42E-10	2.27E-10	8.77E-09
Effective Porosity	%Vb	30.1	28.1	18.8	23.3
Total Porosity	%Vb	33.5	36.6	31.4	30.2
Hydraulic Conductivity	cm/s	7.18E-03	2.47E-05	2.30E-05	8.92E-04
Moisture Content	% wt	17.4	24.7	17.2	25.4
Volumetric Moisture Content	fraction Vb	0.315	0.394	0.291	0.424
Total Sample Volume	cc	445.58	454.64	448.28	397.52
Field Description		Fine Sand	Fine Sand	Silty Fine Sand	Fine to Medium Sand

Table 3-10. Physical Characteristics of Soil (continued)

Location Name		MW1-50	MW1-56	MW1-56	MW1-56
Sample Name		SP-B73-S-9.0-171004	SP-B87-SR-9.0-171017	SP-B87-SR-29.0-171017	SP-B87-SR-37.5-171017
Description		Soil	Soil	Soil	Soil
Description	**Units**	**Result**	**Result**	**Result**	**Result**
Mean Grain Size Description USCS/ASTM	NA	Fine Sand	Fine Sand	Fine Sand	Clay
Gravel	wt. percent	0	0.59	0.12	0
Coarse Sand Size	wt. percent	0	1.1	1.09	0
Medium Sand Size	wt. percent	1.25	14.65	25.68	0
Fine Sand Size	wt. percent	89.67	79.74	61.73	2.13
Clay	wt. percent				62.76
Silt/Clay	wt. percent	9.09	3.92	11.39	
Silt	wt. percent				35.11
Silt & Clay	wt. percent				97.87
Median Grain Size	mm	0.221	0.319	0.26	0.002
TOC	mg/kg	676	770	680	4,050
Fraction Organic Carbon	g/g	0.00068	0.00077	0.00068	0.00405
Dry Bulk Density	g/cc	1.98	1.69	1.82	1.57
Effective Permeability to Water	millidarcy	1005	1.2	2770	0.058
Intrinsic Permeability to Water	cm2	9.92E-09	1.19E-11	2.73E-08	5.70E-13
Effective Porosity	%Vb	19.2	25.1	33.5	4.8
Total Porosity	%Vb	29.9	36.5	37.6	41.6
Hydraulic Conductivity	cm/s	1.00E-03	1.20E-06	2.78E-03	5.84E-08
Moisture Content	% wt	18.7	21.1	16.5	28.3
Volumetric Moisture Content	fraction Vb	0.37	0.356	0.301	0.447
Total Sample Volume	cc	335.61	448.6	445.46	449.19
Field Description		Fine Sand	Fine Sand	Fine Sand	Clay

Table 3-10. Physical Characteristics of Soil (continued)

Location Name		MW1-58	MW1-58	MW1-58				
Sample Name		SP-B89-S-6.5-171101	SP-B89-S-24.0-171101	SP-B89-S-34.0-171101				
Description		Soil	Soil	Soil				
Description	**Units**	**Result**	**Result**	**Result**	**Minimum**	**Maximum**	**Median**	**GeoMean**
Mean Grain Size Description USCS/ASTM	NA	Coarse Sand	Fine Sand	Medium Sand	Silt	Coarse Sand		
Gravel	wt. percent	22.32	0	0.76	0	22.32	0.13	0.54
Coarse Sand Size	wt. percent	22.47	0.18	7.06	0	22.47	0.58	0.90
Medium Sand Size	wt. percent	30.9	33.99	56.31	0	56.31	14.23	11.43
Fine Sand Size	wt. percent	24.14	61.49	29.61	2.13	89.67	75.5	45.87
Clay	wt. percent				62.76	62.76	62.76	62.76
Silt/Clay	wt. percent	0.17	4.34	6.27	0.17	18.93	6.4	4.91
Silt	wt. percent				35.11	35.11	35.11	35.11
Silt & Clay	wt. percent				97.87	97.87	97.87	97.87
Median Grain Size	mm	1.286	0.333	0.55	0.002	1.286	0.26	0.197
TOC	mg/kg	19,000	950	4,100	580	19,000	950	1,473
Fraction Organic Carbon	g/g	0.019	0.00095	0.0041	0.00058	0.019	0.00095	0.00148
Dry Bulk Density	g/cc	0.58	1.9	1.3	0.58	1.98	1.68	1.53
Effective Permeability to Water	millidarcy	0.312	559	3.31	0.058	7,155	24.6	40
Intrinsic Permeability to Water	cm2	3.08E-12	5.51E-09	3.27E-11	5.7E-13	7.06E-08	2.42E-10	3.93138E-10
Effective Porosity	%Vb	33.5	35.9	20.5	4.8	35.9	25.1	22.4
Total Porosity	%Vb	43.8	40.5	35.9	29.9	43.8	36.5	35.9
Hydraulic Conductivity	cm/s	2.93E-07	5.35E-04	3.15E-06	5.84E-08	7.18E-03	2.47E-05	3.93E-05
Moisture Content	% wt	39.1	11.8	11.1	11.1	39.1	18.7	19.7
Volumetric Moisture Content	fraction Vb	0.226	0.224	0.145	0.145	0.447	0.315	0.303
Total Sample Volume	cc	1117.7	574.51	845.51	335.61	1,117.7	448.6	508.7
Field Description		Sandy, Silty Gravel	Fine Sand	Medium Sand				

GeoMean – geometric mean, with zero values ignored.

Table 3-11. Frequency of Detection and Exceedance in Grab Groundwater Samples

Analyte	Number of grab groundwater samples collected	Number of detections in grab groundwater	Percent Detection	Minimum detected concentration (µg/L)	Maximum detected concentration (µg/L)	Maximum LOD	PAL (µg/L)	Number of exceedances above PAL	Percent Exceeding PAL	Number of samples in which each analyte is the highest concentration analyte*	Number of times each analyte that is not TCE, cis-1,2-DCE, or VC is detected in a sample in which none of the key analytes, TCE, cis-1,2-DCE, and VC are detected
cis-1,2-DCE	87	77	89%	0.28	350,000	10,000	16	67	77%	44	NA
1,1-DCA	87	50	57%	0.054	17,600	500	7.7	9	10%	0	1
1,1-DCE	87	50	57%	0.0156	305	200	7	23	26%	0	1
trans-1,2-DCE	87	70	80%	0.099	4,100	15,000	100	22	25%	1	2
TCE	87	65	75%	0.036	540,000	30,000	0.54	51	59%	18	NA
VC	87	67	77%	0.434	32,000	5,000	0.029	67	77%	15	NA
PCE	87	26	30%	0.0159	43	25	5	4	5%	1	1
Chloroethane	87	23	26%	0.19	30,600	10,000	7.7	11	13%	5	0
1,2-DCA	87	27	31%	0.0163	53	200	0.48	8	9%	2	1
1,1,1-TCA	87	16	18%	0.034	5,810	200	200	2	2%	0	0

Table 3-12. COCs and Chloroethane in Grab Groundwater Samples (µg/L)

Location Name		CL-B02		CL-B03		CL-B04		CL-B05		CL-B06a		CL-B07	
Sample Name		CL-B02-GW-20.0-170711		CL-B03-GW-22.0-170712		CL-B04-GW-20.0-170712		CL-B05-GW-19.0-170712		CL-B06a-GW-16.0-170713		CL-B07-GW-29.0-170713	
Sample Type		N		N		N		N		N		N	
ANALYTE_NAME	**PAL**	**Result**		**Result**		**Result**		**Result**		**Result**		**Result**	
1,1,1-Trichloroethane	200	100	UJ	2.5	UJ	2.5	UJ	0.05	UJ	0.05	UJ	0.05	UJ
1,1-Dichloroethane	7.7	50	UJ	2.5	UJ	2.5	UJ	0.15	J	0.054	J	0.069	J
1,1-Dichloroethene	7	200	UJ	**15**	J	**12**	J	0.73	J	0.05	UJ	3.3	J
1,2-Dichloroethane	0.48	**53**	J	2.5	UJ	2.5	UJ	0.05	UJ	0.05	UJ	0.05	UJ
Chloroethane	7.7	350	UJ	10	UJ	10	UJ	0.63	J	0.2	UJ	0.2	UJ
Cis-1,2-Dichloroethene	16	**3,900**	J	**4,500**	J	**4,400**	J	**150**	J	**33**	J	**250**	J
Tetrachloroethene	5	100	UJ	10	UJ	3.5	J	0.2	UJ	0.2	UJ	0.2	UJ
Trans-1,2-Dichloroethene	100	**160**	J	71	J	97	J	2.9	J	1	J	3.1	J
Trichloroethene	0.54	**22**	J	**60**	J	**6.4**	J	**160**	J	0.5	J	0.18	J
Vinyl Chloride	0.029	**270**	J	**210**	J	**1,300**	J	**43**	J	**100**	J	**120**	J

Location Name		CL-B08		CL-B09		CL-B10		CL-B11		CL-B12		CL-B13	
Sample Name		CL-B08-GW-18.0-170713		CL-B09-GW-14.0-170713		CL-B10-GW-12.0-170714		CL-B11-GW-12.0-170714		CL-B12-GW-21.0-170714		CL-B13-GW-12.0-170717	
Sample Type		N		N		N		N		N		N	
ANALYTE_NAME	**PAL**	**Result**		**Result**		**Result**		**Result**		**Result**		**Result**	
1,1,1-Trichloroethane	200	0.05	UJ	0.05	UJ	0.05	U	0.05	U	0.05	U	0.05	U
1,1-Dichloroethane	7.7	2	J	0.083	J	0.19	J	0.3		0.19	J	0.86	
1,1-Dichloroethene	7	5.1	J	0.05	UJ	0.05	U M	0.05	U M	2.2		0.05	U M
1,2-Dichloroethane	0.48	0.05	UJ	0.05	UJ	0.065	J	0.026	J	0.05	U	0.05	U M
Chloroethane	7.7	0.2	UJ	0.2	UJ	0.2	U M	**11**	M	0.83		0.92	M
Cis-1,2-Dichloroethene	16	**270**	J	2.8	J	**16**		0.97		**210**	J	0.28	
Tetrachloroethene	5	0.2	UJ	0.2	UJ	0.2	U M	0.2	U M	0.2	U	0.2	U M
Trans-1,2-Dichloroethene	100	**110**	J	0.17	J	0.25		0.05	U	61	J	0.05	U M
Trichloroethene	0.54	0.1	J	0.1	J	**6.1**		0.099	J	**150**	J	0.087	U
Vinyl Chloride	0.029	**740**	J	**3.5**	J	**3.2**	M	**0.72**	M	**22**		0.015	U M

Table 3-12. COCs and Chloroethane in Grab Groundwater Samples (μg/L) (continued)

Location Name		CL-B14B				CL-B15		CL-B16		CL-B17		CL-B18a	
Sample Name		CL-B14b-GW-22.0-170717		FD-170717-02		CL-B15-GW-23.0-170717		CL-B16-GW-13.0-170718		CL-B17-GW-19.5-170718		CL-B18a-GW-14.5-170718	
Sample Type		P		FD		N		N		N		N	
ANALYTE_NAME	**PAL**	**Result**		**Result**		**Result**		**Result**		**Result**		**Result**	
1,1,1-Trichloroethane	200	0.05	U	0.05	U	0.05	U	37		0.05	U M	0.05	U
1,1-Dichloroethane	7.7	0.05	U M	0.05	U M	0.05	U M	**550**		0.11	J M	0.58	
1,1-Dichloroethene	7	**210**	H	**210**	H	0.05	U M	**37**		0.05	U M	0.05	U M
1,2-Dichloroethane	0.48	0.05	U	0.05	U M	0.05	U	**38**		0.031	J	0.053	J
Chloroethane	7.7	0.2	U M	0.2	U	0.46	J M	**5,300**	M	0.2	U M	2.3	M
Cis-1,2-Dichloroethene	16	**50,000**	J	**46,000**	J	14	J	**1,100**	J	**36**	J	**24**	
Tetrachloroethene	5	0.2	U M	0.2	U M	0.2	U M	0.23	J	0.2	U M	0.2	U M
Trans-1,2-Dichloroethene	100	**1,300**	J	**1,300**	J	0.28		25	U M	0.61		0.66	
Trichloroethene	0.54	**610**	J	**610**	J	0.13	U	**27**	J	0.26		0.38	
Vinyl Chloride	0.029	**22,000**	J	**20,000**	J	**2.5**		**180**	B M	**0.69**	B M	**3.9**	M

Location Name		CL-B18a				CL-B19		CL-B20				CL-B21	
Sample Name		CL-B18a-GW-33.0-170719		CL-B18b-GW-20.0-170807		CL-B19-GW-23.0-170719		CL-B20-GW-26.5-170719		CL-B20-GW-32.0-170719		CL-B21-GW-12.5-170720	
Sample Type		N		N		N		N		N		N	
ANALYTE_NAME	**PAL**	**Result**		**Result**		**Result**		**Result**		**Result**		**Result**	
1,1,1-Trichloroethane	200	0.05	U	500	U	0.05	U	0.05	U	0.05	U	0.05	U
1,1-Dichloroethane	7.7	0.05	U M	250	U	0.23		3.7		0.39		0.14	J
1,1-Dichloroethene	7	10		1,000	U M	0.05	U M	3.4		**26**		0.05	U M
1,2-Dichloroethane	0.48	0.05	U	500	U	0.05	U	0.056	J	0.026	J	**4**	
Chloroethane	7.7	0.2	U M	1,800	U	0.2	U M	**18**		0.2	U M	1,800	U R
Cis-1,2-Dichloroethene	16	**5,700**	J	**22,000**		0.55	J	**1,400**	J	**14,000**	J	250	U R
Tetrachloroethene	5	0.2	U M	500	U	0.2	U M	0.2	U M	0.2	U M	0.2	U M
Trans-1,2-Dichloroethene	100	1,000	U R	1,000	U M	0.099	J	20		**1,000**	U R	1.1	
Trichloroethene	0.54	**6.7**		**1,100**	J	0.23	J	**0.71**		**1.7**		0.05	U
Vinyl Chloride	0.029	**1,300**	J	**2,200**	J	**1**	J	**290**	J	**3,800**	J	0.015	UJ

Table 3-12. COCs and Chloroethane in Grab Groundwater Samples (µg/L) (continued)

Location Name		CL-B21a		CL-B22		CL-B23				CL-B24		CL-B25	
Sample Name		CL-B21a-GW-20.0-170807		CL-B22-GW-19.0-170720		CL-B23-GW-14.0-170720		CL-B23-GW-18.0-170720		CL-B24-GW-16.0-170720		CL-B25-GW-29.0-170720	
Sample Type		N		N		N		N		N		N	
ANALYTE_NAME	**PAL**	**Result**		**Result**		**Result**		**Result**		**Result**		**Result**	
1,1,1-Trichloroethane	200	500	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U
1,1-Dichloroethane	7.7	250	U M	0.47		0.077	J	0.05	U M	0.37		0.15	J
1,1-Dichloroethene	7	1,000	U	5.7		1		2.6		0.7		3.1	
1,2-Dichloroethane	0.48	500	U	**1.1**		0.05	U M	0.05	U	0.05	U M	0.05	U M
Chloroethane	7.7	1,800	U	1,800	U R	0.2	U M	0.2	U M	0.2	U M	0.2	U M
Cis-1,2-Dichloroethene	16	250	U	**26**	B	**410**	J	**1,100**	J	**230**	J	**590**	J
Tetrachloroethene	5	500	U	**9**		0.2	U M	0.39	J	0.2	U M	0.2	U M
Trans-1,2-Dichloroethene	100	1,000	U	45		1.5		31		17		9.3	
Trichloroethene	0.54	**260**	J M	**200**	J	0.14	J	**1.3**		0.068	J	0.18	J
Vinyl Chloride	0.029	250	UJ	**21**	J	**150**	J	250	U R	**350**	J	**250**	U R

Location Name		CL-B26a		CL-B27		CL-B28				CL-B29a		CL-B30a	
Sample Name		CL-B26a-GW-10.0-170721		CL-B27-GW-12.0-170721		CL-B28-GW-10.0-170721		FD-170721-02		CL-B29a-GW-21.0-170724		CL-B30a-GW-21.0-170724	
Sample Type		N		N		N		FD		N		N	
ANALYTE_NAME	**PAL**	**Result**		**Result**		**Result**		**Result**		**Result**		**Result**	
1,1,1-Trichloroethane	200	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U
1,1-Dichloroethane	7.7	0.05	U M	0.11	J	0.05	U M	0.05	U M	**29.5**	J	0.05	U
1,1-Dichloroethene	7	0.05	U M	0.05	U M	0.05	U M	0.05	U M	4.39		0.05	U
1,2-Dichloroethane	0.48	0.05	U	0.05	U	0.05	U	0.05	U	**4.49**		**0.87**	
Chloroethane	7.7	0.2	U M	0.2	U M	0.2	U M	0.2	U M	0.5	UJ	0.5	UJ
Cis-1,2-Dichloroethene	16	250	U H	250	U H	250	U H	250	U H	**108**	J	0.05	U
Tetrachloroethene	5	0.2	U M	0.2	U M	0.2	U M	0.2	U M	1.92		0.192	J
Trans-1,2-Dichloroethene	100	0.05	U	0.33		0.05	U	0.05	U	37.7	J	0.189	J
Trichloroethene	0.54	0.068	J	**0.81**		0.036	J	0.05	U M	**122**	J	0.467	U
Vinyl Chloride	0.029	0.015	U M	0.015	U M	0.015	U M	0.015	U M	**253**	J	**0.434**	

Table 3-12. COCs and Chloroethane in Grab Groundwater Samples (μg/L) (continued)

Location Name		CL-B31		CL-B32		CL-B33		CL-B34		CL-B35		CL-B36a	
Sample Name		CL-B31-GW-12.0-170724		CL-B32-GW-16.0-170724		CL-B33-GW-13.0-170724		CL-B34-GW-20.0-170725		CL-B35-GW-21.0-170725		CL-B36a-GW-17.0-170725	
Sample Type		N		N		N		N		N		N	
ANALYTE_NAME	**PAL**	**Result**		**Result**		**Result**		**Result**		**Result**		**Result**	
1,1,1-Trichloroethane	200	0.05	U	0.05	UJ	0.05	UJ	0.05	U	0.05	U	0.05	U
1,1-Dichloroethane	7.7	0.05	U	0.259	J	0.145	J	1.88		0.05	U	1.25	
1,1-Dichloroethene	7	0.05	U	1.76	J	0.05	UJ	3.15		**23.7**	D	**23.7**	D
1,2-Dichloroethane	0.48	0.05	U	0.05	UJ	0.05	UJ	0.05	U	0.05	U	0.05	U
Chloroethane	7.7	0.5	UJ	0.5	UJ	0.5	UJ	0.5	UJ	0.5	UJ	0.5	UJ
Cis-1,2-Dichloroethene	16	0.05	U	**505**	J	1.21	J	**698**	D	**4,520**	D	**4,790**	D
Tetrachloroethene	5	0.177	J	0.172	J	0.2	UJ	0.171	J	0.17	J	0.172	J
Trans-1,2-Dichloroethene	100	0.05	U	51.8	J	0.667	J	**336**	D	98	D	**122**	D
Trichloroethene	0.54	0.05	U	2.82	U	**1.39**	J	1.87	U	**1.32**	U	17	U
Vinyl Chloride	0.029	0.015	U	**188**	J	0.015	UJ	0.015	U	**1,040**	D	**2,030**	D

Location Name		CL-B37		CL-B39		SP-B01				SP-B01a	
Sample Name		CL-B37-GW-15.0-170726		CL-B39-GW-10.0-170726		SP-B01-GW-13.5-170711		SP-B01-GW-17.5-170711		SP-B01a-GW-28.0-170711	
Sample Type		N		N		N		N		N	
ANALYTE_NAME	**PAL**	**Result**		**Result**		**Result**		**Result**		**Result**	
1,1,1-Trichloroethane	200	0.164	J	0.164	J	1	U	1	UJ	25	UJ
1,1-Dichloroethane	7.7	0.117	J	0.204	J	0.63	J	0.5	UJ	13	UJ
1,1-Dichloroethene	7	0.946	J	0.0156	J	**88**	J	**80**	J	50	UJ
1,2-Dichloroethane	0.48	0.0163	J	0.0179	J	1	U	1	UJ	25	UJ
Chloroethane	7.7	6.46	J	0.408	J	3.5	U	3.5	UJ	88	UJ
Cis-1,2-Dichloroethene	16	**52.2**	J	0.569	J	**150,000**	J	**130,000**	J	**360**	J
Tetrachloroethene	5	0.2	UJ	0.2	UJ	**25**	J	**43**	J	25	UJ
Trans-1,2-Dichloroethene	100	12.4	J	0.595	J	**4,100**	J	**3,700**	J	23	J
Trichloroethene	0.54	**7.1**	J	0.182	J	**150,000**	H	**360,000**	H	**500**	J
Vinyl Chloride	0.029	**46.1**	J	**1.71**	J	**7,900**	J	**2,900**	J	**320**	J

Table 3-12. COCs and Chloroethane in Grab Groundwater Samples (µg/L) (continued)

Location Name		SP-B01B						SP-B40				SP-B41	
Sample Name		FD-0170807-01		SP-B01b-GW-10.0-170807		SP-B01b-GW-15.0-170809		SP-B40-GW-11.0-170726		SP-B40-GW-16.0-170726		SP-B41-GW-10.0-170726	
Sample Type		FD		P		N		N		N		N	
ANALYTE_NAME	**PAL**	**Result**		**Result**		**Result**		**Result**		**Result**		**Result**	
1,1,1-Trichloroethane	200	500	U	500	U	500	U	**5,810**	J	**255**	J	3.8	J
1,1-Dichloroethane	7.7	250	U	250	U	250	U	**17,600**	J	**302**	J	**8.43**	J
1,1-Dichloroethene	7	1,000	U M	1,000	U	1,000	U	**305**	J	5.64	J	1	UJ
1,2-Dichloroethane	0.48	500	U	500	U	500	U	**5.12**	J	1	UJ	1	UJ
Chloroethane	7.7	1,800	U	1,800	U	1,800	U	**30,600**	J	**2,580**	J	**26.5**	J
Cis-1,2-Dichloroethene	16	**100,000**		**350,000**		**120,000**		**456**	J	**3,570**	J	**18.6**	J
Tetrachloroethene	5	500	U	500	U	500	U	0.2	UJ	0.2	UJ	4	UJ
Trans-1,2-Dichloroethene	100	**1,100**	J	**2,300**		**1,100**	J	83.8	J	**103**	J	4.32	J
Trichloroethene	0.54	**320,000**		**260,000**		**310,000**		**195**	J	**380**	J	**9.54**	J
Vinyl Chloride	0.029	**4,300**	J M	**32,000**		**4,800**	J	**571**	J	**3,800**	J	**41.9**	J

Location Name		SP-B42				SP-B43a		SP-B44		SP-B45		SP-B46	
Sample Name		SP-B42-GW-10.0-170727		SP-B42-GW-18.0-170727		SP-B43a-GW-13.0-170807		SP-B44-GW-12.0-170727		SP-B45-GW-18.0-170727		SP-B46-GW-15.0-170728	
Sample Type		N		N		N		N		N		N	
ANALYTE_NAME	**PAL**	**Result**		**Result**		**Result**		**Result**		**Result**		**Result**	
1,1,1-Trichloroethane	200	0.921	J	0.489	J	500	U	1.24	J	0.058	J	0.057	J
1,1-Dichloroethane	7.7	1.41	J	0.572	J	250	U	4.82	J	1.8		**31**	
1,1-Dichloroethene	7	**12.2**	J	3.87	J	1,000	U M	**53.1**	J	**13**		0.58	
1,2-Dichloroethane	0.48	0.0376	J	0.0312	J	500	U	0.198	J	0.2		0.11	J
Chloroethane	7.7	**91.9**	J	**105**	J	1,800	U M	**2,450**	J	**15**		1,800	U R
Cis-1,2-Dichloroethene	16	**4,270**	J	**2,340**	J	**27,000**		**11,900**	J	**8,300**	J	**360**	J
Tetrachloroethene	5	0.55	J	0.0159	J	500	U	0.0687	J	0.2	U M	0.2	U M
Trans-1,2-Dichloroethene	100	62.4	J	36.9	J	1,000	U	**148**	J	94	J	29	
Trichloroethene	0.54	**4,670**	J	**1,200**	J	**10,000**		**5,330**	J	**47**		**1.4**	
Vinyl Chloride	0.029	**498**	J	**339**	J	**4,200**	J	**4,200**	J	**1,200**	J	**2,500**	B

Table 3-12. COCs and Chloroethane in Grab Groundwater Samples (µg/L) (continued)

Location Name		SP-B47		SP-B48b		SP-B49				SP-B50		SP-B51	
Sample Name		SP-B47-GW-15.0-170728		SP-B48b-GW-10.0-170728		SP-B49-GW-10.0-170728		SP-B49-GW-20.0-170728		SP-B50-GW-14.0-170731		SP-B51-GW-14.0-170731	
Sample Type		N		N		N		N		N		N	
ANALYTE_NAME	**PAL**	**Result**		**Result**		**Result**		**Result**		**Result**		**Result**	
1,1,1-Trichloroethane	200	0.13	J	0.042	J	0.05	U	0.05	U M	0.05	U M	0.034	J
1,1-Dichloroethane	7.7	**33**		**13**	J	**17**		0.056	J	1.2		0.05	U
1,1-Dichloroethene	7	0.44		**25**	J	**69**		5	U	**34**		0.45	
1,2-Dichloroethane	0.48	0.097	J	0.33	J	0.05	U	0.05	U M	0.29		0.05	U M
Chloroethane	7.7	1,800	U R	3,500	U R	100	UJ	0.19	J	0.3	J	0.2	U M
Cis-1,2-Dichloroethene	16	**200**	J	**12,000**	J	**77,000**	J	**470**	J	**9,300**	J	**190**	B
Tetrachloroethene	5	0.2	U	0.091	J	**5.3**		0.11	J	0.08	J	0.2	U M
Trans-1,2-Dichloroethene	100	40		**130**		**720**		9.5	J	**110**		1.7	J
Trichloroethene	0.54	**1.7**		**1,700**	J	**63,000**	J	**480**	J	**2,600**	J	**250**	U R
Vinyl Chloride	0.029	**1,800**	B	**3,100**	B	**5,600**	B	**250**	U R	**1,100**		**10**	

Location Name		SP-B52				SP-B53				SP-B54			
Sample Name		SP-B52-GW-11.0-170731		SP-B52-GW-20.0-170731		SP-B53-GW-23.0-170731		SP-B53-GW-33.0-170731		SP-B54-GW-35.0-170801		SP-B54-GW-7.0-170801	
Sample Type		N		N		N		N		N		N	
ANALYTE_NAME	**PAL**	**Result**		**Result**		**Result**		**Result**		**Result**		**Result**	
1,1,1-Trichloroethane	200	0.17	J	0.05	U M	50	U M	0.05	U M	2.5	U M	2.5	U M
1,1-Dichloroethane	7.7	2.3		0.068	J	50	U	0.074	J	2.5	U	2.5	U M
1,1-Dichloroethene	7	**25**		0.53		50	U M	2.5	U	2.5	U M	**64**	
1,2-Dichloroethane	0.48	0.039	J	0.05	U M	50	U M	0.05	U M	2.5	U M	2.5	U M
Chloroethane	7.7	4.3		0.22	J	200	U M	0.2	U M	10	U M	10	U M
Cis-1,2-Dichloroethene	16	**21,000**	B	**630**	B	**63,000**	J	**270**	B	**7,700**	H B	**59,000**	J
Tetrachloroethene	5	2.8		0.096	J M	200	U M	0.34	J	10	U M	10	U M
Trans-1,2-Dichloroethene	100	**200**		8.6	J	**700**		7.5	J	60		**900**	
Trichloroethene	0.54	**26,000**	J	**590**	J	**540,000**	J	**1,900**	J	**270**	J	**250**	J
Vinyl Chloride	0.029	**1,300**		**26**	M	15	U M	**27**		**440**	B	**14,000**	B

Table 3-12. COCs and Chloroethane in Grab Groundwater Samples (µg/L) (continued)

Location Name		SP-B55				SP-B56					
Sample Name		SP-B55-GW-10.0-170801		SP-B55-GW-33.0-170801		FD-170801-02		SP-B56-GW-10.0-170801		SP-B56-GW-27.0-170801	
Sample Type		N		N		FD		P		N	
ANALYTE_NAME	**PAL**	**Result**		**Result**		**Result**		**Result**		**Result**	
1,1,1-Trichloroethane	200	2.5	U M	2.5	U M	0.05	U	0.05	U	0.05	U M
1,1-Dichloroethane	7.7	2.5	U	2.5	U	0.34		0.16	J	0.05	U M
1,1-Dichloroethene	7	**150**		2.5	U M	**18**		**17**		**18**	
1,2-Dichloroethane	0.48	2.5	U M	2.5	U M	0.05	U	**0.72**		0.05	U
Chloroethane	7.7	10	U M	10	U M	0.2	U	0.2	U	0.2	U
Cis-1,2-Dichloroethene	16	**43,000**	B J	**3,800**	B	**31,000**	J	**29,000**	J	**15,000**	B
Tetrachloroethene	5	10	U M	10	U M	0.2	U M	0.2	U	0.2	U M
Trans-1,2-Dichloroethene	100	**290**		52		**370**		**330**		**130**	
Trichloroethene	0.54	**20,000**	B	**520**	J	6.8	U	5.9	U	**250**	J
Vinyl Chloride	0.029	**2,600**	B J	**660**		0.015	U	0.015	U M	**1,900**	B

Location Name		SP-B57				SP-B58		SP-B59		SP-B60			
Sample Name		SP-B57-GW-10.0-170802		SP-B57-GW-29.0-170802		SP-B58-GW-39.0-170802		SP-B59-GW-30.0-170802		SP-B60-GW-24.0-170802		SP-B60-GW-9.0-170802	
Sample Type		N		N		N		N		N		N	
ANALYTE_NAME	**PAL**	**Result**		**Result**		**Result**		**Result**		**Result**		**Result**	
1,1,1-Trichloroethane	200	0.05	U M	0.05	U M	0.05	U M	0.05	U M	0.05	U M	0.05	U M
1,1-Dichloroethane	7.7	0.37		0.11	J	0.05	U M	0.05	U	0.05	U	0.05	U
1,1-Dichloroethene	7	2.8		**32**		**13**	U	0.26		0.082	J	0.05	U
1,2-Dichloroethane	0.48	0.37		0.05	U M	0.03	J	0.05	U M	0.05	U	0.05	U M
Chloroethane	7.7	0.2	U Q	0.2	U Q	0.2	U M Q	0.2	U M Q	0.2	U M Q	0.2	U M Q
Cis-1,2-Dichloroethene	16	**6,600**	B	**1,700**	B	**8,500**	J	250	U R	**250**	UJ	250	UJ
Tetrachloroethene	5	0.2	U	0.2	U M	0.31	J	0.2	U M	0.2	U M	0.2	U M
Trans-1,2-Dichloroethene	100	**120**		61		**130**	J	2.9		0.98		1,000	UJ
Trichloroethene	0.54	**250**	J	**250**	J	**1,400**	J	250	U R	250	UJ	250	UJ
Vinyl Chloride	0.029	**15,000**	B	**280**	B	**1,100**	J	**9.5**	B	250	UJ	250	UJ

Table 3-12. COCs and Chloroethane in Grab Groundwater Samples (µg/L) (continued)

Location Name		SP-B61		SP-B62		SP-B63		SP-B64		SP-B65C		SP-B66	
Sample Name		SP-B61-GW-25.0-170803		SP-B62-GW-26.0-170804		SP-B63-GW-24.0-170804		SP-B64-GW-10.0-170804		SP-B65c-GW-9.0-170806		SP-B66-GW-10.0-170806	
Sample Type		N		N		N		N		N		N	
ANALYTE_NAME	**PAL**	**Result**		**Result**		**Result**		**Result**		**Result**		**Result**	
1,1,1-Trichloroethane	200	0.05	U M	0.05	U M	0.05	U M	0.07	J	500	U	500	U
1,1-Dichloroethane	7.7	0.05	U M	0.12	J	0.05	U	0.26	J	250	U	250	U
1,1-Dichloroethene	7	0.11	M	0.05	U	0.28		6.6	J	1,000	U M	1,000	U M
1,2-Dichloroethane	0.48	0.05	U M	0.05	U M	0.05	U M	0.05	U M	500	U	500	U
Chloroethane	7.7	0.2	U M	0.2	U M	0.2	U M	0.28	J	1,800	U	1,800	U M
Cis-1,2-Dichloroethene	16	7.5	B	5.5	B	**100**	J	**6,500**	J	**260**	J	**22,000**	
Tetrachloroethene	5	0.2	U M	0.2	U M	0.14	J M	2	J	500	U M	500	U
Trans-1,2-Dichloroethene	100	0.93		2.3		2.2		64		1,000	U M	1,000	U
Trichloroethene	0.54	250	UJ	250	UJ	**710**	J	**15,000**	J	**710**	J	250	U M
Vinyl Chloride	0.029	250	UJ	250	UJ	250	UJ	**84**	J	250	UJ	**14,000**	J

Location Name		SP-B67		SP-B68				SP-B69	
Sample Name		SP-B67-GW-14.0-170806		FD-170806-01		SP-B68-GW-13.0-170806		SP-B69-GW-12.0-170806	
Sample Type		N		FD		P		N	
ANALYTE_NAME	**PAL**	**Result**		**Result**		**Result**		**Result**	
1,1,1-Trichloroethane	200	500	U	500	U	500	U	500	U
1,1-Dichloroethane	7.7	250	U	250	U M	250	U M	250	U
1,1-Dichloroethene	7	1,000	U	1,000	U	1,000	U	1,000	U M
1,2-Dichloroethane	0.48	500	U	500	U	500	U	500	U
Chloroethane	7.7	1,800	U M	1,800	U	1,800	U M	**2,700**	
Cis-1,2-Dichloroethene	16	**2,200**		**2,400**		**2,900**		**1,500**	
Tetrachloroethene	5	500	U	500	U	500	U	500	U
Trans-1,2-Dichloroethene	100	1,000	U M	1,000	U	1,000	U	1,000	U
Trichloroethene	0.54	250	U	250	U	250	U	250	U M
Vinyl Chloride	0.029	**9,800**	J	**7,200**	J	**6,600**	J	**1,100**	J

Table 3-12. COCs and Chloroethane GGW (continued)

Notes:
Samples analyzed using EPA Method 8260C
FD - Field Duplicate
P – Parent sample of field duplicate
N – Sample is not part pof a field duplicate pair
PAL - Project Action Limit
D - The reported value is from a dilution.
JD - The reported value is an estimated concentration. / The reported value is from a dilution.
U - The analyte was not detected at or above the stated limit. (sometimes validators will elevate the limit due to the "B" qualifier using the 5x/10x rule so this definition is different than the lab description).
J - The reported value is an estimated concentration.
UJ - The analyte was not detected at or above the sample quantitation limit, which is an estimated value.
B - The analyte was found in an associated blank, as well as in the sample.
B J - The analyte was found in an associated blank, as well as in the sample. / Sample was prepped or analyzed beyond the specified holding time.
H - Sample was prepped or analyzed beyond the specified holding time.
M - A matrix effect was present.
U R - The reported value is unusable, rejected. Analyte may or may not be present.
U H - The analyte was not detected at or above the stated limit. (Sometimes validators will elevate the limit due to the "B" qualifier using the 5x/10x rule so this definition is different than the lab description). / Sample was prepped or analyzed beyond the specified holding time.
U M - The analyte was not detected at or above the stated limit. (sometimes validators will elevate the limit due to the "B" qualifier using the 5x/10x rule so this definition is different than the lab description). / A matrix effect was present.
Underlined values represent analytes not detected at or above the stated limit, which exceeds the PAL.

Bolded values indicate that the reported concentration exceeds the PAL.

Table 3-13. Frequency of Detection and Exceedance in Groundwater Samples from Monitoring Wells

Analyte	Number of groundwater samples collected from monitoring wells	Number of detections in monitoring wells	Percent Detection	Minimum detected concentration (µg/L)	Maximum detected concentration (µg/L)	Maximum LOQ	PAL (µg/L)	Number of exceedances above PAL	Percent Exceeding PAL	Number of samples in which each analyte is the highest concentration analyte*	Number of times each analyte that is not TCE, cis-1,2-DCE, or VC is detected in a sample in which none of the key analytes, TCE, cis-1,2-DCE, and VC are detected
cis-1,2-DCE	25	23	92%	1.76	94,300	2,500	16	22	88%	15	NA
1,1-DCA	25	2	8%	0.357	5.09	2,500	7.7	0	0%	0	0
1,1-DCE	25	7	28%	0.613 JD	26.5 JD	2,500	7	1	4%	0	0
trans-1,2-DCE	25	17	68%	0.64	938	2,500	100	5	20%	0	0
TCE	25	19	76%	1.18	361,000	2,500	0.54	19	76%	8	NA
VC	25	19	76%	0.464	9570	2,500	0.029	19	76%	1	NA
PCE	25	0	0%	NA	NA	2,500	5	0	0%	0	0
1,2-DCA	25	0	0%	NA	NA	2,500	0.48	0	0%	0	0
1,1,1-TCA	24	0	0%	NA	NA	2,500	200	0	0%	0	0
1,4-Dioxane	10	3	30%	2.1	4.94	2.33	0.44	3	30%	0	0

Notes:
Sample counts do not include duplicate samples.
*If a sample had two COCs sharing the highest concentrations, then both of them were counted.
** Maximum LOD was the Laboratory Limit of Detection.
cis-1,2-DCE - cis-1,2-dichloroethene
1,1-DCA - 1,1-dichloroethane
1,1-DCE - 1,1-dichloroethene
trans-1,2-DCE - trans-1,2-dichloroethene
TCE - trichloroethene
VC - vinyl chloride
PCE - tetrachloroethene
1,2-DCA - 1,2-dichloroethane
1,1,1-TCA - 1,1,1-trichloroethane
PAL - project action limit
µg/L - micrograms per liter
NA - not applicable

Table 3-14. COCs in Groundwater Monitoring Wells (µg/L)

Location Name		IW1-S		MW1-17		MW1-42		MW1-43		MW1-44		MW1-45	
Sample Name		IW1-S-171026		CL-MW1-17-GW-170720		MW1-42-171023		MW1-43-171023		MW1-44-171023		MW1-45-171023	
	Sample type	N		N		N		N		N		N	
Analyte	**PAL (µg/L)**	**Result**		**Result**		**Result**		**Result**		**Result**		**Result**	
1,1,1-Trichloroethane	200	0.5	U	0.05	U	1	U	5	U	25	U	1	U
1,1-Dichloroethane	7.7	0.5	U	0.05	U M	5.09	D	5	U	25	U	1	U
1,1-Dichloroethene	7	0.5	U	2.5		0.613	JD	3.76	JD	**26.5**	JD	0.931	JD
1,2-Dichloroethane	0.48	0.5	U	0.05	U	1	U	5	U	25	U	1	U
Chloroethane	7.7			1,800	U R								
Cis-1,2-Dichloroethene	16	1.32	U	**680**	J	**53.6**	D	**982**	D	**5,250**	D	**187**	D
Tetrachloroethene	5	0.5	U	0.2	U M	1	U	5	U	25	U	1	U
Trans-1,2-Dichloroethene	100	0.5	U	0.82		38.7	D	92.1	D	20.8	JD	1	U
Trichloroethene	0.54	**46.6**		250	U R	**1.18**	JD	5	U	25	U	1	U
Vinyl Chloride	0.029	0.5	U	250	U R	**46.9**	D	**452**	D	**723**	D	**83.7**	D

Location Name		MW1-46				MW1-47		MW1-48		MW1-49		MW1-50	
Sample Name		FD-171023-01		MW1-46-171023		MW1-47-171023		MW1-48-171024		MW1-49-171024		MW1-50-171024	
	Sample type	FD		P		N		N		N		N	
Analyte	**PAL (µg/L)**	**Result**		**Result**		**Result**		**Result**		**Result**		**Result**	
1,1,1-Trichloroethane	200	50	U	50	U	100	U	2.5	U	25	U	5	U
1,1-Dichloroethane	7.7	50	U	50	U	100	U	2.5	U	25	U	5	U
1,1-Dichloroethene	7	50	U	50	U	100	U	2.5	U	25	U	5	U
1,2-Dichloroethane	0.48	50	U	50	U	100	U	2.5	U	25	U	5	U
Chloroethane	7.7												
Cis-1,2-Dichloroethene	16	**8,600**	D	**8,500**	D	**20,900**	D	**438**	D	**2,830**	D	**855**	D
Tetrachloroethene	5	50	U	50	U	100	U	2.5	U	25	U	5	U
Trans-1,2-Dichloroethene	100	82	JD	**101**	D	**189**	JD	4.08	JD	27.9	JD	6.76	JD
Trichloroethene	0.54	50	U	50	U	**86.4**	JD	**111**	D	**1,040**	D	**856**	D
Vinyl Chloride	0.029	**2,070**	D	**2,050**	D	**3,400**	D	**98.2**	D	**280**	D	**54.2**	D

Table 3-14. COCs in Groundwater Monitoring Wells (µg/L) (continued)

Location Name		MW1-51		MW1-52		MW1-53				MW1-54		MW1-55	
Sample Name		MW1-51-171024		MW1-52-171024		FD-171026-01		MW1-53-171026		MW1-54-171024		MW1-55-171024	
	Sample type	N		N		FD		P		N		N	
Analyte	**PAL (µg/L)**	**Result**		**Result**		**Result**		**Result**		**Result**		**Result**	
1,1,1-Trichloroethane	200	0.5	U	1	U	5	U	5	U	0.5	U	2.5	U
1,1-Dichloroethane	7.7	0.357	J	1	U	5	U	5	U	0.5	U	2.5	U
1,1-Dichloroethene	7	0.5	U	0.671	JD	5	U	5	U	0.5	U	1.62	JD
1,2-Dichloroethane	0.48	0.5	U	1	U	5	U	5	U	0.5	U	2.5	U
Chloroethane	7.7												
Cis-1,2-Dichloroethene	16	**23.8**		**156**	D	**803**	D	**773**	D	1.76		**492**	D
Tetrachloroethene	5	0.5	U	1	U	5	U	5	U	0.5	U	2.5	U
Trans-1,2-Dichloroethene	100	0.5	U	0.64	JD	31.1	D	29.4	D	0.5	U	5.46	D
Trichloroethene	0.54	0.5	U	**4.37**	D	**220**	D	**216**	D	**2.86**		**357**	D
Vinyl Chloride	0.029	**25.3**		**45.2**	D	**192**	D	**189**	D	**0.464**	J	**75.2**	D

Location Name		MW1-56				MW1-57					
Sample Name		MW1-56-12.0-171025		MW1-56-24.0-171025		MW1-57-10.0-171025		MW1-57-16.0-171025		MW1-57-34.0-171025^{a}	
	Sample type	N		N		N		N		N	
Analyte	**PAL (µg/L)**	**Result**		**Result**		**Result**		**Result**		**Result**	
1,1,1-Trichloroethane	200	1,000	U	1,250	U	1,250	U	1,000	U	25	U
1,1-Dichloroethane	7.7	1,000	U	1,250	U	1,250	U	1,000	U	25	U
1,1-Dichloroethene	7	1,000	U	1,250	U	1,250	U	1,000	U	25	U
1,2-Dichloroethane	0.48	1,000	U	1,250	U	1,250	U	1,000	U	25	U
Chloroethane	7.7										
Cis-1,2-Dichloroethene	16	**31,000**	D	**55,200**	D	**94,300**	D	**58,800**	D	**2,470**	D
Tetrachloroethene	5	1,000	U	1,250	U	1,250	U	1,000	U	25	U
Trans-1,2-Dichloroethene	100	1,000	U	1,250	U	**938**	JD	**661**	JD	49.5	JD
Trichloroethene	0.54	**122,000**	D	**332,000**	D	**361,000**	D	**218,000**	D	**9,490**	D
Vinyl Chloride	0.029	1,000	U	1,250	U	**4,810**	D	1,000	U	**406**	D

Table 3-14. COCs in Groundwater Monitoring Wells (µg/L) (continued)

Location Name		MW1-58						MW1-60	
Sample Name		MW1-58-9.0-171115		MW1-58-19.0-171115		MW1-58-35.0-171115		MW1-60-171026	
	Sample type	N		N		N		N	
Analyte	**PAL (µg/L)**	**Result**		**Result**		**Result**		**Result**	
1,1,1-Trichloroethane	200	100	U	5	U	1	U	0.5	U
1,1-Dichloroethane	7.7	100	U	5	U	1	U	0.5	U
1,1-Dichloroethene	7	100	U	5	U	1	U	0.5	U
1,2-Dichloroethane	0.48	100	U	5	U	1	U	0.5	U
Chloroethane	7.7								
Cis-1,2-Dichloroethene	16	**23,600**	D	**1,110**	D	**79.2**	D	0.5	U
Tetrachloroethene	5	100	U	5	U	1	U	0.5	U
Trans-1,2-Dichloroethene	100	**245**	D	6.85	JD	1	U	0.5	U
Trichloroethene	0.54	**66.6**	JD	**27.6**	D	**8.53**	D	**15.8**	
Vinyl Chloride	0.029	**9,570**	D	**106**	D	**9.64**	D	0.5	U

Notes:

[a] – The sample ID incorrectly indicates the depth of this sample as 34 feet bgs. The actual depth was 31 feet bgs.

Samples analyzed using EPA Method 8260C

FD - Field Duplicate

P – Parent sample of field duplicate

N – Sample is not part of a field duplicate pair

PAL - Project Action Limit

U - The analyte was not detected at or above the stated limit. (sometimes validators will elevate the limit due to the "B" qualifier using the 5x/10x rule so this definition is different than the lab description).

D - The reported value is from a dilution.

JD - The reported value is an estimated concentration. / The reported value is from a dilution.

U R - The reported value is unusable, rejected. Analyte may or may not be present.

J - The reported value is an estimated concentration.

U M - The analyte was not detected at or above the stated limit. (sometimes validators will elevate the limit due to the "B" qualifier using the 5x/10x rule so this definition is different than the lab description). / A matrix effect was present.

Underlined values represent analytes not detected at or above the stated limit, which exceeds the PAL.

Bolded values indicate that the reported concentration exceeds the PAL.

Table 3-15. Groundwater Monitoring Well Results for PFAS Compounds (ng/L)

Location Name		MW1-43	MW1-46	MW1-46	MW1-47	MW1-48	MW1-50
Sample Name		MW1-43-171023	MW1-46-171023	FD-171023-01	MW1-47-171023	MW1-48-171024	MW1-50-171024
Sample Type		N	P	FD	N	N	N
Analyte	**PAL**	Result	Result	Result	Result	Result	Result
Perfluorooctane sulfonate (PFOS)	70	3.68 UJ	1.65 UJ	1.74 UJ	5.3 UJ	10.47 J	0.36 UJ
N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	NE	1.69 UJ	0.74 UJ	0.72 UJ	1.72 UJ	2.08 UJ	0.71 UJ
N-methylperfluorooctane sulfonamidoacetic acid (NMeFOSAA)	NE	1.64 UJ	1.85 UJ	1.81 UJ	1.08 UJ	0.42 J	1.79 UJ
Perfluorobutanesulfonic acid (PFBS)	380,000	0.37 UJ	0.37 UJ	0.36 UJ	0.36 UJ	0.36 UJ	0.36 UJ
Perfluorodecanoic acid (PFDA)	NE	1.1 UJ	0.37 UJ	0.36 UJ	1.03 UJ	0.69 UJ	0.36 UJ
Perfluoroheptanoic acid (PFHpA)	NE	1.8 UJ	0.97 UJ	0.99 UJ	4.37 J	3 J	0.36 UJ
Perfluorohexanesulfonic acid (PFHxS)	NE	3.18 UJ	1.2 UJ	1.22 UJ	4.49 UJ	3.47 UJ	0.36 UJ
Perfluorononanoic acid (PFNA)	NE	1.39 UJ	0.74 UJ	0.72 UJ	1.57 UJ	1.12 UJ	0.71 UJ
Perfluorooctanoic acid (PFOA)	70	6.58 UJ	4.2 UJ	3.78 UJ	13.6 J	14.56 J	1.58 UJ
Perfluorotetradecanoic acid (PFTeDA)	NE	4.24 UJ	1.86 UJ	1.08 UJ	4 UJ	0.71 UJ	0.71 UJ
Perfluorotridecanoic acid (PFTrDA)	NE	2.11 UJ	0.37 UJ	0.59 UJ	1.98 UJ	0.36 UJ	0.36 UJ
Perfluoroundecanoic acid (PFUnA)	NE	1.28 UJ	0.74 UJ	0.72 UJ	1.36 UJ	0.71 UJ	0.71 UJ
Perfluorododecanoic acid (PFDoA)	NE	2.14 UJ	0.37 UJ	0.36 UJ	2.08 UJ	0.36 UJ	0..36 UJ
Perfluorohexanoic acid (PFHxA)	NE	2.19 UJ	1.71 UJ	1.82 UJ	6.39 J	3.99 J	0.36 UJ

Table 3-15. Groundwater Monitoring Well Results for PFAS Compounds (ng/L) (continued)

Location Name		MW1-52	MW1-56	MW1-57	MW1-58	MW1-58	MW1-60
Sample Name		MW1-52-171024	MW1-56-12.0-171025	MW1-57-10.0-171025	MW1-58-9.0-171115	FD-171115-02	MW1-60-171026
Sample Type		N	N	N	P	FD	N
Analyte	**PAL**	Result	Result	Result	Result	Result	Result
Perfluorooctane sulfonate (PFOS)	70	0.62 UJ	2.03 J	8.42	1.95 J	1.71 J	0.36 UJ
N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	NE	0.71 UJ	0.63 J	0.71 U	0.44 U	0.45 U	0.71 UJ
N-methylperfluorooctane sulfonamidoacetic acid (NMeFOSAA)	NE	1.79 UJ	0.72 J	1.79 UJ	1.11 U	1.13 U	1.79 UJ
Perfluorobutanesulfonic acid (PFBS)	380,000	0.36 UJ	0.38 U	0.36 U	0.22 U	0.23 U	0.36 U
Perfluorodecanoic acid (PFDA)	NE	0.36 UJ	0.94 J	0.49 J	0.44 J	0.39 J	0.36 U
Perfluoroheptanoic acid (PFHpA)	NE	0.36 UJ	0.38 U	1.54 J	3.29 J	2.36 J	0.36 U
Perfluorohexanesulfonic acid (PFHxS)	NE	0.36 UJ	4.4 J	8.97	0.22 U	0.23 U	0.36 U
Perfluorononanoic acid (PFNA)	NE	0.71 UJ	1.93 J	0.38 J	0.63 J	0.52 J	0.71 U
Perfluorooctanoic acid (PFOA)	70	1.74 UJ	11.26	6.59 J	6.27 U	6.27 U	3.29 J
Perfluorotetradecanoic acid (PFTeDA)	NE	0.71 UJ	2.56 J	0.36 J	0.44 U	0.55 U	0.71 UJ
Perfluorotridecanoic acid (PFTrDA)	NE	0.36 UJ	1.49 J	0.22 J	0.22 U	0.34 J	0.36 UJ
Perfluoroundecanoic acid (PFUnA)	NE	0.71 UJ	0.69 J	0.71 U	0.44 U	0.45 U	0.71 UJ
Perfluorododecanoic acid (PFDoA)	NE	0.36 UJ	1.03 J	0.36 U	0.22 U	0.12 J	0.36 U
Perfluorohexanoic acid (PFHxA)	NE	0.36 UJ	0.38 UJ	1.8 J	3.5 J	1.57 J	0.36 UJ

Notes:
PFAS compounds analyzed by EPA Method 537-MOD.
Bold text indicates that the result or the LOD exceeds the PAL.
FD - Field Duplicate
P – Parent sample of field duplicate.
N – Sample is not part of a field duplicate pair
J - The reported value is an estimated concentration.
NE - Not established.
PAL - Project action limit as established in the sampling and analysis plan.
U - The analyte was not detected at or above the stated limit. (sometimes validators will elevate the limit due to the "B" qualifier using the 5x/10x rule so this definition is different than the lab description).

Table 3-15. Groundwater Monitoring Well Results for PFAS Compounds (ng/L) (continued)

UJ - The analyte was not detected at the stated sample quantitation limit, which is an estimated value.
ng/L - nanograms per liter

Table 3-16. Groundwater Monitoring Well Results for 1,4-Dioxane (µg/L)

Location Name	Sample Name	Sample Type	PAL	1,4-Dioxane (µg/L)
MW1-43	MW1-43-171023	N	0.44	0.236 U
MW1-46	MW1-46-171023	P	0.44	**4.04**
MW1-46	FD-171023-01	FD	0.44	**3.32**
MW1-47	MW1-47-171023	N	0.44	**2.1**
MW1-48	MW1-48-171024	N	0.44	**4.94**
MW1-50	MW1-50-171024	N	0.44	0.254 U
MW1-52	MW1-52-171024	N	0.44	0.251 U
MW1-56	MW1-56-12.0-171025	N	0.44	0.234 U
MW1-57	MW1-57-10.0-171025	N	0.44	0.246 U
MW1-58	MW1-58-9.0-171115	N	0.44	1.17 U
MW1-60	MW1-60-171026	N	0.44	0.239 U

Samples analyzed using EPA Method 8270D.
FD - Field Duplicate
P – Parent sample of field duplicate
N – Sample is not part of a field duplicate pair
AL - Project Action Limit
U - The analyte was not detected at or above the stated limit. (sometimes validators will elevate the limit due to the "B" qualifier using the 5x/10x rule so this definition is different than the lab description).
Underlined values represent analytes not detected at or above the stated limit, which exceeds the PAL.

Bolded values indicate that the reported concentration exceeds the PAL. µg/L – micrograms per liter

Table 3-17. Laboratory MNA Parameters (mg/L)

Location Name	IW1-S	MW1-42	MW1-43	MW1-44	MW1-45	MW1-46		MW1-47
Sample Name	IW1-S-171026	MW1-42-171023	MW1-43-171023	MW1-44-171023	MW1-45-171023	FD-171023-01	MW1-46-171023	MW1-47-171023
Sample Type	N	N	N	N	N	FD	P	N
Analyte	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Nitrate	0.05 J	0.1 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U
Nitrite	0.1 U	0.1 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U
Sulfate	22.8	1 U	20.3 D	14.4 D	26.3 D	57 D	52.5 D	1.97 JD
Chemical Oxygen Demand	20.9 J	273	38.6 J	45.2 J	45.2 J	36.4 J	40.8 J	47.4 J
Biochemical Oxygen Demand	3 U	3 UJ	3 UJ	6 UJ	6 UJ	4 UJ	4 UJ	4 UJ

Location Name	MW1-48	MW1-49	MW1-50	MW1-51	MW1-52	MW1-53		MW1-54
Sample Name	MW1-48-171024	MW1-49-171024	MW1-50-171024	MW1-51-171024	MW1-52-171024	FD-171026-01	MW1-53-171026	MW1-54-171024
Sample Type	N	N	N	N	N	FD	P	N
Analyte	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Nitrate	0.2 U	0.1 U	0.08 U	0.1 U	0.1 U	0.1 U	0.1 U	0.577
Nitrite	0.2 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.105 J
Sulfate	2 U	16.6	9.47	1.76 J	0.947 J	1 U	1 U	5.78
Chemical Oxygen Demand	78.3	40 U	40 U	40 U	40 U	34.2 J	40 U	40 U
Biochemical Oxygen Demand	6 U	3 U	3 U	3 U	3 UJ	4.4	5.6	3 UJ

Table 3-17. Laboratory MNA Parameters (mg/L) (continued)

Location Name	MW1-55		MW1-56		MW1-56		MW1-57		MW1-57		MW1-57	
Sample Name	MW1-55-171024		MW1-56-12.0-171025		MW1-56-24.0-171025		MW1-57-10.0-171025		MW1-57-16.0-171025		MW1-57-34.0-171025[a]	
Sample Type	N		N		N		N		N		N	
Analyte	**Result**		**Result**		**Result**		**Result**		**Result**		**Result**	
Nitrate	0.1	U	0.5	U	0.093	J	0.549		0.686		0.1	U
Nitrite	0.1	U	0.5	U	0.1	U	0.1	U	0.064	J	0.1	U
Sulfate	0.736	J	245	D	91		6.56		4.86		0.667	J
Chemical Oxygen Demand	40	U	257		211		180		127		20.9	J
Biochemical Oxygen Demand	3	UJ	40		10		15.5		10		3	U

Location Name	MW1-58		MW1-58		MW1-58		MW1-60	
Sample Name	MW1-58-19.0-171115		MW1-58-35.0-171115		MW1-58-9.0-171115		MW1-60-171026	
Sample Type	N		N		N		N	
Analyte	**Result**		**Result**		**Result**		**Result**	
Nitrate	0.1	U	0.1	U	0.2	U	0.1	U
Nitrite	0.1	U	0.1	U	0.2	U	0.1	U
Sulfate	1.9	J	1.25	J	36.2	J	1	U
Chemical Oxygen Demand	40	U	40	U	91.6		20.9	J
Biochemical Oxygen Demand	24	UJ	12	UJ	24	UJ	3.2	

Table 3-17. Laboratory MNA Parameters (mg/L) (continued)

Notes:

[a] – The sample ID incorrectly indicates the depth of this sample as 34 feet bgs. The actual depth was 31 feet bgs.

Samples analyzed for nitrate, nitrite and sulfate used EPA Method 300.

Samples analyzed for COD used EPA Method 410.4 Revision 2.0.

Samples analyzed for BOD used EPA Method 5210B.

FD - Field Duplicate

P – Parent sample of field duplicate

N – Sample is not part of a field duplicate pair

PAL - Project Action Limit

U - The analyte was not detected at or above the stated limit. (sometimes validators will elevate the limit due to the "B" qualifier using the 5x/10x rule so this definition is different than the lab description).

UJ - The analyte was not detected at or above the sample quantitation limit, which is an estimated value.

J - The reported value is an estimated concentration.

D - The reported value is from a dilution.

JD - The reported value is an estimated concentration. / The reported value is from a dilution.

Table 3-18. Field MNA Parameters

Location Name		IW1-S	MW1-42	MW1-43	MW1-44	MW1-45	MW1-46	MW1-47	MW1-48
Sample Name		IW1-S	MW1-42	MW1-43	MW1-44	MW1-45	MW1-46	MW1-47	MW1-48
Begin Depth (ft)		0	15	15	18	15	24	15	15
End Depth (ft)		16.5	25	25	28	25	34	25	25
Analyte	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Dissolved oxygen	mg/L	0.35	0.21	0.04	0.23	2.89	0.12	0.23	3.95
Fe^{2}	mg/L	0.06	0.4	0.67	0.03	0.02	2.4	1.91	1.07
Oxidation Reduction Potential	mV	55	-130	-158	-85	9	-106	-47	-61
pH	pH	7.23	7.75	7.75	8.59	8.8	7.05	6.82	6.78
Conductivity	mS/cm	0.309	0.637	1.41	1.24	1.4	1.41	1.09	0.934
Sulfite	mg/L	1.2	0.4	1.2	0	0.4	0.6	0.8	0.4
Temperature	Deg_C	12.88	16.85	16.38	15.65	15.54	19.55	19.05	16.92
Turbidity	NTU	2.8	4.5	1.2	0	0.9	14.3	12.7	5.4

Location Name		MW1-49	MW1-50	MW1-51	MW1-52	MW1-53	MW1-54	MW1-55	MW1-56-12.0
Sample Name		MW1-49	MW1-50	MW1-51	MW1-52	MW1-53	MW1-54	MW1-55	MW1-56-12.0
Begin Depth (ft)		5	5	10	7	5	29	29	8
End Depth (ft)		15	15	20	17	15	39	39	12
Analyte	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Dissolved oxygen	mg/L	0.43	0.28	0.89	0.23	0.22	0.66	0	0.26
Fe^{2}	mg/L	0.19	0.03	0.03	NM	0.03	0.03	0.03	NM
Oxidation Reduction Potential	mV	-57	-13	-69	-26	25	72	-10	-153
pH	pH	7.85	7.91	8.78	8.76	8.36	7.48	7.1	7.23
Conductivity	mS/cm	0.276	0.624	0.261	0.323	0.305	0.225	0.239	1.18
Sulfite	mg/L	0.4	0.4	0.4	0.4	0.8	0.4	0.4	1.6
Temperature	Deg_C	13.36	14.22	12.76	13.83	12.31	13.15	12.12	14.28
Turbidity	NTU	20.8	9.6	4.1	11.3	6.3	33.2	10.6	7.8

Table 3-18. Field MNA Parameters (continued)

Location Name		MW1-56-24.0	MW1-57-10.0	MW1-57-16.0	MW1-57-34.0	MW1-58-19.0	MW1-58-35.0	MW1-58-9.0	MW1-60
Sample Name		MW1-56-24.0	MW1-57-10.0	MW1-57-16.0	MW1-57-34.0[a]	MW1-58-19.0	MW1-58-35.0	MW1-58-9.0	MW1-60
Begin Depth (ft)		20	6	12	30	15	31	5	15
End Depth (ft)		24	10	16	34	19	35	9	25
Analyte	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Dissolved oxygen	mg/L	0.24	0.12	0.04	0.05	0.07	0	0.56	0.2
Ferrous Iron	mg/L	0.06	0.7	NM	0.7	2.18	0.77	1.53	0.78
Oxidation Reduction Potential	mV	-120	-276	-205	-124	-117	-237	-128	-67
pH	pH	7.27	6.79	6.78	7.06	7.02	8.16	6.98	7.61
Conductivity	mS/cm	0.883	0.388	0.291	0.29	0.356	0.396	0.923	0.339
Sulfite	mg/L	1.6	0.4	1.2	0.4	0.4	0.4	0.4	0.4
Temperature	Deg_C	12.22	11.75	14.15	14.07	11.79	10.89	10.76	12.84
Turbidity	NTU	30.8	20	0	0	11.3	25.1	37.9	4.1

[a] – The sample ID incorrectly indicates the depth of this sample as 34 feet bgs. The actual depth was 31 feet bgs.

Table 3-19. Microbial Data for Groundwater Monitoring Wells (cells/mL)

	Location Name	**MW1-46**	**MW1-47**	**MW1-48**	**MW1-50**	**MW1-52**
	Sample Name	**MW1-46-171023**	**MW1-47-171023**	**MW1-48-171024**	**MW1-50-171024**	**MW1-52-171024**
	Sample Type	**N**	**N**	**N**	**N**	**N**
Analyte	**PAL**	**Result**	**Result**	**Result**	**Result**	**Result**
1,1 DCA Reductase (DCA)	NA	5.00E+00 <	5.00E+00 <	5.00E+00 <	4.40E+00 <	5.00E+00 <
1,2 DCA Reductase (DCAR)	NA	5.00E+00 <	5.00E+00 <	5.00E+00 <	4.40E+00 <	5.00E+00 <
BAV1 Vinyl Chloride Reductase	NA	2.98E+02	8.86E+02	8.39E+02	4.00E-01 J	2.32E+01
Chloroform Reductase (CFR)	NA	5.00E+00 <	5.00E+00 <	5.00E+00 <	4.40E+00 <	5.00E+00 <
Dehalobacter	NA	5.45E+03	1.06E+04	4.19E+04	2.15E+03	1.81E+03
Dehalobacter DCM (DCM)	NA	5.00E+00 <	5.00E+00 <	5.00E+00 <	4.40E+00 <	5.56E+01
Dehalobium Chlorocoercia (DECO)	NA	2.89E+03	6.02E+03	7.34E+03	1.19E+02	1.14E+03
Dehalococcoides (DHC)	NA	4.98E+02	1.16E+03	1.65E+03	9.00E-01	9.72E+01
Dehalogenimonas spp. (DHG)	NA	2.87E+03	8.72E+03	1.23E+04	1.39E+02	1.63E+03
Desulfitobacterium	NA	5.87E+03	1.54E+04	2.90E+04	2.61E+03	6.46E+02
Desulfuromonas	NA	5.00E+00 <	5.00E+00 <	4.64E+02	1.25E+02	8.90E+02
Dichloromethane Dehalogenase (DCMA)	NA	5.00E+00 <	5.00E+00 <	5.00E+00 <	4.40E+00 <	5.00E+00 <
Epoxyalkane Transferase (EtnE)	NA	5.00E+00 <	5.00E+00 <	5.00E+00 <	4.40E+00 <	5.00E+00 <
Ethene Monooxygenase (EtnC)	NA	5.00E+00 <	5.00E+00 <	5.00E+00 <	4.40E+00 <	5.00E+00 <
Eubacteria	NA	3.59E+05	7.92E+05	7.31E+06	5.25E+04	4.27E+05
Methanogens	NA	1.85E+02	4.66E+03	1.44E+04	1.80E+00 J	4.74E+02
Particulate Methane Monooxygenase (PMMO)	NA	5.00E+00 <	5.00E+00 <	5.00E+00 <	4.40E+00 <	5.00E+00 <
Phenol HydroxylaseE (PHE)	NA	1.50E+03	3.32E+02	4.18E+02	2.80E+00 J	1.69E+03
Soluble Methane Monoxygenase	NA	5.00E+00 <	5.00E+00 <	5.00E+00 <	4.40E+00 <	5.00E+00 <
Sulfate Reducing Bacteria (APS)	NA	2.19E+04	2.73E+04	9.48E+04	2.18E+03	2.57E+03
Toluene Dioxygenase (TOD)	NA	9.90E+02	5.00E+00 <	5.00E+00 <	1.15E+02	3.73E+02
Toluene Monooxygenase (RMO)	NA	7.49E+03	3.88E+03	6.49E+02	4.40E+00 <	2.32E+02

Table 3-19. Microbial Data for Groundwater Monitoring Wells (cells/mL) (continued)

	Location Name	**MW1-46**	**MW1-47**	**MW1-48**	**MW1-50**	**MW1-52**
	Sample Name	**MW1-46-171023**	**MW1-47-171023**	**MW1-48-171024**	**MW1-50-171024**	**MW1-52-171024**
	Sample Type	**N**	**N**	**N**	**N**	**N**
Analyte	**PAL**	**Result**	**Result**	**Result**	**Result**	**Result**
Toluene Monooxygenase 2 (RDEG)	NA	1.80E+01	1.05E+03	4.55E+02	4.40E+00 <	4.25E+02
Trichlorobenzene Dioxygenase (TCBO)	NA	2.97E+01	5.00E+00 <	5.00E+00 <	4.40E+00 <	5.00E+00 <
Trichloroethene Reductase	NA	5.00E-01 <	5.00E-01 <	5.00E-01 <	4.00E-01 <	1.40E+00
Vinyl Chloride Reductase	NA	3.31E+01	7.27E+01	2.15E+03	1.30E+00	2.96E+02

Table 3-19. Microbial Data for Groundwater Monitoring Wells (cells/mL) (continued)

Location Name		MW1-56		MW1-56		MW1-57		MW1-57		MW1-57	
Sample Name		**MW1-56-12.0-171025**		**MW1-56-24.0-171025**		**MW1-57-10.0-171025**		**MW1-57-16.0-171025**		**MW1-57-34.0-171025**[a]	
Sample Type		**N**		**N**		**N**		**N**		**N**	
Analyte	**PAL**	**Result**		**Result**		**Result**		**Result**		**Result**	
1,1 DCA Reductase (DCA)	NA	5.00E+00	<	5.00E+00	<	8.30E+00	<	7.70E+00	<	5.00E+00	<
1,2 DCA Reductase (DCAR)	NA	5.00E+00	<	5.00E+00	<	8.30E+00	<	7.70E+00	<	5.00E+00	<
BAV1 Vinyl Chloride Reductase	NA	5.00E-01	<	5.00E-01	<	8.00E-01	<	7.02E+01		2.51E+03	
Chloroform Reductase (CFR)	NA	5.00E+00	<	5.00E+00	<	8.30E+00	<	7.70E+00	<	5.00E+00	<
Dehalobacter	NA	5.00E+00	<	5.00E+00	<	8.30E+00	<	5.59E+03		1.31E+03	
Dehalobacter DCM (DCM)	NA	5.00E+00	<	5.00E+00	<	8.30E+00	<	7.70E+00	<	5.00E+00	<
Dehalobium Chlorocoercia (DECO)	NA	5.00E+00	<	5.00E+00	<	8.30E+00	<	2.52E+03		7.29E+03	
Dehalococcoides (DHC)	NA	5.00E-01	<	5.00E-01	<	8.00E-01	<	1.14E+02		5.12E+03	
Dehalogenimonas spp. (DHG)	NA	5.00E+00	<	5.00E+00	<	8.30E+00	<	7.70E+00	<	5.06E+02	
Desulfitobacterium	NA	5.00E+00	<	5.00E+00	<	8.30E+00	<	7.51E+03		8.60E+03	
Desulfuromonas	NA	5.00E+00	<	5.00E+00	<	8.30E+00	<	1.74E+02		5.48E+02	
Dichloromethane Dehalogenase (DCMA)	NA	5.00E+00	<	5.00E+00	<	8.30E+00	<	7.70E+00	<	5.00E+00	<
Epoxyalkane Transferase (EtnE)	NA	5.00E+00	<	5.00E+00	<	8.30E+00	<	7.70E+00	<	5.00E+00	<
Ethene Monooxygenase (EtnC)	NA	5.00E+00	<	5.00E+00	<	8.30E+00	<	7.70E+00	<	5.00E+00	<
Eubacteria	NA	3.58E+02		7.64E+01		2.39E+02		4.64E+05		1.77E+06	
Methanogens	NA	5.00E-01	J	9.00E-01	J	1.50E+00	J	2.10E+04		1.07E+04	
Particulate Methane Monooxygenase (PMMO)	NA	5.00E+00	<	5.00E+00	<	8.30E+00	<	7.70E+00	<	5.00E+00	<
Phenol HydroxylaseE (PHE)	NA	5.00E+00	<	5.00E+00	<	8.30E+00	<	1.68E+03		1.06E+03	
Soluble Methane Monoxygenase	NA	8.80E+00		5.00E+00	<	8.30E+00	<	7.70E+00	<	5.00E+00	<
Sulfate Reducing Bacteria (APS)	NA	5.00E+00	<	5.00E+00	<	8.30E+00	<	3.74E+03		1.64E+04	
Toluene Dioxygenase (TOD)	NA	5.00E+00	<	5.00E+00	<	3.44E+01		7.70E+00	<	9.90E+02	
Toluene Monooxygenase (RMO)	NA	5.00E+00	<	5.00E+00	<	8.30E+00	<	3.22E+01		1.17E+02	

Table 3-19. Microbial Data for Groundwater Monitoring Wells (cells/mL) (continued)

Location Name		**MW1-56**	**MW1-56**	**MW1-57**	**MW1-57**	**MW1-57**
Sample Name		**MW1-56-12.0-171025**	**MW1-56-24.0-171025**	**MW1-57-10.0-171025**	**MW1-57-16.0-171025**	**MW1-57-34.0-171025**[a]
Sample Type		**N**	**N**	**N**	**N**	**N**
Analyte	**PAL**	**Result**	**Result**	**Result**	**Result**	**Result**
Toluene Monooxygenase 2 (RDEG)	NA	5.00E+00 <	5.00E+00 <	8.30E+00 <	3.82E+02	1.48E+03
Trichlorobenzene Dioxygenase (TCBO)	NA	5.00E+00 <	5.00E+00 <	8.30E+00 <	5.36E+01	8.17E+01
Trichloroethene Reductase	NA	5.00E-01 <	5.00E-01 <	8.00E-01 <	8.00E-01 <	5.00E-01 <
Vinyl Chloride Reductase	NA	5.00E-01 <	5.00E-01 <	8.00E-01 <	4.53E+01	5.73E+03

Notes:
[a] – The sample ID incorrectly indicates the depth of this sample as 34 feet bgs. The actual depth was 31 feet bgs.
Samples analyzed using EPA Method.
N – Sample is not part of the field duplicate pair
PAL - Project Action Limit
< - Not detected above the associated LOD shown
J - The reported value is an estimated concentration.

Table 3-20. Grab Groundwater vs Monitoring Well Contaminants of Concern (µg/L)

Well/Boring Location	**Screen Interval/Depth (ft bgs)**	**TCE**		**cis-1,2-DCE**		**VC**	
		PAL = 0.54		PAL = 16		PAL = 0.029	
MW1-42	20.0	**1.18**	JD	**53.6**	D	**46.9**	D
CL-B02	17.5	**22**	J	**3,900**	J	**270**	J
MW1-43	20.0	5	U	**982**	D	**452**	D
CL-B02	17.5	**22**	J	**3,900**	J	**270**	J
MW1-44	23.0	25	U	**5,250**	D	**723**	D
CL-B35	18.5	**1.32**	U	**4,520**	D	**1,040**	D
CL-B07	26.5	0.18	J	**250**	J	**120**	J
MW1-45	20.0	1	U	**187**	D	**83.7**	D
CL-B25	26.5	0.18	J	**590**	J	**250**	R
MW1-46 (FD)	29.0	50	U	**8,600**	D	**2,070**	D
MW1-46	29.0	50	U	**8,500**	D	**2,050**	D
CL-B20	30.0	**1.7**		**14,000**	J	**3,800**	J
MW1-47	20.0	**86.4**	JD	**20,900**	D	**3,400**	D
CL-B18B	18.0	**1,100**	J	**22,000**		**2,200**	J
MW1-48	23.0	**111**	D	**438**	D	**98.2**	D
CL-B14B	19.5	**610**	J	**50,000**	J	**22,000**	J
CL-B14B (FD)	19.5	**610**	J	**46,000**	J	**20,000**	J
MW1-49	10.0	**1,040**	D	**2,830**	D	**280**	D
SP-B42	7.5	**4,670**	J	**4,270**	J	**498**	J
MW1-50	10.0	**856**	D	**855**	D	**54.2**	D
SP-B49	7.5	**63,000**	J	**77,000**	J	**5,600**	B
MW1-51	15.0	0.5	U	**23.8**		**25.3**	
SP-B67	12.0	250	U	**2,200**		**9,800**	J
MW1-52	12.0	**4.37**	D	**156**	D	**45.2**	D
SP-B40	8.5	**195**	J	**456**	J	**571**	J

Table 3-20. Grab Groundwater vs Monitoring Well Contaminants of Concern (µg/L) (continued)

Well/Boring Location	**Screen Interval/Depth (ft)**	**TCE**		**cis-1,2-DCE**		**VC**	
		0.54		16		0.029	
MW1-53 (FD)	10.0	**220**	D	**803**	D	**192**	D
MW1-53	10.0	**216**	D	**773**	D	**189**	D
SP-B66	7.5	250	U M	**22,000**		**14,000**	J
MW1-55	34.0	**357**	D	**492**	D	**75.2**	D
SP-B58	37.0	0.31	J	**8,500**	J	**1,100**	J
MW1-56	22.0	**332,000**	D	**55,200**	D	1,250	U
SP-B53	20.5	**540,000**	J	**63,000**	J	15	U M
MW1-57	8.0	**361,000**	D	**94,300**	D	**4,810**	D
SP-B01B	7.5	**260,000**		**350,000**		**32,000**	
SP-B01B (FD)	7.5	**320,000**		**100,000**		**4,300**	J M
MW1-57	14.0	**218,000**	D	**58,800**	D	1,000	U
SP-B01B	12.5	**310,000**		**120,000**		**4,800**	J
SP-B01	11.0	**150,000**	H	**150,000**	J	**7,900**	J
MW1-58	7.0	**66.6**	JD	**23,600**	D	**9,570**	D
SP-B54	5.5	**250**	J	**59,000**	J	**14,000**	B
MW1-58	33.0	**8.53**	D	**79.2**	D	**9.64**	D
SP-B54	33.0	**270**	J	**7,700**	H B	**440**	B

Table 3-20. Grab Groundwater vs Monitoring Well Contaminants of Concern (μg/L) (continued)

Notes:

Samples analyzed using EPA Method 8260C.

Ft bgs – feet below ground surface. For well screens, the depth shown is the depth of the approximate center of the screened interval.

FD - Field Duplicate

PAL - Project Action Limit

U - The analyte was not detected at or above the stated limit. (sometimes validators will elevate the limit due to the "B" qualifier using the 5x/10x rule so this definition is different than the lab description).

D - The reported value is from a dilution.

JD - The reported value is an estimated concentration. / The reported value is from a dilution.

J - The reported value is an estimated concentration.

B - The analyte was found in an associated blank, as well as in the sample.

H - Sample was prepped or analyzed beyond the specified holding time.

R - The reported value is unusable, rejected. Analyte may or may not be present.

U M - The analyte was not detected at or above the stated limit. (sometimes validators will elevate the limit due to the "B" qualifier using the 5x/10x rule so this definition is different than the lab description). / A matrix effect was present.

Underlined values represent analytes not detected at or above the stated limit, which exceeds the PAL.

Bolded values indicate that the reported concentration exceeds the PAL.

Table 3-21. Sediment PCB Congener Analysis by EPA Method 1668A (µg/kg)

Location Name		MA-09	MA-14		MA19	SP1-1	TF-21
Sample Name		SED02-10-170906	FD-170906-01	SED01-10-170906	SED04-10-170906	SED03-10-170906	SED05-10-170907
Sample Type		N	FD	P	N	N	N
Analyte	**PAL**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
PCB-001	NA	0.036 U	0.0078 U	0.0065 U	0.0068 U	0.0064 U	0.0091 U
PCB-002	NA	0.022 J	0.0024 J	0.002 J q	0.0019 J q	0.0017 J q	0.004 J q
PCB-003	NA	0.039 J	0.0045 J	0.0031 J q	0.0026 J q	0.0019 J q	0.0072 J
PCB-004	NA	0.42	0.063	0.066	0.035	0.029 q	0.041
PCB-005	NA	0.085 U	0.012 U	0.012 U	0.013 U	0.013 U	0.015 U
PCB-006	NA	0.25 q	0.084	0.091	0.027	0.031 q	0.056
PCB-007	NA	0.085 U	0.0029 J q	0.012 U	0.013 U	0.013 U	0.015 U
PCB-008	NA	0.4	0.14	0.12	0.044	0.052	0.13
PCB-009	NA	0.085 U	0.0047 J q	0.012 U	0.013 U	0.013 U	0.015 U
PCB-010	NA	0.085 U	0.012 U	0.012 U	0.013 U	0.013 U	0.015 U
PCB-011	NA	0.085 U	0.013 U	0.019 U	0.014 U	0.013 U	0.034 U
PCB-012	NA	0.056 J C q	0.012 C q	0.012 q C	0.0088 J C	0.0073 J C q	0.018 C
PCB-013	NA	0.056 J C12 q	0.012 C12 q	0.012 q C12	0.0088 J C12	0.0073 J C12 q	0.018 C12
PCB-014	NA	0.085 U	0.012 U	0.012 U	0.013 U	0.013 U	0.015 U
PCB-015	NA	0.4	0.09	0.088	0.051	0.053	0.089
PCB-016	NA	0.31	0.062	0.062	0.022	0.028	0.045
PCB-017	NA	0.54 B q	0.086 B	0.085 B	0.03 B	0.035 B	0.096 B
PCB-018	NA	1.6 C	0.21 C	0.21 C	0.089 C	0.089 C	0.17 C
PCB-019	NA	0.19	0.025	0.027	0.0085 J	0.0093 J	0.025
PCB-020	NA	1.8 C B	0.27 C B	0.25 C B	0.15 C B	0.15 C B	0.3 C B
PCB-021	NA	0.82 C B	0.084 C B	0.062 C B	0.034 C B	0.032 C B	0.11 C B
PCB-022	NA	0.32	0.057	0.048	0.025	0.026	0.043
PCB-023	NA	0.085 U	0.012 U	0.012 U	0.013 U	0.013 U	0.015 U

Table 3-21. Sediment PCB Congener Analysis (µg/kg) (continued)

Location Name		MA-09	MA-14		MA19	SP1-1	TF-21
Sample Name		SED02-10-170906	FD-170906-01	SED01-10-170906	SED04-10-170906	SED03-10-170906	SED05-10-170907
Sample Type		N	FD	P	N	N	N
Analyte	**PAL**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
PCB-024	NA	0.014 J	0.0026 J q	0.0027 J	0.013 U	0.001 J	0.015 U
PCB-025	NA	1.1	0.07	0.066	0.044	0.038	0.088
PCB-026	NA	3. C	0.13 C	0.13 C	0.1 C	0.08 C	0.14 C
PCB-027	NA	0.25	0.034 q	0.038	0.014 q	0.014 q	0.079
PCB-028	NA	1.8 B C20	0.27 B C20	0.25 C20 B	0.15 B C20	0.15 B C20	0.3 B C20
PCB-029	NA	3. C26	0.13 C26	0.13 C26	0.1 C26	0.08 C26	0.14 C26
PCB-030	NA	1.6 C18	0.21 C18	0.21 C18	0.089 C18	0.089 C18	0.17 C18
PCB-031	NA	1.7 B	0.18 B	0.15 B	0.095 B	0.094 B	0.16 B
PCB-032	NA	0.54 B	0.067 B	0.062 B	0.021 B	0.022 B	0.12 B
PCB-033	NA	0.82 B C21	0.084 B C21	0.062 C21 B	0.034 B C21	0.032 B C21	0.11 B C21
PCB-034	NA	0.085 U	0.012 U	0.012 U q	0.013 U	0.013 U	0.0025 J
PCB-035	NA	0.086	0.0036 J	0.0025 J q	0.013 U	0.0018 J	0.0056 J
PCB-036	NA	0.085 U	0.012 U	0.012 U	0.013 U	0.013 U	0.015 U
PCB-037	NA	0.41	0.052	0.042	0.031	0.03	0.057
PCB-038	NA	0.085 U	0.012 U	0.012 U	0.013 U	0.013 U	0.015 U
PCB-039	NA	0.024 J q	0.012 U	0.012 U	0.013 U	0.013 U	0.015 U
PCB-040	NA	4.7 C	0.15 C	0.14 C	0.087 C	0.078 C	0.37 C
PCB-041	NA	4.7 C40	0.15 C40	0.14 C40	0.087 C40	0.078 C40	0.37 C40
PCB-042	NA	2.1	0.07	0.068	0.028	0.033	0.1
PCB-043	NA	0.085 U C	0.0088 J C q	0.012 C	0.013 U C	0.0094 J C	0.015 U C
PCB-044	NA	15. C B	0.39 C B	0.35 C B	0.18 C B	0.18 C B	0.54 C B
PCB-045	NA	0.64 C	0.032 C	0.032 C	0.017 C	0.017 C	0.047 C
PCB-046	NA	0.085 U	0.016	0.016	0.0059 J	0.0079 J	0.02

Table 3-21. Sediment PCB Congener Analysis (µg/kg) (continued)

Location Name		MA-09		MA-14				MA19		SP1-1		TF-21	
Sample Name		SED02-10-170906		FD-170906-01		SED01-10-170906		SED04-10-170906		SED03-10-170906		SED05-10-170907	
Sample Type		N		FD		P		N		N		N	
Analyte	**PAL**	**Result**		**Result**		**Result**		**Result**		**Result**		**Result**	
PCB-047	NA	15.	B C44	0.39	B C44	0.35	C44 B	0.18	B C44	0.18	B C44	0.54	B C44
PCB-048	NA	0.76	B	0.032	B	0.03	B	0.015	B q	0.015	B q	0.048	B
PCB-049	NA	15.	C	0.35	C	0.34	C	0.19	C	0.19	C	0.66	C
PCB-050	NA	1.3	C	0.065	C	0.062	C	0.038	C	0.035	C	0.12	C
PCB-051	NA	0.64	C45	0.032	C45	0.032	C45	0.017	C45	0.017	C45	0.047	C45
PCB-052	NA	37.	B	0.9	B	0.8	B	0.45	B	0.45	B	1.3	B
PCB-053	NA	1.3	C50	0.065	C50	0.062	C50	0.038	C50	0.035	C50	0.12	C50
PCB-054	NA	0.085	U	0.012	U	0.012	U	0.013	U	0.013	U	0.0025	J B q
PCB-055	NA	0.2	q	0.0059	J q	0.0095	J q	0.0037	J q	0.0085	J	0.0069	J q
PCB-056	NA	2.1		0.077		0.065		0.031		0.036		0.097	
PCB-057	NA	0.085	U	0.012	U	0.012	U	0.013	U	0.013	U	0.015	U
PCB-058	NA	0.14		0.012	U	0.012	U	0.013	U	0.013	U	0.006	J q
PCB-059	NA	0.91	C B	0.047	C B	0.047	C B	0.018	C B	0.016	C B q	0.058	C B
PCB-060	NA	0.73		0.029		0.024		0.017		0.017		0.041	
PCB-061	NA	25.	C B	0.57	C B	0.49	C B	0.25	C B	0.27	C B	0.91	C B
PCB-062	NA	0.91	B C59	0.047	B C59	0.047	C59 B	0.018	B C59	0.016	B C59 q	0.058	B C59
PCB-063	NA	0.3	B	0.012	B	0.0098	J B	0.0044	J B q	0.0054	J B	0.017	B
PCB-064	NA	3.2	B	0.097	B	0.087	B	0.039	B	0.046	B	0.12	B
PCB-065	NA	15.	B C44	0.39	B C44	0.35	C44 B	0.18	B C44	0.18	B C44	0.54	B C44
PCB-066	NA	14.	B	0.35	B	0.29	B	0.18	B	0.19	B	0.57	B
PCB-067	NA	0.25		0.014		0.012		0.0051	J q	0.0066	J	0.017	
PCB-068	NA	0.42		0.0091	J	0.0074	U	0.0045	J	0.0053	J	0.017	
PCB-069	NA	15.	C49	0.35	C49	0.34	C49	0.19	C49	0.19	C49	0.66	C49

Table 3-21. Sediment PCB Congener Analysis (µg/kg) (continued)

	Location Name	MA-09		MA-14				MA19		SP1-1		TF-21	
	Sample Name	SED02-10-170906		FD-170906-01		SED01-10-170906		SED04-10-170906		SED03-10-170906		SED05-10-170907	
	Sample Type	N		FD		P		N		N		N	
Analyte	**PAL**	**Result**		**Result**		**Result**		**Result**		**Result**		**Result**	
PCB-070	NA	25.	C61 B	0.57	C61 B	0.49	C61 B	0.25	C61 B	0.27	C61 B	0.91	C61 B
PCB-071	NA	4.7	C40	0.15	C40	0.14	C40	0.087	C40	0.078	C40	0.37	C40
PCB-072	NA	0.73		0.014		0.012		0.0064	J	0.0081	J	0.026	
PCB-073	NA	0.085	U C43	0.0088	J C43 q	0.012	C43	0.013	U C43	0.0094	J C43	0.015	U C43
PCB-074	NA	25.	C61 B	0.57	C61 B	0.49	C61 B	0.25	C61 B	0.27	C61 B	0.91	C61 B
PCB-075	NA	0.91	B C59	0.047	B C59	0.047	C59 B	0.018	B C59	0.016	B C59 q	0.058	B C59
PCB-076	NA	25.	C61 B	0.57	C61 B	0.49	C61 B	0.25	C61 B	0.27	C61 B	0.91	C61 B
PCB-077	NE	2.2	B	0.046	B	0.038	B	0.021	B	0.023	B q	0.066	B
PCB-078	NA	0.085	U	0.012	U	0.012	U	0.013	U	0.013	U	0.015	U
PCB-079	NA	0.66		0.015	q	0.012		0.0036	J q	0.0056	J	0.017	
PCB-080	NA	0.085	U	0.012	U	0.012	U	0.013	U	0.013	U	0.0026	U
PCB-081	NE	0.046	J B q	0.012	U	0.012	U	0.013	U	0.013	U	0.015	U
PCB-082	NA	6.4	B	0.21	B	0.15	B	0.05	B	0.082	B	0.16	B
PCB-083	NA	45.	C B	1.4	C B	1.1	C B	0.49	C B	0.61	C B	1.6	C B
PCB-084	NA	15.		0.43		0.34		0.1		0.16		0.38	
PCB-085	NA	9.3	C	0.37	C	0.28	C	0.11	C	0.15	C	0.32	C
PCB-086	NA	37.	C B	1.3	C B	0.93	C B	0.32	C B	0.47	C B	0.99	C B
PCB-087	NA	37.	B C86	1.3	B C86	0.93	C86 B	0.32	B C86	0.47	B C86	0.99	B C86
PCB-088	NA	9.8	C	0.26	C	0.21	C	0.082	C	0.11	C	0.29	C
PCB-089	NA	0.71		0.012	U	0.012	U	0.013	U	0.013	U	0.014	J q
PCB-090	NA	60.	C B	2.	C B	1.5	C B	0.56	C B	0.79	C B	1.9	C B
PCB-091	NA	9.8	C88	0.26	C88	0.21	C88	0.082	C88	0.11	C88	0.29	C88
PCB-092	NA	9.6		0.36		0.28		0.091		0.13		0.28	

Table 3-21. Sediment PCB Congener Analysis (µg/kg) (continued)

	Location Name	MA-09		MA-14				MA19		SP1-1		TF-21	
	Sample Name	SED02-10-170906		FD-170906-01		SED01-10-170906		SED04-10-170906		SED03-10-170906		SED05-10-170907	
	Sample Type	N		FD		P		N		N		N	
Analyte	**PAL**	**Result**		**Result**		**Result**		**Result**		**Result**		**Result**	
PCB-093	NA	0.36	C q	0.008	J C q	0.012	U C	0.013	U C	0.0049	J C q	0.016	C q
PCB-094	NA	0.085	U	0.012	U	0.012	U	0.013	U	0.013	U	0.015	U
PCB-095	NA	50.		1.6		1.2		0.4		0.57		1.4	
PCB-096	NA	0.085	U	0.012	U	0.012	U	0.013	U	0.013	U	0.015	U
PCB-097	NA	37.	B C86	1.3	B C86	0.93	C86 B	0.32	B C86	0.47	B C86	0.99	B C86
PCB-098	NA	2.4	C	0.068	C	0.054	C	0.017	C q	0.026	C	0.082	C
PCB-099	NA	45.	C83 B	1.4	C83 B	1.1	C83 B	0.49	C83 B	0.61	C83 B	1.6	C83 B
PCB-100	NA	0.36	C93 q	0.008	J C93 q	0.012	U C93	0.013	U C93	0.0049	J C93 q	0.016	C93 q
PCB-101	NA	60.	B C90	2.	B C90	1.5	C90 B	0.56	B C90	0.79	B C90	1.9	B C90
PCB-102	NA	2.4	C98	0.068	C98	0.054	C98	0.017	C98 q	0.026	C98	0.082	C98
PCB-103	NA	0.62		0.012	U	0.013		0.0052	J	0.013	U	0.024	
PCB-104	NA	0.085	U	0.012	U	0.012	U	0.013	U	0.013	U	0.015	U
PCB-105	NE	19.	B	0.69	B	0.48	B	0.26	B	0.31	B	0.66	B
PCB-106	NA	0.085	U	0.012	U	0.012	U	0.013	U	0.013	U	0.015	U
PCB-107	NA	3.8	B	0.18	B	0.11	B	0.053	B	0.067	B	0.16	B
PCB-108	NA	1.8	C B	0.061	C B	0.041	C B	0.017	C B	0.016	C B q	0.053	C B
PCB-109	NA	37.	B C86	1.3	B C86	0.93	C86 B	0.32	B C86	0.47	B C86	0.99	B C86
PCB-110	NA	77.	C B	2.6	C B	1.9	C B	0.69	C B	0.98	C B	1.9	C B
PCB-111	NA	0.085	U	0.012	U	0.012	U	0.013	U	0.013	U	0.015	U
PCB-112	NA	0.36		0.012	U	0.012	U	0.013	U	0.013	U	0.0095	J q
PCB-113	NA	60.	B C90	2.	B C90	1.5	C90 B	0.56	B C90	0.79	B C90	1.9	B C90
PCB-114	NE	1.2	B	0.028	B q	0.022	B	0.015	B q	0.018	B	0.035	B
PCB-115	NA	77.	B C110	2.6	B C110	1.9	C110 B	0.69	B C110	0.98	B C110	1.9	B C110

Table 3-21. Sediment PCB Congener Analysis (µg/kg) (continued)

Location Name		MA-09		MA-14				MA19		SP1-1		TF-21	
Sample Name		SED02-10-170906		FD-170906-01		SED01-10-170906		SED04-10-170906		SED03-10-170906		SED05-10-170907	
Sample Type		N		FD		P		N		N		N	
Analyte	**PAL**	**Result**		**Result**		**Result**		**Result**		**Result**		**Result**	
PCB-116	NA	9.3	C85	0.37	C85	0.28	C85	0.11	C85	0.15	C85	0.32	C85
PCB-117	NA	9.3	C85	0.37	C85	0.28	C85	0.11	C85	0.15	C85	0.32	C85
PCB-118	NE	58.	B	1.9	B	1.4	B	0.74	B	0.86	B	2.	B
PCB-119	NA	37.	B C86	1.3	B C86	0.93	C86 B	0.32	B C86	0.47	B C86	0.99	B C86
PCB-120	NA	0.63	B	0.012	U	0.01	J B	0.0051	J B q	0.0075	J B	0.0086	J B q
PCB-121	NA	0.085	U	0.012	U	0.012	U	0.013	U	0.013	U	0.015	U
PCB-122	NA	0.95	B	0.026	B q	0.021	B	0.009	J B	0.014	B	0.029	B
PCB-123	NE	1.		0.036		0.018	q	0.011	J	0.013		0.034	
PCB-124	NA	1.8	B C108	0.061	B C108	0.041	C108 B	0.017	B C108	0.016	B q C108	0.053	B C108
PCB-125	NA	37.	B C86	1.3	B C86	0.93	C86 B	0.32	B C86	0.47	B C86	0.99	B C86
PCB-126	NE	0.085	U	0.0067	U	0.012	U	0.013	U	0.0037	U	0.0058	U
PCB-127	NA	0.085	U	0.012	U	0.012	U	0.013	U	0.013	U	0.015	U
PCB-128	NA	11.	C B	0.58	C B	0.37	C B	0.15	C B	0.21	C B	0.45	C B
PCB-129	NA	60.	C B	3.2	C B	2.1	C B	0.82	C B	1.1	C B	2.6	C B
PCB-130	NA	4.		0.21		0.13		0.051		0.069		0.16	
PCB-131	NA	0.92		0.041		0.026		0.013	U	0.011	J q	0.027	
PCB-132	NA	20.	B	0.91	B	0.55	B	0.16	B	0.26	B	0.62	B
PCB-133	NA	0.83		0.039		0.022		0.0099	J	0.012	J	0.03	
PCB-134	NA	3.7	C	0.16	C	0.11	C	0.031	C	0.049	C	0.12	C
PCB-135	NA	12.	C B	0.5	C B	0.37	C B	0.11	C B	0.16	C B	0.33	C B
PCB-136	NA	6.		0.21		0.15		0.041	q	0.063		0.16	
PCB-137	NA	3.4	B	0.18	B	0.11	B	0.041	B	0.059	B	0.13	B
PCB-138	NA	60.	B C129	3.2	B C129	2.1	C129 B	0.82	B C129	1.1	B C129	2.6	B C129

Table 3-21. Sediment PCB Congener Analysis (µg/kg) (continued)

Location Name		MA-09		MA-14				MA19		SP1-1		TF-21	
Sample Name		SED02-10-170906		FD-170906-01		SED01-10-170906		SED04-10-170906		SED03-10-170906		SED05-10-170907	
Sample Type		N		FD		P		N		N		N	
Analyte	**PAL**	**Result**		**Result**		**Result**		**Result**		**Result**		**Result**	
PCB-139	NA	1.4	C B	0.061	C B	0.038	C B	0.016	C B	0.019	C B q	0.054	C B
PCB-140	NA	1.4	B C139	0.061	B C139	0.038	C139 B	0.016	B C139	0.019	B C139 q	0.054	B C139
PCB-141	NA	7.8	B	0.39	B	0.24	B	0.07	B	0.12	B	0.22	B
PCB-142	NA	0.085	U	0.012	U	0.012	U	0.013	U	0.013	U	0.015	U
PCB-143	NA	3.7	C134	0.16	C134	0.11	C134	0.031	C134	0.049	C134	0.12	C134
PCB-144	NA	1.6	B	0.068	B	0.049	B	0.015	B q	0.022	B	0.037	B q
PCB-145	NA	0.085	U	0.012	U	0.012	U	0.013	U	0.013	U	0.015	U
PCB-146	NA	6.8	B	0.36	B	0.23	B	0.089	B	0.13	B	0.32	B
PCB-147	NA	43.	C B	1.9	C B	1.3	C B	0.45	C B	0.63	C B	1.7	C B
PCB-148	NA	0.034	J q	0.0016	J q	0.012	U	0.013	U	0.013	U	0.0015	J q
PCB-149	NA	43.	B C147	1.9	B C147	1.3	C147 B	0.45	B C147	0.63	B C147	1.7	B C147
PCB-150	NA	0.041	J q	0.0017	J q	0.0015	J	0.013	U	0.013	U	0.0021	J q
PCB-151	NA	12.	C135 B	0.5	C135 B	0.37	C135 B	0.11	C135 B	0.16	C135 B	0.33	C135 B
PCB-152	NA	0.043	J q	0.012	U	0.0009	J q	0.013	U	0.013	U	0.00096	J q
PCB-153	NA	39.	C B	2.	C B	1.4	C B	0.56	C B	0.72	C B	1.9	C B
PCB-154	NA	0.085	U	0.027	B	0.012	U	0.0071	J B q	0.013	B	0.021	B
PCB-155	NA	0.085	U	0.012	U	0.012	U	0.013	U	0.013	U	0.015	U
PCB-156	NE	8.1	C B	0.34	C B	0.2	C B	0.096	C B	0.13	C B	0.29	C B
PCB-157	NE	8.1	C156 B	0.34	C156 B	0.2	C156 B	0.096	C156 B	0.13	C156 B	0.29	C156 B
PCB-158	NA	6.6	B	0.33	B	0.2	B	0.085	B	0.12	B	0.24	B
PCB-159	NA	0.085	U	0.012	U	0.012	U	0.013	U	0.013	U	0.015	U
PCB-160	NA	60.	B C129	3.2	B C129	2.1	C129 B	0.82	B C129	1.1	B C129	2.6	B C129
PCB-161	NA	0.085	U	0.012	U	0.012	U	0.013	U	0.013	U	0.015	U

Table 3-21. Sediment PCB Congener Analysis (µg/kg) (continued)

Location Name		MA-09		MA-14				MA19		SP1-1		TF-21	
Sample Name		SED02-10-170906		FD-170906-01		SED01-10-170906		SED04-10-170906		SED03-10-170906		SED05-10-170907	
Sample Type		N		FD		P		N		N		N	
Analyte	**PAL**	**Result**		**Result**		**Result**		**Result**		**Result**		**Result**	
PCB-162	NA	0.085	U	0.012	U	0.012	U	0.013	U	0.013	U	0.015	U
PCB-163	NA	60.	B C129	3.2	B C129	2.1	C129 B	0.82	B C129	1.1	B C129	2.6	B C129
PCB-164	NA	4.	B	0.19	B	0.12	B	0.039	B	0.063	B	0.13	B
PCB-165	NA	0.085	U	0.012	U	0.012	U	0.013	U	0.013	U	0.015	U
PCB-166	NA	11.	C128 B	0.58	C128 B	0.37	C128 B	0.15	C128 B	0.21	C128 B	0.45	C128 B
PCB-167	NE	2.5	B	0.12	B	0.074	B	0.033	B	0.046	B	0.096	B
PCB-168	NA	39.	B C153	2.	B C153	1.4	C153 B	0.56	B C153	0.72	B C153	1.9	B C153
PCB-169	NE	0.085	U	0.012	U	0.012	U	0.013	U	0.013	U	0.015	U
PCB-170	NA	5.	B	0.31	B	0.18	B	0.069	B	0.1	B	0.19	B
PCB-171	NA	1.6	C B	0.099	C B	0.062	C B	0.024	C B	0.033	C B	0.06	C B
PCB-172	NA	0.63	B	0.042	B	0.028	B	0.008	J B	0.015	B	0.02	B q
PCB-173	NA	1.6	C171 B	0.099	C171 B	0.062	C171 B	0.024	C171 B	0.033	C171 B	0.06	C171 B
PCB-174	NA	3.	B	0.21	B	0.14	B	0.036	B	0.059	B	0.1	B
PCB-175	NA	0.13		0.0088	J	0.008	J	0.0023	J	0.0031	J q	0.0064	J
PCB-176	NA	0.48	B	0.029	B	0.018	B	0.0064	J B	0.0077	J B	0.014	J B q
PCB-177	NA	2.1	B	0.14	B	0.095	B	0.035	B	0.046	B	0.093	B
PCB-178	NA	0.55		0.049		0.031		0.012	J	0.014		0.036	
PCB-179	NA	1.3	B	0.086	B	0.063	B	0.018	B	0.025	B	0.057	B
PCB-180	NA	6.5	C B	0.46	C B	0.3	C B	0.1	C B	0.15	C B	0.27	C B
PCB-181	NA	0.13		0.006	J	0.0036	J	0.0013	J q	0.0013	J q	0.0037	J
PCB-182	NA	0.061	J B	0.012	U	0.0023	U	0.013	U	0.013	U	0.0027	U
PCB-183	NA	2.4	C B	0.17	C B	0.11	C B	0.039	C B	0.052	C B	0.11	C B
PCB-184	NA	0.085	U	0.012	U	0.012	U	0.013	U	0.013	U	0.015	U

Table 3-21. Sediment PCB Congener Analysis (µg/kg) (continued)

Location Name		MA-09		MA-14				MA19		SP1-1		TF-21	
Sample Name		SED02-10-170906		FD-170906-01		SED01-10-170906		SED04-10-170906		SED03-10-170906		SED05-10-170907	
Sample Type		N		FD		P		N		N		N	
Analyte	**PAL**	**Result**		**Result**		**Result**		**Result**		**Result**		**Result**	
PCB-185	NA	2.4	B C183	0.17	B C183	0.11	C183 B	0.039	B C183	0.052	B C183	0.11	B C183
PCB-186	NA	0.085	U	0.012	U	0.012	U	0.013	U	0.013	U	0.015	U
PCB-187	NA	3.1	B	0.27	B	0.19	B	0.072	B	0.086	B	0.2	B
PCB-188	NA	0.085	U	0.012	U	0.012	U	0.013	U	0.013	U	0.015	U
PCB-189	NE	0.2	B	0.014	B	0.0081	U	0.0028	U	0.0047	U	0.0085	U
PCB-190	NA	0.81	B	0.047	B	0.028	B	0.0088	J B q	0.016	B	0.027	B
PCB-191	NA	0.2	B	0.01	J B q	0.0024	U	0.0025	U	0.0045	U	0.0058	J B
PCB-192	NA	0.085	U	0.012	U	0.012	U	0.013	U	0.013	U	0.015	U
PCB-193	NA	6.5	C180 B	0.46	C180 B	0.3	C180 B	0.1	C180 B	0.15	C180 B	0.27	C180 B
PCB-194	NA	0.82	B	0.071	B	0.051	B	0.017	B q	0.025	B	0.047	B
PCB-195	NA	0.31	B	0.028	B	0.018	q B	0.0068	J B	0.0099	J B	0.017	B
PCB-196	NA	0.3	B	0.028	B	0.023	B	0.0081	J B	0.0099	J B	0.019	B
PCB-197	NA	0.026	J B	0.0023	U	0.0013	U	0.0012	U	0.013	U	0.0025	U
PCB-198	NA	0.6	C B	0.069	C B	0.052	C B	0.018	C B	0.024	C B	0.051	C B
PCB-199	NA	0.6	C198 B	0.069	C198 B	0.052	C198 B	0.018	C198 B	0.024	C198 B	0.051	C198 B
PCB-200	NA	0.063	J B	0.0058	J B q	0.0051	J B	0.013	U	0.013	U	0.004	J B
PCB-201	NA	0.065	J	0.0081	J	0.0062	J	0.0021	J q	0.0034	J q	0.0068	J q
PCB-202	NA	0.12	B	0.013	B q	0.016	B	0.0075	J B	0.007	J B	0.018	B
PCB-203	NA	0.41	B	0.038	B	0.028	B	0.01	J B	0.013	B	0.022	B
PCB-204	NA	0.085	U	0.012	U	0.012	U	0.013	U	0.013	U	0.015	U
PCB-205	NA	0.037	J B	0.003	U	0.0034	U	0.013	U	0.013	U	0.015	U
PCB-206	NA	0.28	B	0.052	B	0.043	B	0.019	B	0.019	B	0.05	B
PCB-207	NA	0.034	J B	0.0068	J B	0.0048	U	0.0029	U	0.013	U	0.007	J B

Table 3-21. Sediment PCB Congener Analysis (µg/kg) (continued)

Location Name		MA-09	MA-14		MA19	SP1-1	TF-21
Sample Name		SED02-10-170906	FD-170906-01	SED01-10-170906	SED04-10-170906	SED03-10-170906	SED05-10-170907
Sample Type		N	FD	P	N	N	N
Analyte	**PAL**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
PCB-208	NA	0.072 J B q	0.022 B	0.016 B	0.0078 J B	0.0055 J B q	0.022 B
PCB-209	NA	0.18 B	0.068 B	0.055 B	0.038 B	0.023 B	0.063 B
MONOCHLORO- BIPHENYL	NE	0.097	0.015	0.012 q	0.011 J q	0.01 J q	0.02 q
DICHLORO- BIPHENYL	NE	1.6 q	0.41 q	0.4 q	0.18 q	0.18 q	0.37
TRICHLORO- BIPHENYL	NE	13. B q	1.3 B q	1.2 q B	0.66 B q	0.65 B q	1.4 B
TETRACHLORO- BIPHENYL	NE	130. B q	3.3 B q	3. q B	1.6 B q	1.7 B q	5.2 B q
PENTACHLORO- BIPHENYL	NE	410. B q	13. B q	10. q B	4. B q	5.4 B q	12. B q
HEXACHLORO- BIPHENYL	NE	240. B q	12. B q	7.7 q B	2.9 B q	4. B q	9.5 B q
HEPTACHLORO- BIPHENYL	NE	28. B	2. B q	1.3 q B	0.44 B q	0.62 B q	1.2 B q
OCTACHLORO- BIPHENYL	NE	2.8 B	0.27 B q	0.2 q B	0.071 B q	0.092 B q	0.19 B q
NONACHLORO- BIPHENYL	NE	0.39 B q	0.081 B	0.064 q B	0.03 B	0.025 B q	0.078 B
POLY- CHLORINATED BIPHENYLS (PCBS)	NE	830. B q	33. B q	24. q B	9.9 B q	13. B q	30. B q

Notes:

U - The analyte was not detected at or above the limit of detection (LOD). (sometimes validators will elevate the limit due to the "B" qualifier using the 5x/10x rule so this definition is different than the lab description).
FD – Field duplicate
P – Parent sample of field duplicate
N – Sample is not part of a field duplicate pair
J - The reported value is an estimated concentration.
B - The analyte was found in an associated blank, as well as in the sample.
q - One or more quality control criteria failed.
C - Indicates a co-eluting PCB congener. If a number is associated with the C qualifier, this corresponds to the result of the lower co-eluting PCB.
(i.e. the C12 qualifier reported for a PCB-013 result indicates this PCB co-elutes with PCB-012).”
PCB - polychlorinated biphenyls
NA - Not applicable; NE - Not established; FD - Field duplicate; N - Normal
µg/kg - micrograms per kilogram

Table 3-22. Total PCBs in Sediment (µg/kg)

Location Name	**Sample Name**	**Sample type**	**Total PCBs (Sum of analyte value with ND as null) Result (µg/kg)**	**Total number of PCBs detections**	**Total Organic Carbon %**	**Total PCBs (TOC Normalized)[a] (mg/kg OC)**
			Freshwater			**Marine**
SMS Sediment SCO			**110**			**12**
SMS Sediment CSL			**2500**			**65**
MA09	SED02-10-170906	N	**830.** B q	169	1.6	**51.9**
MA14 (DUP)	FD-170906-01	FD	33. B q	164	0.53	6.2
MA14	SED01-10-170906	N	24. q B	157	0.51	4.7
MA19	SED04-10-170906	N	9.9 B q	151	0.58	1.7
SP1-1	SED03-10-170906	N	13. B q	157	0.56	2.3
TF-21	SED05-10-170907	N	30. B q	166	0.79	3.8

Notes:

[a] – If percent TOC is between 0.5 and 3.5, then PCB concentrations TOC-normalized with units of mg/kg OC. To calculate TOC-normalized values, the concentration in µg/kg is divided by the decimal fraction TOC times 1,000 µg/mg.

All samples analyzed using analytical method 1668A.

Bolded values exceed the SCO

DUP – Duplicate

FD - Field Duplicate

P – Parent sample of field duplicate

N – Sample is not part of a field duplicate pair

µg/kg - microgram per kilogram

B - The analyte was found in an associated blank, as well as in the sample.

q - One or more quality control criteria failed.

SCO - sediment cleanup objective

CSL – cleanup screening level

Table 3-23. PCB Aroclor Analysis in Sediments (µg/kg)

		Location Name	MA-09	MA-14	MA-14	MA19	SP1-1	TF-21
		Sample Name	SED02-10-170906	FD-170906-01	SED01-10-170906	SED04-10-170906	SED03-10-170906	SED05-10-170907
		Sample type	N	FD	P	N	N	N
Analyte	**Units**	**ROD RG (mg/kg OC)**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
AROCLOR-1016	µg/kg	NE	48. U	31. U	31. U	36. U	35. U	39. U J
AROCLOR-1221	µg/kg	NE	75. U	48. U	49. U	57. U	55. U	62. U
AROCLOR-1232	µg/kg	NE	94. U	60. U	62. U	71. U	69. U	77. U
AROCLOR-1242	µg/kg	NE	110. U	71. U	73. U	83. U	81. U	91. U
AROCLOR-1248	µg/kg	NE	75. U	48. U	49. U	57. U	55. U	62. U
AROCLOR-1254	µg/kg	NE	350. J	46. U	47. U	54. U	52. U	59. U
AROCLOR-1260	µg/kg	NE	120. J	33. U Q	33. U Q	38. U Q	37. U Q	42. U Q
AROCLOR-1262	µg/kg	NE	130. U	82. U	84. U	96. U	94. U	100. U
AROCLOR-1268	µg/kg	NE	100. U	65. U	66. U	76. U	74. U	82. U
Total PCB Aroclors	mg/kg OC	12	29.38 J	8.68 U	9.22 U	1.61 U	1.66 U	7.47 U
CARBON	mg/kg	NE	16,000.	5,300. J	5,100. J	5,800.	5,600. J	7,900. J

Notes:
Samples analyzed for Aroclor analysis by method 8082 A, carbon analysis by 9060.
FD – Field duplicate
P – Parent Sample of field duplicate
N – Sample is not part of a field duplicate pair
U - The analyte was analyzed but not detected at or above LOD. (sometimes validators will elevate the limit due to the "B" qual using the 5x/10x rule so this definition is different than the lab description).
J - The reported value is an estimated concentration.
U J - The analyte was analyzed but not detected. The sample quantitation limit is an estimated value.
Q - One or more quality control criteria failed.
Total PCB (Aroclor) are derived based on the sum of the concentrations of Aroclors® 1016, 1221, 1232, 1242, 1248, 1254 and 1260.
When all chemicals in a group are undetected, only the single highest individual chemical quantitation limit in a group should be reported and appropriately qualified. If some concentrations were detected and others were not, only the detected concentrations are included in the sum.

Table 3-24. Summary of Analytical Results for PCBs in OU 1 Sediment from April 1996 through September 2017

Location	Sampling Date	TOC (%)[c]	PCBs (µg/kg or mg/kg OC)[d]		
			Aroclor 1254	**Aroclor 1260**	**Total PCB Aroclors**
SMS Marine SCO (mg/kg OC)[a]		**NA**	**NA**	**NA**	**12**
AET Marine SCO (µg/kg dry weight)		**NA**	**NA**	**NA**	**130**
DB-05	April 1996	0.68	0.44 U[e]	0.44 U[e]	0.44U[e]
	June 2000	N/A	10 U	10 U	10 U
	June 2004	0.79	0.34 U[e]	0.34 U[e]	0.34 U[e]
	June 2009	1.42	0.18 J [e]	0.63 U [e]	0.18 J[e]
DB-07	April 1996	0.56	0.54 U[e]	0.54 U[e]	0.54 U[e]
	June 2000	N/A	10 U	10 U	10 U
	June 2004	1.12	0.41 J[e]	0.24 U[e]	0.41 J[e]
	June 2009	0.51	1.45 U[e]	1.45 U[e]	1.45 U[e]
DB-08	April 1996	0.74	0.41 UJ[e]	0.41 UJ[e]	0.41 UJ[e]
	June 2000	N/A	10 UJ	10 UJ	10 UJ
	June 2004	0.69	0.36 U[e]	0.36 U[e]	0.36 U[e]
	June 2009	1.43	0.20 J[e]	0.59 U[e]	0.20 J[e]
DB-08 FD	June 2009	1.35	1.26U[e]	1.26U[e]	1.26U[e]
MA-09	April 1996	0.48	56 A	6 J	62
	June 2000	N/A	200	10 U	**200**
	June 2002	0.55	0.67 J[e]	0.53 U[e]	0.67 J[e]
	June 2004	3.14	2.68A[e]	0.11 U[e]	2.68A[e]
	June 2009	1.18	1.36[e]	0.68 U[e]	1.36[e]
	September 2017	1.6	21.88 J[e]	7.5 J[e]	**29.38 J[e]**
MA-09 FD	April 1996	0.53	26.6 A[e]	2.64[e]	**29.25[e]**
MA-10	April 1996	2.03	1.08A[e]	0.74 U[e]	1.08A[e]

Table 3-24. Summary of Analytical Results for PCBs in OU 1 Sediment from April 1996 through September 2017 (continued)

Location	Sampling Date	TOC (%)[c]	PCBs (µg/kg or mg/kg OC)[d]		
			Aroclor 1254	Aroclor 1260	Total PCB Aroclors
MA-11	April 1996	3.40	1.56 A[e]	0.29 U[e]	1.56 A[e]
	June 2000	N/A	0.5[e]	0.29 U[e]	0.5[e]
	June 2004	1.03	0.27 U[e]	0.27 U[e]	0.27 U[e]
	June 2009	1.91	1.52 U[e]	1.47 U[e]	1.52 U[e]
MA-14	June 2000	N/A	140	10 U	**140**
	June 2002	0.59	1.64 J[e]	0.51 U[e]	1.64 J[e]
	June 2004	2.16	0.6A[e]	0.11 U[e]	0.6A[e]
	June 2009	2.90	3.45[e]	0.45 U[e]	3.45[e]
	September 2017	0.51	9.22 U[e]	6.47 UQ[e]	9.22 UQ[e]
MA-14 FD	June 2002	1.16	0.83 J[e]	0.24 U[e]	0.83 J[e]
	June 2004	2.95	0.75[e]	0.09 U[e]	0.75[e]
	September 2017	0.53	8.68 U[e]	6.23 UQ[e]	8.68 U[e]
TF-18	April 1996	0.56	0.54 U[e]	0.54 U[e]	0.54 U[e]
	June 2000	N/A	6 J	10 U	6 J
	June 2004	28.30	4.7 J	10U	4.7 J
	June 2009	0.59	0.41 JP[e]	1.17 U[e]	0.41 JP[e]
TF-20	April 1996	0.46	3U	3U	3U
	June 2000	N/A	10 U	10 U	20 U
	June 2004	0.70	0.47 J[e]	1.43 U[e]	0.47J[e]
TF-21	June 2009	0.64	1.27 U[e]	1.27 U[e]	1.27 U[e]
	April 1996	0.92	4.57[e]	0.43 J[e]	5[e]
	June 2000	N/A	32	10 U	32
	June 2004	2.42	1.53A[e]	0.15 U[e]	1.53A[e]

Table 3-24. Summary of Analytical Results for PCBs in OU 1 Sediment from April 1996 through September 2017 (continued)

Location	**Sampling Date**	**TOC (%)**[c]	**PCBs (µg/kg or mg/kg OC)**[d]		
			Aroclor 1254	**Aroclor 1260**	**Total PCB Aroclors**
	June 2009	0.92	0.67 J[e]	1.2 U[e]	0.67 J[e]
	September 2017	0.79	7.47 U[e]	5.32 UQ[e]	7.47 UQ[e]
FLD-004[b]	June 2000	N/A	28	10 U	28
MA-19	September 2017	0.58	1.61U[e]	1.13U[e]	1.61U[e]
SP1-1	September 2017	0.56	1.66U[e]	1.18U[e]	1.66U[e]

Notes:
[a] Sediment cleanup objective (SCO) for PCBs based on TOC-normalized values.
[b] PCB-contaminated sediment was removed in October 1999. FLD-004 is a field duplicate of TF-21 in 2000.
[c] TOC was not measured in sediment samples collected in 2000. As a result, TOC values from the 1996 sampling event were used to normalize the 2000 data.
[d] If percent TOC is between 0.5 and 3.5, then PCB concentrations shown in these three columns are TOC-normalized (see footnote e) with units of mg/kg OC. To calculate TOC-normalized values, the concentration in µg/kg is divided by the decimal fraction TOC times 1,000 µg/kg per mg/kg. If the percent TOC is less than 0.5 or greater than 3.5, the PCB concentrations are not normalized and are in units of µg/kg.
[e] TOC-normalized data based on the SCUM II guidance

.

Bolded value exceeds or is equal to the screening level.
Shaded rows indicate the most current sampling period results.
Data from 1996 to 2004 are from U.S. Navy 2005a, with the exception of the TOC data and the TOC-normalized data for PCBs, which are from U.S. Navy 1996d (vol. II), 2003c, and 2005c, and data from 2009 are from U.S. Navy 2009h.
AET - apparent effects threshold
J - The result is an estimated concentration that is less than the LOQ, but greater than or equal to the DL.
DL - detection limit
µg/kg - microgram per kilogram
mg/kg OC - milligram per kilogram of organic carbon
LOQ – limit of quantitation; equivalent to practical quantitation limit
LOD – limit of detection
NA - not applicable
N/A - not analyzed
PCBs - polychlorinated biphenyls
TOC - total organic carbon
U - The compound was not detected ("nondetect") at or above the stated LOD

Table 3-24. Summary of Analytical Results for PCBs in OU 1 Sediment from April 1996 through September 2017 (continued)

For calculating chemical sums of Aroclor data, Total PCB (Aroclor) are derived based on the sum of the concentrations of Aroclors® 1016, 1221, 1232, 1242, 1248, 1254 and 1260.

These rules should be used for reporting and summing the quantitation limits of compounds that were not detected for comparison to the marine and freshwater benthic criteria:

- When all chemicals in a group were not detected, only the single highest individual chemical quantitation limit in a group should be reported and appropriately qualified.
- If some concentrations were detected and others were not**, only the detected concentrations** are included in the sum.

Table 3-25. Non-Normalized PCB Results Sediment – Location MA-09

Location	**Sampling Date**	**TOC (%)**	**PCBs (µg/kg)**		
			Aroclor 1254	**Aroclor 1260**	**Total PCB Aroclors**
AET Screening Level (µg/kg dry weight)		NE	NE	NE	130
MA-09	April 1996	0.48	56 A	6 J	62
	June 2000	N/A	200 A	10 U	**200**
	June 2002	0.55	3.7 J	2.9 U	3.7 J
	June 2004	3.14	84 A	3.4 U	84 A
	June 2009	1.18	16	8 U	16
	September 2017	1.6	350 J	120 J	**470 J**
MA-09 FD	April 1996	0.53	141 A	14	**155**

Notes:
U - The compound was not detected ("nondetect") at or above the LOD.
J - The result is an estimated concentration that is less than the LOQ, but greater than or equal to the DL.
A- The peak was manually integrated as it was not integrated in the original chromatogram.
AET - apparent effects threshold
NE – not established

Table 3-26. Calculated Total Dissolved PCB* and Diffusive PCB Flux Obtained via Passive Samplers (PEDs)

PED Type	**Location**	**Calculated Water Concentration (ng/L)**		**Calculated Flux** (µg/m^2/yr)**
PED Frames		**Porewater**	**Surface Water**	
PED-01	TF-21	3.3	0.6	191
PED-02	MA-14	8.9	0.8	574
PED-03	MA-09	14.6	NA	N/A
PED-04	SP1-1	2.2	NA	N/A
PED-05	MA19	3.4	0.6	200
PED-06	*new*	2.6	0.5	148
Piezometers/Wells		**Groundwater**		
PED-07	P1-1	6.0		NA
PED-08	P1-2	1.1		NA
PED-09	MW1-14	129.2		NA
PED-10	MW1-2	0.9		NA

Notes:
* in PCB summations congeners not detected above the detection limit were counted as zero and within co-eluting congener groups calculations were conducted on the one with the lowest PED-water partition coefficient which results in the highest (more conservative) total PCB estimate (see text for more information)
** positive values of flux indicate transport from porewater to surface water
NA - Not Available – surface water portion of PED damaged during deployment.
µg/m^2/yr - micrograms per squared meters per year
ng/L - nanogram per liter

Table 3-27. Porewater Results for Contaminants of Concern (μg/L)

Location Name		PW1-01	PW1-02		PW1-03	PW1-04
Sample Name		PW1-01-170907	PW1-02-170907	FD-170907-01	PW1-03-170907	PW1-04-170907
Sample Type		N	P	FD	N	N
Analyte	**PAL**	**Result**	**Result**	**Result**	**Result**	**Result**
cis-1,2-Dichloroethene	16	1 U	**1,000** J	**1,160** D	**26,800** D	**297** D
Trichloroethene	0.54	1 U	**10.9** JD	**34.9** D	**6,520** D	**13.8** D
Vinyl Chloride	0.029	1 U	**408** J	**415** D	**3,570** D	**492** D
1,1,1-Trichloroethane	200	1 U	10 U	10 U	125 U	5 U
1,1-Dichloroethane	7.7	1 U	10 U	10 U	125 U	5 U
1,1-Dichloroethene	7	1 U	10 U	10 U	**108** JD	5 U
1,2-Dichloroethane	0.48	1 U	10 U	10 U	125 U	5 U
Tetrachloroethene	5	1 U	10 U	10 U	125 U	5 U
trans-1,2-Dichloroethene	100	1 U	7.25 JD	10.3 JD	**194** JD	5.91 JD

Location Name		PW1-05	PW1-06	PW1-07	PW1-08	PW1-09	PW1-10
Sample Name		PW1-05-170908	PW1-06-170908	PW1-07-170908	PW1-08-170908	PW1-09-170908	PW1-10-170908
Sample Type		N	N	N	N	N	N
Analyte	**PAL**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
cis-1,2-Dichloroethene	16	1 U	1 U	1 U	1 U	1 U	**555** D
Trichloroethene	0.54	1 U	1 U	1 U	1 U	1 U	**15.9** D
Vinyl Chloride	0.029	1 U	1 U	1 U	1 U	1 U	**182** D
1,1,1-Trichloroethane	200	1 U	1 U	1 U	1 U	1 U	2.5 U
1,1-Dichloroethane	7.7	1 U	1 U	1 U	1 U	1 U	2.5 U
1,1-Dichloroethene	7	1 U	1 U	1 U	1 U	1 U	1.76 JD
1,2-Dichloroethane	0.48	1 U	1 U	1 U	1 U	1 U	2.5 U
Tetrachloroethene	5	1 U	1 U	1 U	1 U	1 U	2.5 U
trans-1,2-Dichloroethene	100	1 U	1 U	1 U	1 U	1 U	3.68 JD

Table 3-27. Porewater Results for Contaminants of Concern (μg/L) (continued)

Notes
Samples analyzed using EPA Method 8260C.
FD - Field Duplicate
P – Parent sample of field duplicate
N – Sample is not part of a field duplicate pair
PAL - Project Action Limit
D - The reported value is from a dilution.
JD - The reported value is an estimated concentration./The reported value is from a dilution.
U - The analyte was not detected at or above the stated limit. (sometimes validators will elevate the limit due to the "B" qualifier using the 5x/10x rule so this definition is different than the lab description).
J - The reported value is an estimated concentration.
Underlined values represent analytes not detected at or above the stated limit, which exceeds the PAL.
Bolded values indicate that the reported concentration exceeds the PAL. μg/L - micrograms per liter

Table 3-28. Frequency of Detection and Exceedance in Porewater Samples

Analyte	Number of porewater samples collected	Number of detections in porewater	Percent Detection	Minimum detected concentration (µg/L)	Maximum detected concentration (µg/L)	Maximum LOD	PAL (µg/L)	Number of exceedances above PAL	Percent Exceeding PAL	Number of samples in which each analyte is the highest concentration analyte*	Number of times each analyte that is not TCE, cis-1,2-DCE, or VC is detected in a sample in which none of the key analytes, TCE, cis-1,2-DCE, and VC are detected
cis-1,2-DCE	10	4	40%	297	26,800	250	16	4	40%	3	NA
1,1-DCA	10	0	0%	NA	NA	250	7.7	NA	NA	0	0
1,1-DCE	10	2	20%	1.76	108	250	7	1	10%	0	0
trans-1,2-DCE	10	4	40%	3.68	194	250	100	1	10%	0	0
TCE	10	4	40%	10.9	6,520	250	0.54	4	40%	0	NA
VC	10	4	40%	182	3,570	250	0.029	4	40%	1	NA
PCE	10	0	0%	NA	NA	250	5	NA	NA	0	0
1,2-DCA	10	0	0%	NA	NA	250	0.48	NA	NA	0	0
1,1,1-TCA	10	0	0%	NA	NA	250	200	NA	NA	0	0

Notes:
Sample counts do not include duplicate samples.
*If a sample had two COCs sharing the highest concentrations, then both of them were counted.
** Maximum LOD was the Laboratory Limit of Detection.
cis-1,2-DCE - cis-1,2-dichloroethene
1,1-DCA - 1,1-dichloroethane
1,1-DCE - 1,1-dichloroethene
trans-1,2-DCE - trans-1,2-dichloroethene
TCE - trichloroethene
VC - vinyl chloride
PCE - tetrachloroethene
1,2-DCA - 1,2-dichloroethane
1,1,1-TCA - 1,1,1-trichloroethane
PAL - project action limit
µg/L - micrograms per liter
NA - not applicable

Table 3-29. Surface Water Results in Contaminants of Concern (µg/L)

Location Name		SW1-01		SW1-02		SW1-03		SW1-04		SW1-05		SW1-06	
Sample Name		SW1-01-171026		SW1-02-171026		SW1-03-171026		SW1-04-171026		SW1-05-171026		SW1-06-171026	
Sample Type		N		N		N		N		N		P	
Analyte	**PAL**	Result		Result		Result		Result		Result		Result	
cis-1,2-Dichloroethene	600	**10,600**	D	**2,500**	D	170	D	**744**	D	527	D	293	D
Trichloroethene	0.382	**2,580**	D	**305**	D	**28.8**	D	**115**	D	**79.8**	D	**44.9**	D
Vinyl Chloride	0.021	**981**	D	**399**	D	**1.86**	JD	**32.5**	D	**17.1**	D	**5.89**	D
1,1,1-Trichloroethane	47,000	50	U	25	U	1	U	5	U	2.5	U	2.5	U
1,1-Dichloroethane	9.3	50	U	25	U	1	U	5	U	2.5	U	2.5	U
1,1-Dichloroethene	1,200	50	U	25	U	1	U	5	U	2.5	U	2.5	U
1,2-Dichloroethane	9.3	50	U	25	U	1	U	5	U	2.5	U	2.5	U
Tetrachloroethene	4.9	50	U	25	U	1	U	5	U	2.5	U	2.5	U
trans-1,2-Dichloroethene	600	47.2	JD	25	U	0.789	JD	3.78	JD	2.8	JD	1.67	JD

Location Name		SW1-06		SW1-07		SW1-08		SW1-09		SW1-10		SW1-11		SW1-12	
Sample Name		FD-171026-02		SW1-07-171026		SW1-08-171026		SW1-09-171026		SW1-10-171026		SW1-11-171026		SW1-12-171026	
Sample Type		FD		N		N		N		N		N		N	
Analyte	**PAL**	Result		Result		Result		Result		Result		Result		Result	
cis-1,2-Dichloroethene	600	319	D	62	D	50.5	D	41.1	D	**6,640**	D	246	D	229	D
Trichloroethene	0.382	**49.1**	D	**10.1**	D	**9.18**	D	**58.6**	D	25	U	**10.3**	D	**9.33**	D
Vinyl Chloride	0.021	**5.54**	D	**0.606**	JD	1	U	**9.62**	D	**4,330**	D	**51.8**	D	**45.3**	D
1,1,1-Trichloroethane	47,000	2.5	U	1	U	1	U	1	U	25	U	2.5	U	2.5	U
1,1-Dichloroethane	9.3	2.5	U	1	U	1	U	1	U	25	U	2.5	U	2.5	U
1,1-Dichloroethene	1,200	2.5	U	1	U	1	U	0.644	JD	13.3	JD	2.5	U	2.5	U
1,2-Dichloroethane	9.3	2.5	U	1	U	1	U	1	U	25	U	2.5	U	2.5	U
Tetrachloroethene	4.9	2.5	U	1	U	1	U	1	U	25	U	2.5	U	2.5	U
trans-1,2-Dichloroethene	600	1.84	JD	1	U	1	U	1	U	53.7	D	1.29	JD	1.42	JD

Table 3-29. Surface Water Results in Contaminants of Concern (µg/L) (continued)

Notes:
Samples analyzed using EPA Method 8260C.
N – Sample is not part of a field duplicate pair
FD - Duplicate
P – Parent Sample of field duplicate
PAL - Project Action Limit
D - The reported value is from a dilution.
JD - The reported value is an estimated concentration. The reported value is from a dilution.
U - The analyte was not detected at or above the stated limit. (Sometimes validators will elevate the limit due to the "B" qualifier using the 5x/10x rule so this definition is different than the lab description).
Underlined values represent analytes not detected at or above the stated limit, which exceeds the PAL.
Bolded values indicate that the reported concentration exceeds the PAL. µg/L - micrograms per liter

Table 3-30. Frequency of Detection and Exceedance in Surface Water Samples

Analyte	**Number of surface water samples collected**	**Number of detections in surface water**	**Percent Detection**	**Minimum detected concentration (µg/L)**	**Maximum detected concentration (µg/L)**	**Maximum LOD**	**PAL (µg/L)**	**Number of exceedances above PAL**	**Percent Exceeding PAL**	**Number of samples in which each analyte is the highest concentration analyte***	**Number of times each analyte that is not TCE, cis-1,2-DCE, or VC is detected in a sample in which none of the key analytes, TCE, cis-1,2-DCE, and VC are detected**
cis-1,2-DCE	12	12	100%	41.1	10,600	100	600	4	33%	11	NA
1,1-DCA	12	0	0%	NA	NA	100	9.3	0	0%	NA	0
1,1-DCE	12	2	17%	0.644	13.3	100	1,200	0	0%	0	0
trans-1,2-DCE	12	8	67%	0.789	53.7	100	600	0	0%	0	0
TCE	12	11	92%	9.18	2,580	100	0.382	11	92%	1	NA
VC	12	11	92%	0.606	4,330	100	0.021	11	92%	0	NA
PCE	12	0	0%	NA	NA	100	4.9	0	0%	NA	0
1,2-DCA	12	0	0%	NA	NA	100	9.3	0	0%	NA	0
1,1,1-TCA	12	0	0%	NA	NA	100	47,000	0	0%	NA	0

Samples do not include duplicate samples.
*If a sample had two COCs sharing the highest concentrations, then both of them were counted.
** Maximum LOD was the laboratory Limit of Detection.

Table 3-30. Frequency of Detection and Exceedance in Surface Water Samples (continued)

Analyte	Number of surface water samples collected	Number of detections in surface water	Percent Detection	Minimum detected concentration (µg/L)	Maximum detected concentration (µg/L)	Maximum reporting limit	PAL (µg/L)	Number of exceedances above PAL	Percent Exceeding PAL	Number of samples in which each analyte is the highest concentration analyte*	Number of times each analyte that is not TCE, cis-1,2-DCE, or VC is detected in a sample in which none of the key analytes, TCE, cis-1,2-DCE, and VC are detected
cis-1,2-DCE	12	12	100%	41.1	10,600	100	600	4	33%	11	NA
1,1-DCA	12	0	0%	NA	NA	100	9.3	0	0%	NA	0
1,1-DCE	12	2	17%	0.644	13.3	100	1,200	0	0%	0	0
trans-1,2-DCE	12	8	67%	0.789	53.7	100	600	0	0%	0	0
TCE	12	11	92%	9.18	2,580	100	0.382	11	92%	1	NA
VC	12	11	92%	0.606	4,330	100	0.021	11	92%	0	NA
PCE	12	0	0%	NA	NA	100	4.9	0	0%	NA	0
1,2-DCA	12	0	0%	NA	NA	100	9.3	0	0%	NA	0
1,1,1-TCA	12	0	0%	NA	NA	100	47,000	0	0%	NA	0

Notes:

Sample counts do not include duplicate samples.
*If a sample had two COCs sharing the highest concentrations, then both of them were counted.
** Maximum reporting limit was the Laboratory LOD.
cis-1,2-DCE - cis-1,2-dichloroethene
1,1-DCA - 1,1-dichloroethane
1,1-DCE - 1,1-dichloroethene
trans-1,2-DCE - trans-1,2-dichloroethene
TCE - trichloroethene
VC - vinyl chloride
PCE - tetrachloroethene
1,2-DCA - 1,2-dichloroethane
1,1,1-TCA - 1,1,1-trichloroethane
PAL - project action limit
µg/L - micrograms per liter
NA - not applicable

Table 3-31. Stormwater Sample Results (µg/L)

	Location Name	08-705-STORMW		MH-STORMW			
	Sample Name	08-705-STORMW-171115		FD-171115-01		MH-STORMW-171115	
	Sample Type	N		FD		P	
Analyte	**PAL**	**Result**		**Result**		**Result**	
cis-1,2-Dichloroethene	600	1.14	JD	1	U	1	U
Trichloroethene	0.382	1	U	1	U	1	U
Vinyl Chloride	0.021	1	U	1	U	1	U
1,1,1-Trichloroethane	47,000	1	U	1	U	1	U
1,1-Dichloroethane	9.3	1	U	1	U	1	U
1,1-Dichloroethene	1,200	1	U	1	U	1	U
1,2-Dichloroethane	9.3	1	U	1	U	1	U
Tetrachloroethene	4.9	1	U	1	U	1	U
trans-1,2-Dichloroethene	600	1	U	1	U	1	U

Notes:
Samples analyzed using EPA Method 8260C.
FD - Field Duplicate
P – Parent sample of a field duplicate pair
N – Sample is not part of a field duplicate pair
PAL - Project Action Limit
U - The analyte was analyzed but not detected at or above the stated limit. (Sometimes validators will elevate the limit due to the "B" qual using the 5x/10x rule so this definition is different than the lab description).
JD - The reported value is an estimated concentration. The reported value is from a dilution.
µg/L - micrograms per liter
Underlined values represent analytes not detected at or above the stated limit, which exceeds the PAL.

Bolded values indicate that the reported concentration exceeds the PAL.

4.0 DATA EVALUATION

4.1 EVALUATION PROCESS

Data available for evaluation included the following data generated in 2017, which are tabulated in Section 3:

- Soil and groundwater sample results from direct-push drilling.
- Soil sample results from auger drilling.
- Groundwater sample results from monitoring wells.
- VOC concentrations in porewater from hand-driven pushpoint sampling.
- VOC concentrations in surface water and stormwater samples.
- Calculated PCB concentrations in sediment samples and groundwater, porewater, and surface water based on passive sampler results.
- Locations and elevations of the groundwater monitoring wells installed in 2017 and the peeper sampling tubes installed previously by the USGS based on a land survey.

Key data available from previous studies by others and directly relevant to work under this task order included:

- VOC concentrations in groundwater from recent LTM performed by the Navy’s LTM contractor.
- VOC concentrations in groundwater from piezometers and peeper samplers analyzed by the USGS in 2015, along with measured biodegradation parameters evaluated by the USGS.
- A land survey of the South Plantation and the marsh area immediately surrounding the South Plantation, and the Central Landfill from the crown of the slope down to Marsh Pond.

These data were evaluated based on the decision rules specified in Section 1.5, above, using the following approaches:

- Boring logs were interpreted and used to construct cross sections showing soil lithology beneath the site (Decisions 3 and 5).
- Depth-to-groundwater measurements and top-of-casing survey data were used to prepare a groundwater elevation contour map (Decisions 3 and 5).
- VOC concentrations in soil and groundwater were assessed to select key VOCs for representation on isoconcentration contour maps (Decisions 1a, 1b, 2, and 5).
- Plan view maps were prepared showing the results for all detected VOCs in groundwater samples from wells, porewater samples, and surface water samples (Decision 5 and to assess COC transport pathways in groundwater).
- The results of additional analyses performed on samples exhibiting NAPL were compared to applicable or relevant and appropriate requirement values (Decision 5).
- Plan-view maps showing PCB concentrations in sediment, porewater, surface water, and groundwater were prepared (Decision 4). The PCB concentrations were also compared to the standards selected in the SAP(Decision 4).
- The results of microbial and natural attenuation parameter analyses were compared to ranges of values indicative of biodegradation (Decisions 5 and 6).

The results of this evaluation are described in the remaining subsections.

4.2 SITE GEOLOGY

Logging of continuous soil cores at 69 locations throughout the Central Landfill and South Plantation provides a substantially denser data set for assessing site geology beneath the former landfill than was available at the time of the ROD. The 2017 continuous core data set provides data to a maximum explored depth of 50 ft bgs. Lithologic cross sections were prepared based on these cores to summarize the geology observed (Figures 4-1 through 4-4).

The waste body of the former landfill was observed to range in thickness from approximately 3 ft (SP-B59) to approximately 18 ft (CL-B18A). The former marsh bottom sediments underlying the waste body were discernable at most locations cored, and typically consisted of an organic-rich sandy, clayey silt to silty clay ranging in thickness from a few inches (SP-B55) to approximately 3 ft (SP-B52).

Beneath the former marsh sediments, an interbedded sequence of fine sand, silt, and clay was typically observed. Beds of otherwise poorly graded fine sand were often observed to contain thin (e.g., 2 inches thick) interbeds of silt, or silt and fine sand were interbedded in 4- to 6-inch-thick beds (e.g., SP-B51). Coarser sand beds were observed more rarely, with a gravelly, well-graded sand observed most frequently in the eastern portion of the South Plantation (e.g., SP-B01, SP-B59, SPB-53). Coarser lithology (silty gravel) was also observed beneath the Central Landfill in many borings immediately above a silt or clay unit near the total depth of exploration that is interpreted to be the Clover Park aquitard, an extensive, thick, fine-grained unit (e.g., CL-B39, CL-B37, CL-B09).

Clay observed near the bottom of borings in the eastern portion of the South Plantation was interpreted to be the Lawton Clay unit (or the local equivalent), consistent with the interpretations of the MIP investigation (e.g., SP-B53, SP-B55, MIP-049, MIP-057). The Lawton Clay is a glaciolacustrine deposit commonly found as the lowermost member of the deposits of the Vashon Stade of the Fraser glaciation. The previous interpretations of OU 1 geology (U.S. Navy, 1993a) imply that this occurrence of Lawton Clay may be one of the rare instances of Vashon-age units beneath OU 1. The RI concluded that “At Areas 1 and 2, all or much of the Vashon glacial deposits have been eroded prior to deposition of the estuary or marsh sediment.” The shallow geologic unit beneath OU 1 was identified in the RI as the Kitsap Formation.

Laterally continuous fine-grained units above the Lawton Clay and Clover Park Aquitard that could be interpreted as a shallow aquitard were not observed to the total explored depth. Previous investigations relied upon in the ROD interpreted a laterally continuous aquitard at approximately 15 ft bgs separating an “upper aquifer” and an “intermediate aquifer.” Although this aquitard was inferred to be missing in some areas of the site, and “leaky,” the interpretation of the presence of the aquitard influenced the selection of screened intervals for monitoring wells targeting the two aquifers. Most of the monitoring wells that are currently part of the LTM program and are located within the footprint of the landfill have screen depths ending at 15 ft bgs or shallower. As discussed in Section 4.3, the highest concentrations of cVOCs found during the 2017 investigation typically occurred deeper than 15 ft bgs.

The original interpretation of the relationship between the shallow and intermediate aquifers in the RI (U.S. Navy, 1993a) was:

> *For consistency, the terminology of SCS Engineers (1984, 1987b) is used in this report for water-bearing zones above the Clover Park aquitard; that is, all zones*

> *above this aquitard will be referred to as the "shallow aquifer." It is likely that all water-bearing zones above this aquitard are laterally connected due to horizontal pinching out or the existence of coarser, more permeable materials within the aquitard units. In Area 1, two distinct water-bearing zones were delineated such that a so-called "intermediate aquifer" is, at least locally, present. Whether considered the intermediate aquifer or the lower zone of the shallow aquifer, this zone is immediately above the uppermost clay of the Clover Park unit within relatively coarse-grained material. The upper zone is the unconfined water table aquifer.*

Consistent with this interpretation from the RI, two distinct water-bearing zones were not identified during the 2017 investigation. The upper portion of the water-bearing zone was found to be contiguous with, and discharging to, the original salt marsh, which was filled and paved. The "intermediate aquifer" defined in the ROD was found to be vertically interconnected with the original marsh deposits, forming a single water bearing zone above the Clover Park/Lawton Clay aquitard.

4.3 SITE GROUNDWATER

Groundwater was typically first encountered in direct-push borings and well boreholes at approximately 5 ft bgs. This first water was observed to represent water within the buried former marsh sediments.

Figure 4-5 presents a groundwater elevation contour map based on depth-to-groundwater measurements (Table 4-1) in wells screened at depths representative of both the former "shallow aquifer" and "intermediate aquifer." Treating all wells measured as representative of a single hydrogeologic unit results in a consistent contour map, with the hydraulic heads measured in wells with deeper screens fitting logically within the contours derived from wells with shallower screens. In combination with the lack of a laterally continuous shallow aquitard observed in the continuous cores and the contaminant distribution discussed in Section 4.4 the interpretation of the RI appears consistent with the 2017 observations – that all water-bearing zones above the Clover Park/Lawton Clay aquitard represent a single hydraulically connected water-bearing zone.

The groundwater flow directions indicated by the groundwater elevation contour map are consistent with those shown in Figures 6-9 and 6-10 of the ROD. Although these historical figures were based on the interpretation of two distinct aquifers ("shallow" and "intermediate"), they are consistent with the groundwater flow interpretation based on 2017 data. Given that the upper portion of the shallow water-bearing zone is a remnant of the filled and paved marsh, it is influenced by connection to and daylighting into nearby surface water bodies (e.g., Marsh Creek, Marsh Pond). However, the overall more regional flow direction is to the northwest, as expressed deeper in the shallow water-bearing zone. The ultimate point of discharge for groundwater in the shallow water-bearing zone indicated by the groundwater contours are the adjacent surface water bodies – the marsh, tide flats, and Dogfish Bay. Deeper portions of this water table aquifer may discharge to Dogfish Bay. The USGS is revising the site groundwater model to identify flow paths for the deeper portions of the aquifer.

4.4 NATURE AND EXTENT OF CHEMICALS OF CONCERN

This section presents an evaluation of the laboratory results for the COCs and other potential chemicals of interest compared to the historical MIP results and other historical data to update the CSM regarding the nature and extent of contaminants. “Hotspots” are identified and discussed in this section, following the definition of a “hotspot” in the SAP (U.S. Navy, 2017a). “A ‘hotspot’ was defined as an area where VOC concentrations are substantially higher than in surrounding areas, as determined by the consensus of the project team.”

4.4.1 Nature of Chemicals of Concern

The nature of the contaminants at Keyport OU 1 was established in the ROD as a list of nine cVOCs and PCBs. This list of cVOCs and PCBs was carried forward into the SAP for the 2017 investigation, along with analysis of chloroethane for the purposes of evaluating degradation of parent chlorinated ethanes. The results of the 2017 investigation do not indicate a need to revise the description of the nature of the contaminants at Keyport OU 1. However, the 2017 investigation results provide additional refinement regarding the nature of materials disposed of, and still present in, the former landfill.

As discussed in Section 2, unexpected oily substances were observed in some direct-push borings, and the nature of these oily substances was assessed using additional laboratory analyses for fuels, PCBs, and a full list of VOCs and SVOCs in soil and groundwater samples from borings SP-B01, SP-B18, SP-B21, and SP-B62. Because of the nature of historical operations at NBK Keyport, the on-base laboratory analyzed samples containing the oily substances for Otto fuel, which is used in submarine weapons propulsion. No Otto fuel was detected. These oily substances appear to be petroleum fuels, varying between gasoline-range and diesel/oil-range hydrocarbons depending on the location within the former landfill. PCBs were detected in association with some of these samples, but the concentrations were not indicative of PCB oil as the primary constituent. SVOC and full VOC results indicate that SVOCs and VOCs other than the cVOC COC established in the ROD are present in residual source areas. Many of the SVOC and other VOC compounds detected are typically associated with petroleum.

The observation of these oily substances in discrete areas of the landfill is consistent with the history of disposal described in the RI (U.S. Navy, 1993a) and the ROD, which included the disposal of a wide range of liquid waste. This disposal history, in combination with the analytical results that show the presence of chlorinated solvents, fuel-range hydrocarbons, and PCBs indicate that the oily substances are likely “mixed NAPLs” (EPA, 2009). The presence of these liquid wastes in the landfill was accounted for in the process of COC development in the RI and ROD, and based on the data set available at the time in combination with the exposure pathways, the RI and ROD concluded that only nine cVOCs and PCBs should be considered COCs.

Tables 3-2, 3-11, 3-13, 3-28, and 3-30 summarize key statistics regarding the analytical results for cVOCs in soil, groundwater, surface water, and porewater samples collected in 2017. Relevant statistics include:

- Frequency of detection.
- Minimum and maximum detected concentrations.
- Frequency of PAL exceedance.
- Number of samples in which each analyte is the highest absolute concentration.
- For cVOCs other than TCE, cis-1,2-DCE, and VC, number of times the cVOC was detected when neither TCE, cis-1,2-DCE, nor VC were detected.

The frequency of detection statistics for each medium sampled, and the magnitude of exceedances for each cVOC relative to the PALs, indicate that the key cVOCs are TCE, cis-1,2-DCE, and VC. This analysis demonstrates that cVOCs other than TCE, cis-1,2-DCE, and VC are collocated with TCE, cis-1,2-DCE, and VC. That is, for every location where one of the other cVOCs exceeds its PAL, either TCE, cis-1,2-DCE, or VC also exceeds its PAL. Based on this conclusion, the evaluation of lateral and vertical extent of impacts (Section 4.4.2) relies on TCE, cis-1,2-DCE, and VC as key COCs representing the extent of all cVOCs.

The nature of the PCBs detected in sediment was refined during the 2017 investigation using PCB congener analysis. The results of this analysis are discussed together with the lateral extent of PCBs in Section 4.4.2 below.

4.4.2 Lateral and Vertical Extent of Chemicals of Concern

This section discusses the lateral and vertical extent of COCs observed in samples collected in 2017 and integrates these results with historical results at the site.

Samples collected in 2017 were focused on the identification of “hotspots” and potential residual sources areas. As a result, nearly all samples were collected from within the footprint of the former landfill, or immediately adjacent to the former landfill. These data therefore provide a more detailed understanding of the distribution of COCs within, beneath, and immediately adjacent to the former landfill. Historical sampling efforts, and the results of on-going LTM, provide data regarding the distribution of COCs beyond the former landfill, including beyond the Navy property boundaries.

As described in more detail in the subsections below, the lateral and vertical limits of cVOC COC concentrations exceeding the PALs extend beyond the areas sampled during the 2017 investigation. This is consistent with the investigation design, which was focused on locating and quantifying the highest concentrations of cVOCs, rather than delimiting extents above the PALs (see Decisions 1a and 2, Section 1.5).

Field decisions regarding when to step out laterally from a location, and at what depth to terminate exploration, were based on hand-held PID readings as matched to nearby MIP results. As shown on Figures 3-1 through 3-5, the hand-held PID and MIP instruments were in general agreement. High concentrations detected on the XSD instrument of the MIP correlated well with higher hand-held PID readings. As a result of this correlation, when no detections were noted by the hand-held PID for several feet (or, more typically for entire 5-foot-long cores), drilling was terminated (vertically) or no additional horizontal step-out locations were selected. This approach was successful for meeting the goal of identifying areas of highest concentrations. However, the MIP and hand-held PID were not sensitive enough to the cVOCs to identify when cVOC concentrations could be expected to be below the PALs. The 2017 data set includes numerous examples of samples exhibiting no MIP or hand-held PID indications of contamination yet containing cVOC concentrations exceeding PALs.

The discussion of PCBs in sediment below concludes that the lateral extent of PCBs in sediment exceeding the ROD RG is limited to the vicinity of sampling location MA-09.

Lateral Extent of COCs

The evaluation of the lateral extent of COCs was based on the 2017 concentrations in groundwater, porewater, and surface samples of the key COCs TCE, cis-1,2-DCE, and VC (see discussion in Section 4.4.1). Nearly all of the soil samples collected in 2017 were collected from beneath the static groundwater level, and the concentrations in groundwater were considered more representative of lateral extent of COCs.

The lateral extent of COCs in groundwater was evaluated using isoconcentration contour maps for the grab groundwater samples collected during the direct-push investigation (Figures 3-6 through 3-11) and separately using groundwater samples collected from installed groundwater monitoring wells (Figures 4-6 through 4-10). For both sets of isoconcentration contour maps, the highest COC concentration at each location, regardless of sample depth, was used to provide a conservative estimate of the maximum lateral extent. No contour map was prepared for TCE concentrations in groundwater samples collected from permanent monitoring wells in the Central Landfill because of the rarity of detections.

Central Landfill. In general, for the Central Landfill, the extent of COC concentrations exceeding the PAL is only constrained to the southeast by the data collected in 2017. As shown on Figures 3-6 through 3-8, the samples collected at locations CL-B13 and CL-B28 did not exhibit concentrations of the three key COCs exceeding their respective PALs (note, however, the elevated LOD for cis-1,2-DCE in groundwater at location CL-B28). To the south, north, northeast, and west, PALs are exceeded for one or more COCs at the locations furthest from the center of the area investigated.

The cis-1,2-DCE isoconcentration contour map for the Central Landfill based on grab groundwater sampling (Figure 3-7) implies a contaminant transport direction to the northwest, based on the alignment of relatively higher concentrations in two groups of locations. When the following two groups of locations (ordered roughly southeast to northwest) are compared on Figure 4-1:

- CL-B14B, CL-B18A, CL-B20, CL-B21A, CLB29A
- CL-B04, CL-B36, CL-B35, CL-B03, CL-B23, CL-B02

the two groups of locations appear to be separated by a group of locations exhibiting lower concentrations: CL-B09, CL-B11, CL-B19, and CL-B06A.

This pattern is less apparent on the isoconcentration contour maps for TCE (Figure 3-6) and vinyl chloride (Figure 3-8). However, for these two contaminants a similar lower-concentration area in the center of the Central Landfill is apparent. This lower concentration area confounds a simple explanation of contaminant transport following the apparent westerly groundwater flow direction from the vicinity of sources near CL-B14B, CL-B18A, and CL-B20 to the vicinity of well MW1-17. However, such a simple transport pathway is implied by the isoconcentration contours developed based on COC concentrations from installed groundwater monitoring wells (Figures 4-6 and 4-7). These simpler isoconcentration patterns are an artifact of the less dense data set (many fewer wells than direct-push sample points), and the absence of wells in the apparently lower concentration center of the Central Landfill, or other low concentration areas.

South Plantation. At the South Plantation, the available data (including MIP results in this area and field screening data) suggest that concentrations decrease rapidly to the east at Bradley

Road, from the very high concentrations observed at locations SP-B01, SP-B53, and SP-B58. However, the elevated LODs for key cVOCs in groundwater samples from locations SP-B59, SP-B60, SP-B61, and SP-B62 preclude a definitive assessment of this rapid decrease in concentrations.

Everywhere west of Bradley Road and beneath the South Plantation, concentrations of the key cVOCs exceed their respective PALs (or the elevated LODs achieved exceed the PALs). The extent of cVOCs exceeding PALs appears to blend between the South Plantation and Central Landfill. However, only limited data were collected between these two areas (partly as a result of drilling refusal at multiple locations in the vicinity of CL-B38C).

The isoconcentration contour maps based on data from installed monitoring wells imply that the lateral extent of some COCs (e.g., TCE, cis-1,2-DCE) may be delimited by the well network and may be smaller than the entire South Plantation footprint, however the extent of VC exceedances over the PAL still encompasses the entire South Plantation when contouring data from the monitoring wells installed in 2017.

PCBs in Sediment. The relative concentrations of PCBs at sampling locations within Marsh Creek and the tide flats are consistent when assessed based on total PCBs in sediment and total PCBs in sediment porewater. The highest concentrations of PCBs were detected in sediment at historical location MA-09, and in porewater at this location. Total PCB concentrations in sediment samples from downstream and upstream of MA-09 (including near seep SP1-1) were two orders of magnitude lower than at MA-09. Total PCB concentrations in sediment pore water upstream and downstream of MA-09 were also lower than at MA-09. For both sediment and porewater, PCB concentrations at location upstream of MA-09 (SP1-1 and MA19) were lower than downstream of MA-09 (MA-14). Only the PCB concentrations in the sediment sample from location MA-09 exceeded the ROD RG, indicating that the lateral extent of PCBs exceeding the RG is limited to the vicinity of this station.

Vertical Extent of COCs

The evaluation of the vertical extent of cVOCs was based on the 2017 cVOC concentrations in soil and groundwater. Nearly all of the soil samples collected in 2017 were from beneath the static groundwater level. The variability of the vertical distribution of cVOCs was evaluated through examination of the variability in hand-held PID measurements collected at a frequency of at least every one foot of soil core from the direct-push borings. These PID results were contrasted with the laboratory results for groundwater samples from the soil cores, as discussed further in the paragraphs below.

COCs are found vertically throughout the water-bearing zone above the clayey Clover Park Aquitard and Lawton Clay, in interbedded fine sands and silts. As illustrated on Figures 3-1 through 3-5, the apparent vertical extent of COCs exceeding associated PALs, based on the response of the MIP instruments and the hand-held PID, frequently was not confirmed by measured concentrations in soil and groundwater samples. At depths exhibiting a relatively low response on the MIP instruments and a low or zero hand-held PID concentrations in associated soil and groundwater samples frequently still exceeded the PALs.

The highest COC concentrations at the site, detected in samples from beneath the eastern portion of the South Plantation, extend vertically from the waste body of the landfill at approximately 5 to 7 ft bgs, and penetrate the upper portion of the Lawton Clay at approximately 30 to 35 ft bgs.

Figures 4-11 through 4-14 illustrate that at many sampling locations the deepest soil and groundwater samples collected throughout the South Plantation and the Central Landfill exhibit one or more COC concentrations exceeding the PALs. Other than the eastern portion of the South Plantation, the highest COC concentrations in other areas of the site appear to be shallower, typically from 8 to 25 ft bgs. However, lower concentrations exceeding the PALs are likely to be present throughout the shallow water bearing zone, down to the depth of the clayey Clover Park Aquitard or Lawton Clay.

Appendix H provides a series of images depicting a three-dimensional model of the plumes beneath the Central Landfill and the South Plantation. These images illustrate the vertical complexity of the contaminant distribution beneath the site. On the compact disc that accompanies the paper version of this report, this appendix is provided as a series of images. Clicking through these images provides the reader with a progressive rotation of the plume model, allowing a qualitative visual assessment of the vertical complexity.

The model illustrates the vertical complexity using a three-dimenstional filled iso-concentration based on the data set of hand-held PID readings. The PID readings are the densest data set available, and therefore provide the most detailed depiction of the contaminant distribution. As noted above, however, the hand-held PID was typically responsive to the highest contaminant concentrations, but not relatively lower contaminant concentrations that still exceed the PALs. Therefore, the PID-based plume model in Appendix H should be viewed as a rough depiction of the highest contaminant concentrations (hotspots). For reference to the filled PID isocontours, the measured concentrations of key cVOCs in grab groundwater samples are included in the model views as cylinders representing the screened interval of the sample and color-coded by concentration value.

In the Central Landfill, the model illustrates the two primary hotspots, one more easterly and one more westerly (see also Section 4.4.3 regarding hotspots), with a less-contaminated zone between these two hotspots. The eastern hotspot is seen to exhibit substantial vadose zone contamination, and a relatively continuous plume of elevated concentrations from the vadose zone to 45 feet bgs at its deepest point (CL-B18A).

In contrast, PID readings from the area of the western hotspot implied less wide-spread vadose-zone contamination and indicated a main contaminant mass in a depth range of approximately 15 to 20 feet bgs. However, laboratory results from grab groundwater samples indicate cVOC concentrations exceeding PALs from the groundwater surface to a depth of approximately 20 feet bgs in this area, with at least one exceedance as deep as 29 feet bgs (CL-B07).

In the South Plantation, the model illustrates the hotspot in the eastern portion of the south plantation, with an elongated lateral plume oriented to the west at a depth of approximately 15 to 20 feet bgs. The vertical complexity of the eastern hotspot can be seen by the high PID concentrations separated by lower PID concentrations in the vertical plane. The model shows an overall continuous vertical plume of contamination from the vadose zone to the total depth explored (the Lawton Clay aquitard at approximately 30 feet bgs) in this area.

The model shows high PID concentrations up to the eastern boundary of the model based on elevated PID readings in direct-push borings SP-B59 through SP-B63. Groundwater samples collected from these same borings did not exhibit detectable target VOC concentrations (note the isoconcentration contours on Figures 3-9 through 3-11). This finding indicates that other volatile contaminants are the probable cause of the elevated PID readings at the eastern model boundary. The other volatile contaminants may be petroleum related, based on the detection of petroleum compounds in samples immediately to the west (SP-B01, see Section 4.1).

4.4.3 Identification of Hotspots

The SAP established a definition of a “hotspot” as, “an area where VOC concentrations are substantially higher than in surrounding areas, as determined by the consensus of the project team.” For the purposes of identifying hotspots, the grab soil and groundwater data set provides the densest definitive data, with isoconcentration contours of the highest key VOC concentrations in groundwater, regardless of depth, shown on Figures 3-6 through 3-11. These figures illustrate that there are areas of the Central Landfill and South Plantation with substantially higher VOC concentrations than surrounding areas. However, these figures also show that concentrations of some key VOCs throughout the South Plantation and much of the Central Landfill are orders of magnitude above the RGs. Hotspot identification takes into account this finding of relatively wide-spread elevated VOC concentrations.

As envisioned by the SAP, hotspots were expected to be focus areas for potential supplemental remedial action, with the goal of reducing the restoration timeframe. Based on this goal, hotspots identified in this evaluation based on areas of dissolved COC concentrations above a benchmark value (at 10,000 µg/L cis-1,2-DCE in the Central Landfill area and at either 50,000 µg/L TCE or cis-1,2-DCE in the South Plantation) and areas encompassing sampling points where NAPL was observed or is indicated based on a lines of evidence analysis from EPA guidance (EPA, 2009). Hotspots based on these criteria are shown in Figures 4-15 and 4-16 and consist of one general area in the Central Landfill and two relatively distinct areas in the South Plantation. This identification of hotspots is intended for preliminary discussion of the 2017 data. Hotspots will be further delimited during design of any selected hotspot treatment.

The implications for focused treatment of these hotspots and the potential impact of treatment on restoration timeframe, are discussed in Section 5.6.

4.4.4 Distribution of VOCs in South Plantation Hotspot

The eastern portion of the South Plantation was originally identified as a hotspot during the 2016 MIP investigation (U.S. Navy, 2017b). As illustrated on Figures 3-2, 3-4, and 3-5, the MIP response indicated vertically distinct zones of high VOC concentrations separated by zones of relatively lower VOC concentrations. This pattern was also generally observed in the hand-held PID readings and visual core observations during the 2017 direct-push investigation.

This vertical distribution pattern could result from any of the following mechanisms, or (most likely) a combination of these mechanisms:

- Multiple releases over time and at different depths as the landfill was filled
- Complex three-dimensional transport and matrix diffusion of VOCs in groundwater moving laterally and vertically within the interbedded silts and clays in this relatively small area
- Variations in sorption of VOCs to differing organic carbon content in the profile
- Variations in biodegradation characteristics with depth

Three CMT wells were installed to help assess the temporal distribution of VOCs in this hotspot, and to allow future monitoring of changes in the vertical VOC profile. Variations in the nature of the VOCs in groundwater at each of the three CMT wells were assessed by comparing the mole fraction of TCE, cis-1,2-DCE, and VC. The results of this assessment are presented graphically on Figure 4-17. For each CMT well (MW1-56, MW1-57, and MW1-58), the molar ratios between TCE, cis-1,2-DCE, and VC are shown in bar charts. In addition, a ternary plot depicts the ratios of the TCE, cis-1,2-DCE, and VC concentrations for each depth at CMT wells (MW1-56, MW1-57, and MW1-58).

Both the bar charts and ternary graph on Figure 4-17 illustrate that the molar ratios between TCE, cis-1,2-DCE, and VC are generally similar between depth intervals at each CMT well (MW1-56, MW1-57, and MW1-58). This implies that the nature of the material released, and the vertical fate and transport of the release at each location is similar over the vertical profile. Of the three CMT wells, MW1-58 shows the most variation in mole fraction with depth. The fraction of TCE increases with depth in this well, and the shallowest depth interval (9 ft bgs) exhibits the highest fraction of VC. This vertical pattern at MW1-58 implies more biodegradation in the shallow interval, and decreasing biodegradation with depth.

In contrast to the similarities with depth at each location, the molar fractions are substantially different between locations (i.e., laterally). Well MW1-58, located closest to the former hazardous waste handling building 884, exhibits a high mole fraction of cis-1,2-DCE, a substantial fraction of VC, and very little TCE. Wells MW1-56 and MW1-57, located farther south, exhibit molar ratios similar to one another but different than MW1-58. At these wells TCE is the most prevalent, with a substantial fraction of cis-1,2-DCE and very little VC. Assuming that the parent compound released in the vicinity of all three wells was TCE, these results could be interpreted to mean that the release in the vicinity of well MW1-58 is older and more thoroughly biodegraded than the release(s) in the vicinity of MW1-56 and MW1-57.

4.5 TRANSPORT OF CHEMICALS OF CONCERN

This section evaluates the transport of COCs by comparing the cVOC concentrations in groundwater samples along transport pathways (source area groundwater, downgradient groundwater, and porewater), and cVOC concentrations in stormwater and surface water, with consideration of the groundwater flow direction (Section 4.3).

Stormwater at the South Plantation is concluded to not be a substantial cVOC transport pathway. The 2017 data imply two primary discharge locations for cVOC-contaminated groundwater to surface water at the South Plantation, and no identified discharge for contaminated groundwater to surface water at the Central Landfill. The data imply a potential northwesterly movement of VOC-contaminated groundwater deeper in the aquifer.

The PCB data imply a potentially higher flux of PCBs in groundwater to sediment north of seep SP1-1 than at the seep itself.

As was concluded through past studies, the groundwater flow direction and contaminant patterns do not appear to indicate COC transport from the landfill to off-base drinking water wells.

4.5.1 Stormwater Transport

cVOCs were not detected above associated laboratory LODs in the stormwater samples collected from the outfall or the first catch basin structure in line upstream of the outfall. cVOC concentrations in surface water were found to be lower in samples collected immediately downstream of the stormwater outfall (Figure 2-2), compared to surface water samples collected from upstream of the outfall. Based on these data, it appears that stormwater is not transporting a significant mass of cVOCs.

4.5.2 Groundwater to Surface Water Transport at the South Plantation

Figures 4-6 through 4-10 show isoconcentration contours for the maximum concentration of the three key cVOCs in groundwater, regardless of depth, based on the 2017 results of samples from monitoring wells and pushpoint porewater. For reference, these maps also depict cVOC concentrations in 2017 surface water samples and historical results from existing monitoring wells and USGS peeper samplers.

These maps imply two primary points of discharge of contaminated groundwater to surface water. The first point of discharge is immediately south of the wells exhibiting the highest cVOC concentrations in groundwater - MW1-56, MW1-57, and MW1-58. The highest cVOC concentrations in surface water were measured at station SW1-01, immediately south of MW1-56. The highest cVOC concentrations in porewater were also found in this area, at stations PW1-02 and PW1-03. Shallow groundwater with high cVOC concentrations in the vicinity of well MW1-56 appears to be influenced by a localized southern groundwater direction (see Figure 4-5) that causes discharge at this location.

The second point of discharge indicated by the 2017 data confirms a point of discharge identified historically, in the vicinity of USGS peeper sampler S-4. As shown on Figure 3-15, cVOC concentrations in surface water increase by two orders of magnitude at station SW1-10 compared to stations immediately upstream. At this second point of discharge, cVOCs in groundwater appear to follow the overall westward flow direction for shallow groundwater and are transported from the vicinity of well MW1-49, piezometer P1-7, and potentially areas further upgradient to the east.

Figure 4-18 illustrates the influences on cVOC concentration as surface water flows down the ephemeral channel south of the eastern portion of the South Plantation, flows into Marsh Creek, flows past the second, or western point of discharge, and then flows north into Marsh Pond. High porewater and surface water concentrations south of MW1-56 result from contaminated groundwater discharge to the marsh at this location. Flow along the ephemeral channel passes the stormwater outfall and is diluted by stormwater that does not contain measurable cVOCs.

cVOC concentrations drop by approximately an order of magnitude as a result of this dilution and then are further diluted as the ephemeral channel joins Marsh Creek. At the western point of discharge, cVOC concentrations increase by approximately an order of magnitude and then drop, due to natural degradation, as surface water flows northward to station MA12 and beyond.

4.5.3 Groundwater Transport at the Central Landfill

cVOCs were not detected above the laboratory LODs in the porewater samples collected immediately west of the Central Landfill. This implies that the elevated COC concentrations measured in groundwater samples from wells MW1-17, MW1-42, MW1-43, MW1-44, and MW1-45 are not discharging to surface water in measurable concentrations, at least in the area where porewater was sampled. cVOC concentrations have been measured historically at surface water station MA11 in this area; however, the porewater sample data imply that these surface water concentrations are more likely the result of contaminated surface water flow from upstream than from groundwater discharge in the vicinity of MW1-17. It is possible that the substantial biodegradation along the groundwater to surface water pathway documented through past work by the USGS explains the lack of measurable cVOC concentrations in porewater in this area. Alternatively, cVOCs could be discharging to surface water at a location further north than where porewater samples were collected in 2017, and between surface water stations MA11 and MA-09. This is based on the apparent elongation of high cVOC concentrations beneath the Central Landfill in a southeast to northwest direction (Figure 3-7).

As discussed in Section 4.4.2, the pattern of cis-1,2-DCE distribution beneath the Central Landfill may indicate that groundwater containing cVOCs deeper in the aquifer is transported along a more regional flow direction to the northwest, rather than due west towards adjacent surface water bodies. This transport pathway and flow direction is consistent with past studies indicating ultimate discharge of groundwater in what was termed the “shallow” and “intermediate” aquifers in the tide flats and Dogfish Bay. This transport pathway is also consistent with the historical results at wells located northwest of the Central Landfill (see historical results for MW1-25 and MW1-28 on Figure 4-6 and 4-7, notwithstanding the isoconcentration contour patterns on these figures).

Well MW1-60, located along the base boundary on Keys Road, does not appear to be down groundwater gradient of the Central Landfill or South Plantation. TCE was detected in the groundwater sample from this well, at a concentration of 15.8 µg/L. No other cVOC was detected in this well. The TCE detection in this well should be verified through additional sampling before interpretations regarding contaminant transport are made based on this TCE result.

4.5.4 Transport of PCBs

Because the highest measured concentration of PCB was observed based on the PED sample collected from the monitoring well in the North Plantation (MW1-14), and because that concentration is an order of magnitude higher than any concentrations calculated based on PEDs placed in the marsh, it is likely that groundwater from the landfill area constitutes the source of PCB contamination to the creek. This transport pathway is consistent with the detection of PCBs in groundwater seeping from the landfill at seep SP1-1. Analysis of the spatial patterns in PCB concentration in PED samples (Figure 3-14) does not point to one particular discharge point. Instead, the contamination pattern seems consistent with the groundwater flow direction, which is northwest from station MW1-14 towards the two porewater samples exhibiting the highest PCB concentrations at stations MA-09 and MA-14. However, as discussed in Section 4.6 regarding the fate of PCBs, the PCB data collected at the site do not indicate a shift to lower chlorinated congeners, which would be expected with significant transport in groundwater. This lack of congener shift could imply that the source(s) of the PCBs are relatively close to the locations where PCBs are observed.

At the locations where both porewater and surface water concentrations were available, flux of dissolved PCBs between porewater and overlying water was also calculated. The flux varied from 292 µg/m^2/yr at the new upstream station (PED-06) to 1068 µg/m^2/yr at station MA-14 (PED-02). All calculated fluxes had positive values meaning that the direction of the diffusive flux is from porewater to surface water and that the sediment constitutes a source of contamination to the creek water. Sediment contamination may be historical or from ongoing sources (e.g. contaminated groundwater discharge), or from a combination of historical and ongoing sources.

Figure 6-19 of the Keyport OU 1 ROD (U.S. Navy, et al., 1998) presents the mean concentration over five sampling rounds in 1995 and 1996 of total PCB Aroclors. The carbon-normalized mean value for station MA-09 at the time of the ROD is shown as 29.2 mg/kg, which is very similar to 2017 carbon-normalized value of 29.38 mg/kg at this station. Station MA-09 was called out in the ROD as the one station not meeting the sediment quality standards at the time of the ROD. The sediment remedy described in the ROD was intended to “focus on removing those sediments that are suspendible in the water column and subject to migration via tidal action and stream flow. Sediments that are stabilized by the root structure of the wetlands plant community will be left in place to the extent feasible.” Based on the selective removal of sediments and the composite sediment sampling approach implemented in 2017, the PCB concentration at station MA-09 may reflect concentrations in this area present since the time of the ROD, rather than a temporal increase in concentrations since remedy implementation.

4.6 FATE OF CHEMICALS OF CONCERN

This section evaluates the natural attenuation parameters and microbial analysis results to update the understanding of the fate of the cVOCs in the CSM. Tables 3-17 and 3-18 provide the MNA parameter results from the laboratory analyses and field collection, respectively. Table 3-19 presents the results of the microbial analyses which were performed at selected wells in the Central Landfill (MW1-46, MW1-47, and MW1-48) and Southern Plantation (MW1-50, MW1-52, MW1-56, and MW1-57).

As documented through previous USGS studies (USGS 2012, 2015), the groundwater environment in both the Central Landfill and South Planation has been reported to be conducive for biodegradation of cVOCs. The natural attenuation parameters measured in 2017 were consistent with USGS measurements (Table 3-17 and Table 3-18). Specifically, dissolved oxygen (DO), nitrate, and nitrite concentrations were less than 1 mg/L with the exceptions of MW1-45and MW1-48 for DO, and ferrous iron levels were observed throughout the aquifer in both the Central Landfill and South Planation. These parameters indicate the reducing environment necessary to support biodegradation of the cVOCs via reductive dechlorination is prevalent throughout the site.

The microbial analyses performed in 2017 provide further supporting evidence for the conclusions drawn by the USGS (Table 3-19). In the Central Landfill, the highest concentrations of microorganisms were found in MW1-47 and MW1-48 where not only general bacteria but also halorespiring bacteria were detected at levels $>10^4$ cells/mL, which is a threshold for active dechlorination. Additionally, sulfate reducers were observed at all locations and support the observed dechlorination of TCE to 1,2-cis-DCE throughout the Central Landfill. In the South Plantation, the microbial analyses in monitoring wells MW1-50, MW1-52, and MW1-57 (16 and 34 ft bgs depth) showed levels $\leq 10^3$ cells/mL for halorespiring bacteria and functional genes, and the general bacterial levels (e.g., EBAC, sulfate reducers, methanogens) were an order of magnitude lower than at MW1-48. Even with lower levels of detected bacteria, the cVOCs in groundwater demonstrate ongoing reduction dechlorination in these wells. In contrast at MW1-56 and MW1-57 at the 10 ft bgs depth, the results of the microbial analyses (bacteria and functional genes) were negligible to non-detect. The results at these locations, where high levels of cVOCs were detected, do not suggest a robust dechlorinating community and suggest high levels of cVOCs may inhibit dechlorinating activity. Overall, the microbial analyses indicate active dechlorination is occurring throughout both the Central Landfill and South Planation with the exception of highly contaminated areas.

PCBs can be biotransformed under aerobic and anaerobic environments. Under anaerobic conditions, chlorine can be removed via reductive dechlorination and lesser chlorinated congeners can be formed. If dechlorination can reduce the congeners sufficiently, then cometabolic processes can occur under aerobic conditions to complete mineralization of the congeners. While these biologic processes are slow, they may contribute to the natural attenuation of the PCB contamination. In addition, PCBs have low solubility and tend to sorb to organic material rather than be transported through groundwater.

The PCB data collected at the site do not indicate a shift to lower chlorinated congeners, implying that the source(s) of the PCBs are relatively close to the locations where PCBs are observed.

4.7 RISK IMPLICATIONS OF PCB CONCENTRATIONS MEASURED IN 2017

This section evaluates the human health and ecological risk implications of the PCB concentrations measured in sediment, pore water, and surface water during the 2017 investigation. This preamble summarizes the findings that are discussed in more detail in subsections 4.7.1 and 4.7.2.

The 2017 sampling program included collection of six sediment samples (including a field duplicate for MA-14) and analysis using both Aroclor and PCB congener methods. The Aroclor analysis results were used for comparison to historical sampling events that have been conducted at OU-1 from 1996 to 2009. PCB congener analysis results in sample detection limits that average 400 times lower than Aroclor analysis (Ecology, 2014). Thus, comparison of PCB congener analysis results to SCOs gives greater confidence that PCB sediment concentrations are indeed lower than the SCO.

For human health risk, the 2017 sediment data were compared to natural background for marine sediment which indicated the potential for adverse risk at all of the sediment sampling locations. A more detailed risk evaluation will be conducted for exposure to sediment at these locations in the future.

For ecological risk based on the sediment results for PCBs, the 2017 data indicate a limited area of sediments where minor adverse effects to the benthic community could occur in vicinity of station MA-09, but no adverse effects are predicted for the rest of the area. To assess bioaccumulative exposures, sediment concentrations observed in Marsh Creek sediment were averaged on an area-weighted basis for comparison to the natural background value. The area-weighted dioxin-like PCB congener TEQ is 2.7 ng/kg (0.0027 µg/kg), which exceeds the natural background upper tolerance limit of 0.2 ng/kg for marine sediment in Washington (Ecology, 2017).

The ecological risk evaluation compared the pore water and surface water results to the Water Quality Standards (WQS) for Washington State, and found that the potential for adverse effects for ecological exposure to PCBs in porewater and surface water is low. Conversely, comparison of surface water results to the human health water quality criteria for consumption of organisms (WAC 173-201A), indicates that there is a potential for adverse effects to human receptors from PCBs in surface water.

4.7.1 Human Health

Sediment

To assess whether exposure to PCBs measured in the 2017 sediment samples may be associated with adverse health effects, the approach described in Option 1, Part 1 of the SCUM II guidance was followed per the 2013 Sediment Management Standards (SMS), Chapter 173-204 (WAC 173-204-561) and the Sediment Cleanup User's Manual II (SCUM II) guidance (Ecology, 2017). Under Option 1, it is assumed that risk-based sediment concentrations based on the consumption of fish/shellfish exposure pathway by human are below background concentrations and because it is not feasible to clean up below background concentrations, Option 1, Part 1, represents a simpler, more practical, and protective approach (Ecology, 2017). Although there is not an established regional background data set for Liberty Bay, the measured PCB concentrations are compared to the BOLD data set as Ecology has determined it to be appropriate to establish natural background for marine sediment (Ecology, 2017).

PCB concentrations detected in sediment samples were evaluated as total PCBs and as dioxin-like PCBs. Total PCB concentrations were estimated for each sediment sample by summing the concentrations of all detected congeners (out of the 209 congeners analyzed for). Congeners that were not detected above associated laboratory LODs were not included in the total PCB sum. For coeluting congeners, a single result was included in the summation. For PCB dioxin-like congeners (i.e., PCB-077, PCB-081, PCB-105, PCB-114, PCB-118, PCB-123, PCB-126, PCB-156, PCB-157, PCB-167, PCB-169, and PCB-189), PCB TEQ concentrations were estimated for the 12 coplanar congeners based on the Kaplan-Meier method for computing a sum using USEPA's Excel TEQ calculator found here: https://www.epa.gov/superfund/risk-assessment-dioxin-superfund-sites). Per instructions for the TEQ calculator, for coeluting congeners, specifically PCB-156 and PCB-157, the data for PCB-156 was included in the TEQ calculator, while that of PCB-157 was not included. Output from the USEPA TEQ calculator is provided in Appendix I.

Table 4-2 provides a comparison of the total PCB and PCB TEQ concentrations estimated for each sediment sample to the natural background upper tolerance limit of 0.2 ng/kg (0.0002 µg/kg) for PCB TEQ in marine sediment and 3,500 ng/kg (3.5 µg/kg) for total PCBs in marine sediment. For total PCBs, all samples are higher than the natural background concentration. For PCB TEQs, concentrations in all of the sediment samples are higher than natural background (Table 4-2). The results of these comparisons indicate potential risk for human receptors. Note however, that the results of the comparison to natural background is a very preliminary evaluation of potential risks. These potential risks will be evaluated in more detail by conducting a human health risk assessment in the future.

Aqueous

As described in Section 2.8, total PCB concentrations[2] were estimated using PED samplers in shallow groundwater in the landfill and below (porewater) and above (surface water) the sediment-water interface in Marsh Creek and at the mouth of the tidal marsh (TF-21 in Figure 3-14). Table 3-26 provides the calculated total dissolved PCB concentrations. Total PCBs were estimated by summing the concentrations of all congeners detected on the PED medium. The estimated total PCB concentrations range from 0.49 ng/L (PED-06 – surface water) to 129 ng/L (PED-09/MW1-14 - groundwater). The elevated PCB concentration in groundwater in MW1-14 indicates that a source of PCBs may exist in the landfill.

As a conservative, preliminary evaluation, sediment porewater, surface water, and groundwater total PCB concentrations (Table 3-26) were compared to the state's surface water criterion of 0.17 ng/L for human health (criteria for consumption of organisms in WAC 173-201A, Table 240). Concentrations of total PCBs estimated at all aqueous sampling locations were greater than the surface water criterion. Based on the comparison to the human health WQS, there is a potential for adverse effects to human receptors from PCBs in porewater, surface water, and groundwater.

Additional investigation to better identify the source of the detected PCB contamination is planned in 2019, during ongoing site recharacterization activities. An update of the human health and ecological risk assessment, including evaluation of all potential contaminants, is also planned to begin in late 2019 based on the redefined magnitude and extent of contamination identified during the 2017 investigation. If ongoing investigations or the planned update of the human health and ecological risk assessment identify consumption of organisms as a complete pathway, the existing CSM will be updated and alternative technologies to address sediment contamination will be evaluated.

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[2] Calculated as the sum of 203 congeners with undetected congeners treated as zero. See Section 3.4.2 for more details.

4.7.2 Ecological

Sediment

Table 3-24 summarizes the results of the Aroclor analysis for sediment samples collected in the 2017 event and provides an historical comparison with PCB concentrations for select OU1 sediment stations collected between 1996 and 2009. Sediment samples from MA-09 and MA-14 collected in 2000 exceeded the marine apparent effects threshold (AET) SCOs listed in Table 8-1 of the SCUM II guidance (Ecology, 2017). Note the Aroclor concentrations from 2000 were compared to the dry weight based marine AET because organic carbon data were not available for the 2000 sampling event. PCB concentrations detected at these sample locations in 2002, 2004, and 2009 were 1-2 orders of magnitude lower than the previous years and less than the SMS TOC normalized SCOs. The PCB concentration detected at station MA-09 in 2017, however, has increased since 2009 to concentrations greater than the SMS marine SCO. The recent PCB concentration detected at station MA-09 in 2017 is the highest concentration that has been reported at this station, and is also the highest sediment PCB concentration reported at OU 1 historically. It is not clear, however, that this represents an increasing trend in PCB concentration in Marsh Creek sediments. The sampling method used in the 2017 sampling event employed collection of a composite of three locations within a 20 ft radius of the historic MA-09 station, and the higher result may represent spatial variation. Aroclors were not detected in the samples collected from the remaining sampling stations in 2017.

As congener analysis was conducted for the 2017 sampling event, total PCBs also were estimated by summing the concentrations of all detected congeners (Table 3-22). Because Marsh Creek is a low salinity estuarine habitat, the sediment concentrations were compared to both freshwater and marine SCOs and the contaminant screening level (CSL) listed in Table 8-1 of the SCUM II guidance (Ecology, 2017). The measured PCB concentration values in Marsh Creek were normalized to TOC in units of mg PCB per kg organic carbon (OC) for comparison to the marine SCO and CSL. The total PCB concentration estimated at MA-09 (830 µg/kg or 51.9 mg/kg OC) exceeded both the freshwater SCO (110 µg/kg) and marine sediment SCO (12 mg/kg OC). The total PCBs estimated in the other Marsh Creek sediment samples do not exceed either the freshwater or marine SCOs. The total PCB concentration estimated at the TF-21 location in the tidal flat area (3.8 mg/kg OC) did not exceed the marine SCO. Sediment values at or below the SCO are predicted to have no adverse effects on the benthic community. Sediment values above the SCO but at or below the CSL are expected to have minor adverse effects on the benthic community. The maximum total PCB concentration of 830 µg/kg (51.9 mg/kg OC) at station MA-09 exceeds the SCO, but it is below the freshwater CSL of 2,500 µg/kg and the marine CSL of 65 mg/kg OC. In summary, the 2017 sampling results for PCBs indicate a limited area of sediments where minor adverse effects to the benthic community could occur, but no adverse effects are predicted for the rest of the area.

Numeric bioaccumulative CSLs for sediment have not been promulgated by rule and are currently established on a site-specific basis (Ecology 2017). Risk-based sediment concentrations of bioaccumulative chemicals such as dioxin-like PCB congeners based on the consumption of fish/shellfish exposure pathway by higher trophic level receptors (e.g., fish-eating mammals and birds) can be assumed to be below background concentrations. Therefore, the ecological risks to higher trophic level receptors at OU 1 were evaluated under Option 1 by comparing dioxin-like PCB TEQ concentrations to natural background as described in Chapter 9 in the SCUM II (Ecology 2017). Because bioaccumulative exposures occur on an area-wide basis, sediment concentrations observed in Marsh Creek sediment were averaged on an area-weighted basis for comparison to the natural background value.

Sample TEQs were estimated using the 12 dioxin-like PCB congener concentrations (i.e., PCBs 77, 81, 105, 114, 118, 123, 126, 156, 157, 167, 169 and 189) consistent with the current SMS framework. Calculations are presented in Appendix H. Kaplan-Meier estimated TEQs range from 0.0004 µg/kg (SP1-1) to 0.0118 µg/kg (MA-09). However, these values are considered highly uncertain as the two coplanar congeners, PCBs 126 and 169 —which were not detected in any of the sediment samples— contribute between 78 (MA-09) to 97 (MA-19) percent of the total TEQ due to the magnitude of their TEFs (i.e., 0.1 and 0.03, respectively). An area-weighted average TEQ was calculated for the four sediment samples, MA-14, MA-09, SP1-1, and MA-19, collected in the Marsh Creek estuarine area. The areas of the polygons used to represent each sampling station are provided in Appendix I. The result for the tidal flat sample station TF-21 was not included in the average because the tidal flat is a marine environment. The area-weighted dioxin-like PCB congener TEQ is 2.7 ng/kg (0.0027 µg/kg), which exceeds the natural background upper tolerance limit of 0.2 ng/kg for marine sediment in Washington (Ecology, 2017).

Aqueous

As described in Section 2.8, total PCB concentrations[3] were estimated using PED samplers in shallow groundwater in the landfill and below (porewater) and above (surface water) the sediment-water interface in Marsh Creek and at the mouth of the tidal marsh (TF-21 in Figure 3-14). Table 3-26 provides the calculated total dissolved PCB concentrations. Total PCBs were estimated by summing the concentrations of all congeners detected on the PED medium. The estimated total PCB concentrations range from 0.49 ng/L (PED-06 – surface water) to 129 ng/L (PED-09/MW1-14 - groundwater). The elevated PCB concentration in groundwater in MW1-14 indicates that a source of PCBs exists in the landfill. The landfill groundwater PCB

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[3] Calculated as the sum of 203 congeners with undetected congeners treated as zero. See Section 3.4.2 for more details.

concentrations calculated from PEDs deployed in the two monitoring wells and two piezometers are not evaluated here in the context of ecological risk because ecological receptors are not directly exposed to groundwater.

Only the estimated total dissolved PCB concentrations in sediment porewater and surface water (determined from the PEDs deployed across the sediment-water interface in Marsh Creek and the Tide Flats) are evaluated with regard to potential ecological risk. Sediment porewater and surface water PCB concentrations (Table 3-26) were compared to both the freshwater and marine chronic WQS for Surface Waters of Washington because Marsh Creek is an estuarine environment with fluctuating salinity levels (Ecology, 2016). The highest porewater concentration at MA-09 (PED-03) (14.6 ng/L) slightly exceeds the freshwater chronic standard (14 ng/L) but does not exceed the marine standard (30 ng/L) or the surface water RG of 40 ng/L established in the ROD. The surface waters displayed a narrow range of concentrations (0.5 to 0.8 ng/L) which were all below the more stringent freshwater chronic standard. Based on the comparison to WQS, the potential for adverse effects for ecological exposure to PCBs in porewater and surface water is low.

4.8 EVALUATION OF DATA RELEVANT TO REMEDIAL TECHNOLOGY SCREENING

This section evaluates the implications of the 2017 data with regard to the screening of remedial technologies that was developed as part of team meetings during SAP preparation. Following discussion with the project team on the draft version of this report, updates to the technology screening matrix are deferred until additional data are obtained.

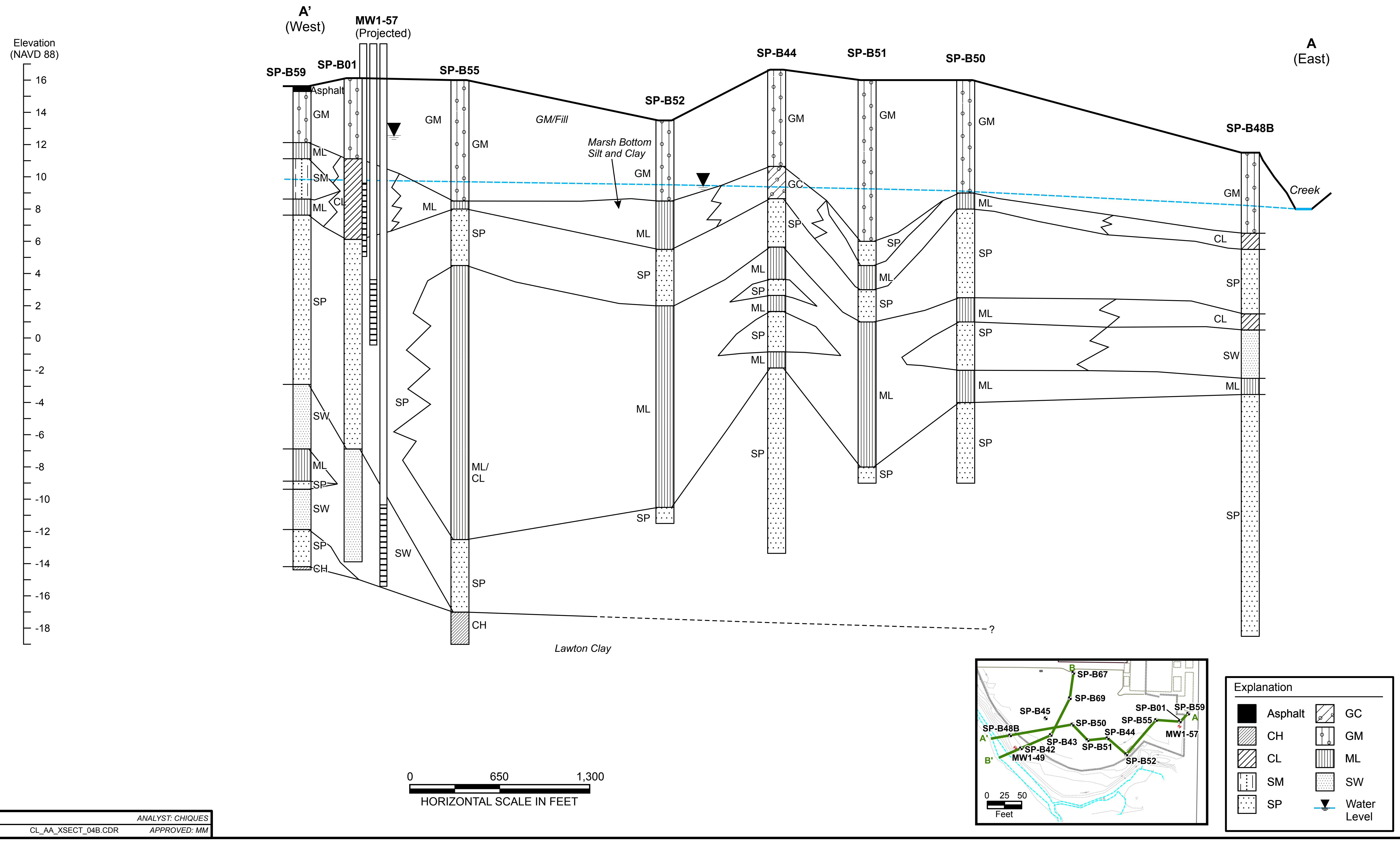
The objective of the investigations reported in this document (Section 1.2.4) was to collect the data needed to evaluate additional remedial alternatives for hotspot treatment to reduce the restoration timeframe. Hotspots, as defined by the project team in the SAP, are identified in Section 4.4.3, and consist of one area in the Central Landfill and two areas in the South Plantation with evidence of NAPL and VOC concentrations significantly higher than other nearby areas.

The presence of NAPL in these hotspots, combined with the flat cVOC trends at several monitoring points over the last two decades of monitoring, implies that the restoration timeframe under existing conditions cannot be meaningfully delimited and is probably on the order of hundreds of years. Treatment of these hotspot areas to remove NAPL and decrease dissolved concentrations by 2 to 3 orders of magnitude could allow natural biodegradation to begin in these areas and subsequently reduce the restoration timeframe. However, given the widespread occurrence of cVOC concentrations exceeding the RG by several orders of magnitude outside of the hotspot areas, even after aggressive treatment of the hotspots, residual COC concentrations throughout the Central Landfill and South Plantation likely imply a restoration timeframe exceeding 100 years, as a result of back diffusion from fine-grained interbeds. The planned USGS groundwater and contaminant transport model (mentioned in Section 4.3) will be expanded to including modeling of contaminant fate, and will better provide quantitative estimates of restoration timeframe under various treatment scenarios.

A key finding of the Phase II investigation relative to technology screening is the vertical location of high COC concentrations relative to the waste body of the landfill. A substantial COC mass is present below the waste body in native materials, which consist of an interbedded sequence of fine sand, silt, and clay. These native materials are more homogenous than the waste, allowing for consideration of technologies that previously appeared less feasible because of the presence of debris in the landfill.

Other findings of the Phase II investigation that allow refinement of the technology screening include:

1. Identification of the presence of free product within the landfill, which was surmised to be present at the time of the ROD, but not directly observed.
2. Demonstration, through field screening of continuous cores and the MIP logs, that matrix diffusion effects should be considered in the conceptual site model. Elevation of cVOC concentrations in finer-grained materials indicate that cVOCs have diffused into these finer-grained materials and that treatment focused on coarser-grained materials will likely result in prolonged back diffusion.
3. Detection of halorespiring bacteria at levels indicative of active dechlorination, supporting past findings of on-going biodegradation at the site. However at locations where high levels of cVOCs were detected, an apparent absence of halorespiring bacteria suggests that high levels of cVOCs may inhibit dechlorinating activity.

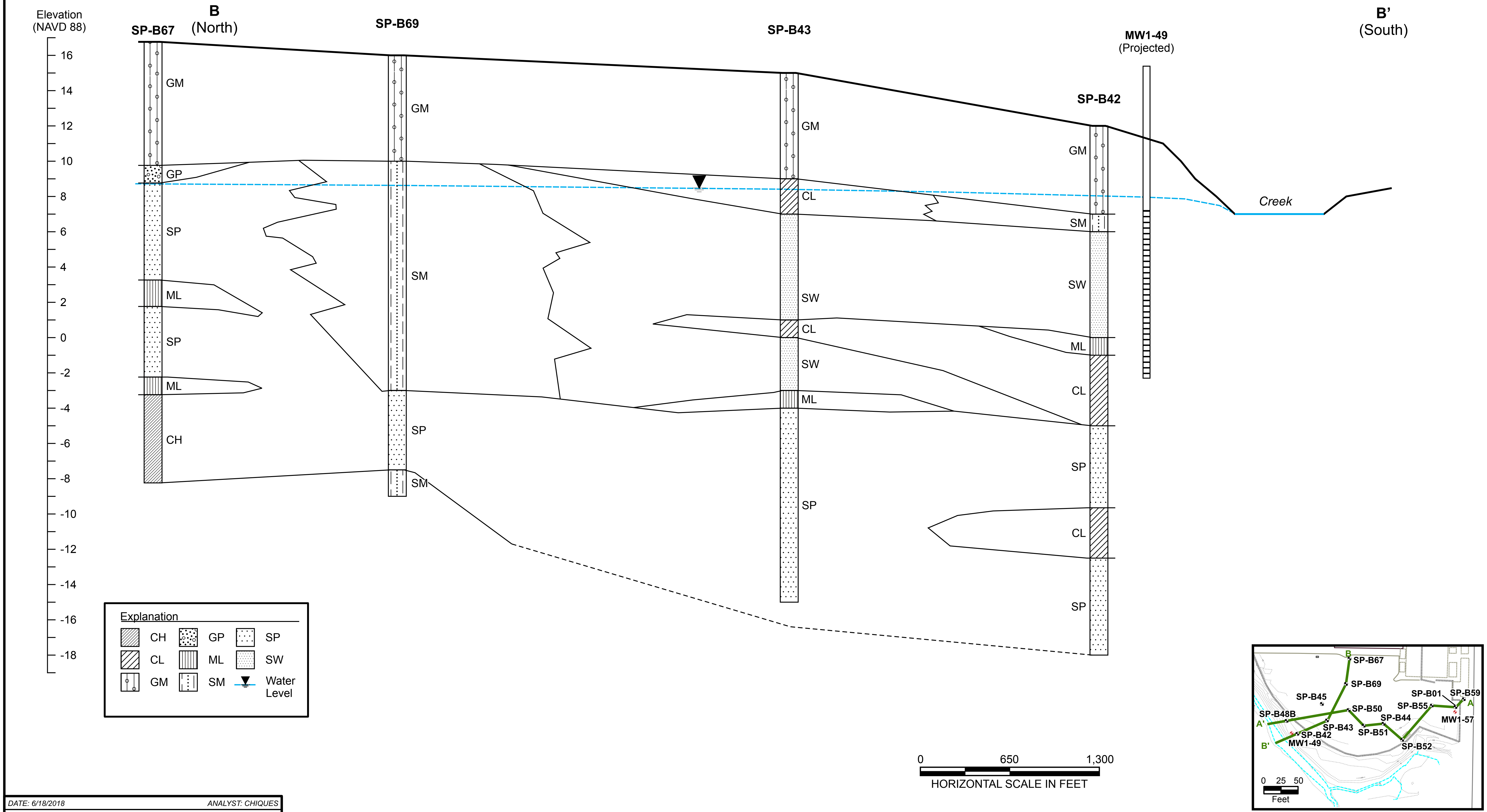


DATE: 6/18/2018 ANALYST: CHIQUES
REV. 3 CL_AA_XSECT_04B.CDR APPROVED: MM

U.S. NAVY

Figure 4-1. South Plantation Cross Section A-A' at OU 1

Naval Base Kitsap
Keyport



DATE: 6/18/2018 ANALYST: CHIQUES
REV. 3 CL_CC_XSECT_04B.CDR APPROVED: MM

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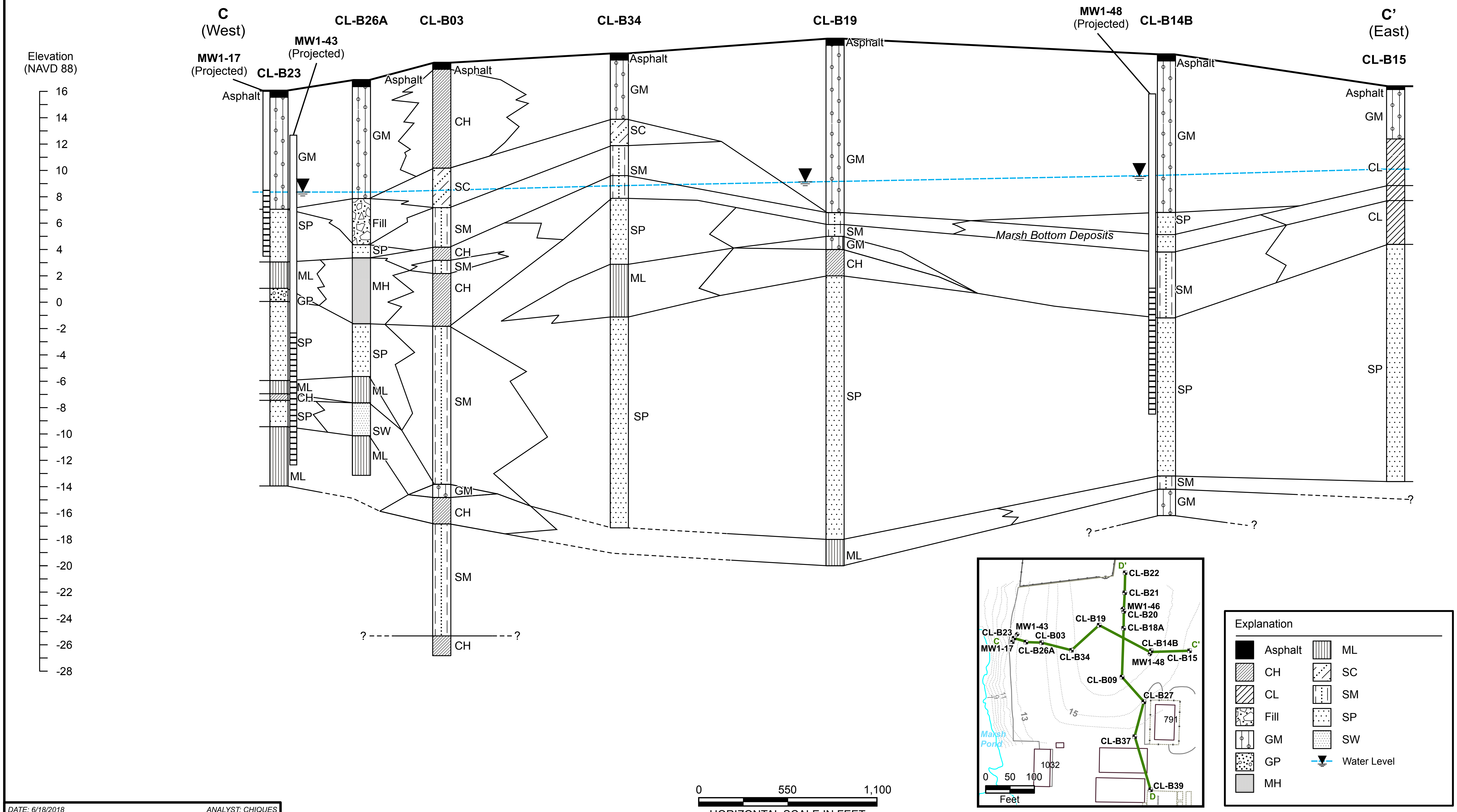
Figure 4-2
South Plantation Cross Section B-B' at OU 1

Naval Base Kitsap
Keyport

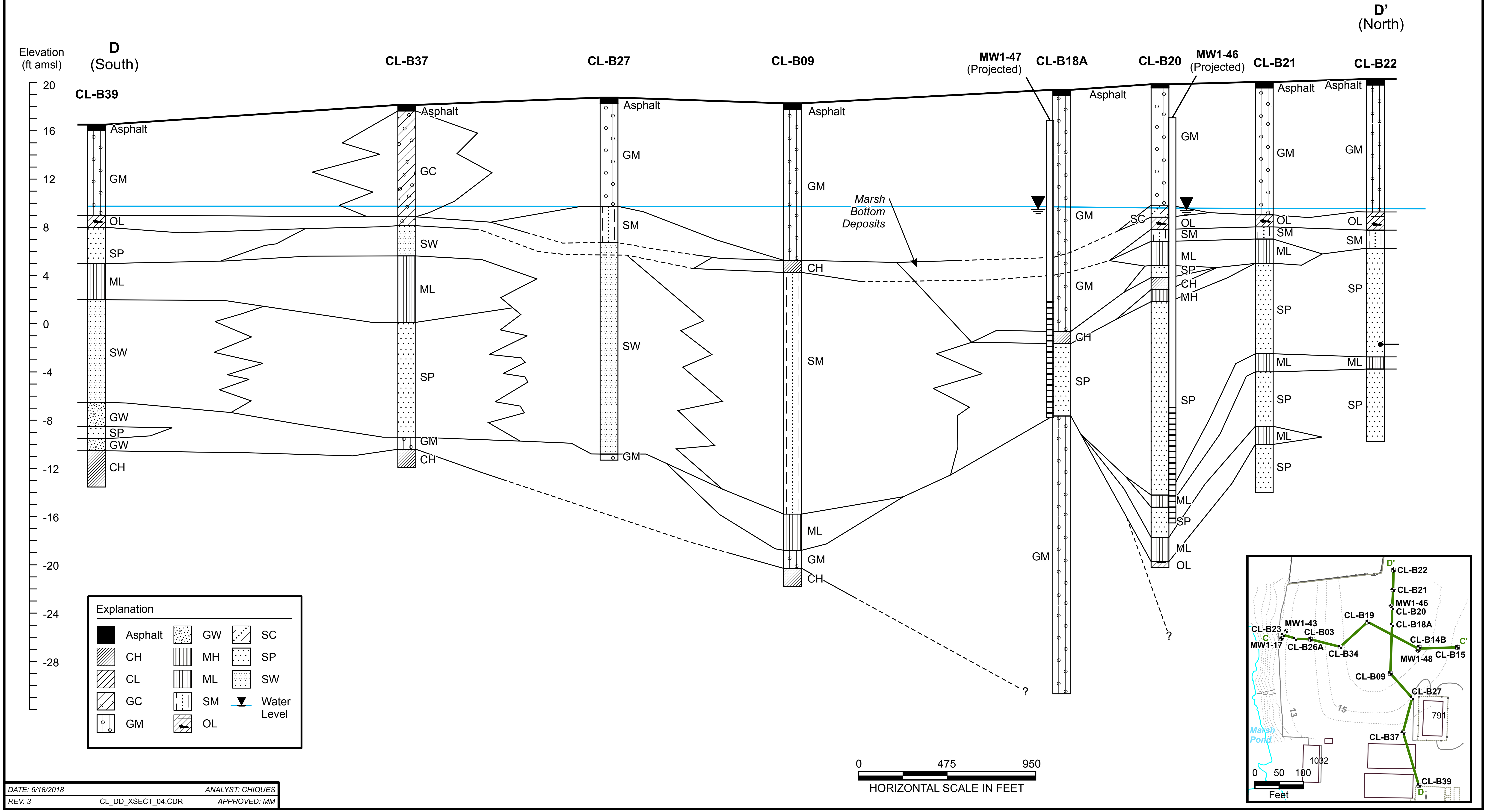


DATE: 6/18/2018 ANALYST: CHIQUES
REV. 3 CL_CC_XSECT_03.CDR APPROVED: MM

U.S. NAVY

Figure 4-3
Central Landfill Cross Section C-C' at OU 1

Naval Base Kitsap
Keyport



DATE: 6/18/2018 ANALYST: CHIQUES
REV. 3 CL_DD_XSECT_04.CDR APPROVED: MM

U.S. NAVY

Figure 4-4
Central Landfill Cross Section D-D' at OU 1

Naval Base Kitsap
Keyport

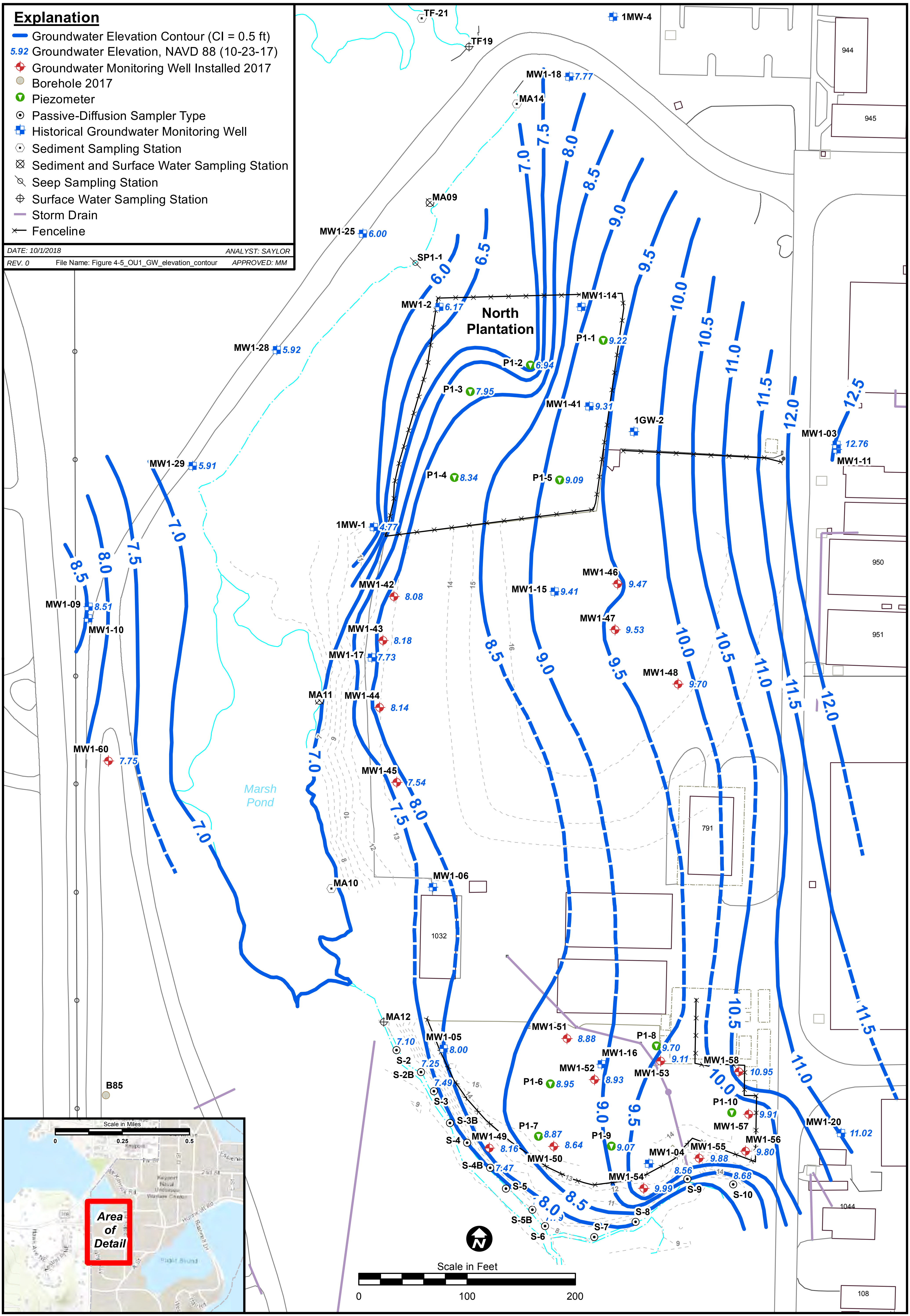


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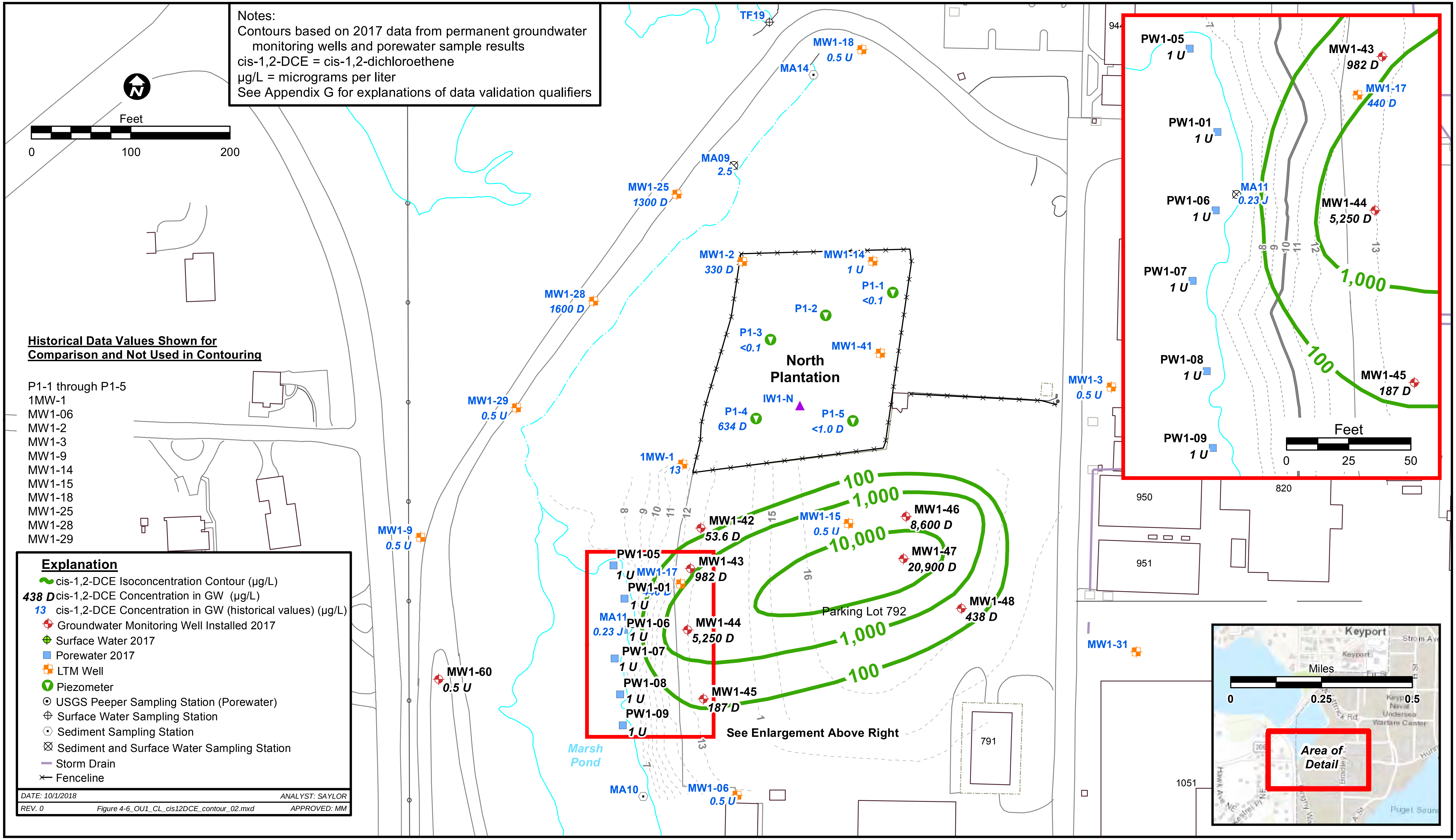
Figure 4-5
Groundwater Elevation Contour Map

Naval Base Kitsap
Keyport



Notes:
Contours based on 2017 data from permanent groundwater monitoring wells and porewater sample results
cis-1,2-DCE = cis-1,2-dichloroethene
µg/L = micrograms per liter
See Appendix G for explanations of data validation qualifiers

Historical Data Values Shown for Comparison and Not Used in Contouring

P1-1 through P1-5
1MW-1
MW1-06
MW1-2
MW1-3
MW1-9
MW1-14
MW1-15
MW1-18
MW1-25
MW1-28
MW1-29

Explanation

〰	cis-1,2-DCE Isoconcentration Contour (µg/L)
438 D	cis-1,2-DCE Concentration in GW (µg/L)
13	cis-1,2-DCE Concentration in GW (historical values) (µg/L)
⊕	Groundwater Monitoring Well Installed 2017
⊕	Surface Water 2017
■	Porewater 2017
⊞	LTM Well
▼	Piezometer
⊙	USGS Peeper Sampling Station (Porewater)
⊕	Surface Water Sampling Station
⊙	Sediment Sampling Station
⊗	Sediment and Surface Water Sampling Station
—	Storm Drain
✕	Fenceline

DATE: 10/1/2018 ANALYST: SAYLOR
REV. 0 Figure 4-6_OU1_CL_cis12DCE_contour_02.mxd APPROVED: MM

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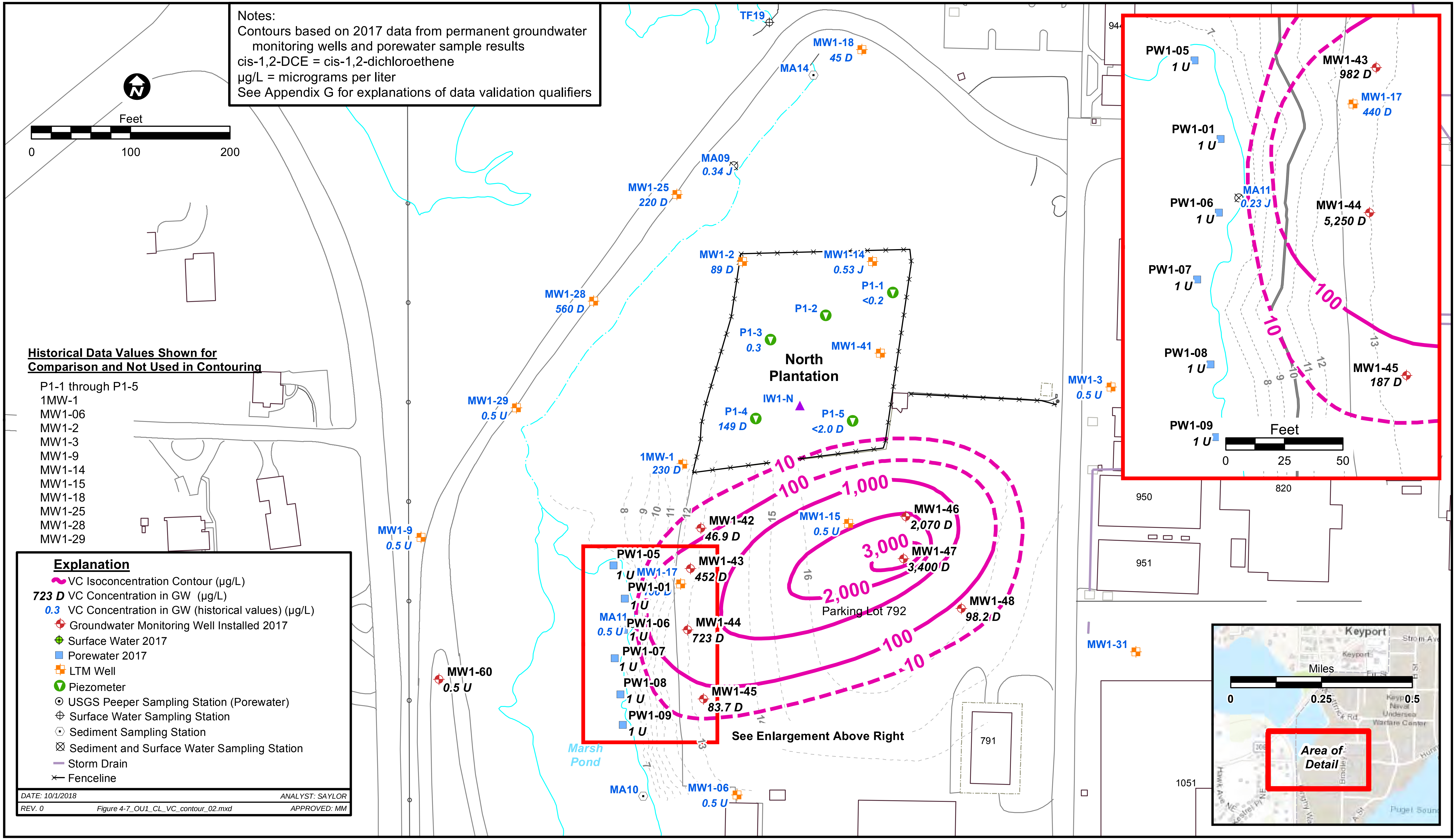
Figure 4-6
cis-1,2-DCE Isoconcentration Contours in Groundwater (Central Landfill)

Naval Base Kitsap
Keyport



Notes:
Contours based on 2017 data from permanent groundwater monitoring wells and porewater sample results
cis-1,2-DCE = cis-1,2-dichloroethene
µg/L = micrograms per liter
See Appendix G for explanations of data validation qualifiers

Historical Data Values Shown for Comparison and Not Used in Contouring

P1-1 through P1-5
1MW-1
MW1-06
MW1-2
MW1-3
MW1-9
MW1-14
MW1-15
MW1-18
MW1-25
MW1-28
MW1-29

Explanation

- VC Isoconcentration Contour (µg/L)
- *723 D* VC Concentration in GW (µg/L)
- *0.3* VC Concentration in GW (historical values) (µg/L)
- Groundwater Monitoring Well Installed 2017
- Surface Water 2017
- Porewater 2017
- LTM Well
- Piezometer
- USGS Peeper Sampling Station (Porewater)
- Surface Water Sampling Station
- Sediment Sampling Station
- Sediment and Surface Water Sampling Station
- Storm Drain
- Fenceline

DATE: 10/1/2018 ANALYST: SAYLOR
REV. 0 Figure 4-7_OU1_CL_VC_contour_02.mxd APPROVED: MM

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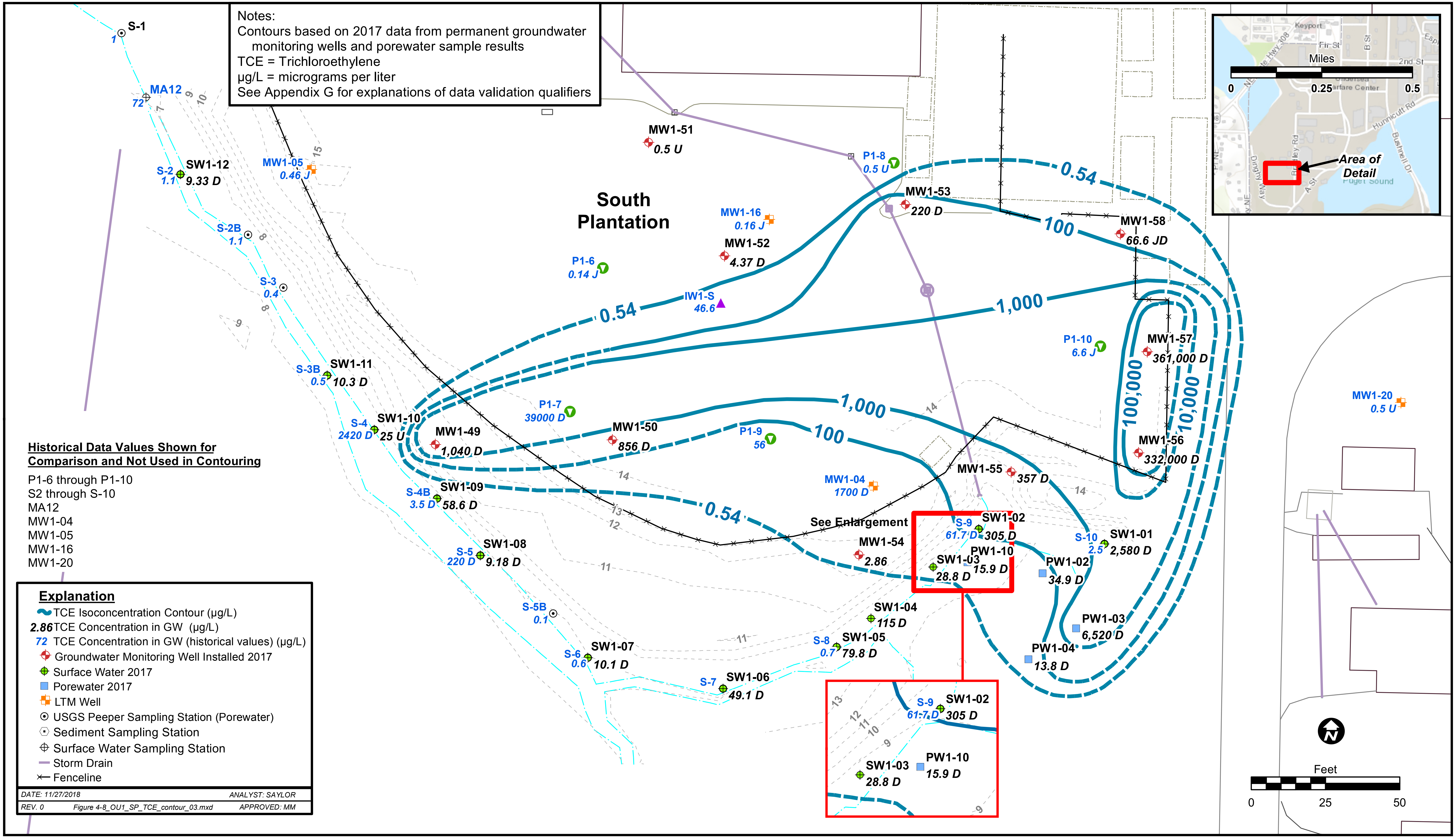
Figure 4-7
Vinyl Chloride Isoconcentration Contours in Groundwater (Central Landfill)

Naval Base Kitsap
Keyport



Notes:
Contours based on 2017 data from permanent groundwater monitoring wells and porewater sample results
TCE = Trichloroethylene
µg/L = micrograms per liter
See Appendix G for explanations of data validation qualifiers

Historical Data Values Shown for Comparison and Not Used in Contouring

P1-6 through P1-10
S2 through S-10
MA12
MW1-04
MW1-05
MW1-16
MW1-20

Explanation

~	TCE Isoconcentration Contour (µg/L)
2.86	TCE Concentration in GW (µg/L)
72	TCE Concentration in GW (historical values) (µg/L)
⊕	Groundwater Monitoring Well Installed 2017
⊕	Surface Water 2017
■	Porewater 2017
⊕	LTM Well
⊙	USGS Peeper Sampling Station (Porewater)
⊙	Sediment Sampling Station
⊕	Surface Water Sampling Station
—	Storm Drain
✕	Fenceline

DATE: 11/27/2018 ANALYST: SAYLOR
REV. 0 Figure 4-8_OU1_SP_TCE_contour_03.mxd APPROVED: MM

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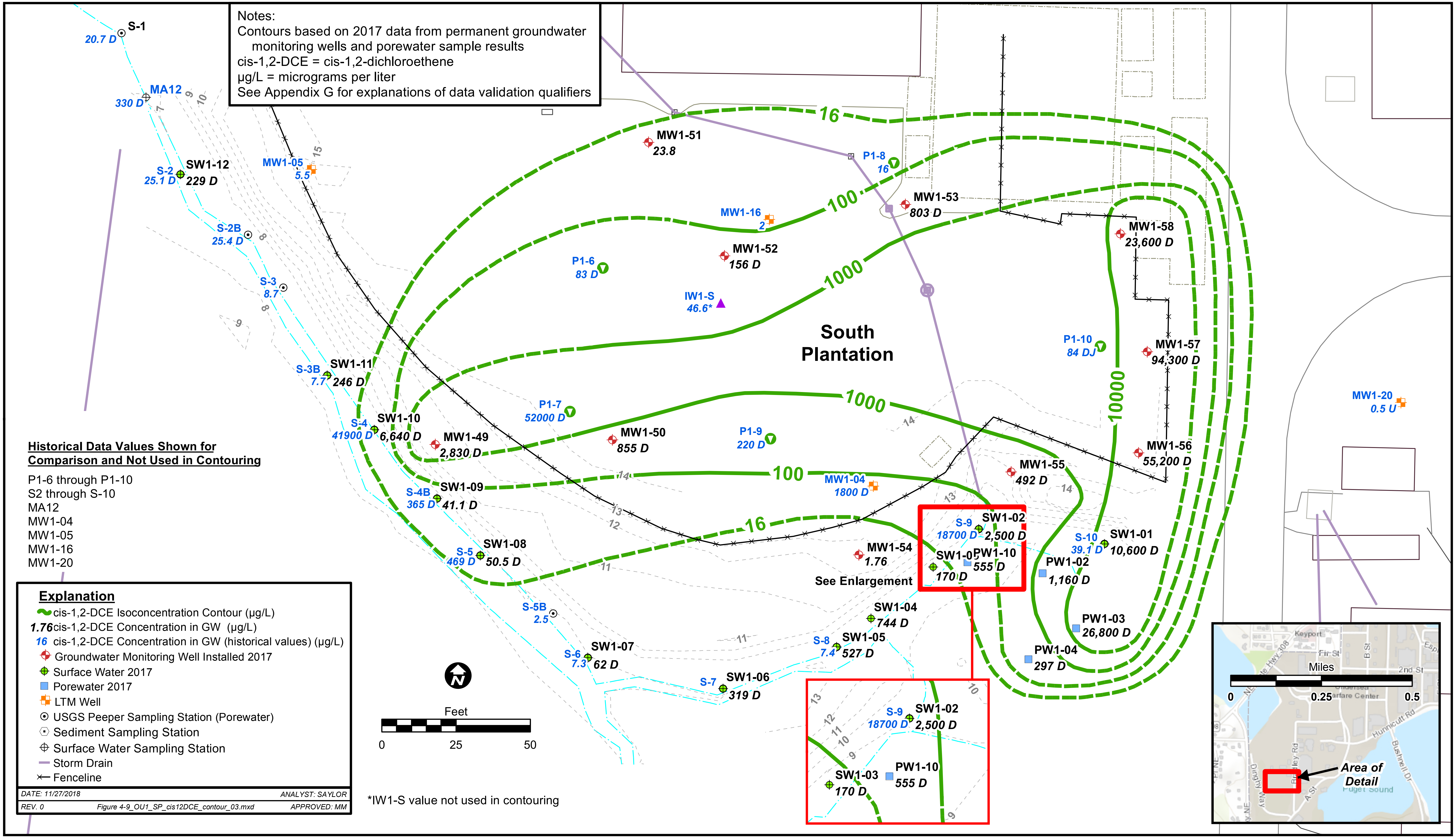
Figure 4-8
TCE Isoconcentration Contours in Groundwater (South Plantation)

Naval Base Kitsap
Keyport



Notes:
Contours based on 2017 data from permanent groundwater monitoring wells and porewater sample results
cis-1,2-DCE = cis-1,2-dichloroethene
µg/L = micrograms per liter
See Appendix G for explanations of data validation qualifiers

Historical Data Values Shown for Comparison and Not Used in Contouring

P1-6 through P1-10
S2 through S-10
MA12
MW1-04
MW1-05
MW1-16
MW1-20

Explanation

- cis-1,2-DCE Isoconcentration Contour (µg/L)
- 1.76 cis-1,2-DCE Concentration in GW (µg/L)
- 16 cis-1,2-DCE Concentration in GW (historical values) (µg/L)
- Groundwater Monitoring Well Installed 2017
- Surface Water 2017
- Porewater 2017
- LTM Well
- USGS Peeper Sampling Station (Porewater)
- Sediment Sampling Station
- Surface Water Sampling Station
- Storm Drain
- Fenceline

DATE: 11/27/2018 ANALYST: SAYLOR
REV. 0 Figure 4-9_OU1_SP_cis12DCE_contour_03.mxd APPROVED: MM

*IW1-S value not used in contouring

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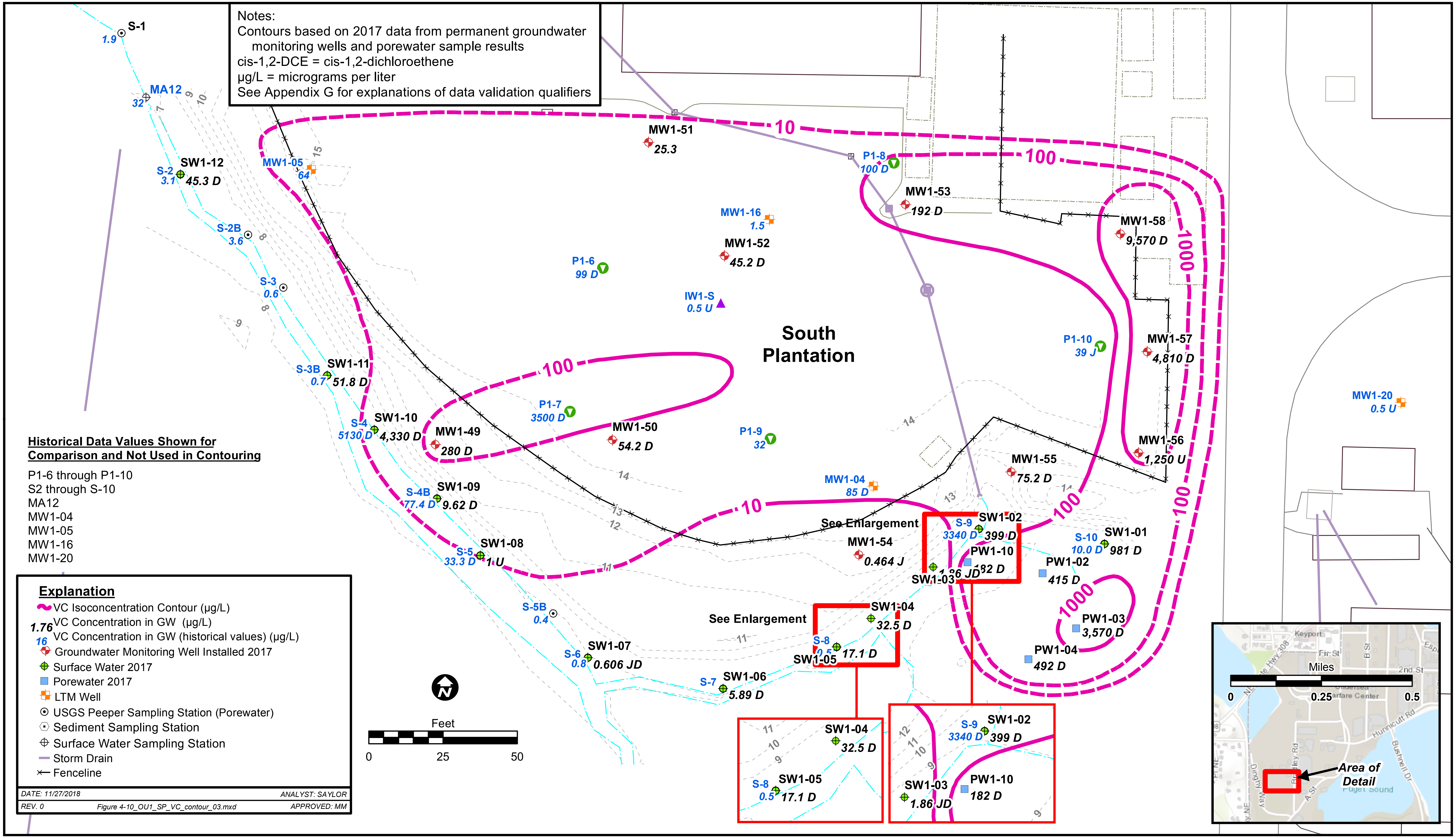
Figure 4-9
cis-1,2-DCE Isoconcentration Contours in Groundwater (South Plantation)

Naval Base Kitsap
Keyport



Notes:
Contours based on 2017 data from permanent groundwater monitoring wells and porewater sample results
cis-1,2-DCE = cis-1,2-dichloroethene
µg/L = micrograms per liter
See Appendix G for explanations of data validation qualifiers

Historical Data Values Shown for Comparison and Not Used in Contouring

P1-6 through P1-10
S2 through S-10
MA12
MW1-04
MW1-05
MW1-16
MW1-20

Explanation

- VC Isoconcentration Contour (µg/L)
- 1.76 VC Concentration in GW (µg/L)
- 16 VC Concentration in GW (historical values) (µg/L)
- Groundwater Monitoring Well Installed 2017
- Surface Water 2017
- Porewater 2017
- LTM Well
- USGS Peeper Sampling Station (Porewater)
- Sediment Sampling Station
- Surface Water Sampling Station
- Storm Drain
- Fenceline

DATE: 11/27/2018
ANALYST: SAYLOR
REV. 0
Figure 4-10_OU1_SP_VC_contour_03.mxd
APPROVED: MM

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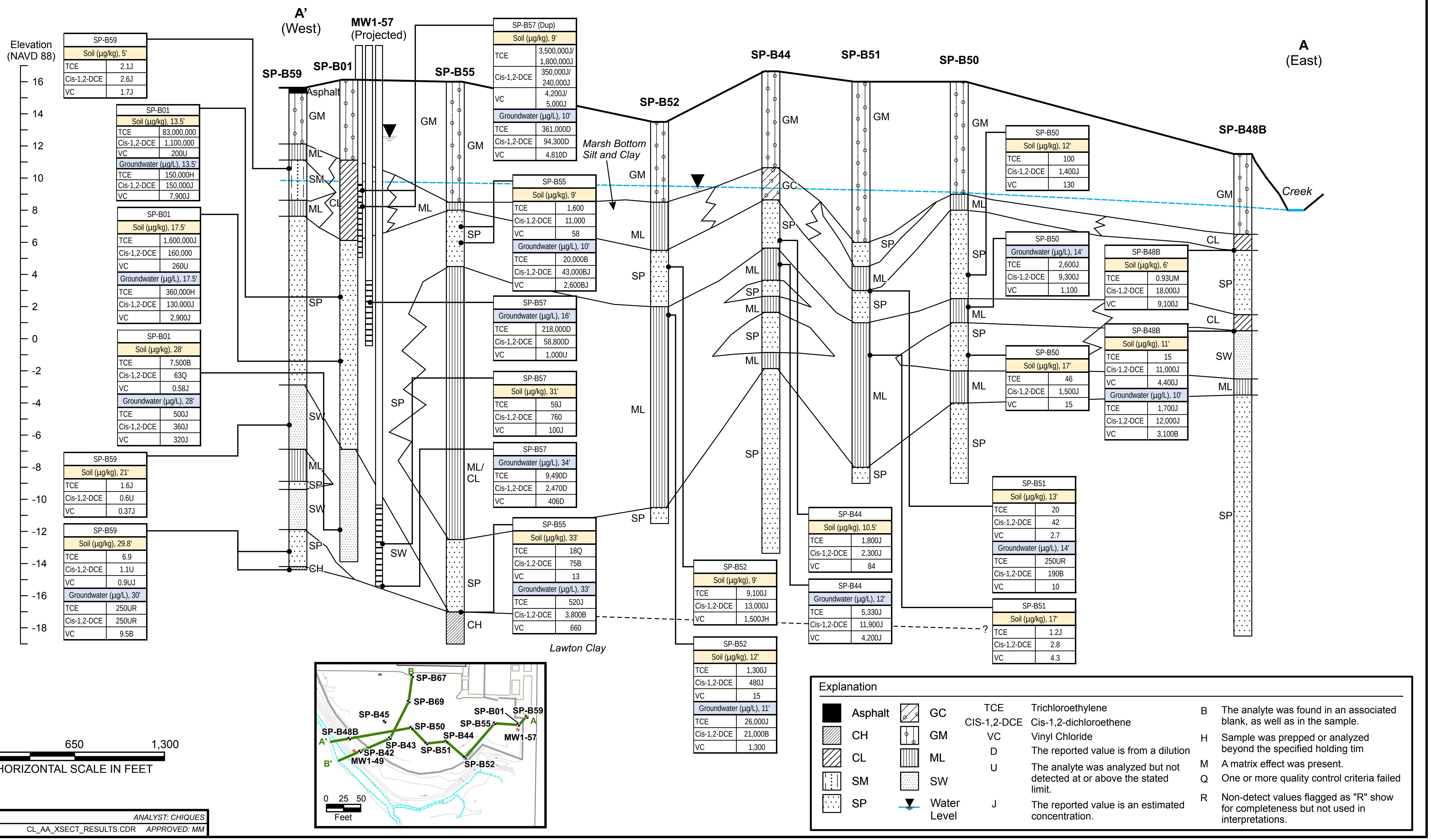
Figure 4-10
Vinyl Chloride Isoconcentration Contours in Groundwater (South Plantation)

Naval Base Kitsap
Keyport



SP-B59

Soil (µg/kg), 5'	
TCE	2.1J
Cis-1,2-DCE	2.6J
VC	1.7J

SP-B01

Soil (µg/kg), 13.5'	
TCE	83,000,000
Cis-1,2-DCE	1,100,000
VC	200U
Groundwater (µg/L), 13.5'	
TCE	150,000H
Cis-1,2-DCE	150,000J
VC	7,900J

SP-B01

Soil (µg/kg), 17.5'	
TCE	1,600,000J
Cis-1,2-DCE	160,000
VC	260U
Groundwater (µg/L), 17.5'	
TCE	360,000H
Cis-1,2-DCE	130,000J
VC	2,900J

SP-B01

Soil (µg/kg), 28'	
TCE	7,500B
Cis-1,2-DCE	63Q
VC	0.58J
Groundwater (µg/L), 28'	
TCE	500J
Cis-1,2-DCE	360J
VC	320J

SP-B59

Soil (µg/kg), 21'	
TCE	1.6J
Cis-1,2-DCE	0.6U
VC	0.37J

SP-B59

Soil (µg/kg), 29.8'	
TCE	6.9
Cis-1,2-DCE	1.1U
VC	0.9UJ
Groundwater (µg/L), 30'	
TCE	250UR
Cis-1,2-DCE	250UR
VC	9.5B

SP-B57 (Dup)

Soil (µg/kg), 9'	
TCE	3,500,000J/ 1,800,000J
Cis-1,2-DCE	350,000J/ 240,000J
VC	4,200J/ 5,000J
Groundwater (µg/L), 10'	
TCE	361,000D
Cis-1,2-DCE	94,300D
VC	4,810D

SP-B55

Soil (µg/kg), 9'	
TCE	1,600
Cis-1,2-DCE	11,000
VC	58
Groundwater (µg/L), 10'	
TCE	20,000B
Cis-1,2-DCE	43,000BJ
VC	2,600BJ

SP-B57

Groundwater (µg/L), 16'	
TCE	218,000D
Cis-1,2-DCE	58,800D
VC	1,000U

SP-B57

Soil (µg/kg), 31'	
TCE	59J
Cis-1,2-DCE	760
VC	100J

SP-B57

Groundwater (µg/L), 34'	
TCE	9,490D
Cis-1,2-DCE	2,470D
VC	406D

SP-B55

Soil (µg/kg), 33'	
TCE	18Q
Cis-1,2-DCE	75B
VC	13
Groundwater (µg/L), 33'	
TCE	520J
Cis-1,2-DCE	3,800B
VC	660

SP-B52

Soil (µg/kg), 9'	
TCE	9,100J
Cis-1,2-DCE	13,000J
VC	1,500JH

SP-B52

Soil (µg/kg), 12'	
TCE	1,300J
Cis-1,2-DCE	480J
VC	15
Groundwater (µg/L), 11'	
TCE	26,000J
Cis-1,2-DCE	21,000B
VC	1,300

SP-B44

Soil (µg/kg), 10.5'	
TCE	1,800J
Cis-1,2-DCE	2,300J
VC	84

SP-B44

Groundwater (µg/L), 12'	
TCE	5,330J
Cis-1,2-DCE	11,900J
VC	4,200J

SP-B50

Soil (µg/kg), 12'	
TCE	100
Cis-1,2-DCE	1,400J
VC	130

SP-B50

Groundwater (µg/L), 14'	
TCE	2,600J
Cis-1,2-DCE	9,300J
VC	1,100

SP-B50

Soil (µg/kg), 17'	
TCE	46
Cis-1,2-DCE	1,500J
VC	15

SP-B51

Soil (µg/kg), 13'	
TCE	20
Cis-1,2-DCE	42
VC	2.7
Groundwater (µg/L), 14'	
TCE	250UR
Cis-1,2-DCE	190B
VC	10

SP-B51

Soil (µg/kg), 17'	
TCE	1.2J
Cis-1,2-DCE	2.8
VC	4.3

SP-B48B

Soil (µg/kg), 6'	
TCE	0.93UM
Cis-1,2-DCE	18,000J
VC	9,100J

SP-B48B

Soil (µg/kg), 11'	
TCE	15
Cis-1,2-DCE	11,000J
VC	4,400J
Groundwater (µg/L), 10'	
TCE	1,700J
Cis-1,2-DCE	12,000J
VC	3,100B

Explanation

■	Asphalt	▨	GC
▨	CH	▥	GM
▨	CL	▥	ML
⁞	SM	░	SW
⁚	SP	▼	Water Level

TCE	Trichloroethylene
CIS-1,2-DCE	Cis-1,2-dichloroethene
VC	Vinyl Chloride
D	The reported value is from a dilution
U	The analyte was analyzed but not detected at or above the stated limit.
J	The reported value is an estimated concentration.
B	The analyte was found in an associated blank, as well as in the sample.
H	Sample was prepped or analyzed beyond the specified holding tim
M	A matrix effect was present.
Q	One or more quality control criteria failed
R	Non-detect values flagged as "R" show for completeness but not used in interpretations.

DATE: 3/13/2018 ANALYST: CHIQUES
REV. 2 CL_AA_XSECT_RESULTS.CDR APPROVED: MM

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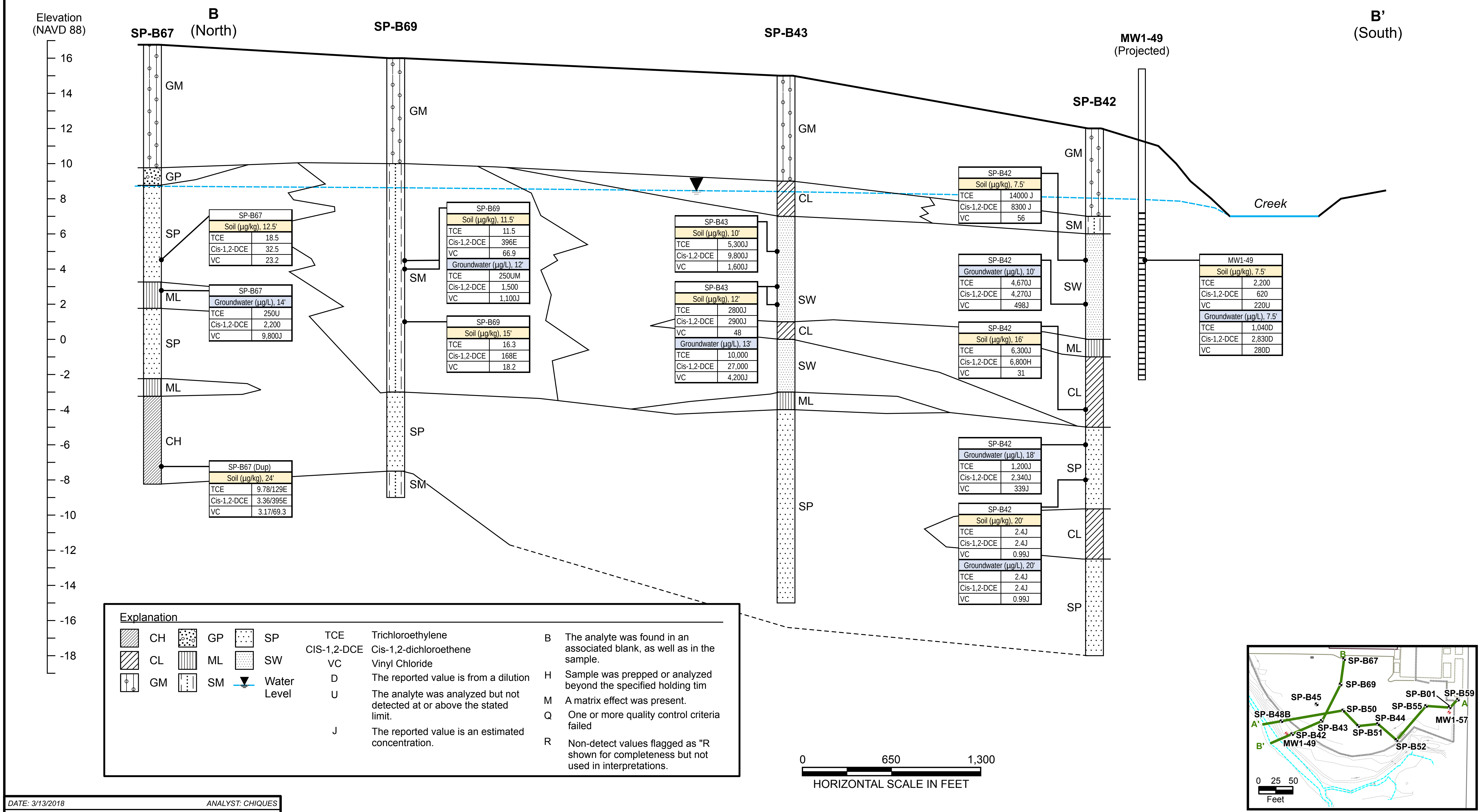
Figure 4-11
South Plantation Cross Section A-A' Showing Analytical Results

Naval Base Kitsap
Keyport



SP-B67	
Soil (µg/kg), 12.5'	
TCE	18.5
Cis-1,2-DCE	32.5
VC	23.2

SP-B67	
Groundwater (µg/L), 14'	
TCE	250U
Cis-1,2-DCE	2,200
VC	9,800J

SP-B67 (Dup)	
Soil (µg/kg), 24'	
TCE	9.78/129E
Cis-1,2-DCE	3.36/395E
VC	3.17/69.3

SP-B69	
Soil (µg/kg), 11.5'	
TCE	11.5
Cis-1,2-DCE	396E
VC	66.9
Groundwater (µg/L), 12'	
TCE	250UM
Cis-1,2-DCE	1,500
VC	1,100J

SP-B69	
Soil (µg/kg), 15'	
TCE	16.3
Cis-1,2-DCE	168E
VC	18.2

SP-B43	
Soil (µg/kg), 10'	
TCE	5,300J
Cis-1,2-DCE	9,800J
VC	1,600J

SP-B43	
Soil (µg/kg), 12'	
TCE	2800J
Cis-1,2-DCE	2900J
VC	48
Groundwater (µg/L), 13'	
TCE	10,000
Cis-1,2-DCE	27,000
VC	4,200J

SP-B42	
Soil (µg/kg), 7.5'	
TCE	14000 J
Cis-1,2-DCE	8300 J
VC	56

SP-B42	
Groundwater (µg/L), 10'	
TCE	4,670J
Cis-1,2-DCE	4,270J
VC	498J

SP-B42	
Soil (µg/kg), 16'	
TCE	6,300J
Cis-1,2-DCE	6,800H
VC	31

SP-B42	
Groundwater (µg/L), 18'	
TCE	1,200J
Cis-1,2-DCE	2,340J
VC	339J

SP-B42	
Soil (µg/kg), 20'	
TCE	2.4J
Cis-1,2-DCE	2.4J
VC	0.99J
Groundwater (µg/L), 20'	
TCE	2.4J
Cis-1,2-DCE	2.4J
VC	0.99J

MW1-49	
Soil (µg/kg), 7.5'	
TCE	2,200
Cis-1,2-DCE	620
VC	220U
Groundwater (µg/L), 7.5'	
TCE	1,040D
Cis-1,2-DCE	2,830D
VC	280D

Explanation

▨	CH
▨	CL
▥	GM
▩	GP
▥	ML
▥	SM
░	SP
░	SW
▼	Water Level

TCE	Trichloroethylene
CIS-1,2-DCE	Cis-1,2-dichloroethene
VC	Vinyl Chloride
D	The reported value is from a dilution
U	The analyte was analyzed but not detected at or above the stated limit.
J	The reported value is an estimated concentration.
B	The analyte was found in an associated blank, as well as in the sample.
H	Sample was prepped or analyzed beyond the specified holding tim
M	A matrix effect was present.
Q	One or more quality control criteria failed
R	Non-detect values flagged as "R shown for completeness but not used in interpretations.

DATE: 3/13/2018
ANALYST: CHIQUES
REV. 2
CL_CC_XSECT_RESULTS.CDR
APPROVED: MM

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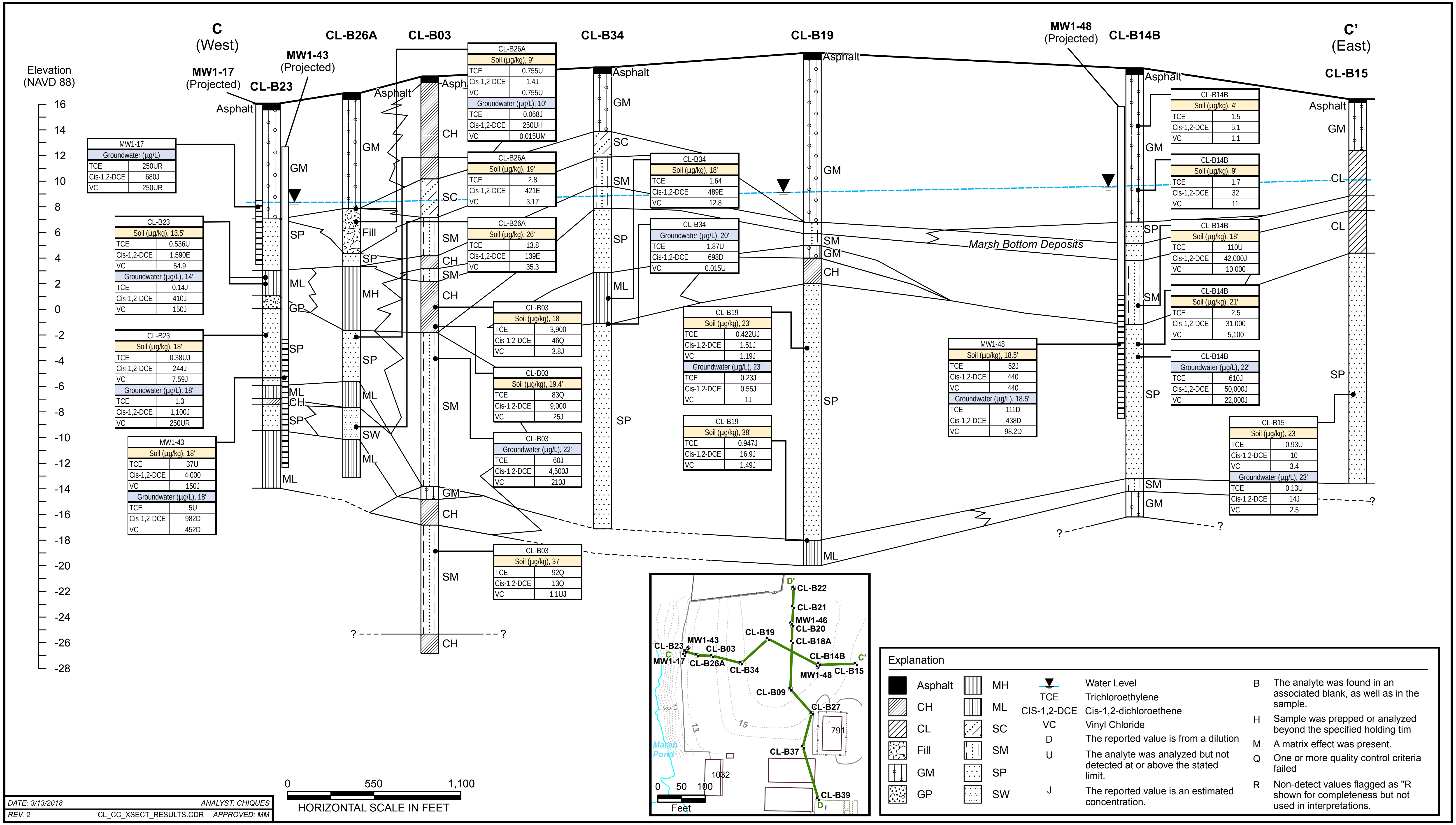
Figure 4-12
South Plantation Cross Section B-B' Showing Analytical Results

Naval Base Kitsap
Keyport



MW1-17	
Groundwater (µg/L)	
TCE	250UR
Cis-1,2-DCE	680J
VC	250UR

CL-B23	
Soil (µg/kg), 13.5'	
TCE	0.536U
Cis-1,2-DCE	1,590E
VC	54.9
Groundwater (µg/L), 14'	
TCE	0.14J
Cis-1,2-DCE	410J
VC	150J

CL-B23	
Soil (µg/kg), 18'	
TCE	0.38UJ
Cis-1,2-DCE	244J
VC	7.59J
Groundwater (µg/L), 18'	
TCE	1.3
Cis-1,2-DCE	1,100J
VC	250UR

MW1-43	
Soil (µg/kg), 18'	
TCE	37U
Cis-1,2-DCE	4,000
VC	150J
Groundwater (µg/L), 18'	
TCE	5U
Cis-1,2-DCE	982D
VC	452D

CL-B26A	
Soil (µg/kg), 9'	
TCE	0.755U
Cis-1,2-DCE	1.4J
VC	0.755U
Groundwater (µg/L), 10'	
TCE	0.068J
Cis-1,2-DCE	250UH
VC	0.015UM

CL-B26A	
Soil (µg/kg), 19'	
TCE	2.8
Cis-1,2-DCE	421E
VC	3.17

CL-B26A	
Soil (µg/kg), 26'	
TCE	13.8
Cis-1,2-DCE	139E
VC	35.3

CL-B03	
Soil (µg/kg), 18'	
TCE	3,900
Cis-1,2-DCE	46Q
VC	3.8J

CL-B03	
Soil (µg/kg), 19.4'	
TCE	83Q
Cis-1,2-DCE	9,000
VC	25J

CL-B03	
Groundwater (µg/L), 22'	
TCE	60J
Cis-1,2-DCE	4,500J
VC	210J

CL-B03	
Soil (µg/kg), 37'	
TCE	92Q
Cis-1,2-DCE	13Q
VC	1.1UJ

CL-B34	
Soil (µg/kg), 18'	
TCE	1.64
Cis-1,2-DCE	489E
VC	12.8

CL-B34	
Groundwater (µg/L), 20'	
TCE	1.87U
Cis-1,2-DCE	698D
VC	0.015U

CL-B19	
Soil (µg/kg), 23'	
TCE	0.422UJ
Cis-1,2-DCE	1.51J
VC	1.19J
Groundwater (µg/L), 23'	
TCE	0.23J
Cis-1,2-DCE	0.55J
VC	1J

CL-B19	
Soil (µg/kg), 38'	
TCE	0.947J
Cis-1,2-DCE	16.9J
VC	1.49J

MW1-48	
Soil (µg/kg), 18.5'	
TCE	52J
Cis-1,2-DCE	440
VC	440
Groundwater (µg/L), 18.5'	
TCE	111D
Cis-1,2-DCE	438D
VC	98.2D

CL-B14B	
Soil (µg/kg), 4'	
TCE	1.5
Cis-1,2-DCE	5.1
VC	1.1

CL-B14B	
Soil (µg/kg), 9'	
TCE	1.7
Cis-1,2-DCE	32
VC	11

CL-B14B	
Soil (µg/kg), 18'	
TCE	110U
Cis-1,2-DCE	42,000J
VC	10,000

CL-B14B	
Soil (µg/kg), 21'	
TCE	2.5
Cis-1,2-DCE	31,000
VC	5,100

CL-B14B	
Groundwater (µg/L), 22'	
TCE	610J
Cis-1,2-DCE	50,000J
VC	22,000J

CL-B15	
Soil (µg/kg), 23'	
TCE	0.93U
Cis-1,2-DCE	10
VC	3.4
Groundwater (µg/L), 23'	
TCE	0.13U
Cis-1,2-DCE	14J
VC	2.5

Explanation

■	Asphalt	▥	MH
▨	CH	▥	ML
▨	CL	▨	SC
▨	Fill	▥	SM
▥	GM	⁘	SP
⁘	GP	⁘	SW

▼	Water Level
TCE	Trichloroethylene
CIS-1,2-DCE	Cis-1,2-dichloroethene
VC	Vinyl Chloride
D	The reported value is from a dilution
U	The analyte was analyzed but not detected at or above the stated limit.
J	The reported value is an estimated concentration.
B	The analyte was found in an associated blank, as well as in the sample.
H	Sample was prepped or analyzed beyond the specified holding tim
M	A matrix effect was present.
Q	One or more quality control criteria failed
R	Non-detect values flagged as "R shown for completeness but not used in interpretations.

DATE: 3/13/2018 ANALYST: CHIQUES
REV. 2 CL_CC_XSECT_RESULTS.CDR APPROVED: MM

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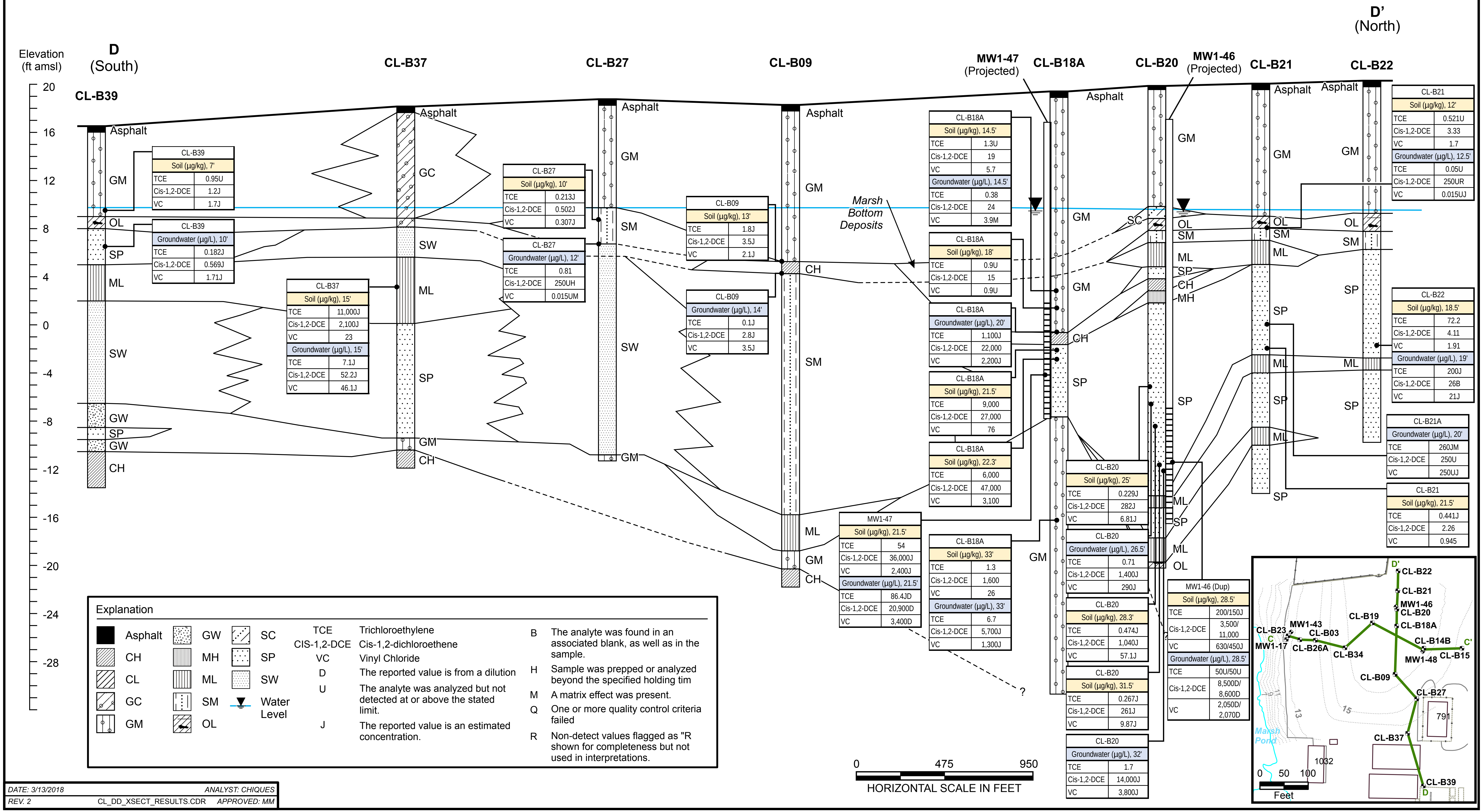
Figure 4-13
Central Landfill Cross Section C-C' Showing Analytical Results

Naval Base Kitsap
Keyport



CL-B39	
Soil (µg/kg), 7'	
TCE	0.95U
Cis-1,2-DCE	1.2J
VC	1.7J

CL-B39	
Groundwater (µg/L), 10'	
TCE	0.182J
Cis-1,2-DCE	0.569J
VC	1.71J

CL-B37	
Soil (µg/kg), 15'	
TCE	11,000J
Cis-1,2-DCE	2,100J
VC	23
Groundwater (µg/L), 15'	
TCE	7.1J
Cis-1,2-DCE	52.2J
VC	46.1J

CL-B27	
Soil (µg/kg), 10'	
TCE	0.213J
Cis-1,2-DCE	0.502J
VC	0.307J

CL-B27	
Groundwater (µg/L), 12'	
TCE	0.81
Cis-1,2-DCE	250UH
VC	0.015UM

CL-B09	
Soil (µg/kg), 13'	
TCE	1.8J
Cis-1,2-DCE	3.5J
VC	2.1J

CL-B09	
Groundwater (µg/L), 14'	
TCE	0.1J
Cis-1,2-DCE	2.8J
VC	3.5J

MW1-47	
Soil (µg/kg), 21.5'	
TCE	54
Cis-1,2-DCE	36,000J
VC	2,400J
Groundwater (µg/L), 21.5'	
TCE	86.4JD
Cis-1,2-DCE	20,900D
VC	3,400D

CL-B18A	
Soil (µg/kg), 14.5'	
TCE	1.3U
Cis-1,2-DCE	19
VC	5.7
Groundwater (µg/L), 14.5'	
TCE	0.38
Cis-1,2-DCE	24
VC	3.9M

CL-B18A	
Soil (µg/kg), 18'	
TCE	0.9U
Cis-1,2-DCE	15
VC	0.9U

CL-B18A	
Groundwater (µg/L), 20'	
TCE	1,100J
Cis-1,2-DCE	22,000
VC	2,200J

CL-B18A	
Soil (µg/kg), 21.5'	
TCE	9,000
Cis-1,2-DCE	27,000
VC	76

CL-B18A	
Soil (µg/kg), 22.3'	
TCE	6,000
Cis-1,2-DCE	47,000
VC	3,100

CL-B18A	
Soil (µg/kg), 33'	
TCE	1.3
Cis-1,2-DCE	1,600
VC	26
Groundwater (µg/L), 33'	
TCE	6.7
Cis-1,2-DCE	5,700J
VC	1,300J

CL-B20	
Soil (µg/kg), 25'	
TCE	0.229J
Cis-1,2-DCE	282J
VC	6.81J

CL-B20	
Groundwater (µg/L), 26.5'	
TCE	0.71
Cis-1,2-DCE	1,400J
VC	290J

CL-B20	
Soil (µg/kg), 28.3'	
TCE	0.474J
Cis-1,2-DCE	1,040J
VC	57.1J

CL-B20	
Soil (µg/kg), 31.5'	
TCE	0.267J
Cis-1,2-DCE	261J
VC	9.87J

CL-B20	
Groundwater (µg/L), 32'	
TCE	1.7
Cis-1,2-DCE	14,000J
VC	3,800J

MW1-46 (Dup)	
Soil (µg/kg), 28.5'	
TCE	200/150J
Cis-1,2-DCE	3,500/ 11,000
VC	630/450J
Groundwater (µg/L), 28.5'	
TCE	50U/50U
Cis-1,2-DCE	8,500D/ 8,600D
VC	2,050D/ 2,070D

CL-B21	
Soil (µg/kg), 12'	
TCE	0.521U
Cis-1,2-DCE	3.33
VC	1.7
Groundwater (µg/L), 12.5'	
TCE	0.05U
Cis-1,2-DCE	250UR
VC	0.015UJ

CL-B22	
Soil (µg/kg), 18.5'	
TCE	72.2
Cis-1,2-DCE	4.11
VC	1.91
Groundwater (µg/L), 19'	
TCE	200J
Cis-1,2-DCE	26B
VC	21J

CL-B21A	
Groundwater (µg/L), 20'	
TCE	260JM
Cis-1,2-DCE	250U
VC	250UJ

CL-B21	
Soil (µg/kg), 21.5'	
TCE	0.441J
Cis-1,2-DCE	2.26
VC	0.945

Explanation

■	Asphalt	▨	GW	▨	SC
▨	CH	▥	MH	▨	SP
▨	CL	▥	ML	▨	SW
▨	GC	▥	SM	▼	Water Level
▥	GM	▨	OL		

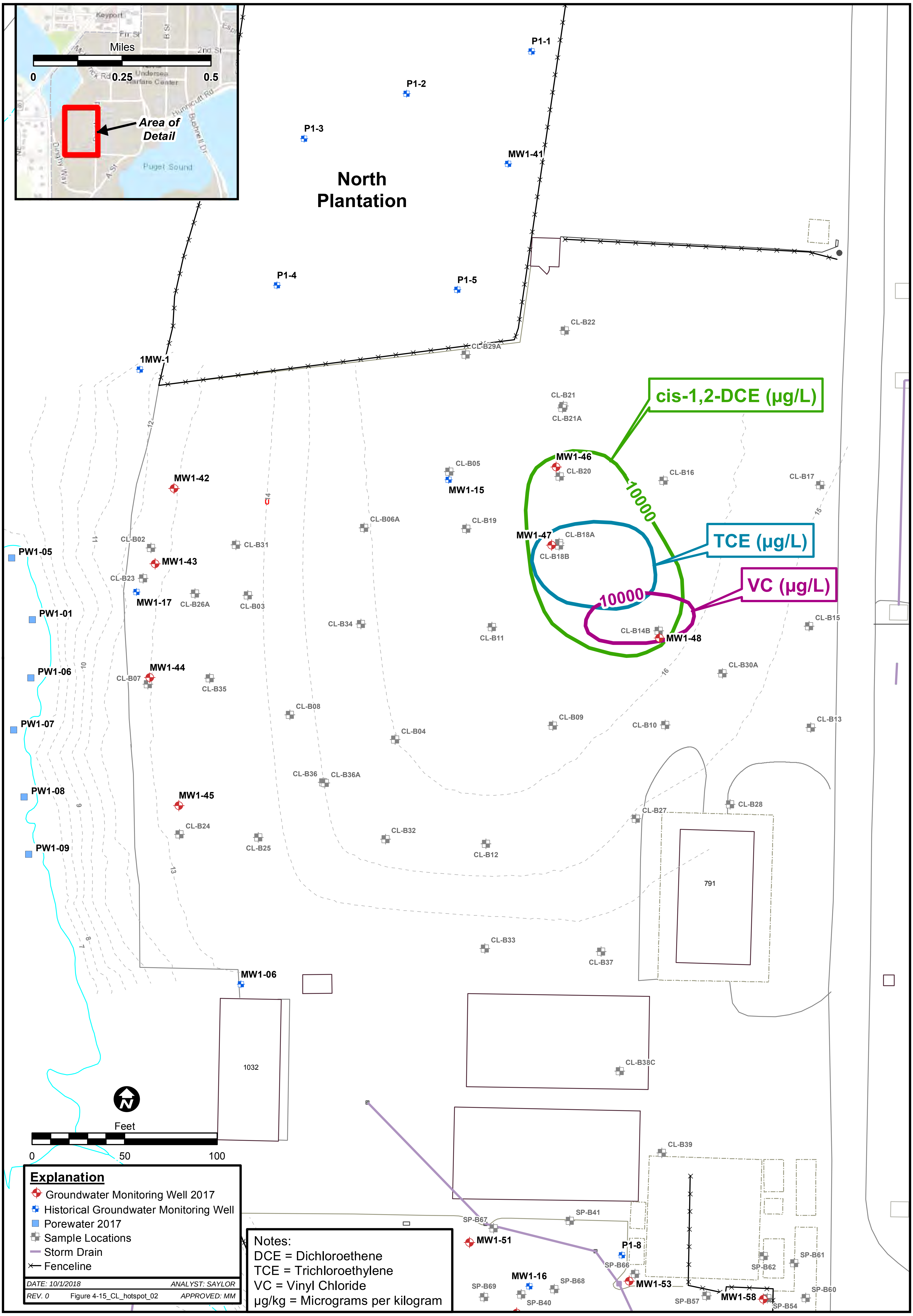
TCE	Trichloroethylene
CIS-1,2-DCE	Cis-1,2-dichloroethene
VC	Vinyl Chloride
D	The reported value is from a dilution
U	The analyte was analyzed but not detected at or above the stated limit.
J	The reported value is an estimated concentration.
B	The analyte was found in an associated blank, as well as in the sample.
H	Sample was prepped or analyzed beyond the specified holding tim
M	A matrix effect was present.
Q	One or more quality control criteria failed
R	Non-detect values flagged as "R shown for completeness but not used in interpretations.

DATE: 3/13/2018 ANALYST: CHIQUES
REV. 2 CL_DD_XSECT_RESULTS.CDR APPROVED: MM

U.S. NAVY

Figure 4-14
Central Landfill Cross Section D-D' Showing Analytical Results

Naval Base Kitsap
Keyport



Notes:
DCE = Dichloroethene
TCE = Trichloroethylene
VC = Vinyl Chloride
µg/kg = Micrograms per kilogram

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Figure 4-15
Central Landfill Hotspot

Naval Base Kitsap
Keyport

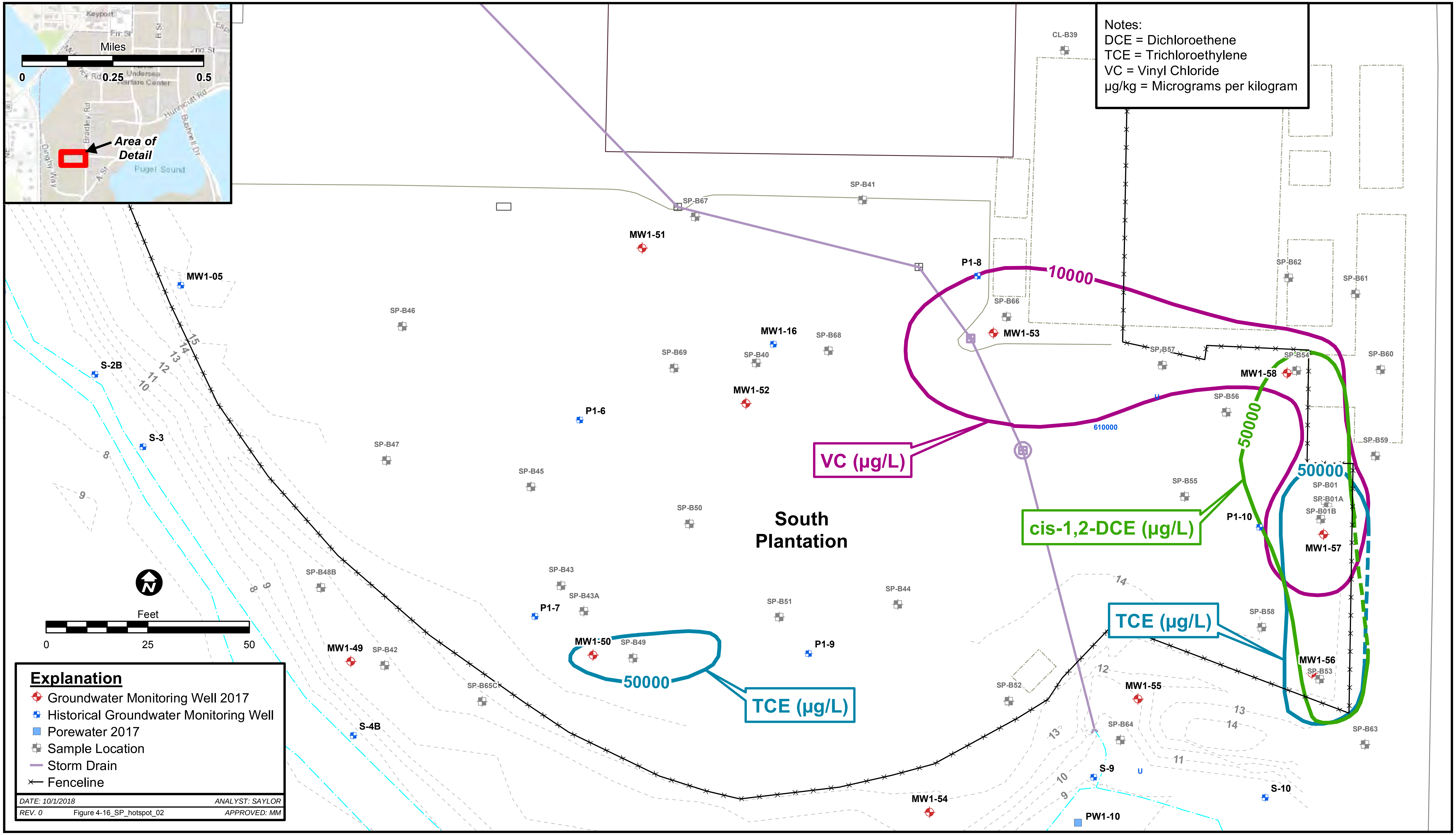

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Figure 4-16
South Plantation Hotspot

Naval Base Kitsap
Keyport

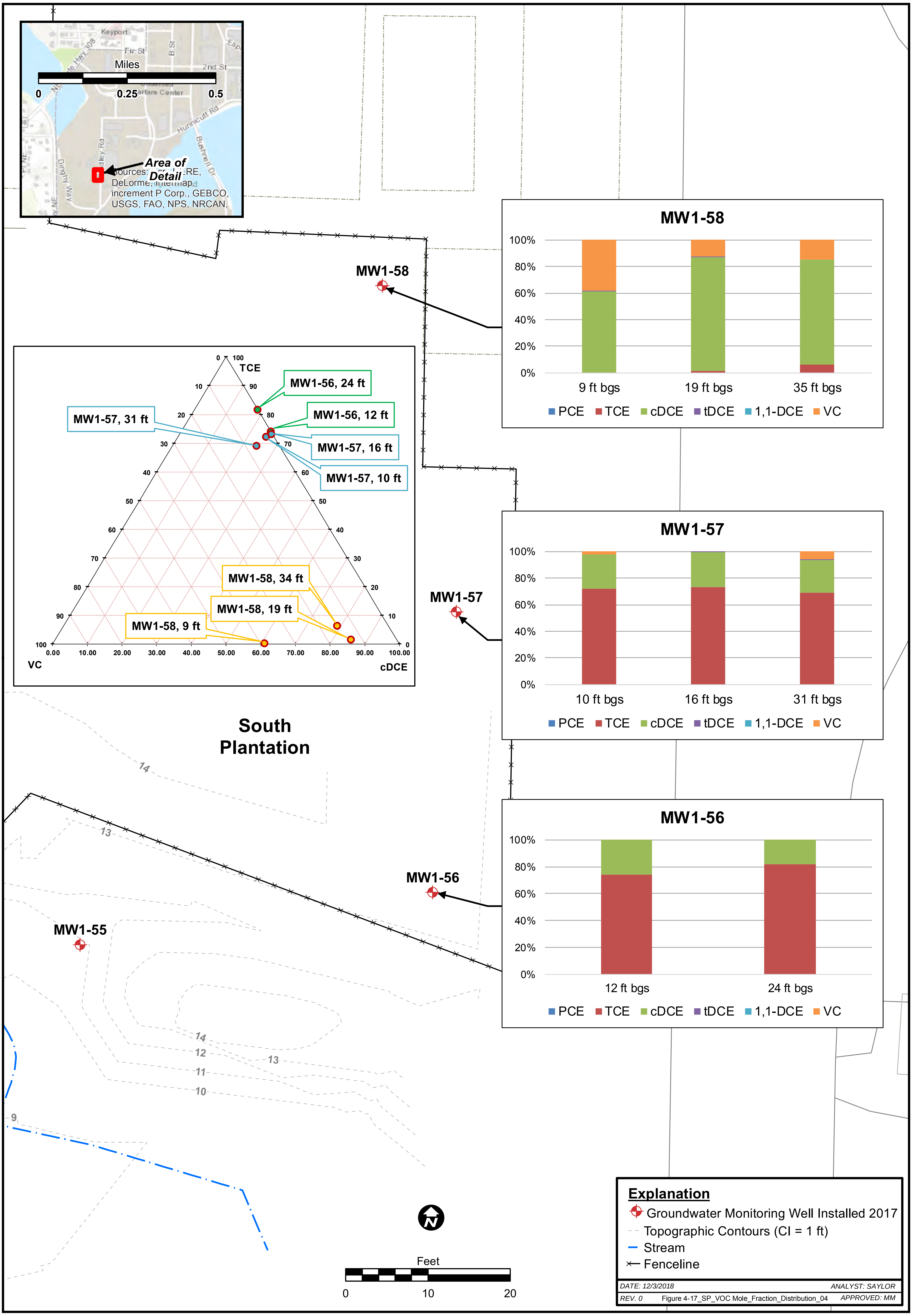

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Figure 4-17
VOC Mole Fraction Distribution (South Plantation)

Naval Base Kitsap
Keyport

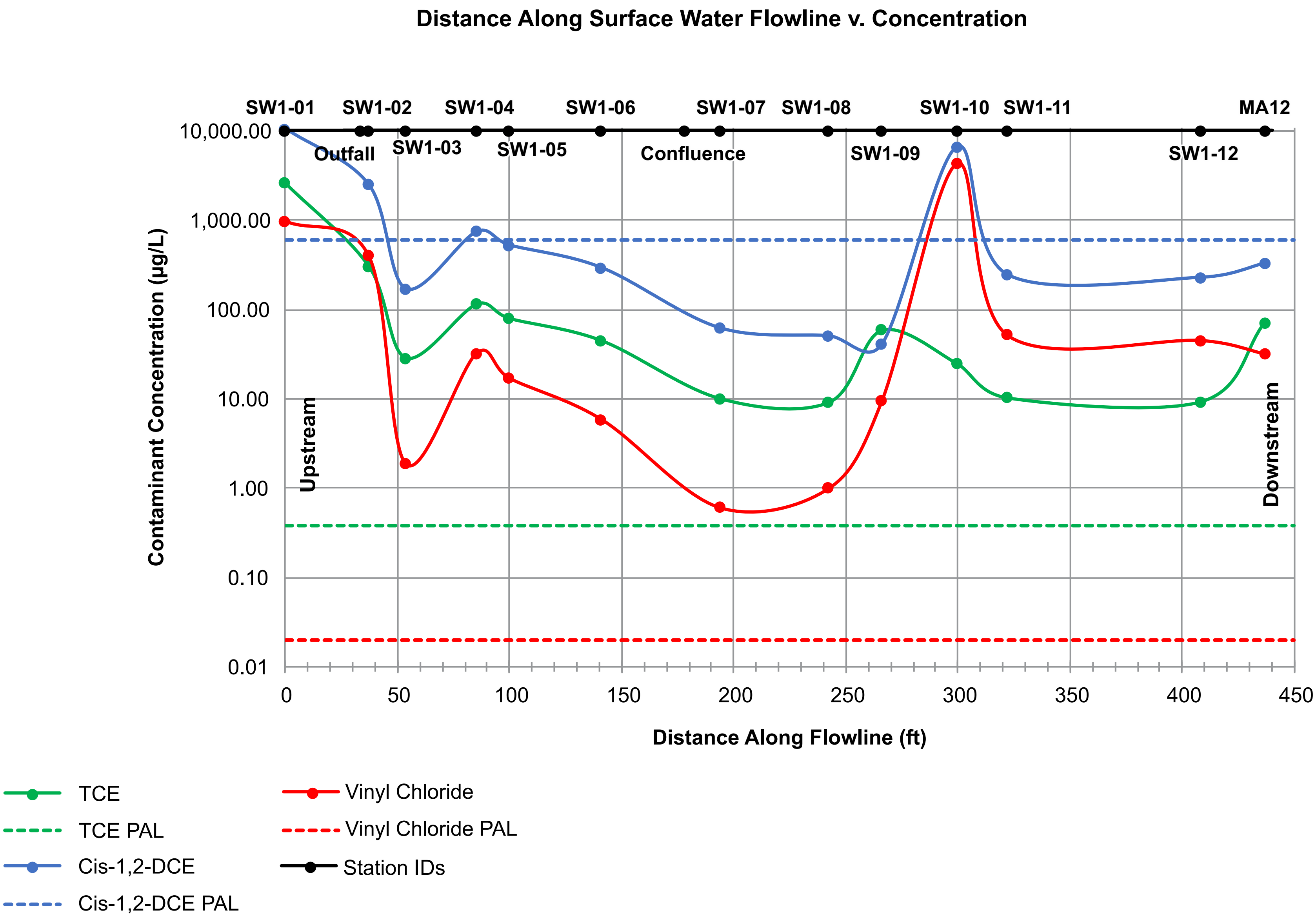


FIG04-18.CDR

U.S. NAVY	**Figure 4-18** **Concentrations in Surface Water along Flowline**	Naval Base Kitsap Keyport

Table 4-1. Depth to Groundwater Measurements

Well Name	TOC (ft, NAVD 88)	Static Depth to Water (ft)[a]	Groundwater Elevation (ft, NAVD 88)
MW1-42	12.77	4.69	8.08
MW1-43	12.69	4.51	8.18
MW1-44	12.24	4.1	8.14
MW1-45	12.99	5.45	7.54
MW1-46	16.71	7.24	9.47
MW1-47	16.44	6.91	9.53
MW1-48	15.80	6.1	9.70
MW1-49	14.17	6.01	8.16
MW1-50	16.75	8.11	8.64
MW1-51	17.23	8.35	8.88
MW1-52	17.11	8.18	8.93
MW1-53	13.40	4.29	9.11
MW1-54	15.57	5.58	9.99
MW1-55	15.60	5.72	9.88
MW1-56[b]	15.82	6.02	9.80
MW1-57[b]	15.62	5.71	9.91
MW1-58[b]	16.84	5.89	10.95
MW1-60	18.01	10.26	7.75
1MW-1	13.55	8.78	4.77
MW1-03	17.04	4.28	12.76
MW1-05	16.59	8.59	8.00
MW1-09	15.52	7.01	8.51
MW1-15	16.81	7.4	9.41
MW1-17	13.06	5.33	7.73
MW1-18	15.53	7.76	7.77
MW1-2	15.36	9.19	6.17
MW1-20	13.93	2.91	11.02
MW1-25	15.42	9.42	6.00
MW1-28	16.61	10.69	5.92
MW1-29	16.22	10.31	5.91
MW1-41	18.72	9.41	9.31

Table 4-1. Depth to Groundwater Measurements (continued)

P1-6	16.21	7.26	8.95
P1-7	15.57	6.7	8.87
P1-8	15.52	5.82	9.70
P1-9	15.36	6.29	9.07
P1-1	17.83	8.61	9.22
P1-2	17.23	10.29	6.94
P1-3	16.24	8.29	7.95
P1-4	16.02	7.68	8.34
P1-5	18.51	9.42	9.09
S-2	10.01	2.91	7.10
S-2B	9.96	2.71	7.25
S-3	9.71	2.22	7.49
S-4B	10.12	2.65	7.47
S-5B	10.46	2.49	7.97
S-6	10.81	3.02	7.79
S-9	11.54	2.98	8.56
S-10	12.05	3.37	8.68

[a] - Measured on October 23, 2017, except for wells MW1-56, MW1-57, and MW1-58.

[b] - Depth to groundwater from purge logs used for these three wells.

ft - feet

NAVD 88 - North American Vertical Datum, 1988
TOC - top of casing

Table 4-2. Comparison of Sediment PCB Concentrations to Natural Background

Sample	**Estimated Total PCB Concentration[a] (µg/kg)**	**Estimated PCB TEQ Concentration[b] (µg/kg)**
MA-09	830	0.012
MA-14 (FD)	33	0.0008
MA-14	24	0.0012
MA-19	9.9	0.0012
SP1-1	13	0.0004
TF-21	30	0.0006
Natural Background[c]	3.5	0.0002

a. Total PCBs were estimated by summing the concentrations of all detected congeners.

b. Sum of dioxin-like PCB TEQs calculated using USEPA’s Advanced KM TEQ Calculator (version 9.1, issued July 31, 2014). PCB dioxin-like congeners include: PCB-077, PCB-081, PCB-105, PCB-114, PCB-118, PCB-123, PCB-126, PCB-156, PCB-157, PCB-167, PCB-169, and PCB-189.

c. Natural background values derived from the BOLD data set per SCUM II guidance, Option 1, Part 1 and obtained from Table 10-1 of the SCUM II guidance (Ecology, 2017)

FD – field duplicate

TEQ – toxicity equivalence

5.0 CONCLUSIONS

This section presents the decisions made based on the data collected and the decision rules established in the SAP. Each section below discusses the decisions based on the decision rules as they were numbered 1 through 6 in the SAP (and listed in Section 1.3 of this report).

5.1 DECISION RULE 1 CONCLUSIONS

5.1.1 Decision 1a

Decision Rule – Establish the locations (horizontally and vertically) of the highest concentrations of COCs beneath the South Plantation and in the adjacent wetlands

The locations (horizontally and vertically) of the highest concentrations of cVOCs beneath the South Plantation and in the adjacent wetlands can be summarized as follows:

1. Laterally in an east-west direction, the highest COC concentrations are located beneath the eastern portion of the South Plantation (see Figure 3-10 for reference), from Bradley Road on the east to approximately the centerline of former Building 884 on the west (SP-B55). In a north-south direction, these highest concentrations are found from approximately the southern edge of former Building 884 to the marsh.
2. The highest COC concentrations beneath the eastern portion of the South Plantation extend vertically from the waste body of the landfill at approximately 5 to 7 ft bgs and penetrate the upper portion of the Lawton Clay at approximately 30 to 35 ft bgs.
3. Other areas of high COC concentrations (but lower than described above), are evident around historical well MW1-16 and from east of piezometer P1-7 westward to the marsh (see Figure 3-9 for reference). In contrast to the eastern portion of the South Plantation, the highest COC concentrations in these areas appear to be shallower, typically found from 8 to 15 ft bgs.
4. Although the areas described in items 1 through 3 above exhibit the highest COC concentrations, exceedances of the ROD RGs are found throughout the South Plantation (see Figure 3-11), and at all surface water sampling locations adjacent to the South Plantation (Figure 3-13).

5.1.2 Decision 1b

Decision Rule – Identify the likeliest transport pathways from the high concentration COC areas at the South Plantation to the adjacent wetlands

The likeliest discharge points along transport pathways from high concentration COC areas at the South Plantation to the adjacent wetlands are (refer to Figures 4-19 and 4-18):

1. From the eastern portion of the South Plantation discharging to the area of the marsh immediately adjacent to Bradley Road and south of the South Plantation, east of the stormwater outfall.
2. From the vicinity of piezometer P1-7 discharging toward monitoring well MW1-49 and peeper sampling stations S-4 and S-4B.

5.1.3 Decision 1c

Decision Rule – Decide whether a vapor intrusion study of buildings east of Bradley Road is warranted

A vapor intrusion study of buildings east of Bradley Road is warranted (this decision was made based on data collected in 2016, and a vapor intrusion study is underway that will be reported under separate cover).

5.2 DECISION RULE 2 CONCLUSIONS

Decision Rule – Conclude whether a cVOC source exists upgradient of well MW1-17, and if one or more sources do exist, delimit their location and extents

Residual cVOC sources exist upgradient of well MW1-17 (Figure 3-7). Residual sources are located in the vicinity of monitoring wells MW1-46, MW1-47, and MW1-48, and appear to represent more than one discrete residual source resulting in a comingled plume. The highest COC concentrations in this area are found in the depth range of 17 to 33 ft bgs.

Residual source(s) also exist in the area of direct-push borings CL-B03, CL-B04, CL-B35, and CL-B36. These residual sources appear to be separated from those in the vicinity of MW1-46, MW1-47, and MW1-48 by an area of relatively lower concentrations. The highest COC concentrations in this area are found in the depth range 13 to 22 ft bgs.

Based on the absence of detectable cVOCs in porewater samples located due west of the Central Landfill (Figures 4-6 and 4-7), and the pattern of highest cVOC concentration observed in grab groundwater samples (Figure 3-7), cVOCs from the Central Landfill do not appear to be discharging to surface water in this area. Rather than the cVOC plume shape implied by the groundwater monitoring well data (Figure 4-7), contaminant transport beneath the Central Landfill appears to be to the northwest along a more regional groundwater flow direction (Figure 3-7).

5.3 DECISION RULE 3 CONCLUSIONS

Decision Rule – Conclude whether an aquitard exists between the shallow and intermediate aquifers in the central portion of the landfill, upgradient of well MW1-17

Based on the continuous soil cores logged in 2017, and the 2016 MIP results, a laterally continuous aquitard does not exist between the shallow and intermediate aquifers in the central portion of the landfill, upgradient of well MW1-17, or anywhere investigated in 2016 and 2017 (Figures 4-1 through 4-2). This finding does not support the geologic interpretation presented in the ROD, but is consistent with that presented in the RI/FS.

5.4 DECISION RULE 4 CONCLUSIONS

Decision Rule – Establish current conditions with regard to PCB concentrations in sediment at, and downstream of seep SP1-1

The highest concentrations of PCBs were detected in sediment at historical location MA-09, and in porewater at this location. Total PCB concentrations in sediment samples from downstream and upstream of MA-09 (including near seep SP1-1) were two orders of magnitude lower than at MA-09. Total PCB concentrations in sediment pore water samples collected upstream and downstream of MA-09 were also lower than at MA-09. For both sediment and porewater, PCB concentrations at location upstream of MA-09 (SP1-1 and MA19) were lower than downstream of MA-09 (MA-14). Only the PCB concentrations in the sediment sample from location MA-09 exceeded the ROD RG, indicating that the lateral extent of PCBs exceeding the RG is limited to the vicinity of this station. These findings are consistent with those of the ROD, which identified station MA-09 as exhibiting the highest PCB concentrations, and the only concentrations exceeding the sediment quality standard at the time. The 2017 PCB concentrations at station MA-09 are nearly identical to the pre-ROD concentrations at this station, prior to the sediment removal action.

Overall the 2017 data are similar to concentrations measured before the ROD. The 2017 result at MA-09 could indicate a temporal increase in PCBs at location MA-09, or a spatial variation in concentration in sediment in this area. The measured concentrations could be residual pre-ROD concentrations, given the selective nature of the sediment removal to protect root systems. Because of the uncertainty regarding concentration trends based on the 2017 results, this Decision 4 recommends three additional annual sampling events performed at the five stations sampled in 2017, using the same sampling techniques and analytical procedures.

The elevated concentrations of PCBs in groundwater at well MW1-14, combined with the groundwater flow direction to the northwest and the location of the highest PCB concentrations in sediment and porewater at location MA-09 (down gradient of MW1-14), implies that recontamination may be occurring from an uncontrolled source within the landfill. In accordance with the recontamination requirements of the SMS (WAC 173-204-500[5][b][iii]), the potential for an uncontrolled source in the landfill should be assessed.

Because the highest current PCB concentrations are not higher than those found at the time of the ROD and are limited to the immediately vicinity of station MA-09, this Decision 4 recommends not reopening the risk assessment regarding PCBs in sediment until additional PCB concentration trend data are available.

5.5 DECISION RULE 5 CONCLUSIONS

Decision Rule – Conclude whether the existing CSM is accurate or needs refinement and refine, as necessary for accuracy

Based on the results of this investigation, a revised physical/chemical CSM is warranted, and an illustration of the contaminant transport pathways associated with such a revised CSM is presented as Figure 5-1. Key features of this illustration are:

1. Two areas at the South Plantation exhibit the highest concentrations of cVOCs, however one or more COCs in groundwater everywhere beneath the South Plantation exceed the ROD RGs.
2. Groundwater movement in the shallow portion of the aquifer is influenced by adjacent surface water bodies, resulting in cVOC transport from shallow groundwater to surface water at two primary locations adjacent to the South Plantation.
3. Surface water with high cVOC concentrations moves downstream from the first point of groundwater to surface discharge adjacent to Bradley Road and is diluted by flow from the stormwater outfall and Marsh Creek.
4. VOC concentrations in surface water increase at the second point of discharge on the western edge of the South Plantation, and then decrease downstream with dilution and degradation, with cVOC concentrations low or not detectable in surface water prior to passing through the tide gate.

5. Two areas in the Central Landfill exhibit the highest cVOC concentrations in this area, with transport apparently to the northwest, following a more regional groundwater flow direction.
6. Based on the porewater samples collected in 2017, cVOC transport from the Central Landfill to adjacent surface water does not appear to be a primary pathway.
7. Groundwater present above the clayey Kitsap Formation (Clover Park Aquitard) and Lawton Clay occurs within interbedded fine sands and silts, with no laterally continuous aquitard separating an "upper aquifer" and "intermediate aquifer." Overall flow within this water table aquifer is to the northwest to the tide flats and Dogfish Bay.
8. A source of PCBs is present in the landfill near the north edge of the North Plantation and may be resulting in discharge of groundwater containing PCBs to sediment and surface water near location MA-09, downstream of seep SP1-1.
9. NAPL is present within the landfill and was directly observed during the 2017 investigation.
10. Matrix diffusion effects are likely to control the restoration timeframe at the site. Elevated cVOC concentrations in finer-grained materials indicate that cVOCs have diffused into these finer-grained materials and that treatment focused on coarser-grained materials will likely result in prolonged back diffusion.
11. Halorespiring bacteria are present at levels indicative of active dechlorination, which supports past findings of on-going biodegradation at the site. However, at locations where high levels of cVOCs were detected an apparent absence of halorespiring bacteria suggests that high levels of cVOCs may inhibit dechlorinating activity.

Based on Key Features 10 and 11, any future cleanup actions should consider treatments that reduce contaminant concentrations below the bioremediation threshold. The data from 2017 also demonstrate that apparent declining trends in cVOC concentrations in individual groundwater monitoring wells may lead to misleading extrapolations to site-wide conditions. Concentration trend graphs from well MW1-16 presented in the fourth five-year review (U.S. Navy, 2015b) document steep declines in VOC concentrations between 1995 and 2014. However, samples from well MW1-52, located approximately 20 ft from MW1-16 and with a similar screened interval, show VOC concentrations 1 to 2 orders of magnitude higher (refer to Figure 4-11).

Refinement of the CSM could be performed with the following data:

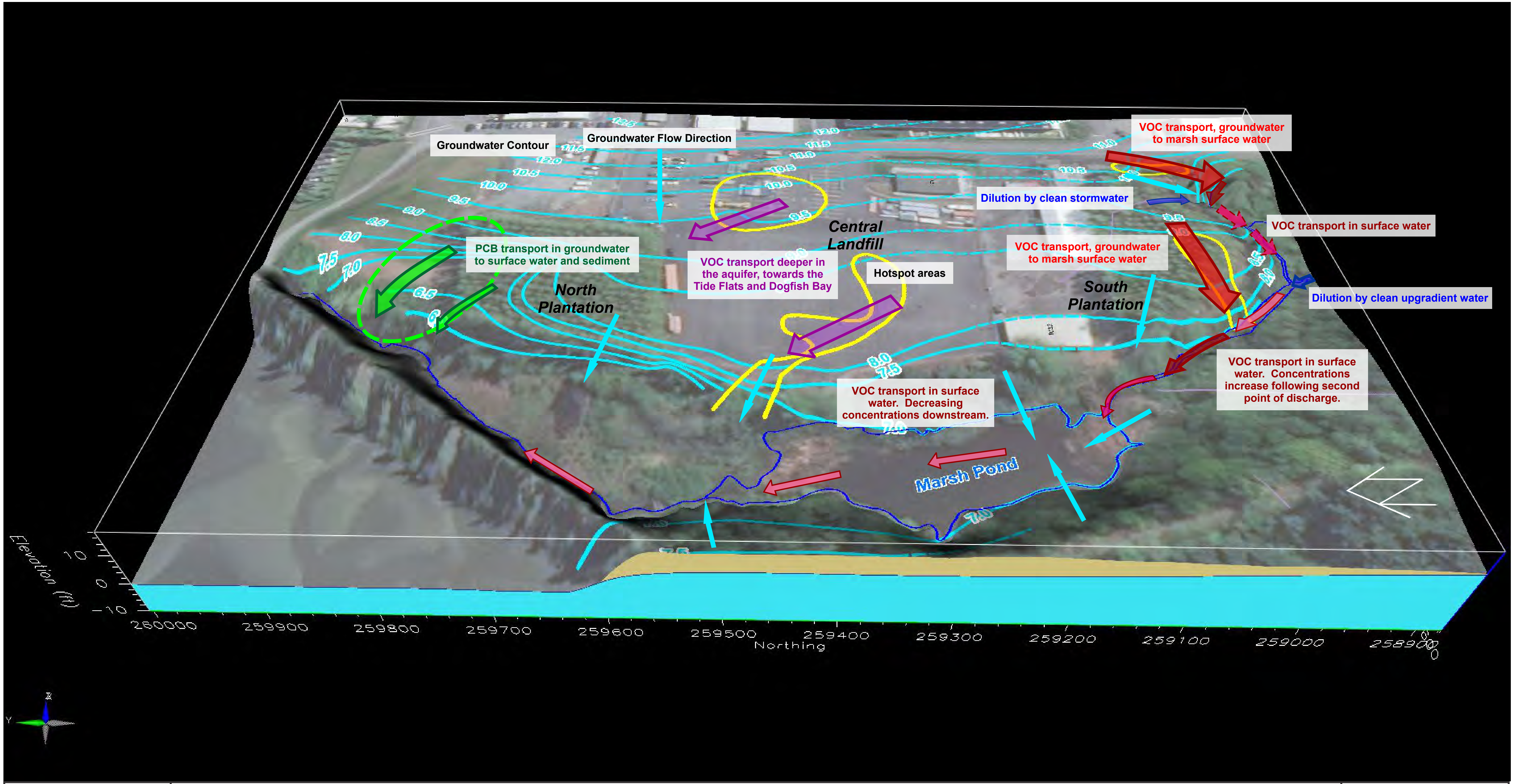
1. Additional samples from all new monitoring wells to establish concentration trends over time.
2. Sampling of MW1-60 to validate the apparently anomalous TCE concentration in this well.

3. Collection of porewater samples to the north of those collected adjacent to the Central Landfill, to confirm that VOCs in groundwater are not discharging to surface water in this area.
4. Installation of one or more deeper wells in the North Plantation to assess the apparent VOC movement from the Central Landfill to the northwest.
5. Additional PCB sampling in the vicinity of MA-09 and in groundwater upgradient to assess the extent of the PCB source and transport to sediment and surface water.

5.6 DECISION RULE 6 CONCLUSIONS

Decision Rule – Develop a shortlist of technologies that could be used to optimize the remedy

Following discussion with the project team on the draft version of this report, addressing this decision rule has been deferred until additional information is obtained.



U.S. NAVY

Figure 5-1
Contaminant Transport Pathways

Naval Base Kitsap
Keyport

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APPENDIX A

Responses to Agency and Stakeholder Comments on the Draft Report

Document Title: DRAFT Operable Unit 1, 2017 Site Recharacterization Phase II, Naval Base Kitsap, Keyport, Washington
Document dated: October 2018

Comments from: Denice Taylor, Suquamish Tribe PM
Comments dated: November 8, 2018

Suquamish Tribe Comments and Responses				
#	**Page No./ Line No.**	**Comment**	**Proposed Response**	**Response Accepted?**
1		The Phase II study has demonstrated that the existing CSM should be refined to update the extent of contamination, including the identification of apparent hot spots, and related transport pathways. However, while it was useful to develop a preliminary list of remedial alternatives, the Tribe suggests that additional screening or evaluation of alternatives be deferred until the project team has concurred on a strategy for addressing source areas (hot spots) as well as dissolved phase contamination. It is also recommended that the team determine performance objectives and criteria for remedial alternatives, including establishing a reasonable restoration timeframe.	The Navy can agree to remove the technology screening from this report and note that this Decision is deferred until additional information is obtained. It should be noted that alternative technologies to address dissolved phase contamination will be evaluated only based on the outcome of ongoing investigations and/or the planned update of the human health and ecological risk assessments. Current investigations are designed to support evaluation of alternative technologies to address hotspots.	
2		The report emphasizes that contaminated groundwater and stormwater are diluted by surface water in the creek and that concentrations in surface water are low or not detectable prior to passing through the tide gate. It should be noted that the groundwater point of compliance is where groundwater discharges to surface water. The marsh pond and creek are resources that are impacted by the site. They are not a remedy component for the site.	The Navy did not intend to imply that the marsh pond and creek are remedy components for the site. The text is simply describing cVOC transport as observed. cVOCs are discharged at the southeastern edge of the South Planation, travel in surface water, are diluted by clean stormwater and clean surface water, increase again at the second point of cVOC discharge, and then decline downstream. The Navy is willing to consider any suggested specific changes to the text.	

3		The report concludes that there is no discharge from the central landfill to surface water. Groundwater from the central landfill is thought to follow a more regional flow path and discharge to the tide flats and Dogfish Bay. The Tribe agrees with recommendations to confirm this finding. If the USGS study will be helpful in evaluating transport pathways associated with the central landfill, please include incorporation of study results in the recommendations.	On page 5-6 the report currently recommends leveraging the results of the USGS study to assess fate and transport. The Navy intends to collect additional samples in 2019 to verify the potential transport of cVOCs from the Central Landfill to the marsh and conduct contaminant fate and transport modeling.	
4		The scope of the recharacterization effort specified collection of data necessary to allow screening of remedial technologies. Section 4.8 presents an evaluation of data relevant to the screening and Table 4.3 evaluates potential technologies against various criteria. Estimated restoration timeframe is one of the most important considerations in evaluating potential technologies, but remains highly uncertain and is described as “hundreds of years”. In Section 4.8, please explain more fully why the presence of NAPL implies that restoration timeframes cannot be meaningfully delimited. In addition, please provide a rationale for the statement that if dissolved contaminant concentrations were decreased by 2 to 3 orders of magnitude, natural biodegradation could begin. What data were used to estimate the concentrations below which natural biodegradation occur?	Further discussion of the observation of the field findings of cVOC retention in fine-grained interbeds at the site is included on page 2-2, which also cites Chapman and Parker, 2005 regarding the observations of back diffusion at sites that have undergone source zone treatment. This paper, for example, states, “Vertical back diffusion from the aquitard combined with horizontal advection and vertical transverse dispersion account for the TCE distribution in the aquifer and that the aquifer TCE will remain much above the MCL for centuries.” The Navy’s experience at numerous cVOC sites leads to the conclusion that it is unrealistic to expect that treatment of hotspots at OU 1 will lead to a reduction of the restoration timeframe to less than 100 years, given the high concentration of the dilute plume present outside of hotspot areas. In addition, the presence of NAPL creates a “constant source” term in any model solution of long-term natural attenuation. As long as the constant source is present, the dissolved concentrations “never” go away (until the NAPL source is fully dissolved).	

4 cont.			Biodegradation has been documented at the site by a decade of USGS studies, however this investigation showed that the microbes necessary for biodegradation were not present in the highest concentration areas, but were active in lower concentration "hotspots". On this basis, there is some concentration range that allows the necessary microbes to flourish, which is a common finding at similar sites. Collection of additional microbial data is planned for 2019 to help quantify this concentration range.	
5		Given that the existing CSM does not accurately convey site conditions or dynamics, the Tribe agrees that the CSM should be revised and updated. It is recommended that the project team concur on a strategy for addressing source areas (hot spots) as well as dissolved phase contamination, and develop preliminary performance criteria, including a reasonable restoration timeframe, prior to additional evaluation of remedial technologies.	The Navy agrees to remove the technology screening from this report and note that this decision is deferred until additional information is obtained. However, at this time the Navy has not agreed to evaluate dissolved plume remedial actions beyond those required by the OU 1 ROD. The project team has agreed to focus potential future remedial actions on hotspot treatment to reduce the restoration timeframe to some calculable number of years. With a continuous NAPL source, the restoration timeframe cannot be meaningfully estimated. Alternative technologies to address dissolved phase contamination will be evaluated only based on the outcome of ongoing investigations and/or the planned update of the human health and ecological risk assessments. Current investigations are designed to support evaluation of alternative technologies to address hotspots.	

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6		In the draft report, PCB sediment concentrations are compared to risk-based benchmarks for direct contact and inadvertent ingestion exposure pathways for subsistence harvesters according to Ecology's SCUM II Option 1, Part 2 approach. The Tribe does not believe there was adequate consultation or discussion regarding the use of this approach and does not support it. The Tribe would support the use of Ecology's default approach, Option 1, Part 1, which compares sediment data to natural background concentrations as a very preliminary evaluation of potential risks. Because there is no established regional background data set for Liberty Bay, the appropriate comparison will use the BOLD data set. This approach is consistent with the approach presented for bioaccumulative ecological risks.	The Navy agrees to use Ecology's default approach, Option 1, Part 1, which compares sediment data to natural background concentrations as a very preliminary evaluation of potential risks. Because there is no established regional background data set for Liberty Bay, the Navy will compare to the BOLD data set. These conclusions will be caveated to indicate that they are preliminary and will be evaluated in more detail during the future risk assessment.	
7		The Tribe agrees that it is not necessary to re-evaluate risk assessment assumptions at this time.	Thank you. However, based on the redefined magnitude and extent of contamination, the Navy will be updating the existing human health and ecological risk assessment beginning in late 2019.	
8		With regard to the question of recontamination, the report states that the 2017 data do not indicate a clearly increasing contaminant trend and recommends additional sampling over a three year period. The Tribe believes that available data indicate that it is likely that the previously remediated area is recontaminating due to discharge of groundwater from the site. The Tribe agrees that the potential source should be assessed. It is not necessary to wait an additional three years.	The Navy plans to include a PCB source investigation in the 2019 work. Based on the concentrations detected and the limited area of contamination detected, the Navy's interpretation of the data is that it is much more likely that the concentrations observed at MA09 represent pre-ROD concentrations stemming from residual sediment contamination left in place after sediment removal by vacuum methods. Additional investigation will be performed in 2019, with development of data quality objectives in collaboration with the regulator/stakeholder Project Team.	

9		As a side note, Figure 3-14 of the report appears to be mislabeled and/or missing.	Thank you. The order of callouts in the text for Figures 3-12 through 3-15 changed late in the report preparation process and an inconsistency was introduced. This inconsistency will be corrected.	

Comments from: John Evered, Ecology
Comments dated: November 8, 2018

Ecology Comments and Responses				
#	**Page No./ Line No.**	**Comment**	**Proposed Response**	**Response Accepted?**
1	Page 4-21, line 722	Although the result is unchanged, it is inappropriate to compare max total PCB concentrations to the marine sediment AETs in SCUM II table 8-1. This is only appropriate when TOC is outside recommended range of 0.5-3.5%, which was not the case in the sampling results.	The clause: "and the marine CSL of 1,000 mg/g.", will be deleted.	
2	Page 4-21, line 734	No regional background concentrations have been established for this area, please change to natural background.	The reference to regional background will be changed to natural background.	
3	Page 5-4, line 108	I would recommend that we continue congener analysis in the additional sampling events. This data will be valuable if the PCB risk assessment is reopened.	The end of the sentence on page 5-4 will be revised as follows, "…using the same sampling techniques ***and analytical procedures*.**"	

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Comments from: Mahbub Alam, Ecology

Comments dated: November 8, 2018

General Ecology Comments and Responses

#	Page No./ Line No.	Comment	Proposed Response	Response Accepted?
1		Remediation Goal (RG) for PCBs Ecology agrees that we can hold off on reopening the risk assessment until the additional sampling has been performed since only one location exceeded remediation goal for sediment. However, it seems recontamination is occurring since contaminated sediment were removed as part of remedial action and we found PCBs in groundwater, seep water, pore water and surface water during 2017 data collection. Assessing and controlling the source(s) should be the next step. In addition, the RG for total PCBs in the OU1 ROD were established for sediment media only. PCBs were also detected in surface water but no screening levels were established. PCBs need to meet surface water quality ARAR as well. It looks like PCBs are exceeding the surface water quality ARAR. See EPA promulgated human health criteria 40 CFR 131.45 and State HHC 173-201A WAC. Ecology asks that the Navy add this information/discussion in section 4.7.1 Human Health similar to the discussion in section 4.7.2 Ecological aqueous paragraph.	Table 1-1 does show the RG established for PCBs in surface water, at the PQL of 0.04 µg/L. However, the Navy does not agree that recontamination has been identified. Based on the limited area of contamination identified and the method of sediment removal used, it appears more likely that the identified contamination is pre-ROD concentrations of residual sediment left in place after the sediment removal action. Surface water quality has not exceeded the surface water remediation goal (RG) identified in the Record of Decision. However, we understand Ecology's position that the surface water quality has exceeded the current surface water ARAR, even though that ARAR is based on human consumption of organisms and consumption of organisms was not identified as a complete receptor pathway in the original human health risk assessment. Additional investigation to better identify the source of the identified PCB contamination is planned during the 2019 site investigation, and the current RG will be evaluated for protectiveness in the upcoming five-year review.	

1 cont.			In addition, an update of the human health and ecological risk assessment is planned to begin in late 2019 based on the redefined magnitude and extent of contamination identified during the 2017 investigation, and all potential contaminants will be evaluated. If ongoing investigations or the planned update of the human health and ecological risk assessment identifies consumption of organisms as a complete pathway, the existing CSM and surface water quality criteria will be updated and alternative technologies to address sediment contamination will be evaluated. Information to this affect will be added to Section 4.7.1.	
2		Plume contour boundaries It is always helpful to see plume boundary maps but they must be based on concrete data. Solid lines in the plume should have a reference groundwater data that can be traced in the map. Some anomalies were noted in the plume boundary maps. For example, see the cVOC plume maps in South Plantation. Several figures (Figure 3-11; Figure 4-8 through 4-10) show cVOC plume for TCE and other degradation products that are not supported from the direct push SP-B63 data. SP-B63 has soil and groundwater data that are contaminated above PAL and there are no more borings beyond SP-B63 in the north-east corner of the site and therefore, it is difficult to interpret the extent of the plume in that direction. However, the plumes show solid lines depicting known boundaries.	The isoconcentration contour maps are based on concrete data, as shown on each contour map, but the isoconcentration contour depictions can undoubtedly be improved. At SP-B63, the vinyl chloride contour line is challenging to interpret because vinyl chloride was not detected at an elevated LOQ because of higher concentration of other cVOCs. We agree to dash the line in this area. On the TCE map, we see that the 100 ppb contour should pass outside of SP-B63, and should be dashed. The Navy is proposing more investigation in this portion of the site, and in similar areas of the site. We will also dash isoconcentration contour lines on Figures 4-8 through 4-10. We would like the team to keep in mind that the objective of this investigation was to identify hotspots, not to delimit concentrations above the PAL. We believe that the isoconcentration contour maps meet this objective.	

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2 cont.		Ecology recommends to reevaluate the plume boundaries not only at this location and but also other areas of the site so that solid plume boundary lines are only drawn where there are referenced groundwater data.		
3		Technology Screening While Table 4-3 provides a starting place to think about potential technologies for further evaluation, Ecology believes more information/research is necessary. The project team should discuss these technologies based on the results of the refined site CSM and whether remedial action objectives can be achieved within a reasonable restoration timeframe.	The Navy agrees that more refinement of Table 4-3 will be needed. Based on Comment 1 from the Suquamish Tribe, the Navy has agreed to remove the technology screening from this report and note that this Decision is deferred until additional information is obtained.	
		Specific Ecology Comments and Responses		
1	Page 3-1. Line 29-31	"One laboratory (Test America, Seattle) experienced instrument issues due to contaminant saturation of some samples which caused delays in sample analysis beyond the method-required holding times for volatile analysis." Did the lab flag these results? What was the outcome of the data validation report? Is the data usable?	As indicated in lines 33-34, "Exceptions to the analytical criteria resulted in the assignment of "J" qualifiers to the data. The "J" qualifier indicates that the result is considered an estimated value." The affected VOC data were qualified as estimated (J/UJ) and are usable for the project DQOs.	

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2	Page 3-2. Line 59-62	"Except where otherwise stated, the data associated with all of the issues identified below were qualified as estimated using either the qualifier "J" where the analyte was detected above the laboratory reporting limit, or "UJ" where the analyte was not detected above the laboratory reporting limit." Avoid using the term laboratory reporting limit (RL). Instead use terms DL, LOD, LOQ as defined in the QAPP. J flag should be used for detected concentration between DL and LOQ. Most labs use RL as identification plus quantification which is closely related to LOQ. In that case, putting "J" flag for concentrations above RL does not make sense.	The text will be corrected to replace "reporting limit" with "LOQ". The "J" and "UJ" qualifiers have been applied by the data validator to estimate results due to failed quality control criteria. The laboratories uses the "J" qualifier to estimate values reported between the DL and LOQ.	
3	Page 3-2. Line 67-69	"If samples were analyzed after more than twice the holding time, results were qualified as rejected with an "R" qualifier." How this rule was devised? Was this discussed in the QAPP? If not, provide a reference which can be used as a precedence.	The EPA National Functional Guidelines for Organic Superfund Method Data Review, January 2017, has the following guidance for holding times for volatile organics analysis: "If holding times are grossly exceeded, qualify detects as estimated (J) and non-detects as unusable (R)." The third-party data validation firm interprets "grossly" to mean "twice" the holding time. This validation reference will be added to the text of the report.	

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4	Page 3-7. Line 225-227	"The following PCB congeners were detected in the laboratory blank: PCB-80, 126, 141, 153, 168, 182, 189, 191, 193, 197, 205, 207, and total heptachlorobiphenyls." This is a fairly large number of congeners detected in the lab blanks. Is it just one blank? Or, this was associated with several blanks? How many blanks were run? Also, why total heptachlorobiphenyls is in the list? In method 1668, this is not an analyte but it is calculated from all analyzed hepta congeners.	There was one laboratory blank each analyzed with the water, soil, and PED samples (total of 3). The target analytes detected in the laboratory blanks were detected at trace levels (less than ½ the LOQ). All 3 laboratory blanks had trace detections; however, the PCB congeners listed are only the ones that effected samples (i.e., where samples had similar concentrations). You are correct that total heptachlorobiphenyl is a calculated value and not a true target analyte. Level IV data validation was performed, and sample concentrations that were <5x the blank contaminant concentrations were reported as not detected in the samples. The text will be clarified.	
5	Page 3-8. Line 228-229	"PCB congeners were detected in the field blanks (equipment blank and/or source blank)." Be specific whether PCB congeners were detected in equipment blank or source blank, or both. The phrase "and/or" is found in several places of the report. It should be avoided.	The text will be revised. "PCB congeners were detected in both the field blank (1) and the source blank (1) collected for PCB congener analyses." The report will be searched for the term "and/or" and text will be clarified.	
6	Table 3-1	It seems duplicate samples e.g. CL-B12-S-31.5-170714 & FD-170714-01 met the RPD criteria. Why this sample set is in the Table? There are other sample set in the Table that should be checked.	Table 3-1 lists all field duplicate sets. The table title will be changed to reflect that. Data exceeding RPDs have been bolded.	

7	Table 3-2, 3-11, & 3-13	It seems there are two separate Table contents are labeled as 3-2. It is difficult to follow the contents of Table 3-2 (continued). Language in the Text (page 3-9) is not clear either. Similar confusion exists for Table 3-11 and 3-13 and corresponding texts (line 472). Tables and texts should be revised to clarify the message.	Tables 3-2, 3-11, and 3-13 were split onto two pages for formatting. We will find a way to fit all columns for these tables onto one page for clarity. Text will be added to specifically discuss the interpretation of the last two columns in these tables. As an example, the following text will be added regarding Table 3-2. *The frequency of detection statistics for cVOCs in soil, and the magnitude of exceedances for each cVOC relative to its related PAL, indicate that the key cVOCs are TCE, cis-1,2-DCE, and VC. This analysis demonstrates that cVOCs other than TCE, cis-1,2-DCE, and VC are collocated with TCE, cis-1,2-DCE, and VC. That is, for every location where one of the other cVOCs exceeds its PAL, either TCE, cis-1,2-DCE, or VC also exceeds its PAL. This conclusion is supported by the results shown in the last two columns of Table 3-2. The penultimate column in Table 3-2 shows that cis-1,2-DCE and TCE exhibited the highest absolute concentration in the vast majority of the soil samples. The last column shows that in samples in which other cVOCs were detected, either TCE, cis-1,2, DCE, or VC were also detected.*	

8	Section 3.2.3 Additional Chemical Analysis of Soil Samples	Ecology applauds and agrees with Navy's decision to run for additional chemical analysis of 4 direct push soil samples that were mixed with oily substances. All of these samples exceed MTCA screening levels for several PAHs including cPAHs (not described in the report) and two of these samples exceed MTCA method A levels for TPH. PCBs were also found screening levels in one sample. While these chemicals are not part of Keyport LTM, Ecology recommends adding monitoring of these chemicals in the nearby downgradient groundwater monitoring wells. The rationale for this monitoring would be to see whether there are separate plumes for these chemicals and whether future source control actions would or could take care of these chemicals.	The RI, Risk Assessment, Summary Data Assessment Report, and ROD considered a wide range of contaminants of interest and contaminants of potential concern before settling on the list of contaminants of concern (COCs) included in the ROD. These assessments were performed with full knowledge of the wide variety of materials disposed and the resulting contaminants potentially present in the Former Landfill. The Navy ran additional analytes in samples from hotspots to provide data for future technology screening for hotspot treatment, but does not agree that these data require a changes to the COC list driving the LTM program at this time. The LTM program will be revised in collaboration with the project team once ongoing investigations and the planned human health and ecological risk assessment have been completed. In the interim, the Navy will research and summarize the history of COC analytes under the LTM program.	
9	Section 3.3.2 Line 490-497: 1,4-Dioxane	1,4-Dioxane is detected in 3 monitoring wells exceeding screening level. In addition, this was found above screening level in base boundary wells. It seems this chemical should also be part of the LTM.	Key monitoring and drinking water wells are currently monitored for 1,4-dioxane every two years under the Contingent Remedial Action Plan.	
10	Table 3-20	Clarify the second column data. For MWs, if it is screen interval, it would helpful to show the depth of the interval bgs to compare the depth of the grab groundwater results.	For monitoring wells, we will clarify in the column heading or via footnote that the depth represents the center of the 10-foot screen interval in bgs.	

11	Table 3-21: Sediment PCB Congener data	More than 100 PCB congeners were flagged as "B" or blank contamination. This was not discussed in QA/QC section 3.1. Was the blank contamination from lab or field (equipment)? Such a high percentage of PCB congeners tainted with blank contamination questions the validity/usability of the data. Ecology assumes the data have gone through level IV validation. Data validation report is not attached. Ecology would like to see the data validation report and discuss the usability of the data later.	"B" flag data are flagged by the laboratory and are due to laboratory blank contamination. As mentioned in the response to comment 4, the method blanks met QAPP criteria of ½ LOQ, so the data are considered usable. Sample concentrations that were <5x the blank contaminant concentrations were reported as not detected in the samples.	
12	Page 3-17. Line 560	"These results are also shown on Figure 3-14." Incorrect reference to the Figure. Check for correctness of other figure references.	Thank you. The order of callouts in the text for Figures 3-12 through 3-15 changed late in the report preparation process. This and any other inconsistences will be corrected.	
13	Table 3-23	The unit of total PCB RG should be ng/g OC. If OC is omitted, it defaults to dry weight.	The units for the RG will be revised to ng/g OC and the values Total PCB Aroclors will be revised to show carbon-normalized results.	
14	Page 3-17. Line 591	"Overall the 2017 data do not indicate a clearly increasing PCB concentration trend." Ecology recommends to strike this line out. First, this sentence does not follow well from the previous sentence and second, there is not enough information to see any trend in the dataset.	The Navy will change the sentence, as follows: "Overall the 2017 data are similar to pre-ROD concentrations. Additional investigation will be conducted in 2019 to evaluate potential sources of PCBs in sediment."	

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15	Page 4-7. Line 209-211	"The 2017 data set includes numerous examples of samples exhibiting no MIP or hand-held PID indications of contamination yet containing cVOC concentrations exceeding PALs." If this is the case then field decision based on PID readings as stated in line 200, "*Field decisions regarding when to step out laterally from a location, and at what depth to terminate exploration, were based on hand-held PID readings as matched to nearby MIP results.*" Becomes less certain and questionable. Is it possible that there could be more hot spot areas that were missed? Ecology would like to see language in the text that explain the limitations of the MIP and PID results.	As stated in this same paragraph, "High concentrations detected on the XSD instrument of the MIP correlated well with higher hand-held PID readings." and, "This approach was successful for meeting the goal of identifying areas of highest concentrations." The weak correlation of low PID readings to lower VOC concentrations (but still above the PAL) does not call into question the ability to detect the highest concentrations (hotspots), which was the goal of the investigation.	
16	Appendix H	The "Three-Dimensional Plume Models (Provided on CD only)" was not found in the CD.	The plume model images can be found in the comprehensive PDF of the report provided on CD, in Appendix H. Text will be changed to better clarify the location of these model drawings.	
17	Page 4-12. Line 379	"hotspots identified in this evaluation based on areas of dissolved COC concentrations above a benchmark value (at 10,000 µg/L cis-1,2-DCE in the Central Landfill area and at 50,000 µg/L TCE or cis-1,2-DCE in the South Plantation)." Why the numbers are different for Central Landfill and South Plantation? Describe the rationale behind this. Also, did the project team decide on a number (e.g., 10000 ug/L) for hotspot delineation during SAP development?	The project team wrestled with the concept of defining a hotspot during preparation of the original Phase I SAP and concluded that a rigid concentration definition would be too arbitrary and restrictive. Instead, the team developed a definition of "hotspot" as "an area where volatile organic compound (VOC) concentrations are substantially higher than in surrounding areas, as determined by the consensus of the project team."	

17 cont.	Page 4-12. Line 379		Using this definition and considering the EPA guidance cited, the Navy selected concentration values for hotspot definitions relative to the overall concentrations in each investigation area at the site. Central Landfill concentrations were significantly lower overall than those identified in the South Plantation. This identification of hotspots is intended for preliminary discussion of the 2017 data. Hotspots will be further delimited during design of any selected hotspot treatment.	
18	Table 4-3. Phytoremediation	Phytoremediation technology cannot be effectively used to treat hotspots given the depth of contamination. It should not be retained as a technology for further evaluation.	This technology was retained by the workgroup on the basis that the existing phytoremediation remedy may still play a role as part of a treatment train along with more aggressive technologies, to focus on lower concentrations to supporting natural biodegradation.	
19	Table 4-3. Pump and Treat	This technology is also not effective when matrix diffusion is involved. Given that there are low permeability lenses, Pump & Treat should not be retained as a technology for further evaluation.	This technology was retained by the workgroup, but the Navy agrees that it can be screened out.	

Comments from: Harry Craig, EPA
Comments dated: November 8, 2018

#	**Page No./ Line No.**	**Comment**	**Proposed Response**	**Response Accepted?**
EPA General Comments and Responses				
1		Based on our overall review EPA believes the draft Recharacterization Report provides an improved Conceptual Site Model (CSM) as the basis on which to evaluate alternative remedial technologies to the current remedy for Keyport OU-1. Long term monitoring at Keyport OU-1 has	Thank you. However, the fourth five-year review found the OU 1 remedy to be protective in the short term, concluding that ongoing exceedances of RGs and migration of contaminants match the conditions expected by the ROD. It should be noted that alternative technologies to address dissolved phase contamination will be evaluated only based \	

1 cont.		consistently shown that groundwater and surface water Remedial Goals (RGs) are not being met for chlorinated VOCs in both groundwater and surface water (EPA 2013).	on the outcome of ongoing investigations and/or the planned update of the human health and ecological risk assessments. Current investigations are designed to support evaluation of alternative technologies to address hotspots.	
2		Conversely, EPA believes that the Technology Screening table (Table 4-3) is disjointed and needs to be substantially revised to address the current understanding of the site based on the CSM, and the applicable technologies based on the updated CSM. EPA strongly recommends that the technology screening be divided into a) source area or "hotspot" (e.g. > 10,000 ug/L CVOCs) remedial technologies evaluation, and b) dissolved phase (e.g. > RG but < 10,000 ug/L CVOCs) remedial technologies evaluation to address CVOCs in groundwater and surface water. The general definition of source areas are considered to be those shown in Figures 4-15 and 4-16 of the draft report.	The technology screening table was developed by the project team during a series of workshops (see Worksheet 9 of the SAP for a summary of these workshops). The Navy made relatively few changes to the Technology Screening Table as part of this report, because the fundamental understanding of the site (NAPL or high-concentration residual source areas within the landfill generating a dissolved-phase plume) was not changed by this investigation. The Navy is willing to meet with the new members of the project team to revise the table. However, at this time the Navy has not agreed to evaluate dissolved plume remedial actions beyond those required by the OU 1 ROD. The project team has agreed to focus potential future remedial actions on hotspot treatment to reduce the restoration timeframe. Alternative technologies to address dissolved phase contamination will be evaluated only based on the outcome of ongoing investigations and/or the planned update of the human health and ecological risk assessments. Based on Comment 1 from the Suquamish Tribe, the Navy agrees to remove the technology screening from this report and note that this Decision is deferred until additional information is obtained.	
3		Several preliminary performance criteria for groundwater technologies were identified in Section 5.6 (Decision Rule 6) of the report (i.e. 2 to 3 order of magnitude reduction in concentration in the source areas, 99% to	The Navy plans to collect additional data in 2019 to support further screening of technologies that could be used for hotspot treatment (not treatment of the dissolved plume; see response to EPA Comments 1 and 2). In general, the Navy agrees that establishing performance criteria will be key to future technology screening. Based on Comment 1 from the Suquamish Tribe, the Navy has agreed to remove the technology screening from this report and note that this Decision is deferred until additional information is obtained.	

3 cont.		99.9% reduction), but none of the technologies in Table 4-3 were evaluated against their capability to meet this performance criteria. EPA recommends that specific performance criteria be developed for both source area and dissolved phase plume treatment technologies, and the ability of each of the evaluated technologies to meet these performance criteria. RGs for groundwater and surface water in the RODs should be specifically identified as performance criteria, particularly for the dissolved phase plume. Several technology reviews have been conducted for CVOCs remediation technologies in groundwater cited in the Reference section below and provide useful information regarding the historical performance of these technologies.		
4	Section 5.6, Decision Rule 6 Conclusions	"However, because widespread occurrence of cVOCs exceeding their respective RGs by several orders of magnitude outside the hotspot areas, residual COC concentrations back diffusing from fine-grained interbeds will likely result in a restoration timeframe exceeding 100 years even after hotspot treatment." – What is the technical analysis	Further discussion of the observation of the field findings of cVOC retention in fine-grained interbeds at the site is included on page 2-2, which also cites Chapman and Parker, 2005 regarding the observations of back diffusion at sites that have undergone source zone treatment. This paper, for example, states, "Vertical back diffusion from the aquitard combined with horizontal advection and vertical transverse dispersion account for the TCE distribution in the aquifer and that the aquifer TCE will remain much above the MCL for centuries." The Navy's experience at numerous cVOC sites leads to the conclusion that it is unrealistic to expect that treatment of hotspots at OU 1 will lead to a reduction of the restoration timeframe to less than 100 years, given	

4 cont.		that supports this restoration timeframe estimate after hotspot treatment? Restoration timeframes for downgradient dissolved phase plumes will likely be highly dependent on the hotspot treatment technology utilized and the actual effectiveness of that technology as implemented on a site-specific basis.	the high concentration dilute plume present outside of hotspot areas. Restoration timeframe will be more accurately estimated based on the contaminant fate and transport modeling included in the ongoing site re-characterization effort.	

EPA Specific Comments and Responses

1	Table 4-3, Phytoremediation	It is unclear why this technology is being retained, historical monitoring has shown it has not met ROD RGs for groundwater and surface water, see General Comment No. 1.	This technology was retained by the workgroup on the basis that the existing phytoremediation remedy may still play a role as part of a treatment train along with more aggressive technologies, but focused on lower concentrations and its support of natural biodegradation functions. Based on Comment 1 from the Suquamish Tribe, the Navy has agreed to remove the technology screening from this report and note that this Decision is deferred until additional information is obtained. Responses are provided to the remaining technology screening comments for future consideration.	
2	Table 4-3, Gas Sparging	Is this air sparging specifically or are other gasses being considered? How effective would this technology be for treatment of CVOCs in a highly heterogeneous low permeability subsurface geological environment?	This technology from the original list has been screened out for the reasons given in Table 4-3. The assumption is that air is the sparge gas.	

3	Table 4-3, Funnel and Gate System	Is this a permeable reactive barrier (PBR)? If so what is the permeable barrier material being evaluated?	Yes, funnel and gate systems are a type of PRB. The technology was screened out for constructability concerns and not meeting the hotspot treatment goal, regardless of the media, as described in Table 4-3. If technologies to treat the dissolved plume are explored in the future, based on identification of receptors, this technology may be reevaluated.	
4	Table 4-3, Excavation	Is excavation considered feasible if the majority of the excavation occurs below the water table to an estimated depth of 30 ft bgs?	Yes. Shoring and dewatering techniques such as a freeze wall could be used to control water entry. However, this technology would be restricted to hotspot treatment.	
5	Table 4-3, ERH, Comment Column	Would CVOCs > 10,000 ug/L not be considered NAPL sources based on 1% of solubility (see EPA 2009)?	Yes, these are considered NAPL areas, and NAPL was observed. The technology is retained. To reduce confusion, the last part of the sentence that mentions NAPL will be deleted.	
6	Table 4-3, Biobarrier	Is this a variant of a biologically based PBR? Would this technology not be employed at the edge of the waste management area and not in the landfill?	Yes, this can be thought of as a PBR variant. The waste ends where the marsh begins, so any barrier would have to be constructed either through the edge of the waste body or within the marsh (destroying existing marsh habitat), which is why barriers were rejected in the original FS. However, if technologies to treat the dissolved plume are explored in the future, based on identification of receptors, this technology may be reevaluated, given the shallow depth of the edge of the waste body.	
7	Table 4-3, ISCR	What is the delivery method that is being evaluated here?	Injection or soil mixing.	
8	Table 4-3, DPE	Recommend this technology be retained, it has shown to be very effective for NAPL removal, particularly when used in conjunction with ERH in source areas.	The Navy agrees to screen in DPE.	

Document Title:
DRAFT Operable Unit 1, 2017 Site Recharacterization Phase II, Naval Base Kitsap, Keyport, Washington

Document dated: October 2018

9	Table 4-3, In Well Aeration/Stripping	How is this different than air sparging?	In-well stripping recirculates water and air within a well. The ART technology website at http://artinwell.com/index.asp describes this technology.	
10	Table 4-3, Low Energy ERH w/ ISB or ZVI	What is the advantage of low energy ERH vs. normal ERH applications for high levels of CVOCs? How is ISB or ZVI delivered in conjunction with ERH?	Low energy ERH may be less prone to energy loss due to conductive debris and voids in the waste body, with the goal being biostimulation rather than boiling groundwater. Amendments can be delivered through the electrode wells, existing wells or separately injected using direct push drilling.	
11	Table 4-3, PBRs	Recommend PBRs be retained. They are normally placed on the downgradient side of a landfill, not in the landfill.	The waste ends where the marsh begins, so any barrier would have to be constructed either through the edge of the waste body or within the marsh (destroying existing marsh habitat), which is why barriers were rejected in the original FS. PRBs also do not meet the agreed-upon goal of hotspot treatment (contrasted with containment). However, if technologies to treat the dissolved plume are explored in the future, based on identification of receptors, this technology may be reevaluated, given the shallow depth of the edge of the waste body.	
12	Table 4-3, EOS	What is the method of delivery for EOS? How is this different from the Biobarrier? I believe that the E in EOS stands for "Emulsified" rather than "Edible". EOS typically lasts on the order of 1 to 2 years for reducing conditions, not 4 years as suggested in the Comments column.	"Edible" will be replaced with "emulsified." Injection is the method considered. EOS can be used as a biobarrier, but so can a compost PRB. The comments column is simply stating what was considered in the optimization report. A statement will be added, "However, EOS has been observed to last on the order of 1 to 2 years under reducing conditions."	

I. REFERENCES

1. EPA, Assessment and Delineation of DNAPL Source Zones at Hazardous Waste Sites, EPA/600/R-09/119, September 2009.

2. EPA, Optimization Review, Naval Base Kitsap OU-1, Keyport, Washington, Office of Solid Waste and Emergency Response, Washington, D.C., EPA 542-R-13-009, August 2013.

3. Baker, Ralph S., Steffen G. Nielsen, Gorm Heron, and Niels Ploug. *How Effective is Thermal Remediation of DNAPL Source Zones in Reducing Groundwater Concentrations? Groundwater Monitoring and Remediation*, 36, No. 1, pp. 38-53, Winter 2016.

4. McDade, J.M. et al., Analysis of DNAPL Source-Depletion Costs at 36 Field Sites*, Remediation*, pp. 9- 18, Spring 2005.

5. McGuire, T.M. et al., Performance of NAPL Source Depletion Technologies at 59 Chlorinated Solvent-Impacted Sites, *Groundwater Monitoring and Remediation*, 26, No. 1, pp. 73-84, Winter 2006.

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7. Triplett Kingston, J.L. et al., State-of-the-Practice Review of In Situ Thermal Technologies, *Groundwater Monitoring and Remediation*, 30, no. 4, pp. 64-72, Fall 2010.

8. Adamson, D.T. et al., Sustained Treatment: Implicants for Treatment Timescales Associated with Source-Depletion Technologies, *Remediation*, pp. 27-50, Spring 2011.

9. Sale, T. & C. Newell, Decision Guide: A Guide for Selecting Remedies for Subsurface Releases of Chlorinated Solvents, ESTCP Project ER-200530, March 2011.

10. Stroo, H.F. et al., Chlorinated Ethene Source Remediation: Lessons Learned*, Environmental Science and Technology*, 46, pp. 6438-6447, 2012.

11. Suchomel, E.J. et al., The Source Zone Remediation Challenge, Chapter 2, In: *Chlorinated Solvent Source Zone Remediation*, Kueper, B.H. et al. (eds.), Springer, New York, 2014.

APPENDIX B

Approved Field Change Request Forms

Battelle Memorial Institute

CONTRACT NUMBER: N39430-16-D-1802

FIELD CHANGE REQUEST (FCR)

TASK ORDER # 010
FCR # TO 010 FCR-01
DATE July 12, 2017
LOCATION: Naval Base Kitsap Keyport, Washington
NTR / RPM Carlotta Cellucci

1. Document to be changed. Identify revision, date, section, drawing, etc.

Phase II Site Recharacterization Sampling and Analysis Plan dated June 29, 2017, WS#14,15-8,18,19,20, and #23-6

2. Description of existing requirement and proposed change (Attach sheet if necessary)

REQUIREMENT: Analysis of grab soil samples for 10 volatile organic compounds VOCs using EPA Method 8260C on a 21-day turn around time (TAT).
PROPOSED CHANGE: Submit initial soil samples on a 5-day TAT to allow correlation of field observations (including PID readings) to VOC concentrations measured in the laboratory. Initial soil samples to include three collected from boring SP-B01 (collected on July 12, 2017), three from CL-B02 (collected on July 12, 2017), and three from CL-B03 (collected on July 11, 2017).
In addition, because of the observation of dark brown free product lining selected sampler sleeves collected from direct-push boring SP-B01 on July 11, add the following analyses to one soil sample collected from the area with the highest PID concentration to assess the product observed:

- NWTPH - HCID
- Follow-on NWTPH-Dx analysis (if warranted)
- Full 8260C analyte list
- PCB Aroclors by EPA Method 8082 (if RRO is identified in the HCID)
- Note that there will be insufficient sample for NWTPH-G (if warranted based on the HCID analysis); however, the primary risk drivers benzene, ethylbenzene, toluene and xylenes will be captured by the full 8260C analyte list.

Request 5-day TAT for these additional analyses to ensure additional samples collected from the hot spot area at soil boring SP-B01 are analyzed appropriately. Request the laboratory standard reporting limits for these additional analyses, and develop and compare to PALs in the draft project report. No field duplicates, equipment blanks, or other QC samples are proposed for the additional analyses.
To allow for timely data interpretation in advance of Mobilization 2, analyze all grab soil and groundwater samples collected during the last week of mobilization (August 7 through 11, 2017) on a 14 day TAT.

3. Reason for Change (Attach sheet if necessary)

Earlier data return from the laboratory is warranted to allow correlation of field observations (including PID readings) to VOC concentrations measured in the laboratory. Also, conditions observed in soil boring SP-B01 were different than anticipated, warranting additional analyses on one sample to assess the product encountered and early data return from the laboratory to ensure additional samples collected from the hot spot area at soil boring SP-B01 are analyzed appropriately. Earlier data return from the laboratory is also warranted for data collected near the end of Mobilization 1 to allow planning for Mobilization 2.

4. Originator: (print name and sign) Michael Meyer, Battelle		**Title** Project Manager	**Date** 7-12-17
Reviewed by: (print name and sign)		**Title**	**Date**
Site Superintendent (Print name and sign)	**Date**	**Task Order Manager (Print name and sign)**	**Date**
Program QC Manager (Print Name and Sign)	**Date**	**NTR Acknowledgement (Print name and sign)** CELLUCCI.CARLOTTA.1383387546 Digitally signed by CELLUCCI.CARLOTTA.1383387546 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=CELLUCCI.CARLOTTA.1383387546 Date: 2017.07.13 10:26:49 -07'00'	**Date** 7/13/17

Battelle Memorial Institute

CONTRACT NUMBER: N39430-16-D-1802

FIELD CHANGE REQUEST (FCR)

TASK ORDER # 010 ⊞ **FCR #** TO-010-FCR-02 ⊞ **DATE** July 12, 2017

LOCATION: Naval Base Kitsap Keyport, Washington **NTR / RPM** Carlotta Cellucci ⊞

1. Document to be changed. Identify revision, date, section, drawing, etc.

2. Description of existing requirement and proposed change (Attach sheet if necessary)

Item 1: REQUIREMENT: Continuous core all soil borings.
PROPOSED CHANGE: To allow more efficient use of time, continuous core select borings as determined in collaboration with the RPM to continue to correlate between MIP EC logs and lithology observed in soil cores and correlate between field PID and MIP PID/XSD results. For borings not selected for continuous coring, drive to selected depths based on data obtained from nearby MIP and/or other direct-push borings, and core discrete ranges to allow collection of soil samples from target contaminated zones.

Item 2: REQUIREMENT: Grab groundwater samples will be collected by driving a decontaminated Geoprobe® Screen Point 22 sampler into undisturbed saturated soil at the appropriate depth.
PROPOSED CHANGE: Allow the use of an alternate collection method for grab groundwater, to consist of a hand-placed, clean, temporary PVC well screen at the target depth, which is removed after groundwater sample collection.

3. Reason for Change (Attach sheet if necessary)

Item 1: Lithology is found to correlate well to the MIP EC log, and continuous coring to establish lithology at each boring location is not necessary. More samples can be collected in the time available if not all of the direct-push borings are continuously cored.

Item 2: The hand-placed temporary well screen is a more efficient way to collect a shallow grab groundwater under some site conditions in some borings. Allowing the use of multiple methods for collecting grab groundwater samples provides flexibility and increases efficiency, allowing data collection to be maximized within the time available.

4. Originator: (print name and sign) Michael Meyer, Battelle	**Title** Project Manager	**Date** 7-12-17
Reviewed by: (print name and sign)	**Title**	**Date**

Site Superintendent (Print name and sign)	**Date**	**Task Order Manager (Print name and sign)**	**Date**
Program QC Manager (Print Name and Sign)	**Date**	**NTR Acknowledgement (Print name and sign)** CELLUCCI.CARLOTTA.1383387546 Digitally signed by CELLUCCI.CARLOTTA.1383387546 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=CELLUCCI.CARLOTTA.1383387546 Date: 2017.07.13 10:39:54 -07'00'	**Date** 7/13/17

Battelle Memorial Institute

CONTRACT NUMBER: N39430-16-D-1802

FIELD CHANGE REQUEST (FCR)

TASK ORDER # 010 **FCR #** TO-010-FCR-03 **DATE** July 18, 2017
LOCATION: Naval Base Kitsap Keyport, Washington **NTR / RPM** Carlotta Cellucci

1. Document to be changed. Identify revision, date, section, drawing, etc.

Phase II Site Recharacterization Sampling and Analysis Plan dated June 29, 2017 and Final Revision 1 APP/SSHP dated June 2017

2. Description of existing requirement and proposed change (Attach sheet if necessary)

REQUIREMENT: Only approved Battelle personnel will act as Site Safety and Health Officer (SSHO).
PROPOSED CHANGE: Add Michael Meyer as an approved collateral duty Site Supervisor and SSHO, based on the attached certifications. Mr. Meyer's last medical fitness clearance was September 19, 2016.

3. Reason for Change (Attach sheet if necessary)

Because of the relatively long duration of field work for this project, staffing flexibility is needed. Allowing the CTO manager to act as SSHO/SS will provide additional staffing flexibility.

4. Originator: (print name and sign) Michael Meyer, Battelle		**Title** Project Manager	**Date** 7-18-17
Reviewed by: (print name and sign)		**Title**	**Date**
Site Superintendent (Print name and sign)	**Date**	**Task Order Manager (Print name and sign)**	**Date**
Program QC Manager (Print Name and Sign)	**Date**	**NTR Acknowledgement (Print name and sign)** CELLUCCI.CARLOTTA.1383387546 Digitally signed by CELLUCCI.CARLOTTA.1383387546 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=CELLUCCI.CARLOTTA.1383387546 Date: 2017.07.18 15:02:34 -07'00'	**Date** 7/18/17

Battelle Memorial Institute

CONTRACT NUMBER: N39430-16-D-1802

FIELD CHANGE REQUEST (FCR)

TASK ORDER # 010 **FCR #** TO 010 FCR-04 **DATE** July 19, 2017

LOCATION: Naval Base Kitsap Keyport, Washington **NTR / RPM** Carlotta Cellucci

1. Document to be changed. Identify revision, date, section, drawing, etc.

Phase II Site Recharacterization Sampling and Analysis Plan dated June 29, 2017, WS#14,15-8,18,19,20, and #23-6

2. Description of existing requirement and proposed change (Attach sheet if necessary)

ITEM 1 REQUIREMENT: Analysis of grab soil samples for 10 volatile organic compounds (VOCs) using EPA Method 8260C on a 21-day turn around time (TAT).

ITEM 1 PROPOSED CHANGE: Because of the observation of free product in direct-push boring CL-B18A at a depth of 18 feet on July 18, and the previous observation of black stained soil at SP-B01, allow for the following additional analyses of soil samples when unexpected conditions are observed:

- NWTPH - HCID
- Follow-on NWTPH-Gx, -Dx analyses (if warranted)
- PCB Aroclors by EPA Method 8082 (if RRO is identified)
- Full 8260C analyte list
- SVOCs via EPA Method 8270

Request a 21 day TAT for these additional analyses.
Request the laboratory standard reporting limits for these additional analyses, and develop and compare to PALs in the project report.
No field duplicates, equipment blanks, or other QC samples are proposed for the additional analyses.

ITEM 2 REQUIREMENT: Holding time for grab soil samples for VOCs is 14 days based on preserved sample vials.

ITEM 2 PROPOSED CHANGE: The laboratory no longer provides preserved sample vials as called for in the SAP. The holding time using unpreserved sample vials is 48hrs. Ship samples more frequently, or use a courier, to meet the 48-hr holding time.

3. Reason for Change (Attach sheet if necessary)

Conditions observed in soil boring CL-B18A and previous soil boring SP-B01 were different than anticipated, warranting the flexibility to add additional analyses to select soil samples at the discretion of the field team in consultation with the RPM.

Based on changes in the laboratory procedures, the hold time for grab soil samples analyzed for VOCs needs to be reduced to 48 hours..

4. Originator: (print name and sign)	**Title**	**Date**
Michael Meyer, Battelle	Project Manager	7-19-17
Reviewed by: (print name and sign)	**Title**	**Date**

Site Superintendent (Print name and sign)	**Date**	**Task Order Manager (Print name and sign)**	**Date**
Program QC Manager (Print Name and Sign)	**Date**	**NTR Acknowledgement (Print name and sign)**	**Date**
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Battelle Memorial Institute

CONTRACT NUMBER: N39430-16-D-1802

FIELD CHANGE REQUEST (FCR)

TASK ORDER # 010 ☐ **FCR #** TO 010 FCR-05 ☐ **DATE** August 11, 2017

LOCATION: Naval Base Kitsap Keyport, Washington **NTR / RPM** Carlotta Cellucci ☐

1. Document to be changed. Identify revision, date, section, drawing, etc.

Phase II Site Recharacterization Sampling and Analysis Plan dated June 29, 2017, WS#12-1, 14, 15-1, 18, 19, 20, 23-5, 24, 25, 28-1, and 30.

2. Description of existing requirement and proposed change (Attach sheet if necessary)

ITEM 1 REQUIREMENT: Analysis of sediment samples for PCB congeners.
ITEM 1 PROPOSED CHANGE: Add PCB aroclor analysis to sediment samples with the same turn-around-time as PCB congenrs. Request the laboratory standard reporting limits for this additional analysis, and develop and compare to PALs in the project report. Also run sediment field duplicates, equipment blanks, and other QC samples for PCB aroclors.

ITEM 2 REQUIREMENT: Collect surface water samples during Mobilization 1.
ITEM 2 PROPOSED CHANGE: Collect surface water samples during Mobilization 2.

ITEM 3 REQUIREMENT: Collect and analyze bulk sediment samples for PCB congeners
ITEM 3 PROPOSED CHANGE: Also deploy, retrieve, and analyze passive sediment samplers at sediment stations and in select monitoring wells and piezometers.

3. Reason for Change (Attach sheet if necessary)

ITEM 1: The Washington State Department of Ecology requested the additional of PCB aroclor analysis to allow comparison to historical results at these sediment stations.

ITEM 2: Because of record-setting dry weather during Mobilization 1, no surface water was present at nearly half of the planned surface water sample stations.

ITEM 3: Cost savings during work plan preparation can be used to optimize the sediment sampling approach (as documented in an approved Concurrence Letter between Battelle and the Navy). The planned optimization using passive samplers will provide direct measurement of PCB concentrations in pore water that can be used as a line of evidence in the risk assessments.

4. Originator: (print name and sign) Michael Meyer, Battelle		**Title** Project Manager	**Date** 8-11-17
Reviewed by: (print name and sign)		**Title**	**Date**
Site Superintendent (Print name and sign)	**Date**	**Task Order Manager (Print name and sign)**	**Date**
Program QC Manager (Print Name and Sign)	**Date**	**NTR Acknowledgement (Print name and sign)** CELLUCCI.CARLOTTA.1383387546 Digitally signed by CELLUCCI.CARLOTTA.1383387546 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=CELLUCCI.CARLOTTA.1383387546 Date: 2017.08.17 11:11:16 -07'00'	**Date** 8/17/17

Battelle Memorial Institute

CONTRACT NUMBER: N39430-16-D-1802

FIELD CHANGE REQUEST (FCR)

TASK ORDER # 010 **FCR #** TO 010 FCR-06 **DATE** September 19, 2017

LOCATION: Naval Base Kitsap Keyport, Washington **NTR / RPM** Carlotta Cellucci

1. Document to be changed. Identify revision, date, section, drawing, etc.

Phase II Site Recharacterization Sampling and Analysis Plan dated June 29, 2017, WS#14, 17, 18, 19, and 20

2. Description of existing requirement and proposed change (Attach sheet if necessary)

REQUIREMENT: Well Construction: The wells will be constructed of flush-threaded Schedule 40 polyvinyl chloride (PVC) and will have a sand trap on the bottom, an estimated 10 feet of 0.010 slot screened well casing, blank well casing to ground surface and sealed with a lockable compression cap. The filter pack around the screen will consist of 2/12 Monterrey sand, and the well seal will consist of hydrated bentonite chips.

PROPOSED CHANGE: At selected well locations (3 to 5 locations), install wells using Continuous Multi-Channel Tubing (CMT). Ports will be cut in each CMT tubing channel at the depths selected based on the geology observed in adjacent continuous core direct-push borings, and based on the vertical contaminant distribution observed. Following positioning of the CMT tubing in the bore hole, four feet of filter pack, consisting of 10/20 Colorado silica sand, will be placed at the depth of each open port (2 feet of sand above and below each port). Each interval of filter pack will be separated from each other filter pack interval with a minimum of 2 feet of hydrated bentonite chips. The CMT will be sealed at ground surface with a minimum of 2 feet of hydrated bentonite chips and finished with a locking well monument set in concrete.

3. Reason for Change (Attach sheet if necessary)

ITEM 1: During the direct-push continuous coring investigation, the vertical distribution of COCs in the eastern portion of the South Plantation was found to be complex, with high COC concentrations found at multiple depths separated by relatively lower concentrations. Installation of CMT wells will allow sampling of discrete vertical intervals within one well bore, to help understand the nature of the vertical distribution of COCs in this area.

4. Originator: (print name and sign) Michael Meyer, Battelle	**Title** Project Manager	**Date** 9-19-17
Reviewed by: (print name and sign)	**Title**	**Date**

Site Superintendent (Print name and sign)	**Date**	**Task Order Manager (Print name and sign)**	**Date**
Program QC Manager (Print Name and Sign)	**Date**	**NTR Acknowledgement (Print name and sign)** CELLUCCI.CARLOTTA.1383387546 Digitally signed by CELLUCCI.CARLOTTA.1383387546 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=CELLUCCI.CARLOTTA.1383387546 Date: 2017.09.25 09:33:24 -07'00'	**Date** 9/25/17

Battelle Memorial Institute

CONTRACT NUMBER: N39430-16-D-1802

FIELD CHANGE REQUEST (FCR)

TASK ORDER # 010 ⊞ FCR # TO-010-FCR-07 ⊞ DATE September 27, 2017

LOCATION: Naval Base Kitsap Keyport, Washington NTR / RPM Carlotta Cellucci ⊞

1. Document to be changed. Identify revision, date, section, drawing, etc.

Phase II Site Recharacterization Sampling and Analysis Plan dated June 29, 2017 and Final Revision 1 APP/SSHP dated June 2017

2. Description of existing requirement and proposed change (Attach sheet if necessary)

REQUIREMENT: Only approved Battelle personnel will act as Site Safety and Health Officer (SSHO).
PROPOSED CHANGE: Add Josh Sacker as an approved collateral duty Site Supervisor and SSHO, based on the attached certifications. Mr. Sacker's last medical fitness clearance was July 21, 2017.

3. Reason for Change (Attach sheet if necessary)

Because of the relatively long duration of field work for this project, staffing flexibility is needed. Allowing Mr. Sacker to act as SSHO/SS will provide additional staffing flexibility.

4. Originator: (print name and sign) Michael Meyer, Battelle	**Title** Project Manager	**Date** 9-27-17
Reviewed by: (print name and sign)	**Title**	**Date**

Site Superintendent (Print name and sign)	**Date**	**Task Order Manager (Print name and sign)** Carlotta Cellucci	**Date** 9/28/17
Program QC Manager (Print Name and Sign)	**Date**	**NTR Acknowledgement (Print name and sign)** Carlotta Cellucci	**Date** 9/28/17

Battelle Memorial Institute

CONTRACT NUMBER: N39430-16-D-1802

FIELD CHANGE REQUEST (FCR)

TASK ORDER # 010 ⊞ FCR # TO-010-FCR-08 ⊞ DATE October 11, 2017

LOCATION: Naval Base Kitsap Keyport, Washington NTR / RPM Carlotta Cellucci ⊞

1. Document to be changed. Identify revision, date, section, drawing, etc.

Phase II Site Recharacterization Sampling and Analysis Plan dated June 29, 2017, WS#12-7, 14, 15-7, 18, 19, 20, 23-4, 24, 25, 28-18, and 30.

2. Description of existing requirement and proposed change (Attach sheet if necessary)

REQUIREMENT: Analysis of groundwater samples for Microbial qPCR, including census of dehalococcoides and dehalobacter, with quantitation of trichloroethene and vinyl chloride reductase genes.

PROPOSED CHANGE: Revise analysis to include a full quantitative array of reductase genes (Microbial Insights analysis "Quantitative Array Core").

3. Reason for Change (Attach sheet if necessary)

The Navy Subject Matter Expert recommends the expanded analysis to better meet the project objectives.

<table>
<tr><td colspan="2">4. Originator: (print name and sign)
Michael Meyer, Battelle</td><td>Title
Project Manager</td><td>Date
10-11-17</td></tr>
<tr><td colspan="2">Reviewed by: (print name and sign)</td><td>Title</td><td>Date</td></tr>
<tr><td>Site Superintendent (Print name and sign)</td><td>Date</td><td>Task Order Manager (Print name and sign)</td><td>Date</td></tr>
<tr><td>Program QC Manager (Print Name and Sign)</td><td>Date</td><td>NTR Acknowledgement (Print name and sign)
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Date: 2017.10.11 12:29:40 -07'00'</td><td>Date
10/11/17</td></tr>
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Battelle Memorial Institute

CONTRACT NUMBER: N39430-16-D-1802

FIELD CHANGE REQUEST (FCR)

TASK ORDER # 010 ⊞ **FCR #** TO-010-FCR-09 ⊞ **DATE** October 20, 2017

LOCATION: Naval Base Kitsap Keyport, Washington **NTR / RPM** Carlotta Cellucci ⊞

1. Document to be changed. Identify revision, date, section, drawing, etc.

Phase II Site Recharacterization Sampling and Analysis Plan dated June 29, 2017, WS#3, 4, 7, 14, 15-5, 23-2, 28-7, and 30.

2. Description of existing requirement and proposed change (Attach sheet if necessary)

REQUIREMENT: Analysis of groundwater samples for PFAS compounds in groundwater samples by ALS, subcontracted to Empirical, under contract to Battelle.
PROPOSED CHANGE: Change analytical laboratory to the Battelle Norwell Laboratory.

3. Reason for Change (Attach sheet if necessary)

The Navy has issued a clarification that analysis of PFAS compounds must be performed by laboratories who are DOD QSM 5.1 certified. Certification to DOD QSM 5.0 is not sufficient. ALS is in the process of obtaining DOD QSM 5.1 certification, but is not yet certified. The Battelle Norwell Laboratory is DOD QSM 5.1 certified for PFAS compounds in groundwater, drinking water, and tissue.

4. Originator: (print name and sign) Michael Meyer, Battelle	**Title** Project Manager	**Date** 10-20-17
Reviewed by: (print name and sign)	**Title**	**Date**

Site Superintendent (Print name and sign)	**Date**	**Task Order Manager (Print name and sign)**	**Date**
Program QC Manager (Print Name and Sign)	**Date**	**NTR Acknowledgement (Print name and sign)** CELLUCCI.CARLOTTA.1383387546 Digitally signed by CELLUCCI.CARLOTTA.1383387546 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=CELLUCCI.CARLOTTA.1383387546 Date: 2017.11.06 12:05:27 -08'00'	**Date** 11/6/17

APPENDIX C

Daily Field Reports

DAILY FIELD REPORT 07 / 10 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: partly cloudy, high 60's to low 70's, no rain, light wind	
To: Carlotta Cellucci	
From: Damon DeYoung	

DAILY FIELD REPORT

PERSONNEL ON SITE:

Carlotta Cellucci (NAVFAC NW)
Michael Meyer, Samuel Moore, Damon DeYoung (Battelle)
Michael Running, Austin Cuda (Holt Services)

SUMMARY OF WORK COMPLETED:

- Field work kickoff meeting
- Drilling rig mobilization (Holt Services) and laydown area setup completed.
- Hand dug catch basin II on eastern side of South Plantation. Depth to water in catch basin was 5.42 feet below ground surface. Depth to water in P1-8 (presumed upgradient direction) was 4.60 feet below ground surface.

DEVIATIONS FROM WORKPLAN:

No drilling operations were conducted as the dig permit had not been approved.

FIELD ACTIVITY CHRONOLOGY

0715 M. Meyer (Battelle) on site

0810 C. Cellucci (NAVFAC NW) on site

0820 D. DeYoung and S. Moore (Battelle) on site. Unloaded/organized field supplies and laboratory coolers. Performed site walk in the central landfill area and the Southern Plantation. Discussed strategies of executing field activities and reviewed MIP logs from 2016.

1055 M. Running and A. Cuda (Holt Services) on site. Held field work kickoff meeting. NAVFAC NW primary NTR is Charlie Escola, but may be in Alaska during this field mobilization. Alternate NTRs are Steve Saepoff and Steve Skeehan. Carlotta Cellucci will likely act as NTR, and will be frequently on site as her schedule allows. Discussions were held in accordance with the meeting agenda (e.g., scope, schedules, strategy/approach for meeting scope/schedule, activity/contracting requirements, health and safety)

1110 Wayne from NBK Keyport motorcycle training operations stopped by the site.

1115 Performed site walk with Holt Services. Located appropriate drilling equipment laydown area (SW corner of central landfill parking lot) and drum staging area (NE of fabric building).

1140 Layne Amos (Bristol) is the superintendent of the water line project, they are using the open steel hangar between the Central Landfill and South Plantation to stage steel water lines for their project. The eastern gate of the fenced area will remain unlocked during the environmental investigation so the drum staging area will be accessible.

1200 C. Cellucci off site. Battelle and Holt Services staff off site for lunch.

1300 Returned to site. Hand dug catch basin II and measured depth to water (5.42 feet below ground surface). Opened piezometer P1-8 and measured depth to water (4.60 feet below ground surface). Note that the lock on P1-8 will not re-lock.

1400 Drillers off site.

1500 All field staff off site.

SUMMARY OF FINDINGS/CONCLUSIONS

First handful of boreholes will target continuous soil cores adjacent to previous MIP locations to calibrate the field PID unit against historic cVOC detections. The motorcycle training area of the Central Landfill area is highest priority to be completed first to minimize the outage of the training facility. Authorization to commence drilling is contingent on approved Dig Permit. The permit is anticipated the morning of July 11, 2017.

PLANS FOR THE FOLLOWING DAY:

Be on site at 8:30 since the dig permit is not yet approved.
Begin drilling at MIP location 18 to calibrate the PID against elevated MIP detections.
Upon concurrence with NAVFAC NW that the PID screening is appropriate, begin drilling in Central Landfill near MW1-17 and recent MIP points.

ATTACHMENTS:

None

Copies to: Michael Meyer	**Battelle - DAILY FIELD REPORT** Signed: ______________________

DAILY FIELD REPORT 07 / 11 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: partly cloudy in the morning to clear skies in the afternoon, low to mid 70's, no rain, slight wind	
To: Carlotta Cellucci	
From: Damon DeYoung	

DAILY FIELD REPORT

PERSONNEL ON SITE:

Carlotta Cellucci (NAVFAC NW)
Samuel Moore, Damon DeYoung (Battelle)
Michael Running, Austin Cuda (Holt Services)

SUMMARY OF WORK COMPLETED:

- Drilling and logging of continuous soil cores at SP-B01 and CL-B02
- Collection of 3 soil and 2 groundwater samples at SP-B01
- Collection of 1 groundwater sample at SP-B01A
- Collection of 3 soil and 1 groundwater sample at CL-B02

DEVIATIONS FROM WORKPLAN:

Borehole locations were positioned adjacent to 2016 MIP locations for correlation of PID as a screening tool.

Field Change Request 1: perform rapid turnaround on select samples from early borings to help guide the field investigation.

Field Change Request 2: A) allow discrete depth sampling versus continuous core sampling at select boreholes; and B) allow use of temporary PVC wells in lieu of Geoprobe Screen Point 22 sampler for discrete groundwater sampling.

FIELD ACTIVITY CHRONOLOGY

0820	D. DeYoung and S. Moore (Battelle) on site.
0830	Holt Services staff on site, unloaded/organized additional truckload of supplies brought today.
0850	Tailgate meeting, upon dig permit receipt plan to collect continuous core adjacent to MIP 18.
0905	Received authorization of dig permit
0945	mobilized to MIP 17 (inadvertently collected core adjacent to MIP 17 rather than MIP 18)
0955	performed safety review of the drill rig (Geoprobe 7822DT) prior to drilling
1000	Began drilling at SP-B01 adjacent to MIP 17
1201	Began drilling at SP-B01A for grab groundwater using slide screen.

SP-B01: collected 3 soil samples (SP-B01-S13.5, SP-B01-S17.5, SP-B01-S28.0) and 2 groundwater samples (SP-B01-GW13.5, SP-B01-GW17.5). Groundwater samples in B01 were collected using PVC temporary wells with 5 foot screens, where the bottom of the screen was set at the target depth (i.e., 13.5 ft bgs and 17.5 ft bgs). Dark brown/black oily substance identified in zones with elevated PID readings. Collected 4-oz jar of soil for hydrocarbon analysis. Soil VOC analyses will be run for larger list of VOCs.

SP-B01A: A one-foot step-out point was pushed to the target depth of 28 ft bgs and a 4-foot slide screen was opened for groundwater collection (SP-B01A-GW28.0)

1230 Abandoned B01 and B01A. Collected GPS data at B01 and B01A. Left ~1 ft PVC well casing as monuments at B01 and B01A.

1320 Lunch break. Drillers off site.

1425 Moved rig to MIP 62 north of MW1-17 for PID correlation and collection of continuous core.

1428 Measured DTW in MW1-17 at 6.06 feet below top of casing. Approximately 6.3 ft below ground surface.

1430 Began drilling borehole CL-B02. Collected continuous core down to 30 ft bgs. Screened core with PID.

CL-B02: collected 3 soil samples (CL-B02-S14.0, CL-B02-S20.0, CL-B02-S29.0) and 1 groundwater sample (CL-B02-GW20.0). Groundwater samples in B02 were collected using PVC temporary wells with 5 foot screens, where the bottom of the screen was set at the target depth (i.e., 20.0 ft bgs).

1610 Completed CL-B02 abandonment, wrapped up site activities.

1630 Drillers off site

1645 Battelle staff off site

SUMMARY OF FINDINGS/CONCLUSIONS

PID correlated well with MIP data near MIP 17; highest PID readings were 3186 ppm at 13.5 feet in B01. PID readings were significantly lower in B02 of the central landfill area with a maximum reading of 1.1 ppm at 20.0 feet. PID can be used in the lower concentration areas.

PLANS FOR THE FOLLOWING DAY:

Be on site at 07:00 to target at least 3 drill holes tomorrow. Continue to establish a transect using older MIP locations near MW1-17. Package and ship samples collected on 7/11/2017 and the morning of 7/12/2017 for 5-Day turnaround of analyses (soil samples only). Michael Meyer and Carlotta Cellucci are planning to be on site in the morning.

ATTACHMENTS:

None

Copies to: Michael Meyer	**Battelle - DAILY FIELD REPORT** Signed: ___________________________

BATTELLE
It can be done

DAILY FIELD REPORT 07 / 12 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: partly cloudy in the morning to clear skies in the afternoon, low to mid 70's, no rain, slight wind	
To: Carlotta Cellucci	
From: Damon DeYoung	

DAILY FIELD REPORT

PERSONNEL ON SITE:

Carlotta Cellucci (NAVFAC NW)
Michael Meyer, Samuel Moore, Damon DeYoung (Battelle)
Michael Running, Austin Cuda (Holt Services)

SUMMARY OF WORK COMPLETED:

- Drilling and logging of continuous soil cores at CL-B03, CL-B04, and CL-B05
- Collection of 3 soil and 1 groundwater samples at CL-B03
- Collection of 3 soil and 1 groundwater samples at CL-B04
- Collection of 1 soil and 1 groundwater samples at CL-B05

DEVIATIONS FROM WORKPLAN:

Field Change Request 1 - None

FIELD ACTIVITY CHRONOLOGY

0700 D. DeYoung and S. Moore (Battelle) on site; calibrated PID and initiated GPS system.
0725 Holt Services staff on site.
0745 Tailgate meeting, plan to start with continuous core adjacent to MIP 65.
0756 Began drilling at CL-B03 adjacent to MIP 65, collected continuous core to 45 ft bgs.
0958 Collected Army Corps water samples at CL-B03 with a PVC temp well from 17 to 22 ft bgs.
CL-B03: collected 3 soil samples (CL-B03-S18.0 at 0830, CL-B03-S19.4 at 0827, CL-B03-S37.0 at 0938) and 1 groundwater sample (CL-B03-GW22.0 at 0958) using PVC temp well screened from 17 to 22 ft bgs.
1058 Moved rig to CL-B04 in between CL-B03 (MIP 65) and MIP 66.
1103 Began drilling CL-B04; collected continuous core to 30 ft bgs.
CL-B04: collected 3 soil samples (CL-B04-S11.5 at 1137, CL-B04-S19.5 at 1135, CL-B04-S29.0 at 1204) and 1 groundwater sample (CL-B04-GW20.0 at 1230) using PVC temp well screened from 15 to 20 ft bgs.
1245 left site for lunch, Sam Moore packaged and shipped samples including 1) rapid turnaround soil samples from B01, B02, and B03; 2) standard turn around for groundwater samples collected to date; and 3) soil and groundwater samples for the Army Corps study.

1345	on site, mobilized drill rig adjacent to MW15
1405	measured depth to water in MW15: 6.63 ft BTOC = approximately 6.90 ft bgs
1408	Began drilling CL-B05 adjacent to MW15; collected continuous core to 40 ft bgs. CL-B05: collected 1 soil sample (CL-B05-S18.3 at 1432) and 1 groundwater sample (CL-B05-GW19.0 at 1625) using PVC temp well screened from 14 to 19 ft bgs.
1635	Completed abandonment of CL-B05.
1650	Drillers off site.
1700	Battelle staff off site.

SUMMARY OF FINDINGS/CONCLUSIONS

Contamination was observed at low concentrations via PID consistently at a depth near 19 ft bgs in 3 boreholes today. A clay unit with organic matter was consistently observed underlying a silty-sandy gravel in all 3 boreholes today, however the depth of occurrence varied from 33 ft bgs (B03) to 29 ft bgs (B04) to 38 ft bgs (B05). This deeper clay unit is thought to be the lower boundary of the intermediate aquifer. Shallower clay bearing intervals ~15 to 20 ft bgs may represent an aquitard between a shallow aquifer 6 to 15 ft bgs and a deeper aquifer 20 to ~30 ft bgs.

PLANS FOR THE FOLLOWING DAY:

Be on site at 07:00 to target at least 3 drill holes tomorrow. Continue to establish large transects across the Central Landfill area.

ATTACHMENTS:

None

Copies to: Michael Meyer	**Battelle - DAILY FIELD REPORT** Signed: ___________________________

BATTELLE
It can be done

DAILY FIELD REPORT 07 / 13 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: cloudy, high 60's, no rain, light wind	
To: Carlotta Cellucci	
From: Damon DeYoung	

DAILY FIELD REPORT

PERSONNEL ON SITE:

Carlotta Cellucci (NAVFAC NW)
Samuel Moore, Damon DeYoung (Battelle)
Michael Running, Austin Cuda (Holt Services)

SUMMARY OF WORK COMPLETED:

- Drilling and logging of continuous soil cores at CL-B06A, CL-B07, CL-B08, and CL-B09
- Collection of 2 soil and 1 groundwater samples at CL-B06A
- Collection of 2 soil and 1 groundwater samples at CL-B07
- Collection of 3 soil and 1 groundwater samples at CL-B08
- Collection of 1 soil and 1 groundwater samples at CL-B09

DEVIATIONS FROM WORKPLAN:

None

FIELD ACTIVITY CHRONOLOGY

0705 Battelle staff onsite with Holt Services staff and Carlotta Cellucci; calibrated PID and initiated GPS system.
0745 Tailgate meeting; moved to point CL-B06 located between CL-B05 and CL-B03.
0752 Began drilling at CL-B06; poor recovery from 5 to 15 ft bgs in CL-B06. Off set point 6 inches and began drilling CL-B06A. Similar recovery was observed from 5 to 15 ft bgs in CL-B06A.
0925 Abandoned CL-B06 and CL-B06A. Open borehole depth in B06 and B06A was 11 ft bgs prior to bentonite backfill.
0948 Began drilling CL-B07; collected continuous core to 35 ft bgs.
1150 Abandoned CL-B07. Open borehole depth was 10 ft bgs prior to bentonite backfill.
1155 left site for lunch
1250 moved drill rig to CL-B08.
1300 Began drilling CL-B08; continuous core to 30 ft bgs.
1435 Abandoned CL-B08. Open borehole depth was 10 ft bgs prior to bentonite backfill.
1445 Began drilling CL-B09; continuous core to 40 ft bgs.

1645 Abandoned CL-B09. Open borehole depth was 12 ft bgs prior to bentonite backfill.

1700 Drillers off site

1705 Battelle off site

SUMMARY OF FINDINGS/CONCLUSIONS

Continuous cores were collected today to document the spatial lithologic variability across the Central Landfill. The clay unit identified on 7/12/2017 inferred as the lower boundary of the intermediate aquifer (clay unit with organic matter) was consistently observed at depths ranging from 28 ft bgs (CL-B08) to 39 ft bgs (CL-B09). The highest PID reading was from a visibly contaminated zone at 13 ft bgs in CL-B09 (PID reading was 10.0 ppm).

PLANS FOR THE FOLLOWING DAY:

Be on site at 07:30 to target at least 3 drill holes tomorrow. Continue to establish large transects across the Central Landfill area.

ATTACHMENTS:

None

Copies to: Michael Meyer	**Battelle - DAILY FIELD REPORT** Signed: ___________________________

DAILY FIELD REPORT 07 / 14 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: sunny, mid 70's, no rain, light wind	
To: Carlotta Cellucci	
From: Damon DeYoung	

DAILY FIELD REPORT

PERSONNEL ON SITE:

Samuel Moore, Damon DeYoung (Battelle)
Michael Running, Austin Cuda (Holt Services)

SUMMARY OF WORK COMPLETED:

- Drilling and logging of continuous soil cores at CL-B10, CL-B11, and CL-B12
- Collection of 2 soil and 1 groundwater samples at CL-B10
- Collection of 1 soil and 1 groundwater samples at CL-B11
- Collection of 3 soil and 1 groundwater samples at CL-B12

DEVIATIONS FROM WORKPLAN:

None

FIELD ACTIVITY CHRONOLOGY

0735 Battelle staff onsite with Holt Services staff; calibrated PID and initiated GPS system.

0745 Tailgate meeting; moved to point CL-B10 located north of secondary containment enclosure.

0755 Began drilling at CL-B10; continuous core to 35 ft bgs.
CL-B10: collected 2 soil samples (CL-B10-S10.0 at 0828, and CL-B10-S21.0 at 0854) and 1 groundwater sample (CL-B10-GW12.0 at 0954) using PVC temp well screened from 7 to 12 ft bgs.

1010 Abandoned CL-B10. Open borehole depth in B10 was 9 ft bgs prior to bentonite backfill.

1020 Began drilling CL-B11; collected continuous core to 35 ft bgs.
CL-B11: collected 1soil sample (CL-B11-S07.0 at 1042) and 1 groundwater sample (CL-B11-GW12.0 at 1142) using PVC temp well screened from 7 to 12 ft bgs.

1155 Abandoned CL-B11. Open borehole depth was 12 ft bgs prior to bentonite backfill.

1205 left site for lunch

1300 Began drilling CL-B12; continuous core to 35 ft bgs.
CL-B12: collected 3 soil samples (CL-B12-S17.5 at 1326, CL-B12-S20.5 at 1357, and CL-B12-S31.5 at 1445 [CL-B12-S31.5 included a field duplicate, matrix spike, and matrix spike duplicate sample]) and 1 groundwater sample (CL-B10-GW21.0 at 1412) using PVC temp well screened from 16 to 21 ft bgs.

1501 Abandoned CL-B12. Open borehole depth was 13 ft bgs prior to bentonite backfill.

1510 Driller off site for the weekend.

1540 Battelle off site after cleaning up the shed and preparing samples for hand delivery to TestAmerica today in Tacoma, WA.

SUMMARY OF FINDINGS/CONCLUSIONS

Continuous cores were collected today to document the spatial lithologic variability across the Central Landfill. The clay unit identified on 7/12/2017 inferred as the lower boundary of the intermediate aquifer (clay unit with organic matter) was consistently observed at depths near 32 ft bgs in CL-B10 and CL-B12. The highest PID reading was from a visibly contaminated zone at 10 ft bgs in CL-B10 (PID reading was 79.5 ppm).

PLANS FOR THE FOLLOWING DAY:

Be on site at 07:00 on Monday July 17, 2017 to target at least 3 drill holes. Continue to establish large transects across the Central Landfill area.

ATTACHMENTS:

None

Copies to: Michael Meyer	**Battelle - DAILY FIELD REPORT** Signed: ___________________________

DAILY FIELD REPORT 07 / 17 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: sunny, mid 70's, no rain, light wind	
To: Carlotta Cellucci	
From: Damon DeYoung	

DAILY FIELD REPORT

PERSONNEL ON SITE:

Samuel Moore, Damon DeYoung (Battelle)
Michael Running, Austin Cuda (Holt Services)

SUMMARY OF WORK COMPLETED:

- Drilling and logging of continuous soil cores at CL-B13, CL-B14, CL-B14A, CL-B14B, and CL-B15
- Collection of 1 soil and 1 groundwater sample at CL-B13
- Collection of 4 soil and 1 groundwater samples at CL-B14B
- Collection of 1 soil and 1 groundwater sample at CL-B15

DEVIATIONS FROM WORKPLAN:

Investigations at CL-B13, CL-B14 and CL-B15 are step-out locations related to elevated PID readings at CL-B10 (drilled 7/14/2017).

FIELD ACTIVITY CHRONOLOGY

0705	Battelle staff onsite with Holt Services staff; calibrated PID and initiated GPS system.
0745	Tailgate meeting; Sealaska on site at North Plantation for O&M activities. Drilling activities will not impact Sealaska activities and vice versa.
0800	mobilized to CL-B13 adjacent to Bradley Road
0811	Began drilling CL-B13; continuous core to 35 ft bgs.
0950	set temporary PVC well in B13 with a screen interval from 7 to 12 ft bgs. CL-B13: collected 1 soil sample (CL-B13-S11.5 at 0840) and 1 groundwater sample (CL-B13-GW12.0 at 1003) using PVC temp well screened from 7 to 12 ft bgs.
1025	Abandoned CL-B13. Open borehole depth in CL-B13 was 12.5 ft bgs prior to bentonite backfill.
1035	Began drilling CL-B14; hit refusal at 5 ft bgs; wood in the core barrel and cutting shoe.
1043	Offset 4 ft to the south and began drilling CL-B14A; hit refusal at 5 ft bgs against concrete.
1056	Offset 4 ft to the west and began drilling CL-B14B; collected continuous core in CL-B14B to 35 ft bgs.
1220	set temporary PVC well in CL-B14B with a screen interval from 17 to 22 ft bgs. Elevated PID readings from 18 to 22.5 ft bgs, with a high of 523 ppm at 21 ft bgs.

CL-B14B: collected 5 soil sample (CL-B14B-S04.0 at 1102, CL-B14B-S09.0 at 1108 [field duplicate collected at 9.0 ft], CL-B14B-S18.0 at 1124, and CL-B14B-S21.0 at 1135) and 2 groundwater samples (CL-B14B-GW22.0 at 1003, and field duplicate at 22.0 ft) using PVC temp well screened from 17 to 22 ft bgs.

1251 Abandoned CL-B14, CL-B14A, and CL-B14B. Open borehole depths for CL-B14 and CL-B14A were 5 ft bgs (where refusal had been met). The open borehole depth of CL-B14B was 11.5 ft bgs prior to bentonite backfill.

1310 left site for lunch

1400 Began drilling CL-B15 east of CL-B14, adjacent to Bradley Rd; collected continuous core to 30 ft bgs. CL-B15: collected 3 soil samples (CL-B15-S23.0 at 1524 [also collected matrix spike and matrix spike duplicate at the 23.0 ft interval]) and 3 groundwater samples (CL-B15-GW23.0 at 1614 [also collected matrix spike and matrix spike duplicate at the 23.0 ft interval]) using PVC temp well screened from 18 to 23 ft bgs. PVC well was set with the DPT rig and expendable tip as hand placement had hit refusal at 17 ft.

1635 Abandoned CL-B15. Open borehole depth was 17.5 ft bgs prior to bentonite backfill.

1700 All staff off site for the day.

SUMMARY OF FINDINGS/CONCLUSIONS

Continuous cores were collected today to document the spatial distribution of contamination based on PID screening at stepout locations to boring CL-B10 (drilled 7/14/2017). The highest PID reading was from a saturated sand interval at 21 ft bgs in CL-B14B (PID reading was 523 ppm).

PLANS FOR THE FOLLOWING DAY:

Be on site at 07:00 to target at least 3 drill holes. Continue to establish large transects across the Central Landfill area and perform appropriate step outs to delineation spatial extent of contamination.

ATTACHMENTS:

None

Copies to: Michael Meyer	**Battelle - DAILY FIELD REPORT** Signed: ___________________________

DAILY FIELD REPORT 07 / 18 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: sunny, high 70's, no rain, light wind	
To: Carlotta Cellucci	
From: Damon DeYoung	

DAILY FIELD REPORT

PERSONNEL ON SITE:

Samuel Moore, Damon DeYoung (Battelle)
Michael Running, Austin Cuda (Holt Services)
Carlotta Cellucci (NAVFAC NW)

SUMMARY OF WORK COMPLETED:

- Drilling and logging of continuous soil cores at CL-B16, CL-B17, CL-B18, and CL-B18A
- Collection of 1 soil and 1 groundwater sample at CL-B16
- Collection of 1 soil and 1 groundwater sample at CL-B17
- Collection of 5 soil and 1 groundwater samples at CL-B18A

DEVIATIONS FROM WORKPLAN:

- Investigations at CL-B16, CL-B17 and CL-B18 are step-out locations related to elevated PID readings at CL-B14 (drilled 7/17/2017).
- Collected 8 ounces of contaminated soil from CL-B18A at the 18 ft depth interval for additional characterization analyses.

FIELD ACTIVITY CHRONOLOGY

0705 Battelle staff onsite, prepared sample kits, calibrated PID and initiated GPS system.

0815 Holt Services onsite. Held tailgate meeting.

0830 Began drilling CL-B16 (located north of B14/B14A/B14B); collected continuous core to 35 ft bgs.

0955 Set well in CL-B16 with a screen interval from 8 to 13 ft bgs.
CL-B16: collected 1 soil sample (CL-B16-S12.5 at 0856) and 1 groundwater sample (CL-B16-GW13.0 at 1000) using PVC temp well screened from 8 to 13 ft bgs, installed by hand.

1010 Carlotta Cellucci on site; abandoned CL-B16, open borehole depth was 9.5 ft bgs prior to bentonite backfill.

1025 Mobilized to CL-B17 adjacent to Bradley Road (north of B15) and began drilling; collected continuous core to 25 ft bgs.
CL-B17: collected 1 soil sample (CL-B17-S20.0 at 1053) and 1 groundwater sample (CL-B17-GW19.5 at 1142) using PVC temp well screened from 14.5 to 19.5 ft bgs, installed by hand.

1145 Abandoned CL-B17. Open borehole depth in CL-B17 was 17.5 ft bgs prior to bentonite backfill.

1210 left site for lunch

1309 Mobilized to CL-B18 (north of B09, northwest of B14); hit refusal at 3 ft bgs.

1315 Stepped out 3 ft to the north and began drilling at CL-B18A. Collected 40 ft of continuous core, but vertical delineation was not achieved due to lack of additional drill rods (deeper soil coring to be performed at CL-B18A on 7/19/2017).

CL-B18A: collected 5 soil samples for VOC analyses (CL-B18A-S14.5 at 1333, CL-B18A-S18.0 at 1405, CL-B18A-S21.5 at 1412, CL-B18A-S22.3 at 1414, CL-B18A-S33.0 at 1445), two 4 ounce containers were filled with soil containing dark brown non-volatile liquid for additional contaminant characterization analyses.

1 groundwater sample was collected (CL-B18A-GW14.5 at 1340) using PVC temp well screened from 9.5 to 14.5 to ft bgs, installed by hand.

1610 Left 10 ft of rod in the ground at B18A for further drilling on 7/19/2017. Drillers left the site.

1640 All staff off site for the day.

SUMMARY OF FINDINGS/CONCLUSIONS

Continuous cores were collected today to document the spatial distribution of contamination based on PID screening at step-out locations to boring CL-B14 (drilled 7/17/2017). Boring locations CL-B16 and CL-B17 had very low PID readings. The highest PID reading was from a saturated sand interval at 23.3 ft bgs in CL-B18A (PID reading was 180 ppm).

PLANS FOR THE FOLLOWING DAY:

Be on site at 07:00 to target at least 3 drill holes. Continue to establish large transects across the Central Landfill area and perform appropriate step outs to delineation spatial extent of contamination.

ATTACHMENTS:

None

Copies to: Michael Meyer	**Battelle - DAILY FIELD REPORT** Signed: ___________________________

DAILY FIELD REPORT 07 / 19 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: cloudy morning/ sunny afternoon, high 70's, no rain, light wind	
To: Carlotta Cellucci	
From: Damon DeYoung	

DAILY FIELD REPORT

PERSONNEL ON SITE:

Michael Meyer, Samuel Moore, Damon DeYoung (Battelle)
Michael Running, Austin Cuda (Holt Services)
Carlotta Cellucci (NAVFAC NW)

SUMMARY OF WORK COMPLETED:

- Drilling and logging of continuous soil cores at CL-B18A, CL-B19, and CL-B20
- Collection of 1 groundwater sample at CL-B18A
- Collection of 2 soil and 1 groundwater sample at CL-B19
- Collection of 3 soil and 2 groundwater samples at CL-B20

DEVIATIONS FROM WORKPLAN:

- Investigations at CL-B19 and CL-B20 are step-out locations related to elevated PID readings at CL-B18A (drilled 7/18/2017).

FIELD ACTIVITY CHRONOLOGY

0700 Battelle and Holt Services staff onsite, prepared sample kits, calibrated PID and initiated GPS system.
0720 Held tailgate meeting; plan to complete boring B18A starting at 40 ft bgs where we left off on 7/18/2017.
0735 Began drilling CL-B18A, completed continuous core to 50 ft bgs; set slip screen DPT sampler screen from 29 to 33 ft bgs.
CL-B18A: collected 1 groundwater sample (CL-B18A-GW33.0 at 0918)
0923 Abandoned CL-B18 and CL-B18A; open borehole was 10.5 ft in CL-B18A and 3 ft in CL-B18 prior to bentonite backfill
0934 Mobilized to CL-B19 (between B05 and B11)
0940 Began drilling CL-B19, completed continuous core to 40 ft bgs
1120 Set temporary PVC well in CL-B19 with a screen interval from 18 to 23 ft bgs.
CL-B19: collected 2 soil sample (CL-B19-S23.0 at 1022, and CL-B19-S38.0 at 1117) and 1 groundwater sample (CL-B19-GW23.0 at 1130) using PVC temp well screened from 18 to 23 ft bgs, installed by hand.
1140 Abandoned CL-B19, open borehole depth was 8.5 ft bgs prior to bentonite backfill.

1205 left site for lunch
1305 Began drilling CL-B20 (north of B18A). Collected continuous core to 40 ft bgs.
1520 Set slip screen DPT sampler screen from 28 to 32 ft bgs.
CL-B20: collected 3 soil samples (CL-B20-S25.0 at 1350, CL-B20-S28.3 at 1406, and CL-B20-S31.5 at 1423) and 1 groundwater sample (CL-B20-GW26.5 at 1515) using PVC temp well screened from 9.5 to 14.5 to ft bgs, installed by hand, and 1 groundwater sample (CL-B20-GW32.0 at 1537) using a slip screen DPT sampler with the screen set at 28 to 32 ft bgs.
1550 Abandoned CL-B20; open borehole depth was 15.5 ft bgs prior to bentonite.
1615 Drummed all core sleeves collected to date.
1640 Driller off site
1645 Battelle staff off site.

SUMMARY OF FINDINGS/CONCLUSIONS

Continuous cores were collected today to document the spatial distribution of contamination based on PID screening at stepout locations to borings CL-B18A (drilled 7/18/2017). Boring location CL-B19 had low PID readings; less than 10 ppm confined to the upper 10 feet of soil. Boring location CL-B20 had elevated PID readings above 10 ppm between 30 and 33 ft bgs, with the highest reading of 76 ppm at 31.5 ft bgs all within a saturated sand interval.

PLANS FOR THE FOLLOWING DAY:

Be on site at 07:00 to target at least 3 drill holes. Continue to establish large transects across the Central Landfill area and perform appropriate step outs to delineation spatial extent of contamination.

ATTACHMENTS:

None

Copies to: Michael Meyer	**Battelle - DAILY FIELD REPORT** Signed: ___________________________

BATTELLE
It can be done

DAILY FIELD REPORT 07 / 20 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: cloudy morning/ sunny afternoon, high 70's, no rain, light wind	
To: Carlotta Cellucci	
From: Damon DeYoung	

DAILY FIELD REPORT

PERSONNEL ON SITE:

Samuel Moore, Damon DeYoung (Battelle)
Michael Running, Kyle Clark (Holt Services)
Carlotta Cellucci (NAVFAC NW)

SUMMARY OF WORK COMPLETED:

- Drilling and logging of continuous soil cores at CL-B21, CL-B22, CL-B23, CL-B24, and CL-B25
- Collection of 2 soil and 1 groundwater sample at CL-B21
- Collection of 1 soil and 1 groundwater sample at CL-B22
- Collection of 2 soil and 2 groundwater samples at CL-B23
- Collection of 1 soil and 1 groundwater sample at CL-B24
- Collection of 2 soil and 1 groundwater sample at CL-B25

DEVIATIONS FROM WORKPLAN:

- Investigations at CL-B21 and CL-B22 are step-out locations related to elevated PID readings at CL-B20 (drilled 7/19/2017).

FIELD ACTIVITY CHRONOLOGY

0655 Battelle and Holt Services staff onsite, prepared sample kits, calibrated PID and initiated GPS system.

0720 Held tailgate meeting; plan to step out from B20 and delineate to the north.

0735 Began drilling CL-B21, completed continuous core to 34 ft bgs, hit refusal at the bottom of the hole; observed a dark brown oily substance in upper 25 ft of borehole (low PID readings <2 ppm)
CL-B21: collected 2 soil samples (CL-B21-S12.0 at 0745 and CL-B21-S21.5 at 0810) and 1 groundwater sample (CL-B21-GW12.5 at 0858) using a temporary PVC well installed by hand with a screen interval from 7.5 to 12.5 ft bgs.

0905 Abandoned CL-B21; open borehole was 12.5 ft prior to bentonite backfill.

0915 Began drilling CL-B22, completed continuous core to 30 ft bgs
CL-B22: collected 1 soil samples (CL-B22-S18.5 at 0938) and 1 groundwater sample (CL-B22-GW19.0 at 1027) using a slip screen DPT sampler with the screen set at 15 to 19 ft bgs.

1038 Abandoned CL-B22; open borehole was 10.0 ft prior to bentonite backfill.

1108 Collected a stabilized groundwater sample from MW1-17. Total depth in MW1-17 is 13.78 ft BTOC.

1115 Began drilling CL-B23 approximately 5 ft north of MW1-17; completed continuous core to 30 ft bgs.
CL-B23: collected 2 soil samples (CL-B23-S13.5 at 1134 and CL-B23-S18.0 at 1205) and 2 groundwater samples (CL-B23-GW14.0 at 1145 and CL-B23-GW18.0 at 1240) using temporary PVC wells installed by hand with screen intervals from 9 to 14 ft and 13 to 18 ft bgs, respectively.

1315 Abandoned CL-B23; open borehole was 18.0 ft prior to bentonite backfill.

1330 off site for lunch

1415 mobilized to CL-B24

1430 Began drilling CL-B24, completed continuous core to 30 ft bgs.
CL-B24: collected 1 soil sample (CL-B24-S15.5 at 1451) and 1 groundwater sample (CL-B24-GW16.0 at 1523) using temporary PVC wells installed by hand with a screen interval from 11 to 16 ft bgs.

1534 Abandoned CL-B24; open borehole was 10.5 ft prior to bentonite backfill.

1538 Began drilling CL-B25, completed continuous core to 36 ft bgs.
CL-B25: collected 2 soil samples (CL-B25-S14.0 at 1557 and CL-B25-S29.0 at 1625) and 1 groundwater sample (CL-B25-GW29.0 at 1722) using temporary PVC wells installed by hand with a screen interval from 24 to 29 ft bgs.

1735 Abandoned CL-B25; open borehole was 13.5 ft prior to bentonite backfill.

1755 All project staff off site.

SUMMARY OF FINDINGS/CONCLUSIONS

Continuous cores were collected today to document the spatial distribution of contamination based on PID screening at stepout locations to borings CL-B20 (drilled 7/19/2017). Boring location CL-B21 had an oily substance observed in the upper 25 ft of core. Boring CL-B22 (north of CL-B21) was relatively uncontaminated compared to CL-B21.

Boring CL-B23 was pushed near MW1-17 to assess VOC distribution at the screen interval depth of MW1-17 and below.

Borings CL-B24 and CL-B25 were placed along the southern side of the central landfill area to assess the potential contamination in this area. Low PID readings (<2 ppm) were observed at these locations.

PLANS FOR THE FOLLOWING DAY:

Be on site at 07:00 to target at least 3 drill holes. Continue to establish large transects across the Central Landfill area and perform appropriate step outs to delineation spatial extent of contamination.

ATTACHMENTS:

None

Copies to: Michael Meyer	**Battelle - DAILY FIELD REPORT** Signed: ___________________________

BATTELLE
It can be done

DAILY FIELD REPORT 07 / 21 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: sunny, high 70's, no rain, light wind	
To: Carlotta Cellucci	
From: Damon DeYoung	

DAILY FIELD REPORT

PERSONNEL ON SITE:

Samuel Moore, Damon DeYoung (Battelle)
Michael Running, Kyle Clark (Holt Services)
Carlotta Cellucci (NAVFAC NW)

SUMMARY OF WORK COMPLETED:

- Drilling and logging of continuous soil cores at CL-B26A, CL-B27, and CL-B28
- Collection of 3 soil and 1 groundwater sample at CL-B26A
- Collection of 1 soil and 1 groundwater sample at CL-B27
- Collection of 1 soil and 1 groundwater sample at CL-B28

DEVIATIONS FROM WORKPLAN:

- Investigations at CL-B26A and CL-B27/CL-B28 are step-out locations related to elevated PID readings at CL-B23 (drilled 7/20/2017) and CL-B10 (drilled 7/14/2017), respectively.

FIELD ACTIVITY CHRONOLOGY

0700 Battelle and Holt Services staff onsite, prepared sample kits, calibrated PID and initiated GPS system.

0735 Held tailgate meeting; plan to step out up gradient from MW1-17 to delineate to the east.

0802 Began drilling CL-B26, hit refusal at 2.5 ft bgs.

0805 Began drilling CL-B26A, completed continuous core to 35 ft bgs
CL-B26A: collected 3 soil samples (CL-B26A-S09.0 at 0819, CL-B26A-S19.0 at 0838, and CL-B26A-26.0 at 0902) and 1 groundwater sample (CL-B26A-GW10.0 at 0920) using a temporary PVC well installed by hand with a screen interval from 5 to 10 ft bgs.

0930 Abandoned CL-B26 and CL-B26A; open borehole depth in B26 as 2.5 ft and in B26A was 11 ft prior to bentonite backfill.

0951 Began drilling CL-B27, completed continuous core to 30 ft bgs
CL-B27: collected 1 soil samples (CL-B27-S10.0 at 1025) and 1 groundwater sample (CL-B27-GW12.0 at 1046) using a temporary PVC well installed by hand with a screen interval from 7 to 12 ft bgs.

1055 Abandoned CL-B27; open borehole was 14.0 ft prior to bentonite backfill.

1100 Began drilling CL-B28, completed continuous core to 25 ft bgs, core section from 25 ft to 30 ft bgs was stuck in the core barrel and was not retrievable.
CL-B28: collected 1 soil sample (CL-B28-S09.0 at 1109) and 1 groundwater sample (CL-B28-GW10.0 at 1211) using temporary PVC wells installed by hand with a screen interval from 5 to 10 ft bgs.
1235 Abandoned CL-B28; open borehole was 10.0 ft prior to bentonite backfill.
1320 All project staff off site for the weekend.

SUMMARY OF FINDINGS/CONCLUSIONS

Continuous cores were collected today to document the spatial distribution of contamination based on PID screening at a step-out location (CL-B26A) to boring CL-B23 (drilled 7/20/2017) adjacent to MW1-17 to delineate the up gradient direction (eastward step-out). Additionally, two step-outs (CL-B27 and CL-B28) were performed south of boring CL-B10 (drilled 7/14/2017). Relatively low PID readings were observed in all three borings today (i.e., max PID reading was 7.5 ppm from CL-B28 at 9 ft bgs).

PLANS FOR THE FOLLOWING DAY:

Be on site at 07:00 to target at least 3 drill holes. Continue to establish large transects across the Central Landfill area and perform appropriate step outs to delineation spatial extent of contamination (e.g., west of CL-B21 to delineate oily substance, west of CL-B06 to further delineate MW1-17, and southeast of B12 to delineate the former hazardous waste facility).

ATTACHMENTS:

None

Copies to: Michael Meyer	**Battelle - DAILY FIELD REPORT** Signed: ___________________________

DAILY FIELD REPORT 07 / 24 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: Sunny, high 70's, no rain, light wind	
To: Carlotta Cellucci	
From: Michael Meyer	

DAILY FIELD REPORT

PERSONNEL ON SITE:

Samuel Moore, Michael Meyer (Battelle)
Michael Running, Kyle Clark (Holt Services)

SUMMARY OF WORK COMPLETED:

- Drilling and logging of continuous soil cores at CL-B29A, CL-B30A, CL-B31, CL-B32, and CL-B33
- Collection of 2 soil and 1 groundwater sample at CL-B29A
- Collection of 2 soil and 1 groundwater sample at CL-B30A
- Collection of 2 soil and 1 groundwater sample at CL-B31
- Collection of 1 soil and 1 groundwater sample at CL-B32
- Collection of 1 soil and 1 groundwater sample at CL-B33

DEVIATIONS FROM WORKPLAN:

- Investigations at CL-B29A, CL-B30A, and CL-B31 are step-out locations related to elevated PID readings at CL-B21 (drilled 7/20/2017), CL-B14B (drilled 7/17/2017), and CL-B26 (drilled 7/21/2017), respectively.
- Investigations at CL-B32 and CL-B33 are intended to assess the presence or absence of contaminants of concern along the southern boundary of the motorcycle training area in the Central Landfill.

FIELD ACTIVITY CHRONOLOGY

0700	Battelle and Holt Services staff onsite, prepared sample kits, calibrated PID and initiated GPS system.
0740	Held tailgate safety and planning meeting; plan to step out from three previous locations to assess the lateral extent of observed contamination, and assess the southern boundary of the motorcycle training area in the Central Landfill.
0745	Began drilling CL-B29, hit refusal at 8 ft bgs.
0755	Began drilling CL-B29A, completed continuous core to 30 ft bgs CL-B29A: collected 2 soil samples (CL-B29A-S07.0 at 0828 and CL-B29A-S21.0 at 0831) and 1 groundwater sample (CL-B29A-GW21.0 at 0831) using a temporary PVC well installed by hand with a screen interval from 17 to 21 ft bgs. Sampling depths were selected based on the highest PID readings in this boring, and the depth of NAPL observed in nearby CL-B21.

0903 Abandoned CL-B29 and CL-B29A; open borehole depth in B29 was 8 ft and in B29A was 14 ft prior to bentonite backfill.

0915 Began drilling CL-B30, hit refusal at 8 ft bgs on wood debris with a creosote odor.

0920 Began drilling CL-B30A, completed continuous core to 30 ft bgs
CL-B30A: collected 2 soil samples (CL-B30A-S10.5 at 1004 and CL-B30A-S21.0 at 1007) and 1 groundwater sample (CL-B30A-GW21.0 at 1028) using a Geoprobe push-point temporary well with a screen interval from 18 to 21 ft bgs. Sampling depths were selected based on the observations of a creosote odor in this boring, and the depth of elevated PID readings observed in nearby CL-B14B.

0947 Motorcycle training instructor stopped by to confirm that the training range would be available for training on Monday, 31 July. A class is scheduled. Training lead then spent time on site preparing the motorcycles and supplies.

1030 Abandoned CL-B30 and CL-B30A; open borehole depth in B30 was 9 ft and in B30A was 17 ft prior to bentonite backfill.

1200 Began drilling CL-B31, completed continuous core to 30 ft bgs.
CL-B31: collected 2 soil samples (CL-B31-S11.5 at 1229 and CL-B31-S19.0 at 1219) and 1 groundwater sample (CL-B31-GW11.5 at 1242) using a temporary PVC well installed by hand with a screen interval from 6.5 to 11.5 ft bgs. Sampling depths were selected based on the highest PID readings observed in this boring, and the screened interval of nearby MW1-17.

1245 Abandoned CL-B31; open borehole depth in B31 was 13 ft prior to bentonite backfill.

1300 Began drilling CL-B32, completed continuous core to 30 ft bgs.
CL-B32: collected 1 soil sample (CL-B32-S15.0 at 1338) and 1 groundwater sample (CL-B32-GW16.0 at 1409) using a temporary PVC well installed by hand with a screen interval from 11.0 to 16.0 ft bgs. Sampling depths were selected based on the highest PID readings observed in this boring.

1409 Abandoned CL-B32; open borehole depth in B32 was 9 ft prior to bentonite backfill.

1422 Began drilling CL-B33, completed continuous core to 27.5 ft bgs, with refusal on hard soil.
CL-B33: collected 1 soil sample (CL-B33-S3.5 at 1455) and 1 groundwater sample (CL-B32-GW13.0 at 1531) using a temporary PVC well installed by hand with a screen interval from 8.0 to 13.0 ft bgs. Sampling depths were selected based on the highest PID readings observed in this boring.

1531 Abandoned CL-B33; open borehole depth in B33 was 14 ft prior to bentonite backfill.

1555 Label drums, check PID and GPS calibrations.

1615 All offsite.

SUMMARY OF FINDINGS/CONCLUSIONS

Continuous cores were collected today to document the spatial distribution of contamination based on PID screening at step-out locations from three previous borings, and assessment of the southern boundary of the motorcycle training area. Relatively low PID readings were observed in all three borings today (i.e., max PID reading was 46.8 ppm from wood waste observed in CL-B33 at 3.5 ft bgs).

PLANS FOR THE FOLLOWING DAY:

Be on site at 07:00 to target at least 3 drill holes. Place holes to the southeast of the motorcycle training area to assess the presence or absence of contamination potentially associated with the former hazardous waste facility. Following work tomorrow, consider moving to the South Plantation for the next phase of the investigation.

ATTACHMENTS:

None

Copies to: Damon DeYoung	**Battelle - DAILY FIELD REPORT** Signed: ______________________________

DAILY FIELD REPORT 07 / 25 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: Sunny, high 84F, winds NNE 8mph	
To: Carlotta Cellucci	
From: Samuel Moore	

DAILY FIELD REPORT

PERSONNEL ON SITE:

Samuel Moore, Lauren March (Battelle)
Carlota Cellucci (NAVFAC Northwest)
Michael Running, Kyle Clark (Holt Services)

SUMMARY OF WORK COMPLETED:

- Drilling and logging of continuous soil cores at CL-B34, CL-B35, and CL-B36
- Collection of 1 soil and 1 groundwater sample at CL-B34
- Collection of 2 soil and 1 groundwater sample at CL-B35
- Collection of 1 soil sample at CL-B36
- Collection of 1 groundwater sample at CL-B36a

DEVIATIONS FROM WORKPLAN:

- None. Investigations at CL-B34, CL-B35, and CL-B36 represent locations indicated in the Sampling and Analysis Plan as potential sampling locations in the western portion of the Central Landfill near MW1-17.

FIELD ACTIVITY CHRONOLOGY

0645 Battelle on site, prepared sample kits, calibrated PID and initiated GPS system.

0700 Holt Services staff onsite, prepared drill rig and equipment.

0730 C. Cellucci and L. March on site, provided site introduction for L. March, decided on several locations near central and western Central Landfill to fulfill sampling grid.

0810 Held tailgate safety, discussed safety concerns with orienting new staff.

0824 Began drilling CL-B34, completed continuous core to 36 ft bgs (depth of refusal). CL-B34: collected one soil sample (CL-B34-S-18.0 at 0909) and one groundwater sample (CL-B34-GW-20.0 at 0935) using a temporary PVC well installed by hand with a screen interval from 15 to 20 ft bgs. Sampling depths were selected based on the highest PID readings in this boring.

1006 Abandoned CL-B34; open borehole depth in B34 was 11.5 ft prior to bentonite backfill.

1028 Began drilling CL-B35, completed continuous core to 30 ft bgs. CL-B35: collected two soil samples (CL-B35-S-18.0 at 1050 and CL-B35-S-20.5 at 1115) and one groundwater sample (CL-B35-GW-21.0 at 1139) using a temporary PVC well installed by hand with a screen interval from 16 to 21 ft bgs. Sampling depths were selected based on the highest PID readings in this boring.

1126 C. Cellucci and L. March left site.

1152 Abandoned CL-B35; open borehole depth in B35 was 11 ft prior to bentonite backfill.

1200 Left site for lunch with Holt Services staff.

1300 Returned to site with Holt Services staff.

1302 Began drilling CL-B36, completed continuous core to 30 ft bgs. CL-B36: collected one soil sample (CL-B36-S-15.5 at 1327). Attempted to collect a groundwater sample using a temporary PVC well installed by hand. Well casing collapsed down-well and had to be abandoned in place.

1344 L. March returned to site.

1358 Began drilling CL-B36a, installed screen point groundwater sampler with a screen interval from 13 to 17 ft bgs. CL-B36a: collected one groundwater sample (CL-B36a-GW-17.0 at 1445).

1453 Abandoned CL-B36 and CL-B36a; open borehole depth in B36 was 20 ft bgs and open borehole depth in B36a was 14 ft bgs prior to bentonite backfill.

1504 Performed calibration checks on PID and GPS system and secured equipment and supplies for the night.

1515 Holt Services left site. L. March left site to relinquish samples collected on 07/24/2017 and 07/25/2017 to TestAmerica Seattle.

1545 All offsite.

SUMMARY OF FINDINGS/CONCLUSIONS

Continuous cores were collected today to evaluate spatial distribution of contamination between previous borings in the western Central Landfill. PID readings observed in the three borings today were relatively low (i.e., the maximum PID reading was 4.6 ppm from CL-B35 at 20.5 ft bgs).

PLANS FOR THE FOLLOWING DAY:

Be on site at 07:00 to target at least 3 drill holes. Place the first two holes to the southeast of the motorcycle training area to assess the presence or absence of contamination potentially associated with the former hazardous waste facility. Depending on the results of these investigations, consider moving to the South Plantation for the next phase of the investigation.

ATTACHMENTS:

None

Copies to: Michael Meyer, Damon DeYoung	**Battelle - DAILY FIELD REPORT** Signed: ___________________________

DAILY FIELD REPORT 07 / 26 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: Sunny, high 79F, winds E 8mph	
To: Carlotta Cellucci	
From: Samuel Moore	

DAILY FIELD REPORT

PERSONNEL ON SITE:

Samuel Moore, Lauren March (Battelle)
Carlota Cellucci (NAVFAC Northwest)
Michael Running, Kyle Clark (Holt Services)

SUMMARY OF WORK COMPLETED:

- Drilling and logging of continuous soil cores at CL-B37, CL-B38c, CL-B39, SP-B40, and SP-B41
- Collection of 1 soil and 1 groundwater sample at CL-B37
- Collection of 1 soil sample at CL-B38c
- Collection of 1 soil and 1 groundwater sample at CL-B39
- Collection of 3 soil and 2 groundwater samples at SP-B40
- Collection of 1 soil and 1 groundwater sample at SP-B41

DEVIATIONS FROM WORKPLAN:

- Investigation at CL-B39 was conducted as a step-out location upon discovery of a reinforced concrete structure underneath CL-B38c and other proposed samples to the west of CL-B38c. CL-B39 is intended to represent a downgradient sample from the former hazardous waste treatment tanks.

FIELD ACTIVITY CHRONOLOGY

0650 Battelle on site, prepared sample kits, calibrated PID and initiated GPS system.

0700 Holt Services staff onsite, prepared drill rig and equipment.

0715 C. Cellucci on site. Decided on two locations southeast of the motorcycle training area to assess the presence or absence of contamination potentially associated with the former hazardous waste facility. Discussed moving to the Southern Plantation to collect four complete borings at the center of each plume and to collect complete borings to develop two perpendicular transects across the Southern Plantation.

0730 Held tailgate safety, discussed encountering much higher contaminant concentrations in the Southern Plantation.

0815 Began drilling CL-B37, completed continuous core to 30 ft bgs. CL-B37: collected one soil sample (CL-B37-S-15.0 at 0900) and one groundwater sample (CL-B37-GW-15.0 at 0930) using a temporary PVC well installed by hand with a screen interval from 10 to 15 ft bgs. Sampling depths were selected based on the highest PID readings in this boring in the saturated zone.

0939 Abandoned CL-B37; open borehole depth in B37 was 12.7 ft prior to bentonite backfill.

0955 Began drilling CL-B38; encountered refusal at 4.0 ft bgs.

0956 Began drilling CL-B38a; encountered refusal at 4.5 ft bgs.

0957 Began drilling CL-B39b; encountered refusal at 4.0 ft bgs.

1001 Began drilling CL-B39c; encountered refusal at 4.0 ft bgs. CL-B39c: collected one soil sample (CL-B39c-S-4.0 at 1015). Sampling depth was selected based on the highest PID reading.

1015 Determined that reinforced concrete is situated under the tented building and the area adjacent. The old concrete ramp is likely an indicator of an old building foundation similar to that of the current tented building. Moved new boring location immediately east of the east entrance to the tented building.

1023 Began drilling CL-B39, completed continuous core to 30 ft bgs. CL-B39: collected one soil sample (CL-B39-S-7.0 at 1050) and one groundwater sample (CL-B39-GW-10.0 at 1155) using a temporary PVC well installed by hand with a screen interval from 5 to 10 ft bgs. Sampling depths were selected based on the highest PID readings in this boring.

1159 Abandoned CL-B39; open borehole depth in B39 was 12.5 ft bgs prior to bentonite backfill.

1205 Left site for lunch with Holt Services staff.

1300 Returned to site.

1327 Began drilling SP-B40, completed continuous core to 30 ft bgs. SP-B40: collected three soil samples (SP-B40-S-7.0 at 1349, SP-B40-S-13.0 at 1357, and SP-B40-S-20.0 at 1417) and two groundwater samples (SP-B40-GW-11.0 at 1456 and SP-B40-GW-16.0 at 1533) using a temporary PVC well installed by hand with a screen interval from 6 to 11 ft bgs and 11 to 16 ft bgs, respectively. Sampling depths were selected based on the two highest PID readings in this boring, as well as a presumably clean sample to bound the vertical extent of the plume.

1538 Abandoned SP-B40; open borehole depth in B40 was 8.5 ft bgs prior to bentonite backfill.

1549 Began drilling SP-B41, completed continuous core to 30 ft bgs. SP-B41: collected one soil sample (SP-B41-S-8.0 at 1606) and one groundwater sample (SP-B41-GW-10.0 at 1630) using a temporary PVC well installed by hand with a screen interval from 5 to 10 ft bgs. Sampling depths were selected based on the highest PID readings in this boring

1656 Abandoned SP-B41; open borehole depth in B41 was 9.8 ft bgs prior to bentonite backfill.

1710 Holt Services left site. Completed post calibrations and secured site.

1740 All offsite.

SUMMARY OF FINDINGS/CONCLUSIONS

Continuous cores were collected today to evaluate spatial distribution of contamination west of the former hazardous waste building and in the northern plume of the Southern Plantation. PID readings observed in the four saturated borings today were relatively low (i.e., the maximum PID reading was 12.2 ppm from SP-B40 at 8.0 ft bgs). PID readings in boring CL-B28, -28a, -28b, and -28c were elevated but represent vadose zone concentrations immediately underneath the asphalt cap (e.g., 83.6 ppm from CL-B38c at 4.0 ft bgs). Preliminary results from borings CL-B37 and CL-B39 indicate very dilute concentrations at shallow intervals (between 5 and 10 ft bgs). Observations at SP-B40 and SP-B41 corroborate observations at collocated MIP locations (MIP-14 and MIP-51, respectively). Elevated concentrations were observed at SP-B40 at 7.0 and 13.0 ft bgs. Slightly elevated concentrations were observed at SP-B41 at 8.0 ft bgs.

PLANS FOR THE FOLLOWING DAY:

Be on site at 07:00 to target at least 4 drill holes. Continue collecting continuous borings at the southern and western plumes in the Southern Plantation to develop transects across the area and to investigate the locations with highest detections in the Southern Plantation.

ATTACHMENTS:

None

Copies to: Michael Meyer, Damon DeYoung	**Battelle - DAILY FIELD REPORT** Signed: ____________________________

DAILY FIELD REPORT 07 / 27 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: Cloudy with occasional light rain, high 71F, winds SE 5mph	
To: Carlotta Cellucci	
From: Samuel Moore	

DAILY FIELD REPORT

PERSONNEL ON SITE:

Samuel Moore, Lauren March (Battelle)
Carlota Cellucci (NAVFAC Northwest)
Michael Running, Kyle Clark (Holt Services)

SUMMARY OF WORK COMPLETED:

- Drilling and logging of continuous soil cores at SP-B42, SP-B43, SP-B44, and SP-B45
- Collection of 3 soil and 2 groundwater samples at SP-B42
- Collection of 2 soil and 1 groundwater sample at SP-B43
- Collection of 1 soil and 1 groundwater sample at SP-B44
- Collection of 2 soil and 1 groundwater sample at SP-B45

DEVIATIONS FROM WORKPLAN:

- None. Investigations at SP-B42, SP-B43, SP-B44, and SP-B45 represent locations indicated in the Sampling and Analysis Plan as potential sampling locations in the Southern Plantation.

FIELD ACTIVITY CHRONOLOGY

0700 Battelle on site, prepared sample kits, calibrated PID and initiated GPS system.

0715 C. Cellucci on site. Discussed sampling plan for the day and decided on locations in the Southern Plantation to collect complete borings to develop two perpendicular transects across the Southern Plantation.

0730 Holt Services staff onsite, prepared drill rig and equipment. C. Cellucci left site.

0806 Held tailgate safety, discussed trip hazards in the Southern Plantation.

0825 Began drilling SP-B42, completed continuous core to 30 ft bgs. SP-B42: collected three soil samples (SP-B42-S-7.5 at 0838, SP-B42-S-16.0 at 0859, and SP-B42-S-20.0 at 0913) and two groundwater samples (SP-B42-GW-10.0 at 0940 and SP-B42-GW-18.0 at 1007) using a temporary PVC well installed first by hand with a screen interval from 5 to 10 ft bgs and then by overdrilling with 2.25” rods to screen an interval of 13 to 18 ft bgs. Sampling depths were selected based on the XSD detections at adjacent MIP-054 and highest PID readings in this boring in the saturated zone, in addition one deeper sample collected as a potentially clean sample to delineate the vertical extent of contamination in the western plume of the Southern Plantation.

1007 Abandoned SP-B42; open borehole depth in B42 was 6.4 ft bgs prior to bentonite backfill.

1017 Began drilling SP-B43, completed continuous core to 30.0 ft bgs. SP-B43: collected two soil samples (SP-B43-S-10.0 at 1049 and SP-B43-S-12.0 at 1108) and one groundwater sample (SP-B43-GW-13.0 at 1134) using a temporary PVC well installed by overdrilling with 2.25" rods with a screen interval from 8 to 13 ft bgs. Sampling depths were selected based on the highest PID reading (at 10.0) and highest XSD detections at adjacent MIP-010 (at 12.0).

1124 Abandoned SP-B43; open borehole depth in B34 was 10.3 ft bgs prior to bentonite backfill.

1145 Left site for lunch with Holt Services staff.

1220 Returned to site.

1244 Began drilling SP-B44, completed continuous core to 30.0 ft bgs. SP-B44: collected one soil sample (SP-B44-S-10.5 at 1308) and one groundwater sample (SP-B44-GW-12.0 at 1407) using a temporary PVC well installed by hand with a screen interval from 7 to 12 ft bgs. Sampling depths were selected based on the highest PID readings and highest XSD detections at adjacent MIP-038. Results from MIP-038 PID indicated concentrations in lower intervals (20 to 30 ft bgs) that were not observed in PID readings or odor in SP-B44 and could be potential instrument error.

1409 Abandoned SP-B44; open borehole depth in B44 was 9.9 ft bgs prior to bentonite backfill.

1415 Began drilling SP-B45, completed continuous core to 25.0 ft bgs, where refusal was met due to collapsing pea gravel observed in upper intervals. SP-B45: collected two soil samples (SP-B45-S-12.5 at 1438 and SP-B45-S-18.0 at 1445) and one groundwater sample (SP-B45-GW-18.0 at 1537) using a stainless-steel screen point sampler installed with a screen interval from 14 to 18 ft bgs. Sampling depths were selected based on the highest PID readings and highest XSD detections at adjacent MIP-031.

1515 L. March left the site to deliver samples collected on July 26 and July 27, 2017 to TestAmerica Seattle.

1541 Abandoned SP-B45; open borehole depth in B45 was 3 ft bgs prior to bentonite backfill.

1600 Holt Services staff left site. Completed post-calibrations and secured site.

1630 All offsite.

SUMMARY OF FINDINGS/CONCLUSIONS

Continuous cores were collected today to evaluate spatial distribution of contamination in the Southern Plantation in the western and southern plumes of the Southern Plantation. PID readings observed in SP-B42, -44, and -45 were relatively low (i.e., below 27.2 ppm identified in SP-B42 at 16.0 ft bgs) but were moderate in SP-B43 (with the highest reading of 146.7 ppm at 10.0 ft bgs). PID readings corroborate observations by the XSD in collocated MIP locations (MIP-54, -10, -38, and -31, respectively).

PLANS FOR THE FOLLOWING DAY:

Be on site at 07:00 to target at least 4 drill holes. Continue collecting continuous borings at the southern and western plumes in the Southern Plantation to develop transects across the area and to investigate the locations with highest detections in the Southern Plantation.

ATTACHMENTS:

None

Copies to: Michael Meyer, Damon DeYoung	**Battelle - DAILY FIELD REPORT**

	Signed: ___________________________

DAILY FIELD REPORT 07 / 28 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: Mostly cloudy, high 78F, winds ENE 4mph	
To: Carlotta Cellucci	
From: Samuel Moore	

DAILY FIELD REPORT

PERSONNEL ON SITE:

Michael Meyer, Samuel Moore, Lauren March (Battelle)
Michael Running, Kyle Clark (Holt Services)

SUMMARY OF WORK COMPLETED:

- Drilling and logging of continuous soil cores at SP-B46, SP-B47, SP-B48b, and SP-B49
- Collection of 1 soil and 1 groundwater sample at SP-B46
- Collection of 1 soil and 1 groundwater sample at SP-B47
- Collection of 2 soil and 1 groundwater sample at SP-B48b
- Collection of 1 soil and 2 groundwater samples at SP-B49

DEVIATIONS FROM WORKPLAN:

- None. Investigations at SP-B46, SP-B47, SP-B48b, and SP-B49 represent locations indicated in the Sampling and Analysis Plan as potential sampling locations in the Southern Plantation.

FIELD ACTIVITY CHRONOLOGY

0715 Battelle on site, prepared sample kits, calibrated PID and initiated GPS system.
Holt Services staff onsite, prepared drill rig and equipment.

0800 Held tailgate safety, discussed sampling plan for the day.

0815 Began drilling SP-B46, completed continuous core to 25 ft bgs. SP-B46: collected one soil sample (SP-B46-S-13.0 at 0843) and one groundwater sample (SP-B46-GW-15.0 at 0923) using a temporary PVC well installed by overdrilling with 2.25” rods to screen an interval of 10 to 15 ft bgs. Sampling depths were selected based on the XSD detections at adjacent MIP-028 and highest PID readings in this boring.

0925 Abandoned SP-B46; open borehole depth in B46 was 8.0 ft bgs prior to bentonite backfill.

0933 Began drilling SP-B47, completed continuous core to 30.0 ft bgs. SP-B47: collected one soil sample (SP-B47-S-14.0 at 1003) and one groundwater sample (SP-B47-GW-15.0 at 1037) using a temporary PVC well installed by hand with a screen interval from 10 to 15 ft bgs. Sampling depths were selected based on the highest PID reading and highest XSD detections at adjacent MIP-005.

1042 Abandoned SP-B47; open borehole depth in B47 was 8.2 ft bgs prior to bentonite backfill.

1047 Began drilling SP-B48; met refusal at 2 ft bgs (likely concrete).

1056 Began drilling SP-B48a; met refusal at 2 ft bgs (likely concrete).

1100 Began drilling SP-B48b, completed continuous core to 30.0 ft bgs. SP-B48b: collected two soil samples (SP-B48b-S-6.0 at 1117 and SP-B48b-S-11.0 at 1123) and one groundwater sample (SP-B48b-GW-10.0 at 1200) using a temporary PVC well installed by overdrilling with 2.25" rods to screen an interval from 5 to 10 ft bgs. Sampling depths were selected based on the highest PID reading and highest XSD detections at adjacent MIP-053.

1210 Abandoned SP-B48b; open borehole depth in B48b was 3.7 ft bgs prior to bentonite backfill.

1220 Left site for lunch with Holt Services staff.

1320 Returned to site.

1330 Began drilling SP-B49, completed continuous core to 30.0 ft bgs. SP-B49: collected one soil sample (SP-B49-S-9.5 at 1358) and two groundwater samples (SP-B49-GW-10.0 at 1435 and SP-B49-GW-20.0 at 1458) using a temporary PVC well installed first by hand with a screen interval from 5 to 10 ft bgs and then by overdrilling with 2.25" rod to screen an interval between 15 and 20 ft bgs. Sampling depths were selected based on the highest PID readings and highest XSD detections at adjacent MIP-051 (at 9.5 ft bgs) and to investigate whether there is insufficient concentrations in groundwater below elevations that discharge into the nearby stream to suggest migration of contamination west of the stream (at 20.0 ft bgs).

1503 Abandoned SP-B49; open borehole depth in B49 was 9.8 ft bgs prior to bentonite backfill.
Cleaned motorcycle training area of debris from drilling. Performed post-calibrations and secured site.

1600 Holt Services staff left site.

1630 All offsite.

SUMMARY OF FINDINGS/CONCLUSIONS

Continuous cores were collected today to evaluate spatial distribution of contamination in the Southern Plantation in the western plume of the Southern Plantation. Increasing PID readings were observed consecutively moving from SP-B46 to -B47, -B48b, and -B49. The highest PID readings detected in each boring were 1.1 ppm at 13.0 ft bgs in SP-B46, 3.7 ppm at 14.0 ft bgs at SP-B47, 50.3 ppm at 6.0 ft bgs at SP-B48b, and 265.0 ppm at 9.5 ft bgs at SP-B49. PID readings apparently corroborate observations by the XSD in collocated MIP locations (MIP-028, -005, -053, and -051, respectively).

PLANS FOR THE FOLLOWING DAY:

Be on site at 07:00 to target at least 4 drill holes. Continue collecting continuous borings in the Southern Plantation to develop transects across the area and to investigate the locations with highest detections in the Southern Plantation.

ATTACHMENTS:

None

Copies to: Michael Meyer, Damon DeYoung	**Battelle - DAILY FIELD REPORT** Signed: ___________________________

DAILY FIELD REPORT 07 / 31 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: Sunny, high 91F, light wind	
To: Carlotta Cellucci	
From: Michael Meyer	

DAILY FIELD REPORT

PERSONNEL ON SITE:

Michael Meyer, Lauren March (Battelle)
Carlota Cellucci (NAVFAC Northwest)
Michael Running, Kyle Clark (Holt Services)

SUMMARY OF WORK COMPLETED:

- Drilling and logging of continuous soil cores at SP-B50, SP-B51, SP-B52, SP-B53
- Collection of 2 soil and 2 groundwater samples at SP-B50
- Collection of 2 soil and 1 groundwater samples at SP-B51
- Collection of 2 soil and 2 groundwater samples at SP-B52
- Collection of 4 soil and 2 groundwater samples at SP-B53

DEVIATIONS FROM WORKPLAN:

- None. Investigations at SP-B50, SP-B51, SP-B52, and SP-B53 represent locations indicated in the Sampling and Analysis Plan as potential sampling locations to assess and delimit hotspots in the South Plantation.

FIELD ACTIVITY CHRONOLOGY

0700	Battelle on site, prepared sample kits, calibrated PID and initiated GPS system.
0715	Holt Services staff onsite, prepared drill rig and equipment.
0740	Held tailgate safety, discussed safety concerns with unusually hot weather this week. In addition, Bristol will be offloading more water line pipe in their laydown area near the South Plantation. Based on location of borings selected for today relative to MIP locations and hotspot extents, decide that continuous coring continues to be warranted.
0824	Began drilling SP-B50, located between MIP-11 and MIP-33. Completed continuous core to 25 feet based on material observed and low PID readings at depth. SP-B50: collected two soil samples (SP-B50-S-12.0 at 0835 and SP-B50-S-16.0 at 0902) and one groundwater sample (SP-B50-GW-14.0 at 0927) using a temporary PVC well installed by hand with a screen interval from 14 to 9 ft bgs. Sampling depths were selected based on the highest PID readings in this boring.
0927	Abandoned SP-B50; open borehole depth in B50 was 9 ft prior to bentonite backfill.

0950 Began drilling SP-B51, located between MIP-34, MIP-36, and MIP-37. Completed continuous core to 25 feet based on material observed and low PID readings at depth. SP-B51: collected two soil samples (SP-B51-S-13.0 at 1023 and SP-B51-S-17.0 at 1030) and one groundwater sample (SP-B51-GW-14.0 at 1047) using a temporary PVC well installed by hand with a screen interval from 14 to 9 ft bgs. Sampling depths were selected based on the highest PID readings in this boring, with the 17 ft soil sample intended to assess vertical extent of contamination.

1050 Abandoned SP-B51; open borehole depth in B51 was 8.7 ft prior to bentonite backfill.

1057 Began drilling SP-B52, located adjacent to MIP-02. Completed continuous core to 25 feet based on material observed and low PID readings at depth. SP-B52: collected two soil samples (SP-B52-S-9.0 at 1116 and SP-B52-S-12.0 at 1129) and two groundwater samples (SP-B52-GW-11.0 at 1146 and SP-B52-GW-20.0 at 1209). The shallow groundwater sample was collected to assess a shallow water bearing zone exhibiting relatively high PID concentrations (358 ppm at 9 ft bgs) using a temporary PVC well installed by hand with a screen interval from 11 to 6 ft bgs. The deeper groundwater sample was collected to assess vertical extent of contamination in groundwater, in a lower water bearing zone exhibiting no detections on the PID, using screen point groundwater sampler with a screen interval of 20 to 16 feet bgs.

1210 Abandoned SP-B52; open borehole depth in B52 was 9.6 ft prior to bentonite backfill.

1215 Left site for lunch with Holt Services staff.

1300 Returned to site with Holt Services staff.

1310 Began drilling SP-B53, located adjacent to MIP-19. Completed continuous core to 35 feet based on material observed and low PID readings at depth. SP-B53: collected four soil samples (SP-B53-S-10.0 at 1333, SP-B53-S-24.0 at 1356, SP-B53-S-32.0 at 1433 and SP-B53-S-33.5 at 1440) and two groundwater samples (SP-B53-GW-23.0 at 1458 and SP-B53-GW-33 at 1529). The shallow groundwater sample was collected to assess a shallow water bearing zone exhibiting relatively high PID concentrations (716 ppm at 21 ft bgs) using a temporary PVC well installed by hand with a screen interval from 23 to 18 ft bgs. The deeper groundwater sample was collected to assess vertical extent of contamination in groundwater, in a lower water bearing zone exhibiting low detections on the PID (8.4 ppm at 32 ft bgs), using screen point groundwater sampler with a screen interval of 33 to 28 feet bgs. The 33 ft bgs groundwater sample and the 32 ft bgs soil sample were collected from a well-graded sand immediately above a clay unit. The 33.5 ft bgs soil sample was collected from the clay.

1530 Abandoned SP-B53; open borehole depth in B53 was 7 ft prior to bentonite backfill.

1545 Performed calibration checks on PID and GPS system and secured equipment and supplies for the night.

1600 Holt Services left site.

1615 All offsite.

SUMMARY OF FINDINGS/CONCLUSIONS

Continuous cores were collected today to evaluate hotspots identified by the previous MIP investigation in the South Plantation. PID readings observed in two of the four borings (SP-B50 and SP-B51) were relatively low (i.e., the maximum PID reading was 14.9 at 12 ft bgs in boring SP-B50, with the maximum in SP-B51 being 0.3 ppm from at 13 ft bgs). PID readings were substantially higher in boring SP-B52 (358 ppm at 9 ft bgs) and SP-B53 (946 ppm at 24 ft bgs).

PLANS FOR THE FOLLOWING DAY:

Perform continuous cores near MIP-59 and MIP-22 to calibrate the MIP log to the soil and groundwater samples and field PID. Continue with borings in the vicinity of the eastern plume in the South Plantation, and consider targeted sampling (rather than continuous coring) based on the correlation between the field PID and the MIP results.

ATTACHMENTS:

None

Copies to: Sam Moore, Lauren March, Damon DeYoung	**Battelle - DAILY FIELD REPORT** Signed: ______________________________

DAILY FIELD REPORT 08 / 01 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: Sunny, high 80s, light wind	
To: Carlotta Cellucci	
From: Michael Meyer	

DAILY FIELD REPORT

PERSONNEL ON SITE:

Michael Meyer, Lauren March (Battelle)
Carlota Cellucci (NAVFAC Northwest)
Michael Running, Kyle Clark (Holt Services)

SUMMARY OF WORK COMPLETED:

- Drilling and logging of continuous soil cores at SP-B54, SP-B55, and SP-B56
- Collection of 3 soil and 2 groundwater samples at SP-B54
- Collection of 2 soil and 2 groundwater samples at SP-B55
- Collection of 2 soil and 2 groundwater samples at SP-B56

DEVIATIONS FROM WORKPLAN:

- None. Investigations at SP-B54, SP-B55, and SP-B56 represent locations indicated in the Sampling and Analysis Plan as potential sampling locations to assess and delimit hotspots in the South Plantation.

FIELD ACTIVITY CHRONOLOGY

0700 Battelle on site, prepared sample kits, calibrated PID and initiated GPS system.

0730 Holt Services staff onsite, prepared drill rig and equipment.

0810 Held tailgate safety, reiterated safety concerns with unusually hot weather this week. Iced water is available in a cooler onsite. Reviewed proper safe work attire, including safety glasses. Review utility locate marks near drilling locations for today, especially the abandoned power and compressed air lines in the area. Based on location of borings selected for today relative to MIP locations and hotspot extents, decide that continuous coring continues to be warranted.

0820 Began drilling SP-B54, located immediately adjacent to MIP-59. Continuously cored to refusal at 35 ft bgs. A gravel unit at 25 ft bgs resulted in difficult drilling conditions. SP-B54: collected three soil samples (SP-B54-S-7.0 at 0833, SP-B54-S-17.0 at 0913, and SP-B54-S-3.0 at 0952) and two groundwater samples (SP-B54-GW-7.0 at 0833 and SP-B54-GW-35.0 at 1108). The shallow groundwater sample was collected to assess a shallow water bearing zone exhibiting relatively high PID concentrations (1,808 ppm at 7 ft bgs) using a temporary PVC well installed by hand with a screen interval from 7 to 2 ft bgs. The deeper groundwater sample was collected to assess vertical extent of contamination in groundwater, in a lower water bearing zone exhibiting low detections on the PID, using screen point groundwater sampler with a screen interval of 35 to 31 feet bgs.

1120 Abandoned SP-B54; open borehole depth in B54 was 5-6 ft prior to bentonite backfill. The drill crew made best efforts to drive bentonite chips to the depth of the former marsh silt (observed at 7 ft bgs in this boring).

1125 Began drilling SP-B55, located adjacent to MIP-22. Completed continuous core to 35 feet based on material observed and low PID readings at depth. SP-B55: collected two soil samples (SP-B55-S-9.0 at 1154 and SP-B55-S-33.0 at 1338) and two groundwater (SP-B55-GW-10.0 at 1212 and SP-B55-GW-33.0 at 1356). The shallow groundwater sample was collected to assess a shallow water bearing zone exhibiting relatively higher PID concentrations (54 ppm at 9 ft bgs) using a temporary PVC well installed by hand with a screen interval from 10 to 5 ft bgs. The deeper groundwater sample was collected to assess vertical extent of contamination in groundwater, in a lower water bearing zone exhibiting low detections on the PID using screen point groundwater sampler with a screen interval of 33 to 31 feet bgs. The crew took a staggered lunch to continue making progress on this boring.

1356 Abandoned SP-B55; open borehole depth in B55 was 11. 5 ft prior to bentonite backfill.

1413 Began drilling SP-B56, located between MIP-59 and MIP-21. Completed continuous core to 30 feet based on material observed and low PID readings at depth. SP-B56: collected two soil samples (SP-B56-S-10.0 at 1453 and SP-B56-S-27.0 at 1501) and two groundwater samples (SP-B56-GW-10.0 at 1518 and SP-B56-GW-27.0 at 1550). The shallow groundwater sample was collected to assess a shallow water bearing zone exhibiting relatively high PID concentrations (716 ppm at 10 ft bgs) using a temporary PVC well installed by hand with a screen interval from 10 to 5 ft bgs. The deeper groundwater sample was collected to assess vertical extent of contamination in groundwater, in a lower water bearing zone exhibiting no detections on the PID, using screen point groundwater sampler with a screen interval of 27 to 23 feet bgs.

1510 L. March left the site to deliver samples to the laboratory.

1554 Abandoned SP-B56; open borehole depth in B56 was 15.5 ft prior to bentonite backfill.

1600 Holt Services left site.

1630 M. Meyer offsite.

SUMMARY OF FINDINGS/CONCLUSIONS

Continuous cores were collected today to evaluate the eastern hotspot identified by the previous MIP investigation in the South Plantation. PID readings observed in two of the three borings (SP-B54 and SP-B56) were in the range of highest observed at the site (i.e., the maximum PID reading was 1,808 at 7 ft bgs in boring SP-B54, with the maximum in SP-B56 being 716 ppm at 10 ft bgs). PID readings were substantially lower in boring SP-B55 (54 ppm at 9 ft bgs).

PLANS FOR THE FOLLOWING DAY:

Continue with borings in the vicinity of the eastern plume in the South Plantation, using targeted sampling (rather than continuous coring) based on the correlation between the field PID and the MIP results to assess the apparent lateral extent of the plume in this area.

ATTACHMENTS:

None

Copies to: Sam Moore, Lauren March, Damon DeYoung	**Battelle - DAILY FIELD REPORT**

	Signed:

DAILY FIELD REPORT 08 / 02 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: Sunny, high 80s, light wind, poor air quality from wildfires in Canada	
To: Carlotta Cellucci	
From: Michael Meyer	

DAILY FIELD REPORT

PERSONNEL ON SITE:

Michael Meyer, Lauren March (Battelle)
Carlota Cellucci (NAVFAC Northwest)
Michael Running, Kyle Clark (Holt Services)

SUMMARY OF WORK COMPLETED:

- Drilling and logging of continuous soil cores at SP-B57, SP-B58, SP-59, and SP-B60
- Collection of 2 soil and 2 groundwater samples at SP-B57
- Collection of 3 soil and 1 groundwater samples at SP-B58
- Collection of 3 soil and 1 groundwater samples at SP-B59
- Collection of 3 soil and 2 groundwater samples at SP-B60

DEVIATIONS FROM WORKPLAN:

- As discussed during the initial site walk, locations SP-B59 and SP-B60 were placed slightly further west than shown in the SAP, west of Bradley Road. The MIP locations in Bradley Road did not show evidence of contamination, and the intent of moving the locations to the west was to more closely constrain the eastward lateral extent of contamination observed at MIP-17, MIP-18, and MIP-59.

FIELD ACTIVITY CHRONOLOGY

0700 Battelle on site, prepared sample kits, calibrated PID and initiated GPS system.

0725 Holt Services staff onsite, prepared drill rig and equipment. Fueled drill rig and loaded water tank.

0745 Discuss planned work for day.

0805 Held tailgate safety, look over utility locate marks along Bradley Road. Discuss traffic hazards and poor air quality from wildfires in British Columbia.

0809 Began drilling SP-B57, located just south of gate into former Building 884, west of MIP-59. Continuously cored to Lawton Clay at 30 ft bgs. SP-B57: collected two soil samples (SP-B57-S-10.0 at 0844 and SP-B57-S-29.0 at 0854) and two groundwater samples (SP-B57-GW-10.0 at 0912 and SP-B57-GW-29.0 at 0933). The shallow groundwater sample was collected to assess a shallow water bearing zone exhibiting elevated PID concentrations (35.8 ppm at 10 ft bgs) using a temporary PVC well installed by hand with a screened interval from 10 to 5 ft bgs. The deeper groundwater sample was collected to assess vertical extent of contamination in groundwater, in a sand just above the Lawton Clay using a screen point groundwater sampler with a screened interval of 29 to 25 feet bgs.

0935 Abandoned SP-B57; open borehole depth in B57 was 9 ft prior to bentonite backfill.

0947 Began drilling SP-B58, located between MIP-19 and MIP-23. Based on results at these two MIP locations, attempted to target the initial coring depth to 20 feet bgs. Pushing with a solid probe tip, however, was not successful because of soil density. Ultimately returned to continuous coring, with cores retrieved from 0-5 feet and in five-foot intervals from 15 feet to 40 feet bgs, terminating in the Lawton Clay. SP-B58: collected three soil samples (SP-B58-S-21.0 at 1056, SP-B58-S-37.0 at 1129, and SP-B58-S-39.5 at 1136) and one groundwater sample (SP-B58-GW-39.0 at 1148). The groundwater sample was collected to assess vertical extent of contamination in groundwater from just above the Lawton Clay using a screen point groundwater sampler with a screened interval of 39 to 35 feet bgs.

1153 Abandoned SP-B58; open borehole depth in B58 was approximately 12 feet prior to bentonite backfill.

1200 Lunch

1245 Began drilling SP-B59, located east of MIP-17 and west of Bradley Road. Initial attempts at this location met refusal at 2.5 feet on wood debris, and the boring was moved approximately 10 feet north of the original location. Completed continuous core to 30 feet, terminating in the Lawton Clay. SP-B59: collected three soil samples (SP-B59-S-5.0 at 1350, SP-B59-S-21.0 at 1356, and SP-B59-S-29.8 at 1404) and one groundwater sample (SP-B59-GW-30.0 at 1420). The groundwater sample was collected to assess vertical extent of contamination in groundwater, from just above the Lawton Clay, using a screen point groundwater sampler with a screened interval of 30 to 26 feet bgs.

1420 Abandoned SP-B59; open borehole depth in B59 was 11 ft prior to bentonite backfill.

1430 Began drilling SP-B60, located east of MIP-59 and west of Bradley Road. Completed continuous core to refusal on dense, well-graded, gravelly sand at 24 feet bgs. SP-B60: collected two soil samples (SP-B60-S-7.5 at 1505, SP-B60-S-17.0 at 1519, and SP-B60-S-23.5 at 1523) and two groundwater samples (SP-B60-GW-9.0 at 1532 and SP-B60-GW-24.0 at 1547). The shallow groundwater sample was collected to assess a shallow water bearing zone exhibiting elevated PID concentrations (310 ppm at 7.5 ft bgs) using a temporary PVC well installed by hand with a screened interval from 9 to 4 ft bgs. The deeper groundwater sample was collected to assess vertical extent of contamination in groundwater at the maximum depth of the boring, using a screen point groundwater sampler with a screened interval of 24 to 20 feet bgs.

1550 Abandoned SP-B60; open borehole depth in B60 was 9 ft prior to bentonite backfill.

1600 Holt Services left site. Check calibration of PID and GPS.

1615 Battelle offsite.

SUMMARY OF FINDINGS/CONCLUSIONS

Continuous, or nearly continuous, cores were collected today to evaluate the lateral extent of the eastern hotspot identified by the previous MIP investigation in the South Plantation. PID readings observed in three of the four borings (SP-B58, SP-B59 and SP-B60) were in the high range observed at the site (i.e., the maximum PID reading in these three borings was 637 at 5 ft bgs in boring SP-B59, with PID readings greater than 300 ppm in SP-B58 and SP-B60 as well). PID readings were substantially lower in boring SP-B57 (35.8 ppm at 10 ft bgs). The Lawton Clay was identified in three of the four borings completed today.

PLANS FOR THE FOLLOWING DAY:

Continue with borings in the vicinity of the eastern plume in the South Plantation, using continuous coring. Complete two borings in areas of asphalt paving to the northeast and north of MIP-59, then proceed to the boring immediately adjacent to the southwest corner of the foundation pad for Building 884. Then proceed to complete the remaining borings planned for assessing the northern hotspot within the South Plantation. Borings through concrete, and in areas of brush, will be completed in the following days.

<u>ATTACHMENTS</u>:

None

Copies to: Sam Moore, Lauren March, Damon DeYoung	**Battelle - DAILY FIELD REPORT** Signed: ______________________

DAILY FIELD REPORT 08 / 03 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: Sunny but smoky, high 92F, winds NNE 5-10mph	
To: Carlotta Cellucci	
From: Samuel Moore	

DAILY FIELD REPORT

PERSONNEL ON SITE:

Samuel Moore, Lauren March (Battelle)
Michael Running, Kyle Clark (Holt Services)

SUMMARY OF WORK COMPLETED:

- Drilling and logging of continuous soil cores at SP-B61 and SP-B62
- Collection of 2 soil and 1 groundwater sample at SP-B61
- Collection of 3 soil samples at SP-B62

DEVIATIONS FROM WORKPLAN:

- None. Investigations at SP-B61 and SP-B62 represent locations indicated in the Sampling and Analysis Plan as potential sampling locations in the Southern Plantation.

FIELD ACTIVITY CHRONOLOGY

0800 Battelle on site, prepared sample kits, calibrated PID.
Holt Services staff onsite, prepared drill rig and equipment.

0830 Held tailgate safety, discussed heat stress with high temperatures forecasted as well as sampling plan for the day.

0858 Began drilling SP-B61, northeast of MIP-059, completed continuous core to 35 ft bgs (refusal). SP-B61: collected two soil samples (SP-B61-S-18.0 at 0923 and SP-B61-S-23.5 at 0932) and one groundwater sample (SP-B61-GW-25.0 at 1040) using a sampling point stainless steel screen installed to screen an interval of 21 to 25 ft bgs. Sampling depths were selected based on the XSD detections at nearby MIP-059 and highest PID readings in this boring.

1048 Abandoned SP-B61; open borehole depth in B61 was 9.8 ft bgs prior to bentonite backfill.

1055 Began drilling SP-B62, completed continuous core to 25.0 ft bgs prior to Geoprobe malfunction. SP-B62: collected three soil samples (SP-B62-S-7.0 at 1113, SP-B62-S-16.0 at 1149, and SP-B62-S-24.0 at 1503). Sampling depths were selected based on the highest PID readings in the boring and highest XSD detections at nearby MIP-059. Additional sample volume was collected from SP-B62-S-7.0—a tar-oil-rubber conglomerate layer—for potential further analytical characterization.

1130 Geoprobe rig developed electrical issues, went offline, and would not restart.

1140 Left for lunch. Holt Services staff left to acquire a voltmeter to troubleshoot drill rig.

1220 Returned to site. Troubleshooted electrical issues on the rig with the Geoprobe vendor on the phone. Stepped through electrical connections to diagnose potential shorts and faulty connections.

1420 Identified the controller module as the source of the electrical issues with the Geoprobe rig. Ordered replacement part for overnight delivery. Bypassed the starter relay to restart drilling operations. Proceeded drilling to 25 ft bgs. Drill rig shut off again and would not restart. Performed post calibrations and secured equipment for the night.

1510 Holt Services staff left site. L. March left site to deliver samples that were collected on August 2 and 3, 2017 to TestAmerica Seattle.

1530 All offsite.

SUMMARY OF FINDINGS/CONCLUSIONS

Continuous cores were collected today to evaluate spatial distribution of contamination in the eastern plume of the Southern Plantation. Elevated PID readings were observed between 23 to 24 ft bgs in both SP-B61 and SP-B62 (407.1 ppm and 59.5 ppm, respectively).

PLANS FOR THE FOLLOWING DAY:

Be on site at approximately 09:00 with replacement parts to repair the Geoprobe rig. Complete SP-B62. Target at 3 additional drill holes. Continue collecting continuous borings in the Southern Plantation.

ATTACHMENTS:

None

Copies to: Michael Meyer, Damon DeYoung	**Battelle - DAILY FIELD REPORT** Signed: ____________________

DAILY FIELD REPORT 08 / 04 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: Sunny but smoky, high 89F, winds NNE 0-5mph	
To: Carlotta Cellucci	
From: Damon DeYoung	

DAILY FIELD REPORT

PERSONNEL ON SITE:

Damon DeYoung, Lauren March (Battelle)
Michael Running, Kyle Clark (Holt Services)

SUMMARY OF WORK COMPLETED:

- Drilling and logging of continuous soil cores at SP-B62, SP-B63 and SP-B64
- Collection of 1 soil and 1 groundwater sample at SP-B62
- Collection of 2 soil and 1 groundwater sample at SP-B63
- Collection of 2 soil and 1 groundwater sample at SP-B64

DEVIATIONS FROM WORKPLAN:

- Borings SP-B63 and SP-B64 were relocated from the prescribed locations in the SAP as follows: SP-B63 was placed 5 feet northwest of MIP-057 to help delineate the contamination observed in SP-B53 (adjacent to MIP-019) to the northwest; SP-B64 was relocated to be adjacent to the outfall pipe south of MIP-058 and west of MIP-056 to combine the proposed points near these MIP locations and delineate this area.

FIELD ACTIVITY CHRONOLOGY

0830 D. DeYoung on site, reviewed field maps and discussed the strategy for completion of the field program with Michael Meyer via phone

0845 Michael Running (Holt Services) called notifying the delivery of the Geoprobe 7822 DT relay module at the Holt Services yard. Drillers will be onsite by 0945. Calibrated PID.

0945 Performed tailgate safety meeting. Drillers onsite repairing the Geoprobe 7822 DT. Rig did not start following relay module replacement. Drillers called Geoprobe to troubleshoot the electrical system of the rig.

1145 Rig started after troubleshooting additional relays and fuses. Following startup, the rig would shut-off upon throttling up, and is likely due to a faulty/loose wire causing a grounding issue. However, the rig is capable of running.

1154 Began drilling the continuation of SP-B62. Completed continuous core to 30 feet bgs. Gravels locked up the core barrel and sleeve in the 25 to 30 foot section. Challenges with gravel locking precluded continuation below 30 ft.

SP-B62: collected one additional soil samples (SP-B62-S-26.0 at 1215) and one groundwater sample (SP-B62-GW-26.0 at 1244) using a DPT sampling point stainless steel screen installed to screen an interval of 22 to 26 ft bgs.

1315 Abandoned SP-B62; open borehole depth in B62 was 15 ft bgs prior to bentonite backfill.

Left site for lunch

1355 onsite after lunch, moved to SP-B63 approximately 5 ft northwest of MIP-057.

1400 Began drilling SP-B63, completed continuous core to 30.0 ft.

SP-B63: collected two soil samples (SP-B63-S-18.5 at 1435 and SP-B63-S-24.0 at 1447) and one groundwater sample (SP-B63-GW-24.0 at 1529) using a DPT sampling point stainless steel screen installed to screen an interval of 20 to 24 ft bgs.

1540 Abandoned SP-B63; open borehole depth in B63 was 8.5 ft bgs prior to bentonite backfill.

1550 Moved to SP-B64 near the drainage outfall south of MIP-058, collected continuous core to 25 ft bgs.

SP-B64: collected two soil samples (SP-B64-S-05.5 at 1609 and SP-B64-S-12.0 at 1625) and one groundwater sample (SP-B64-GW-10.0 at 1648) using a hand installed PVC well screened from 5 to 10 ft bgs.

1705 Abandoned SP-B64; open borehole depth in B64 was 0.5 ft bgs prior to bentonite backfill.

1745 Completed post-calibrations on PID and GPS. Left site for the short weekend (plan to work on Sunday 8/6/2017).

SUMMARY OF FINDINGS/CONCLUSIONS

Continuous cores were collected today to evaluate spatial distribution of contamination in the eastern plume of the Southern Plantation. Elevated PID readings were observed at 26 ft bgs in SP-B62 (79.3 ppm) then dropped to under 10 ppm at 29 and 30 ft bgs. Low PID readings were observed in SP-B63 (less than 2 ppm throughout the 30 ft boring). Elevated PID readings were observed in two zones in SP-B64; one zone between 4.5 and 6 feet (high of 96.9 ppm at 5.5 ft), and the other from 10 to 15 ft (high of 35.3 ppm at 11 ft).

PLANS FOR THE FOLLOWING DAY:

Be on site at approximately 08:00 on Sunday August 6, 2017. Target 3 to 4 additional drill holes. Continue collecting continuous borings at prescribed locations in the Southern Plantation.

ATTACHMENTS:

None

Copies to: Michael Meyer, Samuel Moore	**Battelle - DAILY FIELD REPORT** Signed: ___________________________

DAILY FIELD REPORT 08 / 06 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: Hazy due to smoke, but sunny, high 80F, winds NNE 0-5mph	
To: Carlotta Cellucci	
From: Damon DeYoung	

DAILY FIELD REPORT

PERSONNEL ON SITE:

Damon DeYoung, Lauren March (Battelle)
Michael Running, Kyle Clark (Holt Services)

SUMMARY OF WORK COMPLETED:

- Drilling and logging of continuous soil cores at SP-B65C, SP-B66, SP-B67, SP-B68 and SP-B69
- Collection of 1 soil and 1 groundwater sample at SP-B65C
- Collection of 2 soil and 1 groundwater sample at SP-B66
- Collection of 2 soil and 1 groundwater sample at SP-B67
- Collection of 3 soil and 1 groundwater samples at SP-B68
- Collection of 2 soil and 1 groundwater samples at SP-B69
- Cored concrete at SP-B70

DEVIATIONS FROM WORKPLAN:

- All borings were prescribed in the work plan with the exception of SP-B67. SP-B67 was relocated to combine two proposed locations into one to delineate the northern extent of the plume area surrounding well MW1-16.

FIELD ACTIVITY CHRONOLOGY

0730	D. DeYoung on site and L. March on site for daily preparation, PID calibration and GPS initiation
0830	Holt Services onsite, performed tailgate meeting, moved rig to SP-B65 west of MIP-051.
0845	Began drilling SP-B65, hit refusal at 3 ft bgs. Offset to SP-B65A, hit refusal at 3 ft bgs. Offset to SP-B65B, hit refusal at 3 ft bgs. Offset to SP-B65C, collected continuous core to 25 ft bgs. SP-B65C: collected one soil sample (SP-B65C-S-08.0 at 0905) and one groundwater sample (SP-B65C-GW-09.0 at 0958) using a hand installed PVC well screened from 4 to 9 ft bgs.
1000	Abandoned SP-B65, B65A, B65B and B65C; open borehole depth in B65C was 8.5 ft bgs prior to bentonite backfill.
1005	Moved to SP-B66 near MIP-024; Completed continuous core to 25 ft bgs.

SP-B66: collected two soil samples (SP-B66-S-09.0 at 1020 and SP-B66-S-10.5 at 1031) and one groundwater sample (SP-B66-GW-10.0 at 1057) using a hand installed PVC well screened from 5 to 10 ft bgs.

1100 Abandoned SP-B66; open borehole depth in B66 was 8.5 ft bgs prior to bentonite backfill.

1104 Began drilling SP-B67, completed continuous core to 25.0 ft.

SP-B67: collected two soil samples (SP-B67-S-12.5 at 1121 and SP-B67-S-24.0 at 1150) and one groundwater sample (SP-B67-GW-14.0 at 1153) using a DPT sampling point stainless steel screen installed to screen an interval of 10 to 14 ft bgs.

1200 Abandoned SP-B67; open borehole depth in B67 was 6.5 ft bgs prior to bentonite backfill.

1218 offsite for lunch

1325 Moved to SP-B68 east of MW1-16, collected continuous core to 25 ft bgs.

SP-B68: collected three soil samples (SP-B68-S-00.5 at 1335, SP-B68-S-9.5 at 1345, and SP-B68-S-12.5 at 1355) and one groundwater sample (SP-B68-GW-13.0 at 1425, plus one groundwater field duplicate) using a hand installed PVC well screened from 8 to 13 ft bgs.

1438 Abandoned SP-B68; open borehole depth in B68 was 8.5 ft bgs prior to bentonite backfill.

1445 Moved to SP-B69, collected continuous core to 25 ft bgs.

SP-B69: collected two soil samples (SP-B69-S-11.5 at 1506, plus a soil field duplicate at 11.5 ft, and SP-B69-S-15.0 at 1521, plus MS and MSD at 15.0 ft) and one groundwater sample (SP-B69-GW-12.0 at 1552, plus MS and MSD at 12.0 ft) using a hand installed PVC well screened from 7 to 12 ft bgs.

1605 Abandoned SP-B69; open borehole depth in B69 was 9.0 ft bgs prior to bentonite backfill.

1640 Cored concrete at SP-B70 located in the middle of the former hazardous waste facility foundation footprint.

1650 Cleaned up the site and completed post-calibrations on PID and GPS.

1655 Left the site.

SUMMARY OF FINDINGS/CONCLUSIONS

Continuous cores were collected today to evaluate spatial distribution of contamination in the southern and central areas of the Southern Plantation. Contamination in the borings today were limited to the upper 20 feet of soil. The highest PID reading occurred in SP-B66 at 9.2 ft bgs with a reading of 205 ppm.

PLANS FOR THE FOLLOWING DAY:

Be on site at approximately 07:00 tomorrow. Collect a continuous core from SP-B70. Collect targeted soil and groundwater samples from SP-B01 including a SVOC sample. Collect targeted groundwater samples from CL-B14 and CL-B18 for NAPL identification. Collect targeted groundwater sample at SP-B43 at 13 ft due to sample breakage at the lab.

ATTACHMENTS:

None

Copies to: Michael Meyer, Samuel Moore	**Battelle - DAILY FIELD REPORT** Signed: ___________________________

DAILY FIELD REPORT 08 / 07 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: Hazy due to smoke, but sunny, high 80F, winds NNE 0-5mph	
To: Carlotta Cellucci	
From: Damon DeYoung	

DAILY FIELD REPORT

PERSONNEL ON SITE:

Damon DeYoung, Lauren March (Battelle)
Michael Running, Kyle Clark (Holt Services)

SUMMARY OF WORK COMPLETED:

- Drilling and logging of continuous soil cores at SP-B70 and SP-B01B
- Collection of 1 soil and 2 groundwater samples at SP-B01B
- Collection of 1 groundwater sample at SP-B43A
- Collection of 1 groundwater sample at CL-B21A
- Collection of 1 groundwater sample at CL-B18B
- Collection of 1 soil sample at SP-B62A

DEVIATIONS FROM WORKPLAN:

- All borings were prescribed in the work plan with the exception of SP-B67. SP-B67 was relocated to combine two proposed locations into one to delineate the northern extent of the plume area surrounding well MW1-16.

FIELD ACTIVITY CHRONOLOGY

0645 D. DeYoung and L. March on site for daily preparation, PID calibration and GPS initiation, prepared bottle kits for the last day of sampling.

0730 Holt Services onsite, performed tailgate meeting, moved rig to SP-B70 in the center of the former hazardous waste building foundation.

0745 Began drilling SP-B70, hit refusal due to second layer of concrete at 2 feet bgs.

0800 Abandoned SP-B70, capped with concrete.

0820 Began drilling SP-B01B to target collection of possible NAPL for Otto Fuel analysis observed in SP-B01A on 07/11/2017.

SP-B01B: collected one soil sample (SP-B01B-S-08.0 at 0840) for VOC and SVOC analyses at TestAmerica, also collected one 4-oz soil jar for Otto fuel analysis at NBK Keyport Laboratory. Collected two groundwater samples (SP-B01B-GW-10.0 at 0854 and SP-B01B-GW-15.0 at 1000) for VOC analysis at

TestAmerica and Otto fuel analysis at NBK Keyport Laboratory. Groundwater samples were collected using hand installed PVC wells screened from 5 to 10 ft bgs and 10 to 15 ft bgs, respectively.

1010 Abandoned SP-B01B; open borehole depth in B01B was 10 ft bgs prior to bentonite backfill.

1025 Pushed DPT groundwater sampler at SP-B43A for resampling at 13 ft bgs due to the laboratory freezing the original sample.
SP-B43A: collected one groundwater sample (SP-B43A-GW-13.0 at 1050) using a stainless steel direct push groundwater sampler with a screen from 9 to 13 ft bgs.

1100 abandoned SP-B43A; offsite for lunch

1210 Pushed DPT groundwater sampler to 20 ft bgs at CL-B21A to collect an Otto fuel sample for analysis by NBK Keyport Laboratory. A VOC sample was collected for analysis by TestAmerica (CL-B21A-GW-20.0 at 1230).

1238 Abandoned CL-B21A.

1245 Pushed DPT groundwater sampler to 20 ft bgs at CL-B18B to collect an Otto fuel sample for analysis by NBK Keyport Laboratory. A VOC sample was collected for analysis by TestAmerica (CL-B18B-GW-20.0 at 1255).

1305 Abandoned CL-B18B.

1314 Drilled SP-B62A and collected continuous core to 10 ft bgs to target tarry material at near 7 ft bgs as observed in boring SP-B62. Collected one soil sample in the vadose zone at 6.5 ft bgs for analysis of Otto fuel by NBK Keyport Laboratory (SP-B62A-S-06.5 at 1320)

1355 Performed site cleanup activities to conclude the first mobilization, including post-calibrations and demobilization of equipment.

1500 Completed demobilization efforts and left the site.

SUMMARY OF FINDINGS/CONCLUSIONS

Targeted interval sampling was performed to wrap up data gaps including collection of Otto fuel samples at locations where NAPL substances were observed (i.e., SP-B01B, SP-B62A, CL-B18B, and CL-B21A). Very high PID screening levels (>5000 ppm) were observed in SP-B01B at shallow depths (less than 10 ft bgs) where previous drill cores had poor recovery in this shallow zone.

ATTACHMENTS:

None

Copies to: Michael Meyer, Samuel Moore	**Battelle - DAILY FIELD REPORT** Signed: ______________________

DAILY FIELD REPORT 09 / 06 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: Very smoky, high 89F, light winds	
To: Carlotta Cellucci	
From: Samuel Moore	

DAILY FIELD REPORT

PERSONNEL ON SITE:

Samuel Moore, Joshua Sacker, Michael Meyer (Battelle)
Carlotta Cellucci (NAVFAC NW)

SUMMARY OF WORK COMPLETED:

- Held pre-construction meeting
- Collection of 4 composite sediment samples (SED-01 through SED-04)
- Deployment of 5 passive sediment samplers (PED-02 through PED-06)
- Deployment of 2 passive samplers in piezometers P1-1 and P1-2 (PED-07 and PED-08)

DEVIATIONS FROM WORKPLAN:

- Locations of composite sediment samples SED-02 and SED-04 were each shifted approximately 10 feet from the planned coordinates to align with actual surface water flow. Deployment of passive samplers is in accordance with a pre-approved deviation from the work plan.

SAFETY GOOD CATCHES:

- M. Meyer identified that the potential exists for slips/trips/falls while working along marsh creek which could lead to an unconscious or drowned worker. The team decided on the additional requirement of line-of-sight for the “buddy system” to be effective in the marsh creek.

FIELD ACTIVITY CHRONOLOGY

0730 Battelle on site, loaded sample coolers and gear, calibrated PID.

0800 Held tailgate safety meeting, discussed difficulties with moving through the muddy marsh and stream, importance of not losing line-of-sight, and wearing nitrile gloves while handling sediment and PEDs.

0905 C. Cellucci on site. Held pre-construction meeting. Communicated with C. Cellucci the scope of this mobilization and discussed the potential of dry sediment south of the Southern Plantation that could inhibit sample collection. Walked sample locations.

0945 C Cellucci off site.

1030 M. Meyer off site. Prepared to collect sediment samples.

1045 Mobilized to sample sediment locations in marsh creek.

1124 Collected SED-01-10-170906 coincident with MA14 by compositing three samples across transect of creek.

1151 Collected SED-02-10-170906 coincident with MA09 by compositing three samples across transect of creek. Shifted sample location approximately 10 ft east to sit centrally in creek.

1205 Collected SED-03-10-170906 coincident with SP1-1 by compositing three samples across transect of creek.

1219 Collected SED-04-10-170906 coincident with MA19 by compositing three samples along the creek, which is only several feet wide at this location. Shifted sample location approximately 10 ft east to sit centrally in creek. Flagged final PED location for later deployment.

1230 S. Moore left site to pick up cooler with PEDs. J. Sacker remained to label bottles and organize supplies.

1330 S. Moore returned to site.

1426 Deployed sediment PED-02, PED number 20170821AS-004, coincident with SED-01.

1431 Deployed sediment PED-03, PED number 20170821AS-003, coincident with SED-02.

1436 Deployed sediment PED-04, PED number 20170821AS-006, coincident with SED-03.

1439 Deployed sediment PED-05, PED number 20170821AS-007, coincident with SED-04.

1445 Deployed sediment PED-06, PED number 20170821AS-008, upstream of SED-04.

1604 Deployed piezometer PED-07, PED number 20170821AS-013, down P1-1 such that the bottom of the device sits approximately 0.3 ft above the bottom of the well screen.

1630 Deployed piezometer PED-08, PED number 20170821AS-014, down P1-2 such that the bottom of the device sits approximately 0.3 ft above the bottom of the well screen.

Performed post-calibrations and secured site.

1710 All offsite.

SUMMARY OF FINDINGS/CONCLUSIONS

Composite sediment samples were collected and passive sampling devices were deployed today to assess potential migration pathways of contamination west toward the marsh creek and tide flats.

PLANS FOR THE FOLLOWING DAY:

Be on site at approximately 07:30. Deploy groundwater monitoring well PEDs. Collect SED-05 in the tide flats and deploy sediment PED-01. Proceed with collecting porewater samples; target 6 porewater samples.

ATTACHMENTS:

None

Copies to: Michael Meyer, Damon DeYoung	**Battelle - DAILY FIELD REPORT** Signed: ___________________________

BATTELLE
It can be done

DAILY FIELD REPORT 09 / 07 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: Partly cloudy and very smoky, high 78F, light winds	
To: Carlotta Cellucci	
From: Samuel Moore	

DAILY FIELD REPORT

PERSONNEL ON SITE:

Samuel Moore, Joshua Sacker (Battelle)

SUMMARY OF WORK COMPLETED:

- Collection of 1 composite sediment samples (SED-05)
- Deployment of 2 passive samplers in groundwater monitoring wells (PED-09 and PED-10)
- Deployment of 1 passive sediment sampler (PED-01)
- Collection of 4 porewater samples (PW1-1 through PW1-4)

DEVIATIONS FROM WORKPLAN:

- None. Collection of sediment samples and porewater samples is in line with the specifications of the work plan. Deployment of passive samplers is in accordance with a pre-approved deviation from the work plan.

SAFETY GOOD CATCHES:

- J. Sacker identified that the potential exists for eye injury from brush in the areas south of the South Plantation. The team reaffirmed the requirement for protective eyewear during work.

FIELD ACTIVITY CHRONOLOGY

0730 Battelle on site, prepared sampling equipment, calibrated water quality meter and PID.

0820 Held tailgate safety meeting, discussed slips/trips/falls with muddy marsh and stream.

0906 Deployed groundwater PED-09, PED number 20170821AS-012, in MW1-14, approximately 0.5 ft above the bottom of the well.

0959 Deployed groundwater PED-10, PED number 20170821AS-011, in MW1-2. MW1-2 is a monitoring well with a 4” casing and total depth of approximately 21 ft BTOC. The PED was deployed 0.5 ft above the bottom of the well.

1010 Left site to pick up water quality meter; J. Sacker remained to fill out COCs and pack up samples.

1055 Returned to site.

1153 Set up at PW1-01 and began purging. Significant amount of air in line. The location was allowed to purge to fill the water quality meter (WQM) sonde and clear.

1210 Collected PW1-01-170907.

1313 Collected SED-05-10-170907 coincident with TF-21 by compositing 3 samples in a close, 5 ft circle around the waypoint.

1316 Deployed sediment PED-01, PED number 20170821AS-005, coincident with SED-05.

1344 Collected Equipment Blank EB-170907-01 using DI water rinsed from the stainless-steel bowl used for sediment sampling.

1345 Broke for lunch.

1415 Returned to site.

1505 On location intended for “PWS-13.” Location and surrounding area is dry to 1.5 ft bgs.

1515 Set up on PW1-02 and began purge. Much higher flow compared to PW1-01. Allowed to purge to fill sonde WQM.

1525 Collected PW1-02-170907.

1618 Set up on PW1-03 and began purge. Allowed to purge to fill sonde WQM.

1626 Collected PW1-03.

1653 Set up on PW1-04 and began purge, but it ran dry. Moved 2 ft east, but that ran dry as well. Moved an additional 1 ft east. Likely silty water causing the blockage in pumping.

1715 Collected PW1-04, nearly ran dry during sampling.

Packed up and decontaminated equipment. Performed post-calibrations. Secured site.

1830 All offsite.

SUMMARY OF FINDINGS/CONCLUSIONS

Composite sediment samples and porewater samples were collected and passive sampling devices were deployed today to assess potential migration pathways of contamination south and west toward the marsh creek and tide flats.

PLANS FOR THE FOLLOWING DAY:

Be on site at approximately 07:30. Proceed with collecting porewater samples; target 4 porewater samples.

ATTACHMENTS:

None

Copies to: Michael Meyer, Damon DeYoung	**Battelle - DAILY FIELD REPORT** Signed: ____________________________

BATTELLE

It can be done

DAILY FIELD REPORT 09 / 08 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)

Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II

Location: Naval Base Kitsap Keyport, WA OU1

Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle

Weather: Cloudy with occasional rain, high 68F, winds SSE 5mph

To: Carlotta Cellucci

From: Samuel Moore

DAILY FIELD REPORT

PERSONNEL ON SITE:

Samuel Moore, Joshua Sacker (Battelle)

SUMMARY OF WORK COMPLETED:

- Collection of 6 porewater samples (PW1-05 through PW1-10)
- Demobilization from site

DEVIATIONS FROM WORKPLAN:

- Porewater sample locations were moved from planned waypoints (<10 ft horizontally) due to access issues and to guarantee production of porewater. Three porewater sample locations south of the South Plantation were abandoned because they (and the surrounding area) were dry. One additional location south of the South Plantation was abandoned because the waypoint was situated immediately within the root structure of a thick section of woody undergrowth. Water quality parameters were not collected from porewater samples due to the low production rates of porewater at these locations.

SAFETY GOOD CATCHES:

- S. Moore identified that hauling equipment through the brush was physically taxing and presented a heat exhaustion risk while wearing chest waders. Rest breaks were allotted between sampling locations.

FIELD ACTIVITY CHRONOLOGY

0730 Battelle on site, prepared sampling equipment, calibrated water quality meter and PID.

0815 Held tailgate safety meeting, discussed safety hazards associated with navigating the muddy marsh and stream.

0902 Set up on location PW1-05, northernmost location west of the Central Lot. Location was moved eastward due to access issues. Purged to clear the silty porewater prior to collecting PW1-05-17-0908. Moved southward along transect to collect the remaining samples.

0926 Set up on location PW1-06, west of the Central Lot. Location was moved eastward due to access issues. Purged to clear silty porewater prior to collecting PW1-06-170908.

0947 Set up on location PW1-07, west of the Central Lot adjacent to Marsh Pond. Location was moved westward due to access issues. First attempt did not produce porewater (likely due to silt). Second attempt produced porewater. Purged to clear silty porewater prior to collecting PW1-07-170908, but sample is still somewhat turbid.

1005 Set up on location PW1-08, west of the Central Lot adjacent to Marsh Pond. Location was moved westward due to access issues. Purged to clear silty porewater prior to collecting PW1-08-170908. Slower flow was observed at this station (likely due to silt).

1032 Set up on location PW1-09, the southernmost location west of the Central Lot, set slightly back from Marsh Pond. Location was moved east and north due to access issues. Purged to clear silty porewater prior to collecting PW1-09-170908. Location could not be recorded in the GPS unit due to connectivity issues in the brush.

1125 Mobilized to area south of South Plantation. Attempted sample at southernmost porewater location; no porewater was available. Footing appeared solid, dry, and heavily vegetated as compared to the water-producing areas on the east side of the area south of the South Plantation. Moving northward, no porewater was available at the west central porewater waypoint either. Another waypoint, centrally located within the porewater sampling area south of the South Plantation, was inaccessible being in an area of thick woody undergrowth and appeared to be dry as well.

1148 Set up on location PW1-10, the northwesternmost location south of the South Plantation. Purged to clear silty porewater prior to collecting PW1-10-170908.

1212 Collected EB-170908-01 from the stainless-steel porewater sampler.

1216 Collected SB-170908-01. Performed post-calibrations. Packed samples and equipment for shipment. Cleaned and secured site for demobilization.

1330 J. Sacker left site to ship samples.

1430 All off site.

SUMMARY OF FINDINGS/CONCLUSIONS

Porewater samples were collected today to assess potential migration pathways of contamination south and west toward the marsh creek and tide flats. Numerous sample locations were dry due to little rainfall recently.

PLANS FOR THE FOLLOWING DAY:

None. Today concludes the work intended for this mobilization.

ATTACHMENTS:

None

Copies to: Michael Meyer, Damon DeYoung	**Battelle - DAILY FIELD REPORT** Signed: ___________________________

DAILY FIELD REPORT 10 / 02 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: Sunny, high 65F, winds E 8mph	
To: Carlotta Cellucci	
From: Josh Sacker	

- PERSONNEL ON SITE:

Joshua Sacker, Michael Meyer (Battelle)
Carlotta Cellucci (NAVFAC NW)
Abe Causland, Austin Cuder (Holt Services, Inc.)

SUMMARY OF WORK COMPLETED:

- Obtained Base Passes
- Held pre-construction meeting
- Discussed rationale for some adjustments to sampling depths
- Marked out remaining boring locations with paint (paved surfaces) or stakes
- Performed site reconnaissance of all drilling locations and access routes
- Off-loaded and staged drilling supplies and equipment
- Mobilized to first drilling location (MW1-51)
- Drilled, collected soil samples, and installed monitoring well MW1-51 in South Plantation Area.

DEVIATIONS FROM WORKPLAN:

- No deviations to work plan occurred during field work to install MW1-51. Some minor adjustments to the “Working Summary of Proposed Wells” table were made to ensure representative samples would be collected of the various stratigraphic layers of interest.

SAFETY GOOD CATCHES:

M. Meyer identified that the potential exists for slips/trips/falls due to housekeeping practices close to the drilling rig. The team decided on making periodic informal “field checks” approximately every 30 mins to check on the housekeeping around the drilling sites.

FIELD ACTIVITY CHRONOLOGY

0715	Battelle arrives at Base Pass Office to extend DBIDS.
0755	Josh Sacker’s DBIDS Pass extended to Nov 10, 2017.
0815	Holt Services drilling crew arrives at Bass Pass Office.
0830	Josh Sacker confirms that passive sampler appears to be in place at the tidal flat location.
0840	Base Passes issued to Holt Service crew of Abe Causland and Austin Cuda.

0850 Drill crew and Josh Sacker arrive at staging area. Michael Meyer and Carlotta Cellucci already onsite, marking out boring locations in Central Landfill, in vicinity of motorcycle training range.

0900 Preconstruction meeting with Holt Services, Battelle, and NAVFAC to discuss scope of work, logistics, scheduling conflicts, contamination levels, groundwater flow direction, and underground utilities.

0915 Base facilities personnel arrived to install backflow preventer on closest fire water hydrant for crew to use to fill up water tanks.

0930 Walked each drilling location in Central Landfill, discussed logistics and order of wells, BMPs to protect storm drain catch basins, and which wells would receive the non-skid well covers (MW1-42, -45, -46, and -47).

1000 Unloading supplies, organizing equipment and materials in shed, and driller staging equipment near Conex Boxes in Central Landfill area.

1030 Some additional discussions with C. Cellucci and M. Meyers regarding soil sampling rationale and changes to sampling depths. Carlotta indicated she would provide a revised Working Summary of Proposed Wells" table to reflect these changes.

1040 Walked well locations with C. Cellucci and M. Meyers in South Plantation. M. Meyers setting stakes at some locations. C. Cellucci indicated that MW1-55 should be moved close to storm drain outlet next to SP-B64 if possible, which would represent a drop in ground elevation of approximately 3 feet. Discussed logistics of access to South Plantation wells, including cutting fence between marsh and South Plantation, if necessary.

1100 Driller took early lunch break. J. Sacker finishing staging supplies and equipment in shed, and getting supplies needed for drilling, and took lunch break.

1145 Driller back from lunch break.

1150 J. Sacker Calibrated PID.

1155 M. Meyers arrived with small freezer needed to preserve TerraCore samples. J. Sacker and M. Meyers set up freezer in shed and turned on unit.

1215 Maneuvering drill rig to MW1-51 in South Plantation.

1230 Getting all equipment set up for drilling. Plastic sheeting placed under rig as precaution for any leaks. Observed decontamination of Dames and Moore type split spoon samplers using Alconox and water and water rinse.

1330 Attempted to hand dig to clear underground utilities, which was very difficult due to the presence of many tree roots. Hand digging met with refusal at approximately 1 foot.

1355 Hollow Stem Auger (HSA) drilling started. PID monitoring readings taken during drilling.

1429 Split spoon sampler used to collect soil sample, and TerraCore kit used to collect soil samples for VOC analyses from split spoon sampler.

1505 Started installing well MW1-51. Heaving sands encountered, and added 12-15 gallons of potable water to control heaving.

1515 Carlotta returned to work site and delivered revised "Working Summary of Proposed Wells" table.

1550 Well screen and sand installed.

1620 Bentonite well seal installed and complete.

1630 Begin site cleanup. Left augers wrapped up in plastic sheeting to decontaminate next day, when Bobcat loader arrives and can move augers around site more easily.

1700 Driller left site.

1705 J. Sacker placed sample VOAs in freezer.

1725 J. Sacker leaves site.

SUMMARY OF FINDINGS

Soil sample for VOC analysis collected from 13.5 feet bgs in MW1-51. Sample material described as silty clay. PID reading in head space sample was 3.2 ppm.

PLANS FOR THE FOLLOWING DAY:

Driller to start at 0730 by decontaminating auger flights. Will move to MW1-52 to collect soil samples and install monitoring well. This location will require collecting samples for both physical and chemical testing. Following this location, will plan to drill at MW1-50, with goal of getting two wells sampled and installed.

ATTACHMENTS:

None

Copies to: Michael Meyer	**Battelle - DAILY FIELD REPORT** Signed: Josh Sacker

DAILY FIELD REPORT 10 / 03 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: Sunny, high 65F, winds E 8mph	
To: Carlotta Cellucci	
From: Josh Sacker	

- PERSONNEL ON SITE:

Joshua Sacker (Battelle)
Abe Causland, Austin Cuder (Holt Services, Inc.)

SUMMARY OF WORK COMPLETED:

- Confirmed location and sampling methodology for collecting ESTCP soil sample
- Confirmed rationale behind sampling depths on the revised “Working Summary of Proposed Wells” table.
- Driller delivered and off-loaded Bobcat loader to assist with drilling operations
- Mobilized to a second drilling location (MW1-52), for soil sampling (chemical, physical, and ESTCP)
- Drilled, collected soil samples, and installed monitoring well MW1-52 in South Plantation Area
- Evaluated options for avoiding problems with heaving sand condition that was encountered in first two wells
- Driller evaluated access to well locations in south of South Plantation
- Identified horizontal steel bar at top of fence (top bar) where gap already exists in wire mesh. Will require cutting steel bar to allow rig clearance through gap in wire mesh (chain link)
- Set up rig at MW1-50 to avoid access complications for rig tomorrow, including decontaminated auger flights

ROM WORKPLAN:

- No deviations to work plan occurred during field work to install MW1-52.

SAFETY GOOD CATCHES:

J. Sacker identified the need for driller to avoid injury by being properly prepared to cut the steel bar at the top of the fencing, including a proper cutting tool and PPE (eye protection and gloves) during cutting of horizontal steel bar at top of fence.

FIELD ACTIVITY CHRONOLOGY

0720	Battelle (Josh Sacker) arrives on site.
0725	J. Sacker assembling sample equipment needed at MW1-52.
0730	Calibrated PID.
0739	Confirmed with M. Meyer and lab about which sample containers would be frozen vs. kept cold in ice chest (only VOAs with stir tabs require freezer storage)

0740 J. Sacker notified M. Meyer that driller was running late due to difficulties with loading Bobcat.

0747 M. Meyers relayed information from Carlotta Cellucci that ESTCP sample should be collected at MW1-52.

0752 M. Meyers explained the steps to be followed in collecting the ESTCP soil sample.

0830 Holt Services crew arrives on site with a trailer used to transport the Bobcat.

0900 Health and Safety Tailgate Safety Meeting conducted

0920 Driller moving auger flights to decon trailer.

0930 Startup of rig staged overnight at MW1-51, being moved to MW1-52, and assembling supplies needed to drill and install well MW1-52.

0930 Assembling supplies for ESTCP sampling.

0945 Drill rig moved onto MW1-52.

1030 Driller supplied Battelle with plastic containers and plastic caps for storage of sample sleeves being shipped to PTS labs.

1055 Confirmed with PTS labs that these plastic containers are acceptable for holding sample sleeves.

1130 Started drilling at MW1-52.

1218 Collected Sample No: SP-B52-S-12-171003:

- Two 6 inch sleeves collected for Geotech lab.
- Bulk sample collected from drilling cuttings at approximately 13 feet for analysis by Geotech lab – one 1-gallon zip lock, partially filled will be submitted to the lab.
- Six, 1-gallon, partially filled ziplock bags collected for ESTCP program (to make up 9 liter requirement)
- Elevated PID (at 65.5 ppm) in head space sample collected at approximately 13 feet bgs.

1240 Encountered heaving sands, making it difficult to reach planned TD.

1330 After adding some water as pressure head, able to clear out hole, and advance auger to 17 feet.

1330 Started installing well with 2-inch PVC screen (0.01 inch slotted, 10 foot screen)

1415 Completed well installation, as originally planned. Discussed options with D. Smith of Holt Services for minimizing effects of heaving sands on future wells.

1430 Started to demobilize from MW1-52.

1445 Started to look for best location to install next well and set up drill rig.

1500 Noticed that where there is a gap in the fencing at south end of South Plantation, there is also a horizontal bar at an approximate height of 8 feet, which is less than the 10 feet of vertical clearance need by the tracked drill rig on-site.

1505 M. Meyer provided clarification that drilling crew should cut the top bar to allow drill rig to access well locations bordering the marsh.

1510 Due to time constraints of starting a 2nd well location so late in the day, crew was not able to install 2nd well, and driller's opinion is that it would be risky to leave augers in place overnight, given heaving and the potential for the augers to get stuck.

1545 Drill rig moved to MW1-50 in South Plantation, and set up for drilling is completed, so that work can begin quickly tomorrow to start installing the next well.

1600 Decontaminated auger flights, so ready for use first thing tomorrow morning.

1605 Cleaned up drilling site at MW1-52.

1615 Labeled drums, photo documented information on drum labels.

1630 Moved sampling equipment back to shed. Charging PID.

1640 Driller off site.

1655 Confirmed that VOAs are being stored correctly: Stir tab VOAs are being stored in freezer; bulk sample in ziplocks, and methanol preserved VOAs, and 4 oz jars for geotechnical moisture content being stored on ice (cold, but not frozen).

1725 J. Sacker off site.

SUMMARY OF FINDINGS

Soil sample collected for analysis of VOCs, physical geotechnical samples, and ESTCP samples from depths between approximately 11 to 14.5 feet bgs, in two split spoon samplers (end to end) that were lined with 6-inch stainless steel sleeves. Due to poor recovery in sleeves, it was necessary to collect soil cuttings from approximately 13 feet for bulk sample analysis. Sample material obtained (partial recovery) described as poorly sorted sand interbedded with clay and some silt. An elevated PID reading of 65.5 ppm was detected in the head space sample collected at approximately 13 feet bgs.

PLANS FOR THE FOLLOWING DAY:

The drill rig crew will not arrive at the site until around 9:30 am tomorrow due to a driver license renewal issue. J. Sacker to arrive at site at approximately 8 am to prepare for drilling. Will then resume drilling at MW1-50. This location will require collecting samples for both physical and chemical testing. Following MW1-50, will plan to drill either MW1-49 or MW1-54, south of South Plantation.

ATTACHMENTS:

None

Copies to: Michael Meyer	**Battelle - DAILY FIELD REPORT** Signed: Josh Sacker

DAILY FIELD REPORT

10 / 04 / 2017

Contract No.
N39430-16-D-1802, CTO 010

Reference
Sampling and Analysis Plan (Battelle 2017)
Accident Prevention Plan (Battelle 2017)

Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II

Location: Naval Base Kitsap Keyport, WA OU1

Client: Naval Facilities Engineering Command Northwest

Contractor: Battelle

Weather: Sunny, high 65F, winds E 8mph

To: Carlotta Cellucci

From: Josh Sacker

- PERSONNEL ON SITE:

Joshua Sacker (Battelle)
Abe Causland, Austin Cuda (Holt Services, Inc.)

SUMMARY OF WORK COMPLETED:

- Replaced ice in sample coolers.
- Conducted health and safety tailgate safety meeting with drillers.
- Drilled, collected soil samples, and installed monitoring well MW-50 in South Plantation Area.
- Cut off top steel support bar using a Sawzall at gap in chain link fence mesh, to allow drill rig access south of fence.
- Labeled all three IDW drums filled with soil cutting from MW-50, 51, and -52.
- Measured water levels in the three new wells (measured pre-development).
- Worked with Holt Services PM (Dale Smith) to schedule well development crew and well head installation work.
- In late afternoon, driller mobilized rig to MW1-44 in motorcycle training range, with augers decontaminated and staged at well location - all set up to drill at MW1-44 first thing in morning.
- Filled out chain of custody forms in advance of sample pick up tomorrow, including COCs for Test America and COC for ESTCP sample.

ROM WORKPLAN:

- No deviations to work plan occurred during field work to install MW-50.

SAFETY GOOD CATCHES:

Abe Causland, drill rig operator, noted that numerous cobbles and chucks of asphalts on ground surface of South Plantation represent a tripping hazard, and suggested we attempt to clear rocks and asphalt from the immediate area around rig.

FIELD ACTIVITY CHRONOLOGY

0820 Battelle (Josh Sacker) arrives on site.
0830 Started calibrating PID
0900 Changed ice in cooler – small sample freezer also used to regenerate ice for coolers.
0915 Assembled a few TerraCore kits from bottles in shed.

0920	Confirmed that additional lab containers are waiting for pickup by Battelle at the Oxford Suites.
0930	Drill crew on site (driller delayed due to appointment at DMV to renew his drivers' license.
0945	Tailgate Health and Safety Meeting conducted.
1000	Moving gear to start drilling at MW-50.
1045	Started drilling at MW-50.
1130	Minimal heaving sands encountered
1140	Soil Samples were collected for physical (geotechnical) and chemical testing, per planning documents.
1155	Driller cleared out cuttings from boreholes, added approximately 20 gallons of water to minimize heaving, and installed well casing to 15 feet, with 10 feet of 0.01 slotted PVC screen installed from 5 to 15 feet and blank to grade, plus stickup of approximately 37 inches.
1245	Well installation completed.
1300	Driller leaves for Home Depot, and to take lunch break.
1405	Driller returns to site with Sawzall to cut top steel bar at gap in chain link fence mesh.
1410	Discussion with driller on ways of maximizing production and safely cut steel bar.
1445	Drill rig operator able to reach up and cut steel bar with Sawzall without need for ladder.
1500	Battelle agreed to allow driller to set up on one of wells in Motorcycle training area and be ready to get an early start on these wells rather than attempting to mobilize, then drill, sample, and install MW-49 before sundown. This allows for drilling to start promptly tomorrow morning, and allows rig to maximum time spent drilling on the motorcycle training range.
1515	Labeled remaining IDW drums.
1545	Measured water levels in all three new wells, ranging between 5.8 and 6.1 feet bgs (accounting for stickup), which is prior to well development.
1630	At shed, organizing samples, changing ice, preparing equipment for tomorrow.
1700	Filled out chain of custody forms.
1715	Driller left site.
1800	Josh Sacker leaves site.

SUMMARY OF FINDINGS

Soil sample collected in split spoon samples for analysis of VOCs and physical geotechnical samples from depths between approximately 8.5 and 12 feet, which is designated as the 9-foot sample. PID reading of 365 ppm observed in head space reading.

PLANS FOR THE FOLLOWING DAY:

Will start drilling at MW1-44 at western edge of Central Landfill. All set up to begin drilling early tomorrow and maximize use of access available tomorrow. Will have six wells to complete within motorcycle training area on Oct 5th, 6th, 7th, and 9th.

ATTACHMENTS:

None

Copies to: Michael Meyer	**Battelle - DAILY FIELD REPORT** Signed: ___________________________

DAILY FIELD REPORT 10 / 05 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: Sunny, high 65F, winds E 8mph	
To: Carlotta Cellucci	
From: Josh Sacker	

- PERSONNEL ON SITE:

Joshua Sacker, Michael Meyer, Samuel Moore (Battelle)
Carlotta Cellucci (NAVFAC NW)
Abe Causland, Austin Cuda (Holt Services, Inc.)

SUMMARY OF WORK COMPLETED:

- Organized gear for drilling, calibrated PID, replenished ice.
- Conducted health and safety tailgate safety meeting with drillers.
- Drilled, collected soil samples, and installed monitoring wells MW1-44 and MW145 in Central Landfill.
- Mobilized drill rig to MW1-42 to start following morning (Friday, 10/6).
- Confirmed with Holt Services that well development would start tomorrow, and that two Holt Services personnel were scheduled to start on Monday with air knife rig to complete the six flush mounted well heads in the motorcycle training range.
- Labeled two IDW drums filled with soil cutting from MW1-44 and MW1-45.
- Added VOCs samples to COCs in advance of courier pickup, and completed ESTCP chain of custody. Battelle relinquished soil samples to test America courier and shipped ESTCP soils samples via UPS (also see Section below for details regarding shipment of Passive Polyethylene Sampling Devices or “PEDs”).
- Battelle retrieved the PEDs from the tidal flat, Marsh Creek, and select wells and piezometers.

DEVIATION FROM WORKPLAN:

- No deviations to work plan occurred during field work.

SAFETY GOOD CATCHES:

Josh Sacker noted that most sample barrels were being opened without the use of the tripod designed for this purpose, and requested that the tripod be set up and made available for this purpose.

WELL DRILLING FIELD ACTIVITY CHRONOLOGY

0715	Battelle (Josh Sacker) arrived on site.
0720	Got field equipment and supplies ready for drilling.
0735	Calibrated PID after initial readings indicated instrument was outside of calibration.
0800	Drill crew arrived on site.
0815	Health and Safety meeting conducted.

0825 Driller finished coring through asphalt at MW1-45 in Central Landfill.

0850 Michael Meyer arrived.

0900 Samuel Moore arrived.

0905 Discussed status of coolers and samples ready for shipment today with Michael and Samuel.

0920 Soil sample collected (CL-B74-S-18.5-171005). This sample collected at 0920 at 18.5 feet bgs.

0930 Proceeded with well installation at MW1-45, with wells screen installed between 15 and 25 feet bgs. After collecting sample, approximately 15 to 20 gallons of water was added to the annulus of the augers to control heaving sands while installing the well.

1025 Well installation nearly complete, with only a little cleanup of drilling location remaining.

1050 Starting moving rig and equipment to location of MW1-44. Large area under the rig covered with plastic sheeting, which extended to cover the storm drain catch basin near MW1-44. Set up rig at MW1-44.

1125 Driller cored through asphalt pavement with drill rig.

1145 Driller left for lunch.

1205 Carlotta Cellucci on site, and clarified sampling approach at MW1-44. C. Cellucci indicated that MW1-44 should be drilled to 28 feet bgs, with well screen installed 18-28 feet bgs and soil sample collected between 25 and 27 feet bgs.

1250 Drillers returned from lunch.

1300 Started drilling at MW1-44.

1311 Cleared soil cutting from up inside annulus of hollow stem augers.

1325 C. Cellucci on site at drilling location and Battelle confirmed that all the flush mounted well heads in the motorcycle training area would be installed by COB Monday, 10/9/17.

1330 Cellucci also discussed the details of soil sampling and well installation for MW1-56 an MW1-58 from the "Working Summary of Proposed Well". C. Cellucci indicated she would review the details for MW1-56 and MW-58 and see if any minor adjustments were needed.

1400 Collected soil sample in MW1-44 between 26 and 27.5 feet bgs (CL-B75-S-26-171003). Added about 15 to 20 gallons of water after collecting sample to control heaving sands while installing the well. Well screen installed from 18-28 feet bgs.

1500 Drillers completed installation at MW1-44. Drillers proceeding with cleanup at drilling location MW1-44. Battelle directed drillers to move rig to MW1-42 and skip MW1-43 for now. Would return to drill MW1-43 after MW1-42, but MW1-42 is higher priority because it requires a non-skid well cover.

1540 Drill rig moved to MW1-42. Plastic sheeting placed under the drill rig.

1600 Drill crew loading supplies and equipment into their stake bed support truck.

1630 Augers placed in decontamination trailer for cleaning.

1635 Drillers left site.

1645 Josh Sacker left site.

CHRONOLOGY OF RETREIVAL OF PASSIVE POLYETHYLENE SAMPLING DEVICES

1157 Retrieved sediment PED-01, located in the marsh flats coincident with SED-05. PED was in good condition, but several inches were exposed to air at low tide. Wrapped the entire apparatus in solvent-rinsed foil for shipment.

1215 Retrieved sediment PED-06, located upstream from SED-05. Half of the PED (most of what would be exposed to air at low tide) was missing. Wrapped the entire apparatus in solvent-rinsed foil for shipment.

1225 Retrieved sediment PED-05, located in the stream coincident with SED-04. Some thin tears were visible, and a number of mussels had to be removed. None was exposed to air at low tide. Wrapped the entire apparatus in solvent-rinsed foil for shipment.

1230 Retrieved sediment PED-04, located in the stream coincident with SED-03. Missing nearly half of the PED, although none of the PED was air exposed at low tide. Wrapped the entire apparatus in solvent-rinsed foil for shipment.

1237 Retrieved sediment PED-03, located in the stream coincident with SED-02. Missing half of the PED (the entirety of the air-exposed and water-exposed segments at low tide) and the bottom section was stretched upon removal from the sediment. Wrapped the entire apparatus in solvent-rinsed foil for shipment.

1243 Retrieved sediment PED-02, located in the stream coincident with SED-01. Missing half of the water-exposed segment at low tide. Wrapped the entire apparatus in solvent-rinsed foil for shipment.

1350 Retrieved porewater PED-07 from piezometer P1-1. For the piezometer PED samples, three pieces of low-density polyethylene (5 x 40 cm each) were wrapped around a stainless-steel mesh frame in a spiral fashion and secured with small nylon cable ties. Once retrieved from the piezometer, the PEDs were found to be in good condition, and the three pieces were wrapped together in solvent-rinsed foil for shipment.

1400 Retrieved porewater PED-08 from piezometer P1-2. Removed the PEDs, which were all in good condition, and wrapped them together in solvent-rinsed foil for shipment.

1406 Retrieved groundwater PED-09 from monitoring well MW1-14. For the well PED samples, three pieces of the low density polyethene were wrapped around a stainless-steel frame in a lengthwise fashion and secured with several rubber bands. Once retrieved from the well, the PEDs were found to be in good condition, and wrapped them together in solvent-rinsed foil for shipment.

1414 Retrieved groundwater PED-10 from monitoring well MW1-2. Removed the PEDs, which were all in good condition, and wrapped them together in solvent-rinsed foil for shipment.

1500 Packaged samples for shipment to the Battelle Norwell laboratory. The sample cooler was shipped via FedEx tracking # 770352143739.

SUMMARY OF FINDINGS

Soil samples were collected from wells MW1-44 and MW1-45 in split spoon samples for analysis of VOC. No physical samples were proposed for MW1-44 and MW1-45. The PID reading in the head space sample from MW1-44 at 26 feet was 30.2 ppm and the PID reading in the head space sample from MW1-45 at 18.5 feet was 4.2 ppm.

PLANS FOR THE FOLLOWING DAY:

Will start drilling at MW1-42, which will require a non-skid flush-mounted cover. Drilling will probably switch back to MW1-43 (after MW1-42) which does not require non-skid flush mounted cover. Both of these locations are at the western edge of Central Landfill. Following installation of MW1-44 and MW1-55, there are four more wells to complete within the motorcycle training area on Oct 6th, 7th, and 9th.

ATTACHMENTS:

None

Copies to: Michael Meyer	**Battelle - DAILY FIELD REPORT** Signed: Josh Sacken

DAILY FIELD REPORT 10 / 06 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: Sunny, high 65F, winds, westerly with gusts up to 20 mph	
To: Carlotta Cellucci	
From: Josh Sacker	

- PERSONNEL ON SITE:

Joshua Sacker, Samuel Moore (Battelle)
Abe Causland, Austin Cuda, and Lukas Louwien (Holt Services, Inc.)

SUMMARY OF WORK COMPLETED:

- Organized gear for drilling, calibrated PID, replenished ice.
- Conducted health and safety tailgate safety meeting with drillers, including one person scheduled for well development.
- Drilled, collected soil samples, and installed monitoring wells at MW1-42 and MW1-43 in Central Landfill.
- Due to Pass and ID Office being closed on Columbus Day, had to rearrange the work scheduled for Monday to ensure that all the flush mounted well heads in the motorcycle training area are completed on Monday. Holt Services will only have a 3-man crew on site on Monday and the priority will be finishing the well heads on Monday (at the expense of drilling or well development).
- Labeled IDW drums filled with soil cuttings from MW1-42 and MW1-43.
- Mobilized drill rig to MW1-46 to start following morning (Saturday, 10/7).
- Driller moved six drums into the east end of temporary “pop-up” shelter located just south of the motorcycle training area.
- Covered driller materials and equipment with plastic due to forecast rainfall overnight.

DEVIATION FROM WORKPLAN:

- No deviations to work plan occurred during field work.

SAFETY OBSERVATIONS / GOOD CATCHES:

Driller cautioned about using pipe wrenches in combination with the torque of the drill stem to uncouple drilling rods. Ensure pipe wrenches are inspected for metal fatigue; and use the right tool for the job.

WELL DRILLING FIELD ACTIVITY CHRONOLOGY

0720 Battelle (Josh Sacker) arrived on site.
0730 Got field equipment and supplies ready for drilling.
0805 Calibrated PID after initial readings indicated instrument was outside of calibration.
0815 Drill crew arrived on site – they stopped at Pass and ID office to get Lukas his badge. Discussed plan for today for drill rig being to start at MW1-42, and move to MW1-43, and that tomorrow we would start on

either MW1-46 or MW1-47, and complete at least one of these wells on Saturday, and possibly both depending on difficulty in installing these somewhat deeper wells in the immediate vicinity of the hotspots.

0830 Health and Safety meeting conducted with Holt Service personnel.

0845 Sam Moore arrived on-site.

0850 Sam given abbreviated safety briefing.

0857 Called Michael Meyer to confirm plan for today, Saturday, and Monday. Also confirmed the well development approach to removing water added to prevent interference from heaving sands.

0930 Driller cores through asphalt at MW1-42 with specialized bit on auger.

1000 Driller at 10 feet bgs with augers, knocked out plug of soil up inside augers using rods.

1025 Collected soil sample at MW1-42 with 18-inch split spoon from 18-19.5 feet. Terra Core kit used to collect soil sample for analysis of VOCs.

1040 Well installation started.

1055 Approximately 20 gallons of water added to augers to minimize effects of heaving sands.

1130 Well installed at MW1-42 to 25 feet bgs.

1150 Unpreserved VOAs from MW1-42 placed in freezer.

1200 Plastic laid down at MW1-43 to go under rig.

1210 Drillers move rig to MW1-43.

1220 Drillers take lunch.

1300 Sampling equipment moved to MW1-43.

1320 Drillers return from lunch.

1335 Driller working to core asphalt with specialized bit attached to rig.

1340 Redirected sample shipment to PTS to corrected address after it was refused by recipient. Samples will arrive for Saturday delivery.

1345 Cored through asphalt.

1355 Started auger drilling with rig. Lots of wood/fibrous debris encountered. Appears approximately 40% to 50% of the cuttings are wood debris.

1415 Knocked out plug of soil that was inside augers using rods. Heaving sands were not significant in this well, and it was not necessary to add water to prevent heaving.

1450 An 18-inch split-spoon sample was collected from 17.0 to 18.5 feet in MW1-43, and a TerraCore kit used to collect sample for analysis of VOCs.

1500 Started to construct well.

1505 Unpreserved VOAs from MW1-43 placed in freezer in shed.

1540 Well installation to depth of 25 feet bgs almost complete.

1550 Site cleanup at MW1-43 is underway.

1630 Driller (Abe) moved the rig to MW1-46, and set up rig for tomorrow morning. Austin moved six drums from South Plantation to the fabric covered pop-up structure just south of the motorcycle training range.

1640 All soil drums generated during well installation were labeled to connect the cuttings to the boring of origin.

1650 Drillers covered decon trailer with plastic sheeting in anticipation of rain forecast for tomorrow.

1700 Driller off-site.

1700 Josh put away field gear, charging PID, and exchanging ice in cooler for ice in freezer.

1720 Josh left site. Sam put away field gear and secured site.

1740 All off site.

SUMMARY OF WORK COMPLETED FOR WELL COMPLETION:

- Organized and calibrated equipment for well development.
- Conducted health and safety tailgate safety meeting with well developer from Holt Services.
- Developed three wells installed in the South Plantation (MW1-50, MW1-51, and MW1-52) and one well in the Central Landfill (MW1-45). Recorded total well depth, static water level, purging operational parameters, water quality parameters, depth to water, and other field observations during development.

WELL DEVELOPMENT FIELD ACTIVITY CHRONOLOGY

0845 Sam Moore arrived to work with Lukas Louwien (Holt Services, Inc.) on well development.

0850 Health and safety briefing conducted for Sam Moore. Calibrated water quality meter and prepared equipment for well development.

0915 Started to develop the three wells installed in the South Plantation (MW1-50, MW1-51, and MW1-52), and then followed this with one well in the Central Landfill (MW1-45).

0957 Began development of MW1-50. Surged and then purged with a submersible pump at 5.7 Lpm, collecting water quality parameter measurements approximately every 10 minutes (57 L or 15 gallons) until parameter stabilization at 1102, with 370.5 L (98 gallons) extracted. Development of MW1-50 complete with a final turbidity of 8.9 NTU.

1113 Began development of MW1-51. Surged and then purged with a submersible pump at 6.0 Lpm, collecting water quality parameter measurements approximately every 10 minutes (60 L or 16 gallons) until parameter stabilization at 1224, with 420 L (111 gallons) extracted. Development of MW1-51 complete with a final turbidity of 109 NTU. The submersible pump was intentionally agitated near the end of purging, which accounts for the elevated turbidity.

1400 Began development of MW1-52. Surged and then purged with a submersible pump at 2.0 Lpm (gradually decreased from 6 Lpm due to low battery power), collecting water quality parameter measurements approximately every 10 minutes (20 L or 5 gallons) until parameter stabilization at 1515, with 220 L (58 gallons) extracted. Well was nearly purged dry, indicating a low-producing well. Development of MW1-52 complete with a final turbidity of 65.6 NTU. The submersible pump was intentionally agitated throughout purging, which accounts for the elevated turbidity.

1543 Began development of MW1-45. Surged and then purged with a submersible pump at 6.6 Lpm, collecting water quality parameter measurements approximately every 10 minutes (66 L or 17 gallons) until parameter stabilization at 1720, with 627 L (166 gallons) extracted. Development of MW1-45 complete with a final turbidity of 49.6 NTU. The submersible pump was intentionally agitated throughout purging, which accounts for the elevated turbidity.

1720 Returned field equipment to shed and secured site.

1740 All off site.

SUMMARY OF FINDINGS

Soil samples were collected from wells MW1-42 and MW1-43 in split spoon samples for analysis of VOC. No physical samples were proposed for MW1-42 and MW1-43. The PID reading in the head space sample from MW1-42 at 19 feet was 5.6 ppm, and the PID reading in the head space sample from MW1-43 at 18 feet was 22.3 ppm. Water quality parameters for wells MW1-50, -51, -52, and -45 stabilized and clarified with development. MW1-52 was observed to have low production rates.

PLANS FOR THE FOLLOWING DAY:

Will start drilling at MW1-46 tomorrow (Saturday) which will require a non-skid flush-mounted cover. Depending on progress and weather, drilling may continue at MW1-47. If not installed on Saturday, the plan is to install well MW1-47 on Monday morning and complete the well head Monday afternoon, along with all the rest of the well heads within the motorcycle training range. Alternatively, MW1-47 could be installed on Friday, Oct 13th, with the well head installed on the same Friday or on Saturday, Oct 14th.

ATTACHMENTS:

None

Copies to: Michael Meyer, Sam Moore	**Battelle - DAILY FIELD REPORT** Signed: Josh Sacken

DAILY FIELD REPORT

10 / 07 / 2017

Contract No.
N39430-16-D-1802, CTO 010

Reference
Sampling and Analysis Plan (Battelle 2017)
Accident Prevention Plan (Battelle 2017)

Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II

Location: Naval Base Kitsap Keyport, WA OU1

Client: Naval Facilities Engineering Command Northwest

Contractor: Battelle

Weather: Sunny, high 65F, winds, westerly with gusts up to 15 mph

To: Carlotta Cellucci

From: Josh Sacker

-**PERSONNEL ON SITE:**

Joshua Sacker (Battelle)
Abe Causland, Austin Cuda (Holt Services)

SUMMARY OF WORK COMPLETED:

- Organized gear for drilling, calibrated PID, replenished ice.
- Conducted health and safety tailgate safety meeting with drillers.
- Drilled, collected soil samples, and installed monitoring well at MW1-46 in Central Landfill.
- Labeled IDW drums filled with soil cuttings from MW1-46 and decon drums generated from pumping out water from decon trailer.
- Steam cleaner spray wand malfunctioned (blown gasket), and it was not possible to decontaminate the augers after completing MW1-46. As such, drilling had to be suspended after MW1-46.
- Drillers will be prepared with either necessary replacement parts, a new decon unit, or additional clean augers to complete MW1-47.
- Mobilized drill rig to MW1-47 to start drilling on Monday morning.
- Covered driller materials and equipment with plastic sheeting to protect from potential rainfall on Sunday.

DEVIATION FROM WORKPLAN:

- No deviations to work plan occurred during field work.

SAFETY OBSERVATIONS / GOOD CATCHES:

Discussed using caution in handling cuttings with debris, which may obscure sharp edges, and represents a potential for getting cut. Use proper gloves in handling cuttings.

WELL DRILLING FIELD ACTIVITY CHRONOLOGY

0745	Battelle (Josh Sacker) arrived on site. Holt personnel already on site.
0755	Got field equipment and supplies ready for drilling.
0805	Calibrated PID after initial readings indicated instrument was outside of calibration.
0815	Drill crew got set up to drill at MW1-46.
0820	Drill crew started coring through asphalt using specialized drill bit on auger rig.
0830	Conducted tailgate Health and Safety meeting with drilling crew.
0845	Started drilling with augers at MW1-46.

0935 At a drilled depth of 25 feet bgs, knocked out soil plug that was up inside auger annulus with rods so that soil sample could be collected.

1010 Drillers sampled with 18-inch split spoon sampler between 27- 28.5 feet bgs, followed immediately by driving 24-inch split spoon sampler between 28.5 and 30.5 feet bgs. VOCs collected with TerraCore Kit in middle sleeve of 18-inch sampler, and also collected duplicate for VOCs in this sleeve. Collected bottom sleeve (somewhat disturbed) in 18-inch sampler as bulk geotechnical sample sleeve. Used bottom two sleeves of 24-inch sampler as undisturbed sleeves for geotechnical testing, and used the sleeve from 29.0 to 29.5 feet bgs in the 24-inch sampler as the 2nd sleeve for the bulk sample. The primary sample was labeled CLL-B78-S-28.5-171007 and the duplicate was labeled as FD-171007-01.

1030 Drillers started installing well.

1040 Added approximately 20 gallons of water to the augers to minimize heaving sands.

1045 PID reading on head spaced (Ziplock bag) was 26.3 ppm.

1145 Well installation complete at MW1-46, with TD of well at 34 feet bgs, screened from 24 to 34 feet bgs.

1200 VOAs with stir bars moved from iced cooler to freezer.

1215 Spray wand to the steam cleaner malfunctioned due to a blown gasket, and it was not possible to decontaminate the augers, and so drilling was suspended for the day.

1230 Driller begin to clean up the drill site, consolidate drums, and set up rig at MW1-47, which will be drilled Monday morning. Driller (Abe Causland) will operate the rig solo on Monday, and the two other Holt personnel scheduled to be on-site on Monday will start installing well heads upon arrival.

1320 Drillers off site.

1330 Josh Sacker off site.

SUMMARY OF FINDINGS

Soil sample were collected from well MW1-46 in split spoon samples for analysis of VOC and geotechnical (physical) tests. The PID reading in the head space sample from MW1-46 at 28.5 feet was 26.3 ppm.

PLANS FOR THE FOLLOWING DAY:

Will start drilling at MW1-47 on Monday morning. This well will require a non-skid flush-mounted cover, which will be completed on Monday afternoon. The two other Holt personnel scheduled for Monday morning will focus on installing the other five well heads within the motorcycle training range. As a backup option, MW1-47 could be installed on Friday, Oct 13th, with the well head installed on the same Friday or on Saturday, Oct 14th.

ATTACHMENTS:

None

Copies to: Michael Meyer	**Battelle - DAILY FIELD REPORT** Signed: Josh Sacker

DAILY FIELD REPORT 10 / 09 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: Sunny, high 65F, winds, mild easterly winds, up to 10 mph	
To: Carlotta Cellucci	
From: Josh Sacker	

- PERSONNEL ON SITE:

Joshua Sacker, Samuel Moore (Battelle)
Abe Causland, Austin Cuda, and Lukas Louwien (Holt Services, Inc.)

SUMMARY OF WORK COMPLETED:

- Organized gear for drilling, calibrated PID, replenished ice.
- Conducted health and safety tailgate safety meeting with drillers, who were scheduled to focus on completing the well heads in the motorcycling training range.
- Drilled, collected soil samples, and installed monitoring well at MW1-47 in Central Landfill, which was the last of six wells impacting the motorcycle training range.
- Labeled IDW drums filled with soil cutting from MW1-47.
- Mobilized drill rig to MW1-48, outside the motorcycle training area, which will be drilled on Tuesday 10/10).
- Driller moved all remaining 55-gallon drums out of the motorcycle training range, which included purged groundwater from well development, soil cuttings from well installation, and asphalt waste and shallow soil excavated with the air knife during well head installation.
- Many of the drums were moved to the temporary “pop-up” shelter located just south of the motorcycle training area, and the remainder were relocated to the driller’s staging area east of the motorcycle training area.
- Covered driller materials and equipment with plastic due to potential for rainfall.

DEVIATION FROM WORKPLAN:

- No deviations to work plan occurred during field work to install MW1-47 or installation of flush mounted well heads.

SAFETY OBSERVATIONS / GOOD CATCHES:

Caution taken during cutting of metal mesh on chain link fence to avoid small pieces of metal mesh falling from above head height. Ensured personnel had hard hats, gloves and safety glasses before cutting metal mesh with bolt cutters.

WELL DRILLING FIELD ACTIVITY CHRONOLOGY

0720	Battelle (Josh Sacker) arrived on site.
0725	Sam Moore on Site.

0735 Sam calibrated PID.

0740 The Holt Services Drill crew arrived on site. Confirmed that Holt Services would be able to get the steam cleaner on the decon unit working shortly.

0750 Health and Safety Tailgate Meeting. Discussed the “Good Catch” topics from the last few days, including: 1) using pipe wrenches, inspection of tools, using the right tool for the job; 2) use caution with sharp debris coming out of auger holes: and 3) moving cobbles and asphalt debris out of immediate work areas in the South Plantation to avoid tripping hazards.

0810 Austin and Lukas set up the air knife rig at MW1-45, which along with MW1-42, MW1-46, and MW1-47 will require the 18-inch non-skid well head installations.

0825 Sawcut 24-inch square in asphalt for the 18-inch non-skid well boxes.

0830 Got confirmation from Michael that the 24-inch size should be fine.

0840 Set up gear at well MW1-47 for logging and soil sampling.

0915 Abe Causland started drilling with augers at MW1-47.

0935 Concrete placed around 18-inch well box at MW1-45, nearly done with first installation.

1020 Abe from Holt Services knocking out the soil plug from the auger at a depth of nearly 20 feet, which will clear the augers and allow for soil sample collection and well installation.

1030 Sawcut asphalt for the well box installation at MW1-42. Air knife used to clear and excavate holes to a depth of approximately 1.5 feet bgs, which are needed to fit the large 18-inch non-skid well heads.

1045 Set the well box in the excavated hole at MW1-42, then started mixing concrete, and then set the box in concrete.

1100 Collected soil samples for both VOCs and physical tests. First sampled with the 18-inch sampler, which was immediately followed by the 24-inch sampler. Also collected MS/MSD at this location (CL-B79-S-21.5-171009), all labeled with the same sample ID.

1115 Air Knife crew of Austin and Lukas move to MW1-46 to saw cut asphalt and start excavation hole to install well box.

1130 At MW1-47, Abe Causland drilled to total depth of 25 feet to install well. Approximately 20 gallons added to minimize heaving sands.

1205 Abe adding 10/20 Premium sand to annulus of augers.

1230 Seal placed with bentonite chips.

1300 Well installation at MW1-47 is complete to total depth of 25 feet, with a 10-foot well screen (0.01 inch slotted) installed from 15 to 25 feet bgs.

1300 Austin and Lukas finished the well head at MW1-46.

1300 Drillers at lunch.

1345 Josh Sacker leaves site to buy bolt cutters that can be used to cut the wire mesh of the fencing.

1440 Josh Sacker returned to the Site. Austin and Lukas are working on the well head installation at MW1-47.

1500 Driller (Abe) cuts holes in wire mesh to allow drill rig access to wells MW1-54 and -55 (note that there was already a hole in the fence to access location MW1-49).

1530 Austin and Lukas working to complete regular-sized flush mounts at MW1-44 and MW1-43.

1530 Abe moving drums out of the motorcycle training range with the forklift and storing them in the temporary shelter being used as a temporary drum storage area (at Navy’s request).

1600 Rig set up on MW1-48 to be drilled the following morning.

1630 Austin and Lukas picked up the excess concrete mix from around wells, putting away tools and supplies, and packing truck.

1700 Driller’s swept up around well boxes and did minor touch up on wet concrete.

1800 Site clean-up by drillers complete, and the area is ready for motorcycle training.

1810 Drillers left site.

1815 Josh Sacker left site.

WELL DEVELOPMENT FIELD ACTIVITY CHRONOLOGY

0725 Sam Moore arrives on site.

0735 Calibrated PID and water quality meter and prepared equipment for well development.

0750 Health and Safety Tailgate Meeting.

0857 Began development of MW1-44. Surged and then purged with a submersible pump at 5.7 Lpm, collecting water quality parameter measurements approximately every 10 minutes (57 L or 15 gallons). Well repeatedly ran dry. Allowed to recharge to static water level between 0925-0955. Purged until well went dry again, then allowed to recharge to 50% water column, then purged dry again. Repeated until parameter stabilization at 1350, with 644 L (170 gallons) extracted. Development of MW1-44 complete with a final turbidity of 376 NTU. Discontinuous operation of the submersible pump accounts for the elevated turbidity.

1442 Began development of MW1-42. Surged and then purged with a submersible pump at 6.0 Lpm, collecting water quality parameter measurements approximately every 10 minutes (60 L or 16 gallons) until parameter stabilization at 1630, with 600 L (159 gallons) extracted. Development of MW1-42 complete with a final turbidity of 85.6 NTU. Lowest recorded turbidity was 50.2 NTU. The submersible pump was intentionally agitated near the end of purging, which accounts for the elevated turbidity.

1700 Returned field equipment to shed and performed post-calibrations.

1740 Sam Moore left site.

SUMMARY OF FINDINGS

Soil samples were collected from well MW1-47 in split spoon samplers for analysis of VOC and physical samples. The PID reading in the head space sample from MW1-47 at 21.5 feet was 134.2 ppm. Water quality parameters for wells MW1-44 and MW1-42 stabilized and clarified with development. MW1-44 was observed to have low production rates.

PLANS FOR THE FOLLOWING DAY:

Will start drilling at MW1-48 tomorrow (Tuesday) and will continue in the South Plantation at wells MW1-49, MW1-54, or MW1-55.

ATTACHMENTS:

None

Copies to: Michael Meyer, Sam Moore	**Battelle - DAILY FIELD REPORT** Signed: Josh Sacker

DAILY FIELD REPORT 10 / 10 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: Sunny, high 65F, winds, mild easterly winds, up to 10 mph	
To: Carlotta Cellucci	
From: Josh Sacker	

PERSONNEL ON SITE:

Joshua Sacker, Samuel Moore (Battelle)
Abe Causland, Austin Cuda, and Lukas Louwien (Holt Services, Inc.)

SUMMARY OF WORK COMPLETED:

- Organized gear for drilling, calibrated PID, replenished ice.
- Conducted health and safety tailgate safety meeting with drillers.
- Encountered drilling refusal at two locations while attempting to install MW1-48. Relocated drill rig to MW1-49 in South Plantation. Will need to discuss options for relocating MW1-48 with NAV FAC NW.
- Drilled, sampled, and installed well at MW1-49.
- Moved drill rig to start drilling at MW1-54 in morning.
- Well development conducted at MW1-46 and MW1-47.
- Covered driller materials and equipment with plastic due to potential for rainfall.

DEVIATION FROM WORKPLAN:

- No deviations to work plan occurred during field work.

SAFETY OBSERVATIONS / GOOD CATCHES:

Use caution around potentially slippery surfaces due to rainy condition.

WELL DRILLING FIELD ACTIVITY CHRONOLOGY

0730 Battelle (Josh Sacker) arrived on site.
0740 Exchanged ice in coolers.
0810 Health and Safety tailgate meeting held with drillers.
0825 Unpacked fold up rain canopy, and got it ready for use.
0845 Set up soil sampling gear at MW1-48. Drill rig already on top of well location from previous day.
0900 Drill rig starts advancing augers.
0940 Drilled down to a depth of 9 feet and met with refusal. Drove SPT samplers to 10 feet, wood filling sampler, no soil in sampler.
0945 Photo-documented the wood in the sampler.

0950 Called Michael about relocating MW1-48 to NW, consistent with instructions from Carlotta on Oct. 2nd. Moved MW1-48 7 feet to Northwest.

1015 Backfilled original borehole location with bentonite chips and then patched asphalt with colored concrete.

1025 At 2nd location of MW1-48.

1115 Encountered refusal again at 9 feet bgs. Drove SPT sampler, and again sampler came up with all wood in the sample barrel. Talked to Sam Moore and the drilling crew about what our options were at this point.

1125 Called Michael Meyer and following discussion on where to relocate MW1-48 to avoid refusal, decided to wait until we have further input from NAVFAC NW on where to attempt a third location for MW1-48.

1130 The drilling crew backfilled the 2nd attempted location of MW1-48 and then patched the concrete.

1135 Drill rig crew started relocating equipment to MW1-49 in South Planation.

1200 All drilling materials set up at a MW1-49.

1200 Drillers take lunch.

1230 Geologist (Josh Sacker) sets up sampling gear at MW1-49, including a shade canopy/rain shelter.

1300 Driller returns from lunch.

1330 Drillers start to advance augers.

1345 Knocked out soil plug preventing sampler from being driven to the target depth.

1415 Soil sampling on-going with a 2-foot split spoon.

1430 Collected soil samples for VOCs with TerraCore kit. (Sample ID SP-B80-S-7.5-171010).

1445 VOAs with stir bars were placed in freezer, and the VOA with methanol preservative and 4 oz jar for moisture content kept in cooler with ice.

1500 MW1-49 drilled to 15 feet, and added 15 gallons of water to the augers to minimize heaving during well installation. Well installed to depth of 15 feet bgs, with 0.01” screen between 15-5 feet.

1545 Well installation at MW1-49 was completed.

1550 Drillers cleaning up site and moving equipment to MW1-54 in South Plantation.

1620 MW1-54 set up for drilling tomorrow morning.

1630 Drillers returning supplies and equipment to staging area.

1650 Drillers left site.

1700 Josh put away field gear in shed, checked ice in coolers – ice exchange was not necessary due to lack of melted ice.

1710 Josh left site – Sam Moore still on site packing up equipment for shipping – Sam is demobilizing from site.

WELL DEVELOPMENT FIELD ACTIVITY CHRONOLOGY

0830 Sam Moore arrived on site.

0855 Calibrated PID and water quality meter and prepared equipment for well development.

0956 Began development of MW1-47. Surged and then purged with a submersible pump at 6.0 Lpm, collecting water quality parameter measurements approximately every 10 minutes (60 L or 16 gallons). Stood down from 1042 to 1217 for motorcycle training activities. Achieved parameter stabilization at 1307, with 507 L (134 gallons) extracted. Development of MW1-47 complete with a final turbidity of 5.8 NTU.

1442 Began development of MW1-46. Surged and then purged with a submersible pump at 6.0 Lpm, collecting water quality parameter measurements approximately every 10 minutes (60 L or 16 gallons) until parameter stabilization at 1458, with 480 L (127 gallons) extracted. Development of MW1-46 complete with a final turbidity of 37.7 NTU.

1605 Returned field equipment to shed, performed post-calibrations, and secured site.

1735 All off site.

SUMMARY OF FINDINGS

Soil sample was collected for VOCs from well MW1-49 using a split spoon sampler. The PID reading in the head space sample at 7.5 feet bgs was 94.3 ppm. Water quality parameters for wells MW1-46 and MW1-47 stabilized and clarified with development.

PLANS FOR THE FOLLOWING DAY:

Will start drilling at MW1-54 tomorrow (Tuesday) and will continue to MW1-55.

ATTACHMENTS:

None

Copies to: Michael Meyer, Sam Moore	**Battelle - DAILY FIELD REPORT** Signed: ___________________________

BATTELLE
It can be done

DAILY FIELD REPORT 10 / 11 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: Sunny, high 65F, winds, mild easterly winds, up to 10 mph	
To: Carlotta Cellucci	
From: Josh Sacker	

- PERSONNEL ON SITE:

Joshua Sacker, Samuel Moore (Battelle)
Abe Causland, Austin Cuda, and Lukas Louwien (Holt Services, Inc.)
Carlotta Cellucci, NAVFAC NW

SUMMARY OF WORK COMPLETED:

- Organized gear for drilling, calibrated PID, replenished ice.
- Conducted health and safety tailgate safety meeting with drillers.
- Drilled, sampled, and installed wells MW1-54 and MW1-53 at planned sampling and well construction depths.
- Worked with drillers and NAVFAC NW to evaluate options for drilling the two Boundary Wells and for re-drilling MW1-48, which had encountered refusal at 9 feet bgs on two previous attempts.
- Holt Services, Inc. will be mobilizing an air knife to clear the borehole locations of the boundary wells.
- Holt Services, Inc also will mobilize the bigger, blue-colored track mounted rig, which is a more powerful rig than the one currently on site, and also is faster when moving the rig between drilling locations.
- Covered driller materials and equipment with plastic due to potential for rainfall.

DEVIATION FROM WORKPLAN:

- No deviations to work plan occurred during field work.

SAFETY OBSERVATIONS / GOOD CATCHES:

Don raingear as soon as rainfall begins to avoid becoming wet and cold, which is both a safety and productivity issue.

WELL DRILLING FIELD ACTIVITY CHRONOLOGY

0735	Battelle (Josh Sacker) arrives on site, drillers already on site.
0740	Exchanged ice in coolers for ice in freezer and calibrated PID.
0825	Met with driller and discussed strategy of what order to drill wells to maximum resources.
0830	Confirmed with Michael Meyer that, following installing well MW1-54, we would move to well MW1-53.
0849	Held health and safety meeting with drilling crew.
0900	Drove over to Boundary Wells with driller, so that he could become familiar with those two locations. Austin and Lukas remained on the rig at MW1-54 while Abe was looking at Boundary Wells.

0907 Contacted Dale Smith at Holt Services to discuss plan for tomorrow, and Dale concurred with providing the bigger blue rig and the air knife tomorrow.

0915 Told Abe to collect soil sample at two depths (34- 35.5; and 37-38.5), per discussions with Michael to collect a shallower sample in case the deeper one is compromised by the Lawton Clay.

9035 Performed air monitoring in accordance with APP/HHSP, in breathing zone, in cuttings, and at borehole.

0945 Austin installed stickup protective steel casing and surrounding bollards at MW1-49.

0958 Again performed air monitoring.

01020 Collected sample SP-B81-S-35.5-171011 (shallower sample agreed upon in case of poor recovery in deeper sample). PID in head space (zipock). PID at 35.5 feet bgs at 0.6 ppm.

1115 Able to collect deeper sample in MW1-54 (SP-B81-S-38.5-1710110)

1130 Started installing well MW1-54 to 39 feet bgs, with the screen between 29 to 39 feet bgs. Had to add approximately 50 gallons of water to prevent heaving during well installation.

1210 Well MW1-54 installed.

1215 Driller takes lunch.

1245 Carlotta Cellucci on site to provide input on the drilling locations at the boundary wells, and to evaluate where to attempt another location for MW-48. Performed reconnaissance of these well locations. Moved the southern Boundary Well about 100 feet further based on the map features. Also estimated the elevation gain between the northern and southern Boundary Wells, with the intention of adjusting the depths due to elevation difference between the Boundary Wells.

1305 Drillers back from lunch.

1330 Drove back to Boundary Wells with Abe and Carlotta to explain the various options and also to get input from driller on possible locations.

1400 Went back out to Boundary Wells (alone), and sprayed white paint to emphasize where the silver paint was originally marked out.

1430 Drillers advance boring at MW1-53, which was drilled after MW1-54. Air monitoring performed, which indicated a high PID reading (20.4 ppm) inside augers, as materials were being added, displacing the air. Breathing zone readings with the PID were 0.2 ppm, which was close to background (0.1 ppm).

1525 Collected sample SP-B82-S-10-171011 (1525).

1540 Carlotta finalized two proposed locations to re-drill MW1-48, with marks in the field to indicate which was is to be attempted 1st and 2nd.

1550 Installing MW1-53, with screen placed 5-15 feet bgs.

1640 Drillers cleaning up site. Arrangements for tomorrow include mobilizing 2nd drill rig to site – the big blue track-mounted rig which is more powerful that the Landa L-10-T rig being used. Also bringing out an air knife rig to clear the Boundary Well drilling locations.

1715 Drillers assist with breakdown of temporary rain shelter.

1720 Drillers leave site.

1725 Labeling drums of IDW soil cuttings.

1805 Unloading field gear into shed, charging PIDs, and arranging sample coolers.

1810 Collecting information for chain of custodies, in advance of lab pick up tomorrow.

1830 Josh leaves site.

SUMMARY OF FINDINGS

Soil sample were collected for VOCs from wells MW1-54 and MW1-53 using a split spoon sampler. The PID reading in the head space sample at 38.5 feet bgs in MW1-54 was 0.4 ppm, and the PID reading in the head space sample at 0 feet in MW1-53 was 21.3 ppm.

PLANS FOR THE FOLLOWING DAY:

Will start drilling at MW1-48 tomorrow (Thursday), concurrently clearing the Boundary Wells using an air knife rig. After MW1-48, the drill rig will proceed to drilling one of the two Boundary Wells.

ATTACHMENTS:

None

Copies to: Michael Meyer, Sam Moore	**Battelle - DAILY FIELD REPORT** Signed: ___________________________

BATTELLE
It can be done

DAILY FIELD REPORT 10 / 12 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: Sunny, high 65F, winds, mild easterly winds, up to 10 mph	
To: Carlotta Cellucci	
From: Josh Sacker	

- **PERSONNEL ON SITE:**

Joshua Sacker, Michael Meyer (Battelle)
Abe Causland, Austin Cuda, and Lukas Louwien (Holt Services, Inc.)

SUMMARY OF WORK COMPLETED:

- Organized gear for drilling, calibrated PID, replenished ice.
- Conducted health and safety tailgate safety meeting with drillers.
- Drilled, sampled, and installed well MW1-48 and MW1-60, at planned sampling and well construction depths.
- Worked to finalize planned depth of MW1-61, based on elevation rise from MW1-60.
- Coordinated with Videographers from Battelle.
- Continued with well development.
- Chemical samples submitted to laboratory courier.
-

DEVIATION FROM WORKPLAN:

- No deviations to work plan occurred during field work to install MW1-48 or MW1-60, except that minor adjustments were made to their drilling locations to avoid underground obstructions.

SAFETY OBSERVATIONS / GOOD CATCHES:

Be extra cautious driving home in rain at night, with daylight hours decreasing this time of year.

WELL DRILLING FIELD ACTIVITY CHRONOLOGY

0730 Battelle (Josh Sacker) arrives on site.
0745 Calibrated PID.
0750 Michael Meyer on site.
0755 Getting sampling gear loaded into vehicle. Drillers arrive. Drillers begin to unload new rig (track-mounted Mobile B-57) and also brought an air knife rig to clear underground utilities at boundary well locations MW1-60 and MW1-61.
0820 Health and Safety tailgate meeting conducted.
0845 Drillers had to trouble shoot tangled hoist wire.
0855 Wire untangled and rig fully operable.

0900 Coring through asphalt with specialized bit attached to auger rig.

0910 Drilling with augers to advance boring.

0925 Able to get through the 9-11 foot zone that stopped the other auger locations.

1015 Collected soil sample for VOCs and physical tests at MW1-48, with sample ID: CL-B83-S-18.5-171012, which was collected at 18.5 feet bgs. One 18” and one 24” sampler outfitted with stainless steel sleeves were driven end-to-end between 17.0 and 20.5 feet.

1030 Drillers start installing well MW1-48 to 25 feet total depth with screen from 15-25 feet.

1100 Filled out chain of custody for samples being picked up by Test America courier later today.

1145 Well installation complete at MW1-48. It was not necessary to add any water at this location – heaving sands were not an issue.

1200 Drillers take lunch break.

1230 Organizing field forms from previous two-weeks of field work.

1250 Driller back from lunch.

1305 Drillers moved blue rig to MW1-60, and support vehicles also mobilized to this well.

1315 Driller positions rig and starts drilling.

1400 Josh and Michael pack up samples in advance of courier pick up.

1450 Sample at 20.0 feet collected in MW1-60 for VOCs only: BB-B84-S-20.0-171012

1500 Drive over to MW1-49, where Michael has started well development and try to trouble shoot malfunctioning water level meter, but conclude it is broken, and we will have to get a replacement.

1510 Returned to MW1-60 to finish logging soil samples.

1640 Drillers done installing well to 25 feet. Due to fine grained soil samples collected/logged, had drillers use finer 20/40 filter sand for the upper four feet of the sand pack. Added about 20 gallons of water during well installation to minimize heaving sands.

1645 Start packing up gear.

1715 Unloaded gear at shed, and labeled two drums at MW1-48.

1720 Drillers left site.

1740 Josh S. left Site.

AIR KNIFING AND WELL DEVELOPMENT CHRONOLOGY

0800 M. Meyer on site at shed. Coordinate day’s activities with J. Sacker.

0845 M. Meyer review boring locations along Keys Road. Assessed elevation difference between two boring locations. Using Theodolite application and phone GPS, northernmost location (MW1-60) elevation consistently 14-15 feet. Apparent poor satellite coverage at southernmost location, MW1-61, leads to inconsistent elevation readings using this technique.

0900 Battelle videography crew on site. Safety briefing – stay away from drill rig at least as far as the height of the mast. Stay away from soil and groundwater, which is contaminated. Watch each other with regard to traffic as we are working in a parking lot. Beware of motorcycle training area, which will be active today. Oriented videography crew as to bathroom facilities and provided hard hats and hearing protection.

0915 Begin air knifing MW1-60. Confer with the driller and C. Cellucci regarding boring placement. All concur that it is safe to drill within 3 feet of marked utility as long as hole is cleared the full diameter of the augers.

1005 MW1-60 cleared to 9 ft bgs. No pea gravel or evidence of prior excavation. Layer of asphalt at about 2 feet bgs. Placed cuttings back in hole.

1020 Air knife MW1-61. Cleared to approximately 4 feet bgs. Met refusal in hard clay (Till) from ground surface to 4 feet bgs. No evidence of prior excavation. Placed cuttings back in hole.

1130 M. Meyer offsite for lunch and supplies.

1300 M. Meyer uses Jacobs Staff techniques to assess relative elevation of MW1-60 and MW1-61. Elevation difference is approximately 20 feet. Therefore MW1-61 will be drilled to 45 feet bgs.
1415 M. Meyer meets courier to deliver samples.
1430 Meyer begins development of MW1-49.
1509 Stop well development at MW1-49 after one drum of water removed because of faulty water level indicator and need to use Bobcat (supplying power to pump) for other work. Will resume tomorrow with battery power so that Bobcat will not be needed.
1515 Clean up and stow equipment.
1545 M. Meyer off site.

SUMMARY OF FINDINGS

Soil samples were collected for VOCs from wells MW1-48 and MW1-60 using a split spoon sampler. The PID reading in the head space sample at 18.5 feet bgs in MW1-48 was 115.2 ppm, and the PID reading in the head space sample at 20 feet in MW1-60 was 0.2 ppm.

PLANS FOR THE FOLLOWING DAY:

Will start drilling at MW1-61 tomorrow (Friday). After MW1-61, the drill rig will proceed to drilling MW1-55 in the South Plantation, which would be the last non-CMT well left to complete.

ATTACHMENTS:

None

Copies to: Michael Meyer, Sam Moore	**Battelle - DAILY FIELD REPORT** Signed: Josh Sacken

DAILY FIELD REPORT 10 / 13 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: Rain, some hail, intermittent sun, high 60F, easterly winds, up to 15 mph	
To: Carlotta Cellucci	
From: Josh Sacker	

- PERSONNEL ON SITE:

Joshua Sacker, Michael Meyer (Battelle)
Abe Causland, Austin Cuda, and Lukas Louwien (Holt Services, Inc.)

SUMMARY OF WORK COMPLETED:

- Organized gear for drilling and well development, calibrated PID, replenished ice.
- Don PPE and raingear.
- Conducted health and safety tailgate safety meeting with drillers.
- Drilled MW1-61 (with B-85) at planned location, but encountered continuous clay lithology from 11 to 46.5 feet, which necessitated abandoning the boring (backfilled with bentonite chips) and, therefore, eliminating this well location.
- Well development conducted at MW1-49 and MW1-43.

DEVIATION FROM WORKPLAN:

Deviation to planned field work occurred due to abandonment of boundary well location MW1-61 based on the occurrence of continuous clay from approximately 11 - 46.5 feet bgs.

SAFETY OBSERVATIONS / GOOD CATCHES:

Be aware of tendency to rush and/or take unsafe “shortcuts” on Friday afternoon, when everyone is tired and eager to start their weekend.

WELL DRILLING FIELD ACTIVITY CHRONOLOGY

0725 Michael Meyer arrives on site.
0745 Josh Sacker arrives on site.
0800 Dons PPE and raingear.
0810 Drillers arrive at staging area, and are getting equipment ready for drilling. Calibrated PID.
0815 Discussion with Michael about remaining work and schedule – two non-CMT wells (MW1-61 and MW1-55) remain to be drilled, and three CMT wells (MW1-56, -57, and -58).
0825 Loading field gear into vehicle for sampling and logging. Talked to drillers about remaining drilling and well development – the following wells are waiting to be developed: MW1-43, -48, -49, 53, -54. This excludes

the wells that have not yet been drilled, which will also require development. Conducted health and safety meeting.

0930 Drillers setting up at MW1-61.

1030 Boring advanced to 25 feet bgs, and encountered continuous clay between approximately 10 to 25 feet bgs.

1040 Conferred with Michael on presence of continuous clay.

1055 Michael arrives at drill rig (MW1-61) to compare a previously collected sample core of Lawton clay with the cuttings from this location, and it appeared the material encountered in cuttings was the same or very similar.

1100 Carlotta confirmed that boring should be advanced to 45 feet bgs to verify the presence of any water bearing deposits at these depths in relation to the presence of nearby shallow domestic supply wells.

1110 Drillers continue advancing boring.

1150 Boring at 45 feet, and cuttings continue to indicate continuous clay from about 11 to 45 feet. Contacted Michael, who contacted Carlotta with this information, who indicated we should abandon the boring and backfill it with bentonite chips. Michael requested that a sample be collected from 45 to 46.5 feet bgs.

1200 SPT sampler was driven from 45 - 46.5 feet, which confirmed the presence of continuously clay.

1205 Briefly discussed plan for remainder of day with the drillers, which will include a lunch break, returning after lunch to remove and decontaminate augers (which will be more difficult due to the continuous clay) then decontaminating the blue rig, and loading/demobilizing the blue rig. The drillers confirmed that the red Landa rig and the blue Mobile B57 rig used the same set of samplers (18-inch and 24-inch split spoons), and that a field equipment blank did not need to be collected from the blue rig. If time permits, will set up red rig on MW1-55.

1210 Created a boring log based on the drilling cutting and the one driven SPT sample. Measured head space reading with PID (1.8 ppm). Loading up sampling equipment and moving everything back to shed.

1330 All equipment and supplies returned to shed. Organizing field documents and coordinating with Michael regarding next week.

1430 Josh Sacker Left site.

WELL DEVELOPMENT CHRONOLOGY

0725 M. Meyer on site. Calibrated Horiba water quality instrument and confirmed that the water level indicator is not responding in clear water, but has no obvious damage and a good battery. Replacement is on order for expedited delivery. Decided to develop wells today without the water level indicator. Can still meet the well development objectives without the depth to water data. Loaded up for well development.

0820 Set up to continue developing well MW1-49.

0830 Discussed plan for day with drillers.

0852 Began continued development of well MW1-49.

0926 Ended development of MW1-49 after removing approximately 10 borehole volumes of water and measuring low turbidity. Decontaminate equipment and move to MW1-43.

0950 Set up on MW1-43. Developed with surge block initially, then high flow pumping (6 lpm). Water level meter is now working. Discover that the meter will work in turbid or soapy water, but not in clear water.

1020 Called Noel Philip at Ecology (425.649.7044) and left voicemail. 48-hr notification of CMT well install, as required by the variance granted.

1300 Finished development of MW1-43 after removing four drums of water. Very turbid for much of the development cycle. Stopped for lunch and decontamination. After lunch worked on moving and labelling drums. Drillers pulled out of MW1-61 and decontaminated augers. Cleaned up site for the weekend. Second (blue) rig mobilized offsite.

1615 All offsite.

SUMMARY OF FINDINGS

Due to the presences of continuous clay lithology encountered from approximately 11 to 45 feet bgs, the boring at location MW1-61 was abandoned and backfilled with bentonite chips. A soil sample was collected in MW1-61 from 45.0 to 46.5 feet bgs using an SPT sampler, and the PID reading in the head space sample was 1.8 ppm. Wells MW1-43 and -49 were developed.

PLANS FOR THE FOLLOWING DAY:

Will start drilling at MW-55 on Oct 17 (Monday) just south of the South Plantation, with CMT well installation planned for Oct. 18 – through Oct. 20 (Tuesday through Thursday) inside the South Plantation.

ATTACHMENTS:

None

Copies to: Michael Meyer, Sam Moore	**Battelle - DAILY FIELD REPORT** Signed: Josh Sacken

DAILY FIELD REPORT

10 / 17 / 2017

Contract No.

N39430-16-D-1802, CTO 010

Reference

Sampling and Analysis Plan (Battelle 2017)

Accident Prevention Plan (Battelle 2017)

Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II

Location: Naval Base Kitsap Keyport, WA OU1

Client: Naval Facilities Engineering Command Northwest

Contractor: Battelle

Weather: Intermittent rain showers, cloudy, high 55F, moderate westerly winds, gusts up to 20 mph

To: Carlotta Cellucci

From: Josh Sacker

- PERSONNEL ON SITE:

Joshua Sacker, Michael Meyer (Battelle)
Abe Causland, Austin Cuda, and Lukas Louwien (Holt Services, Inc.)

SUMMARY OF WORK COMPLETED:

- Organized gear for drilling and well development, calibrated PID, replenished ice.
- Don PPE and raingear.
- Conducted health and safety tailgate safety meeting with drillers.
- Drilled MW1-56 (B-87) and collected planned soil samples for VOCs and physical samples at three depth intervals. Due to delivery delay in receiving CMT well materials, the multi-channel well could not be installed; augers were left in the ground, keyed into the Lawton clay at approximately 40 feet bgs. The plan is to install well MW1-56 tomorrow once Holt Services receives the well materials.
- Well development completed at MW1-53 and MW1-54.
- Collected equipment blank from split spoon soil sampler.

DEVIATION FROM WORKPLAN:

No deviations to work plan occurred during field work to install MW1-56 or during well development at MW1-53 and MW1-54.

SAFETY OBSERVATIONS / GOOD CATCHES:

Be aware of slippery surfaces due to rainy conditions, posing a slip/trip/fall hazards and also a driving hazard.

WELL DRILLING FIELD ACTIVITY CHRONOLOGY

0730 Michael Meyer arrives on site.
0740 Josh Sacker arrives on site.
0745 Sampling team dons PPE and raingear and organizes field equipment for soil sampling and well development.
0830 Drillers arrive at staging area, and are getting equipment ready for drilling. Michael calibrated PID.
0840 Met driller at well MW1-56 in South Plantation.
0845 Health and Safety tailgate meeting conducted with entire field crew.

0855 Discussed plan for day. CMT well materials have not arrived. Will drill and sample well while we wait for CMT well materials. If materials do not arrive, we will either leave augers in hole overnight, or abandon hole with chips, and re-drill boring 5 to 7 feet away once well materials arrive on site (without having to collect soil samples). Two Holt Services personnel will be on rig (Abe and Lukas), and one person (Austin) will be installing well heads.

0915 Michael Meyer begins development activities at MW1-53.

0935 Collected soil sample SP-B87-S-9.0-171017 at 9.0 feet bgs for VOCs and physical samples.

1045 Difficulty in sampling due to heaving sands. Sampler got sand-locked up inside augers, and took additional time to free sampler.

1115 Contacted Dale Smith in the Holt Service's office to determine status of delivery of CMT materials. Holt Services is attempting to get confirmation from the shipper (manufacturerer; Solnist) and also from transported (UPS).

1145 Collected soil sample SP-B87-S-29.0-171017 at 29.0 feet bgs for VOCs and physical samples.

1125 Driller takes lunch break.

1330 Drillers return from lunch.

1430 Collected samples from 31.5 t0 33.0 feet (18-inch sampler). No clay encountered. Difficult to collect representative samples due to heaving sands. Approximately half of 18-inch sampler contained slough.

1530 Collected sample from 33.0 to 35.0 feet (24-inch sampler). No clay encountered. Difficult to collect representative samples due to heaving sands, approximately half of 24-inch sampler contained slough.

1550 Michael Meyer off site.

1600 Collected Equipment Blank after decontamination (steam cleaning) of 18-inch sampler. Note that after collecting soil samples at each boring location, all soil samplers in use have been decontaminated using the steam cleaner.

1715 Collected soil sample from 37.0 to 39.0 feet bgs using 24-inch sampler. Clay encountered at depth of 37 feet. Collected sample SP-B87-S-37.5-171017 for VOCs and physical tests. Approximately 12-inch out of 18-inch were slough.

1735 Collected soil sample from 39.0 to 41.0 feet bgs using 24-in sampler to obtain sleeves needed for physical tests.

1800 Packaged samples for analytical and geotechnical labs, and competed field documentation (boring logs and field notes).

1830 At shed unloading gear, repacking coolers. ‘

1850 Josh Sacker off site.

WELL DEVELOPMENT CHRONOLOGY

0730 Calibrate PID and Horiba water quality meter.

0848 Surge MW1-53. Note new water level indicator onsite.

0935 Being pumping MW1-53.

1055 End development of MW1-53, 11 borehole volumes of water removed. Decon and lunch.

1203 Set up to develop MW1-54.

1213 Surge MW1-54

1220 Being pumping MW1-54.

1230 Battery used to run pump exhausted, development paused.

1330 Continue development of MW1-54 using generator to run pump.

1435 End development of MW1-54 after removal of 110 gallons of water, relatively stable parameters, low turbidity. Decon and prepare for tomorrow's development.

SUMMARY OF FINDINGS

Soil samples were collected from three intervals at MW1-56: at 9.0 feet, PID head space readings were 2.2 ppm; at 29.0 feet, the PID head spaced was elevated at 334.2 ppm; and at 37.5 feet bgs, the PID reading was 1.2 ppm. Note that the 37.5-foot sample was collected in a thick clay deposit that is interpreted as being the Lawton Clay, a regional geological unit. Well development was completed at MW1-53 and MW1-54.

PLANS FOR THE FOLLOWING DAY:

Will start drilling and sampling at MW1-57 on Oct 18 with another set of augers (i.e., auger keyed into clay at MW1-56 will remain in place until CMT well materials arrive on site). Perform well development at MW1-48. Assuming CMT well materials arrive on site by midday, will install one CMT well. If time permits, will start installing a second CMT well.

ATTACHMENTS:

None

Copies to: Michael Meyer, Sam Moore	**Battelle - DAILY FIELD REPORT** Signed: ___________________________

DAILY FIELD REPORT

10 / 18 / 2017

Contract No.

N39430-16-D-1802, CTO 010

Reference

Sampling and Analysis Plan (Battelle 2017)

Accident Prevention Plan (Battelle 2017)

Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II

Location: Naval Base Kitsap Keyport, WA OU1

Client: Naval Facilities Engineering Command Northwest

Contractor: Battelle

Weather: Heavy Rain, high 50 F, strong northwesterly winds, with gusts up to 30 mph

To: Carlotta Cellucci

From: Josh Sacker

- PERSONNEL ON SITE:

Joshua Sacker, Michael Meyer (Battelle)
Abe Causland, Austin Cuda, and Lukas Louwien (Holt Services, Inc.)

SUMMARY OF WORK COMPLETED:

- Organized gear for drilling and well development, calibrated PID, replenished ice.
- Don PPE and raingear.
- Conducted health and safety tailgate safety meeting with drillers.
- Drilled MW1-57 (B-88) and collected planned soil samples for VOCs at two depth intervals. Due to delivery delay in receiving CMT well materials, multi-channel wells could not be installed; augers were left in the ground at MW1-57, keyed into the Lawton clay at approximately 32 feet bgs.
- Received confirmation in afternoon that CMT well materials arrived at Holt Service’s yard.
- The plan is to install CMT wells MW1-56 and perhaps MW1-57 tomorrow (both are drilled and sampled, with augers left in the ground, keyed in to the Lawton Clay).
- Well development completed at MW1-48 and MW1-60.
- Well head installed at MW1-53.
- Relocated IDW drums to centralized temporary storage area (inside temporary fabric structure at south end of Central Landfill).

DEVIATION FROM WORKPLAN:

No deviations to work plan occurred during field work to drill or install well MW1-57 or develop wells MW1-48 and MW1-60.

SAFETY OBSERVATIONS / GOOD CATCHES:

Elevated readings were detected on PID while advancing augers at MW1-57. Consulted Health and Safety Plan for exposure monitoring and action levels. Average PID readings within breathing zone were within acceptable levels (< 5 ppm action level). Advised drillers to be prepared to don respirators tomorrow while installing CMT wells.

WELL DRILLING FIELD ACTIVITY CHRONOLOGY

0720	Michael Meyer arrives on site.
0740	Josh Sacker arrives on site.

0745 Sampling team dons PPE and raingear and organizes field equipment for soil sampling and well development.

0755 Prepare for soil sampling at MW1-57 (B88).

0820 Drillers arrive in staging area.

0845 Health and Safety tailgate safety meeting with Battelle personnel and Holt Services personnel.

0900 Drilling starts at MW1-57. Elevated PID levels detected in cuttings and in drum. Breathing zone readings generally < 5 ppm. Only brief periods when breathing zone PID readings exceed 5 ppm is when driller's helper crouches down near cuttings being expelled at ground surface (to tighten bolt when adding auger flights, or during shoveling of soil cuttings).

0920 Air monitoring indicated 374 ppm inside IDW drum full of cuttings. Air monitoring at breathing zone indicated level fluctuate up to a maximum of approximately 2.0 ppm. Air monitoring results when driller's helper crouches down near ground surface (brief periods) are between 4.0 and 12.0 ppm.

0945 PID in breathing zone (personnel upright) is 0.2 to 0.5 ppm, inside augers is 94.3 ppm and inside IDW drum containing cuttings 172 ppm.

1005 Collected sample SP-B88-S-9.0-171018. PID reading of "over" 15,000 ppm was detected in the heads space sample, usign a ziplock baggie.

1010 Collected Field Duplicate FD-171018-01 (duplicate of SP-B88-S-9.0-151018).

1030 Told drillers to have respirators on site for tomorrow in case they are needed (i.e., Level C). Today's activities only involved advancing augers to total depth, and did not involve cleaning augers off as they are removed from the string following well installation. Also reminded drillers that facial hair will prevent a good mask fit, and that facial hair is not allowed when a respirator must be wore.

1035 Keeping drum lid closed whenever possible to minmize release of volatiles to the breathing zone.

1040 PID reading at drum of cuttings at 1,074 ppm. PID readings in breathing zone while in upright position are less than the 5 ppm standard. While crouching to work near augers, breathing zone readings are 2.0 to 15.0 ppm.

1045 Talked to drillers about high PID air monitoring readings and explained that the average air monitoring air readings were less than 5 ppm, but they had a right to don a respirator if they felt it was necessary, regardless of air monitoring results.

1100 Abe Causland talked to the Holt Services office, and they have respirators ready to bring on site, to have on hand if warranted.

1230 Collected SP-B88-S-31.0-171017. Well drilling terminated with augers to be left overnight, with auger bit keyed into the Lawton clay formation.

1240 Drillers leave for lunch.

1350 Drillers return from lunch.

1420 Drillers start well head completion at MW1-53 – flush mounted on asphalt within South Plantation.

1545 Well head complete at MW1-53, and drillers are preparing to leave site.

1600 Organizing samples and filling out Chains of Custody (COCs) forms for tomorrow's pickup.

1605 Michael Meyer off site.

1610 Driller leaves site.

1715 Josh Sacker off site.

WELL DEVELOPMENT CHRONOLOGY

0720 M. Meyer onsite. Prepare for and lead field readiness teleconference in advance of groundwater sampling next week.
0848 Calibrate water quality meter and load up for well development.
0915 Surge MW1-48.
0930 Pump well MW1-48.
1120 End development of MW1-48 after removal of 9 borehole volumes, relatively stable parameters, and relatively low turbidity.
1300 Surge MW1-60.
1320 Pump MW1-60. Pumps dry at 5.5 liters per minute. 17.26 feet of water in well initially. Pumps dry in approximately 2.5 minutes, taking approximately 5.5 minutes to recover to approximately 75% of original water column. Pumped well dry numerous times, with pauses for additional surging.
1505 End development of MW1-60 after removing approximately two borehole volumes. Pumped water was slightly clearer visually, however turbidity still measures above 1,000 NTUs. Decontaminated the well development equipment to be used tomorrow.

SUMMARY OF FINDINGS

Soil samples were collected from two intervals at MW1-57: at 9.0 feet, PID head space readings were over 15,000 ppm; and at 31 feet bgs, the PID head spaced was 14.3 ppm. Note that the 31.0-foot sample was collected in a thick clay deposit that is interpreted as being the Lawton Clay, a regional geological unit. Well development was completed at MW1-48 and MW1-60.

PLANS FOR THE FOLLOWING DAY:

Will start installing the CMT well at MW1-56 in the morning, proceeding next to CMT well MW1-57 (i.e., auger keyed into clay at MW1-56 and MW1-57 will remain in place until CMT well materials arrive on site). Perform well development at MW1-55. If time permits, will start installing a second CMT well at MW1-57.

ATTACHMENTS:

None

Copies to: Michael Meyer, Sam Moore	**Battelle - DAILY FIELD REPORT** Signed: ___________________________

DAILY FIELD REPORT 10 / 16 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: Partly cloudy, fog in morning, high 60F, breezy	
To: Carlotta Cellucci	
From: Michael Meyer	

PERSONNEL ON SITE:

Michael Meyer (Battelle)
Abe Causland and Austin Cuda (Holt Services, Inc.)

SUMMARY OF WORK COMPLETED:

- Organized gear for drilling, calibrated PID.
- Don PPE.
- Conducted health and safety tailgate safety meeting with drillers.
- Drilled and installed MW1-55 (B-86), located approximately 10 feet east of staked location – lower and closer to the marsh, but not in the marsh.
- Decon augers and set up on MW1-56

DEVIATIONS FROM WORKPLAN:

No deviations from SAP; MW1-55 drilled and installed as planned.

SAFETY OBSERVATIONS / GOOD CATCHES:

The concrete pads located between our work location and drum staging area are extremely slippery when wet.

FIELD ACTIVITY CHRONOLOGY

0720 Michael Meyer arrives on site.
0730 James Ruef and Mitch from Sealaska on site for Tide Gate maintenance.
0740 Calibrate PID and prepare daily paperwork and supplies
0845 Drillers on site
0910 Move rig onto MW1-55. Discuss location and access. Rig clearance and soft marsh sediment preclude drilling lower into marsh, but move location approximately 10 feet east and lower, closer to marsh. Location is about 2 feet below the elevation of SP-B58. Adjust planned sample and well depth accordingly. Position augers and Bobcat. Tight work area.
0930 Safety meeting. Discuss expectations of relative low COCs at shallow depths, but potentially high concentrations at depth. Plan to look for a well-graded sand and tag the Lawton Clay. Set well on top of clay. Discuss slippery concrete foundations and soft sediment in marsh behind rig.
1007 At 10 ft bgs. Prepare water buckets to control heave.

1020 At 20 ft bgs. Adding water to control heave.
1048 At 30 ft bgs. Still in silty fine to medium sand. Decide to drive sampler at 35 to 36.5 ft bgs.
1130 Collect 18” Modified California split spoon sample, 35-36.5 ft bgs. Lawton Clay in shoe and catcher. Decide to set well at 36.5 ft bgs. Drillers off site for lunch.
1230 Begin well install.
1400 Complete well install. Move rig off of MW1-55. Fuel drill rig.
1430 Move onto MW1-56 and tower up. Discuss sampling requirements at this CMT well location. Cleanup site and decon augers.
1530 Off site.

SUMMARY OF FINDINGS

MW1-55 was installed as planned with 10 feet of well screen immediately on top of the Lawton Clay (identified at approximately 36.5 feet bgs. One sample for VOC analysis was collected from soil at 35 feet bgs in a fine sand unit within the screened interval.

PLANS FOR THE FOLLOWING DAY:

Drill and install CMT well MW1-56. Continue development of previously installed wells.

ATTACHMENTS:

None

Copies to: Josh Sacker, Sam Moore	**Battelle - DAILY FIELD REPORT** Signed:

DAILY FIELD REPORT 10 / 19 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: Overcast with heavy rain at times, high 50F, breezy	
To: Carlotta Cellucci	
From: Michael Meyer	

PERSONNEL ON SITE:

Michael Meyer (Battelle)
Dale Smith, Abe Causland, Austin Cuda, and Lukas Louwien (Holt Services, Inc.)

SUMMARY OF WORK COMPLETED:

- Organized gear for well install, calibrated PID.
- Don PPE.
- Conducted health and safety tailgate safety meeting with drillers.
- Installed CMT well at location MW1-56.
- Attempted install at MW1-57, set up to complete this install tomorrow.

DEVIATIONS FROM WORKPLAN:

No deviations from SAP.

SAFETY OBSERVATIONS AND GOOD CATCHES:

Observe that materials handling personnel from nearby buildings are very conscientious about using short taps on forklift horns as they approach other vehicles or blind corners to make sure everyone is aware of their movements. Good safety practice.

FIELD ACTIVITY CHRONOLOGY

0630	Michael Meyer arrives on site. Load up for day, calibrate instruments
0740	Dale Smith from Holt Services on site. Set up CMT materials.
0830	Carlotta Cellucci from NAVFAC NW on site. Discuss that gate should be able to close when we are done. Agree to prune tree as needed to install MW1-58. Discuss and agree on screened intervals of MW1-57.
0845	C. Cellucci offsite. Holt drill crew arrives. Begin surging MW1-55.
0900	Safety meeting. Discuss high VOC concentrations in the wells being installed today. Use fan, back away from hole to allow to clear, and be prepared to go to Level C. Watch for very slippery conditions in mud.
0915	Place sand for bottom of MW1-57, build well casing. Include three centralizers on casing. Grout unused channels.
0930	Begin development pumping at MW1-55.
0945	Sand set 31-29 feet bgs in MW1-57. Load water in auger to minimize heave.

1005 Very turbid water in MW1-55. Stop pumping and bail turbid water.
1023 Restart pumping in MW1-55.
1127 MW1-57 casing is complete, set in borehole. Being building casing for MW1-56.
1144 Place sand and bentonite seal for lower screen of MW1-57.
1200 End pumping MW1-55 after removing 6 borehole volumes and relatively low turbidity.
1230 MW1-57 bentonite bridge. Jet borehole to try and clear.
1305 Bridge appears clear, but well casing is still coming up with augers. Suspect that centralizer is catching on auger, or the sinuous nature of the well casing is causing the well to catch on remaining bentonite bridge. Try twists and pulls to shake casing loose, but to no avail.
1330 Pull MW1-57 well casing back out. Undamaged, except lower screen pulled off. Move to MW1-56 while cleaning auger to redrill MW1-57.
1450 MW1-56 well casing in borehole.
1515 First sand pack set with bentonite seal. Using bentonite pellets to set seal, rather than chips. Pellets are falling better and not bridging.
1530 Drillers break for lunch.
1600 Continue with well construction.
1610 Second sand pack set.
1630 Third sand pack set. 2-foot pellet seal, then chips to within 2 feet of ground surface.
1700 All offsite.

SUMMARY OF FINDINGS

MW1-56 was installed as planned:

- TD of borehole 36 ft bgs (expected to be 1-ft into Lawton Clay).
- Lower screen set at 34 ft bgs (center port), 2 ft of sand above and below.
- Middle screen set at 22 ft bgs (port 1), 2 ft of sand above and below.
- Top screen set at 10 ft bgs (port 2), 2 ft of sand above and below.
- Bentonite pellets between all sand intervals.

Note that the lead auger was observed to be coated with clay over the entire 5-foot length. This may indicate that the bottom screen was set deeper in the clay than expected based on the split spoon sampling. However, the sand pack is expected to extend above the clay in either case.

MW1-55 was developed.

PLANS FOR THE FOLLOWING DAY:

Install CMT well MW1-57.
Because of schedule constraints MW1-58 will be drilled, sampled, and installed the first week of November.

ATTACHMENTS:

None

Copies to: Josh Sacker, Sam Moore	**Battelle - DAILY FIELD REPORT** Signed:

DAILY FIELD REPORT 10 / 20 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: Overcast high 50F, breezy	
To: Carlotta Cellucci	
From: Michael Meyer	

PERSONNEL ON SITE:

Michael Meyer (Battelle)
Abe Causland and Austin Cuda (Holt Services, Inc.)

SUMMARY OF WORK COMPLETED:

- Organized gear for well install, calibrated PID.
- Don PPE.
- Conducted health and safety tailgate safety meeting with drillers.
- Installed CMT well at location MW1-57.

DEVIATIONS FROM WORKPLAN:

No deviations from SAP.

SAFETY OBSERVATIONS AND GOOD CATCHES:

None today.

FIELD ACTIVITY CHRONOLOGY

0720 Michael Meyer arrived on site. Loaded up for day, calibrated instruments. Wrote up daily report from yesterday.

0845 Drillers onsite after obtaining wood plugs for bottom of augers. Discussed and decided to not reuse old borehole for MW1-57 because of the presence of bentonite in hole that could block the CMT screens. Moved to new location approximately 3-4 feet south.

0945 Previous borehole MW1-57 open to 20 feet bgs. Abandoned with bentonite chips.

1054 Began drilling MW1-57A. M. Meyer labeled peeper sampling tubes for field team reference next week.

1125 Reached total depth of 31 feet bgs in MW1-54A. Loaded water in augers and knocked out wood plug. Heave in augers despite wood plug and water. Knocked out heave with rods.

1145 Rods became stuck in augers.

1230 Rods unstuck, and 1 foot of heave remained in augers.

1300 Heave cleared. Place well casing and set lower sand pack 26 feet bgs to 31 feet bgs, screen at 29 feet bgs.

1330 Bentonite pellets 26 ft bgs to 16 feet bgs. Set second sand pack around second screen at 14 feet bgs.

1342 Second sand pack set 16 feet bgs to 12 feet bgs, bentonite pellet seal.

1349 Top sand pack set 5.5 feet bgs to 10 feet bgs, with screen at 8 feet bgs. Set surface seal, cleanup and leave site.

SUMMARY OF FINDINGS

MW1-57 was installed as planned:

- TD of borehole 31 ft bgs (expected to be 1-ft into Lawton Clay).
- Lower screen set at 29 ft bgs (center port), 2 ft of sand below and 3 ft above.
- Middle screen set at 14 ft bgs (port 1), 2 ft of sand above and below.
- Top screen set at 8 ft bgs (port 2), 2 ft of sand below and 2.5 below.
- Bentonite pellets between all sand intervals.

PLANS FOR THE FOLLOWING DAY:

Install CMT well MW1-58 on November 1, 2017 tentative.

Well sampling and survey to be conducted 23 October to 27 October.

ATTACHMENTS:

None

Copies to: Josh Sacker, Sam Moore	**Battelle - DAILY FIELD REPORT** Signed: ______________

DAILY FIELD REPORT 10 / 23 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: Partly cloudy, high 63 F, winds SE 5 mph	
To: Carlotta Cellucci	
From: Michael Meyer	

PERSONNEL ON SITE:

Michael Meyer, Samuel Moore, Vivek Lal, Lauren March (Battelle)

SUMMARY OF WORK COMPLETED:

- Acquired badges for L. March and V. Lal
- Organized supplies and calibrated equipment
- Collected 6 groundwater samples in the Central Landfill from wells MW1-42 through MW1-47
- Measured groundwater elevations from 46 locations across the site

DEVIATIONS FROM WORKPLAN:

No deviations from SAP.

SAFETY OBSERVATIONS AND GOOD CATCHES:

Oriented new staff with the safety concerns of working on the Central Landfill with active motorcycle training. Finished all work within the motorcycle training area today so that no further work will be conducted during motorcycle training this mobilization.

FIELD ACTIVITY CHRONOLOGY

0730 Michael Meyer and Sam Moore arrived on site. Discussed work up to date and identified wells for groundwater elevation measurement and surveying.

0820 Vivek Lal and Lauren March arrived on site after receiving badges from Pass and ID. Held tailgate safety meeting and site orientation with V. Lal.

0845 M. Meyer left site. Prepared equipment and supplies and performed calibrations.

0940 Began low-flow groundwater sampling from MW1-45. Purged until parameter stabilization prior to sampling with a total of 18 L purged. Collected groundwater samples for VOCs and monitored natural attenuation parameters at 1054.

0957 Began low-flow groundwater sampling from MW1-44. Purged until parameter stabilization prior to sampling with a total of 5 L purged. Collected groundwater samples for VOCs and monitored natural attenuation parameters at 1042.

1135 Began low-flow groundwater sampling from MW1-43. Purged until parameter stabilization prior to sampling with a total of 6 L purged. Collected groundwater samples for VOCs, monitored natural attenuation parameters, PFAS, and 1,4-dioxane at 1212.

1140 Began low-flow groundwater sampling from MW1-42. Purged until parameter stabilization prior to sampling with a total of 9 L purged. Collected groundwater samples for VOCs and monitored natural attenuation parameters at 1218.

1145 Collected groundwater elevation measurements across the Central Landfill.

1300 Left site for lunch.

1400 Returned to site. Collected groundwater elevation measurements across the North Plantation, along Keys Road, in the South Plantation, and in the Peeper wells.

1413 Began low-flow groundwater sampling from MW1-47. Purged until parameter stabilization prior to sampling with a total of 13 L purged. Collected groundwater samples for VOCs, monitored natural attenuation parameters, PFAS, and 1,4-dioxane at 1510. Collected duplicate, MS, and MSD samples.

1430 Began low-flow groundwater sampling from MW1-46. Purged until parameter stabilization prior to sampling with a total of 5 L purged. Collected groundwater samples for VOCs, monitored natural attenuation parameters, PFAS, and 1,4-dioxane at 1500.

1700 Collected equipment blank samples for VOCs, monitored natural attenuation parameters, PFAS, and 1,4-dioxane from the water level indicator.

1730 Performed post-calibrations and secured site.

1800 All off-site.

SUMMARY OF FINDINGS

Groundwater sampling was conducted with little groundwater depression, rapid stabilization of water quality parameters and low turbidity in wells MW1-42 through MW1-47. Groundwater elevations were recorded throughout the site within a 6-hour duration in order to capture a snapshot of groundwater flow across the site.

PLANS FOR THE FOLLOWING DAY:

Continue groundwater sampling from MW1-48 and five additional locations in the South Plantation. Ship samples collected on October 23 and 24 to arrive at their respective laboratories within holding time.

ATTACHMENTS:

None

Copies to: Michael Meyer, Vivek Lal, Lauren March	**Battelle - DAILY FIELD REPORT** Signed: __________________________

DAILY FIELD REPORT 10 / 24 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: Sunny, high 64 F, winds NE 7 mph	
To: Carlotta Cellucci	
From: Michael Meyer	

PERSONNEL ON SITE:

Samuel Moore, Vivek Lal, Lauren March (Battelle)

SUMMARY OF WORK COMPLETED:

- Collected 1 groundwater sample in the Central Landfill from well MW1-48
- Purged CMT wells MW1-56-33.0 and MW1-57-34.0 to develop in preparation of sampling
- Collected 6 groundwater samples in the South Plantation from wells MW1-48 through MW1-52 and MW1-54 and MW1-55.

DEVIATIONS FROM WORKPLAN:

No deviations from SAP.

SAFETY OBSERVATIONS AND GOOD CATCHES:

Discussed tripping hazards in the uneven ground of the South Plantation.

FIELD ACTIVITY CHRONOLOGY

0720	Sam Moore and Vivek Lal arrived on site. Prepared equipment and supplies and performed calibrations.
0735	Lauren March arrived on site. Held the daily tailgate safety meeting.
0806	Began low-flow groundwater sampling from MW1-48. Purged until parameter stabilization prior to sampling with a total of 14 L purged. Effluent appeared to have an oily sheen. Collected groundwater samples for VOCs, monitored natural attenuation parameters, microbial population quantification, PFAS, and 1,4-dioxane at 0935.
1030	Collected source blank samples. Organized the shed and field logs and prepared sample coolers for shipment for later this afternoon.
1044	Began purging/development of CMT well MW1-57-34.0. Purged until effluent sufficiently cleared with a total of 18.5 L purged at 1131.
1054	Began low-flow groundwater sampling from MW1-49. Purged until parameter stabilization prior to sampling with a total of 8 L purged. Collected groundwater samples for VOCs and monitored natural attenuation parameters at 1145.

1157 Began purging/development of CMT well MW1-56-33.0. Effluent produced a white/grey liquid with possible NAPL layer. The well ran dry repeatedly and was still producing significant amounts of air mixed with water. Discontinued development at 1226 with only 0.3 L purged.

1220 C. Cellucci on site to escort AAA driver to unlock an accidentally locked vehicle on site. The car was unlocked and C. Cellucci and the AAA driver left the site at 1240.

1228 Began low-flow groundwater sampling from MW1-50. Purged until parameter stabilization prior to sampling with a total of 4 L purged. Collected groundwater samples for VOCs, monitored natural attenuation parameters, microbial population quantification, PFAS, and 1,4-dioxane at 1300.

1250 S. Moore off site to pick up shipments and procure additional coolers, supplies, and equipment.

1255 L. March off site for lunch,

1350 L. March back on site.

1350 Began low-flow groundwater sampling from MW1-51. Purged until parameter stabilization prior to sampling with a total of 6 L purged. Collected groundwater samples for VOCs and monitored natural attenuation parameters at 1425.

1400 Began low-flow groundwater sampling from MW1-52. Purged until parameter stabilization prior to sampling with a total of 3.5 L purged. Collected groundwater samples for VOCs, monitored natural attenuation parameters, microbial population quantification, PFAS, and 1,4-dioxane at 1450.

1440 S. Moore returned to site, unloaded equipment, and prepared COCs and samples for shipment.

1540 S. Moore left site to ship samples to Empirical Laboratories and Microbial Insights. S. Moore returned to site at 1610.

1613 Began low-flow groundwater sampling from MW1-54. Purged until parameter stabilization prior to sampling with a total of 5.8 L purged. Collected groundwater samples for VOCs and monitored natural attenuation parameters at 1700.

1620 Began low-flow groundwater sampling from MW1-55. Purged until parameter stabilization prior to sampling with a total of 5 L purged. Collected groundwater samples for VOCs, monitored natural attenuation parameters, microbial population quantification, PFAS, and 1,4-dioxane at 1650.

1715 Performed post-calibrations and secured site.

1800 All off site.

SUMMARY OF FINDINGS

Groundwater sampling was conducted with little groundwater depression, rapid stabilization of water quality parameters and low turbidity in wells MW1-48 through MW1-52 and MW1-54 and MW1-55. CMT well MW1-57-34.0 developed and clarified as expected, but CMT well MW1-56-33.0 appears to have very poor recharge rates and might not be able to be properly developed and sampled.

PLANS FOR THE FOLLOWING DAY:

Continue groundwater sampling from CMT wells MW1-56 and MW1-57. Ship samples collected in the late afternoon on October 24 and October 25 to arrive at their respective laboratories within holding time.

ATTACHMENTS:

None

Copies to: Michael Meyer, Vivek Lal, Lauren March	**Battelle - DAILY FIELD REPORT** Signed: ___________________________

DAILY FIELD REPORT 10 / 25 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: Overcast with occasional light rain, high 58 F, winds E 5 mph	
To: Carlotta Cellucci	
From: Samuel Moore	

PERSONNEL ON SITE:

Samuel Moore, Vivek Lal, Lauren March (Battelle)

SUMMARY OF WORK COMPLETED:

- Collected 5 groundwater samples from CMT wells MW1-56 and MW1-57

DEVIATIONS FROM WORKPLAN:

- The deepest interval of CMT well MW1-56 does not produce groundwater and is likely installed with its screen interval completely within the clay layer bounding the deepest extent of contamination.
- Groundwater elevations could not be measured while purging or sampling the CMT wells due to the small casing diameter of the channels.

SAFETY OBSERVATIONS AND GOOD CATCHES:

Discussed hazards of working in cold, rainy weather and how persistently chilly weather can lead to cold stress.

FIELD ACTIVITY CHRONOLOGY

0715	Vivek Lal and Lauren March arrived on site. Prepared equipment and supplies and performed calibrations.
0830	Samuel Moore arrived on site. Held the daily tailgate safety meeting. Determined the sampling ports and total depths of CMT wells MW1-56 and MW1-57.
0935	Began low-flow groundwater sampling from MW1-56-33.0, with little to no recovery. Purged a total of 0.25 L of very turbid clayey liquid before the well ran dry. Interval was abandoned.
0938	Began low-flow groundwater sampling from MW1-57-10.0. Purged until parameter stabilization prior to sampling with a total of 6.4 L purged. Collected groundwater samples for VOCs, monitored natural attenuation parameters, microbial population quantification, PFAS, and 1,4-dioxane at 1100.
1030	Began low-flow groundwater sampling from MW1-56-24.0. Purged until parameter stabilization prior to sampling with a total of 14 L purged. Collected groundwater samples for VOCs, monitored natural attenuation parameters, and microbial population quantification at 1155.
1210	S. Moore left site to pick up equipment shipments.
1245	L. March left site for lunch.

1249 Began low-flow groundwater sampling from MW1-57-16.0. Purged until parameter stabilization prior to sampling with a total of 6.0 L purged. Collected groundwater samples for VOCs, monitored natural attenuation parameters, and microbial population quantification at 1345.

1310 S. Moore returned to site.

1335 L. March returned to site.

1350 Began low-flow groundwater sampling from MW1-56-12.0. Purged until parameter stabilization prior to sampling with a total of 11 L purged. Collected groundwater samples for VOCs, monitored natural attenuation parameters, microbial population quantification, PFAS, and 1,4-dioxane at 1450.

1440 Began low-flow groundwater sampling from MW1-57-34.0. Purged until parameter stabilization prior to sampling with a total of 7.2 L purged. Collected groundwater samples for VOCs, monitored natural attenuation parameters, and microbial population quantification at 1526.

1450 Preparing COCs and packing up samples for shipment.

1530 S. Moore off site to ship samples to Empirical Laboratories and Microbial Insights.

1620 S. Moore returned to site. Performed post-calibrations and secured site.

1700 All off site.

SUMMARY OF FINDINGS

Groundwater sampling was conducted with rapid stabilization of water quality parameters and low turbidity in all intervals of CMT wells MW1-56 and MW1-57 except MW1-56-33.0. CMT well MW1-56-33.0 appears to have very poor recharge rates and is likely installed with its screened interval completely in clay.

PLANS FOR THE FOLLOWING DAY:

Continue groundwater sampling from wells MW1-53, MW1-60, and IW1-S. Collect surface water samples, time permitting. Ship samples collected in the late afternoon on October 25 and October 26 to arrive at their respective laboratories within holding time.

ATTACHMENTS:

None

Copies to: Michael Meyer, Vivek Lal, Lauren March	**Battelle - DAILY FIELD REPORT** Signed: ___________________________

DAILY FIELD REPORT 10 / 26 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: Partly cloudy, high 67 F, winds NNE 10 mph	
To: Carlotta Cellucci	
From: Samuel Moore	

PERSONNEL ON SITE:
Samuel Moore, Vivek Lal, Lauren March (Battelle)

SUMMARY OF WORK COMPLETED:

- Collected 3 groundwater samples from wells MW1-53, IW1-S, and MW1-60
- Collected 12 surface water samples from locations SW1-01 through SW1-12, south of the South Plantation

DEVIATIONS FROM WORKPLAN:

- The Plan specifies 11 surface water samples, but 12 locations were indicated on the South Plantation figure within the Plan, and so 12 samples were collected.

SAFETY OBSERVATIONS AND GOOD CATCHES:
Discussed hazards of soft footing around the banks of the stream, where the surface water sampling took place.

FIELD ACTIVITY CHRONOLOGY

0800 Samuel Moore, Vivek Lal, and Lauren March arrived on site. Prepared equipment and supplies and performed calibrations.

0830 Held the daily tailgate safety meeting.

0856 Began low-flow groundwater sampling from MW1-53. Purged until parameter stabilization prior to sampling with a total of 10.4 L purged. Collected groundwater samples for VOCs and monitored natural attenuation parameters at 1005. Collected field duplicate, MS, and MSD samples.

1005 Began low-flow groundwater sampling from IW1-S. IW1-S is a 24” manhole with installed extraction pump and electrical hook-up. A spare 1” PVC casing was used to keep the tubing from locking itself inside the larger-diameter casing. Purged until parameter stabilization prior to sampling with a total of 4 L purged. Collected groundwater samples for VOCs and monitored natural attenuation parameters at 1025.

1120 Began low-flow groundwater sampling from MW1-60. Purged until parameter stabilization prior to sampling with a total of 3 L purged. Collected groundwater samples for VOCs, monitored natural attenuation parameters, microbial population quantification, PFAS, and 1,4-dioxane at 1140.

1130 Collected remaining ferrous iron samples from across the site. Packed up equipment, performed post-calibrations and prepared samples for shipment.

1330 All off site for lunch.

1400 All on site. Prepared equipment and supplies for surface water sampling.

1430 L. March left to ship samples to Empirical Laboratories, Microbial Insights, and Battelle Norwell laboratory and return rented generators.

1450 Collected surface water sample SW1-01, nearby Peeper S-10.

1458 Collected surface water sample SW1-02, nearby Peeper S-9.

1504 Collected surface water sample SW1-03, west of Peeper S-9 by approximately 20 feet.

1514 Collected surface water sample SW1-04, east of Peeper S-8 by approximately 15 feet.

1523 Collected surface water sample SW1-05, nearby Peeper S-8.

1531 Collected surface water sample SW1-06, nearby Peeper S-7. Collected field duplicate, MS, and MSD.

1545 Collected surface water sample SW1-07, nearby Peeper S-6.

1551 Collected surface water sample SW1-08, nearby Peeper S-5.

1556 Collected surface water sample SW1-09, nearby Peeper S-4B.

1609 Collected surface water sample SW1-10, nearby Peeper S-4.

1615 Collected surface water sample SW1-11, nearby Peeper S-3B.

1621 Collected surface water sample SW1-12, nearby Peeper S-2

1630 L. March returned to site. Performed remaining post-calibrations and packaged samples and remaining equipment. Prepared COCs and finished paperwork.

1720 Secured site.

1740 All off site.

SUMMARY OF FINDINGS

Groundwater sampling was conducted with little depression and rapid stabilization of water quality parameters and low turbidity in wells MW1-53, IW1-S, and MW1-60. Surface water samples were collected from 12 locations SW1-01 through SW1-12. Surface water locations varied in characteristics from shallow, nearly stagnant turbid puddles to a rapidly flowing, clear stream.

PLANS FOR THE FOLLOWING DAY:

Ship the remaining surface water samples to Empirical Laboratories. Demobilize from the site. Future endeavors include completing the installation of the final CMT well MW1-58, completing development of MW1-58, collecting groundwater samples from MW1-58, and collecting the two storm water samples.

ATTACHMENTS:

None

Copies to: Michael Meyer, Vivek Lal, Lauren March	**Battelle - DAILY FIELD REPORT** Signed: ___________________________

DAILY FIELD REPORT

11 / 01 / 2017

Contract No.

N39430-16-D-1802, CTO 010

Reference

Sampling and Analysis Plan (Battelle 2017)

Accident Prevention Plan (Battelle 2017)

Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II

Location: Naval Base Kitsap Keyport, WA OU1

Client: Naval Facilities Engineering Command Northwest

Contractor: Battelle

Weather: Partly cloudy, high 50F

To: Carlotta Cellucci

From: Michael Meyer

PERSONNEL ON SITE:

Michael Meyer (Battelle)

Dale Smith, Abe Causland, and Austin Cuda (Holt Services, Inc.)

SUMMARY OF WORK COMPLETED:

- Organized gear for drilling, calibrated PID.
- Don PPE.
- Conducted health and safety tailgate safety meeting with drillers.
- Drilled and installed MW1-58 (B-89), located at staked location.
- Demobilize drilling equipment

DEVIATIONS FROM WORKPLAN:

No deviations from SAP; MW1-58 drilled and installed as planned.

SAFETY OBSERVATIONS / GOOD CATCHES:

High VOC concentrations at today's drilling location had the opportunity to present an inhalation hazard. However, frequent monitoring using the hand-held PID allowed for adjusting work practices (such as keeping faces away from the top of auger) that allowed for safe work. Measured VOC concentrations within the breathing zone remained well below action levels for upgrading of PPE to Level C.

FIELD ACTIVITY CHRONOLOGY

0720 Michael Meyer arrived on site. Calibrated PID and prepared daily paperwork and supplies

0815 Drillers on site

0900 Moved rig onto MW1-58.

0920 Safety meeting. Discussed contaminant levels, on-going water line construction traffic. Discussed target sampling depths. Plan to look for a well-graded sand and tag the Lawton Clay. Set well on top of clay.

0930 Began drilling MW1-58 (SP-B89).

0935 At 5 ft bgs. First sample interval.

1036 At 22.5 ft bgs. Second sample interval. Added water to control heave.

1100 Dale Smith from Holt Services on site to build CMT well casing.

1138 At 32.5 ft bgs. Third sample interval.

1215 No clay in sampler. Drove SPT sampler 35-36.5 feet bgs, observed all medium grained sand. Drilled to 40 ft bgs, but stopped at apparent drilling change at 38 ft bgs. Drive SPT sampler 38-39.5 ft bgs. Clay in shoe of sampler.

1245 Based on depth to Lawton Clay, selected 36 ft bgs as depth of lower screen, with 2 feet of sand below to keep the screen well above the clay and avoid potential auger smear effects. Completed well casing build, including grouting unused channels.

1320 Casing set in hole. Bottom screen (center channel) set at 36 ft bgs. Sand 38 ft to 33.5 ft bgs. Bentonite pellet seal above.

1430 Second screen set at 17 ft bgs (channel 2). Sand 19 ft to 14.5 ft bgs. Bentonite pellet seal above.

1453 Third screen set at 7 ft bgs (channel 1). Sand 9 ft to 4.5 ft bgs. Bentonite pellet seal above. Set well monument, cleanup, and demobilize drilling equipment.

1600 Off site.

SUMMARY OF FINDINGS

MW1-58 was installed as planned using CMT with screens at 7 ft bgs, 17 ft bgs, and immediately on top of the Lawton Clay (screen at 36 ft bgs). Samples for VOC and physical analyses were collected from soil within each screened interval.

PLANS FOR THE FOLLOWING DAY:

The next field event at the site is scheduled for 3 November, 2017 – land survey of well locations and elevations.

ATTACHMENTS:

None

Copies to: Josh Sacker, Sam Moore	**Battelle - DAILY FIELD REPORT** Signed: ___________________________

DAILY FIELD REPORT 11 / 15 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: Cloudy with rain showers, high 47 F, winds S 14 mph	
To: Carlotta Cellucci	
From: Samuel Moore	

PERSONNEL ON SITE:

Samuel Moore, Michael Meyer (Battelle)

SUMMARY OF WORK COMPLETED:

- Collected samples from two stormwater locations (08-705-STORMW and MH-STORMW)
- Collected groundwater samples from all depths at CMT well MW1-58 (-9.0, -19.0, and -35.0)
- Reattempted to collect a groundwater sample from the deepest interval in CMT well MW1-56, but no groundwater had recharged into the well

DEVIATIONS FROM WORKPLAN:

- Samples could not be collected from the deepest interval in CMT well MW1-56.
- Samples collected from shallowest interval in CMT well MW1-58-9.0 for analysis of PFAS also included a duplicate and matrix spike and matrix spike duplicate sample, due to being analyzed in a separate batch from previous samples collected for analysis of PFAS.

SAFETY OBSERVATIONS AND GOOD CATCHES:

Discussed hazards of leaving the manhole open during sampling and decided to cone off the manhole at any time it is open.

FIELD ACTIVITY CHRONOLOGY

0745 Samuel Moore on site. The OU1 storage shed was beginning to flood due to the amount of rainfall the previous several days. Extended the sump pump outlet to drain farther into the North Plantation. Prepared equipment and supplies.

0830 Michael Meyer on site. Calibrated equipment.

0900 Held the tailgate safety meeting. M. Meyer removed the manhole cover in preparation for sampling and allowed time for any surface debris that might have fallen down the manhole. Depth to water in the manhole immediately upstream of outfall 08-705 was measured to be 54” below ground surface, with the depth to the invert for the outfall at 58” bgs.

0920 Attempted to measure the static depth to water at MW1-56-31.0. Could not detect any groundwater in the well, indicating that it is not recharging.

0942 Began low-flow groundwater sampling from MW1-58-9.0. Purged until parameter stabilization prior to sampling with a total of 14.7 L purged. Solvent odors were detected during purging. Collected groundwater samples for VOCs, monitored natural attenuation parameters, PFAS, and 1,4-dioxane at 1117.

1025 Collected surface water sample 08-705-STORMW-171115 using a plastic graduated dipper.

1040 Collected surface water sample MH-STORMW-171115 using a plastic graduated dipper.

1140 Collected equipment blank sample from the plastic graduated dipper.

1200 Broke for lunch.

1240 Returned to the site.

1251 Began low-flow groundwater sampling from MW1-58-19.0. Purged until parameter stabilization prior to sampling with a total of 13.0 L purged. Slight solvent odors were detected during purging. Collected groundwater samples for VOCs and monitored natural attenuation parameters at 1356.

1419 Began low-flow groundwater sampling from MW1-58-35.0. Purged until parameter stabilization prior to sampling with a total of 7.5 L purged. Slight hydrogen sulfide odors were detected during purging. Collected groundwater samples for VOCs and monitored natural attenuation parameters at 1509.

1530 Packed up equipment, performed post-calibrations, and secured site.

1615 All off site.

SUMMARY OF FINDINGS

Stormwater samples were collected from outfall 08-705 and the manhole upstream from it during rainy weather and stormwater flow. Groundwater sampling was conducted with rapid stabilization of water quality parameters and low turbidity in all intervals of CMT well MW1-58. Solvent odors were detected in the shallow and intermediate depths (MW1-58-9.0 and -19.0). Hydrogen sulfide odors and elevated pH and sulfite concentrations were apparent in the deepest interval (MW1-58-35.0). CMT well MW1-56-33.0 appears to have very poor recharge rates and is likely installed with its screened interval smeared or completely in clay.

PLANS FOR THE FOLLOWING DAY:

None.

ATTACHMENTS:

None

Copies to: Michael Meyer	**Battelle - DAILY FIELD REPORT** Signed: ___________________________

DAILY FIELD REPORT 11 / 16 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: Cloudy with rain showers, high 46 F, winds S 10 mph	
To: Carlotta Cellucci	
From: Samuel Moore	

PERSONNEL ON SITE:

Samuel Moore (Battelle)

SUMMARY OF WORK COMPLETED:

- Shipped all samples to their respective laboratories
- Demobilized all Battelle equipment from the site

DEVIATIONS FROM WORKPLAN:

- None.

SAFETY OBSERVATIONS AND GOOD CATCHES:

None.

FIELD ACTIVITY CHRONOLOGY

0800	Samuel Moore on site at OU1 preparing equipment.
0850	Pre-calibrated GNSS surveying instrument. Surveyed soil vapor monitoring locations OU2A8-SV-1 through -6.
0915	Performed post-calibrations and demobilized site. Prepared samples for shipment.
1245	All off site.

SUMMARY OF FINDINGS

Samples were sent to their respective laboratories.

PLANS FOR THE FOLLOWING DAY:

None.

ATTACHMENTS:

None

Copies to: Michael Meyer	**Battelle - DAILY FIELD REPORT**

	Signed: ___________________________

BATTELLE
It can be done

DAILY FIELD REPORT 12 / 14 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: Partly sunny, high 45F	
To: Carlotta Cellucci	
From: Michael Meyer	

PERSONNEL ON SITE:

Michael Meyer (Battelle)
Dale Hunt, T.J., and Devin from Keyport Hazardous Waste

SUMMARY OF WORK COMPLETED:

- GPS coordinates of MW1-61 well bore location.
- Conducted health and safety tailgate safety meeting with hazardous waste sampling staff.
- Sampled soil investigation-derived waste (IDW) drums.

DEVIATIONS FROM WORKPLAN:

No deviations from SAP.

SAFETY OBSERVATIONS AND GOOD CATCHES:

Observed that discarded boards with nails remain just outside door of tent covering IDW drums. Combined with the accumulation of slippery mud between the debris pile and the tent, this presents a risk of slips/trips/falls to pedestrians entering the door.

FIELD ACTIVITY CHRONOLOGY

0720 Michael Meyer arrives on site. Collect GPS coordinates of well bore of MW1-61. N 47.69621; W 122.62656. Decimal degrees, NAD27.
0750 Set up for drum sampling.
0840 Drums labeled according to composite sample. Set up bottle kits and label bottles.
0920 Four bottle kits set up and labeled. Meet with Dale Hunt of Keyport Hazardous Waste. T.J. and Devin assigned to open drums and create composite samples. Go over safety. Review contaminants. Use long gloves to sample, be prepared to use respirators if needed. Agree with Dale Hunt to sample soil beneath any standing water.
0944 Begin opening drums.
1000 Sample A drums – OU1-DRUM-S-A
1003 Discover that Drum 24 is entirely asphalt cores – no sample collected.
1010 Sample C drums – OU1-DRUM-S-C
1024 M. Meyer offsite for VI meeting with C. Cellucci. Drum sampling continues.

1200 Sample D drums – OU1-DRUM-S-D
1230 Sample G drums – OU1-DRUM-S-G. Lunch.
1330 Sample I drums – OU1-DRUM-S-I
1345 Sample L drums – OU1-DRUM-S-L
1400 Sample M drum (Area 8) – OU1-DRUM-S-M
1420 Sample O drums – OU1-DRUM-S-O. Pack up. Note that drum 68 is mostly water on top of about 6-inches of soil. Soil included in O composite sample. Recommend also including water in P composite sample.
1510 Offsite.

SUMMARY OF FINDINGS

- Drum 24 is entirely asphalt – no sample collected.
- Upon opening, a few drums were found to be water, rather than soil cuttings – reassigned to water sampling.
- Drum 68 is mostly water on top of about 6-inches of soil. Soil included in O composite sample. Recommend also including water in P composite sample.

PLANS FOR THE FOLLOWING DAY:

Sample water drums on Monday, 18 December.

ATTACHMENTS:

Updated drum inventory.

Copies to: Josh Sacker, Sam Moore	**Battelle - DAILY FIELD REPORT** Signed: ___________________________

DAILY FIELD REPORT 12 / 18 / 2017	**Contract No.** N39430-16-D-1802, CTO 010 **Reference** Sampling and Analysis Plan (Battelle 2017) Accident Prevention Plan (Battelle 2017)
Project: 100098089 Naval Base Kitsap Keyport, WA OU1 Site Recharacterization Phase II	
Location: Naval Base Kitsap Keyport, WA OU1	
Client: Naval Facilities Engineering Command Northwest	**Contractor:** Battelle
Weather: Raining, high 50F	
To: Carlotta Cellucci	
From: Michael Meyer	

PERSONNEL ON SITE:

Michael Meyer (Battelle)
D.J., and Devin from Keyport Hazardous Waste

SUMMARY OF WORK COMPLETED:

- Sampled water investigation-derived waste (IDW) drums.
- Replaced lock box on shed (same combination used)

DEVIATIONS FROM WORKPLAN:

No deviations from SAP.

SAFETY OBSERVATIONS AND GOOD CATCHES:

None this site visit.

FIELD ACTIVITY CHRONOLOGY

0720 Michael Meyer arrives on site. Note that lock box for shed key not operating properly – nearly impossible to open. Set up for drum sampling.
0755 Check in with D.J. – Dale Hunt is out for the holidays.
0810 D.J. and Devin on site for sampling water drums.
0830 Sampled B drums – OU1-DRUM-W-B
0850 Sampled E drums – OU1-DRUM-W-E
0910 Sampled F drums – OU1-DRUM-W-F
0925 Sampled H drums – OU1-DRUM-W-H
0950 Sampled J drums – OU1-DRUM-W-J
Paused sampling for conference call regarding OU 1 data evaluation and presentation
1130 Sample N drums – OU1-DRUM-W-N
1145 Sampled P drums – OU1-DRUM-W-P. Took lunch, purchased additional ice, packed and shipped samples, and replaced lock box programmed to the same combination as the old box.
1430 Offsite.

SUMMARY OF FINDINGS

- All IDW drums (soil and water) have now been sampled.

PLANS FOR THE FOLLOWING DAY:

Field work is comkplete.

ATTACHMENTS:

Updated drum inventory.

Copies to: Josh Sacker, Sam Moore	**Battelle - DAILY FIELD REPORT** Signed: ___________________________

APPENDIX D

Boring and Well Logs

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
Northwest Regional Office • 3190 160th Ave SE • Bellevue, WA 98008-5452 • 425-649-7000
711 for Washington Relay Service • Persons with a speech disability can call 877-833-6341

OCT 02 2017

Michael Meyer
Battelle Memorial Institute
25814 78th Ave SW
Vashon, WA 98070-8508

RE: Variance request from Washington Administrative Code (WAC) for installation of a product not meeting various requirements. The project is located at 1051 Bradley Road, Naval Undersea Warfare Center, Keyport, in SW¼ SW¼, Section 36, Township 26N, Range 01 E, W.M. in Kitsap County.

Dear Mr. Meyer:

You requested a waiver from various construction codes for installation of a Solinst-brand Continuous Multi-channel Tubing (CMT) monitoring well at one location on US Navy property. The location of the proposed construction is detailed on a map submitted with the variance request.

After an investigation, interview, and review of information available, a variance is hereby **granted** in accordance with WAC 173-160-106 to allow installation of up to (4) CMT wells at the sites identified by the site map. This decision is based upon, but not limited to, the following:

1. Access agreements must be current and applicable to work described in the variance request for the property. Approval of the request for variance does not grant access to the site.
2. Installation/construction of the CMT well shall occur only at the sites identified by the site map submitted with the request
3. The CMT shall be allowed to relax once removed from the bale to promote plumb installation.
4. The unused channel spaces in each CMT shall be pre-grouted to seal the wells and prepare them for decommissioning at the end of their useful life.

5. Filter packing and sealing shall follow the plan submitted with the variance request.

6. Installation shall be completed for each individual CMT well as the pre-grout is allowed to set, to prevent cracking of hardened seal material during installation.

7. The CMT wells shall be decommissioned by grouting with a tremie tube from the bottom to the top of each individual channel at the end of each well's useful life.

8. Enough seal material shall be used in decommissioning the CMT wells to fill the void space in the filter pack outside each screened interval.

9. Inform Ecology (Noel S. Philip, 425-649-7044) two business days before any work begins. The site must be accessible to Mr. Philip or any county delegate to inspect any and/or all construction work.

CMT by this manufacturer and the proposed construction does not meet the following WAC for the reasons given:

- WAC 173-160-430, the casing standards for material composition are not met, and structural integrity is suspect

- WAC 173-160-444, polymers and additives are not NSF/ANSI approved, namely the plasticizer used to decrease the viscosity of the slurry used to pre-grout the unused channel space in the CMT

- WAC 173-160-450, the multiple screened areas do not provide casing stability as well as the minimum standard, a continuous seal to land surface

- WAC 173-160-460, decommissioning standards will be impossible to meet due to the configuration of open area (screened interval) in each continuous channel at the point of sampling, preventing grouting to the bottom of the well. Further, the manufacturer recommends against overdrilling, or pulling the CMT, and perforating is impossible due to the honeycomb interior structure of the CMT.

Department of Ecology (Ecology) received your variance request via email September 11, 2017. The request was submitted with the following:

- Scaled site maps showing the project location and proposed location of CMT well site

- Cross section of the site showing subsurface conditions interpreted from existing well construction in the area

- Letter of request describing, conceptually, groundwater occurrence and movement, geologic conditions, and presence of low-permeability layers.

The wells will likely be completed within the same shallow aquifer. Installation of these wells poses little to no risk of interconnecting aquifers due to target depths of installation and the areal hydrogeology. Installation shall include pre-grouting of unused channel space so decommissioning leaves no void space in any well or channel at the end of its useful life. Installation shall not penetrate the aquitards, or confining layer, at the base of the water table aquifer less than 50 feet bgs. Chemical analysis suggests the superplasticizer additive does not contain constituents promoting bacteriological growth, or potential to contaminate groundwater. Use of CMT in other states (California) has shown apparent structural integrity to depths greater than 250 feet.

You have a right to appeal this action to the Pollution Control Hearing Board (PCHB) within 30 days of the date of receipt of this document. The appeal process is governed by chapter 43.21B RCW and chapter 371-08 WAC. "Date of receipt" is defined in RCW 43.21B.001(2).

To appeal, you must do the following within 30 days of the date of receipt of this document:

- File your appeal and a copy of this document with the PCHB (see addresses below). Filing means actual receipt by the PCHB during regular business hours.

- Serve a copy of your appeal and this document on Ecology in paper form - by mail or in person (see addresses below). Email is not accepted.

You must also comply with other applicable requirements in chapter 43.21B RCW and chapter 371-08 WAC.

Street Addresses	Mailing Addresses
Department of Ecology Attn: Appeals Processing Desk 300 Desmond Drive SE Lacey, WA 98503	Department of Ecology Attn: Appeals Processing Desk P.O. Box 47608 Olympia, WA 98504-7608
Pollution Control Hearings Board Environmental Hearings Office 1111 Israel Road SW, Suite 301 Tumwater, WA 98501	Pollution Control Hearings Board P.O. Box 40903 Olympia, WA 98504-0903

For additional information, visit the Environmental Hearings Office Website:
http://www.eho.wa.gov

To find laws and agency rules, visit the Washington State Legislature Website:
http://www1.leg.wa.gov/CodeReviser

Your attention to these laws and regulations, and cooperation with the Department of Ecology in this matter, is appreciated. Please telephone Noel S. Philip at (425) 649-7044 or email him at noel.philip@ecy.wa.gov if you have any questions concerning this variance.

DATED this 2 day of October, 2017, at Bellevue, Washington.

Sincerely,

Ria Berns
Interim Section Manager
Water Resources Program

By certified mail: 9171 9690 0935 0163 8182 28

Enclosure: Your Right to be Heard

cc: Noel S. Philip, NWRO WR

I certify that I mailed this Order, or an identical copy thereof, postage prepaid, to the above addressee(s) this 2nd day of October 2017.
Michelle (SIGNATURE)

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B02

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259464.835
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1198807.395
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	16.3
Date Logged:	7/11/2017	Drilling Method:	DPT	Borehole Abandoned:	7/11/2017
Geologist:	Damon DeYoung	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips
Total Depth:	30 feet bgs	Sampler Type:	Macro-Core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0		Asphalt	Asphalt from 0 to 6 inches bgs.							
		Fill	Pea gravel 6 inch to 1 ft.							
2 4		GC	Dark gray clayey gravelly SAND approximately 6 inch wood debris .	10	40	50	0	2.5		
		CL	Dark brown sandy CLAY.							
6 8 10 12		SW	Saturated dark brown silty to fine SAND, dark gray at bottom 6 inch, no PID detection, 10YR 3/3, continuation of dark gray gravelly sand. Dark gray gravelly SAND continues.	5	90	5	0	2.5 5		
14		CH	Dark gray fat CLAY, interbedded with fine sand/silt, silt, silty sand seams approximately 0.5 to 1 inch thick, 5Y 5/1.	5	5	95	0.1 0.2		B02-S14.0 @1450	
16 18 20 22		SP	Dark gray silty SAND, fine grading to medium from 16 to 18 ft, fine sand from 18 to 20 ft, poor recovery from 17.5 to 18 ft, 5Y 5/1.	5	90	5	0.3 0.5 0.7 1.1 0	4 5	B02-S20.0 @1518/B02-GW20 @1531	
24		CL	Interbedded CLAY and fine sand/silt, fat clay seams up to 2 inch thick, gravelly silty sand zone at 24 to 24.5 ft, medium gray, 5Y 5/1.	5	5	95				
26 28 30		CH	Fat clay with 1 to 2 inch lenses of silty sand, gray 5Y 5/1, no PID detections.	5	5	95	0	4.5	B02-S29.0 @1605	

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B03

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259439.156
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1198859.716
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	18.2
Date Logged:	7/12/2017	Drilling Method:	DPT	Borehole Abandoned:	7/12/2017
Geologist:	Damon DeYoung	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips with Asphalt
Total Depth:	45 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	 % Sand	 % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0	▬	Asphalt	Poor recovery, asphalt approximately 0.5 inch.	30	30	40				
4	▨	CH	Gravelly sandy CLAY, medium gray, 5Y 4/1, woody debris below asphalt down to 7 ft.				0	3		
							0	3		
8	▧	SC	Brown clayey SAND, 10YR 3/3.	10	70	20				
12	⁞	SM	Gray SAND with fines, low clay content.	10	70	20	0	5		
	▨	CH	Gray fat CLAY, 10YR 5/1.	< 5	< 5	95				
	⁞	SM	Gray medium SAND.							
16	▨	CH	CLAY with fine sand interbedded approximately 1 to 3 inches thick, 10YR 5/1, PID readings low near 19 ft.	< 5	30	70	0	5	B03-S18.0 @0830, B03-S19.4 @0827	
20	⁞	SM	Fine SAND with low clay content, small clay interbeds less than one inch thick, slight PID readings throughout.	< 5	95	< 5	2.6 0.8 1.3	5	B03-GW22.0 @0958	
24, 28							0.2 0.8 0.1 0.2 0.3 0.2	5		
32	○	GM	Gravelly basal layer to SM unit above.	60	30	10	0	5		
	▨	CH	CLAY with fine sand/silt 10YR 5/1.	< 5	< 5	95				
36	⁞	SM	Clayey silty fine SAND with interbedded thin clay lenses, gray 10YR 5/1, woody material at 41 ft and bits of woody material at 42 to 43 ft.				0.2	5	B03-S37.0 @0938	
40							0	5		
44	▨	CH	CLAY with silty fine sand, 10YR 5/1.	< 5	< 5	95				
48										

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B04

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259361.082
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1198939.307
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	19.1
Date Logged:	7/12/2017	Drilling Method:	DPT	Borehole Abandoned:	7/12/2017
Geologist:	Damon DeYoung	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips/Asphalt
Total Depth:	30 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	% Sand	% Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0		Asphalt	Asphalt from 0 to 6 inches bgs.							
2 4 6 8 10		GM	Gravelly clayey SAND with landfill debris, copper wire, poor recovery likely due to landfill waste.	30	50	20	0.1 0.7 0.9 5.7 0.2	2.5 2		
12 14		SM	Saturated gray silty SAND with brownish water at 11 to 12 ft, sheen on soil from 12 to 14 ft, no PIDs hits, 10YR 5/1.	5	80	15	0	5	B04-S11.5 @1137	
16 18 20		CL	Silty CLAY, gray 10YR 5/1, highest PID detection at 19.5 ft.				1.3 0.4 0.3 0 0.3 0.1 1.3 0.9	5	B04-S19.5 @1135 B04-GW20.0 @1230	
22 24 26		SM	Clayey silty fine SAND, gray 10YR 5/1.				0 0.2 0.5 0 0 0 0	5 5		
28		GM	Sandy GRAVEL at the base of clayey silty SAND.				0 0			
30		CH	CLAY below gravel bed, woody material				0.5 0		B04-S29.0 @1204	

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B05

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259506.043
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1198968.735
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	19.2
Date Logged:	7/12/2017	Drilling Method:	DPT	Borehole Abandoned:	7/12/2017
Geologist:	Damon DeYoung	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips/Asphalt
Total Depth:	40 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0		Asphalt	Asphalt from 0 to 6 inches bgs, poor recovery of soil.	40	50	10				
2 4 6 8		SW	Gravelly clayey SAND, no recovery from 5 to 10 ft.				1.5 0.8 2.2 0	1.5 0		
10 12		SW	Gravelly clayey SAND with wood debris (treated lumber) likely waste in landfill.	30	60	10	0.3 0	4		
14		SM	Silty SAND, gray-brown with thin clay seams (approximately 1 to 2 inches thick).	5	80	15	0.2			
16 18		CH	Silty CLAY with 6 inch interbeds of sand.	< 5	5	95	0.1 0 0.3 1	5	B05-S18.3 @1432 B05-GW19.0 @1625	
20 22 24 26 28 30 32 34 36		SP	SAND with slight gravelly silt, gray 10YR 5/1, coarsens downward into gravelly sand. 5 ft recoveries from 20 ft-40 ft	< 5	95	5	0.6 0.3 0 0.2 0.3 0.2 0 0 0 0 0 0	5 5 5		
		GM	Silty GRAVEL at 6 inch basal layer.				0	5		
38 40		CH	Organic rich clay with woody material, gray 10YR 5/1.				0 0			

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B06A

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259475.704
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1198922.519
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	19.6
Date Logged:	7/12/2017	Drilling Method:	DPT	Borehole Abandoned:	7/12/2017
Geologist:	Damon DeYoung	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips/Asphalt
Total Depth:	35 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0		Asphalt	Asphalt from 0 to 6 inches bgs.							
0.5		GM	Brown to dark brown sandy GRAVEL.	70	30	<5	0.5	2.5		
4		SC	Gray gravelly clayey SAND, 10YR 5/1	30	50	20	0.9 0.3			
5			No recovery 5 to 15 ft.				0 0	0 0		
15		CL	Silty CLAY, gray 10YR 5/1, interbedded silty fine sand lenses less than 1 inch thick. Coarsens downward to sand at 20 ft.	<5	<5	90	2.1 2.3 0.1 0 0	3	B06A-S16.0 @0825	
20		SM	Gray silty SAND, saturated/heavings. Coarsening downward to fine/medium SAND at 30 ft, 2 to 3 inch thick silty clay interbeds from 31 to 33 ft. No basal gravel above clay unit.	<5	90	10	0 0.1 0 0	3 5 5	B06A-S33.0 @0906	
33		CH	Tight gray CLAY with woody debris 10YR 5/1.							
35										

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B07

Permit Number: 17-EP110
Contract: N39430-16-D-1802/CTO 010
Project: 100098089
Date Logged: 7/13/2017
Geologist: Damon DeYoung
Total Depth: 35 feet bgs
Reviewer: Michael Meyer

Drilling Contractor: Holt Services
Driller: Michael Running
Drilling Equipment: 7822 DT
Drilling Method: DPT
Boring Diameter: 2-1/4"
Sampler Type: Macro-core
Hammer Type: Hydraulic

Northing (NAD 83): 259391.098
Easting (NAD 83): 1198805.611
Surface Elevation (NAVD 88): 16.4
Borehole Abandoned: 7/12/2017
Backfill Method: Bentonite Chips/Asphalt
Monitoring Device Installed: No
Device Type: N/A

Depth (ft bgs)	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0	Asphalt	Asphalt from 0 to 6 inches bgs.							
	GM	Sandy clayey GRAVEL with landfill debris (plastic, wood, metal scraps).				2.1 7.9 2.1 0	2.5 2	B07-S4.0 @1005	
9	SM	Brown SAND at 9 ft bgs. Transitions to gray coarse sand with gravel down to 13 ft bgs.	10	70	20	0	5		
13	CL	Coarsening downward sequence of SILT and CLAY layers approximately 6 inches thick.	< 5	5	95				
15	SM	SAND and gravel.	5	80	15				
17	CL	Coarsening downward sequence of CLAY above silt above interbedded silt and fine sand.	< 5	5	95	0	5		
19	SM	SILT and fine SAND, silty clay beds up to 1 ft thick interbedded with silty sand layers between 26 and 29 ft bgs.	< 5	80	20	1.8 0.3 0.2 1.2 0.6 0.7 0.9 0.4 0.6 0.2 0.7 0.8 2.3 0.7 1	5 5	B07-S20.0 @1020 B07-S28.5 @1047 B07-GW29.0 @1122	
30	GM	GRAVEL at 30 ft bgs.	70	20	10	0			
31	CH	Coarsening downward sequence with tight clay at 31 ft bgs with brown organic matter.	< 5	5	95				
32	SM	Grades downward to fine SAND.	< 5	80	20	0	5		
35									

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B08

Permit Number: 17-EP110
Contract: N39430-16-D-1802/CTO 010
Project: 100098089
Date Logged: 7/13/2017
Geologist: Damon DeYoung
Total Depth: 30 feet bgs
Reviewer: Michael Meyer

Drilling Contractor: Holt Services
Driller: Michael Running
Drilling Equipment: 7822 DT
Drilling Method: DPT
Boring Diameter: 2-1/4"
Sampler Type: Macro-core
Hammer Type: Hydraulic

Northing (NAD 83): 259374.430
Easting (NAD 83): 1198882.391
Surface Elevation (NAVD 88): 18.0
Borehole Abandoned: 7/13/2017
Backfill Method: Bentonite Chips/Asphalt
Monitoring Device Installed: No
Device Type: N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0		Asphalt	Asphalt from 0 to 6 inches bgs.							
2 4		SM	Brown to gray gravelly SAND with wood and landfill debris.	30	60	10		2.5		
6 8 10 12		SM	Brown to gray SAND, coarsening downward to medium sand at 14 ft.				0.9 3.3 3.4	1 5		Rock stuck in core barrel prevented retrieval of core from 6 to 10 ft
14		CL	Silty CLAY, gray 10YR 5/1, finely interbedded with silt layers and fine sand lenses.	< 5	< 5	90	0.4			
16 18 20 22 24		ML	Predominantly SILT from 19 to 26 ft with interbeds of fine sand and 1 to 2 inch clay layers.	< 5	< 5	90	0.5 0.1 0.5 2.4 1 0.6 0.3 0 0.2 0.3 0.3 0.5 0.1 0.1 0.2	5 5	B08-S17.5 @1320 B08-GW18.0 @1425	
26		GM	Grades to sand with GRAVEL base at 27.5 ft.	50	40	10	0 0.7 1			
28 30		CH	Gray CLAY with brown woody material.	< 5	< 5	90	0.3 0 0	5	B08-S27.0 @1347	

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B09

Permit Number: 17-EP110
Contract: N39430-16-D-1802/CTO 010
Project: 100098089
Date Logged: 7/17/2017
Geologist: Damon DeYoung
Total Depth: 40 feet bgs
Reviewer: Michael Meyer

Drilling Contractor: Holt Services
Driller: Michael Running
Drilling Equipment: 7822 DT
Drilling Method: DPT
Boring Diameter: 2-1/4"
Sampler Type: Macro-core
Hammer Type: Hydraulic

Northing (NAD 83): 259368.646
Easting (NAD 83): 1199024.652
Surface Elevation (NAVD 88): 18.3
Borehole Abandoned: 7/17/2017
Backfill Method: Bentonite Chips/Asphalt
Monitoring Device Installed: No
Device Type: N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	 % Sand	 % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0		Asphalt	Asphalt from 0 to 6 inches bgs.							
2 4 6 8 10 12		GM	Gravelly clayey SAND to sandy GRAVEL, brown to greenish gray, GLEY1 5GY2 4/2. Thin layers of debris and asphalt chunks. Saturated at 9 ft.	70	15	15	0.2 0.2 0 0.4 1.5 10 1.9	3.5 3.5 3.5		
		CH	CLAY with organic matter (thin roots), greenish gray, overlying gray sand and clay layer. Contaminated odor at 13 ft; black hydrocarbon.	<5	20	80	0		B09-S13.0 @1459	
14 16		SM	Silty SAND, gray 10YR 5/1, fining downward from 14 to 17 ft. Silty CLAY at 16 to17 ft.	<5	70	30	4.2 2 0.9		B09-S14.0 @1624	
18 20 22 24 26 28 30 32 34		SM	Fine SAND coarsening to medium SAND from 17 to 34 ft. Gray 10YR 5/1.	<5	90	<5	0 0 0 0	4.5 5 5 5		
36		ML	Gravelly sandy SILT.							
38		GM	GRAVEL with silt and sand at base above clay.				0.2 0	5		
40		CH	Fat CLAY with woody matter, gray 10YR 5/1. Peat layer at 40 ft.				0.1			

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B10

Permit Number:	17-EP110	Drilling Contractor:	Holt Services
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running
Project:	100098089	Drilling Equipment:	7822 DT
Date Logged:	7/14/2017	Drilling Method:	DPT
Geologist:	Damon DeYoung	Boring Diameter:	2-1/4"
Total Depth:	35 feet bgs	Sampler Type:	Macro-core
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic

Northing (NAD 83):	259368.866
Easting (NAD 83):	1199085.302
Surface Elevation (NAVD 88):	18.6
Borehole Abandoned:	7/14/2017
Backfill Method:	Bentonite Chips/Asphalt
Monitoring Device Installed:	No
Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0		Asphalt	Asphalt from 0 to 6 inches bgs.							
2 4 6 8		GM	Sandy clayey sandy clay, landfill debris. Saturated at 8 ft.	60	20	20	0.1	3 1.5		
10		SM	Greenish gray gravelly SAND with woody debris, gravel at base.	<5	90	<5	17.6 79.5	5	B10-S10.0 @0828	
		SW	Greenish gray SAND with 2 inch clay at top, organic matter throughout.	<5	90	<5	32.1			
12 14 16 18 20 22 24 26		SP	Gray 10YR 5/1 medium SAND with fine sands, low fines, low gravels, 2 inch clay layer at 14 ft, 6 inch gravel layer at 21 ft.	<5	90	<5	0 0 0.1 0.1 0.2 2.9	5 5 5	B10-GW12.0 @0954 B10-S21.0 @0854	
28		GM	Gravel with coarse sand and interbedded silt layers, 4 inch thick layer at 29 ft.	80	15	5	0			
30 32 34		GM	Interbedded GRAVEL with silty SAND & CLAY beds. 1 foot clay bed at 32 ft bgs, wood/peat organic matter.	80	5	15	0.2 0	5		
36										

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B11

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259421.924
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1198991.528
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	20.1
Date Logged:	7/14/2017	Drilling Method:	DPT	Borehole Abandoned:	7/14/2017
Geologist:	Damon DeYoung	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips/Asphalt
Total Depth:	35 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0		Asphalt	Asphalt from 0 to 6 inches bgs.							
			Mixed GRAVEL, SAND & CLAY layers, wood debris, fill material brown to gray.	70	20	10				
2								3.5		
4		GM					0.6 1.7			
6									B11-S7.0 @1042	
8							10.3 5.4	3		
		SM	Gravelly, silty SAND.	30	60	10	0.5			
10										
		SM	Gravelly, clayey SAND, dark gray to dark brown, metal debris (nails).	30	60	10				
12								0.5	B11-GW12.0 @1142	Limited recovery because of rocks stuck in cutting shoe.
14							0			
16			Gray fine SAND 10YR 5/1.	<5	95	<5				
18							0	5		
20		SP								
22							0	5		
24										
26			Fine to medium sand, gray 10YR 5/1, poorly graded (sand only).							
28							0	5		
30		SP								
32							0	5		
34		ML	SILT with interbedded fine to medium SAND, no clay.							
36										

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B12

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259304.613
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1198988.310
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	18.3
Date Logged:	7/14/2017	Drilling Method:	DPT	Borehole Abandoned:	7/14/2017
Geologist:	Damon DeYoung	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips/Asphalt
Total Depth:	35 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0–0.5		Asphalt	Asphalt from 0 to 6 inches bgs.							
0.5–9		GM	Sandy, clayey GRAVEL, poorly recovered from 0 to 10 ft, likely compressed sample.	60	20	20	0 0.4 0.3 0.2 0 0	2.5 2.5		
9–14		SP	Gray fine to medium SAND, mottled brown staining (iron oxide).				0 0 0 0 0	5		
14–20		CH	CLAY, gray, interbedded with SILT, finely bedded.				0 0.5 0.3 0.5 0.6 0.3 0	5	B12-S17.5 @1326	
20–29		SP	Fine SAND with 3 to 4 inch thick beds of silt and clayey silt. 3 inch thick gravel bed at 28 ft.				0.4 1 0.9 0 0.2 0 0 0 0 0	5 5	B12-S20.5 @1357 B12-GW21.0 @1412	
29–31		ML	SILT, dark gray, peat layer approximately 0.5 inch thick at the base.				0 0.3 0.6 1.1			
31–35		SM	Medium SAND approximately 6 inches thick overlying clay with black organic matter grading downward to silt, then to fine sand down to TD. 5 ft recovery from 30-35 ft bgs.				0.7 2.3 0 0 0	5	B12-S31.5 @1445	
35–36							0			

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B13

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259367.568
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1199164.105
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	16.4
Date Logged:	7/17/2017	Drilling Method:	DPT	Borehole Abandoned:	7/17/2017
Geologist:	Damon DeYoung	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips/Asphalt
Total Depth:	35 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0		Asphalt	Asphalt from 0 to 6 inches bgs.							
2		GM	Sandy, clayey GRAVEL, gray to brown (Fill), only recovered 1.5 ft.	80	15	5				
4 6							0	1.5		
8		CH	Gray to greenish gray sandy gravelly CLAY, only recovered 0.5 ft.	15	15	70	0	0.5		
10 12		CH	Saturated at 10 ft. Interbedded sandy CLAY, clayey SAND and silty SAND greenish gray, dark interval of contaminated clayey sand at 11.5 ft.	<5	40	60	0 0 2.5 0 0	5	B13-S11.5 @0840 B13-GW12.0 @1003	
14		CH	Gray CLAY approximately 1 ft thick.	<5	5	95	0			
16		SM	Interbedded silty SAND and fine SAND, gray.	<5	80	20	0 0			
18 20 22 24 26 28 30		SP	Fine to medium SAND, gray, interbedded silt layers approximately 1 inch thick at 22.5 and 23.5 ft, unit is consistent from 17 to 31.5 ft bgs.	<5	90	10	0 0 0 0 0 0 0 0 0 0	5 5 5		
32 34		GM	Interbedded sandy GRAVEL and sandy SILT with beds of clean SAND, gray.	40	30	30	0	5		
36										

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B14B

Permit Number: 17-EP110
Contract: N39430-16-D-1802/CTO 010
Project: 100098089
Date Logged: 7/17/2017
Geologist: Damon DeYoung
Total Depth: 35 feet bgs
Reviewer: Michael Meyer

Drilling Contractor: Holt Services
Driller: Michael Running
Drilling Equipment: 7822 DT
Drilling Method: DPT
Boring Diameter: 2-1/4"
Sampler Type: Macro-core
Hammer Type: Hydraulic

Northing (NAD 83): 259419.948
Easting (NAD 83): 1199081.709
Surface Elevation (NAVD 88): 18.8
Borehole Abandoned: 7/17/2017
Backfill Method: Bentonite Chips/Asphalt
Monitoring Device Installed: No
Device Type: N/A

Depth (ft bgs)	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0	Asphalt	Asphalt from 0 to 6 inches bgs.							
2 4 6 8 10	GM	Sandy, clayey, GRAVEL brown to gray, wood material mixed with greenish gray clay, saturated at 6 ft bgs. 6 inch greenish gray gravelly silty clay at 9 ft bgs with elevated PID reading, wood stops at 11 ft bgs (Fill).	70	15	15	4.8 2.8 1.2 4.8 0.2 0.4 7.3 9.1 114 9.8 8.4	3 3	B14B-S4.0 @1102 B14B-S9.0 @1108	Collected soil field duplicate at 9.0 ft bgs
12 14	SP	Interbedded silty SAND and clayey SILT, greenish gray, mottled orange at 13 ft bgs, sheen from 16 to 19 ft.	<5	30	70	4.8 0.4 0.3	3.5		
16 18	SM	Interbedded silty SAND and fine to medium SAND, gray.	<5	50	50	6 34.3 0.5 22.5 124.8 96.4 102.3	5	B14B-S18.0 @1124	
20 22 24 26 28 30	SP	Fine to medium SAND, gray, high PID readings from 20 ft (449 ppm) to 22.5 ft (229 ppm), no clay or silt layers until 32 ft bgs.	<5	100	<5	449 178 523 423 124.7 229 5 1.9 4.9 1.9 1.3 0.9 0 2 0.1	5 5	B14B-S21.0 @1135 B14B-GW22.0 @1240	
32	SM	Thin silty SAND layers less than 1 inch at 32 ft transitions to sandy gravel from 32 ft to 33 ft.				0	5		
34	GM	Sandy, silty GRAVEL, gray.				0 0 0			
36									

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B15

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259422.470
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1199163.177
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	16.4
Date Logged:	7/17/2017	Drilling Method:	DPT	Borehole Abandoned:	7/17/2017
Geologist:	Damon DeYoung	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips/Asphalt
Total Depth:	30 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	 % Sand	 % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0		Asphalt	Asphalt from 0 to 3 inches bgs.	70	20	10				
2		GM	Brown to greenish gray sandy - clayey GRAVEL, dark brown. Woody debris and clayey SAND at 3 to 4 ft bgs. (Fill)				0 0.1 0	3.5		
4 6 8 10		CL	Greenish gray mottled with orange silty sandy CLAY with brown peat interval from 8 to 9 ft.	<5	30	70	0 0 0	3.5		
12 14		SP	Interbedded thin fine SAND, silty CLAY and clayey SILT, clay layers are less than 2 inches thick.	<5	30	70		4.5		
16 18 20 22		SP	Interbedded SNAD and silty fine SAND. Slight PID reading (1.0 ppm) at 23 ft within silty sand layer approximately 4 inches thick.	<5	80	20	0 0 0 0 0 1 0.2	4.5 5	B15-S23.0 @1524, B15-GW23.0 @1614	Collected MS and MSD at 23.0 ft.
24 26 28 30		SP	SAND gray. Thin silt layer less than 1 inch at 26.5 ft bgs.	<5	95	5	0 0 0	5		

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B16

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259501.176
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1199084.296
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	18.8
Date Logged:	7/18/2017	Drilling Method:	DPT	Borehole Abandoned:	7/18/2017
Geologist:	Damon DeYoung	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips/Asphalt
Total Depth:	35 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Sample ID Date/Time	Comments
0	Asphalt	Asphalt from 0 to 6 inches bgs.						
2 4 6	GM	Compressed core, sandy, clayey GRAVEL fill, brown to greenish gray. Waste debris at 2 to 3 ft bgs. Saturated at 7 ft bgs.	70	15	15	0.2 0.1 0.2 1.8 1.1 5.7 0.9 0.5		
8 10	GM	Sandy, clayey GRAVEL, gray. Grades downward to coarse gravel at 11 ft bgs.	70	15	15	0.4 0.4 0.6		
12	ML	Clayey SILT, orangish brown (mottled). Transitions to greenish gray at 12.5 ft bgs where highest PID reading is 7.2 ppm.	<5	20	80	0.6 1.6 7.2 0.5	B16-S12.5 @0856 B16-GW13.0 @1000	
14	GM	Interbedded SILT and fine SAND coarsening down to GRAVEL at 15.5 ft bgs.	30	60	10	0.5 1.1		
16 18 20 22	SP	Fine to medium SAND.	<5	90	10	0 0 0 0 0 0 0		
24 26	ML	Clayey, sandy SILT, gray, tightly interbedded with fine sand layers and thin clay layers.	<5	40	60	0 0 0 0		
28 30 32 34	SP	Fine SAND, gray. Coarsening to medium sand and gravel at 32 ft bgs, interbedded SILT and fine SAND from 32 to 35 ft, dark organic layers at 34.5 ft.				0 0 0 0 0 0 0 0		
36						0		

Depth (ft bgs)	Measured Recovery (ft)
0–5	3
5–10	3
10–15	5
15–20	5
20–25	5
25–30	5
30–35	5

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B17

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259498.816
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1199169.089
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	17.3
Date Logged:	7/18/2017	Drilling Method:	DPT	Borehole Abandoned:	7/18/2017
Geologist:	Damon DeYoung	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips/Asphalt
Total Depth:	25 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0	■	Asphalt	Asphalt from 0 to 6 inches bgs.							
2 4		GM	Poor recovery. Sandy, clayey GRAVEL, brownish black.	70	15	15	7.5 17.4 0.6	1.5		
6	▨	CH	Greenish gray CLAY with sand and gravel.	<5	5	95	0			
		OL	PEAT from 6.5 to 8 ft bgs.					4.5		
8 10 12	▨	CL	Greenish gray silty CLAY, mottled orangish brown.	<5	5	95	0 0	4		
14 16		SP	Silty clayey SAND, gray interbedded layer. Poor recovery.	5	80	20				
18		SP	Fine SAND, gray. Fines downward to interbedded SILT and fine SAND from 19 to 20 ft bgs.				0	3	B17-GW19.5 @1142 B17-S20.0 @1053	
20 22		SP	Interbedded SILT and fine SAND from 22 to 22.5 ft bgs, fine SAND from 22.5 to 24 ft.	<5	80	20	0	5		
24		GM	Sandy GRAVEL from 24 to 25 ft.	80	20	<5				
26										

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B18A

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259467.436
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1199027.965
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	19.4
Date Logged:	7/18/2017	Drilling Method:	DPT	Borehole Abandoned:	7/19/2017
Geologist:	Damon DeYoung	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips/Asphalt
Total Depth:	50 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0		Asphalt	Asphalt from 0 to 6 inches bgs.	70	15	15				
4		GM	Sandy to clayey GRAVEL, brown to greenish-gray, wood debris at 5 ft bgs.				0 0 0.4 0.1 0.4 0.1	3		
8		GM	Mixed wood waste and clayey, sandy GRAVEL.				0 0 0	3		
12		GM	Poor recovery, core barrel caught wood debris, coarse sandy GRAVEL, creosote, odor in wood debris at 14.5 ft.	70	15	15	1	0.5	B18A-S14.5 @1333, B18A-GW14.5 @1340	Sheen present from recovered material in 10 to 15 ft core barrel.
16		GM	Poor recovery from 15 to 17 ft, dark gray clayey sandy GRAVEL with wood debris, black non-volatile liquid seeping out of material at 18 ft.	60	20	20	0.1 0	3	B18A-S18.0 @1405	Sheen present from recovered material in 15 to 20 ft core barrel. Collected SVOC sample at 18.0 ft.
20		CH	0.5 ft CLAY, gray.	<5	5	95	5.9			
24		SP	Fine SAND, gray, thin layers of silt at 22, 23, 24 ft.	10	80	10	75.2 141 68 180 32.4 3.6 39.1 11.3	5	B18A-S21.5 @1412 B18A-S22.3 @1414	
28		GM	Grades to medium to coarse SAND and GRAVEL.	10	80	10	3.8 7.4 4.7 2.8	5		
32 36 40 44 48		GM	Mixed SAND (coarse) and GRAVEL. PID readings above 0.0 ppm from 30 to 45 ft, not detected from 46 to 50 ft.	50	40	10	4.7 1.4 6.9 11.4 3.4 6.9 4 6.5 2.6 4.2 3.7 3.6 0 0 0 0 0	5 5 2 5	B18A-S33.0 @1445, B18A-GW33.0 @0918 on 7/19	Core barrel stuck in drive rod. Drilled 40 ft to 50 ft section on 7/19/17.
52										

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B19

Permit Number: 17-EP110
Contract: N39430-16-D-1802/CTO 010
Project: 100098089
Date Logged: 7/19/2017
Geologist: Damon DeYoung
Total Depth: 40 feet bgs
Reviewer: Michael Meyer

Drilling Contractor: Holt Services
Driller: Michael Running
Drilling Equipment: 7822 DT
Drilling Method: DPT
Boring Diameter: 2-1/4"
Sampler Type: Macro-core
Hammer Type: Hydraulic

Northing (NAD 83): 259475.198
Easting (NAD 83): 1198977.635
Surface Elevation (NAVD 88): 20.0
Borehole Abandoned: Yes
Backfill Method: Bentonite Chips/Asphalt
Monitoring Device Installed: No
Device Type: N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0		Asphalt								
2		GM	Sandy clayey GRAVEL, dark brown to greenish gray (Fill).				7.1 0.1 0.2	3		
4		GM	Wood and metal debris.				0			
6 8 10 12		GM	Sandy clayey GRAVEL, gray to brown. Saturated at 11 ft bgs. Wood plug at 13 ft bgs.	60	20	20	0 2 1.1 1.8 5.7 0 0.2	3 5		
		GM	Black silty CLAY.	60	20	20	0			
14		SM	Silty SAND with clay lamina (less than 0.5 inch), greenish gray.	<5	80	20	0			
		GM	Sandy GRAVEL, brown.	50	50	<5	0			
16		CH	CLAY, gray, with 6inch bed of sand. Thin silt lamina present in clay layers.	<5	10	90	0	5		
18 20 22 24 26 28 30 32 34 36		SP	Gray, fine to medium SAND with gravel observed intermittently.	5	95	<5	0 0 0 0	5 5 5 5	B19-S23.0 @1022, B19-GW23.0 @1130 B19-S38.0 @1117	
38 40		ML	Basal GRAVEL at 38 ft bgs. Clayey sandy SILT with brown organics from 38 to 40 ft	<5	10	90				

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B20

Permit Number: 17-EP110
Contract: N39430-16-D-1802/CTO 010
Project: 100098089
Date Logged: 7/19/2017
Geologist: Damon DeYoung
Total Depth: 40 feet bgs
Reviewer: Michael Meyer

Drilling Contractor: Holt Services
Driller: Michael Running
Drilling Equipment: 7822 DT
Drilling Method: DPT
Boring Diameter: 2-1/4"
Sampler Type: Macro-core
Hammer Type: Hydraulic

Northing (NAD 83): 259503.505
Easting (NAD 83): 1199028.280
Surface Elevation (NAVD 88): 19.9
Borehole Abandoned: 7/19/2017
Backfill Method: Bentonite Chips/Asphalt
Monitoring Device Installed: No
Device Type: N/A

Depth (ft bgs)	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0	Asphalt	Poor recovery.							
2 4	GM	Sandy clayey GRAVEL, light gray to blackish brown to greenish gray (Fill).				2.8 0 0.1 0.1 0.4	2.5		
6 8	GM	Poor recovery, wood and metal debris to 8 ft bgs, bluish gray clay to 9.5 ft, wood debris from 9.5 to 10 ft.	70	15	15	4.2 1.2 0 0 0.2	3.5		
10	SC	Clayey SAND, grayish brown, saturated.	10	60	30	0			
	OL	PEAT, dark brown, saturated.	<5	80	20				
12	SM	Silty SAND, brown to greenish gray.	<5	60	40	0	5		
14	ML	Interbedded clayey SILT and silty CLAY, clay up to 3 inches thick.	<5	10	90				
16	SP	Fine SAND grades to silty CLAY, brown, then grades to gray silty CLAY/ clayey SILT.	<5	90	10				
	CH		<5	10	90				
	MH		<5	50	50	0	5		
18 20 22 24 26 28 30 32	SP	Fine SAND, gray with thin interbeds of silty sand at 22.5, 24.5, 25.5, 27 and 29 ft.	<5	80	20	0 0.5 0.5 0.1 2 3.8 2.4 7.1 4.7 1.1 19.8 58.4 76.7 33.1 12.5	5 5 5	B20-S25.0 @1350 B20-GW26.0 @1515 B20-S28.3 @1406 B20-S31.5 @1423 B20-GW32.0 @1537	
34	ML	Fine sandy SILT.	<5	30	70	0			
36	SP	Fine to medium SAND firming downward to silt.	<5	80	20	0.8 0.5 0 0			
38	ML	SILT, gray, with one thin sand bed 1 inch thick at 38.5 ft.	<5	20	80	0 0	5		
40	OL	GRAVEL overlying dark brown organic layer (PEAT) at 40 ft bgs.	60	30	10	0			
42									

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B21

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259541.734
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1199030.234
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	20.1
Date Logged:	7/20/2017	Drilling Method:	DPT	Borehole Abandoned:	7/20/2017
Geologist:	Damon DeYoung	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips/Asphalt
Total Depth:	34 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0		Asphalt	Asphalt from 0 to 6 inches bgs.							
2 4 6 8 10		GM	Clayey sandy GRAVEL with wood debris, gray to brown to greenish gray at 10 ft bgs. (Fill)	70	15	15	4.1 1.3 1.8 2.7 0.3 0 0 1.9	3 2.5		
		OL	Brown PEAT transitions to silty SAND.	< 5	90	10	0.8			
12		SM	Silty SAND, brown to greenish gray, saturated with brown oily substance from, 12 to 12.5 ft, then transitions to clayey SILT.	< 5	70	30	0.6	5	B21-S12.0 @0745 B21-GW12.5 @0858	
14		ML	Clayey SILT, greenish gray to light brownish orange mottling.	< 5	20	80	0.3 0.1			
16 18 20 22		SP	Fine SAND, gray, sheen present, oily substance ponding on the core.	< 5	90	10	0 0 0 0 3.3 0.1	5	B21-S21.5 @0810	
		ML	Sandy SILT, gray.	< 5	30	70	0	5		
24 26 28		SP	Fine SAND, gray.	< 5	90	10	0 4.1 2.2 0.7 0	5		
		ML	Sandy SILT, gray.	< 5	30	70	0			
30 32 34		SP	Fine SAND, gray.	< 5	90	10	0.1 0.7 0.4 0 0 0	4/4		Hit refusal at 34 ft bgs.

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B22

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259582.650
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1199031.018
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	20.3
Date Logged:	7/20/2017	Drilling Method:	DPT	Borehole Abandoned:	7/20/2017
Geologist:	Damon DeYoung	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips/Asphalt
Total Depth:	30 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0		Asphalt	Asphalt from 0 to 6 inches bgs.							
2 4 6 8 10		GM	Clayey sandy GRAVEL, gray to brown to greenish gray, saturated at 9 ft bgs. (Fill)	70	15	15	0.9 0 0	3.5 3		
12		OL	PEAT, dark brown.	< 5	80	20				
		SM	Silty clayey SAND, light brown to greenish gray, transitions to interbedded sandy SILT and clayey SILT, greenish gray to gray SAND.	< 5 < 5	10 90	90 10	0	5		
14 16 18 20 22		SP	Fine SAND, gray, thin lamina of silt at 17.5 ft, approximately 1 inch thick.				0 0 0 0.9 1.3 0.4 0.2 0.1 0	5 5	B22-S18.5 @0938 B22-GW19.0 @1027	
		ML	Sandy SILT approximately 1 ft thick, gray.	< 5	30	70	0			
24 26 28 30		SP	Fine SAND with thin sandy silt layers from 28 to 30 ft, approximately 2 inches thick, spaced 3 to 6 inches apart.	< 5	80	20	0 0 0	5		

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B23

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259448.409
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1198803.053
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	16.1
Date Logged:	7/20/2017	Drilling Method:	DPT	Borehole Abandoned:	7/20/2017
Geologist:	Damon DeYoung	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips/Asphalt
Total Depth:	30 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0		Asphalt	Asphalt from 0 to 6 inches bgs.							
2 4 6 8		GM	Sandy clayey GRAVEL, with wood, metal and plastic waste to 9 ft bgs, light brown to brown to greenish gray. (Fill)	70	15	15	0 0	2.5 2		
10 12		SP	Saturated fine to medium SAND, brown to gray, coarsening to GRAVEL at 13 ft bgs.	25	65	10	0	4/4		Collected groundwater from nearby existing monitoring well MW1-17 with ID: CL-MW1-17-GW-170720.
14		ML	Clayey SILT and CLAY starting at 13 ft bgs, interbedded, PID hits in the fine material at 13.5 ft.	5	5	95	0.9 0.2		B23-S13.5 @1134 B23-GW14.0 @1145	
		GP	Coarse SAND and GRAVEL.	70	30	< 5	0.1			
16 18		SP	Interbedded coarse SAND, silty CLAY, and SILT, gravel bed at 17 to 17.5 ft, clays have PID readings from 0.1 to 0.7 ppm.	15	35	50	0 0 0 0.4 0	5	B23-S18.0 @1205, B23-GW18.0 @1240	
20		SP	Fine SAND, gray, fining downward to SILT at 22 ft bgs.	10	80	10	0.1 0 0.5			
22		ML	SILT				0	5		
		CH	Thin gravel layer at 23 ft, approximately 2 inches thick, overlying 6 inches of CLAY down to 23.5 ft bgs.	10	10	80	0.3			
24		SP	Fine SAND, dark gray, interbedded with SILT, coarsening downward to a basal GRAVEL at 25.5 ft.	< 5	90	10	0.1 0.8			
26 28 30		ML	Thinly laminated silt with dark brown organic lamina.	< 5	10	90	1.7 0 0 0 0	5		

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B24

Permit Number: 17-EP110
Contract: N39430-16-D-1802/CTO 010
Project: 100098089
Date Logged: 7/20/2017
Geologist: Damon DeYoung
Total Depth: 30 feet bgs
Reviewer: Michael Meyer

Drilling Contractor: Holt Services
Driller: Michael Running
Drilling Equipment: 7822 DT
Drilling Method: DPT
Boring Diameter: 2-1/4"
Sampler Type: Macro-core
Hammer Type: Hydraulic

Northing (NAD 83): 259309.740
Easting (NAD 83): 1198822.750
Surface Elevation (NAVD 88): 16.4
Borehole Abandoned: 7/20/2017
Backfill Method: Bentonite Chips/Asphalt
Monitoring Device Installed: No
Device Type: N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0		Asphalt	Asphalt.							
2 4 6		GM	Clayey, sandy GRAVEL, brown to gray. (Fill) Approximately 1 foot of wood debris at 5 ft bgs.				0.4 0 0	2.5 3.5		
8 10 12		SW	Mottled orange/greenish gray SAND, with brown 3 inch thick bed of silty SAND at 8.5 ft. Coarsening downward to coarse SAND, gray.				0	5		
14		MH	Finely laminated clayey SILT, gray. Thin (less than 0.5 inch) laminae of CLAY and fine SAND from 14.3 to 14.6 ft.							
		SP	Coarse SAND from 15 to 16 ft.				0.4 0.8		B24-S15.5 @1451 B24-GW16.0 @1523	
16 18 20 22 24 26 28 30		ML	Interbedded SILT, CLAY, and silty fine SAND, gray, no PID detections from 15.5 to 30 ft bgs.				0 0 0 0 0 0 0 0 0 0 0	5 5 5		

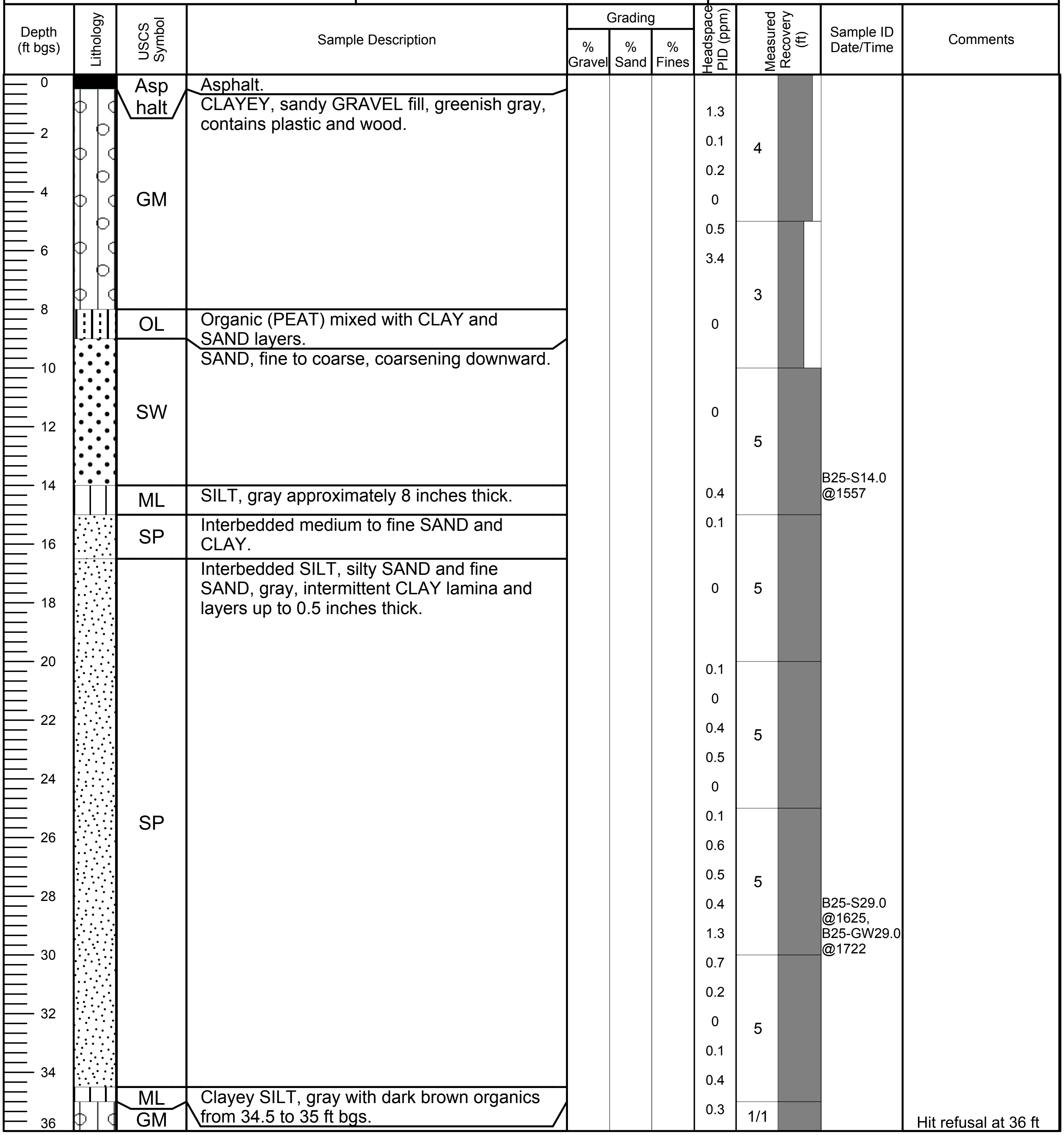
BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B25

Permit Number: 17-EP110
Contract: N39430-16-D-1802/CTO 010
Project: 100098089
Date Logged: 7/20/2017
Geologist: Damon DeYoung
Total Depth: 36 feet bgs
Reviewer: Michael Meyer

Drilling Contractor: Holt Services
Driller: Michael Running
Drilling Equipment: 7822 DT
Drilling Method: DPT
Boring Diameter: 2-1/4"
Sampler Type: Macro-core
Hammer Type: Hydraulic

Northing (NAD 83): 259309.740
Easting (NAD 83): 1198822.750
Surface Elevation (NAVD 88): 17.7
Borehole Abandoned: 7/20/2017
Backfill Method: Bentonite Chips/Asphalt
Monitoring Device Installed: No
Device Type: N/A



USCS Symbol	Sample Description
Asphalt	Asphalt.
GM	CLAYEY, sandy GRAVEL fill, greenish gray, contains plastic and wood.
OL	Organic (PEAT) mixed with CLAY and SAND layers.
SW	SAND, fine to coarse, coarsening downward.
ML	SILT, gray approximately 8 inches thick.
SP	Interbedded medium to fine SAND and CLAY.
SP	Interbedded SILT, silty SAND and fine SAND, gray, intermittent CLAY lamina and layers up to 0.5 inches thick.
ML	Clayey SILT, gray with dark brown organics from 34.5 to 35 ft bgs.
GM	

Headspace PID (ppm)
1.3
0.1
0.2
0
0.5
3.4
0
0
0.4
0.1
0
0.1
0
0.4
0.5
0
0.1
0.6
0.5
0.4
1.3
0.7
0.2
0
0.1
0.4
0.3

Measured Recovery (ft)
4
3
5
5
5
5
5
1/1

Sample ID Date/Time
B25-S14.0 @1557
B25-S29.0 @1625, B25-GW29.0 @1722

Comments: Hit refusal at 36 ft

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B26A

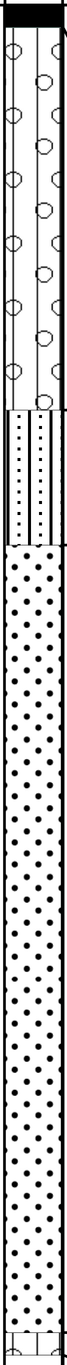
Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259440.173
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1198831.165
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	16.9
Date Logged:	7/21/2017	Drilling Method:	DPT	Borehole Abandoned:	7/21/2017
Geologist:	Damon DeYoung	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips/Asphalt
Total Depth:	30 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0		Asphalt	Asphalt.							Boring CL-26 hit refusal in the waste body. Location was: Northing: 259440.225; Easting 1198828.671; Elevation: 16.8
2 4 6 8		GM	Poor recovery, sandy-clayey GRAVEL fill with glass, plastic, metal, and wood debris, brown to black.	70	15	15	0.2 0 0 1 0.1 0.2 3.5	1.5 2.5	B26A-S9.0 @0819	
10 12		Fill	Black landfill waste, wood, glass, metal, and concrete from 9.5 to 12.5 ft.				2.6 3.2		B26A-GW10.0 @0920	
		SP	Medium SAND, gray.	< 5	100	< 5	0	4		
14 16 18		MH	Sandy SILT and clayey SILT (MH) interbedded with fine SAND (SP) up to 3 inches thick and CLAY (CH) up to 2 inches thick, gray.	< 5	50	50	0 0.9 1 1.6 0.7	5		
20 22		SP	Fine SAND, gray.	< 5	90	10	1.7 2.3 0.4 0.3 0.4		B26A-S19.0 @0838	
24		ML	Interbedded sandy SILT (ML) and clayey SILT (MH), gray.	< 5	10	90	0 0.7 0.9	5		
26		SW	Fine to coarse SAND with basal GRAVEL, gray.	20	70	10	0.2 0.1 0.4		B26A-S26.0 @0902	
28 30		ML	Dense SILT (ML) with brown organic laminae with silty CLAY (CH).	< 5	5	95	0	5		

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B27

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259318.150
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1199069.466
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	18.8
Date Logged:	7/21/2017	Drilling Method:	DPT	Borehole Abandoned:	7/21/2017
Geologist:	Damon DeYoung	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips/Asphalt
Total Depth:	30 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A



Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	 % Sand	 % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0		Asp halt	Asphalt.							
			Sandy-clayey GRAVEL, brown to greenish gray, contains wood and plastic debris. (Fill)	70	15	15				
2							0	3		
4		GM								
6							0.1			
8							0	3		
			Clayey-gravelly SAND, greenish gray.	25	50	25			B27-S10.0 @1025, B27-GW10.0 @1046	
10		SM								
12			Fine SAND, gray to greenish gray clayey with organics at 12.5 to 13 ft (marsh layer), coarsening downward to medium sand with thin beds less than 2 inches of fine SAND from 18 to 20 ft, 24 to 25 ft and 27 to 29.5 ft.	5	90	5	0	5		
14										
16										
18							0	5		
20		SW								
22							0	5		
24										
26										
28							0	5		
30		GM	SILT, gray overlying silty-sandy GRAVEL.	70	20	10				
32										

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B28

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259325.981
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1199120.302
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	17.7
Date Logged:	7/21/2017	Drilling Method:	DPT	Borehole Abandoned:	7/21/2017
Geologist:	Damon DeYoung	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips/Asphalt
Total Depth:	30 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0		Asphalt	Asphalt.							
2 4 6 8		GM	Sandy-Clayey GRAVEL fill, brown to greenish gray, contains wood and metal debris to 4 ft bgs.	70	15	15	0 0 0 0 0 1.7	3 2.5		
10		CL	Silty CLAY, olive green to greenish gray, interbedded with gray SAND (fine to medium), contains organic matter (roots).	10	40	50	7.5 4.8 3.2 3.3		B28-S9.0 @1109 B28-GW10.0 @1211	
12 14 16 18 20 22 24		SP	Medium SAND, gray, interbedded with fine SAND beds less than 2 inches thick at 12.5 and 15.5 ft. Contains gravel throughout.	5	90	5	1.3 0.1 0 0 0 0	5 5 5		
26 28 30		SP	SAND at rod end. No recovery from 25 to 30 ft, core barrel stuck in rod. GRAVEL at rod end.				0	0		

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B29

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259569.817
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1198978.895
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	20.1
Date Logged:	7/24/2017	Drilling Method:	DPT	Borehole Abandoned:	7/24/2017
Geologist:	Michael Meyer	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips/Asphalt
Total Depth:	8 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Damon DeYoung	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0 0.4		Asphalt	Asphalt.					4		
0.8 1.2 1.6 2 2.4 2.8 3.2		GM	Light to dark brown silty, sandy GRAVEL with wood waste, Styrofoam debris, loose.				0.6 0 6.1 0.3			
3.6 4 4.4 4.8 5.2 5.6		SM	Medium brown silty very fine SAND to very fine sandy SILT. Dry, medium dense.				0.5 1			
6 6.4 6.8 7.2 7.6		GW	Medium gray fine to coarse sandy GRAVEL, wet at 7 ft.				1.7 4.2	2.5		Refusal at 8 ft, move over to B29A.

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B29A

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259569.612
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1198977.298
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	20.0
Date Logged:	7/24/2017	Drilling Method:	DPT	Borehole Abandoned:	7/24/2017
Geologist:	Michael Meyer	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips/Asphalt
Total Depth:	30 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Damon DeYoung	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0		Asphalt	Asphalt.							
2 4		GM	Light to dark brown silty, sandy GRAVEL with plastic debris. Loose, dry.				0.6 0.2 0.7 0.6 0	3		
6		SM	Medium brown silty very fine SAND to very fine sandy SILT. Dry, medium dense.				0 0.2 4.3	3	B29A-S7.0 @0828	
8		GM	Medium gray fine to coarse sandy GRAVEL, moist, medium, dense.				2			
		CL	2 inch clay layer medium gray. Silty CLAY, medium plasticity.				0.4			
10 12		GW	Medium brown silty, sandy GRAVEL fine to coarse SAND. Wet, dense.				0.1 0 0			
		ML	Medium brown fine sandy SILT with organics, soft moist.				0	3		
14 16		SP	Medium gray fine SAND, dense, wet.				0 0 0			
18		CL	Medium gray silty CLAY, medium plasticity, wet, soft.				0 0	5		
20 22 24 26		SP	Medium gray clean SAND, fine grained grading to silty fine SAND with depth, wet.				0.2 0 0 0 0 0 0 0 0	5 5	B29A-S21.0 @0831, B29A-GW21.0 @0853	
28 30		SP	Medium gray, medium SAND, wet, medium dense 2 inch GRAVEL bed at top of core.				0 0			

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B30

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259392.279
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1199117.879
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	18.6
Date Logged:	7/24/2017	Drilling Method:	DPT	Borehole Abandoned:	7/24/2017
Geologist:	Michael Meyer	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips/Asphalt
Total Depth:	8 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Damon DeYoung	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0 0.4	■	Asp halt	Asphalt.					3		
0.8 1.2 1.6 2 2.4 2.8 3.2 3.6 4		GM	Light gray to dark brown silty, sandy GRAVEL with wood debris.				0 0			
4.4 4.8 5.2 5.6 6 6.4 6.8 7.2 7.6		GM	Light gray silty, clayey GRAVEL. Substantial wood debris from 7 to 8 ft, strong odor, creosote odor.				0 0.8 0 0.2	2		Refusal at 8'. PID reading of wood (creosote odor) at 7 ft is 15.1 ppm.

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B30A

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259396.862
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1199116.300
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	18.5
Date Logged:	7/24/2017	Drilling Method:	DPT	Borehole Abandoned:	7/24/2017
Geologist:	Michael Meyer	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips/Asphalt
Total Depth:	30 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Damon DeYoung	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0		Asphalt	Asphalt.							
2 4		GM	Dark brown, sandy, silty GRAVEL, loose, moist.				0.7 0 0.1 0.3 0.2	2		
6 8		GM	Light gray silty, clayey GRAVEL, wood debris from 7 to 10 ft.				0.3 0 0 0 0	2		
10		GM	Sheen and creosote for 6 inches at 10.5 to 11 ft in wood debris.				0.1		B30A-S10.5 @1004	
12		SM	Medium gray, six-inch interbeds of fine SAND and fine sandy SILT, moist, soft/medium dense.				0 0	4		
14 16		ML	Medium gray fine sandy, clayey SILT, moist, soft trace organics.				0 0 0 0			
18 20 22 24 26 28		SP	Medium gray fine SAND. Wet, medium dense.				0 0 0 0 0 0 0 0 0 0 0 0	5 5 5	B30A-S21.0 @1007, B30A-GW21.0 @1028	
30		GW	Medium gray sandy GRAVEL. Wet, medium dense.				0 0			
32										

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B31

Permit Number: 17-EP110
Contract: N39430-16-D-1802/CTO 010
Project: 100098089
Date Logged: 7/24/2017
Geologist: Michael Meyer
Total Depth: 30 feet bgs
Reviewer: Damon DeYoung

Drilling Contractor: Holt Services
Driller: Michael Running
Drilling Equipment: 7822 DT
Drilling Method: DPT
Boring Diameter: 2-1/4"
Sampler Type: Macro-core
Hammer Type: Hydraulic

Northing (NAD 83): 259466.615
Easting (NAD 83): 1198853.308
Surface Elevation (NAVD 88): 17.4
Borehole Abandoned: 7/24/2017
Backfill Method: Bentonite Chips/Asphalt
Monitoring Device Installed: No
Device Type: N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0		Asphalt	Poor recovery, abundant waste (wood, concrete, wire and nails).							
2 4 6 8		GM	Gray to black silty, sandy GRAVEL. Dry, loose. Apparent voids.				1 0 0 0 0 0	2 1		
10 12		SW	Black gravelly SAND, fine to medium grained with abundant wood debris. Wet, loose. Rootlets. Grades to medium brown at 11 ft. Landfill debris to 13 ft.				0.4 0.2 0 0.2	4	B31-S11.5 @1229, B31-GW11.5 @1242	
		SP	Medium gray grading to medium brown with depth, slightly silty medium SAND. Wet medium dense.				0			
14		CL	Medium gray silty CLAY. Medium plasticity, soft, wet.				0.1			
		SP	Medium gray medium SAND. Wet, medium dense.				0			
16 18		ML	Interbedded silty CLAY and fine sandy clayey SILT with 2 inch fine sand interbeds. Wet, dense with one gravel clast.				0 0 0 0 0 0.5 0.1	5	B31-S19.0 @1219	
20 22 24 26		SP	Medium gray fine SAND. Wet.				0.4 0 0 0 0 0 0	5		
		ML	Interbedded clayey SILT and silty CLAY, same as 16 to 20 ft.				0	5		
28 30		SP	Medium gray fine SAND. Wet.				0 0			

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B32

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259307.236
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1198934.101
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	18.4
Date Logged:	7/24/2017	Drilling Method:	DPT	Borehole Abandoned:	7/24/2017
Geologist:	Michael Meyer	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips/Asphalt
Total Depth:	30 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Damon DeYoung	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0	Asphalt	Asphalt.							
2 4	GW	Medium brown sandy GRAVEL. Dry, dense.				0.9 1.4	3		
6	GM	Dark brown silty GRAVEL. Dry, dense.				0.9 0.5 0	3		
8	SP	Light gray grading to medium brown fine SAND. Dry, dense.				0.6			
	OL	Organic, low-plasticity SILT (peat). Wood and rootlets, moist.				0			
10	SM	Mottled light gray and light brown silty fine SAND. Moist.				0			
12	SP	Medium gray medium SAND, wet, medium dense. 2 inch silt interbed at 13.5 ft.					5		
14 16 18	ML	Medium gray clayey SILT to silty CLAY. Soft, wet. 0.5 to 2 inch thick medium sand interbeds spaced roughly 1 ft apart.				0.2 1 1.6 0 0 0.2 0	5	B32-S15.0 @1338 B32-GW16.0 @1409	
20	SP	Medium gray fine SAND wet.				0.3			
22 24	SM	Medium gray silty very fine SAND to sandy SILT. Moist, hard.				0 0 0.2 0	5		
26 28	SP	Medium gray fine to medium SAND. Wet.				0 0 0 0	5		
30	GW	Medium gray sandy GRAVEL. Wet, dense.				0			

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B33

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259247.975
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1198987.785
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	17.5
Date Logged:	7/24/2017	Drilling Method:	DPT	Borehole Abandoned:	7/24/2017
Geologist:	Michael Meyer	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips/Asphalt
Total Depth:	27.5 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Damon DeYoung	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Sample ID Date/Time	Comments
0	Asphalt	Asphalt.					
0.5–8	GM	Medium gray silty, sandy GRAVEL. Dry, dense. High PID reading from wood waste at 3.5 ft.				B33-S3.5 @1455	
8–10	GM	Brown and black wood debris. Wet at 9 ft.					
10–13		No recovery.				B33-GW13.0 @1531	
13–15	SM	Medium brown silty very fine SAND with thin silt interbeds.					
15–17.5	SP	Medium brown fine to medium SAND. 2 inch gravel lens at 17 ft, wet.					
17.5–24.5	ML	Clayey SILT, medium gray, medium soft. Occasional 2 inch sand lenses.					
24.5–27.5	SP	Medium gray medium SAND, occasional 1 inch gravel clasts, very dense.					Refusal at 27.5'

Depth (ft bgs)	Headspace PID (ppm)
0.5	0
1	0
2	0
3	5.4
3.5	46.8
4	10.3
5	2.9
6	0
7	2.5
8	1.5
9	0
10	0
12.5	0
13	0
14	0
15	0
16	0
17	0
18	0
19	0
20	0
21	0
22	0
23	0
24	0
25	0
26	0
27	0
27.5	0

Depth (ft bgs)	Measured Recovery (ft)
0–5	3
5–10	3
10–15	2.5
15–20	4
20–25	5
25–27.5	2.5

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B34

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259423.572
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1198920.908
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	18.9
Date Logged:	7/25/2017	Drilling Method:	DPT	Borehole Abandoned:	7/25/2017
Geologist:	Sam Moore	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips/Asphalt
Total Depth:	36 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0		Asphalt	Asphalt from 0 to 6 inches bgs.							
2 4		GM	Medium sandy GRAVEL with silt, dry, medium dense, brown (2.5YR 4/2), some debris.	70	20	10	1 0 0 0	1.25		
6		SC	Clayey fine SAND with gravel, medium dense, dark gray (10YR 4/1), dry.	10	70	20	0 0.3			Metal debris at 6.5 ft.
8 10		SM	Silty fine SAND with fine gravel, wet, dense, layered black (Gley 1 2.5/N), gray (10YR 4/1).	15	55	30	0.6 1 0.1 0	2		Sheet metal at 10.0 ft.
12 14		SP	Fine SAND, medium dense green/gray (2.5YR 4/1).	0	95	5	0.6 0.1 0.1 0.1 1.2	2.5		
16 18		ML	Clayey SILT with lenses of silty clay, soft, damp, gray/green (10YR 4/1).	0	5	95	0.1 3.3 3.9 0.9	5	B34-S18.0 @0909 B34-GW20.0 @0935	
20 22 24 26 28 30 32 34		SP	Fine SAND with lenses of silt (approximately 0.2 ft thick) opportunity per ft, medium dense, gray (7.5YR 3/1). Some gravel at 35 to 36 ft.	0	80	20	0.4 1.7 0 1.2 0.8 0 0.3 0.2 0 0.9 0.3 0 0 0.1 0.4 0.8	5 5 5 5 5		Refusal at 36'
36 38							0			

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B35

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259394.347
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1198839.089
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	16.9
Date Logged:	7/25/2017	Drilling Method:	DPT	Borehole Abandoned:	7/25/2017
Geologist:	Sam Moore	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips/Asphalt
Total Depth:	30 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	USCS Symbol	Sample Description	% Gravel	% Sand	% Fines	Headspace PID (ppm)	Sample ID Date/Time	Comments
0	Asphalt	Asphalt debris.						Asphalt top surface
2 4 6	GC	Clayey GRAVEL with sand, dense, dry, tan (10YR 5/2)/gray (10YR 4/1) and very dark brown (10YR 2/1).	55	20	25	0 0 0 0.1		Plastic debris at 5 ft. Wood debris at 5.5 ft. Organic matter from 6 to 8 ft.
8 10	SP	Fine SAND with silt, wet, dense, dark red-brown (5YR 25/2).	0	90	10	0 0 0 0		
12	SW	Fine to coarse SAND with gravel dense, wet, gray-brown (10YR 4/2).	20	80	0	0		
	SW	Fine to coarse SAND, dense, wet, dark gray (gray 25/2).	0	100	0	0		
14 16 18	CL	Silty CLAY and interbedded clayey SILT and some fine sand (approximately 0.1 to 1 ft) intervals, damp, medium stiff, gray (10YR 4/1).	5	10	85	0.8 0.7 0.1 2.5 2.8	B35-S18.0 @1050	
20 22 24 26	SP	Fine SAND with sporadic interbedded silt clay (approximately 0.2 to 2 ft intervals), medium dense, wet, gray (10YR 4/1).	0	90	10	0.7 1.4 4.6 1.1 0.6 0.2 1.6 2 0.1 3.8	B35-S20.5 @1115 B35-GW21.0 @1115	
28	GM	GRAVEL with sand and silt, wet, medium dense, gray (10YR 4/1).	70	20	10			
30	CH	Fat CLAY, very stiff, damp, dark gray (10YR 3/1).	0	0	100	0 0		

Depth (ft bgs)	Measured Recovery (ft)
0–5	2
5–10	2.5
10–15	5
15–20	5
20–25	5
25–30	5

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B36

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259337.839
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1198900.443
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	18.9
Date Logged:	7/25/2017	Drilling Method:	DPT	Borehole Abandoned:	7/25/2017
Geologist:	Sam Moore	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips/Asphalt
Total Depth:	30 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0		Asphalt	Asphalt debris.							Asphalt top
		GW	Fine sandy GRAVEL with silt, medium dense, dry, light brown gray (2.5Y 6/2).	60	30	10	0.7			Woody matter at 8'
2		GM	Silty GRAVEL, stiff, dry blue gray (Gley 4/5GY).	60	10	30	0 0	4		
4 6 8		SM	Fine SAND with interbedded clayey silts, becoming wet, medium stiff, tan (10YR 4/1) to dark brown (7.5YR 3/2) at 8.0 ft.	0	50	50	0 1.8 0 0.4 0 0	0.75		
10 12 14		SP	Fine SAND, wet, medium dense, gray (2.5Y 4/1), becoming coarser at 15 to 16 ft).	0	100	0	0 0 0 0 0 0 2.6	4.75	B36-S15.5 @1327	
16 18		CL	Silty CLAY with interbedded fine SAND (0.3 ft every 1 ft), stiff, damp, gray (10YR 4/1).	0	30	70	1.3 0 0.4 0.7	5	B36-GW17.0 @1445	
20		SP	Medium SAND, wet, medium dense, gray (10YR 4/1).	0	100	0	0.3 1.2			
22 24		SM	Silty fine SAND with interbedded clayey SILT, dense, damp, gray (10YR 4/1).	5	60	35	0.2 0.1 0	5		
26			No recovery, very wet, silty fine sand fell out of core.				0	0		
28 30		GM	Silty sandy GRAVEL, dense, damp, dark gray (10YR 4/1).	70	15	15	0 0.4	5		

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BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B37

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259246.314
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1199050.669
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	18.2
Date Logged:	7/26/2017	Drilling Method:	DPT	Borehole Abandoned:	7/26/2017
Geologist:	Sam Moore	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips/Asphalt
Total Depth:	30 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0	■	Asp halt	Asphalt from 0 to 6 inches bgs.							Asphalt top
	○	GC	Clayey sandy fine GRAVEL, dense, dry until wet at 2.5 ft, mixed brown and green gray (10YR 4/1 and 5Y 4/1). High plastic clay lenses at 3.5 to 4.0 ft and 9.5 to 10.0 ft. Organics at 9.5 to 10.0 ft, very dark coloration (Gley 1 2.5/N).	40	35	25				
							0			
2							0	3		
							0			
4							1			
							0.4			Wood debris 3.0-4.0
6							0.2			
							0	2.5		
8							0			
							0			
10	⁘	SW	Coarse to fine SAND, medium dense, wet, green-gray brown (5Y 4/1 and 2.5Y 3/1).	5	85	10	0			
							0			
12							0			
	‖	ML	Interbedded clayey SILT, silty CLAY and silty SAND. (sands approximately 0.2 ft thick at 1 ft intervals) soft to medium stiff, damp with wet sand bands, olive gray (10YR 5/1).	0	25	75	0	5		
14							0		B37-S15.0 @0900, B37-GW15.0 @0930	
							0.3			
16							0			
							0	5		
18	⋯	SP	Fine SAND, wet, medium dense, olive gray (2.5 Y 3/1).	0	100	0	0			
							0			
20							0			
							0			
22							0	5		
							0			
24							0			
							0			
26							0			
							0	5		
28	○	GM	Sandy silty GRAVEL, wet, dense, grayish green (10Y-5GY 4/2).	70	15	15	0			
	▨	CH	CLAY, very stiff, damp, olive gray (2.5 Y 3/1).	0	0	100	0			
30										

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B38C

Permit Number: 17-EP110
Contract: N39430-16-D-1802/CTO 010
Project: 100098089
Date Logged: 7/26/2017
Geologist: Sam Moore
Total Depth: 4 feet bgs
Reviewer: Michael Meyer

Drilling Contractor: Holt Services
Driller: Michael Running
Drilling Equipment: 7822 DT
Drilling Method: DPT
Boring Diameter: 2-1/4"
Sampler Type: Macro-core
Hammer Type: Hydraulic

Northing (NAD 83): 259181.655
Easting (NAD 83): 1199060.732
Surface Elevation (NAVD 88): 16.7
Borehole Abandoned: 7/26/2017
Backfill Method: Bentonite Chips/Asphalt
Monitoring Device Installed: No
Device Type: N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0	■	Asp halt	Asphalt from 0 to 6 inches bgs.							Asphalt top
0.4		GC	Sandy, clayey GRAVEL, dry, dense, gray (10YR 4/1).	60	20	20	0			
0.8							0.1			
1.2										
1.6										
2							0.1	0		Refusal on reinforced concrete at 4 feet bgs.
2.4										
2.8										
3.2							67.5			
3.6										
4							83.6		B38C-S-4.0 @1015	
4.4										
4.8										
5.2										

BATTELLE

Project: Keyport OU 1
Site: Central Landfill
Boring Log: CL-B39

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259137.181
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1199083.389
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	16.5
Date Logged:	7/26/2017	Drilling Method:	DPT	Borehole Abandoned:	7/26/2017
Geologist:	Sam Moore	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips/Asphalt
Total Depth:	30 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Comments
Asphalt	Asphalt from 0 to 6 inches bgs.				Asphalt top
GM	Sandy silty GRAVEL, dry, medium dense, brown (10YR 3/3). Transitioning to gray (10YR 3/1).	70	15	15	
OL	Fine sandy silty CLAY, wet, soft, black (Gley 1 2.5/N).	5	25	70	organic plant material 7.0-8.5
SP	Fine SAND with CLAY interbedded (approximately 0.1 ft every 1 ft), medium dense, wet, olive gray (5Y 3/1).	5	95	0	
ML	Clayey SILT, interbedded silty SAND (approximately 0.2 ft every 1 ft), medium stiff, wet, gray (2.5Y 4/1).	0	30	70	
SW	Fine to medium SAND, gravel occasionally, medium dense, wet, olive gray (2.5Y 4/1).	5	95	0	
GW	Sandy fine GRAVEL, medium dense, wet, dark gray (2.5Y 3/1).	60	40	0	
SP	Fine SAND, medium dense, wet, olive gray (2.5Y 4/1).	0	100	0	
GW	Sandy fine GRAVEL, medium dense, wet, dark green (2.5Y 3/1).	60	40	0	
CH	CLAY, very stiff, damp, gray (10 YR 5/1).	0	0	100	

Depth (ft bgs): 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30

Headspace PID (ppm): 0, 0, 0, 0.2, 0, 0, 0.8, 0.3, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0

Measured Recovery (ft): 3, 4, 5, 5, 5, 5

Sample ID Date/Time
B39-S7.0 @1050
B39-GW10.0 @1155

BATTELLE

Project: Keyport OU 1
Site: South Plantation
Boring Log: SP-B01

Permit Number: 17-EP110
Contract: N39430-16-D-1802/CTO 010
Project: 100098089
Date Logged: 7/11/2017
Geologist: Damon DeYoung
Total Depth: 30 feet bgs
Reviewer: Michael Meyer

Drilling Contractor: Holt Services
Driller: Michael Running
Drilling Equipment: 7822 DT
Drilling Method: DPT
Boring Diameter: 2-1/4"
Sampler Type: Macro-core
Hammer Type: Hydraulic

Northing (NAD 83): 259026.463
Easting (NAD 83): 1199147.602
Surface Elevation (NAVD 88): 16.1
Borehole Abandoned: 7/11/2017
Backfill Method: Bentonite Chips
Monitoring Device Installed: No
Device Type: N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0 2 4		GM	Poor recovery, approximately 6 inches of 5 ft dry, silty sandy GRAVEL, 10YR 4/2.	50	20	30	0	0.5		
6 8		CL	Poor recovery, approximately 6 inches of 5 ft. 2 inches of sandy CLAY, (5Y 3/1).	10	30	60	0.6	0.5		
10 12 14		SP	Full recovery, poorly graded SAND, highly contaminated up to 3,185 ppm with sheens dark gray (5Y 3/1), medium to fine SAND.				35.5 32.1 18.5 44.5 951.5 3185 175.3	5	B01-S13.5 @1020; B01-GW13.5 @1041	
16 18		SP	Full recovery, poorly graded SAND, dark gray (5Y 3/1), medium to fine SAND, highly contaminated up to 984 ppm.	5	90	5	36 13.6 115.1 984 103.9 44	5	B01-S17.5 @1030; B01-GW17.5 @1207	collected 4 oz jar. B01-S17.5@1109
20 22		SP	Full recovery, poorly graded SAND, dark gray (5Y 3/1) medium to fine SAND.	5	90	5	129.1 35.6 12.6	5		
24		SW	Well graded SAND with gravel and fines, (5Y 3/1) coarse to fine SAND.	20	70	10	8.7 9.1			
26 28 30		SW	Well graded gravelly SAND, low fines coarse to fine SAND, (5Y 3/1).	30	65	5	9.2 0.4 0.5 0.6 0.5	5	B01-S28.0 @1150; B01-GW28.0 @1229	

Project: Keyport OU 1
Site: South Plantation
Boring Log: SP-B01B

Permit Number: 17-EP110
Contract: N39430-16-D-1802/CTO 010
Project: 100098089
Date Logged: 8/07/2017
Geologist: Damon DeYoung
Total Depth: 15 feet bgs
Reviewer: Michael Meyer

Drilling Contractor: Holt Services
Driller: Michael Running
Drilling Equipment: 7822 DT
Drilling Method: DPT
Boring Diameter: 2-1/4"
Sampler Type: Macro-core
Hammer Type: Hydraulic

Northing (NAD 83): 259021.967
Easting (NAD 83): 1199146.521
Surface Elevation (NAVD 88): 16.3
Borehole Abandoned: 8/07/2017
Backfill Method: Bentonite Chips/Soil Cover
Monitoring Device Installed: No
Device Type: N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0		GM	Mixed GRAVEL, SAND and SILT, light brown.	40	30	30				
3		SM	Clayey-gravelly SAND, light brown transitions to gray. Oily substance at 8 ft, black/dark brown with orange matter (marsh deposits).	<5	95	5				
6										Slough in top of 5 to 10 ft core sleeve.
8							>5000		B01B-S8.0 @0840	
10		GM	GRAVEL with sand.	70	20	10	>5000		B01B-GW-10.0@0854	
11		SP	SAND, medium to fine, gray with orange matter.	<5	95	5	4578			
12							5000			
							4791			
13										Field duplicate gw sample collected at 15 ft bgs
14							4970			
15									B01B-GW-15.0@1000	

BATTELLE

Project: Keyport OU 1
Site: South Plantation
Boring Log: SP-B40

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259060.391
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1199007.477
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	17.5
Date Logged:	7/26/2017	Drilling Method:	DPT	Borehole Abandoned:	7/26/2017
Geologist:	Sam Moore	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips
Total Depth:	30 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

USCS Symbol	Sample Description	% Gravel	% Sand	% Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
GC	Sandy clayey GRAVEL, medium dense, dry, tan to gray (10YR 3/1) / (10YR 4/2).	70	15	15	0 0 1.3 3.3 1.1	2		Grass at surface. Wood debris at 2.0 ft., plastic debris at 3.0 ft.
SW	Fine to coarse SAND with gravel, dry, loose, tan (70YR 5/2).	20	80	0	0.8	1.5		
OL	Sandy CLAY, wet, soft, black (Gley 1 2.5/N).	0	30	70			B40-S7.0 @1319	
SW	Fine to medium SAND, wet, medium dense, olive gray (5Y 4/1), some GRAVEL from 11.0 to 12.0 ft. No recovery from 10.0 to 11.0 ft bgs.	15	75	10	12.2 4.4 1.7			
					1 0 0.5 5.1	0 5	B40-GW11.0 @1456 B40-S13.0 @1357	
ML	Clayey SILT with large interbeds of fine SAND (approximately 0.4 ft every 1 ft), medium stiff, wet, gray (5Y 4/1).	0	50	50	0.2 0 0.9 0.9 0	5	B40-GW16.0 @1533	
SP	Fine SAND with interbedded CLAY (approximately 0.2 ft every 1 ft), medium dense, wet, gray (5Y 4/1).	0	80	20	0 0 0 0	4.75	B40-S20.0 @1417	
SP	Fine SAND, medium dense, wet, gray (5Y 4/1).	0	100	0	0 0 0	5		

BATTELLE

Project: Keyport OU 1
Site: South Plantation
Boring Log: SP-B41

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259100.398
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1199033.725
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	27.8
Date Logged:	7/26/2017	Drilling Method:	DPT	Borehole Abandoned:	7/26/2017
Geologist:	Sam Moore	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips
Total Depth:	30 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0 2 4		GW	Fine sandy GRAVEL, medium dense, dry, tan to gray (10YR 3/1)(10YR 4/2).	60	30	10	0 0 0 0 0	2.5		Moss surface
6		OL	Silty CLAY, stiff, wet, dark gray (10YR 2/1).	0	0	100	0 0	3.75		Groundwater observed at 6 ft bgs.
8 10 12 14		SP	Fine SAND with one thin clay lens at 8.5 ft and some fine gravel at 13.5 ft, medium dense, wet, olive gray (5Y 4/1).	5	90	5	2.8 0.5 0 0 0 0 0	3	B41-S8.0 @1606 B41-GW10.0 @1649	
16 18 20 22		SP	Fine SAND with interbedded clayey SILT and silty CLAY (approximately 0.2 ft every 2 ft), medium dense, wet, olive gray (5Y 4/1).	0	70	30	0 0 0 0 0 0 0 0 0	5 5		
24 26 28 30		SP	Fine SAND with occasional fine gravel, medium dense, wet, olive gray (5Y 4/1).	5	95	0	0 0 0 0 0 0	5		

BATTELLE

Project: Keyport OU 1
Site: South Plantation
Boring Log: SP-B42

Permit Number: 17-EP110
Contract: N39430-16-D-1802/CTO 010
Project: 100098089
Date Logged: 7/27/2017
Geologist: Sam Moore
Total Depth: 30 feet bgs
Reviewer: Michael Meyer

Drilling Contractor: Holt Services
Driller: Michael Running
Drilling Equipment: 7822 DT
Drilling Method: DPT
Boring Diameter: 2-1/4"
Sampler Type: Macro-core
Hammer Type: Hydraulic

Northing (NAD 83): 258986.010
Easting (NAD 83): 1198916.067
Surface Elevation (NAVD 88): 12.0
Borehole Abandoned: 7/27/2017
Backfill Method: Bentonite Chips
Monitoring Device Installed: No
Device Type: N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0 2 4		GM	Silty fine sandy GRAVEL, dry, loose, olive brown (2.5Y 5/4), yellow brown (10YR 4/4) and brown (10YR 4/3).	50	30	20	0 0 0 0.1	2		Grass at ground surface. Wood matter at 2.0 ft and 4.5 ft. Concrete debris at 2.5 to 3.5 ft.
		SM	Gravelly silty SAND, wet, loose, gray (10YR 4/1).	30	40	30	1.7 6.4			Wood matter at 6.0 ft.
6 8 10		SW	Fine SAND that grades to medium SAND near 11.5 ft, wet, medium dense, olive gray (5Y 4/1) to gray green (Gley 1 4/5GY).	0	100	0	9.7 10 32.4 18.4 1.8 1.2 2.1	3	B42-7.5 @0838 B42-GW10.0 @0940	
12		ML/ CL	Clayey SILT and silty CLAY with interbedded fine sands (approximately 0.2 ft per 1 ft), medium stiff, wet, gray (5Y 4/1).	5	20	75	4.6 0.2	5		
14 16 18 20		SP	Fine SAND with interbedded clay (0.2 ft every 1 ft), medium dense, wet, gray (5Y 4/1).	5	75	20	0 0 1.3 27.2 0.4 0 0 0 0	5	B42-S16.0 @0859 B42-GW18.0 @1007 B42-S20.0 @0913	
22 24		CL	Fine sandy CLAY, damp, stiff, gray (5Y 4/1).	0	40	60	0 0 0	5		
26 28 30		SP	Fine SAND with interbedded clay (0.2 ft every 2 ft), dense, wet, gray (5Y 4/1), transition to olive brown near 29.0 ft (5Y 4/2).				0 0 0 0 0	5		

BATTELLE

Project: Keyport OU 1
Site: South Plantation
Boring Log: SP-B43

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259005.599
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1198959.503
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	15.0
Date Logged:	7/27/2017	Drilling Method:	DPT	Borehole Abandoned:	7/27/2017
Geologist:	Sam Moore	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips
Total Depth:	30 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading			Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
				% Gravel	% Sand	% Fines				
0		GM	Silty sandy GRAVEL, dry, loose, brown (10YR 4/3).	60	30	10				
							0			
2							0	3		
							0			leaf hummus top
4							0			
							0			
6		CL	Silty sandy CLAY, damp, stiff, brown (10YR 2/2).	0	20	80	0			
							1.2	4		
8		SW	Fine to medium SAND, wet, medium dense, gray green (5Y 4/1).	0	100	0	10.6			
							77.3			
10							146.7			
							69.8		SP-B43-S11. 0, @1049	
12							20.7	5	B43-S12.0 @1108	
							6		B43-GW13.0 @1124	
14		CL	Silty CLAY, medium stiff, damp, gray green (5Y 4/1).	0	0	100	2			
		SW	Fine to medium SAND, wet, medium dense, gray green (5Y 4/1).	0	100	0	1.5			
							36.7			
16							76.3			
							79.2	5		
18		ML	Clayey SILT, medium stiff, wet, gray green (5Y 4/1).	0	0	100	0.8			
		SP	Fine SAND with interbedded clayey SILT (approximately 0.2 ft every 1 ft), dense, wet, gray green (5Y 4/1).	0	80	20	0			
20							0			
							0.7			
22							0.1	5		
							0			
24		SP	Fine SAND with occasional gravel, dense, wet, gray-green (5Y 4/1).	5	95	0	0			
							0			
26							0			
							0	5		
28							0			
							0			
30										

BATTELLE

Project: Keyport OU 1
Site: South Plantation
Boring Log: SP-B44

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259000.922
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1199042.348
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	16.6
Date Logged:	7/27/2017	Drilling Method:	DPT	Borehole Abandoned:	7/27/2017
Geologist:	Sam Moore	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips
Total Depth:	30 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0–6		GM	Silty fine sandy GRAVEL, loose, dry, brown (10YR 4/3).	60	30	10	0 0 0 0 0	3		Leaf hummus top, concrete debris at 1.5 to 3.0 ft.
6–8		GC	Sandy, clayey GRAVEL, medium dense, wet, very dark gray (Gley 1 2.5/N).	40	30	30	0 1	3.75		Plant matter at 6.5 to 8.0 ft.
8–11		SP	Fine SAND, medium dense, wet, gray-green (5Y 4/1).	0	100	0	0.7 0 32 16.2 22.3		B44-S10.5 @1308	
11–13		ML	Clayey SILT, soft, wet, gray-green (Gley 1 4/5 6Y).	0	5	95	14.2 0.5	5	B44-GW12.0 @1408	
13–14		SP	Fine SAND, dense, wet, gray green (Gley 1 4/5 6Y).	0	100	0	0.1			
14–15		ML	Clayey SILT, medium stiff, wet, gray-green (Gley 1 4/5 6Y).	0	10	90	0			
15–17.5		SP	Fine gravel SAND, medium dense, wet, olive gray (5Y 4/1).	0	100	0	0 25.3 7.3 22.7			
17.5–20		ML	Clayey SILT with interbedded fine, poorly graded sands (0.5 ft per 1 ft), medium stiff, wet, gray green (Gley 1 4/5 6Y).	0	50	50	0.1 0	5		
20–30		SP	Fine SAND, dense, wet gray-green (Gley 1 4/5 6Y) becoming brown at 29.0 ft.	0	100	0	0 0 0 0 0 0 0 0 0 0	5 5		

BATTELLE

Project: Keyport OU 1
Site: South Plantation
Boring Log: SP-B45

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259029.882
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1198952.083
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	25.7
Date Logged:	7/27/2017	Drilling Method:	DPT	Borehole Abandoned:	7/27/2017
Geologist:	Sam Moore	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips
Total Depth:	25 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines
0	GM	Silty sandy GRAVEL, loose, dry, brown (2.5 Y 4/2) and (10YR 4/4).	60	30	10
7.5	CL	Sandy CLAY, medium stiff, wet, green-gray (Gley 1 5/5 GY).	10	40	50
9	SW	Fine to medium SAND, medium dense, wet, green-gray (Gley 1 3/5 GY).	5	95	0
14	CL	Silty CLAY, medium stiff, damp, gray (Gley 1 4/N).	0	0	100
15	SP	Fine SAND with lenses of silty CLAY (approximately 0.2 ft every 2 ft), dense, wet, green-gray (Gley 1 3/5 GY). Very little recovery in core from 20 to 25 ft bgs due to damaged core barrel from pea gravel.	5	80	15

Depth (ft bgs)	Headspace PID (ppm)
1	0
2	0
3	0
4	0
5	0
6	0
7	0
8	0
9	0
10	0
11	0.3
12	0.6
13	2.8
14	3.3
15	0.1
15.5	1.4
16	3.3
17	1.7
17.5	5.3
18	7.9
19	0
20	0
23	0.3
25	0

Depth (ft bgs)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0–5	2.5		Leaf hummus surface, concrete debris at 2.5 to 3.0 ft bgs.
5–10	3.75		Plant matter at 8.0 ft bgs.
10–15	5	B45-S13.5 @1438	
15–20	5	B45-S18.0 @1445, B45-GW18.0 @1537	
20–25	0		Refusal at 25.0 ft.

BATTELLE

Project: Keyport OU 1
Site: South Plantation
Boring Log: SP-B46

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259069.346
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1198920.442
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	16.0
Date Logged:	7/28/2017	Drilling Method:	DPT	Borehole Abandoned:	7/28/2017
Geologist:	Sam Moore	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips
Total Depth:	25 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	% Sand	% Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0 2		GM	Sandy silty GRAVEL, loose, dry, tan (10YR 4/2).	50	25	25	0 0 0	3		Leaf hummus surface.
4 6 8		GM	Silty sandy GRAVEL, medium dense, damp, gray (5Y 3/1).	40	30	30	0 0 0.2 0 0	3		
10 12		SW	Fine to medium SAND, medium dense, wet, gray green (Gley, 1 4/5 GY).	5	95	0	0 0 0 0 1.1	5	B46-S13.0 @0843	
14		CL	Silty CLAY with interbedded fine SAND (0.2 feet per foot), medium stiff, wet, olive gray (5Y 4/1).	0	20	80	0.4 0		B46-GW15.0 @0923	
16 18 20 22 24		SP	Fine SAND with interbedded silty CLAY (0.2 ft per 1 ft), medium dense, wet, olive gray (5Y 4/1).	0	80	20	0.4 0 0 0 0 0 0 0 0 0	5 5		
26							0			

BATTELLE

Project: Keyport OU 1
Site: South Plantation
Boring Log: SP-B47

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259036.421
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1198916.528
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	15.0
Date Logged:	7/28/2017	Drilling Method:	DPT	Borehole Abandoned:	7/28/2017
Geologist:	Sam Moore	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips
Total Depth:	30 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0		GM	Silty sandy GRAVEL, loose, dry, tan (10YR 4/2).	50	25	25				
							0			Leaf hummus surface.
2							0	3.75		
		GW	Fine sandy GRAVEL, medium dense, dry, gray (Gley 1 4/5 GY).	50	50	0	0			
4							0.6			Plastic debris at 4.0 ft bgs.
		CL	Fine sandy CLAY, medium soft, wet, green-gray (Gley, 1 4/5 GY).	10	40	40	0			
6							0.6			Wood matter at 6.0 ft bgs.
							0	3.75		
8							0			
		SW	Fine to coarse SAND, medium dense, wet, dark gray (Gley 1 3/N).	0	100	0	0			
10							0			
							0			
12							1.7	5		
							3			
14		ML	Clayey SILT with interbedded fine to coarse SAND (0.5 ft per 1 ft), medium stiff, wet, gray (Gley 1 4/N).	5	40	55	3.7		B47-S14.0 @1037	
							0		B47-GW15.0 @1037	
16							0			
							0	5		
18							0			
							0			
20		SP	Fine SAND, medium dense, wet, gray (Gley 1 4/N).	0	100	0	0			
							0			
22							0	5		
		ML	Clayey SILT with interbedded fine SAND (0.1 ft every 0.5 ft), stiff, wet, gray (Gley 1 4/N).	0	25	75	0			
24							0			
		SP	Fine SAND with interbedded SILT (0.1 ft every 1.0 ft), medium dense, wet, gray (5Y 4/1).	0	90	10	0			
26							0			
							0	5		
28							0			
							0			
30										

BATTELLE

Project: Keyport OU 1
Site: South Plantation
Boring Log: SP-B48B

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259005.058
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1198900.281
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	11.5
Date Logged:	7/28/2017	Drilling Method:	DPT	Borehole Abandoned:	7/28/2017
Geologist:	Sam Moore	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips
Total Depth:	30 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0 2 4		GM	Silty sandy GRAVEL, loose, dry, tan (104R 4/2).	50	25	25	0 0 0 0	1.5		Grass ground surface.
		CL	Fine sandy CLAY, medium stiff, wet, green-gray (gray 1 3/10Y).	10	40	40	1.9 3.9	3	B48B-S6.0 @1117, B48B-GW6.0 @1200	Fabric debris at 5.0 ft bgs.
6 8		SP	Fine SAND, medium dense, wet, green gray (Gley 1 3/10Y)	0	100	0	50.3 16 17.6 15.8			
10		CL	Sandy CLAY with gravel, medium stiff, wet, mottled brown (10YR 2/2) and green (Gley, 3/10Y).	10	40	50	2.6	5	B48B-S11.0 @1123	
12		SW	Fine to medium SAND, medium dense, wet, gray green (Gley 1 4/10Y).	0	95	5	12.3 5.9 0.9			
14		ML	Clayey SILT, medium stiff, wet, gray green (Gley 1 4/10Y).	0	0	100	8.3			
16 18 20 22 24 26 28 30		SP	Fine to coarse SAND with interbedded clayey SILT (approximately 0.3 ft every 1 ft). Pockets of sand are sometimes coarse and sometimes very fine. Medium dense, wet, green-gray (gray 1 4/10Y).	5	65	30	0 8.2 5.5 6.9 2.7 0 0 5.6 1.2 1.2 0 0 0 2.1 0 0 0	5 5 5 5		

BATTELLE

Project: Keyport OU 1
Site: South Plantation
Boring Log: SP-B49

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	258987.781
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1198977.216
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	15.5
Date Logged:	7/28/2017	Drilling Method:	DPT	Borehole Abandoned:	7/28/2017
Geologist:	Sam Moore	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips
Total Depth:	30 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0 2 4		GM	Silty sandy GRAVEL, loose, dry, tan (10YR 4/2).	50	25	25	0 0 0.2 0.6	2.5		
6		CL	Sandy CLAY, medium stiff, wet, gray-green (Gley 1 4/10Y).	10	45	45	0 1.1 2.8 6.5	3		
8 10 12		SW	Fine to medium SAND, medium dense, wet, gray (10YR 2/1) and brown (10YR 4/2).	0	100	0	5.6 33.6 138.3 265 73 6.1 4.6 1.1	5	B49-S9.5 @1358 B49-GW10.0 @1935	
14		ML	Clayey SILT, medium stiff, wet, green (Gley 1 3/5GY).	5	5	90	0.4			
16		SP	Medium SAND, medium dense, wet, green (Gley 1 3/5GY).	5	95	0	0 2.3			
18		ML	Clayey SILT with interbedded fine sands (approximately 0.3 ft every 1 ft), medium stiff, wet, green (Gley 1 3/5GY).	0	30	70	0.1 0 0	5	B49-GW18.0 @1458	
20		SP	Fine SAND, medium dense, wet, green-gray (Gley 1 3/5GY).	0	100	0	0 0			
22 24		ML	Clayey SILT with interbedded silty sands (0.2 ft per 1 ft), stiff, wet, gray (Gley 1 3/5GY).	0	20	80	0 0 0	5		
26 28 30		SW	Fine and medium SAND, dense, wet, gray (Gley 4/5GY) transition to brown (10YR3/3).	0	95	5	0 0 0 0 0	5		

BATTELLE

Project: Keyport OU 1
Site: South Plantation
Boring Log: SP-B50

Permit Number: 17-EP110
Contract: N39430-16-D-1802/CTO 010
Project: 100098089
Date Logged: 7/31/2017
Geologist: Michael Meyer
Total Depth: 25 feet bgs
Reviewer: Damon DeYoung

Drilling Contractor: Holt Services
Driller: Michael Running
Drilling Equipment: 7822 DT
Drilling Method: DPT
Boring Diameter: 2-1/4"
Sampler Type: Macro-core
Hammer Type: Hydraulic

Northing (NAD 83): 259020.837
Easting (NAD 83): 1198991.092
Surface Elevation (NAVD 88): 16.0
Borehole Abandoned: 7/31/2017
Backfill Method: Bentonite Chips
Monitoring Device Installed: No
Device Type: N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0 2 4 6		GM	Poor recovery. Light brown silty GRAVEL, loose, dry with plastic and asphalt debris.				0 0	1.5		
		ML	Medium brown fine sandy SILT, medium dense, dry. Grades to sand, wet at 8 ft.				0	3		
8 10 12		SP	Medium gray fine SAND. Soft, wet.				0 0 0.5 4.7 14.9 6.4	5	B50-S12.0 @0835	
14		ML	Medium gray clayey SILT, soft, wet, low plasticity.				0		B50-S14.0 @0927	
16		SP	Medium gray fine SAND, medium dense, wet.				5.2 12.8 3.6	5	B50-S16.0 @0902	
18		ML	Medium gray fine sandy SILT, medium dense, wet.				1 0			
20		SP	Medium gray fine SAND, medium dense, wet.				0 0			
22		SP	6-inch interbeds of SILT and SAND as above.				0	5		
24		SP	Medium gray fine SAND, medium dense, wet.				0 0			
26							0			

BATTELLE

Project: Keyport OU 1
Site: South Plantation
Boring Log: SP-B51

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	258997.819
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1199013.227
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	16.0
Date Logged:	7/31/2017	Drilling Method:	DPT	Borehole Abandoned:	7/31/2017
Geologist:	Michael Meyer	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips
Total Depth:	25 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Damon DeYoung	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0		GM	Light brown silty, sandy GRAVEL, dry, loose. No recovery from 5 to 10 ft.							
2								2		
3							0			
4							0			
5							0			
7.5								0		
10		SP	Grading downward from medium gray to medium brown fine SAND. 2 inch silt interbed at 11.2 ft. Medium dense, wet.				0			
11							0.1			
12							0	5		
13		SP	Interbedded gray fine SAND and SILT. 4 to 6 inch beds. Wet.				0.3		B51-S13.0 @1023	
14							0		B51-GW14.0 @1047	
15		SP	Medium brown, medium-grained SAND. Wet.				0			
16		ML	Medium gray, SILT with 2 inch fine sand interbeds. Dense, wet.				0			
17							0	5	B51-S17.0 @1030	
18							0			
19							0			
20							0			
21							0			
22							0	5		
23							0			
24		SP	Medium gray fine SAND. Dense, wet.				0			
25							0			
26										

BATTELLE

Project: Keyport OU 1
Site: South Plantation
Boring Log: SP-B52

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	258977.198
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1199069.667
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	13.5
Date Logged:	7/31/2017	Drilling Method:	DPT	Borehole Abandoned:	7/31/2017
Geologist:	Michael Meyer	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips
Total Depth:	25 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Damon DeYoung	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	 % Sand	 % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0			Medium brown, silty, sandy, GRAVEL, loose, dry.							
2		GM						2		
4							0			
			Black, grading downward to mottled gray and brown fine sandy SILT with organic odor. Moist.				0			
6		ML					0.1			
							1.1	4		
8			Medium gray medium SAND, medium dense, wet. 1 inch SILT interbed at 9 ft. Grades to medium brown at 14.2 ft.				13.6			
							358		B52-S9.0 @1116	
10		SP					45			
							30.5		B52-GW11.0 @1146	
12			Medium brown grading to medium gray sandy SILT and silty SAND interbeds, 4 to 12 inches thick. Wet, medium dense.				6.7	5	B52-S12.0 @1129	
							1.7			
14							0.1			
							0.5			
16							0			
							0.1	5		
18		ML					0			
							0			
20							0		B52-GW20.0 @1209	
							0			
22							0	5		
							0			
24		SP	Medium brown, medium SAND. Dense, wet.				0			
							0			
26										

BATTELLE

Project: Keyport OU 1
Site: South Plantation
Boring Log: SP-B53

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	258982.625
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1199146.267
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	16.3
Date Logged:	7/31/2017	Drilling Method:	DPT	Borehole Abandoned:	7/31/2017
Geologist:	Michael Meyer	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips
Total Depth:	35 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Damon DeYoung	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0			Silty, sand GRAVEL. Medium brown, dry, loose.							
2								1.5		
		GM								
4							0			
							0			
6							0			
		ML	Black SILT with abundant organics. Soft, wet.				0	4		
8			Mottled medium brown and gray SAND. Wet medium dense. Grades to medium gray at 9 ft. 1 inch gravel lens at 16 ft. Fine to medium grained. Trace sheen at 20 ft.				0			
							0			
10							0		B53-S10.0 @1833	
							0.5			
12							0.5	5		
							43.3			
14							38.4			
							590.5			
16							407			
		SP					751	5		
18							109.8			
							525			
20							667			
							716			
22							195	5		
							131		B53-GW23.0 @1458	
24							946		B53-S24.0 @1356	
							130.8			
26							67.5			
			Medium gray gravely, well-graded SAND. Very dense, wet.				82.1	5		
28							2			
							2.1			
30		SW					21.7			
							4.9			
32							8.4	5	B53-S32.0 @1433	
			Blue-gray CLAY, hard, high plasticity (Lawton Clay).				0.5		B53-GW33.0 @1529	
34		CH					0.3		B53-S33.5 @1440	
36										

BATTELLE

Project: Keyport OU 1
Site: South Plantation
Boring Log: SP-B54

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259058.422
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1199140.572
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	17.6
Date Logged:	8/01/2017	Drilling Method:	DPT	Borehole Abandoned:	8/01/2017
Geologist:	Michael Meyer	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips
Total Depth:	35 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Damon DeYoung	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0		GM	Light brown silty, sandy GRAVEL. Dry, loose. Treated wood at high PID location at 7 ft.							
1							0			
2								1.5		
3										
4							0.2			
5							0.5			
6							44.7		B54-S7.0 @0833, B54-GW7.0 @1024	
7		ML	Mottled medium brown and gray fine sandy SILT. Soft, moist. Rootlets.				180.8	4		
8		SP	Medium brown, medium SAND. Loose, wet clayey silt interbeds, 2 to 4 inches thick, 12 to 13 ft bgs. Gravel interbeds 2 to 4 inches thick, 14 to 19 ft bgs.				90.5			
9							82.1			
10							296.5			
11							375			
12							790	5		
13							240.1			
14							120			
15							92			
16							127			
17							477	5	B54-S17.0 @0913	
18							186			
19		SW	Medium gray gravely, well-graded SAND. Dense, wet.				351			
20							489			
21							302			
22							98	5		
23							235			
24		ML	Medium gray fine sandy SILT. Medium dense, wet, low plasticity.				137			
25		GW	Sandy GRAVEL. Wet. No recovery from 25 to 29 ft.				90			
26										
27								1		
28										
29		ML	Medium gray fine sandy SILT. Moist, hard.							
30		SW	Medium gray gravelly SAND. Dense, wet.				63.8			
31							70.3			
32		SP	Medium gray SAND. 12 inch interbeds of fine sand and medium sand. Very dense, wet. Refusal at 35 ft.				46.2	5		
33							48.9			
34							5.2		B54-S35.0 @0952, B54-GW35.0 @1108	
35							2.2			
36										

BATTELLE

Project: Keyport OU 1
Site: South Plantation
Boring Log: SP-B55

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259027.477
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1199113.010
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	16.0
Date Logged:	8/01/2017	Drilling Method:	DPT	Borehole Abandoned:	8/01/2017
Geologist:	Michael Meyer	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips
Total Depth:	35 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Damon DeYoung	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs): 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36

USCS Symbol	Sample Description	% Gravel	% Sand	% Fines
GM	Medium brown silty GRAVEL. Dry, loose.			
ML	Dark brown to black organic-rich SILT. Dry, soft.			
SP	Medium gray fine SAND. Wet, medium dense.			
ML/ CL	Medium gray clayey SILT to silty CLAY with fine sand interbeds 2 to 12 inches thick and occasional gravel.			
SP	Medium brown, medium grained SAND. Very dense, wet. 4 inch thick interbeds of well-graded gravelly sand 30 to 33 ft bgs.			
CH	Blue gray, CLAY. Hard, medium brown for top 4 inches. 2 inch sand lens at 33.3 ft bgs. (Lawton Clay)			

Headspace PID (ppm)
0
0
0
0.6
23.7
6.6
13.3
8.6
39
54.4
43.7
23.9
51.5
4.2
2.9
8.2
6.4
1
0.4
0.1
2.2
0.6
0
0
0
0
0
0
0.5
2.1
1.9
1.5
1.9
2.9
0
0

Measured Recovery (ft)
3
3
4
5
5
5
5

Sample ID Date/Time	Comments
B55-S9.0 @1154 B55-GW10.0 @1212	
B55-GW33.0 @1356 B55-S33.0 @13338	

BATTELLE

Project: Keyport OU 1
Site: South Plantation
Boring Log: SP-B56

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259048.221
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1199123.247
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	16.0
Date Logged:	8/01/2017	Drilling Method:	DPT	Borehole Abandoned:	8/01/2017
Geologist:	Michael Meyer	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips
Total Depth:	30 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Damon DeYoung	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0 2 4 6		GM	Medium brown silty GRAVEL, dry, loose.				0 0 0 0 0.3 9.9	3 3		
8		ML	Dark brown and black organic SILT with rootlets, moist, soft.				54.3 30.1			
10 12 14 16 18 20		SP	Mottled brown and gray fine to medium SAND, wet, medium dense, grades to medium gray, 12 inch silt beds from 12.5 ft to 13.5 ft and 14 ft to 15 ft bgs. Very poor recovery 15 to 20 ft.				90.9 716 318 228.8 101 49.2 24.8 8.6 5.3 4.7	4 2	B56-S10.0 @1453, B56-GW10.0 @1518 FD at 1520	
22		SW	Medium gray, gravelly, well-graded SAND, wet, dense.				77.5 34.9 39.5	5		
24		CH	Medium brown CLAY grading to blue-gray at 24.5 ft clay, very hard, dry (Lawton Clay).				5			
26		SW	Medium gray, gravelly, well-graded SAND, wet, dense.				4.9 12.6 6.8	5	B56-S27.0 @1501, B56-GW27.0 @1550	
28 30		CH	Blue-gray, very hard, dry CLAY. (Lawton Clay)				2.4 1.8			

BATTELLE

Project: Keyport OU 1
Site: South Plantation
Boring Log: SP-B57

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259059.814
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1199107.555
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	16.0
Date Logged:	8/02/2017	Drilling Method:	DPT	Borehole Abandoned:	8/02/2017
Geologist:	Michael Meyer	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips
Total Depth:	30 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Damon DeYoung	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0 2 4 6		GM	Medium brown silty GRAVEL, dry, grades to silty sandy GRAVEL at 3.5 ft, mottled brown and gray.				0 0 0 0.3 4.3 0.6 8.2	3.5 3		
8		ML	Black SILT, low plasticity with rootlets, moist, soft.				33 6.1			
10 12		SP	Mottled brown and gray fine SAND with roots, moist, medium dense.				15.7 35.8 8 1.7		B57-S10.0 @0844, B57-GW10.0 @0912	
14 16		ML	Medium gray interbedded fine sandy SILT and fine SAND, 6 to 12 inch interbeds, wet.				9.3 4.9 1.6 1.7 0.5	5		
18 20 22		SP	Medium brown medium SAND, wet, dense, 1 to 2 inch silt interbeds.				0.6 1.3 0.5 0 0.2	5 5		
24 26 28		SW	Medium gray, gravelly, well-graded SAND, wet, dense.				0.1 0.2 0.5 0 0 2.2 1.2	5	B57-S29.0 @0854, B57-GW29.0 @0933	
30		CL	Blue-gray CLAY, dry, very hard. (Lawton Clay)							
32							0			

KEYPORT_LOGS_2017_REV2.SDG

BATTELLE

Project: Keyport OU 1
Site: South Plantation
Boring Log: SP-B58

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	258995.333
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1199131.984
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	26.0
Date Logged:	8/02/2017	Drilling Method:	DPT	Borehole Abandoned:	8/02/2017
Geologist:	Michael Meyer	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips
Total Depth:	40 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Damon DeYoung	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0–5		GM	Medium brown silty GRAVEL, dry, loose.				0 0 0 0 0	3.5		
5–10			No core recovery from 5 to 15 ft.					0		
10–15								0		
15–20		SP	Medium brown, medium SAND, occasional gravel clasts.				0 0 0 0 0.2	4.5		
20–25							0 0.4 0 0 0	5	B58-S21.0 @1056	
25–30							5.7 3 3.1 1.5 1.3	5		
30–33		SP	Color grades to medium gray, mottled with medium brown.				22.7 56.1 60.3	5		
33–35		SW	Mottled brown and gray, gravelly, well-graded SAND, wet, very dense interbedded medium brown, medium-grained SAND at 37.5 to 38.5 ft with copper colored water.				12 126.4			
35–39							104.5 46.4 333 64.2 50.7	5	B58-S37.0 @1129 B58-GW39.0 @1148 B58-S39.5 @1136	Sheen at 36.5'
39–40		CH	Blue-gray CLAY, high plasticity, dry, very hard. (Lawton Clay)				4.6			

BATTELLE

Project: Keyport OU 1
Site: South Plantation
Boring Log: SP-B59

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259037.489
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1199159.941
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	15.6
Date Logged:	8/02/2017	Drilling Method:	DPT	Borehole Abandoned:	8/02/2017
Geologist:	Michael Meyer	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips
Total Depth:	30 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Damon DeYoung	Hammer Type:	Hydraulic	Device Type:	N/A

USCS Symbol	Sample Description
Asphalt	Asphalt at surface, 0 to 4 inches bgs.
GM	Silty GRAVEL, light brown and gray, black staining at 3.5 ft.
ML	Gray sandy SILT with rootlets, dry.
SM	Silty fine SAND, wet, medium brown and gray, black staining at 6.5 ft.
ML	Medium gray, clayey SILT with trace sand and gravel, rootlets, treated wood at 8 ft.
SP	Dark gray fine SAND, wet, dense.
SW	Medium gray, gravelly, well-graded SAND, wet, dense.
ML/ SM	Light brown fine sandy SILT to silty fine SAND, wet, medium dense.
SP	Fine SAND, grades downward brown to gray.
SW	Gray, well graded gravelly SAND, wet, dense.
SP	Interbedded gray fine SAND and gravelly, well graded SAND, 6 to 12 inch interbeds, wet, dense.
CH	Blue-gray, clay (Lawton Clay)

Depth (ft bgs): 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32

Grading: % Gravel | % Sand | % Fines (no entries)

Headspace PID (ppm)
0
2.5
273
364.9
637.4
169.2
170.1
104.5
6.2
62.7
73.7
23.1
21.9
5.4
5.5
6
4.5
2.4
5.5
355
470
71.3
40.6
14.5
8.8
54.9
52.9
8.5
5.1
2

Measured Recovery (ft)
3
4
5
5
5
5

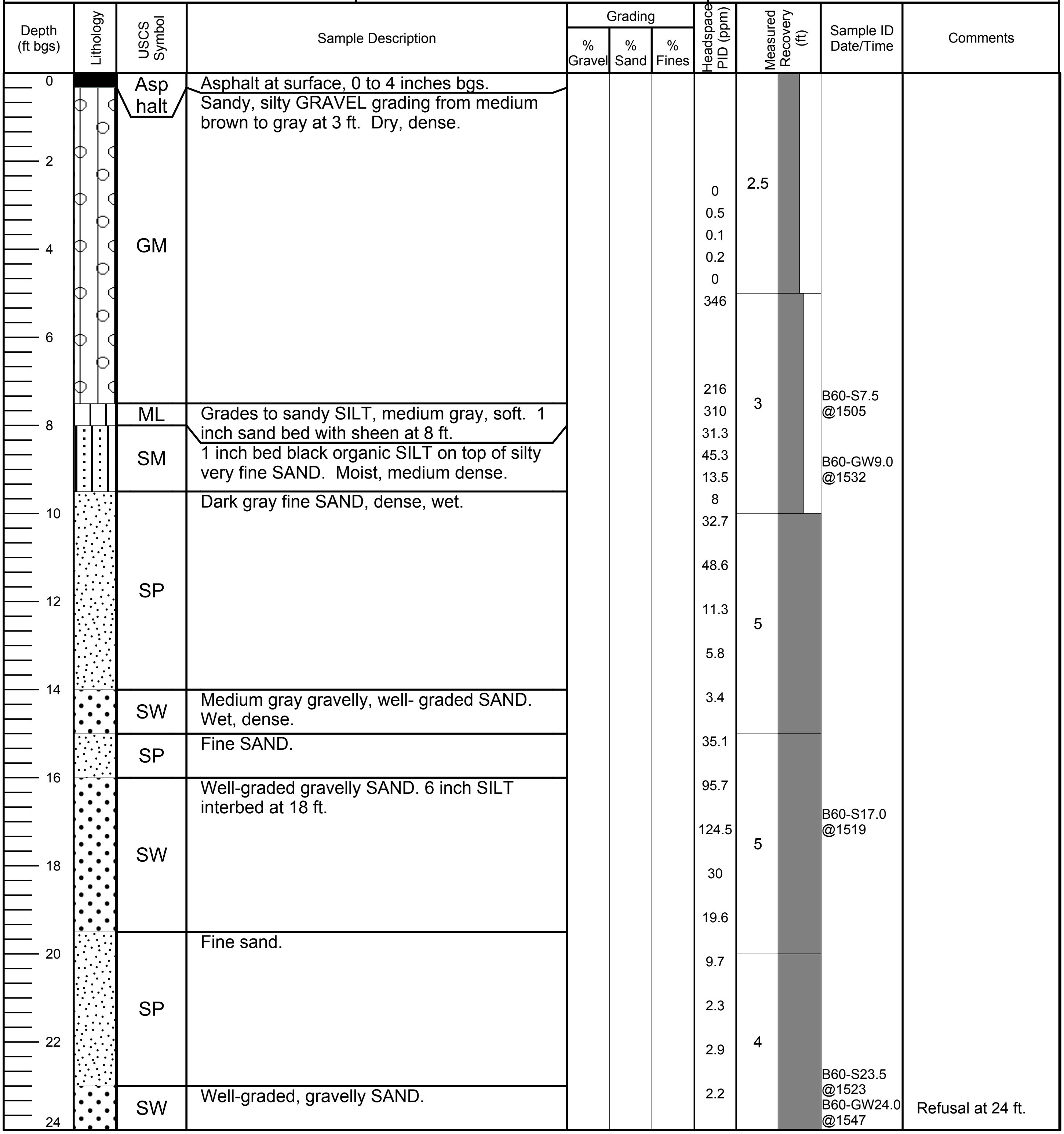
Sample ID Date/Time
B59-S5.0 @1350
B59-S21.0 @1356
B59-S29.8 @1404
B59-GW30.0 @1420

Comments: Refusal at 2.5 ft on wood debris. After 2 attempts, moved 10 ft North.

BATTELLE

Project: Keyport OU 1
Site: South Plantation
Boring Log: SP-B60

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259058.654
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1199161.256
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	15.6
Date Logged:	8/02/2017	Drilling Method:	DPT	Borehole Abandoned:	8/02/2017
Geologist:	Michael Meyer	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips
Total Depth:	24 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Damon DeYoung	Hammer Type:	Hydraulic	Device Type:	N/A



USCS Symbol	Sample Description
Asphalt	Asphalt at surface, 0 to 4 inches bgs.
GM	Sandy, silty GRAVEL grading from medium brown to gray at 3 ft. Dry, dense.
ML	Grades to sandy SILT, medium gray, soft. 1 inch sand bed with sheen at 8 ft.
SM	1 inch bed black organic SILT on top of silty very fine SAND. Moist, medium dense.
SP	Dark gray fine SAND, dense, wet.
SW	Medium gray gravelly, well- graded SAND. Wet, dense.
SP	Fine SAND.
SW	Well-graded gravelly SAND. 6 inch SILT interbed at 18 ft.
SP	Fine sand.
SW	Well-graded, gravelly SAND.

Headspace PID (ppm): 0, 0.5, 0.1, 0.2, 0, 346, 216, 310, 31.3, 45.3, 13.5, 8, 32.7, 48.6, 11.3, 5.8, 3.4, 35.1, 95.7, 124.5, 30, 19.6, 9.7, 2.3, 2.9, 2.2

Measured Recovery (ft): 2.5, 3, 5, 5, 4

Sample ID Date/Time
B60-S7.5 @1505
B60-GW9.0 @1532
B60-S17.0 @1519
B60-S23.5 @1523
B60-GW24.0 @1547

Comments: Refusal at 24 ft.

BATTELLE

Project: Keyport OU 1
Site: South Plantation
Boring Log: SP-B61

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259077.349
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1199155.090
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	16.4
Date Logged:	8/03/2017	Drilling Method:	DPT	Borehole Abandoned:	8/03/2017
Geologist:	Sam Moore	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips/Asphalt
Total Depth:	35 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0		Asp halt	Asphalt from 0 to 6 inches bgs.							
2 4 6		GM	Fine sandy, silty, GRAVEL; dry, loose, tan (10YR 5/2).	60	20	20	0 0 0 0 0 0	2.5 0.75		
8 10		ML	Sandy SILT, medium stiff, damp, gray (10 YR 4/1).	0	20	80	1.3 0			
12 14 16 18		SP	Fine SAND, medium dense, wet, gray (10YR 4/1).	0	100	0	0 0 0 0 0 0 0 0.3	5 5	B61-S18.0 @0923	
20 22 24 26		SW	Gravely, coarse SAND with fine sand, dense, wet, gray (10YR 4/1).	30	70	0	0.2 0 0 0 0 407.1 15.7 0.2 0.6	5	B61-S23.5 @0932 B61-GW25.0 @1040	
28 30		SM	Silty fine SAND, dense, wet, dark gray (Gley 1 3/N).	0	85	15	0 0 0	5		
32 34		GM	Very poor recovery. Sand-silt - GRAVEL mixture. Very dense, damp, gray (Gley 1 3/N).	30	40	30	0	0.5		Refusal @ 35'
36										

BATTELLE

Project: Keyport OU 1
Site: South Plantation
Boring Log: SP-B62

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259081.276
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1199138.618
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	16.2
Date Logged:	8/3/2017-8/4/2017	Drilling Method:	DPT	Borehole Abandoned:	8/04/2017
Geologist:	Sam Moore/Damon DeYoung	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips with Asphalt
Total Depth:	30 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0 2 4		GM	Fine, silty GRAVEL, dense, dry, tan (10 YR 5/2).	50	25	25	0 0 0.3 1 0.9	2.5		
6		Deb ris	Black oily tar / rubber fragments.				12.5 125.2 276.9 33.1	4	B62-S7.0 @1113	
8		ML	Sandy SILT, medium stiff, wet, gray/olive (5Y 3/1).	0	40	60				
10		SP	Fine SAND with occasional gravel, medium dense, wet, olive/gray (5Y 3/1).	10	90	0	15.2 3.9 2.4 0			
12		ML	Clayey SILT, medium stiff, wet, gray (Gley 1 4/N).	0	0	100	0.5 0.4	5		
14 16 18 20		SW	Fine to coarse SAND with occasional gravelly lenses, dense, wet, gray (5Y 4/1).	15	80	5	1 1.9 3.3 3.2 2.2 0.4 0.3 0	5	B62-S16.0 @1139	
22 24 26 28		SW	Fine SAND, gray, transitions to coarse sand/gravel at 24 ft, gravelly sand in the 25 to 30 ft core barrel locked up core sleeve resulting in poor recovery.	20	70	10	0 0.4 59.5 0.5 79.3 59.6 17.1	5 4	B62-S24.0 @1503 B62-S26.0 @1215, B62-GW26.0 @1244	Poor recover with the core stuck in the barrel. Needed to hammer out the first 2 ft of core.
30		SM	Fine SAND, gray, with silt.	0	70	30	3.5			

BATTELLE

Project: Keyport OU 1
Site: South Plantation
Boring Log: SP-B63

Permit Number: 17-EP110
Contract: N39430-16-D-1802/CTO 010
Project: 100098089
Date Logged: 8/04/2017
Geologist: Damon DeYoung
Total Depth: 30 feet bgs
Reviewer: Michael Meyer

Drilling Contractor: Holt Services
Driller: Michael Running
Drilling Equipment: 7822 DT
Drilling Method: DPT
Boring Diameter: 2-1/4"
Sampler Type: Macro-core
Hammer Type: Hydraulic

Northing (NAD 83): 258966.506
Easting (NAD 83): 1199157.438
Surface Elevation (NAVD 88): 15.4
Borehole Abandoned: 8/04/2017
Backfill Method: Bentonite Chips/Asphalt
Monitoring Device Installed: No
Device Type: N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	 % Sand	 % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0		GM	Sandy-silty GRAVEL, light brown. Poor recovery from 0 to 5 ft.	50	40	10				
							0			
2							0	2		
							0			
4							0			
							0			
6							0			
		SM	Clayey - gravelly SAND, greenish - gray 7 to 8 ft, mottled with orange.	20	50	30	0	3.5		
8		SP	Medium to fine SAND, brown-gray with iron staining at 9 ft, thin bed of light brown silt approximately 2 inches thick at 11 ft bgs. Thin silt bed at 19 ft bgs.	5	90	5	0			
							0			
10							0			
							0			
12							0	5		
							0			
14							0			
							0.1			
16							0.2			
							0.1	5		
18							0.2		B63-S18.5 @1435	
							1			
		SW	SAND grades to coarse SAND & gravel.	30	70	0	0			
20							0.4			
							0.2			
22							0.3	5		
									B63-S24.0 @1447, B63-GW24.0 @1529	
24		CH	CLAY, blue-gray with minor sand and gravel.	5	5	90	1.3			
		SW	Sandy GRAVEL (maybe sluff from upper section of borehole).				1			
26							0.3			
		CH	CLAY, blue-gray, no sand/gravel.				1	5		
28							0			
							0			
30										

BATTELLE

Project: Keyport OU 1
Site: South Plantation
Boring Log: SP-B64

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	258967.606
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1199097.229
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	9.5
Date Logged:	8/04/2017	Drilling Method:	DPT	Borehole Abandoned:	8/04/2017
Geologist:	Damon DeYoung	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips
Total Depth:	25 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0 2 4		SP	Poor recovery, organics approximately at 2 inches, medium SAND, brown with greenish gray clay.		50	50	6.3 31.3 96.8	1	B64-S5.5 @1609	
6		SP	Medium to fine SAND, mottled brown-gray.		90	10	24.7			
8		CH	Finely interbedded SILT, CLAY, and fine SAND gray from 6 to 10 ft bgs.		50	50	0 0 0	5		
10 12		SP	Washed out SAND, brown, fine to medium.	5	90	5	6.4 35.3 35 4.5	5	B64-GW10.0 @1648 B64-S12.0 @1625	
14		ML	Interbedded silty CLAY & fine SAND, gray.		50	50	2.1 1			
16 18 20 22 24		SP	Fine to medium SAND, brown.	<5	95	5	0 0 0 0 0 0 0 0 0	5 5		
26							0			

BATTELLE

Project: Keyport OU 1
Site: South Plantation
Boring Log: SP-B65C

Permit Number: 17-EP110
Contract: N39430-16-D-1802/CTO 010
Project: 100098089
Date Logged: 8/06/2017
Geologist: Damon DeYoung
Total Depth: 25 feet bgs
Reviewer: Michael Meyer

Drilling Contractor: Holt Services
Driller: Michael Running
Drilling Equipment: 7822 DT
Drilling Method: DPT
Boring Diameter: 2-1/4"
Sampler Type: Macro-core
Hammer Type: Hydraulic

Northing (NAD 83): 258977.132
Easting (NAD 83): 1198940.083
Surface Elevation (NAVD 88): 14.8
Borehole Abandoned: 8/06/2017
Backfill Method: Bentonite Chips/Soil Cover
Monitoring Device Installed: No
Device Type: N/A

Depth (ft bgs)	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines
0	GM	Poor recovery, mixed GRAVEL, SAND and SILT light brown, PID hits throughout. 3 inches of clayey-silty sand at 7 ft, mottled light brown and orange.	33	33	33
7	ML	Clayey, sandy SILT grades to coarse SAND with gravel from 7 to 11 ft, greenish gray silt to dark gray sands. Fines downward into fine SAND to 12.5 ft, then a sandy SILT to 13 ft, gray.	<5	70	30
13	SM	Medium SAND from 13 to 14 ft, dark gray, tightly interbedded fine sand, silt and clay, gray. Poor recovery from 15 to 20 ft.	<5	60	40
20	SW	Coarse SAND to fine sand, grading downward from 20 to 22.5 ft.	<5	90	10
22.5	ML	Tightly interbedded SILT, SAND and CLAY gray, from 22.5 to 25 ft.	<5	50	50

Depth (ft bgs)	Headspace PID (ppm)
0.5	2.2
2	6.4
3	4.2
4	1.7
5	6
6	1.8
7	2.5
8	40.6
9	1.9
10	2.8
11	1.8
12	0.1
13	0
14	0
15	0
16	0
20	0
21	0
22	0
23	0
24	0
25	0

Depth (ft bgs)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0–5	2		
5–10	4	B65-S8.0 @0905 B64-GW9.0 @0958	
10–15	5		
15–20	1		Core sleeve stuck in barrel.
20–25	5		

BATTELLE

Project: Keyport OU 1
Site: South Plantation
Boring Log: SP-B66

Permit Number: 17-EP110
Contract: N39430-16-D-1802/CTO 010
Project: 100098089
Date Logged: 8/06/2017
Geologist: Damon DeYoung
Total Depth: 25 feet bgs
Reviewer: Michael Meyer

Drilling Contractor: Holt Services
Driller: Michael Running
Drilling Equipment: 7822 DT
Drilling Method: DPT
Boring Diameter: 2-1/4"
Sampler Type: Macro-core
Hammer Type: Hydraulic

Northing (NAD 83): 259071.687
Easting (NAD 83): 1199069.092
Surface Elevation (NAVD 88): 15.8
Borehole Abandoned: 8/06/2017
Backfill Method: Bentonite Chips/Asphalt
Monitoring Device Installed: No
Device Type: N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	 % Sand	 % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0		Asp halt	Asphalt from 0 to 3 inches bgs.							
		GM	Mixed GRAVEL, SAND and SILT, light brown soil moist at 4.5 ft, saturated at 7 ft, dark brown.	35	50	15				
							2.4			
2							0.2	3.5		
							0.4			
4							1			Groundwater at 7 ft bgs.
							0.1			
6										
							0	3.5		
8		SP	Medium to fine SAND from 8 to 9.5 ft gray, contains black layer at 8.5 ft with petroleum odor.	<5	90	10	22.6			
							73.6		B66-S9.0 @1020	
		SM	Silty SAND, gray, transitions to fine to medium sand from 10 to 11.5 ft.	0	100	0	205		B66-GW10.0 @1057	
10							53.8		B66-S10.5 @1031	
							99.4			
							39.2			
12		SM	Tightly interbedded fine SAND, SILT and CLAY, gray with sand beds to 5 inches.	0	40	60	4.1	5		
							2.8			
14		SP	Fine SAND, poorly graded, gray with interbedded silt from 17.5 to 18.5 ft.	0	90	10	1.2			
							2			
16							0.4			
							1.6	5		
18		ML	Silt interbed.				0			
		SP	Fine SAND.	0	100	0	0			
20							0			
							0			
22							0.1	5		
		SW	Grades to medium SAND.				0			
24							0.4			
							0.1			
26										

BATTELLE

Project: Keyport OU 1
Site: South Plantation
Boring Log: SP-B67

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259096.313
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1198992.490
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	16.8
Date Logged:	8/06/2017	Drilling Method:	DPT	Borehole Abandoned:	8/06/2017
Geologist:	Damon DeYoung	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips/Soil Cover
Total Depth:	25 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0		GM	Mixed GRAVEL, SAND and SILT, light brown, grades to sandy gravel down to 8 ft bgs.	40	30	30				
							0.3			
2							0	2.5		
							0			
4							0			
							0			
6							1.1			
		GP		90	10	0	0.9	4		Groundwater at 7.5 ft bgs.
8		SP	Fine to medium SAND, gray, thin bed of silt at 9 ft, approximately 1 inch thick, continuous sand from 8 to 13.5 ft bgs.	<5	95	5	0			
							0			
10							8.5			
							10.8			
12							23.3	5	B67-S12.5 @1121	
							34.3			
							23.6			
		ML	Tightly interbedded SILT, CLAY, and fine SAND from 13.5 to 15 ft.	<5	40	60				
14							0.2		B67-GW14.0 @1153	
		SP	Medium to fine SAND with gravel.	15	80	5	0			
16							12			
							9.8	5		
18							12.8			
		ML	Interbedded SILT, CLAY, and fine SAND, gray.	<5	40	60	0			
20		SP	Medium to fine SAND with silt layers from 20 to 25 ft.	<5	95	5	9.2			
							0			
22							0	5		
							0			
24							0		B67-S24.0 @1150	
							0			
26										

BATTELLE

Project: Keyport OU 1
Site: South Plantation
Boring Log: SP-B68

Permit Number: 17-EP110
Contract: N39430-16-D-1802/CTO 010
Project: 100098089
Date Logged: 8/06/2017
Geologist: Damon DeYoung
Total Depth: 25 feet bgs
Reviewer: Michael Meyer

Drilling Contractor: Holt Services
Driller: Michael Running
Drilling Equipment: 7822 DT
Drilling Method: DPT
Boring Diameter: 2-1/4"
Sampler Type: Macro-core
Hammer Type: Hydraulic

Northing (NAD 83): 259063.327
Easting (NAD 83): 1199025.317
Surface Elevation (NAVD 88): 16.0
Borehole Abandoned: 8/06/2017
Backfill Method: Bentonite Chips/Soil Cover
Monitoring Device Installed: No
Device Type: N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	Grading % Sand	Grading % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0 2 4		GM	Mixed GRAVEL, SAND and SILT, light to dark brown. Gravelly-sandy clay at 4.75 ft, greenish gray, wet.	40	40	20	8.1 0.1 0 0	3	B68-S0.5 @1335	
6 8		SM	Organic layer at 7 ft, dark brown- black, saturated clayey SAND, dark gray, mottled with orange.	<5	50	50	0.2 0 14.2 9.3	3.5		Groundwater at 5 ft bgs.
10 12		SP	Medium SAND, dark gray from 8.5 to 13 ft bgs.	<5	95	5	17.1 17.8 12.3 4.8 20.1 38.5	5	B68-S9.5 @1345 B68-S12.5 @1355 B68-GW13.0 @1425	
14		SM	Interbedded silty SAND and silty CLAY from 13 to 15 ft bgs.	0	50	50	3.3 0.1			Field duplicate groundwater @1436
16		SP	Medium to fine SAND, gray, from 15 to 18 ft bgs.	0	80	20	7 13.2 5.3	5		
18		SM	Interbedded silty SAND, SILT, and CLAY from 18 to 20 ft bgs.	0	50	50	0.1 0			
20 22 24		SM	Fine SAND interbedded with SILT, gray from 20 to 25 ft.	0	80	20	0.6 0 0 0 0	5		
26							0			

BATTELLE

Project: Keyport OU 1
Site: South Plantation
Boring Log: SP-B69

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259059.099
Contract:	N39430-16-D-1802/CTO 010	Driller:	Michael Running	Easting (NAD 83):	1198987.307
Project:	100098089	Drilling Equipment:	7822 DT	Surface Elevation (NAVD 88):	16.0
Date Logged:	8/06/2017	Drilling Method:	DPT	Borehole Abandoned:	8/06/2017
Geologist:	Damon DeYoung	Boring Diameter:	2-1/4"	Backfill Method:	Bentonite Chips/Soil Cover
Total Depth:	25 feet bgs	Sampler Type:	Macro-core	Monitoring Device Installed:	No
Reviewer:	Michael Meyer	Hammer Type:	Hydraulic	Device Type:	N/A

Depth (ft bgs)	Lithology	USCS Symbol	Sample Description	Grading % Gravel	 % Sand	 % Fines	Headspace PID (ppm)	Measured Recovery (ft)	Sample ID Date/Time	Comments
0 2 4		GM	Mixed GRAVEL, SAND and SILT, light brown with rust staining and plastic debris at 4.5 ft bgs.	40	40	20	0 0 0 0 9	2.5		
6 8 10		SM	Saturated dark brown medium SAND, color changes to olive brown then to gray at 9 ft, silt bed at 9.5 ft.	10	70	20	4.4 0 0.2 4.1 1.3 22.5	3	B69-S11.5 @1506 B69-GW12.0 @1552	Groundwater at approximately 7 ft bgs. Collected FD-5 at 11.5 ft.
12 14 16 18		SM	Interbedded fine SAND, SILT, and CLAY with 3 inch sand layers at 14 ft and 15 ft, gray.	<5	30	70	2.8 0 0 7 1 0 0	5 5	B69-S15.0 @1521	Collected MS & MSD for groundwater at 12 ft. Collected MS & MSD for soil at 15 ft.
20 22		SP	Fine to medium SAND, gray from 19 to 23.5 ft.	<5	90	10	0 0 0 0 0	5		
24		SM	Interbedded SILT and fine SAND, gray.	<5	50	50	0			
26							0			

BATTELLE

Project: NBK Keyport
Site: OU 1
Boring Log: MW1-42/B76

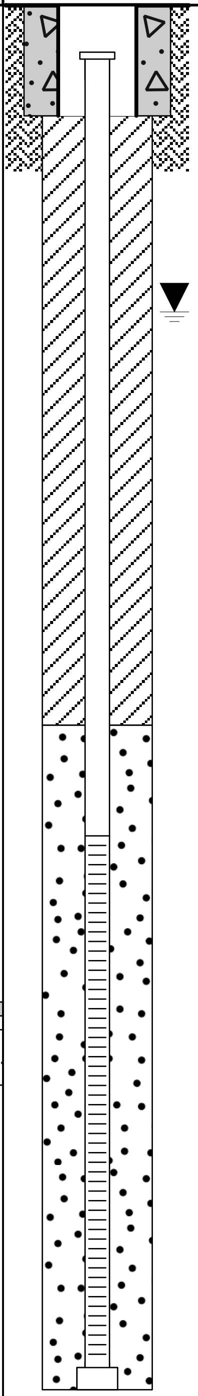
Permit Number: 17-EP110
Project Number: 100098089
Contract Number: N39430-16-D-1802/CTO 010
Task Order Number: 10
Date Logged: 10/6/2017
Geologist: Joshua Sacker
Total Depth (ft bgs): 25
Reviewer: Michael Meyer

Drilling Contractor: Holt Services
Driller: Abe Causland
Drilling Equipment: Landa L-10-T
Drilling Method: Hollow Stem Auger
Boring Diameter: ~9"
Sampler Type: split spoon (18")
Hammer Type: 140 lb

Northing (NAD 83): 259497.016
Easting (NAD 83): 1198819.77
Surface Elevation (NAVD 88): 13.6
Borehole Abandoned: N
Backfill Method: Well Installed

Depth (ft bgs)	USCS Symbol	Sample Description	Blow Counts	Sample Recovery	Sample ID/Time	Headspace Readings	Lithology
0							
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18	NR	No recovery - 3" section of sampler.					
19	ML SP	SAND, fine grained, trace fines, very dark gray (5Y 3/1), saturated ~3% fines, decreasing grain size @ 19.25', increasing fines (~5%), medium dense.	6/8/12	83%	B76-S-19 @ 1025	5.6	
20							
21							
22							
23							
24							
25							
26							

Well Construction



Flush-mounted traffic rated well box:
Rim elevation: 13.60 ft AMSL (NAVD 88).
Brand/size: EMCO Wheaton / 18" diameter

Surface Seal: Cement

Blank Well Casing:
Top of Casing: 12.77 ft AMSL (NAVD 88), 0.85 ft below ground surface.
Bottom of Casing: 15' bgs
Type: 2" dia. Sch. 40 PVC well casing

Bentonite:
3/8" Bentonite Chips (Halliburton Coarse Grade Wyoming Sodium Bentonite)

DTW: 5.54' bgs

Filter Pack:
Type: 10/20 Colorado Silica sand (Premium Silica LLC.)

Well Screen:
Top of Screen: 15' bgs
Bottom of Screen: 25' bgs
Type: 2" dia. Sch. 40 PVC Screen
Slot Size: 0.010" slot size

End Cap: 2.375" PVC End Cap

Notes: ~20 gals potable water added during well installation to minimize heaving.

BATTELLE

Project: NBK Keyport
Site: OU 1
Boring Log: MW1-43/B77

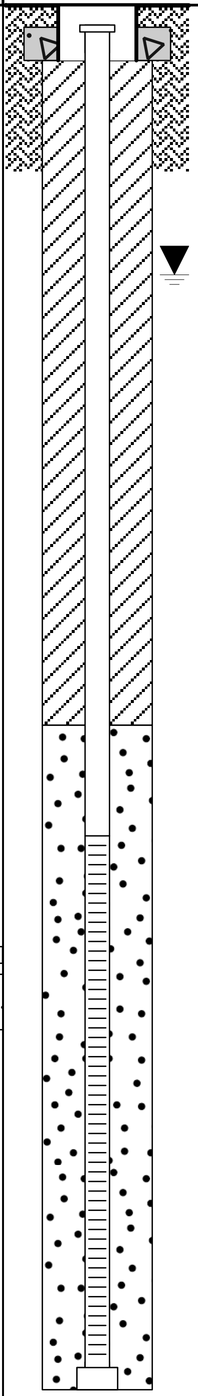
Permit Number:	17-EP110
Project Number:	100098089
Contract Number:	N39430-16-D-1802/CTO 010
Task Order Number:	10
Date Logged:	10/6/2017
Geologist:	Joshua Sacker
Total Depth (ft bgs):	25
Reviewer:	Michael Meyer

Drilling Contractor:	Holt Services
Driller:	Abe Causland
Drilling Equipment:	Landa L-10-T
Drilling Method:	Hollow Stem Auger
Boring Diameter:	~9"
Sampler Type:	split spoon (18")
Hammer Type:	140 lb

Northing (NAD 83):	259325.258
Easting (NAD 83):	1198822.32
Surface Elevation (NAVD 88):	13.1
Borehole Abandoned:	N
Backfill Method:	Well Installed

Depth (ft bgs)	USCS Symbol	Sample Description	Blow Counts	Sample Recovery	Sample ID/Time	Headspace Readings	Lithology
17	slough	4" of slough.					
18	ML	SILT, ~5% fine grained sand, ~20% clay, very dark gray (5Y 3/1), saturated, debris, small fibrous/woody material, small pieces of metal.		80%	B77-S-18.0 @ 1450	22.3	
	SP	SAND, fine grained (very fine-grained), ~5% fines, very dark gray (5Y 3/1/), saturated, medium dense.					
25							

Well Construction



Flush-mounted traffic rated well box:
Rim elevation: 13.06 ft AMSL (NAVD 88)
Brand/size: Morris / 8" diameter

Surface Seal: Cement

Blank Well Casing:
Top of Casing: 12.69 ft AMSL (NAVD 88), 0.36 ft below ground surface.
Bottom of Casing: 15' bgs
Type: 2" dia. Sch. 40 PVC well casing

Bentonite:
3/8" Bentonite Chips (Halliburton Coarse Grade Wyoming Sodium Bentonite)

DTW: 4.87' bgs

Filter Pack:
Type: 10/20 Colorado Silica sand (Premium Silica LLC.)

Well Screen:
Top of Screen: 15' bgs
Bottom of Screen: 25' bgs
Type: 2" dia. Sch. 40 PVC Screen
Slot Size: 0.010" slot size

End Cap: 2.375" PVC End Cap

Notes: No water added during water well installation.

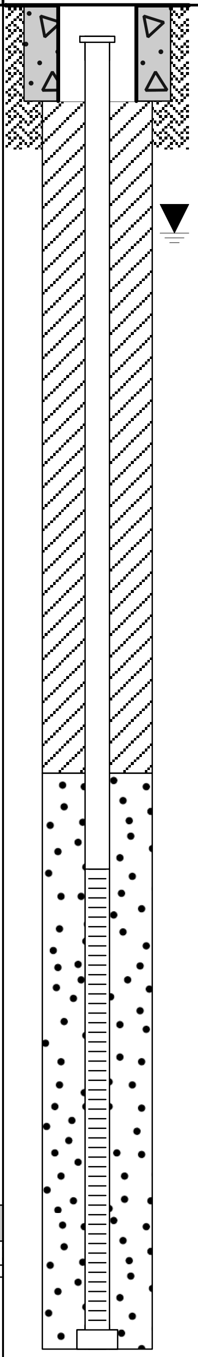
BATTELLE

Project: NBK Keyport
Site: OU 1
Boring Log: MW1-44/B75

Permit Number: 17-EP110
Project Number: 100098089
Contract Number: N39430-16-D-1802/CTO 010
Task Order Number: 10
Date Logged: 10/5/2017
Geologist: Joshua Sacker
Total Depth (ft bgs): 28
Reviewer: Michael Meyer

Drilling Contractor: Holt Services
Driller: Abe Causland
Drilling Equipment: Landa L-10-T
Drilling Method: Hollow Stem Auger
Boring Diameter: ~9"
Sampler Type: split spoon (18")
Hammer Type: 140 lb

Northing (NAD 83): 259394.516
Easting (NAD 83): 1198806.5
Surface Elevation (NAVD 88): 12.9
Borehole Abandoned: N
Backfill Method: Well Installed

Depth (ft bgs)	USCS Symbol	Sample Description	Blow Counts	Sample Recovery	Sample ID/Time	Headspace Readings	Lithology	Well Construction
0								
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25	NR	Poor recovery - slough.						
26	SM	Silty SAND, fine grained sand, little silt (~15%) very dark gray (5Y 3/1) (f:m:c 100:0:0) saturated	9/11/16	50%	B75-S-26.0 @ 1400	30.2		
27	ML	SILT, ~ 20% to 30% clay, <1% fine sand, very dark gray (5Y 3/1), saturated. @ 26.5, ~ 2" layer of fine-grained sand (SP) in shoe of sampler.						
28								
29								
30								

Flush-mounted traffic rated well box:
Rim elevation: 12.87 ft AMSL (NAVD 88)
Brand/size: Morris / 8" diameter

Surface Seal: Cement

Blank Well Casing:
Top of Casing: 12.24 ft AMSL (NAVD 88), 0.65 ft below ground surface.
Bottom of Casing: 18' bgs
Type: 2" dia. Sch. 40 PVC well casing

Bentonite:
3/8" Bentonite Chips (Halliburton Coarse Grade Wyoming Sodium Bentonite)

DTW: 4.75' bgs

Filter Pack:
Type: 10/20 Colorado Silica sand (Premium Silica LLC.)

Well Screen:
Top of Screen: 18' bgs
Bottom of Screen: 28' bgs
Type: 2" dia. Sch. 40 PVC Screen
Slot Size: 0.010" slot size

End Cap: 2.375" PVC End Cap

Notes: Approx. 20 gals of potable water added during well installation to suppress heaving sands.

Project: NBK Keyport
Site: OU 1
Boring Log: MW1-45/B74

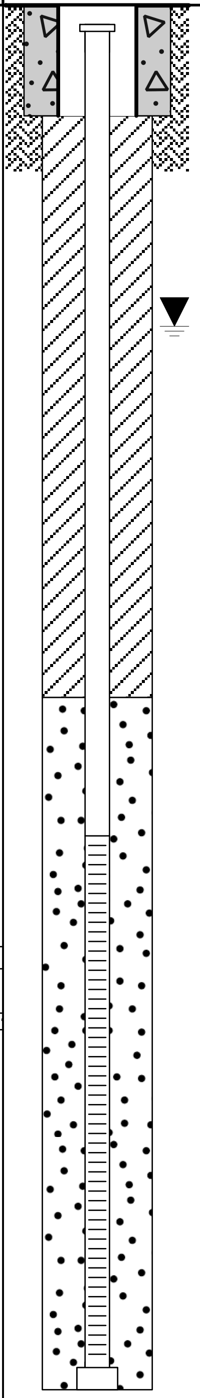
Permit Number: 17-EP110
Project Number: 100098089
Contract Number: N39430-16-D-1802/CTO 010
Task Order Number: 10
Date Logged: 10/5/2017
Geologist: Joshua Sacker
Total Depth (ft bgs): 25
Reviewer:

Drilling Contractor: Holt Services
Driller: Abe Causland
Drilling Equipment: Landa L-10-T
Drilling Method: Hollow Stem Auger
Boring Diameter: ~9"
Sampler Type: split spoon (18")
Hammer Type: 140 lb

Northing (NAD 83): 259325.258
Easting (NAD 83): 1198822.32
Surface Elevation (NAVD 88): 13.3
Borehole Abandoned: N
Backfill Method: Well Installed

Depth (ft bgs)	USCS Symbol	Sample Description	Blow Counts	Sample Recovery	Sample ID/Time	Headspace Readings	Lithology
17	SP	SAND, fine to coarse grained (f:m:c: 70:28:2),trace fines (~2%), trace pea gravel (~1%); saturated, very dark gray (5Y 3/1).	7/11/22	100%	B74-S-18.5 @ 0920	4.2	
	ML	SILT, trace fine grained sand, very dark gray (5Y 3/1), saturated.					
	SM	Silty SAND, fine grained sand, some silt, very dark gray (5Y 3/1), saturated, increasing sand in shoe of sampler.					
25							

Well Construction



Flush-mounted traffic rated well box:
Rim elevation: 13.33 ft AMSL (NAVD 88)
Brand/size: EMCO Wheaton / 18" diameter

Surface Seal: Cement

Blank Well Casing:
Top of Casing: 12.99 ft AMSL (NAVD 88), 0.35 ft below ground surface.
Bottom of Casing: 15' bgs
Type: 2" dia. Sch. 40 PVC well casing

Bentonite:
3/8" Bentonite Chips (Halliburton Coarse Grade Wyoming Sodium Bentonite)

DTW: 5.80' bgs

Filter Pack:
Type: 10/20 Colorado Silica sand (Premium Silica LLC.)

Well Screen:
Top of Screen: 15' bgs
Bottom of Screen: 25' bgs
Type: 2" dia. Sch. 40 PVC Screen
Slot Size: 0.010" slot size

End Cap: 2.375" PVC End Cap

Notes: Approximately 20 gals potable water added during well installation to minimize heaving.

BATTELLE

Project: NBK Keyport
Site: OU 1
Boring Log: MW1-46/B78

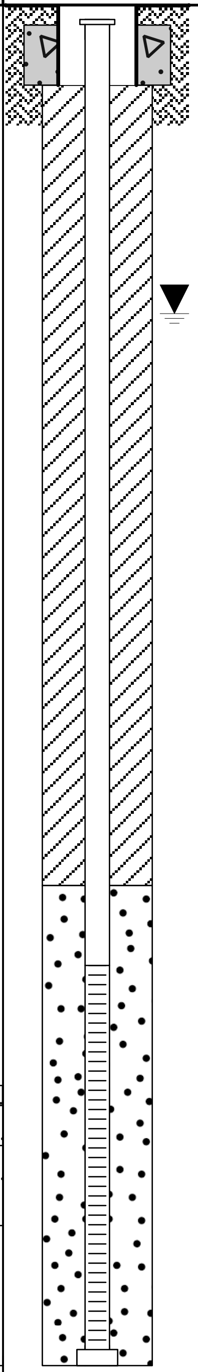
Permit Number: 17-EP110
Project Number: 100098089
Contract Number: N39430-16-D-1802/CTO 010
Task Order Number: 10
Date Logged: 10/7/2017
Geologist: Joshua Sacker
Total Depth (ft bgs): 34
Reviewer: Michael Meyer

Drilling Contractor: Holt Services
Driller: Abe Causland
Drilling Equipment: Landa L-10-T
Drilling Method: Hollow Stem Auger
Boring Diameter: ~9"
Sampler Type: split spoon (18")
Hammer Type: 140 lb

Northing (NAD 83): 259508.604
Easting (NAD 83): 1199026.27
Surface Elevation (NAVD 88): 17.1
Borehole Abandoned: N
Backfill Method: Well Installed

Depth (ft bgs)	USCS Symbol	Sample Description	Blow Counts	Sample Recovery	Sample ID/Time	Headspace Readings	Lithology
27	slough	Slough.					
28	SP	SAND, fine grained, trace medium to coarse grained, trace fines, very dark gray (5Y 3/1), saturated, medium dense, (f:m:c: 98:1:1).		66%	B78-S-28.5 @ 1010	26.3	
29	SP	SAND, increasing grain size (f:m:c: 96:2:2), very dark greenish gray (GLEY 1 3/5 GY), saturated, medium dense.		100%			
34	ML	SILT, 20% to 30% clay, dark gray (5Y 4/1), sampled from end of drill bit upon retrieval.					

Well Construction



Flush-mounted traffic rated well box: Rim elevation: 17.08 ft AMSL (NAVD 88) Brand/size: EMCO Wheaton / 18" diameter

Surface Seal: Cement

Blank Well Casing: Top of Casing: 16.71 ft AMSL (NAVD 88), 0.36 ft below ground surface. Bottom of Casing: 24' bgs Type: 2" dia. Sch. 40 PVC well casing

Bentonite: 3/8" Bentonite Chips (Halliburton Coarse Grade Wyoming Sodium Bentonite)

DTW: 7.71' bgs

Filter Pack: Type: 10/20 Colorado Silica sand (Premium Silica LLC.)

Well Screen: Top of Screen: 24' bgs Bottom of Screen: 34' bgs Type: 2" dia. Sch. 40 PVC Screen Slot Size: 0.010" slot size

End Cap: 2.375" PVC End Cap

Notes: Approximately 20 gals of water added during water well installation to control heaving sands.

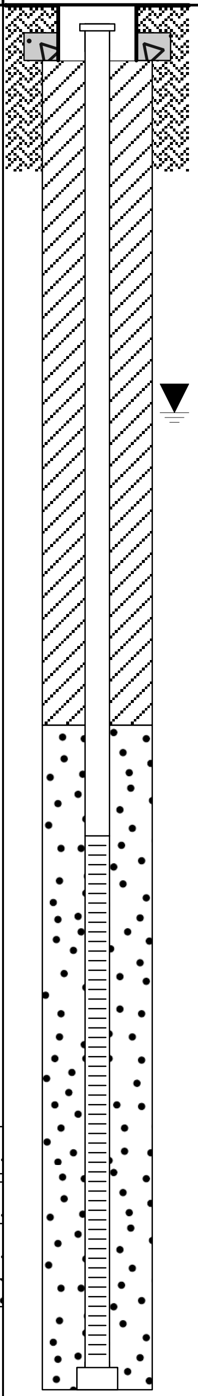
BATTELLE

Project: NBK Keyport
Site: OU 1
Boring Log: MW1-47/B79

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	259466.248
Project Number:	100098089	Driller:	Abe Causland	Easting (NAD 83):	1199023.85
Contract Number:	N39430-16-D-1802/CTO 010	Drilling Equipment:	Landa L-10-T	Surface Elevation (NAVD 88):	16.8
Task Order Number:	10	Drilling Method:	Hollow Stem Auger	Borehole Abandoned:	N
Date Logged:	10/9/2017	Boring Diameter:	~9"	Backfill Method:	Well Installed
Geologist:	Joshua Sacker	Sampler Type:	split spoon (18" & 24")		
Total Depth (ft bgs):	25	Hammer Type:	140 lb		
Reviewer:	Michael Meyer				

Depth (ft bgs)	USCS Symbol	Sample Description	Blow Counts	Sample Recovery	Sample ID/Time	Headspace Readings	Lithology
0–20							
21	SP-SM	SAND with silt fine grained sand, ~10% fines, very dark greenish gray (1 GLEY 3/10Y) to very dark gray (5Y 3/1), saturated, medium dense, wood debris).	5/7/15	83%	B79-S-21.5 @ 1100	134.2	
	ML	~2" layer of SILT, few sand (5% to 10%), very dark gray (5Y 3/1).	6/12/22/23	100%			
22	SP	SAND, fine grained, <5% fines, very dark gray (5Y 3/1), saturated, medium dense.					
23	SP-SM	SAND with silt fine grained sand, ~10% fines, very dark gray (5Y 3/1), saturated.					
24	SW	SAND, fine grained, ~2% fines, very dark gray (5Y 3/1), saturated, medium dense, uniform.					
25–26							

Well Construction



Flush-mounted traffic rated well box:
Rim elevation: 16.78 ft AMSL (NAVD 88)
Brand/size: EMCO Wheaton / 18" diameter

Surface Seal: Cement

Blank Well Casing:
Top of Casing: 16.44 ft AMSL (NAVD 88), 0.34 ft below ground surface.
Bottom of Casing: 15' bgs
Type: 2" dia. Sch. 40 PVC well casing

Bentonite:
3/8" Bentonite Chips (Halliburton Coarse Grade Wyoming Sodium Bentonite)

DTW: 7.36' bgs

Filter Pack:
Type: 10/20 Colorado Silica sand (Premium Silica LLC.)

Well Screen:
Top of Screen: 15' bgs
Bottom of Screen: 25' bgs
Type: 2" dia. Sch. 40 PVC Screen
Slot Size: 0.010" slot size

End Cap: 2.375" PVC End Cap

Notes: Approximately 20 gals of water added during water well installation to control heaving sands.

BATTELLE

Project: NBK Keyport
Site: OU 1
Boring Log: MW1-48/B83

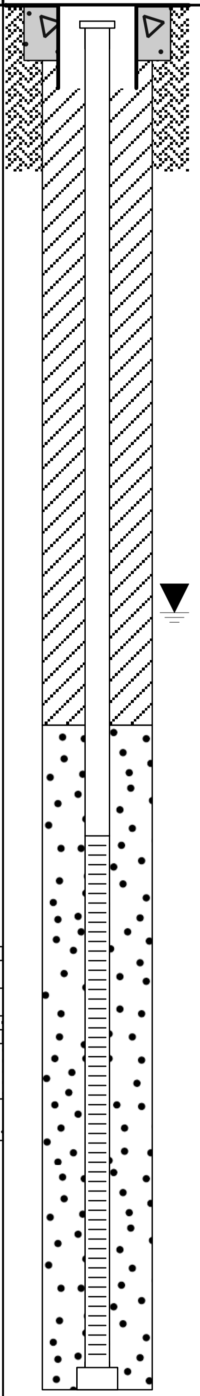
Permit Number: 17-EP110
Project Number: 100098089
Contract Number: N39430-16-D-1802/CTO 010
Task Order Number: 10
Date Logged: 10/12/2017
Geologist: Joshua Sacker
Total Depth (ft bgs): 25
Reviewer: Michael Meyer

Drilling Contractor: Holt Services
Driller: Abe Causland
Drilling Equipment: Landa L-10-T
Drilling Method: Hollow Stem Auger
Boring Diameter: ~9"
Sampler Type: split spoon (18" & 24")
Hammer Type: 140 lb

Northing (NAD 83): 259416.029
Easting (NAD 83): 1199082.01
Surface Elevation (NAVD 88): 16.1
Borehole Abandoned: N
Backfill Method: Well Installed

Depth (ft bgs)	USCS Symbol	Sample Description	Blow Counts	Sample Recovery	Sample ID/Time	Headspace Readings
17	slough	Slough	6/8/12	83%	B83-S-18.5 @ 1015	115.2
	SP-SM	SAND with SILT, fine grained, ~10% fines, very dark gray (5Y 3/1), medium dense, saturated.				
18	SP	SAND (f:m:c: 98/2/0), saturated, very dark gray (5Y 3/1), medium dense.				
	SM	Silty SAND, fine-grained sand (f:m:c: 100/0/0), saturated, very dark gray (5Y 3/1).	6/8/15/22	87%		
19	slough	3" of slough.				
	SM	Silty SAND, fine grained sand, ~15% fines, saturated, dense, very dark gray, (5Y 3/1).				
20	SP	SAND, fine grained, (f:m:c: 98/2/0) saturated, very dark gray (5Y 3/1), medium dense.				

Well Construction



Flush-mounted traffic rated well box:
Rim elevation: 16.07 ft AMSL (NAVD 88)
Brand/size: Morris / 8" diameter

Surface Seal: Cement

Well Casing:
Top of Casing: 15.80 ft AMSL (NAVD 88), 0.29 ft below ground surface.
Bottom of Casing: 15' bgs
Type: 2" dia. Sch. 40 PVC well casing

Bentonite:
3/8" Bentonite Chips (Halliburton Coarse Grade Wyoming Sodium Bentonite)

DTW: 10.97' bgs

Filter Pack:
Type: 10/20 Colorado Silica sand (Premium Silica LLC.)

Well Screen:
Top of Screen: 15' bgs
Bottom of Screen: 25' bgs
Type: 2" dia. Sch. 40 PVC Screen
Slot Size: 0.010" slot size

End Cap: 2.375" PVC End Cap

Notes: *No water added during drilling for heaving.

BATTELLE

Project: NBK Keyport
Site: OU 1
Boring Log: MW1-53/B82

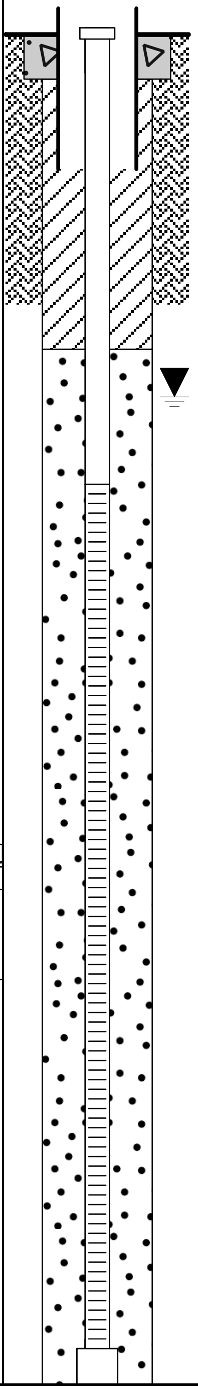
Permit Number: 17-EP110
Project Number: 100098089
Contract Number: N39430-16-D-1802/CTO 010
Task Order Number: 10
Date Logged: 10/11/2017
Geologist: Joshua Sacker
Total Depth (ft bgs): 15
Reviewer: Michael Meyer

Drilling Contractor: Holt Services
Driller: Abe Causland
Drilling Equipment: Landa L-10-T
Drilling Method: Hollow Stem Auger
Boring Diameter: ~9"
Sampler Type: split spoon (18")
Hammer Type: 140 lb

Northing (NAD 83): 259067.698
Easting (NAD 83): 1199065.84
Surface Elevation (NAVD 88): 13.3
Borehole Abandoned: N
Backfill Method: Well Installed

Depth (ft bgs)	USCS Symbol	Sample Description	Blow Counts	Sample Recovery	Sample ID/Time	Headspace Readings	Lithology
9	slough	3" of slough.					
	SP	SAND, fine grained, very dark gray (5Y 3/1), saturated, medium dense.	6/8/10	83%	B82-S-10.0 @ 1525	21.3	
10	ML	SILT, ~15% to 30% clay, very dark gray (5Y 3/1), saturated, firm.					

Well Construction



Flush-mounted traffic rated well box:
Top of Casing: 13.62 ft AMSL (NAVD 88)
Brand/size: Morris / 8" diameter

Surface Seal: Cement

Well Casing:
Top of Casing: 13.40 ft AMSL (NAVD 88), 0.22 below ground surface.
Bottom of Casing: 5' bgs
Type: 2" dia. Sch. 40 PVC well casing

Bentonite:
3/8" Bentonite Chips (Halliburton Coarse Grade Wyoming Sodium Bentonite)

DTW: 4.03' bgs

Filter Pack:
Type: 10/20 Colorado Silica sand (Premium Silica LLC.)

Well Screen:
Top of Screen: 5' bgs
Bottom of Screen: 15' bgs
Type: 2" dia. Sch. 40 PVC Screen
Slot Size: 0.010" slot size

End Cap: 2.375" PVC End Cap

Notes: 10 gallons water added during installation to minimize heaving sands.

BATTELLE

Project: NBK Keyport
Site: OU 1
Boring Log: MW1-54/B81

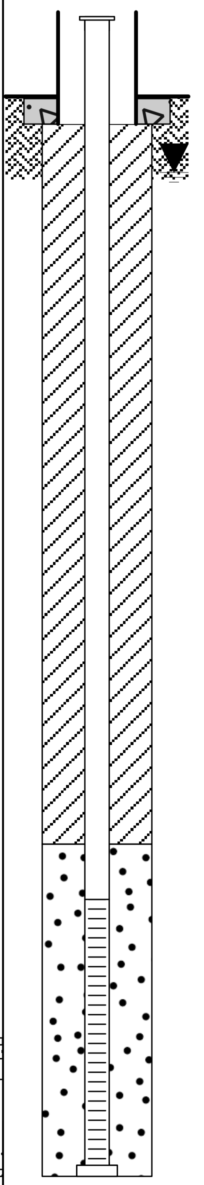
Permit Number:	17-EP110
Project Number:	100098089
Contract Number:	N39430-16-D-1802/CTO 010
Task Order Number:	10
Date Logged:	10/11/2017
Geologist:	Joshua Sacker
Total Depth (ft bgs):	39
Reviewer:	Michael Meyer

Drilling Contractor:	Holt Services
Driller:	Abe Causland
Drilling Equipment:	Landa L-10-T
Drilling Method:	Hollow Stem Auger
Boring Diameter:	~9"
Sampler Type:	split spoon (18" & 24")
Hammer Type:	140 lb

Northing (NAD 83):	258949.791
Easting (NAD 83):	1199050.16
Surface Elevation (NAVD 88):	12.7
Borehole Abandoned:	N
Backfill Method:	Well Installed

Depth (ft bgs)	USCS Symbol	Sample Description	Blow Counts	Sample Recovery	Sample ID/Time	Headspace Readings	Lithology
0		Unpaved, in south plantation.					
34	slough	3" of slough.	44790	83%	B81-S-35.5 @ 1020	0.6	
35	SM	Silty SAND, fine grained, ~15% fines, saturated, medium dense, olive gray (5Y 4/2).					
36	SP	SAND, fine grained, uniform, saturated medium dense (f:m:c: 100/0/0), olive gray (5Y 4/2).					
37	SP-SW	SAND fine grained, uniform, saturated, medium dense (f:m:c: 100/0/0), olive gray (5Y 4/2).	9/13/17/20	100%	B81-S-38.5 @ 1115	0.4	
39	SM	Silty SAND, fine grained, ~15% fines, saturated medium dense, olive gray (5Y 4/2).					

Well Construction



Above Ground Steel Protective Casing:
Top of Casing: 15.73 ft AMSL (NAVD 88), 3.04 ft stickup above ground surface.
Type: 6" Steel Casing

Surface Seal: Cement

Well Casing:
Top of Casing: 15.57 ft AMSL (NAVD 88), 2.88 ft stickup above ground surface.
Bottom of Casing: 29' bgs
Type: 2" dia. Sch. 40 PVC well casing

Bentonite:
3/8" Bentonite Chips (Halliburton Coarse Grade Wyoming Sodium Bentonite)

DTW: 2.75' bgs

Filter Pack:
Type: 10/20 Colorado Silica sand (Premium Silica LLC.)

Well Screen:
Top of Screen: 29' bgs
Bottom of Screen: 39' bgs
Type: 2" dia. Sch. 40 PVC Screen
Slot Size: 0.010" slot size

End Cap: 2.375" PVC End Cap

Notes: 50 gallons water added during installation to minimize heaving sands. Sample collected at 35.5 ft bgs not submitted to lab in favor of sample collected at 38.5 bgs

BATTELLE

Project: NBK Keyport
Site: OU 1
Boring Log: MW1-55/B86

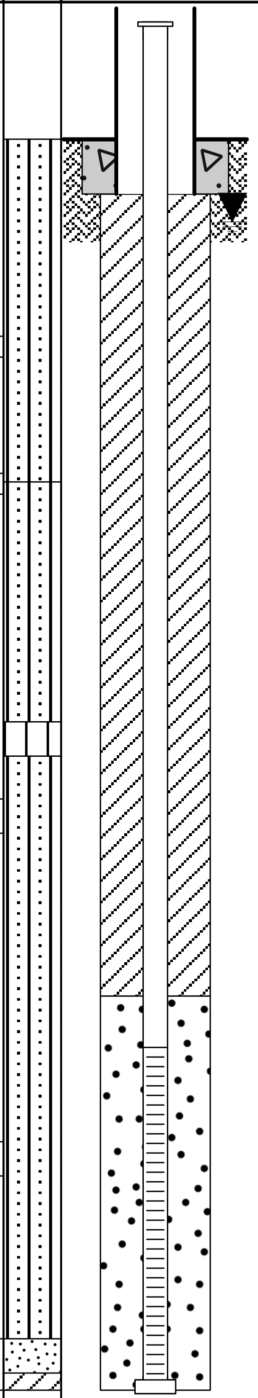
Permit Number:	17-EP110
Project Number:	100098089
Contract Number:	N39430-16-D-1802/CTO 010
Task Order Number:	10
Date Logged:	10/16/2017
Geologist:	Michael Meyer
Total Depth (ft bgs):	36.5
Reviewer:	Joshua Sacker

Drilling Contractor:	Holt Services
Driller:	Abe Causland
Drilling Equipment:	Landa L-10-T
Drilling Method:	Hollow Stem Auger
Boring Diameter:	~9"
Sampler Type:	split spoon (18")
Hammer Type:	140 lb

Northing (NAD 83):	259345.114
Easting (NAD 83):	1198555.91
Surface Elevation (NAVD 88):	12.2
Borehole Abandoned:	N
Backfill Method:	Well Installed

Depth (ft bgs)	USCS Symbol	Sample Description	Blow Counts	Sample Recovery	Sample ID/Time	Headspace Readings
0	SM	Silty SAND, fine grained, with gravel, medium brown. At 6' bgs, saturated, and gray, with strong odor. Logged from auger cuttings.				
6				N/A%		6.3
10	SM	Silty SAND, fine to medium grained, medium gray, wet. Logged from cuttings.		N/A%		4.3
17	ML	SILT, 1 foot thick layer (based on cuttings and drill response).				
18	SM	Logged from cuttings.				
20				N/A%		7.1
30				N/A%		2.2
35	SP	SAND, poorly graded, fine grained, wet, dense, olive gray.	4/8/12	100%	B86-35.0 @ 1130	9.2
36	CL	CLAY, blue-gray, hard, plastic. (Lawton Clay Formation).				

Well Construction



Above Ground Steel Protective Casing:
Top of Casing: 16.00 ft AMSL (NAVD 88), 3.82 ft stickup above ground surface.
Type: 6" Steel Casing

Surface Seal: Cement

Blank Well Casing:
Top of Casing: 15.60 ft AMSL (NAVD 88), 3.42 ft stickup above ground surface.
Bottom of Casing: 26.5' bgs
Type: 2" dia. Sch. 40 PVC well casing

Bentonite:
3/8" Bentonite Chips (Halliburton Coarse Grade Wyoming Sodium Bentonite)

DTW: 2.41' bgs

Filter Pack:
Type: 10/20 Colorado Silica sand (Premium Silica LLC.)

Well Screen:
Top of Screen: 26.5' bgs
Bottom of Screen: 36.5' bgs
Type: 2" dia. Sch. 40 PVC Screen
Slot Size: 0.010" slot size

End Cap: 2.375" PVC End Cap

Notes: PID readings from cuttings or from augers at 6, 10, 20 and 30 ft bgs (6.3, 4.3, 7.1 and 2.2, respectively).

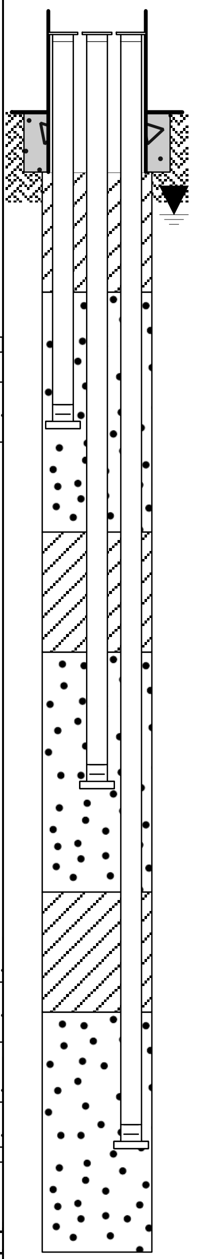
BATTELLE

Project: NBK Keyport
Site: OU 1
Boring Log: MW1-56/B87

Permit Number:	17-EP110	Drilling Contractor:	Holt Services	Northing (NAD 83):	258984.05
Project Number:	100098089	Driller:	Abe Causland	Easting (NAD 83):	1199144.3
Contract Number:	N39430-16-D-1802/CTO 010	Drilling Equipment:	Landa L-10-T	Surface Elevation (NAVD 88):	13.2
Task Order Number:	10	Drilling Method:	Hollow Stem Auger	Borehole Abandoned:	N
Date Logged:	10/17/2017	Boring Diameter:	~9"	Backfill Method:	Well Installed
Geologist:	Joshua Sacker	Sampler Type:	split spoon (18")		
Total Depth (ft bgs):	41	Hammer Type:	140 lb		
Reviewer:	Michael Meyer				

Depth (ft bgs)	USCS Symbol	Sample Description	Blow Counts	Sample Recovery	Sample ID/Time	Headspace Readings	Lithology
8	slough	Slough from 7.5' to 8.0'.	6/8/15	67%	B87-9.0 @ 0935	2.2	
9	SP	SAND, fine grained (f:m:c 7.5': 95:3:2), trace fines, very dark gray (5Y 3/1), saturated, medium dense.					
10	SP	Same as above	8/10/12/22	100%			
28	SP	SAND, fine grained (f:m:c: 100/0/0), trace fines, olive gray (5Y 4/2), saturated (slough at top of sampler).	10/12/16	100%	B87-29.0 @ 1145	334.2	
30	SP	SAND (f:m:c: 100/0/0), trace fines, olive gray (5Y 4/2), saturated (2" to 3" slough at top of sampler). (No gravel in sample.)		100%			
32	SP	SAND, fine grained (f:m:c: 99/1/0) olive gray (5Y 4/2) appears to be all slough sampled through heaving sands.	28/31/35	50%			
34	SP	SAND, fine grained (f:m:c: 99/1/0), trace fines, olive gray (5Y 4/2) , saturated.	12/17/13/10	100%			
35	GP	GRAVEL with Sand, ~30% to 45% fine to coarse grained sand (f:m:c: 25/50/25), olive gray (5Y 4/2).					
38	CL	CLAY, dark gray (Gley 1, 4/N).	15/17/18/19	50%	B87-37.5.0 @ 1715	1.2	
40	CL	CLAY, dark gray (Gley, 1 4/N).	16/18/20/21	50%			

Well Construction



Above Ground Steel Protective Casing:
Top of Casing: 16.53 ft AMSL (NAVD 88), 3.37 ft stickup above ground surface.
Type: 6" Steel Casing

Surface Seal: Cement

Well Casing:
Top of Casing: 15.82 ft AMSL (NAVD 88), 2.66 ft stickup above ground surface.

Bentonite:
Bentonite Pellets used to seal between screens, and 3/8" chips used for surface seal

DTW: 6.08; 6.02; 18.5' bgs

Filter Pack:
Type: 10/20 Colorado Silica sand (Premium Silica LLC.)

Well Screen:
Multiple well screens, each 6" in length, centered at 10, 22, and 34 ft bgs Screen Mesh: 0.01" openings Bottom Screen Tip: Placed to seal off each channel of tubing

Notes: This well was installed using continuous multi-channel tubing, under an approved variance from the Washington State Department of Ecology. PID Readings from Cuttings at 6.0' bgs, and from top of auger annulus at 10' bgs, 20' bgs, and 30' bgs. Well tubing placed with 3 centralizers.

BATTELLE

Project: NBK Keyport
Site: OU 1
Boring Log: MW1-57/B88

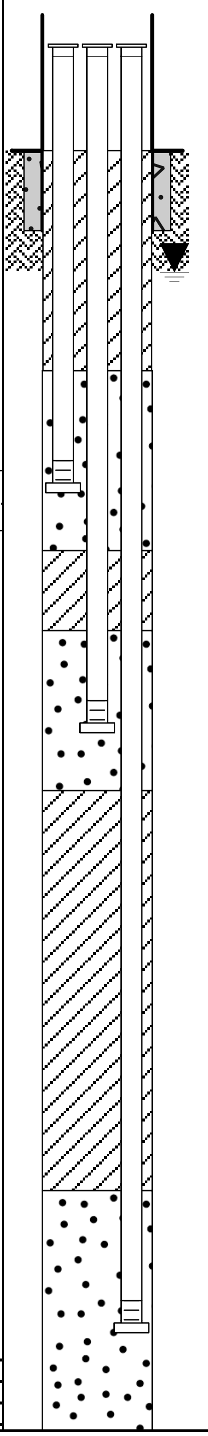
Permit Number: 17-EP110
Project Number: 100098089
Contract Number: N39430-16-D-1802/CTO 010
Task Order Number: 10
Date Logged: 10/18/2017
Geologist: Joshua Sacker
Total Depth (ft bgs): 32
Reviewer: Michael Meyer

Drilling Contractor: Holt Services
Driller: Abe Causland
Drilling Equipment: Landa L-10-T
Drilling Method: Hollow Stem Auger
Boring Diameter: ~9"
Sampler Type: split spoon (18")
Hammer Type: 140 lb

Northing (NAD 83): 259018.138
Easting (NAD 83): 1199147.17
Surface Elevation (NAVD 88): 13
Borehole Abandoned: N
Backfill Method: Well Installed

Depth (ft bgs)	USCS Symbol	Sample Description	Blow Counts	Sample Recovery	Sample ID/Time	Headspace Readings	Lithology
8	SP	SAND, fine grained (f:m:c: 99/1/0), trace fines, very strong odor, saturated, olive gray (5Y 4/2).	15/18/20	78%	B88-S-9.0 @ 1010	>15,000	
30	CL	CLAY, ~10% to 20% silt, trace fine grained sand (<1%) moist, dark gray (Gley 1 4/N) (B/C).	42414	100%	B88-S-31.0 @ 1230	14.3	

Well Construction



Above Ground Steel Protective Casing: Top of Casing: 16.35 ft AMSL (NAVD 88), 3.39 ft stickup above ground surface.
Type: 6" Steel Casing

Surface Seal: Cement

Well Casing: Top of Casing: 15.62 ft AMSL (NAVD 88), 2.66 ft stickup above ground surface. Continuous Multichannel Tubing (CMT).

Bentonite: Bentonite Pellets used to seal between screens and 3/8" bentonite chips used for surface seal.

DTW: 5.70; 5.71; 5.72' bgs

Filter Pack: Type: 10/20 Colorado Silica sand (Premium Silica LLC.)

Multiple Well Screens: Each 6" in length, centered at 8, 14, and 29 ft bgs
Screen Mesh: 0.01" openings
Bottom Screen Tip: Placed to seal off each channel of tubing.

Notes: This well was installed using continuous multi-channel tubing, under an approved variance from the Washington State Department of Ecology. End of boring = 32'; not able to install CMT well on 10/18/17. Materials arrived 10/19/17. Headspace readings exceeded range of PID. Well tubing placed with 3 centralizers.

BATTELLE

Project: NBK Keyport
Site: OU 1
Boring Log: MW1-58/B89

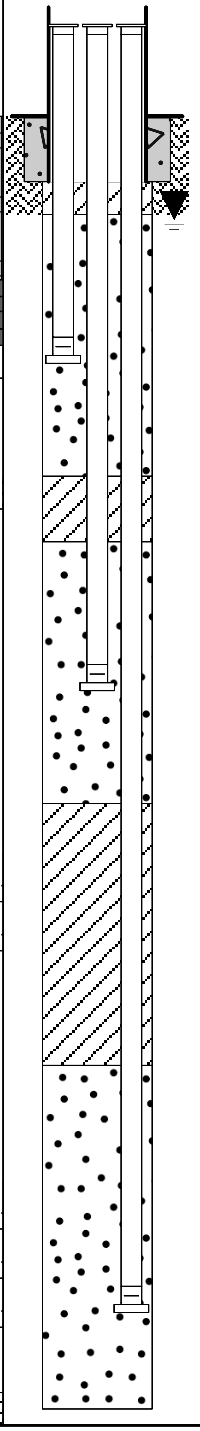
Permit Number: 17-EP110
Project Number: 100098089
Contract Number: N39430-16-D-1802/CTO 010
Task Order Number: 10
Date Logged: 11/1/2017
Geologist: Michael Meyer
Total Depth (ft bgs): 39.5
Reviewer: Joshua Sacker

Drilling Contractor: Holt Services
Driller: Abe Causland
Drilling Equipment: Landa L-10-T
Drilling Method: Hollow Stem Auger
Boring Diameter: ~9"
Sampler Type: split spoon (18")
Hammer Type: 140 lb

Northing (NAD 83): 259057.791
Easting (NAD 83): 1199138.21
Surface Elevation (NAVD 88): 16.8
Borehole Abandoned: N
Backfill Method: Well Installed

Depth (ft bgs)	USCS Symbol	Sample Description	Blow Counts	Sample Recovery	Sample ID/Time	Headspace Readings	Lithology
0 1 2 3 4	GM	Silty GRAVEL with sand, medium brown to dark brown, wet @5' bgs (logged from cuttings).					
5 6	GM	Silty GRAVEL with sand, medium brown, loose, wet.	3/1/4				
	GM	Same as above.	0/1/2		B89-S-6.5 @ 1005	75.1	
7	ML	Sandy SILT with gravel, medium brown, rootlets. soft, wet.					
8 9 10							
11	SM	Silty SAND, fine-grained, light brown, wet (logged from cuttings).					
12 13 14 15 16 17 18 19 20 21 22							
23 24	SP	SAND, fine grained, medium gray, dense, wet.	27/5/2/3 2				
25	SP	Same as above.	23/9/6/2 7		B89-S-24.0 @ 1110	63.2	
26 27 28 29 30 31 32							
33 34	SP	SAND, medium grained sand, medium gray, dense, wet.	6/32/35				
35	SP	Same as above.	13/33/39		B89-S-34.0 @ 1210	3.3	
36	SP	Same as above.					
37							
38	SP	Same as above.					
39 40	CH	CLAY, blue gray, hard, dry				2.6	

Well Construction



Above Ground Steel Protective Casing:
Top of Casing: 17.36 ft AMSL (NAVD 88), 3.33 ft stickup above ground surface.
Type: 6" Steel Casing

Surface Seal: Cement

Well Casing:
Top of Casing: 16.84 ft AMSL (NAVD 88), 2.81 ft stickup above ground surface.

Bentonite:
Bentonite Pellets used to seal between screens and 3/8" bentonite chips used for surface seal.

DTW: 5.98; 5.24; 5.89' bgs

Filter Pack:
Type: 10/20 Colorado Silica sand (Premium Silica LLC.)

Multiple Well Screens:
Each 6" in length centered at 7, 17, and 36 ft bgs.
Screen Mesh: 0.01" openings.
Bottom Screen Tip: Placed to seal at each channel of tubing.

Notes: This well was installed using continuous multi-channel tubing, under an approved variance from the Washington State Department of Ecology. Build CMT well. Port 0 - 36 ft bgs. Port 1 - 7 ft bgs. Port 2 - 17 ft bgs. Well tubing placed with 3 centralizers.

BATTELLE

Project: NBK Keyport
Site: OU 1
Boring Log: MW1-60/B84

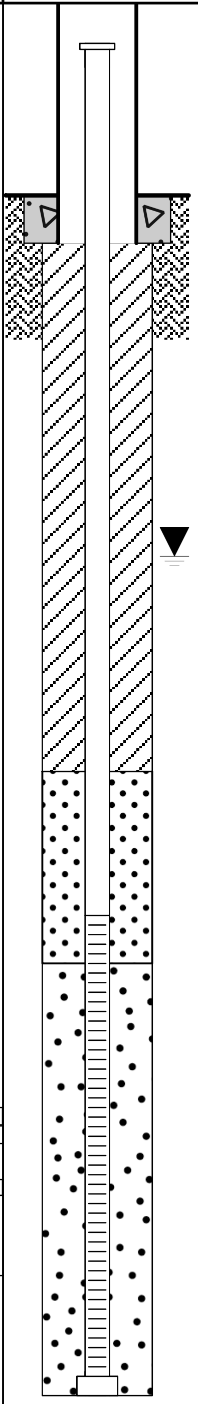
Permit Number: 17-EP110
Project Number: 100098089
Contract Number: N39430-16-D-1802/CTO 010
Task Order Number: 10
Date Logged: 10/12/2017
Geologist: Joshua Sacker
Total Depth (ft bgs): 25
Reviewer: Michael Meyer

Drilling Contractor: Holt Services
Driller: Abe Causland
Drilling Equipment: Mobile B-57
Drilling Method: Hollow Stem Auger
Boring Diameter: ~9"
Sampler Type: split spoon (18")
Hammer Type: 140 lb

Northing (NAD 83):
Easting (NAD 83):
Surface Elevation (NAVD 88): 14.8
Borehole Abandoned: N
Backfill Method: Well Installed

Depth (ft bgs)	USCS Symbol	Sample Description	Blow Counts	Sample Recovery	Sample ID/Time	Headspace Readings	Lithology
0		Unpaved ground surface.					
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19	slough	Slough.	8/10/12	50%	B84-S-20 @ 1450	0.2	
20	ML	SILT, trace fine grained sand, ~10% clay, saturated, very dark gray (5Y 3/1), minor sandy-silt layers < 1" thick, SP-SAND at tip of shoe.					
21	slough ML		9/11/15	83%			
22		Slough 4". SILT, few sand fine grained sand (5% to 10%), very dark gray (5Y 3/1), saturated, firm, minor seams of SILT with SAND (15-125% fine sand) and minor seams of sand (SP-SM to SM) (< 1" of sand in 2' sampler) (B/C: 9/11/15).					
23							
24							
25							
26							

Well Construction



Above Ground Steel Protective Casing:
Top of Casing: 18.69 ft AMSL (NAVD 88), 3.83 ft stickup above ground surface.
Type: 6" Steel Casing

Surface Seal: Cement

Well Casing:
Top of Casing: 18.01 ft AMSL (NAVD 88), 3.16 ft stickup above ground surface.
Bottom of Casing: 15' bgs
Type: 2" dia. Sch. 40 PVC well casing

Bentonite:
3/8" Bentonite Chips (Halliburton Coarse Grade Wyoming Sodium Bentonite)

DTW: 7.52' bgs

Filter Pack:
Type: 20/40 Colorado Silica sand (Premium Silica LLC.) 12-16 ft bgs. 10/20 Colorado Silica sand (Premium Silica LLC) 16-25 ft bgs.

Well Screen:
Top of Screen: 15' bgs
Bottom of Screen: 25' bgs
Type: 2" dia. Sch. 40 PVC Screen
Slot Size: 0.010" slot size

End Cap: 2.375" PVC End Cap

Notes: ~20' gallons added for heaving sands during well installation.

BATTELLE

Project: NBK Keyport
Site: OU 1
Boring Log: B85

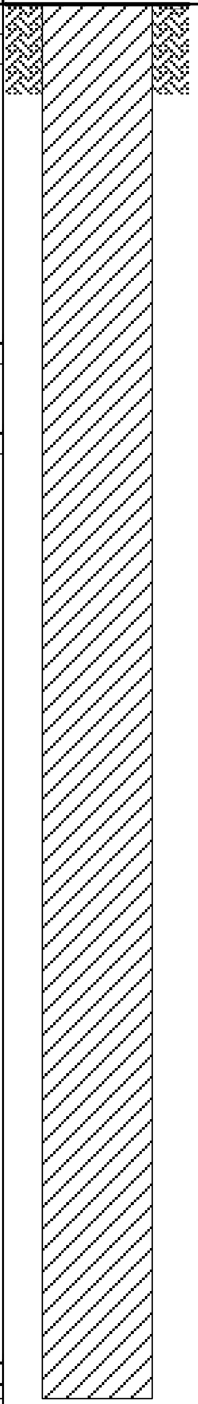
Permit Number: 17-EP110
Project Number: 100098089
Contract Number: N39430-16-D-1802/CTO 010
Task Order Number: 10
Date Logged: 10/12/2017
Geologist: Joshua Sacker
Total Depth (ft bgs): 45
Reviewer: Michael Meyer

Drilling Contractor: Holt Services
Driller: Abe Causland
Drilling Equipment: Mobile B-57
Drilling Method: Hollow Stem Auger
Boring Diameter: ~9"
Sampler Type: split spoon (18")
Hammer Type: 140 lb

Northing (NAD 83): 259345.114
Easting (NAD 83): 1198555.91
Surface Elevation (NAVD 88): 18.7
Borehole Abandoned: N
Backfill Method: Well Installed

Depth (ft bgs)	USCS Symbol	Sample Description	Blow Counts	Sample Recovery	Sample ID/Time	Headspace Readings	Lithology
1–2	ML	SILT, trace fine grained sand and little clay (logged from cuttings).					
11–12	CL	CLAY, ~trace to few silt, 5% to 10% silt, 5Y 3/1 very dark gray. Logged from cuttings.					
14–15	CL	Same as above, (cuttings consist of clay balls). Clay continues to total depth of 45'					
45–46	CL	CLAY, ~5% to 10% silt, very dark gray to dark olive gray (5Y 3/1 to 5Y 3/2), moist to wet, very firm to hard, trace salt deposits.		100%		1.8	

Well Construction



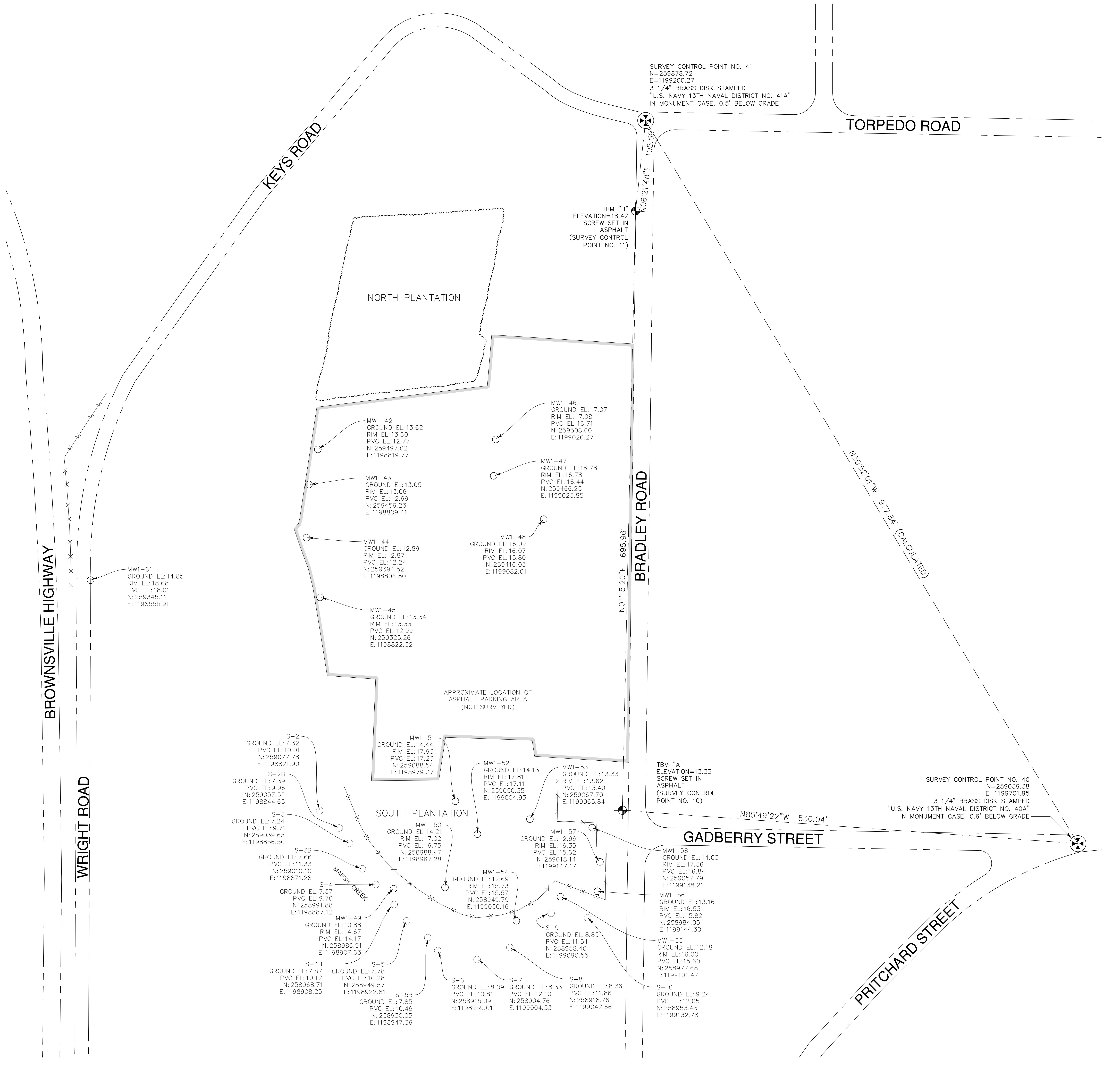
Bentonite:
3/8" Bentonite Chips
(Halliburton Coarse Grade
Wyoming Sodium Bentonite)

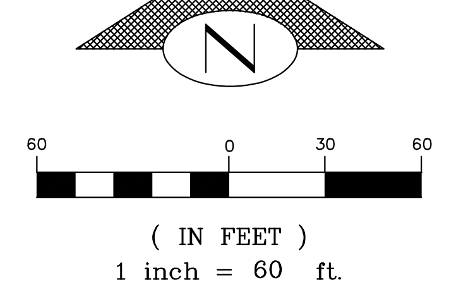
Notes: No well installed. SPT sampler driven to 46.5'. Boring backfilled with 3/8" bentonite chips. Cuttings from entire boring consist of clay. SPT sampler used to confirm presence of clay at bottom of boring.

APPENDIX E

Land Survey Report

SW 1/4, SEC 36, TWP 26 N, RGE 1 E, W.M.





(IN FEET)
1 inch = 60 ft.

NOTES:

HORIZONTAL DATUM:
NAD 83/11

BASIS OF POSITION:
WASHINGTON STATE DEPARTMENT OF TRANSPORTATION (WSDOT) SURVEY CONTROL MONUMENT "GP18308–31", MONUMENT ID = 3180.

MONUMENT DATA;
NORTHING=260301.136
EASTING=1198547.091
ELEVATION=13.064
COORDINATES PER WASHINGTON STATE PLANE COORDINATE SYSTEM, NORTH ZONE, US SURVEY FEET.

VERTICAL DATUM:
NAVD 88

PROJECT BENCHMARK:
ABOVE REFERENCED BASIS OF POSITION MONUMENT.

DERIVATION OF CALCULATION FOR REFERENCE BETWEEN "MEAN SEA LEVEL" (MSL) AND "MEAN LOWER LOW WATER" (MLLW) TO NAVD 88;
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA) TIDAL BENCHMARK "BREMERTON", STATION ID=9445958.
BENCHMARK DATA;
TIDAL EPOCH=1983 THROUGH 2001
LOCATION; LATITUDE 47°33.7' N, LONGITUDE 122°37.4' W.
TIDAL BENCHMARK ELEVATIONS;
MLLW=0.00
NAVD 88=2.52 FEET
MSL=6.82

ELEVATION CONVERSION FACTOR:

MSL +4.30'
NAVD 88
MLLW −2.52'

SITE BENCHMARKS:

TBM "A"	ELEVATION=13.33	SCREW SET IN ASPHALT ON WEST SIDE OF BRADLEY ROAD, JUST NORTH OF GADBERRY STREET.
TBM "B"	ELEVATION=18.42	SCREW SET IN ASPHALT ON WEST SIDE OF BRADLEY ROAD, EASTERLY OF THE NORTH LINE OF THE NORTH PLANTATION GROUP OF TREES.

SITE SURVEY CONTROL POINTS:

10:	N=259077.99	E=1199173.32	EL=13.33	SCREW SET IN ASPHALT
11:	N=259773.78	E=1199188.57	EL=18.42	SCREW SET IN ASPHALT
40:	N=259039.38	E=1199701.95	EL=15.80	MONUMENT IN CASE
41:	N=259878.72	E=1199200.27	EL=18.70	MONUMENT IN CASE

–DATE OF FIELDWORK; NOVEMBER, 2017

–LOCATION OF ROADS AND ASPHALT PARKING AREA SHOWN ON MAP IS FOR GRAPHIC ORIENTATION PURPOSES ONLY. THESE FEATURES WERE NOT SURVEYED, THEY WERE TRACED FROM AN AERIAL PHOTOGRAPH.

LEGEND

▨	ASPHALT (ASPH)
—×—×—	CHAIN LINK FENCE (CLF)
⊗	FOUND SURVEY MONUMENT (AS NOTED)
○ MW/ PVC	MONITOR WELL/ PVC PIPE
⊕	TEMPORARY BENCHMARK (TBM)

MONITOR WELL LOCATIONS

11/21/17

BUSH, ROED & HITCHINGS, INC.
CIVIL ENGINEERS & LAND SURVEYORS
2009 MINOR AVE. EAST
SEATTLE, Washington
98102-3513
(206) 323-4144
1-800-935-0508
FAX# (206) 323-7135

NO.	REVISION	DATE

MONITOR WELL LOCATIONS
NAVAL BASE KITSAP
BATTELLE
KEYPORT KITSAP COUNTY WASHINGTON

drawn by JRM	checked by TRS
scale 1"=20'	date 11/21/17
job no. 2014114.01	
sheet 1 of 1	

11/27/2017 U:\C3D\2014\2014114 URS\SURVEYING\DWG\XS-SUR-01.DWG

APPENDIX F

Chlorinated Solvent Degradation Chemistry

Natural Attenuation of Chlorinated Aliphatic Hydrocarbons (CAH) Version 1.0

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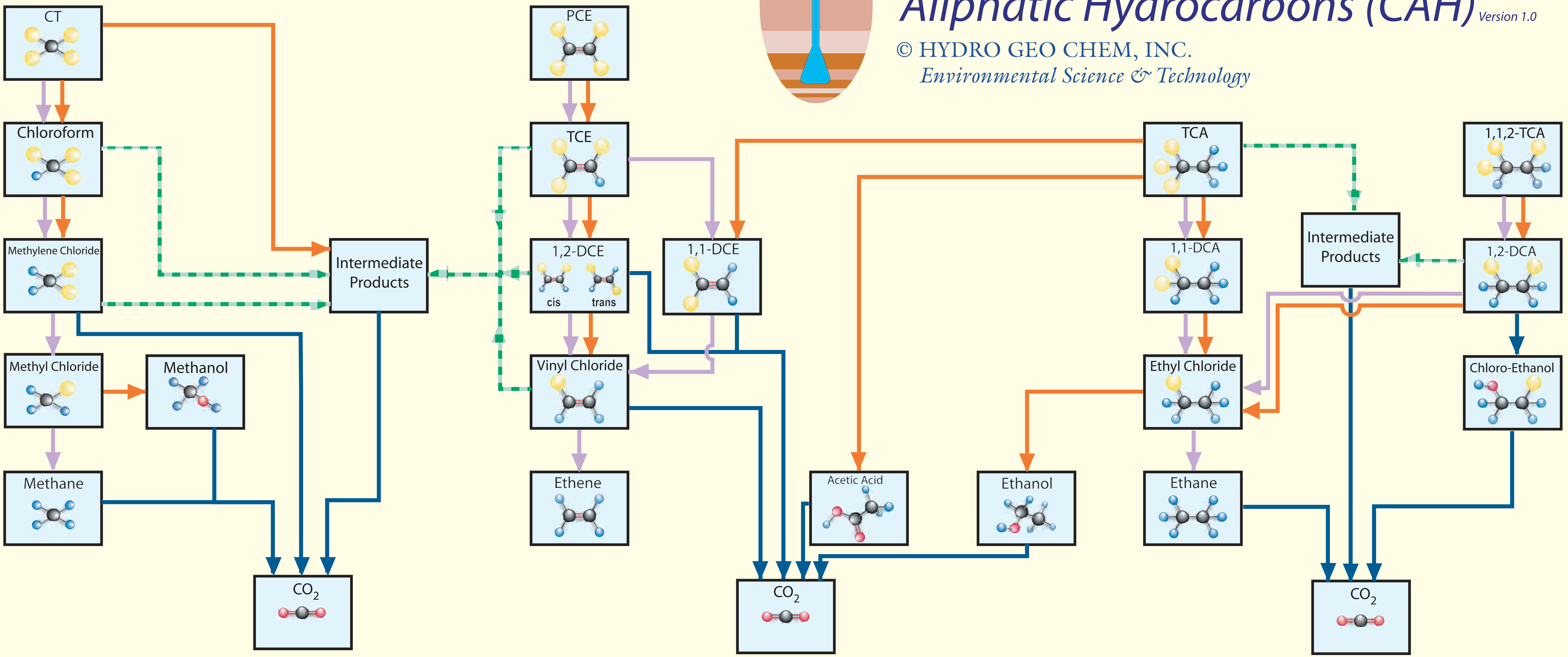
Environmental Science & Technology



CT

Chloroform

Methylene Chloride

Methyl Chloride

Methanol

Methane

Intermediate Products

CO_2

PCE

TCE

1,2-DCE

cis

trans

1,1-DCE

Vinyl Chloride

Ethene

Acetic Acid

Ethanol

CO_2

TCA

1,1-DCA

Ethyl Chloride

Ethane

Intermediate Products

1,1,2-TCA

1,2-DCA

Chloro-Ethanol

CO_2

LEGEND:

- Hydrogen
- Oxygen
- Carbon
- Chlorine
- Single Molecular Bond
- Double Molecular Bond
- Abiotic
- Halorespiration
- Aerobic and/or Anaerobic Oxidation
- Cometabolism

REACTION TYPE:

ABIOTIC: REACTIONS WITHOUT MICROBIAL FACILITATION. CAH'S UNDERGO FOUR TYPES OF ABIOTIC REACTIONS; SUBSTITUTION OF OH FOR Cl (HYDROLYSIS), SUBSTITUTION OF HS FOR Cl (FROM SULFIDES), REDUCTIVE DECHLORINATION (FERROUS IRON), AND ELIMINATION OF HCl TO FORM A DOUBLE BOND (DEHYDRO-HALOGENATION).

HALORESPIRATION: ANAEROBIC REDUCTIVE DECHLORINATION DRIVEN BY HYDROGEN. IN THE CASE OF CAH'S REDUCTION REPLACES HALOGENS WITH HYDROGEN.

AEROBIC OXIDATION: CAH AS ELECTRON DONOR AND SOURCE OF ORGANIC CARBON FOR MICROBE; OXYGEN AS ELECTRON ACCEPTOR.

ANAEROBIC OXIDATION: CAH AS ELECTRON DONOR AND ORGANIC CARBON SOURCE; NITRATE, FERRIC IRON, SULFATE, OR OTHER COMPOUNDS AS ELECTRON ACCEPTORS. OCCURS IN OXYGEN-DEPLETED ZONES.

COMETABOLISM: (PARTIAL) DEGRADATION OF CAH'S BY ENZYMES FROM MICROBES GROWING ON DIFFERENT SUBSTRATES; MICROBE OBTAINS NO ENERGY IN THE PROCESS. LIMITED UNDER NATURAL CONDITIONS; CAN SOMETIMES BE ENGINEERED BY PROVIDING HIGH CONCENTRATIONS OF THE UTILIZABLE SUBSTRATE. MEASURED RATES VARY; (INCLUDES AEROBIC AND ANAEROBIC PATHWAYS).

COMPOUND PROPERTIES:

COMMON NAME	COMPOUND	CAS NUMBER	M.W.	H (atm-m^3/mol)	Log Koc
CT	CARBON TETRACHLORIDE	56-23-5	154	0.02	2.64
CHLOROFORM	TRICHLORMETHANE	67-66-3	119	0.00375	1.64
METHYLENE CHLORIDE	DICHLOROMETHANE	75-09-2	85	0.00257	0.94
METHYL CHLORIDE	CHLOROMETHANE	74-87-3	51	0.0023	0.94
PCE	TETRACHLOROETHENE	127-18-4	166	0.0227	2.82
TCE	TRICHLOROETHENE	79-01-6	131	0.00892	2.10
1,2-DCE (CIS)*	CIS-1,2-DICHLOROETHENE	156-59-2	97	0.0075	1.50
1,2-DCE (TRANS)*	TRANS-1,2-DICHLOROETHENE	156-60-5	97	0.0066	1.77
1,1-DCE	1,1-DICHLOROETHENE	75-35-4	97	0.154	1.81
VINYL CHLORIDE	CHLOROETHENE	75-01-4	62.5	0.695	0.91
TCA	1,1,1-TRICHLOROETHANE	71-55-6	133	0.00276	2.18
1,1,2-TCA	1,1,2-TRICHLOROETHANE	79-00-5	133	0.00117	1.75
1,2-DCA	1,2-DICHLOROETHANE	107-06-2	99	0.0011	1.15
1,1-DCA	1,1-DICHLOROETHANE	75-34-3	99	0.0057	1.48
ETHYL CHLORIDE	CHLOROETHANE	75-00-3	64.5	0.011	1.17

*CIS- AND TRANS- ISOMERS; CIS- FORM PREDOMINATES AS REACTION PRODUCT

GENERAL NOTES:

DISCLAIMER:
This illustrates reported biodegradation pathways for common industrial pollutants. Its use should be limited to preliminary assessment of the necessary microbiological niche for a specific biodegradation reaction to occur. The chart is NOT a comprehensive reveiw of possible reaction pathways, but rather those that are generally accepted in the literature. This image (and portions thereof) may only be reproduced by permission.

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Tucson, AZ 85705
(520) 293-1500 / (520) 293-1550 (fax)
www.hgcinc.com / info@hgcinc.com

APPENDIX G

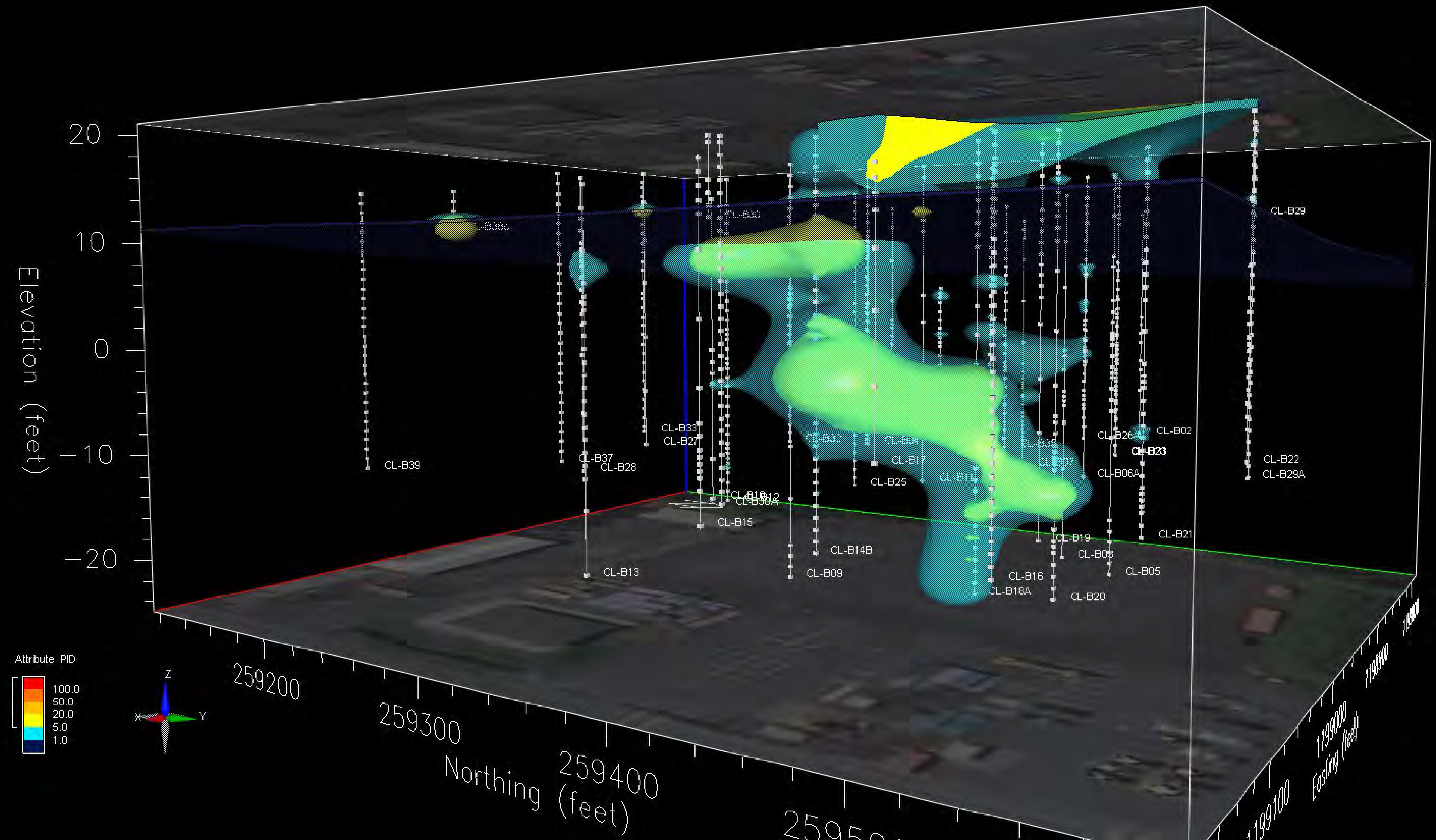
Laboratory Data Qualifiers

Table G-1
Qualifier Definitions

Final Qualifier	Description
A	The peak was manually integrated as it was not integrated in the original chromatogram
D	The reported value is from a dilution
JD	The reported value is an estimated concentration./The reported value is from a dilution
U	The analyte was analyzed but not detected at or above the stated limit. (sometimes validators will elevate the limit due to the "B" qual using the 5x/10x rule so this definition is different than the lab description).
J	The reported value is an estimated concentration.
E	The reported value exceeded the instrument calibration range, estimated concentration
UJ	The analyte was analyzed but not detected. the sample quantitation limit is an estimated value.
B	The analyte was found in an associated blank, as well as in the sample.
B J	The analyte was found in an associated blank, as well as in the sample./Sample was prepped or analyzed beyond the specified holding time
H	Sample was prepped or analyzed beyond the specified holding time
J H	The reported value is an estimated concentration./Sample was prepped or analyzed beyond the specified holding time
M	A matrix effect was present.
Q	One or more quality control criteria failed
R	The reported value is unusable, rejected. Analyte may or may not be present.
U H	The analyte was analyzed but not detected at or above the stated limit. (sometimes validators will elevate the limit due to the "B" qual using the 5x/10x rule so this definition is different than the lab description)./Sample was prepped or analyzed beyond the specified holding tim
U M	The analyte was analyzed but not detected at or above the stated limit. (sometimes validators will elevate the limit due to the "B" qual using the 5x/10x rule so this definition is different than the lab description)./A matrix effect was present.

APPENDIX H

Three-Dimensional Plume Models



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Easting (feet)
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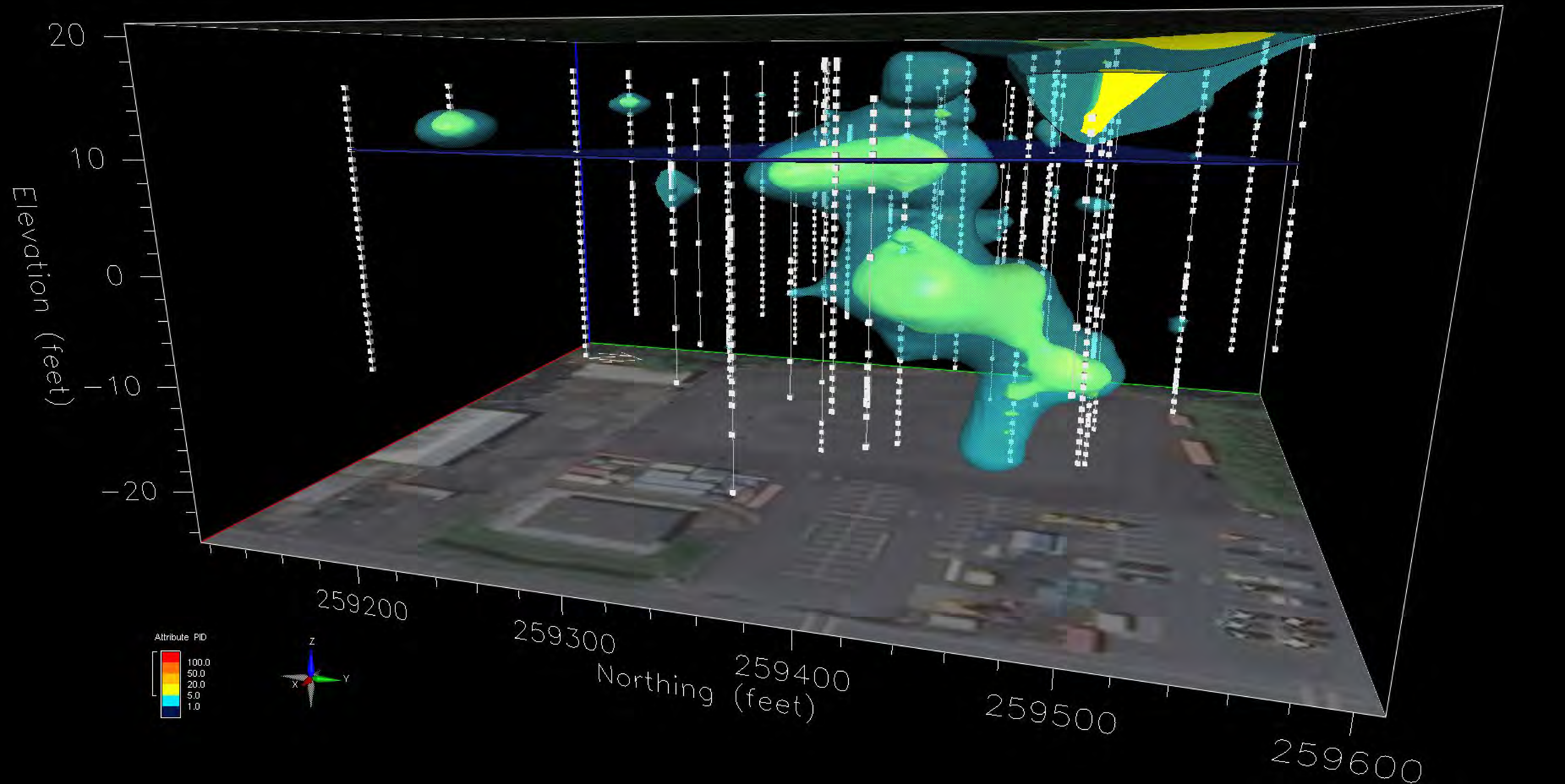
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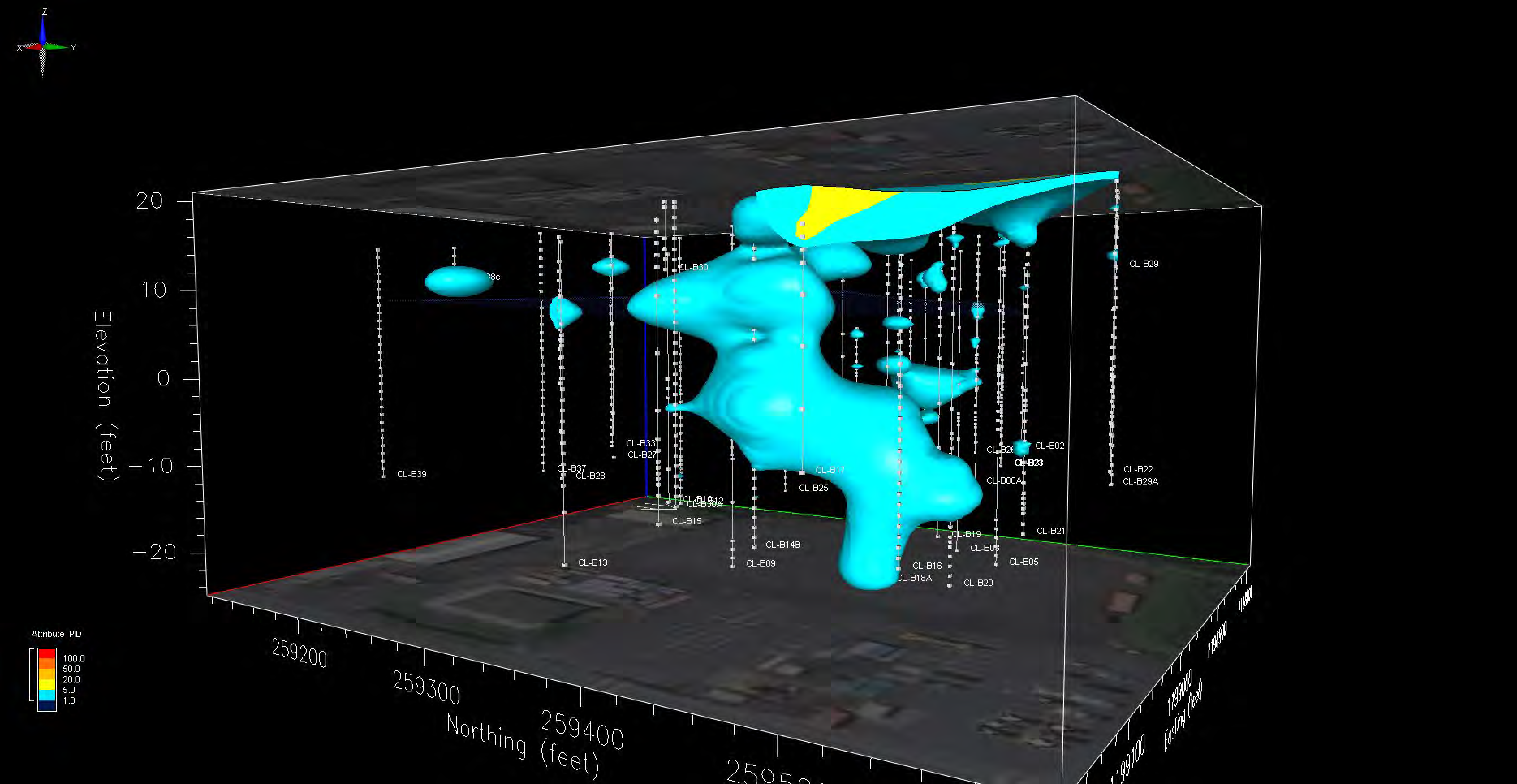
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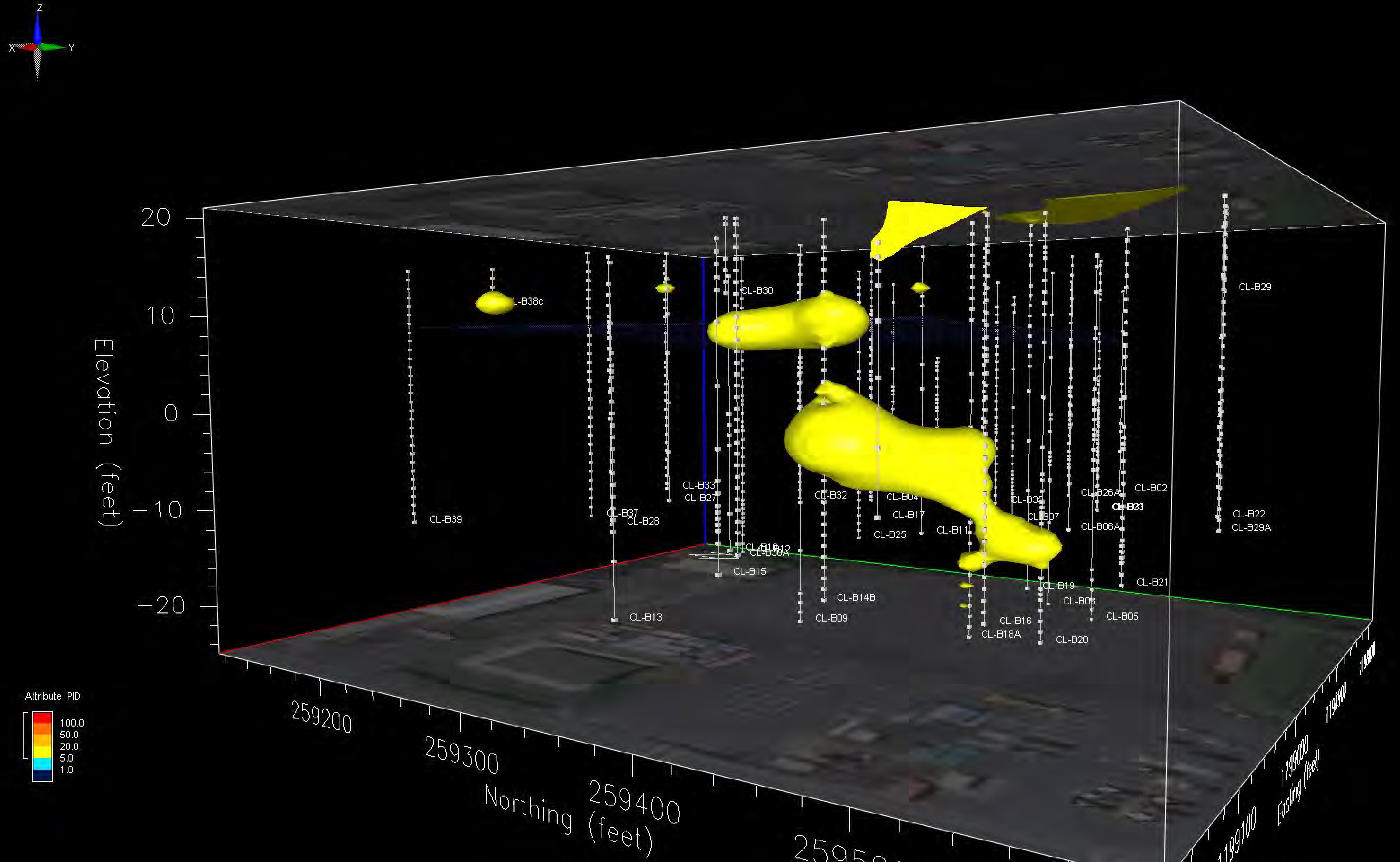
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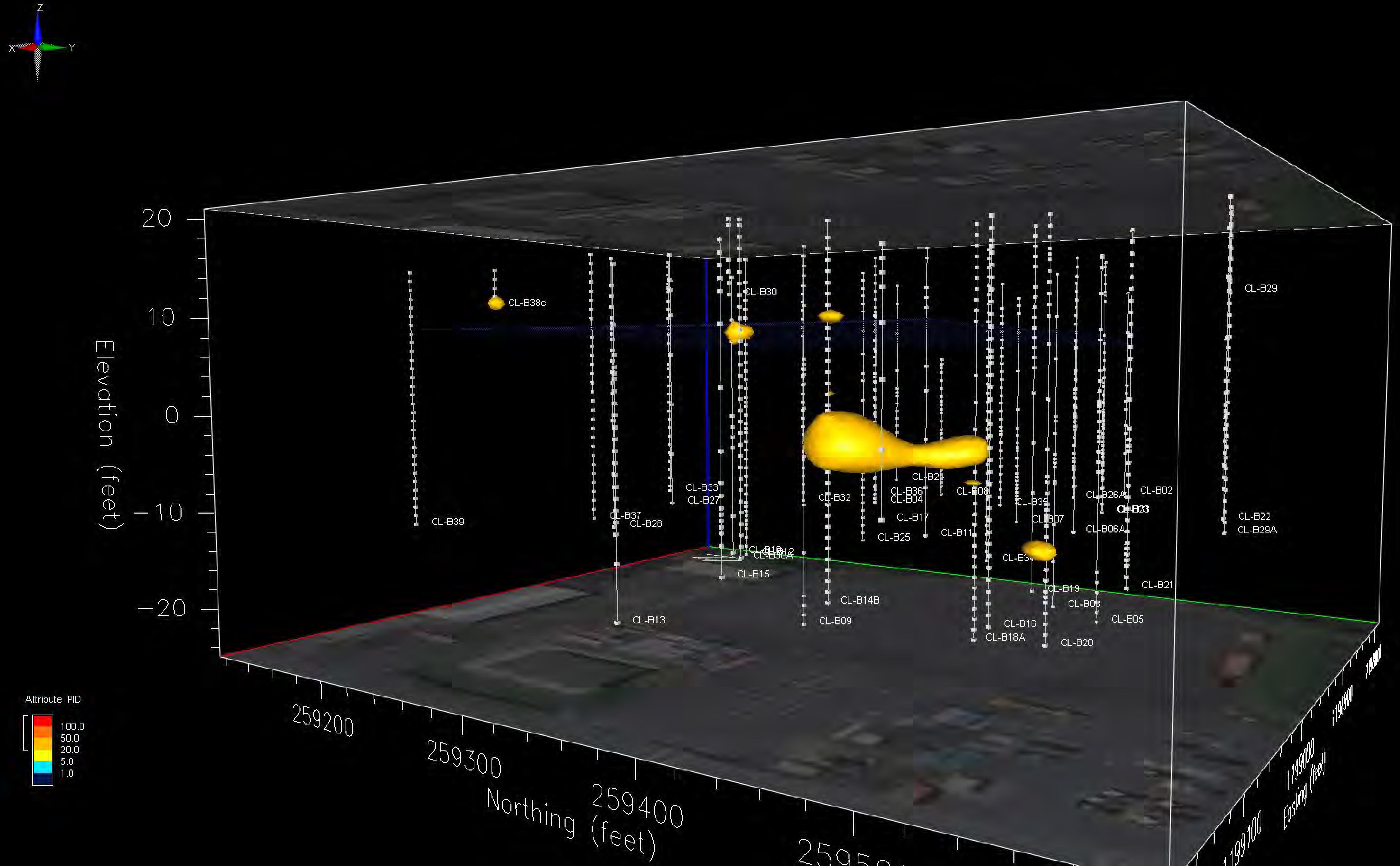
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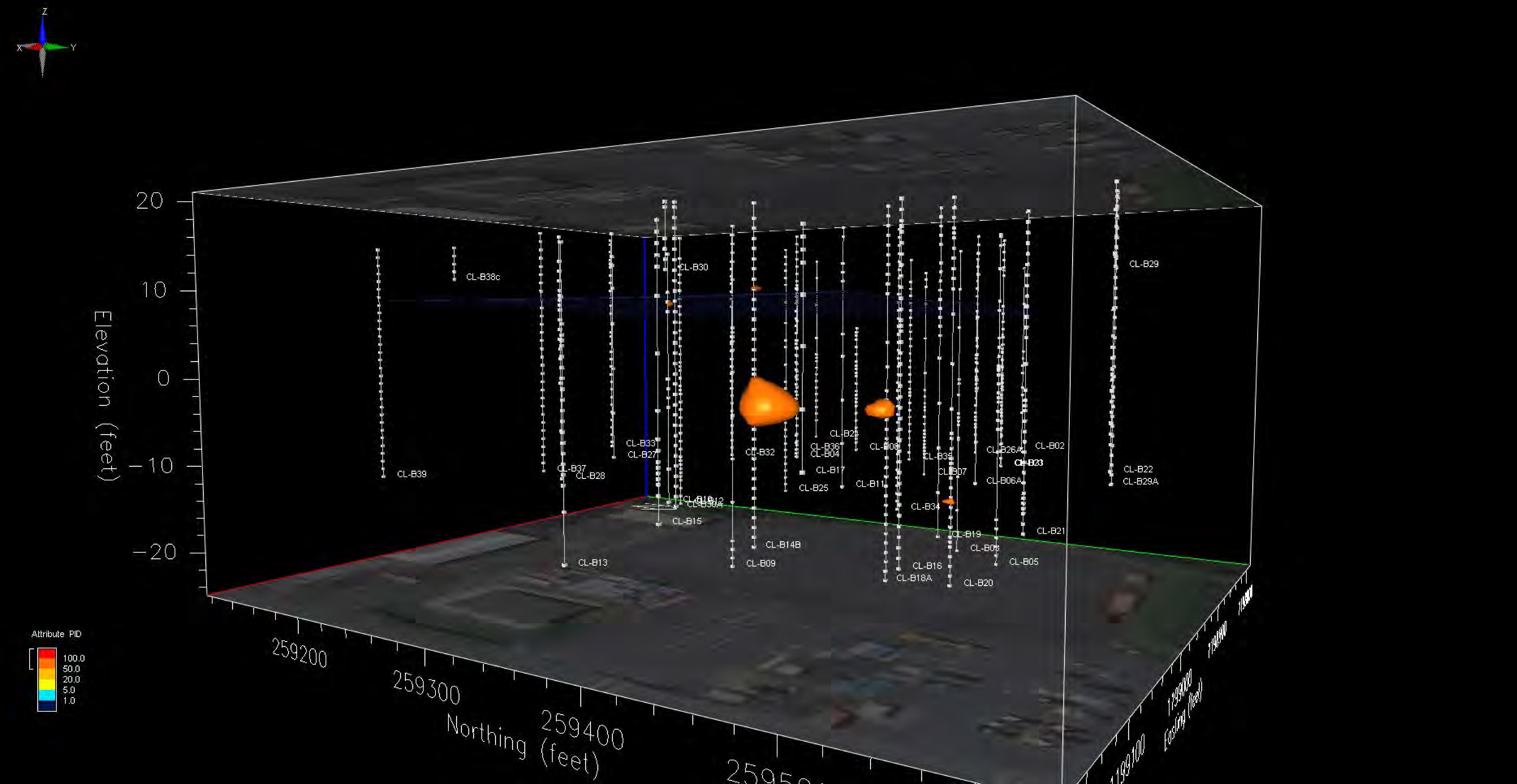
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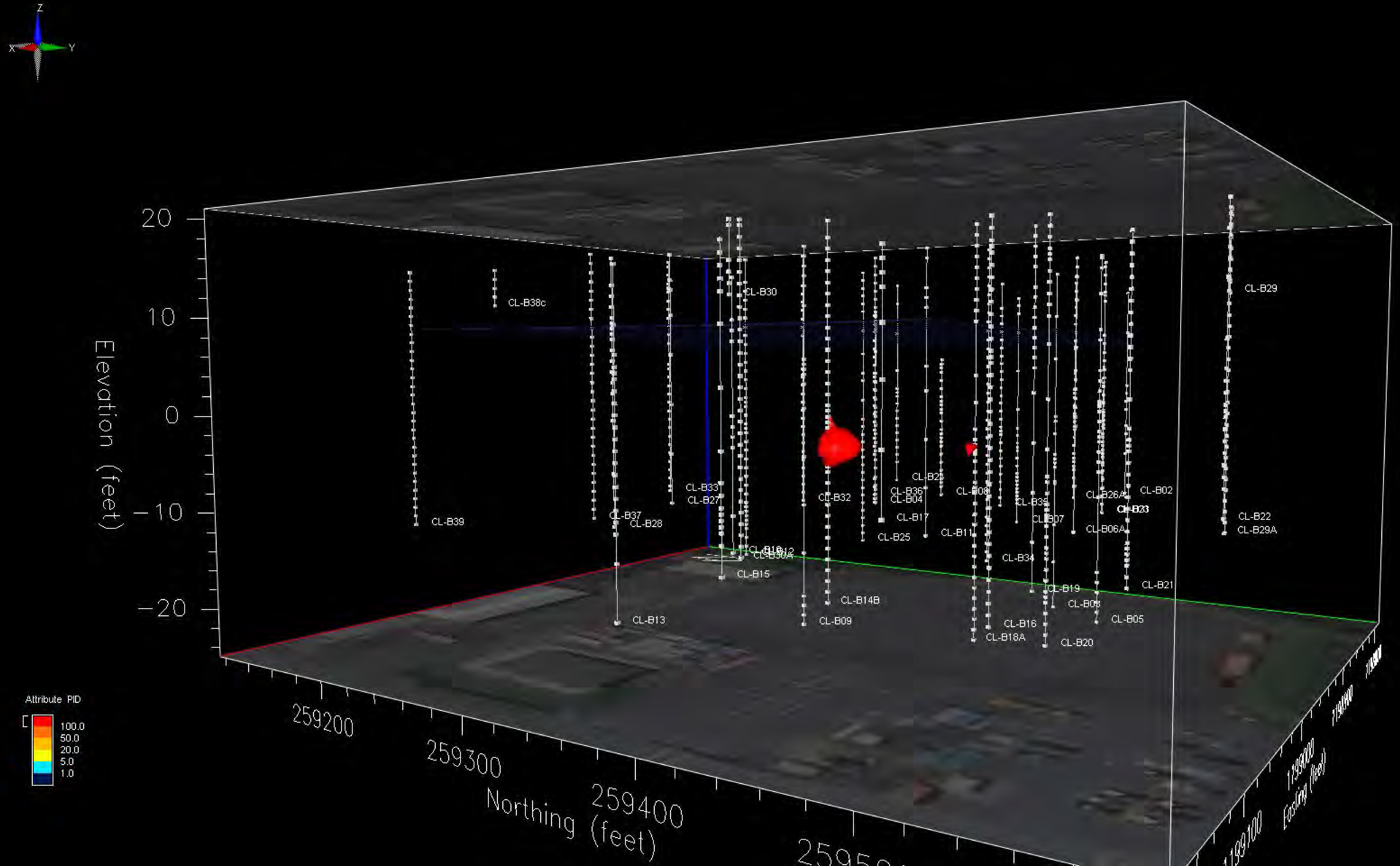
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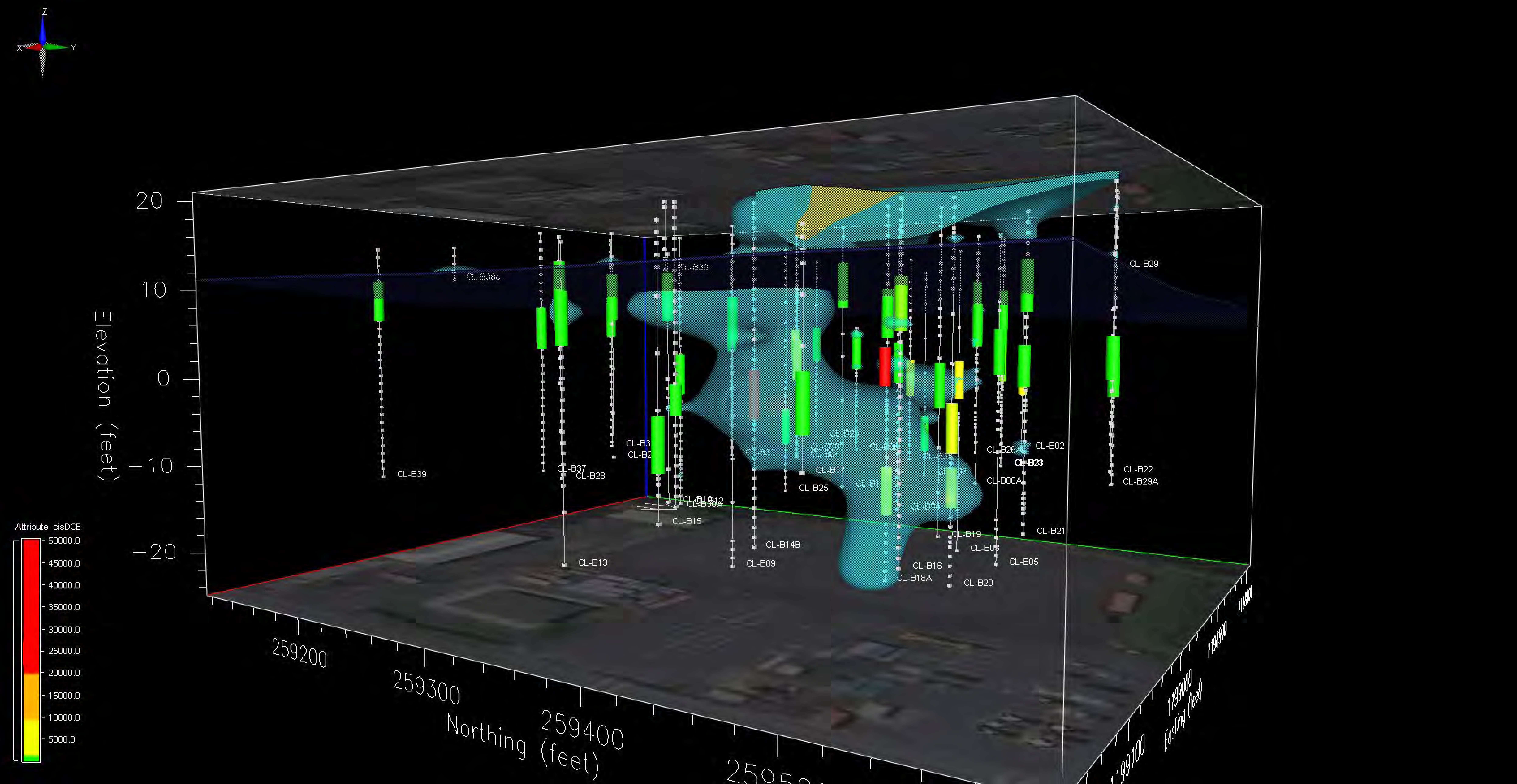
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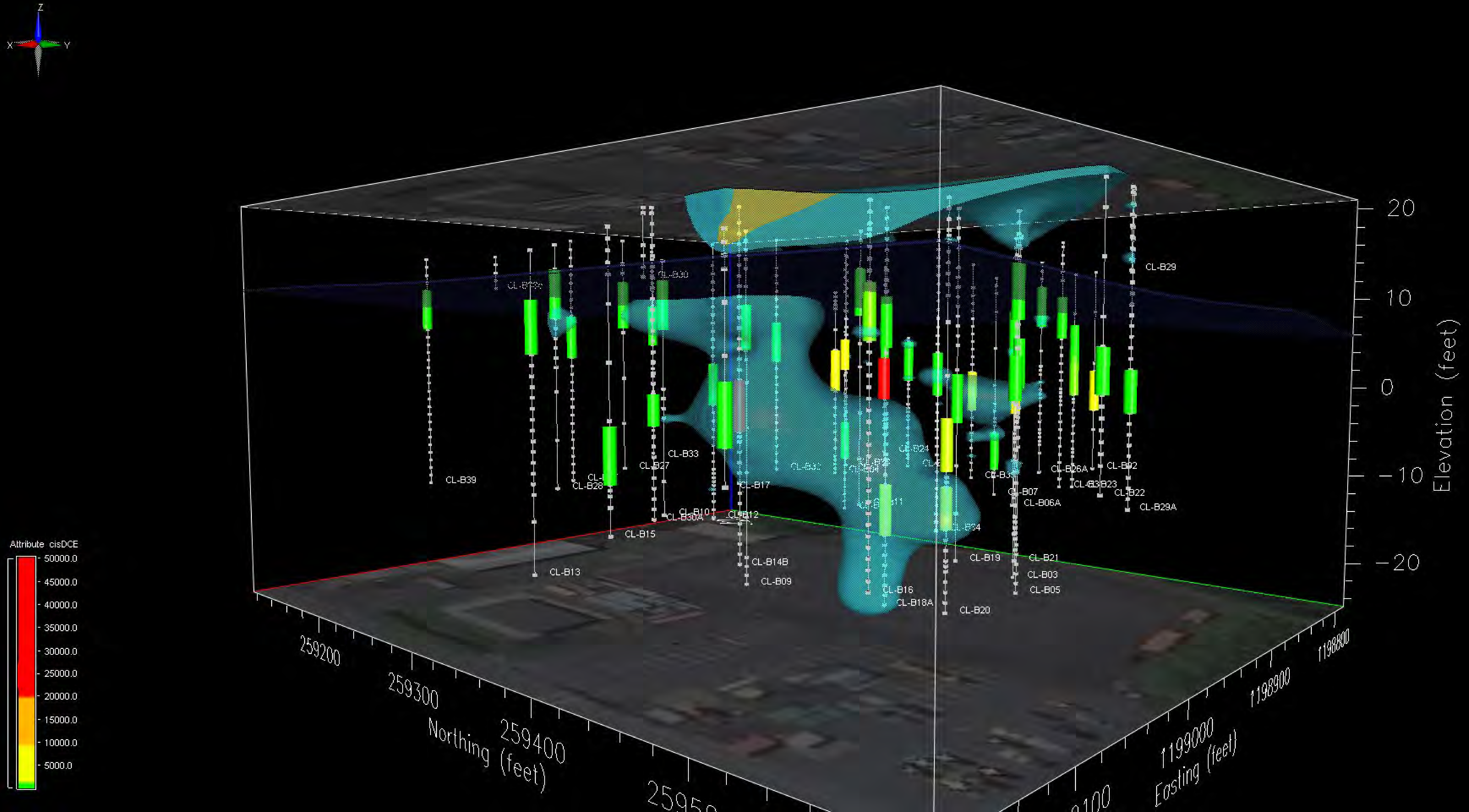
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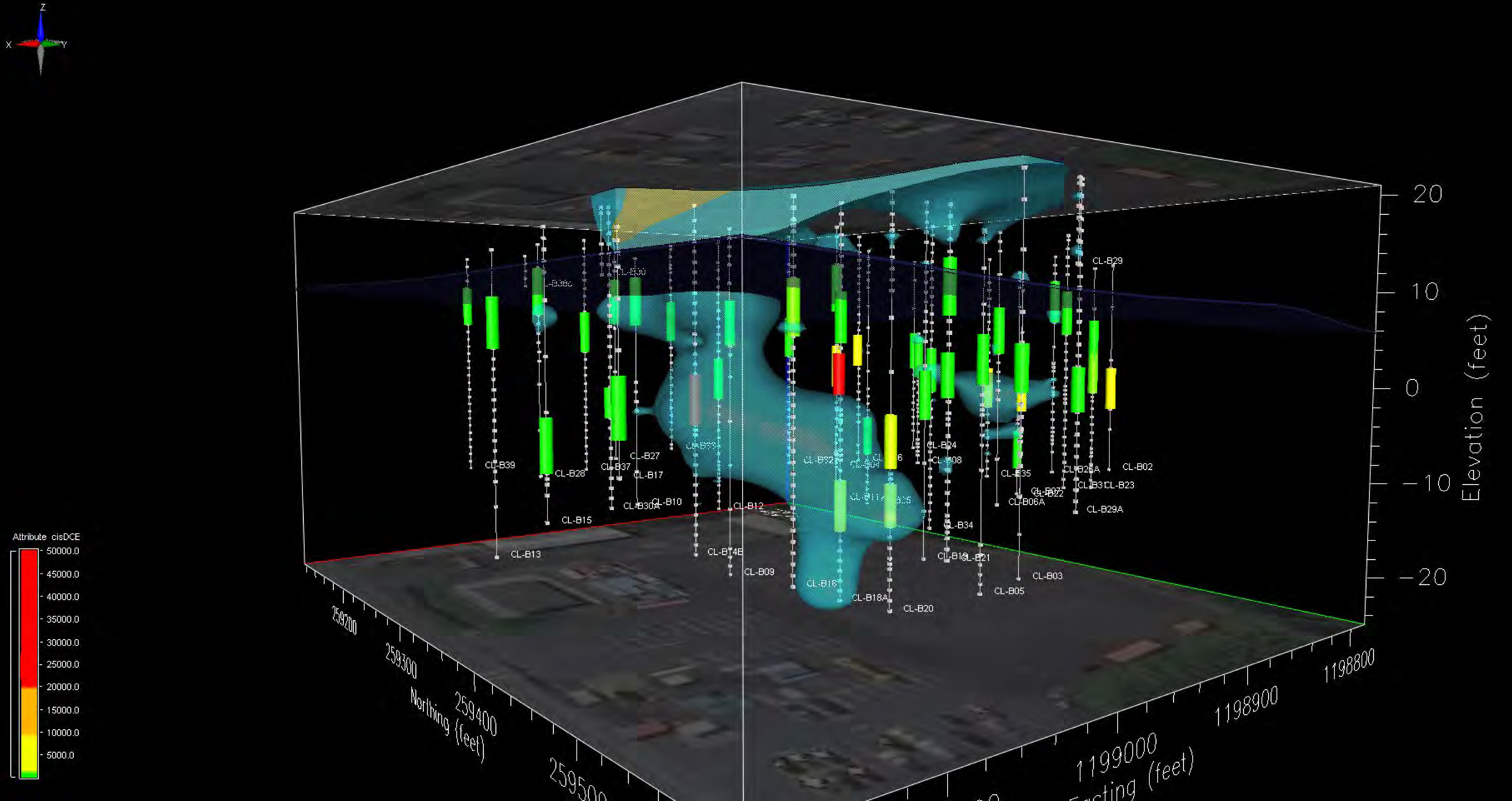
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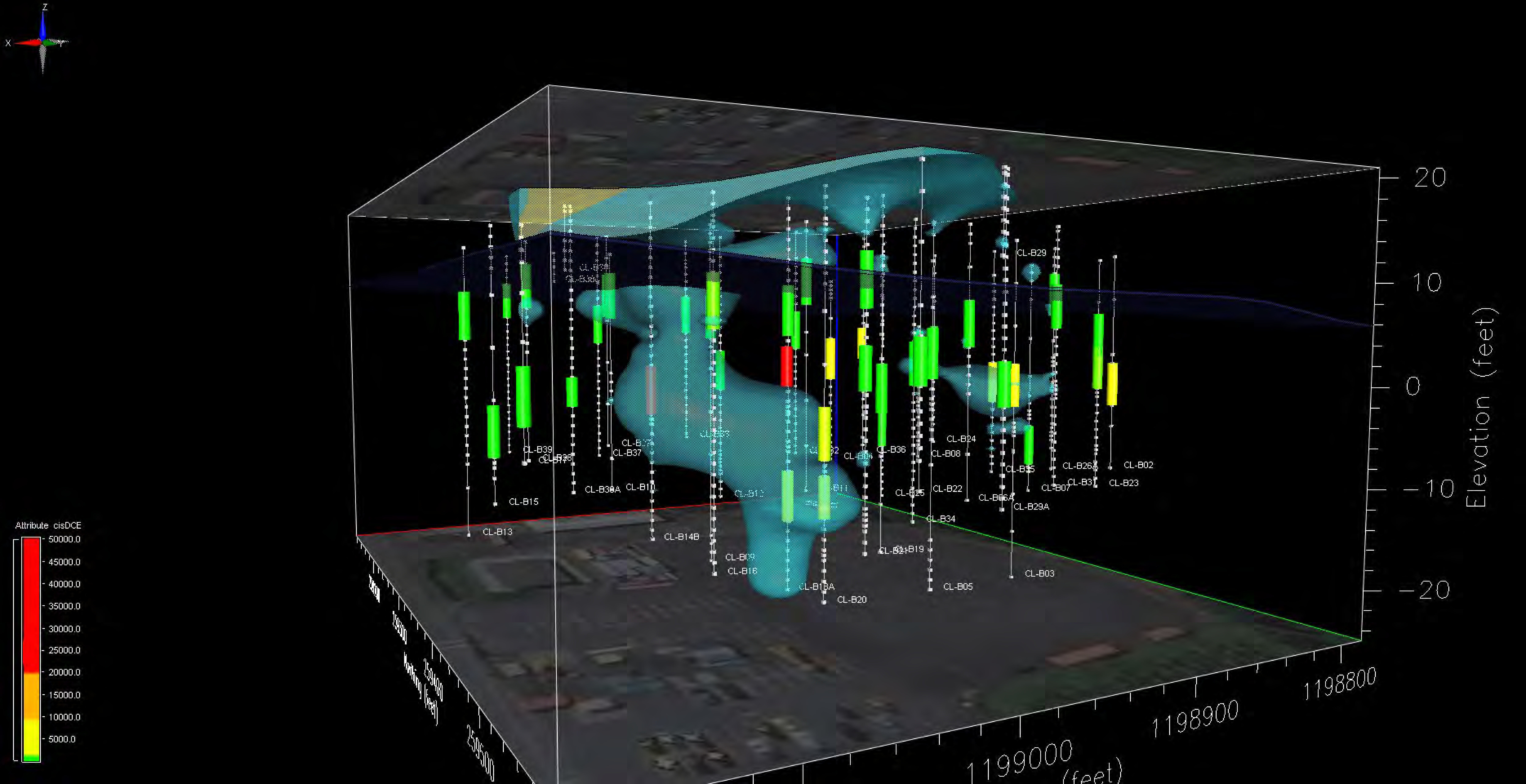
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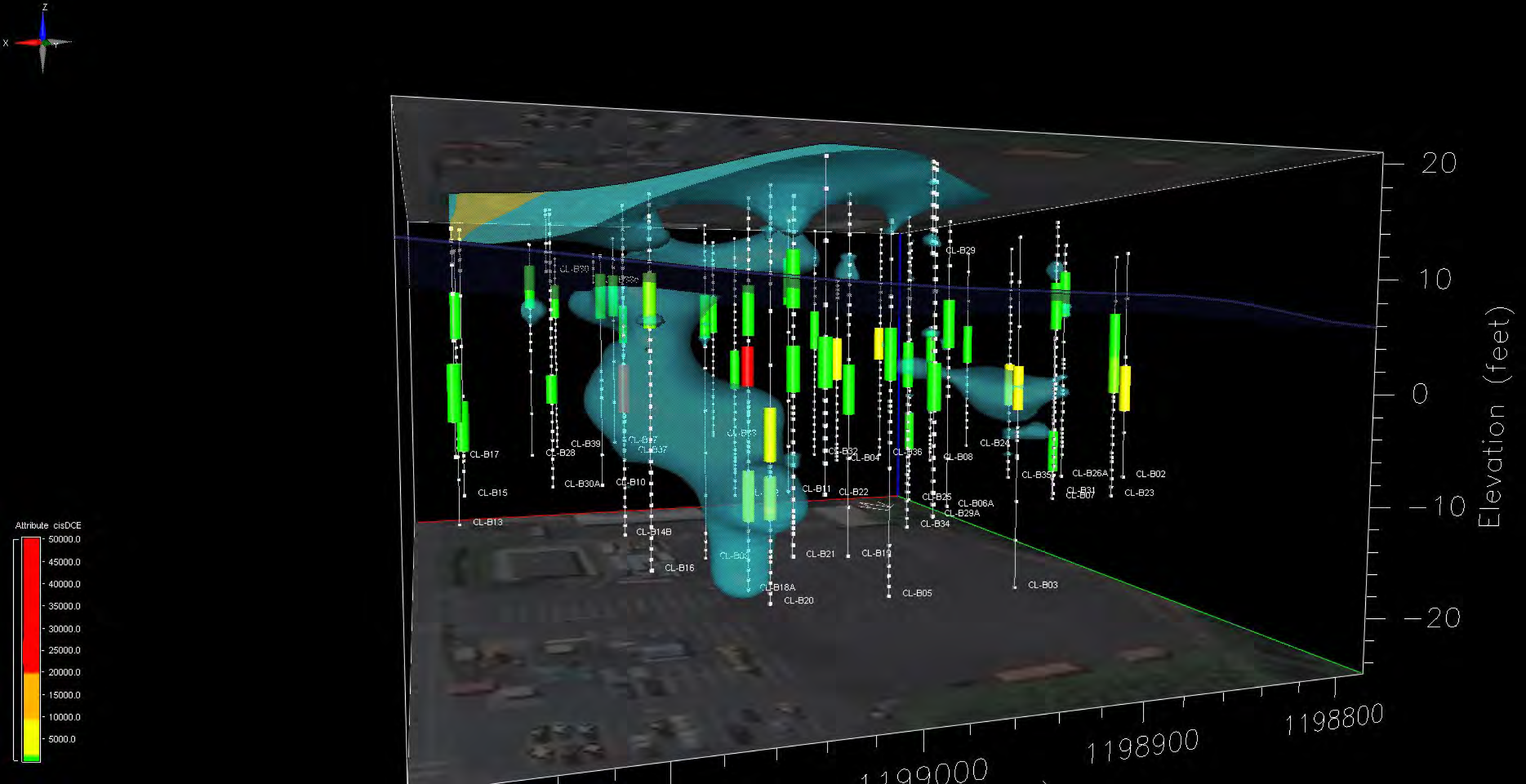
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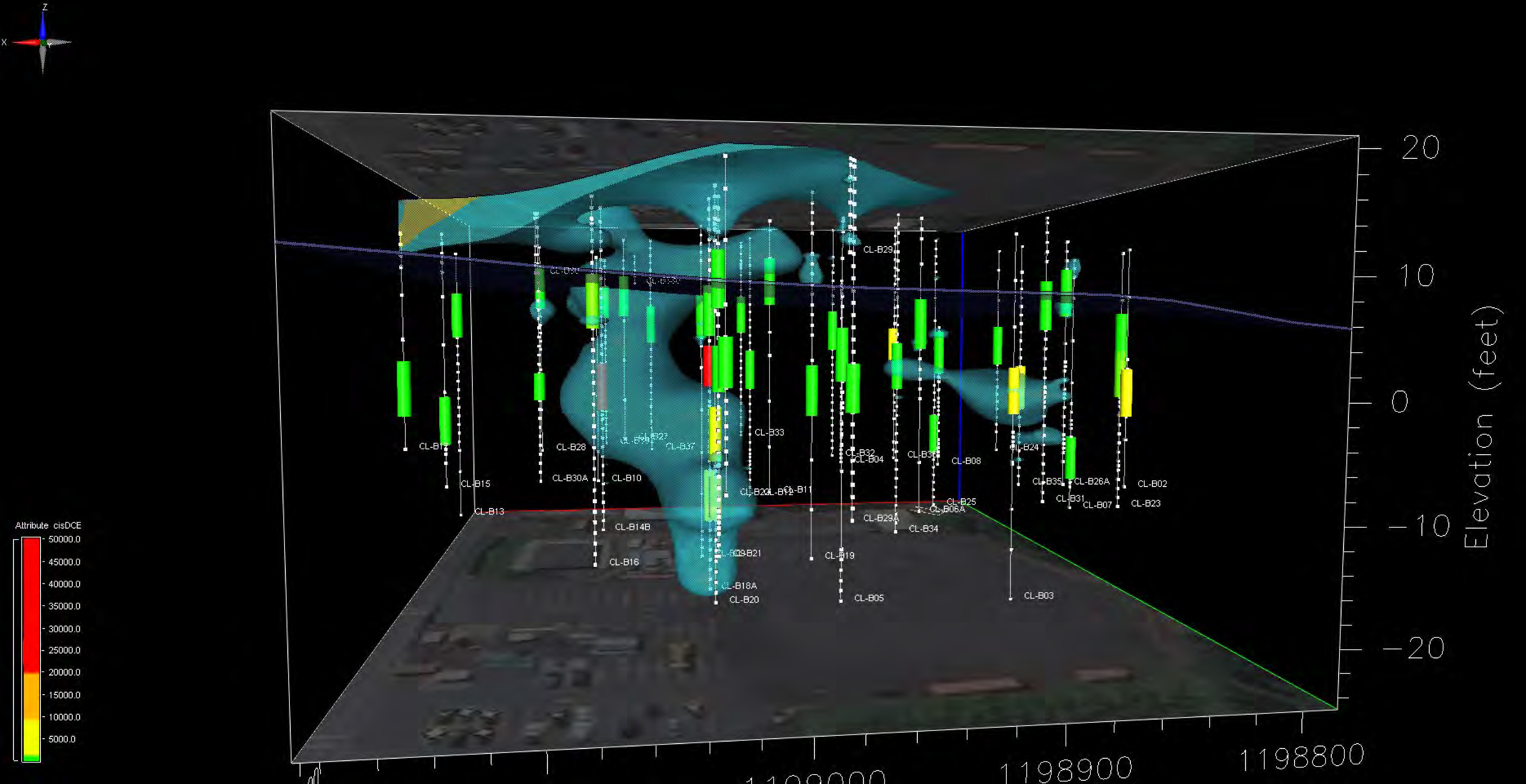
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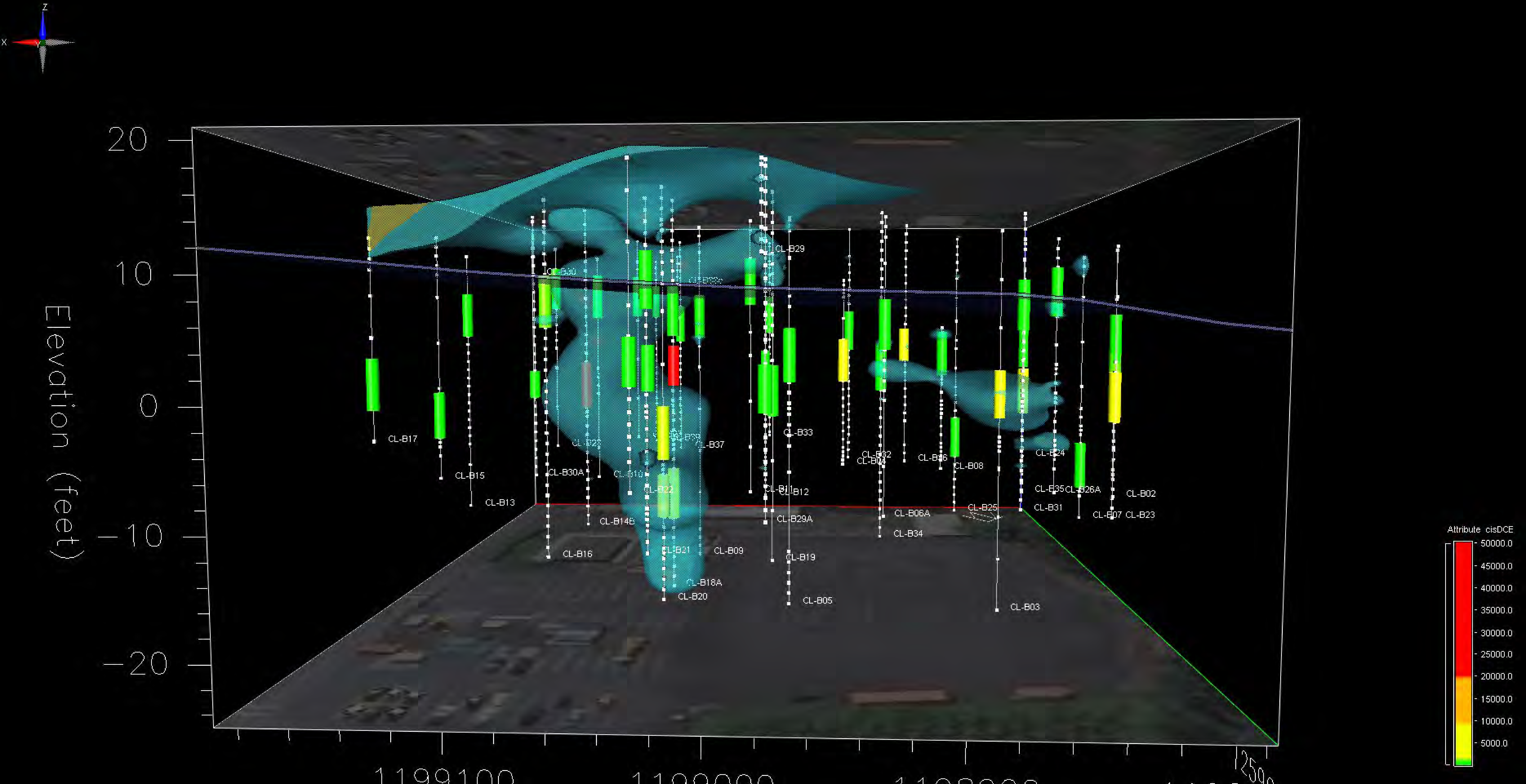
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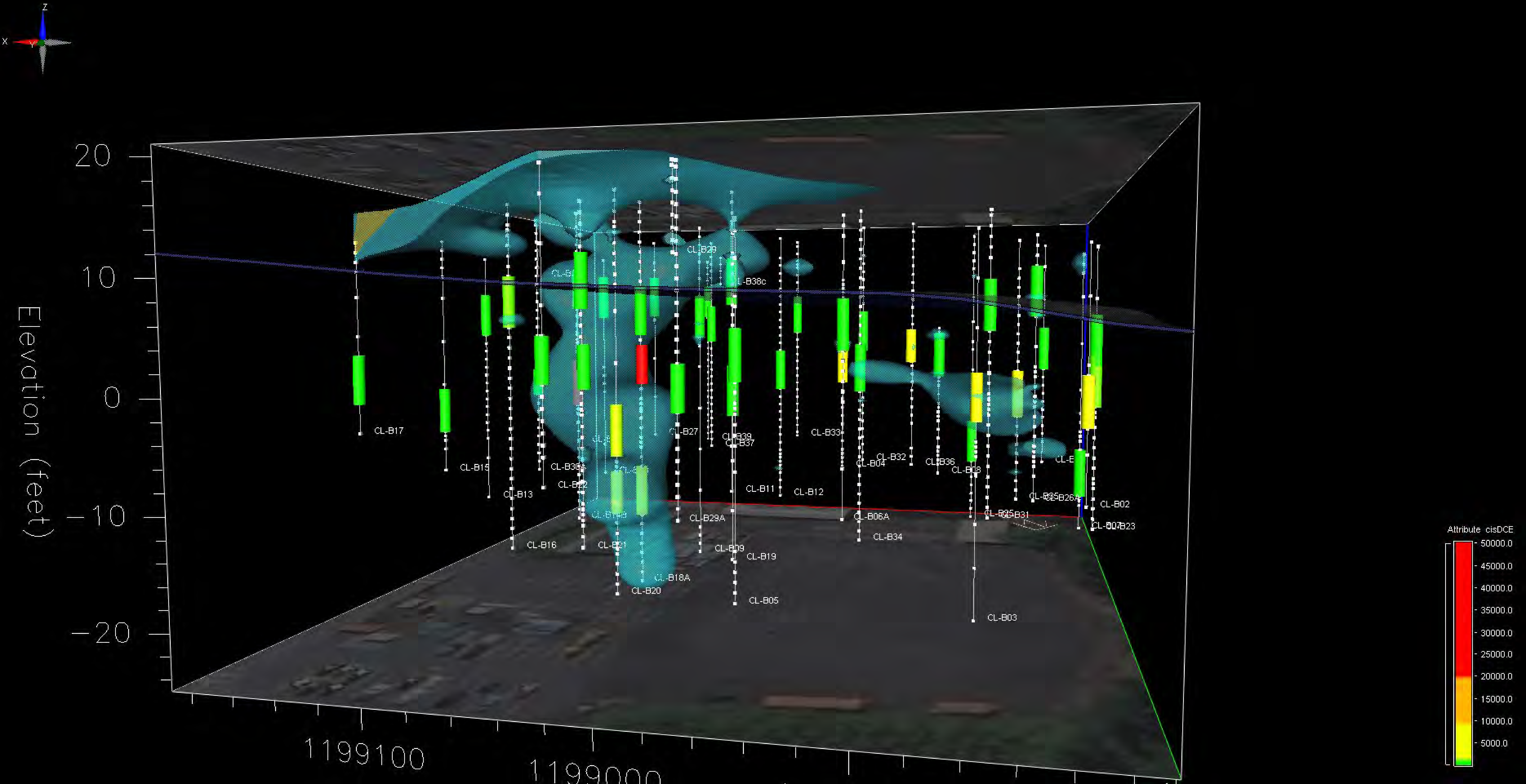
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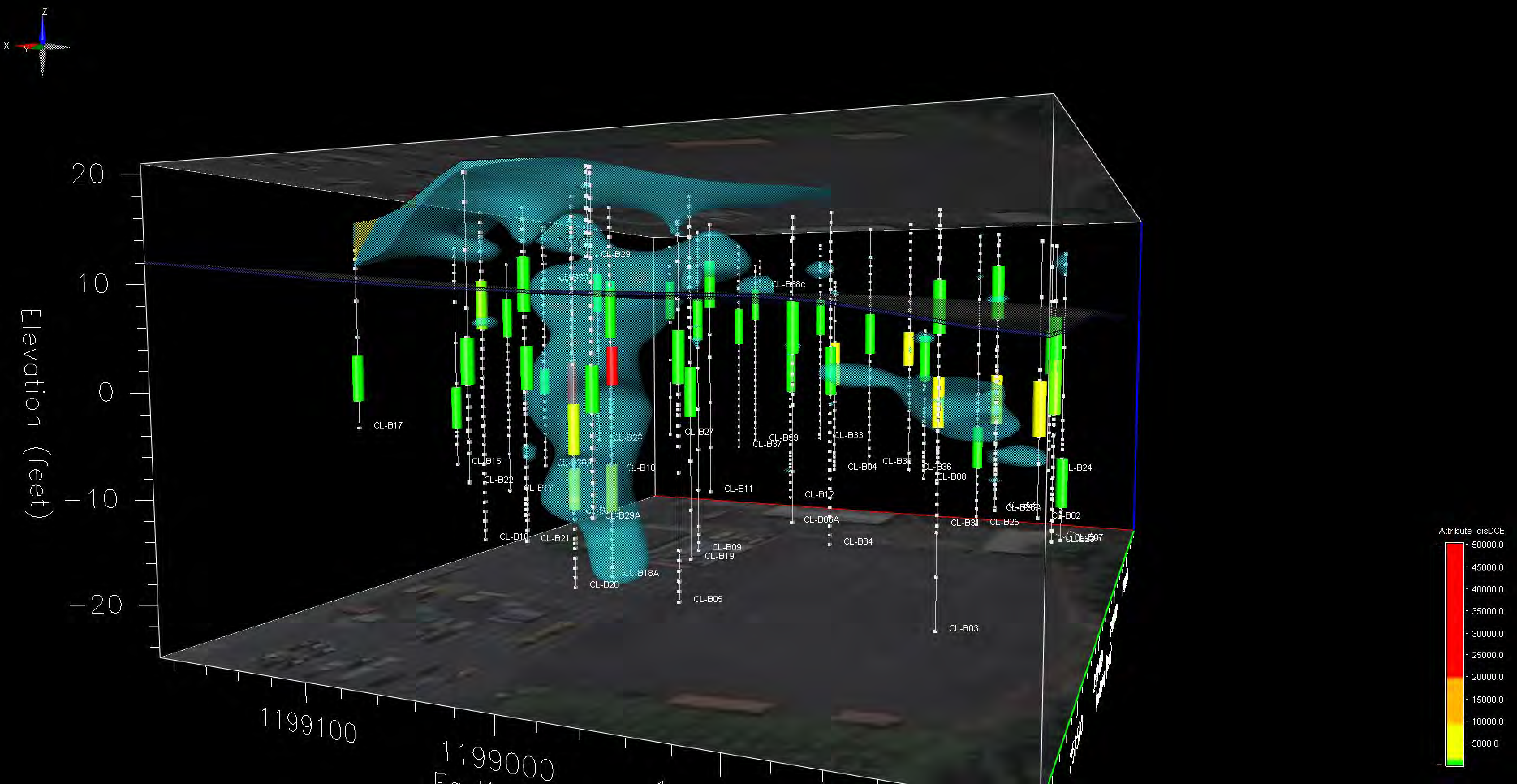
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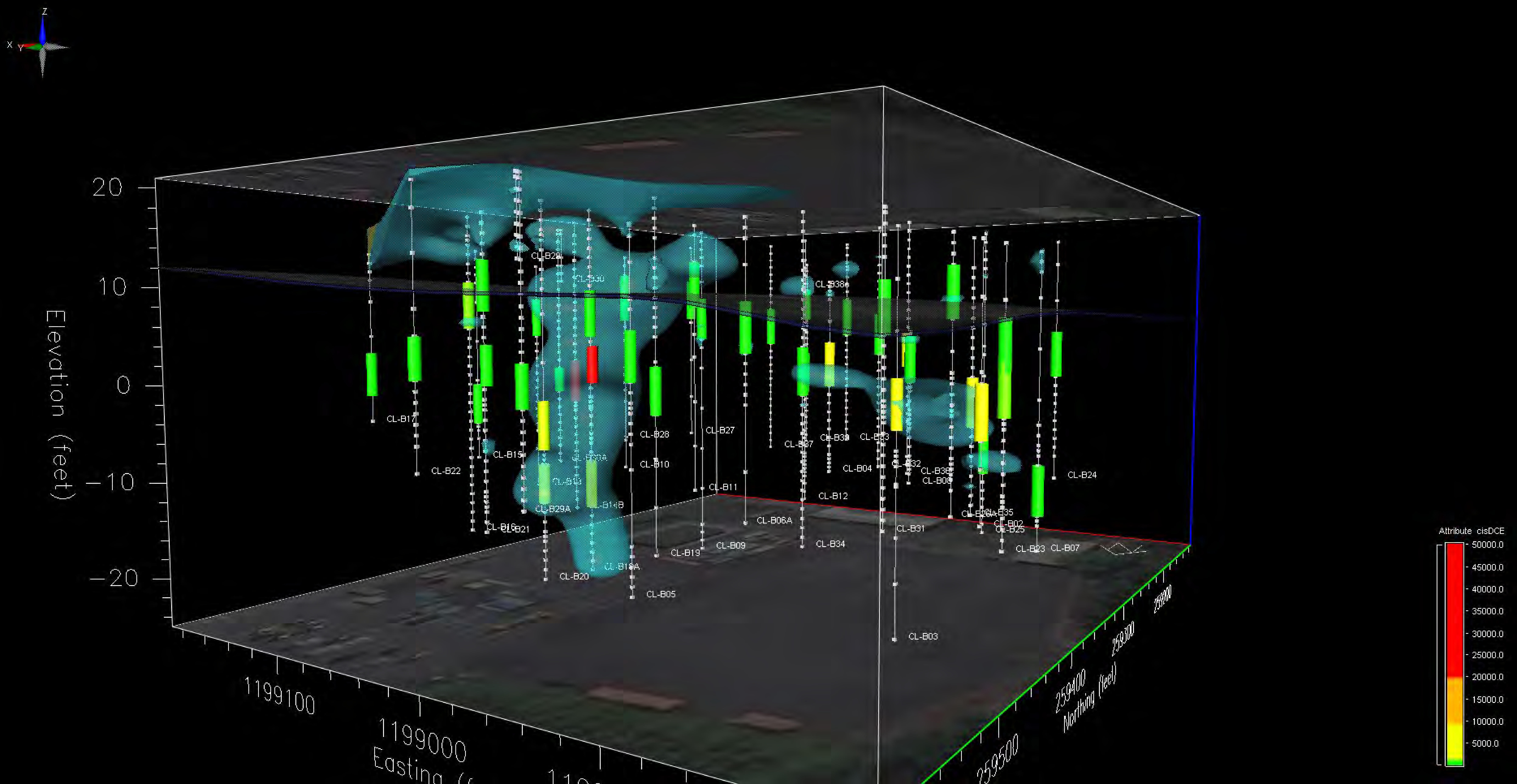
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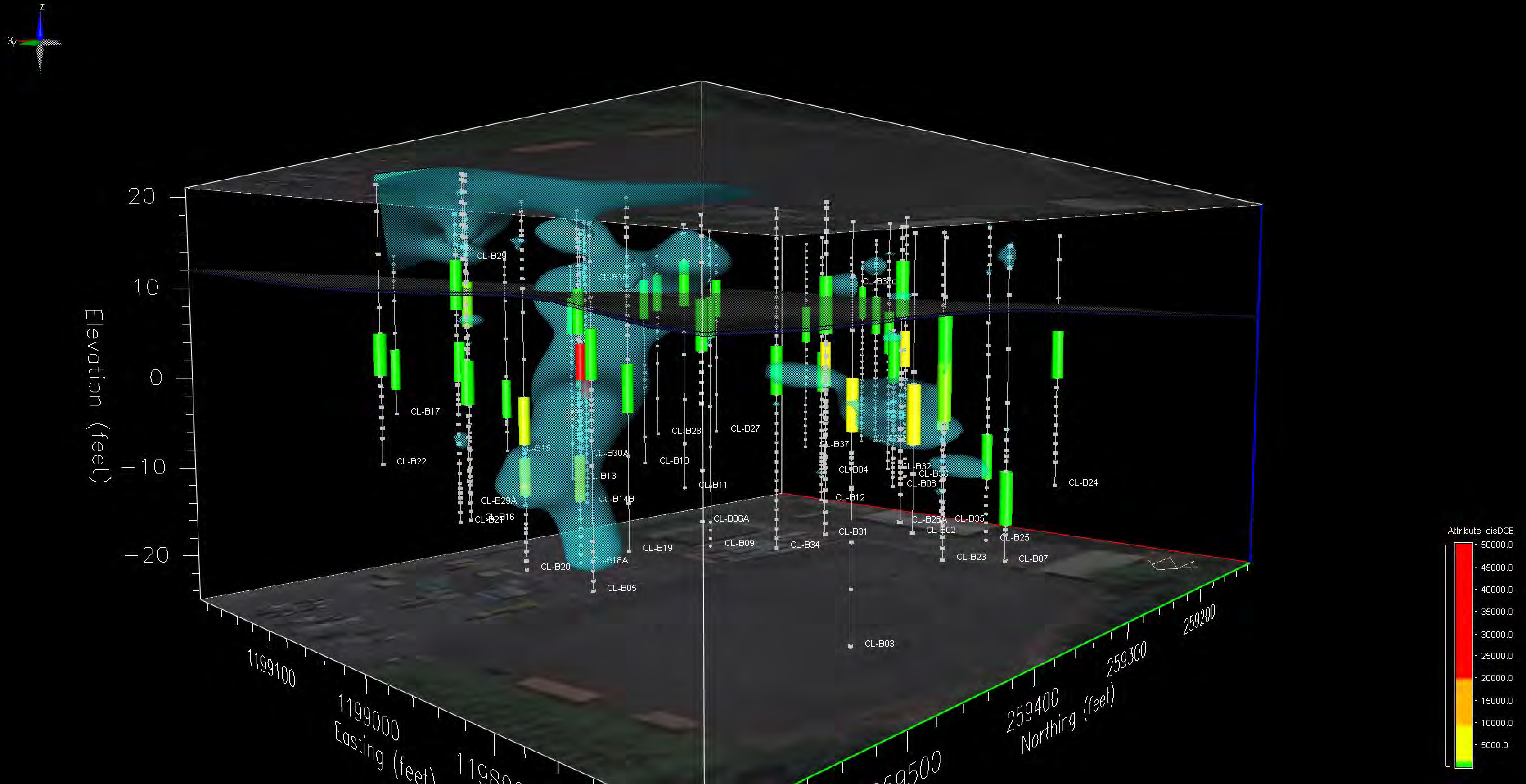
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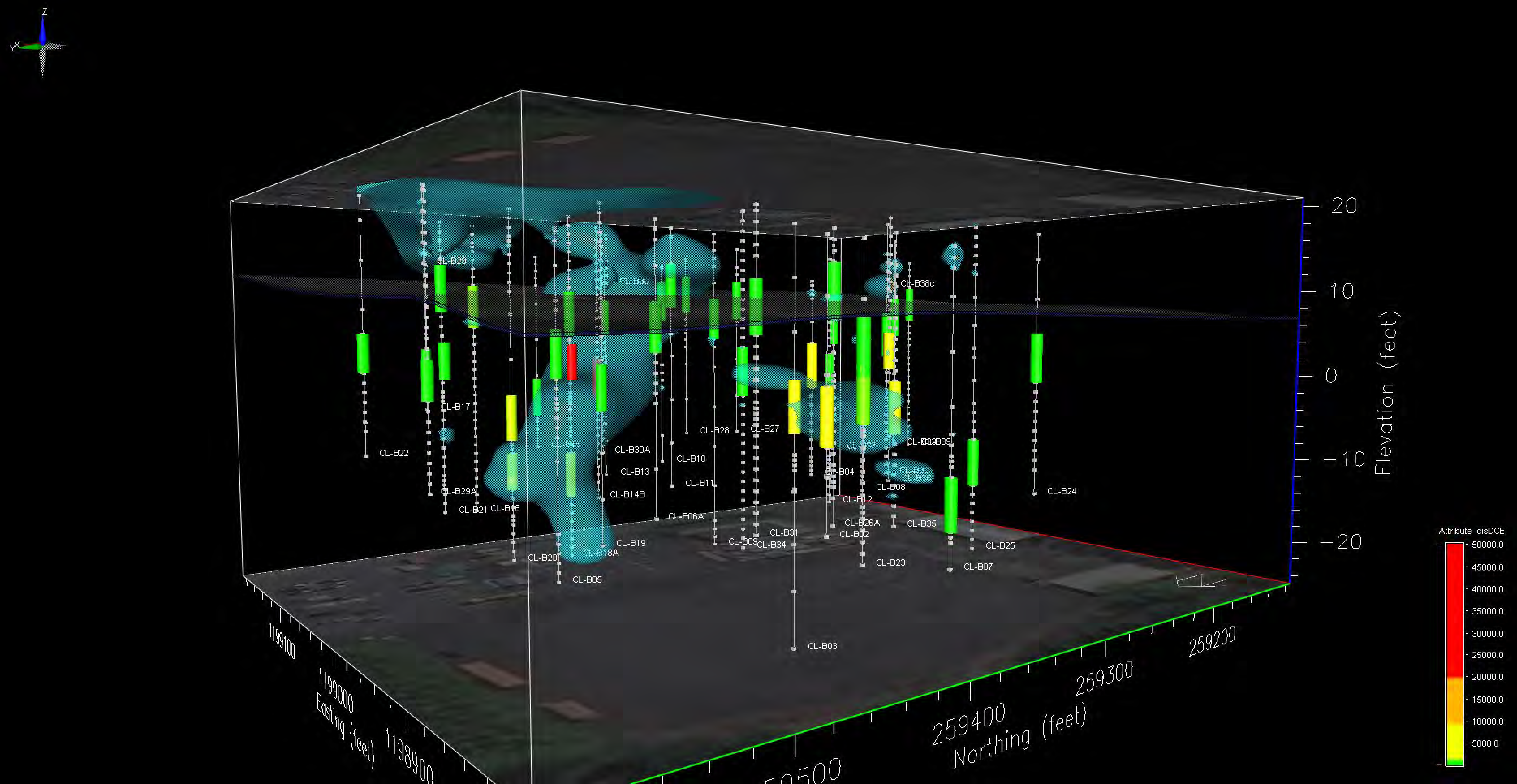
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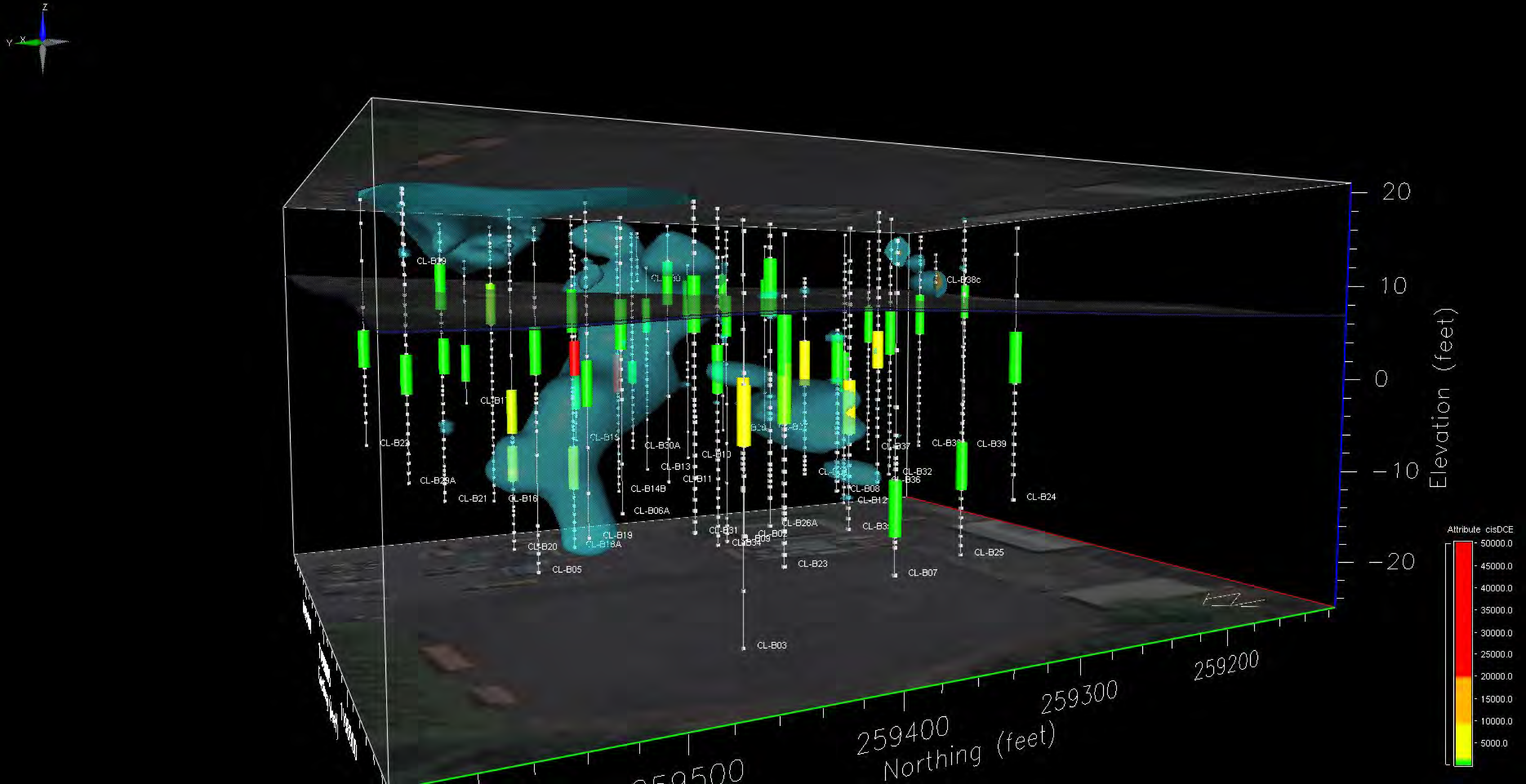
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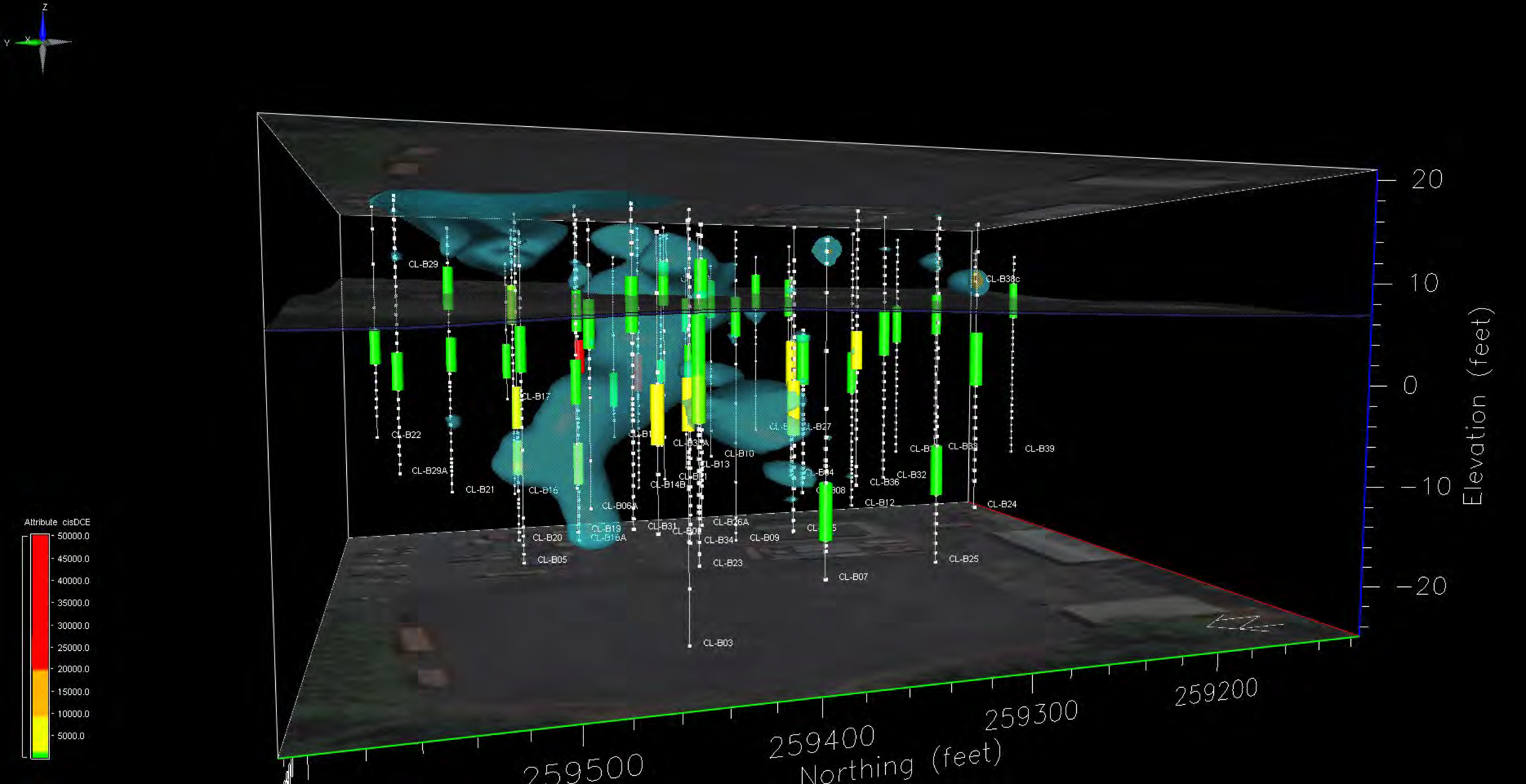
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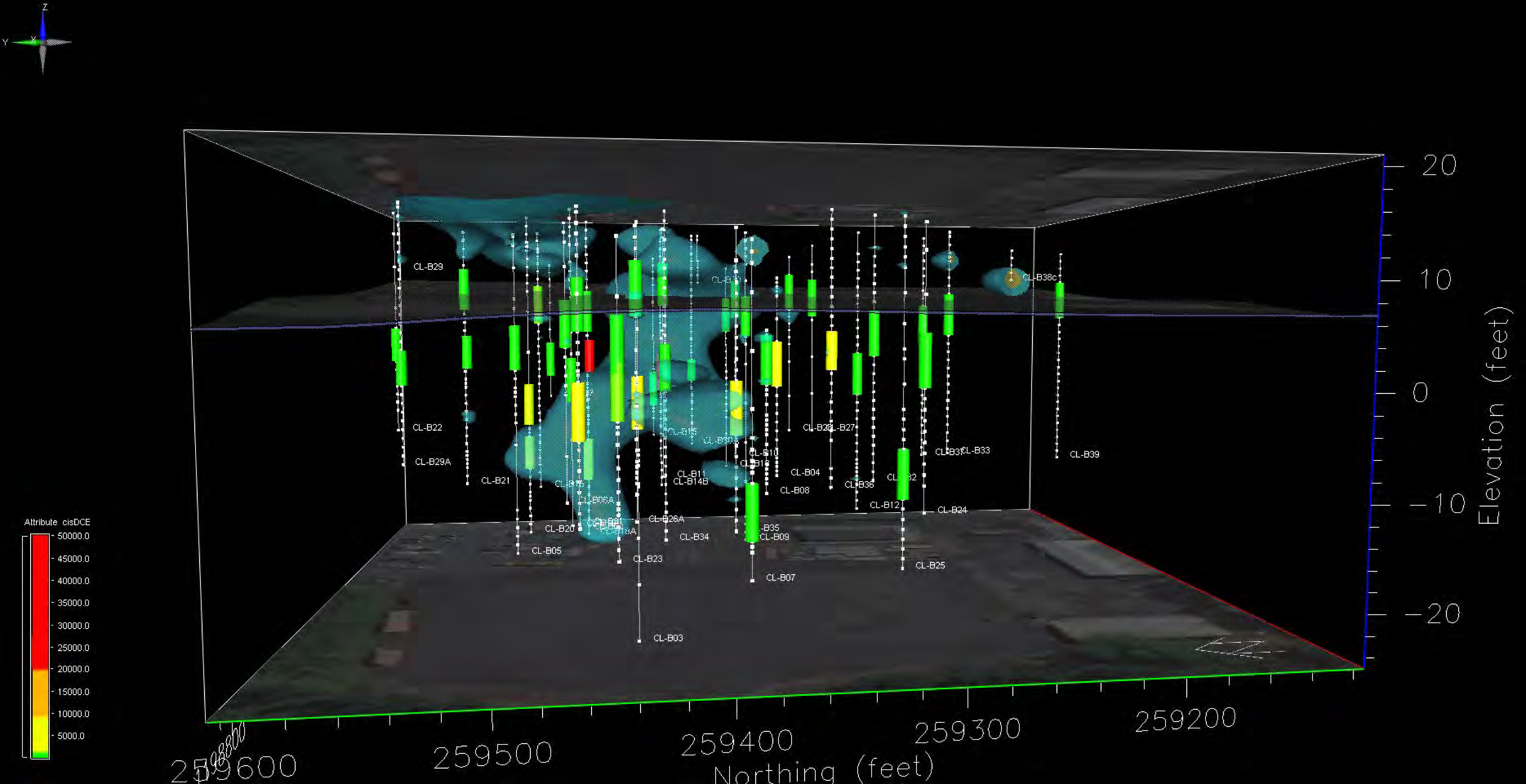
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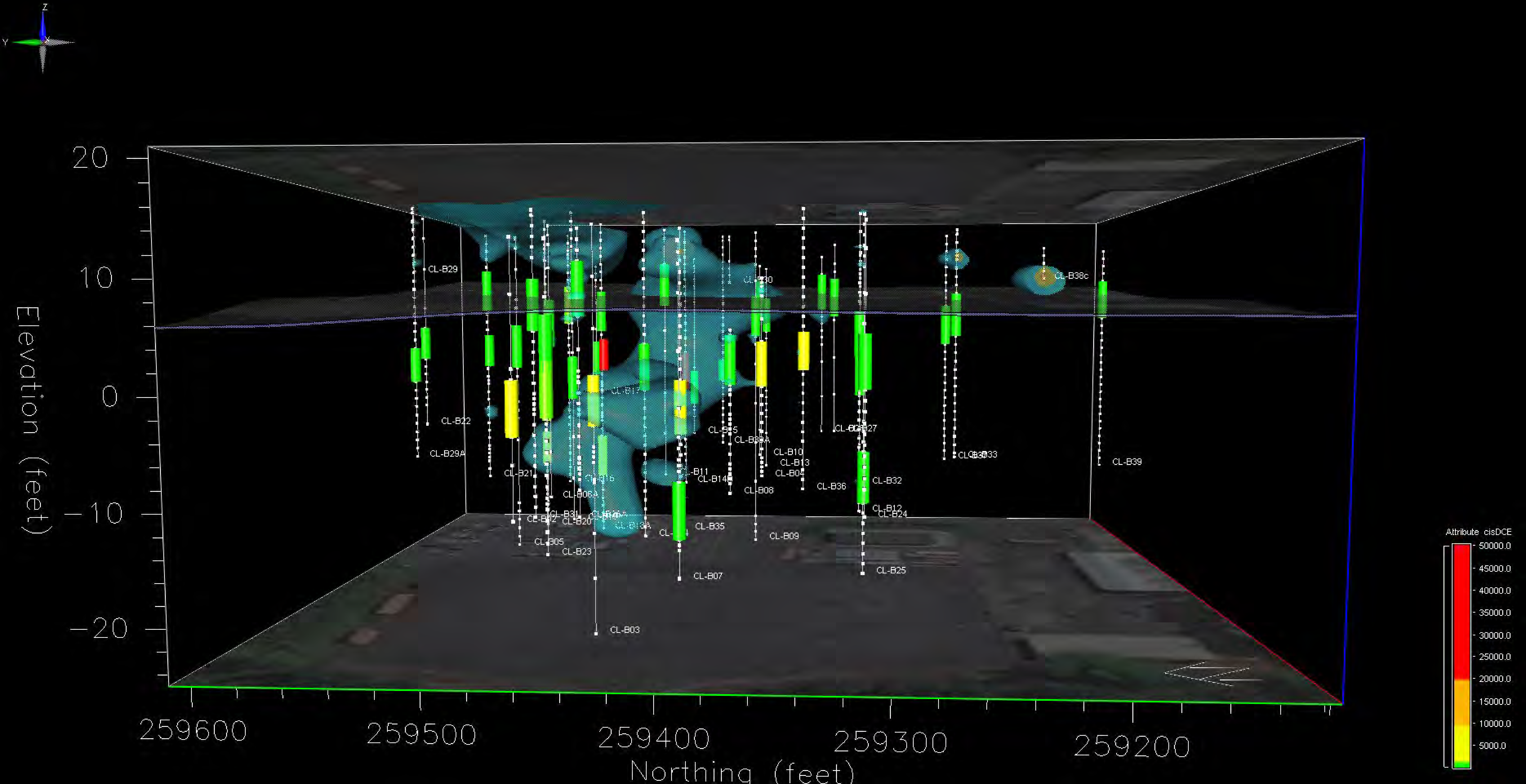
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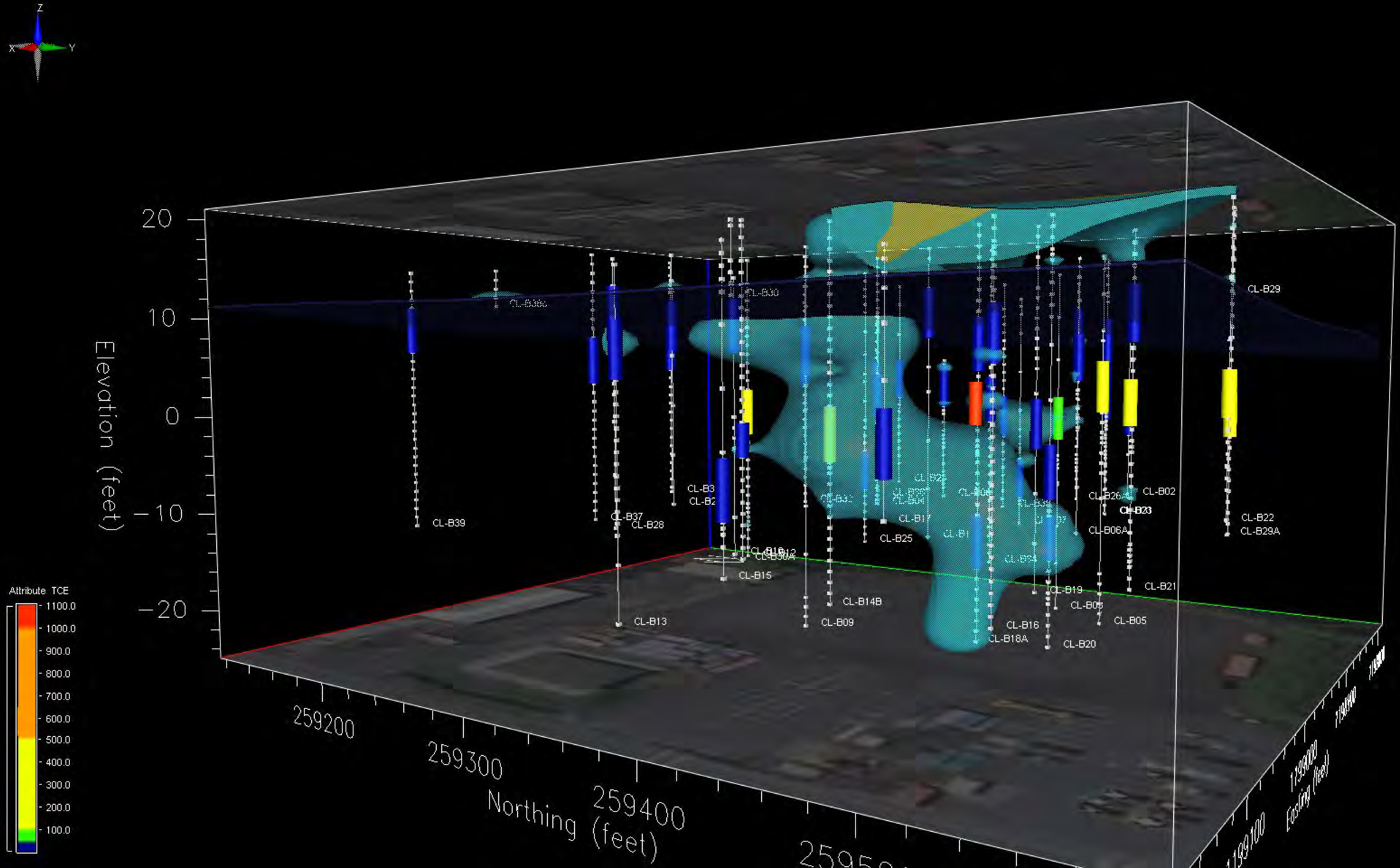
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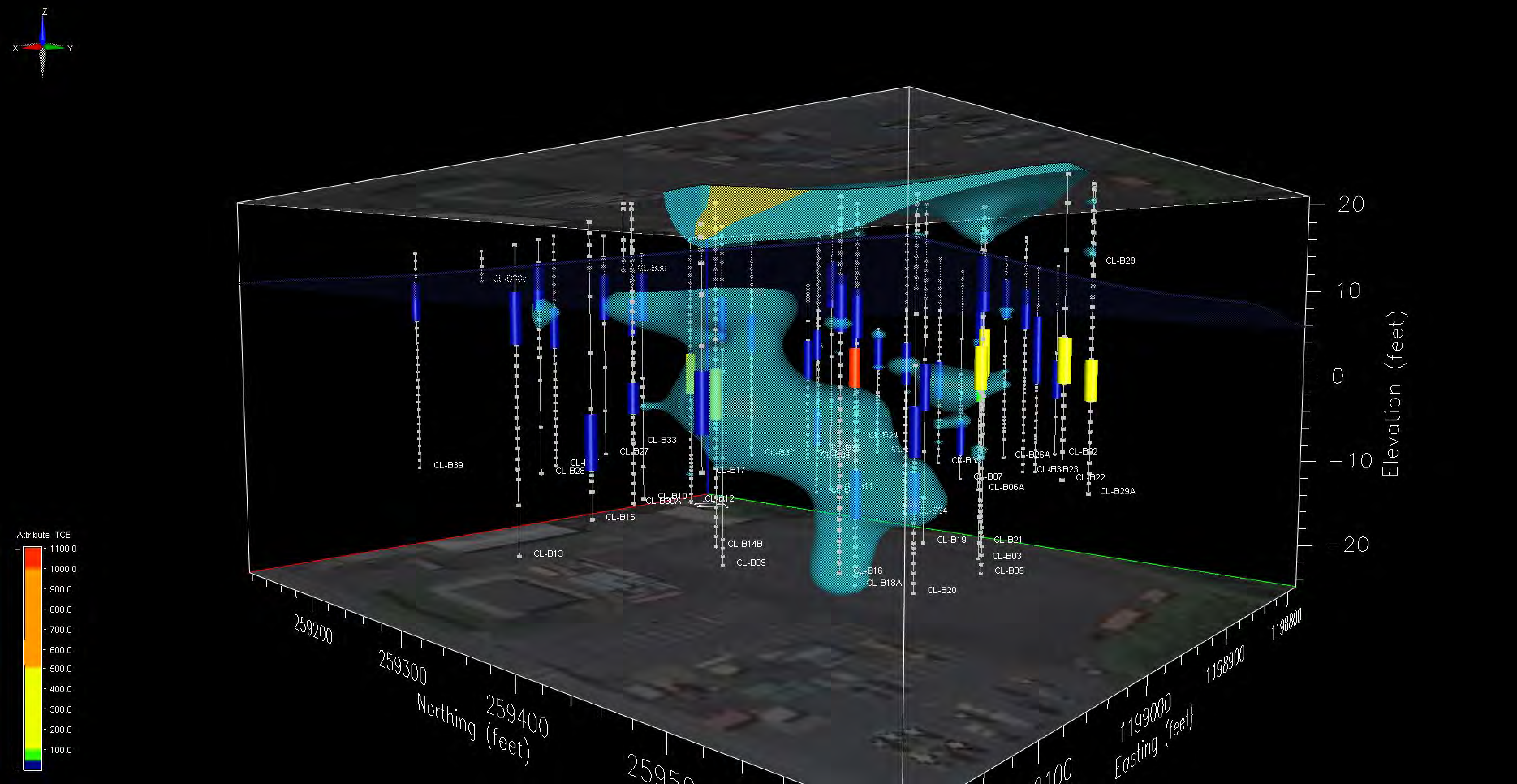
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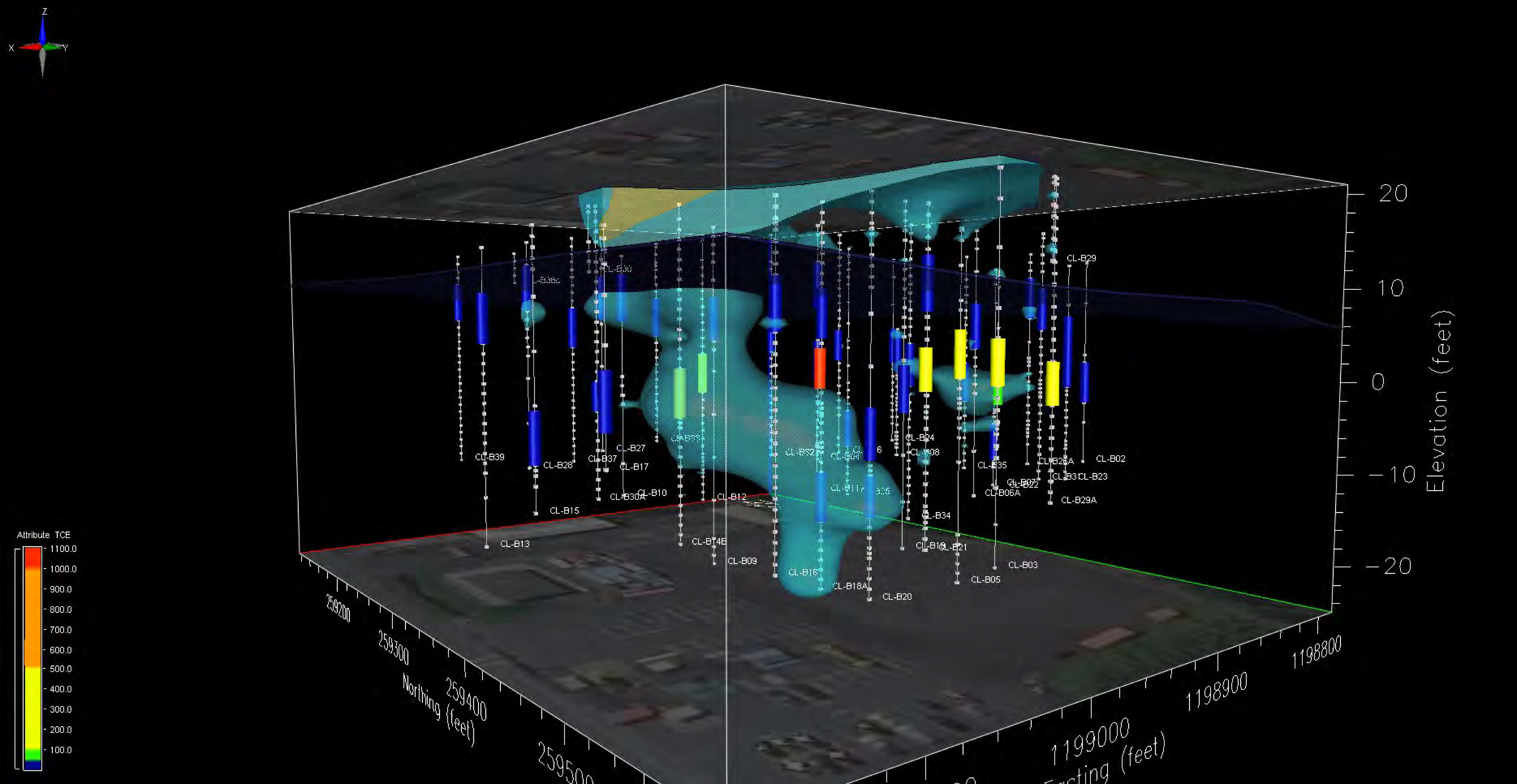
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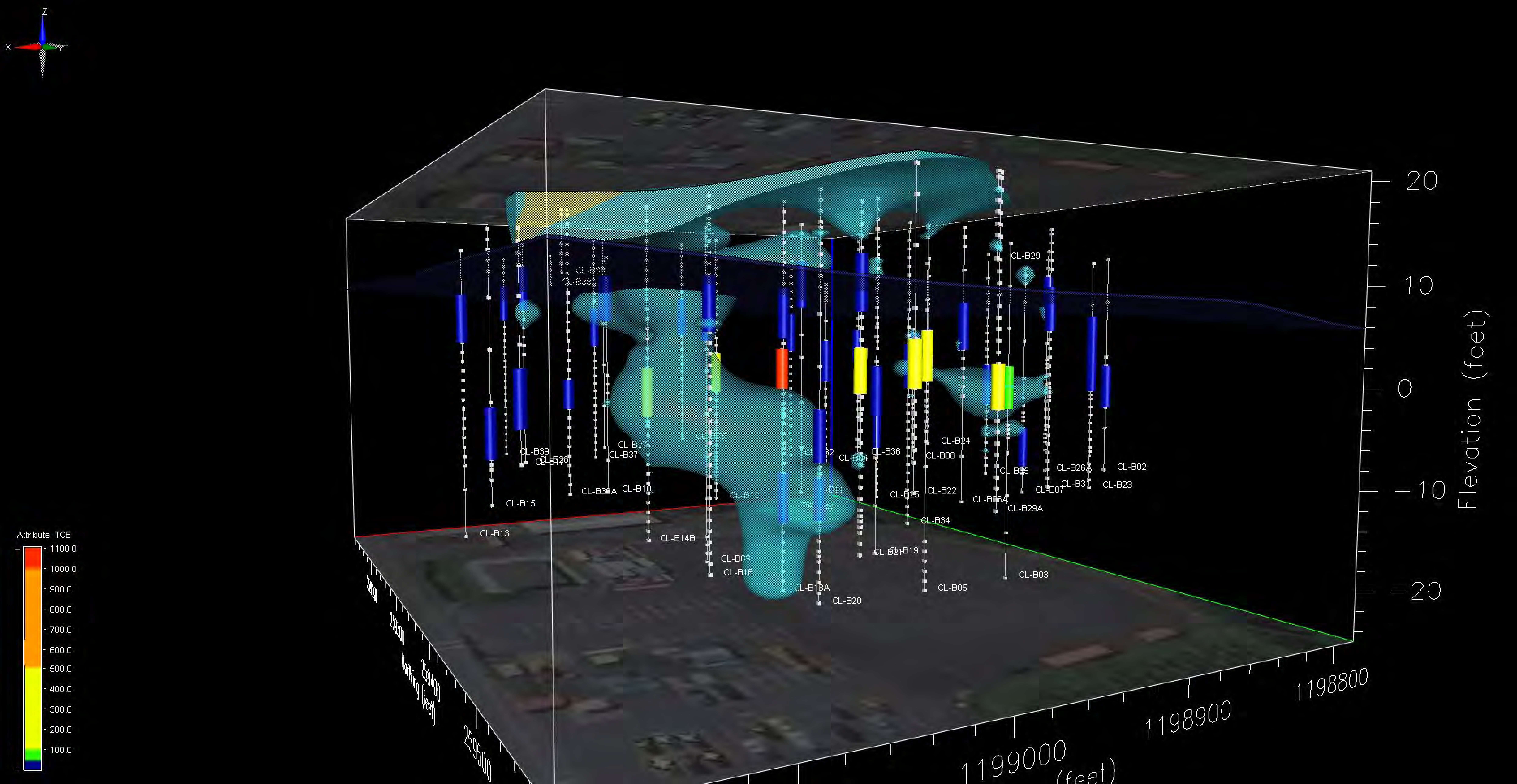
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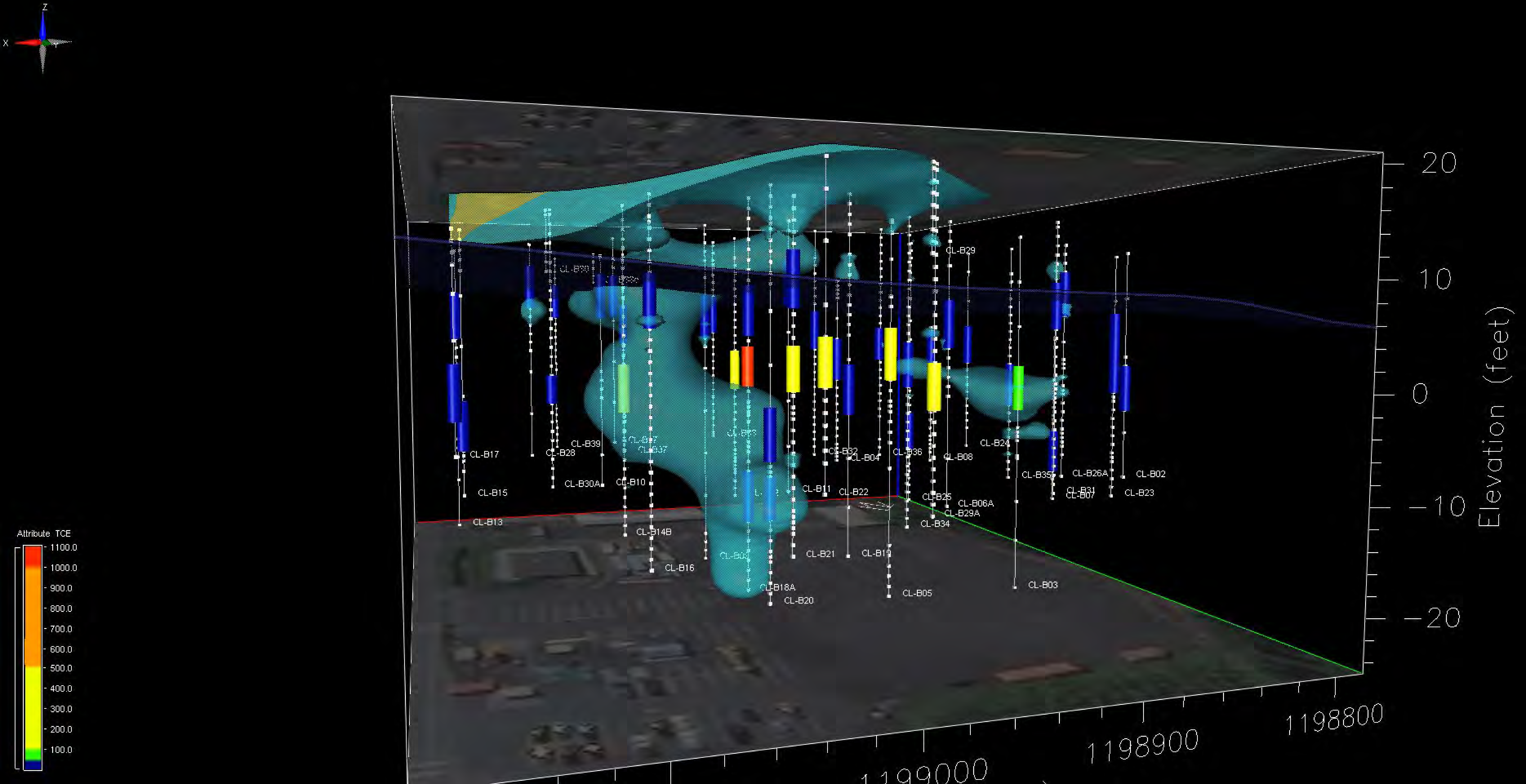
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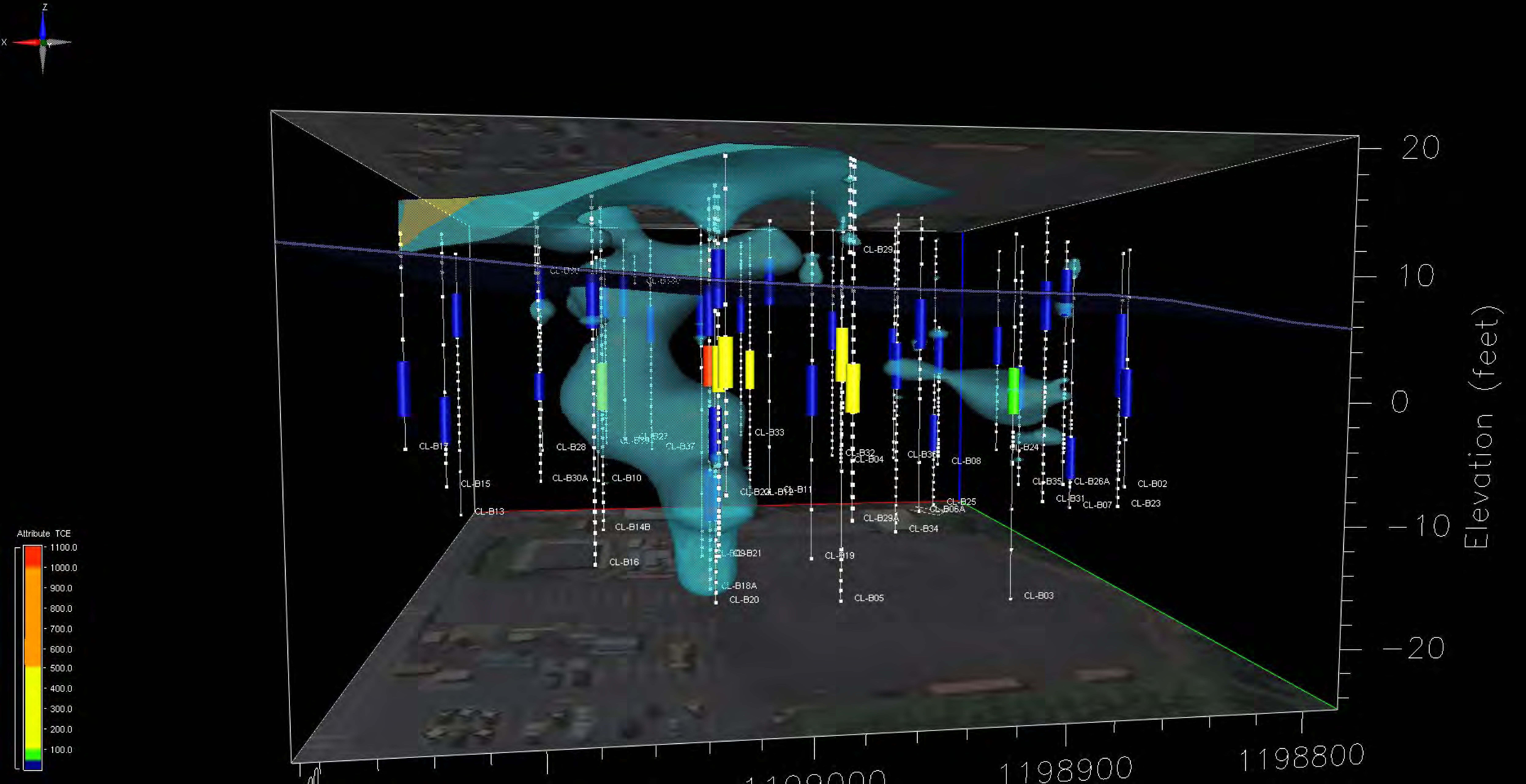
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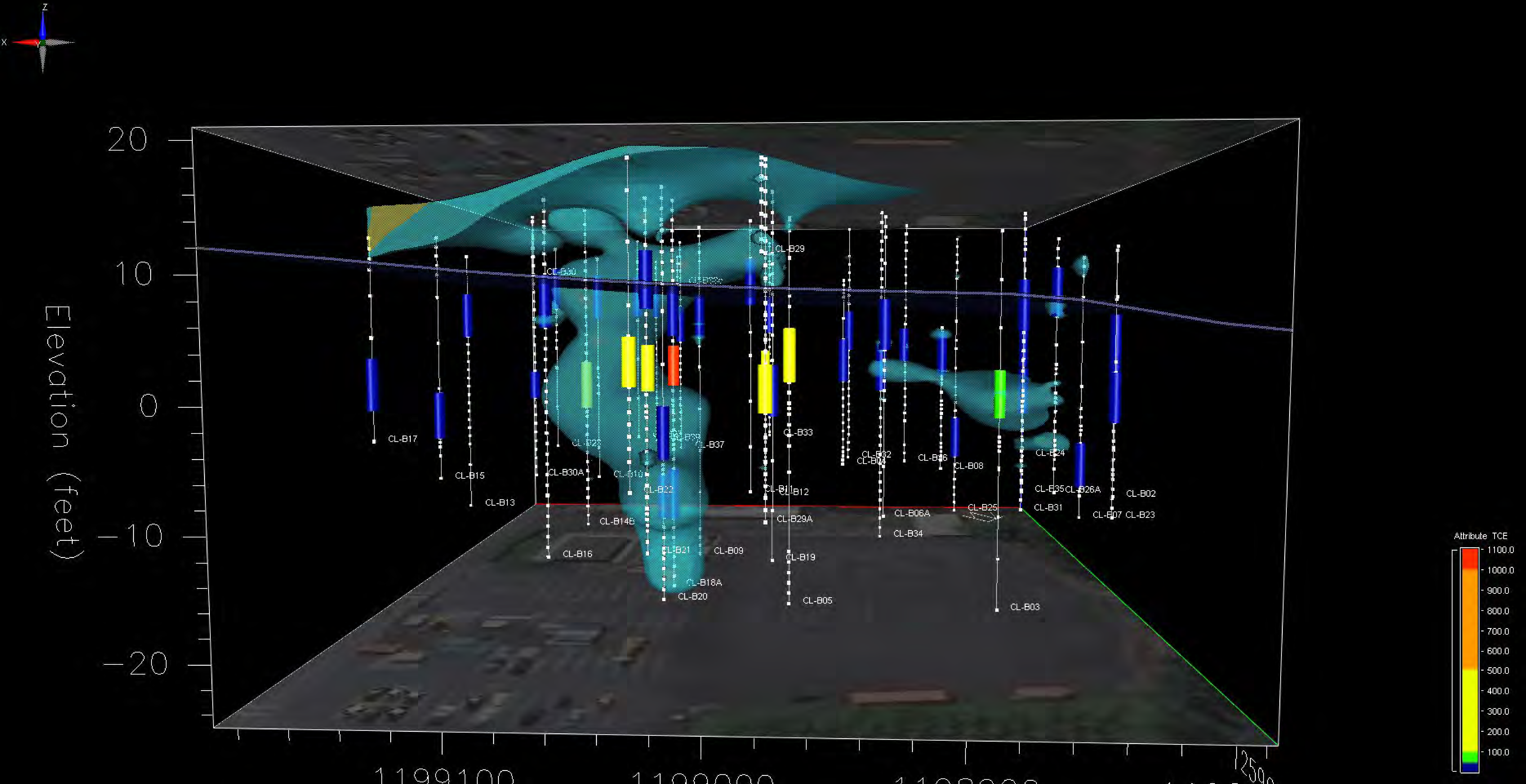
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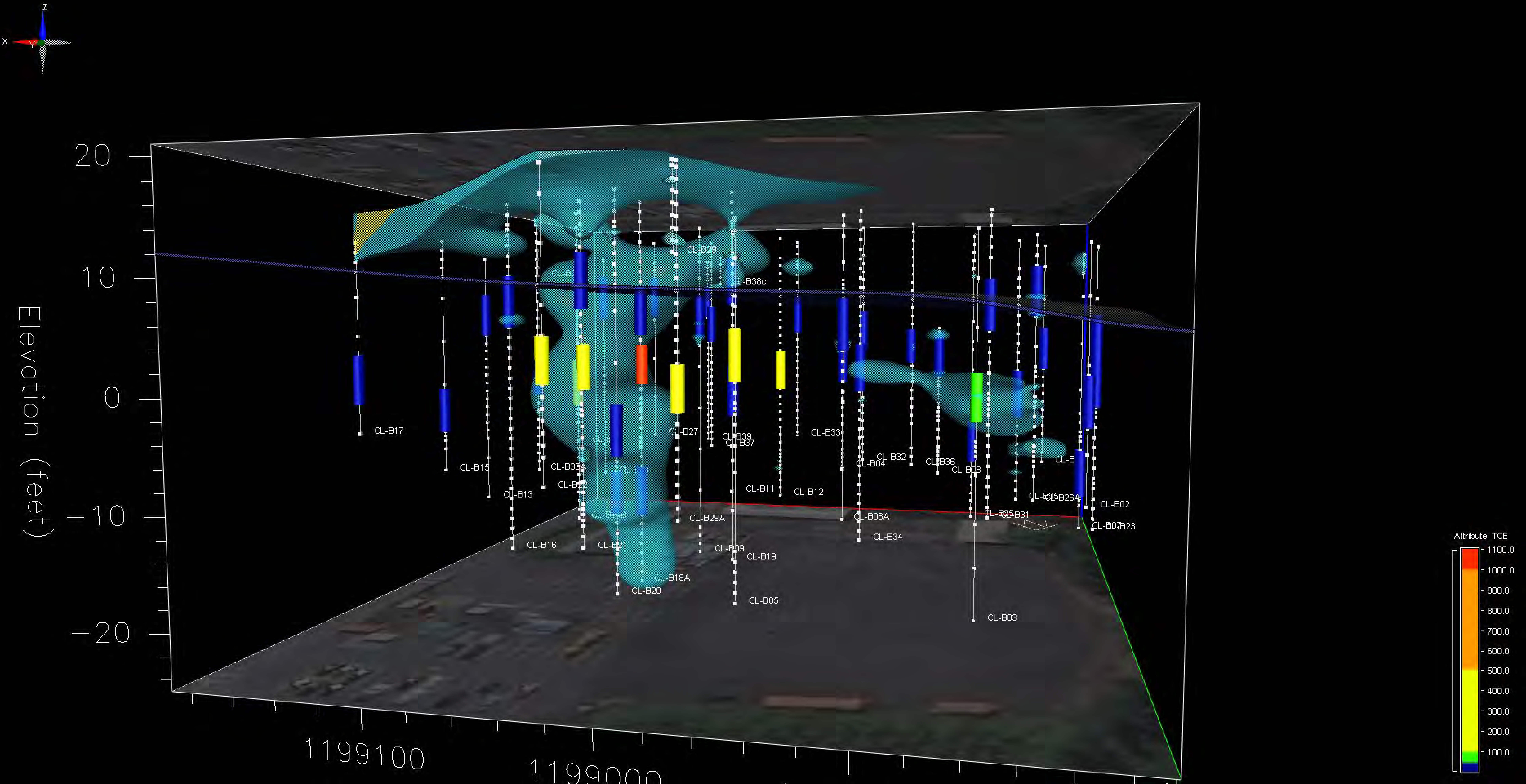
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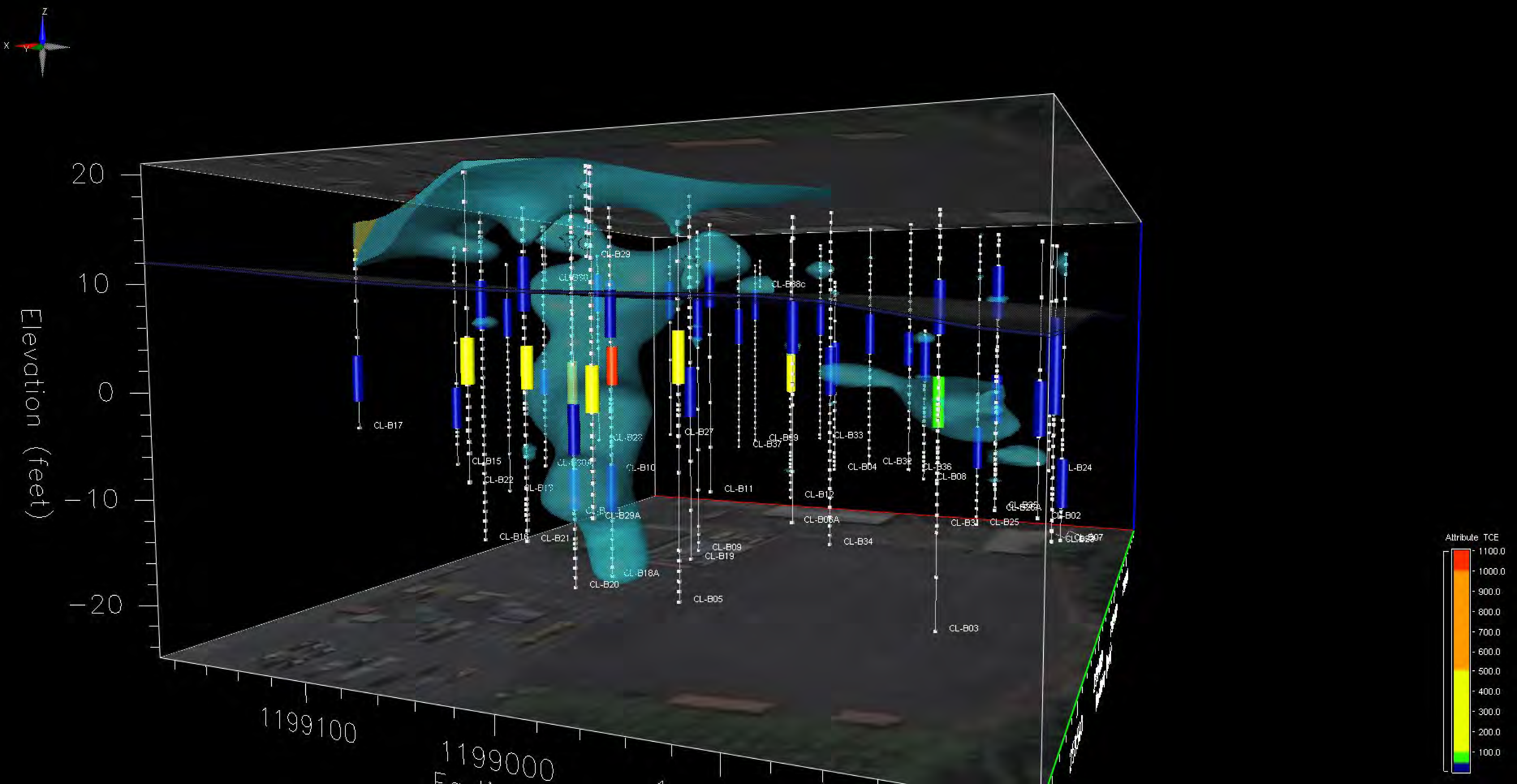
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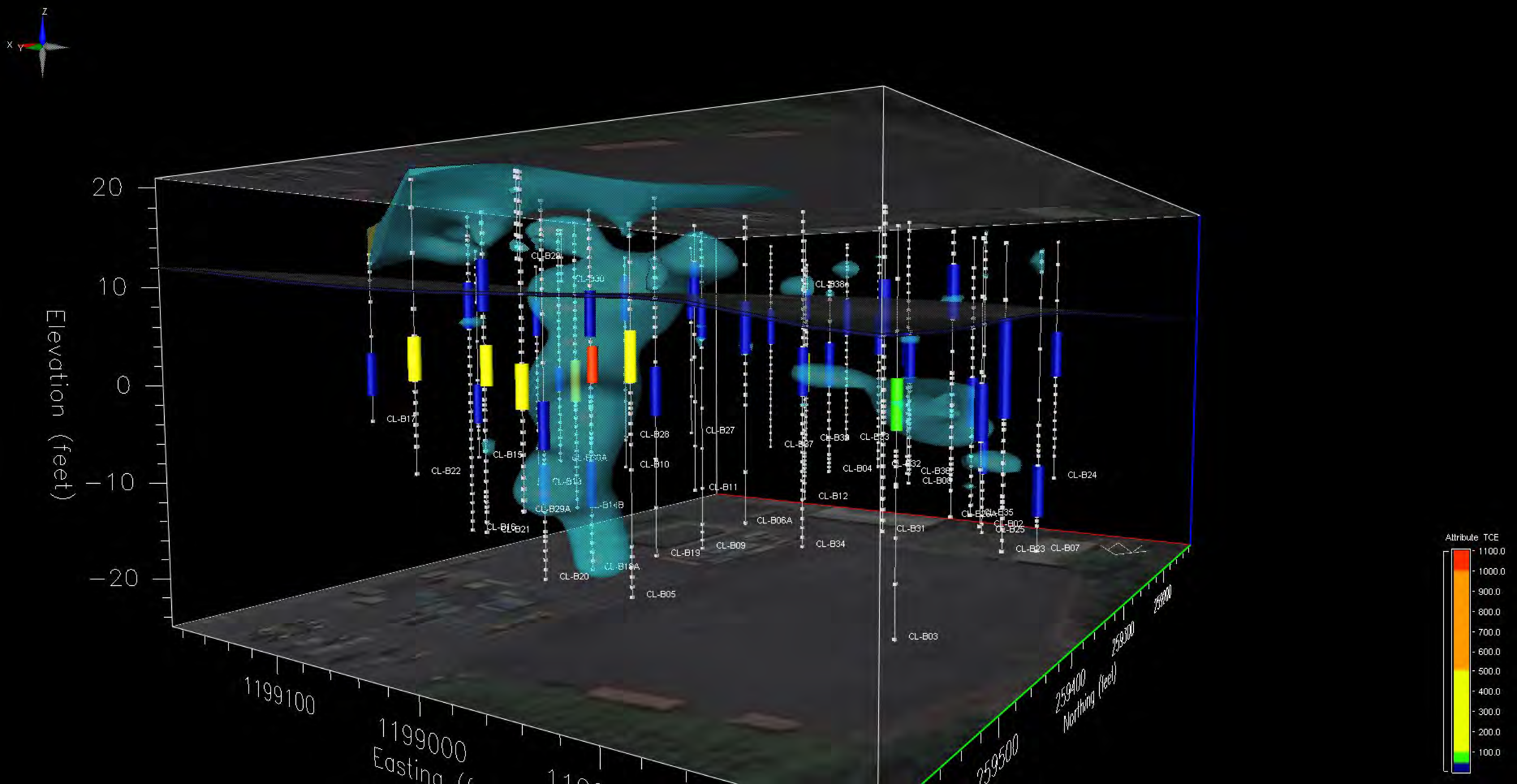
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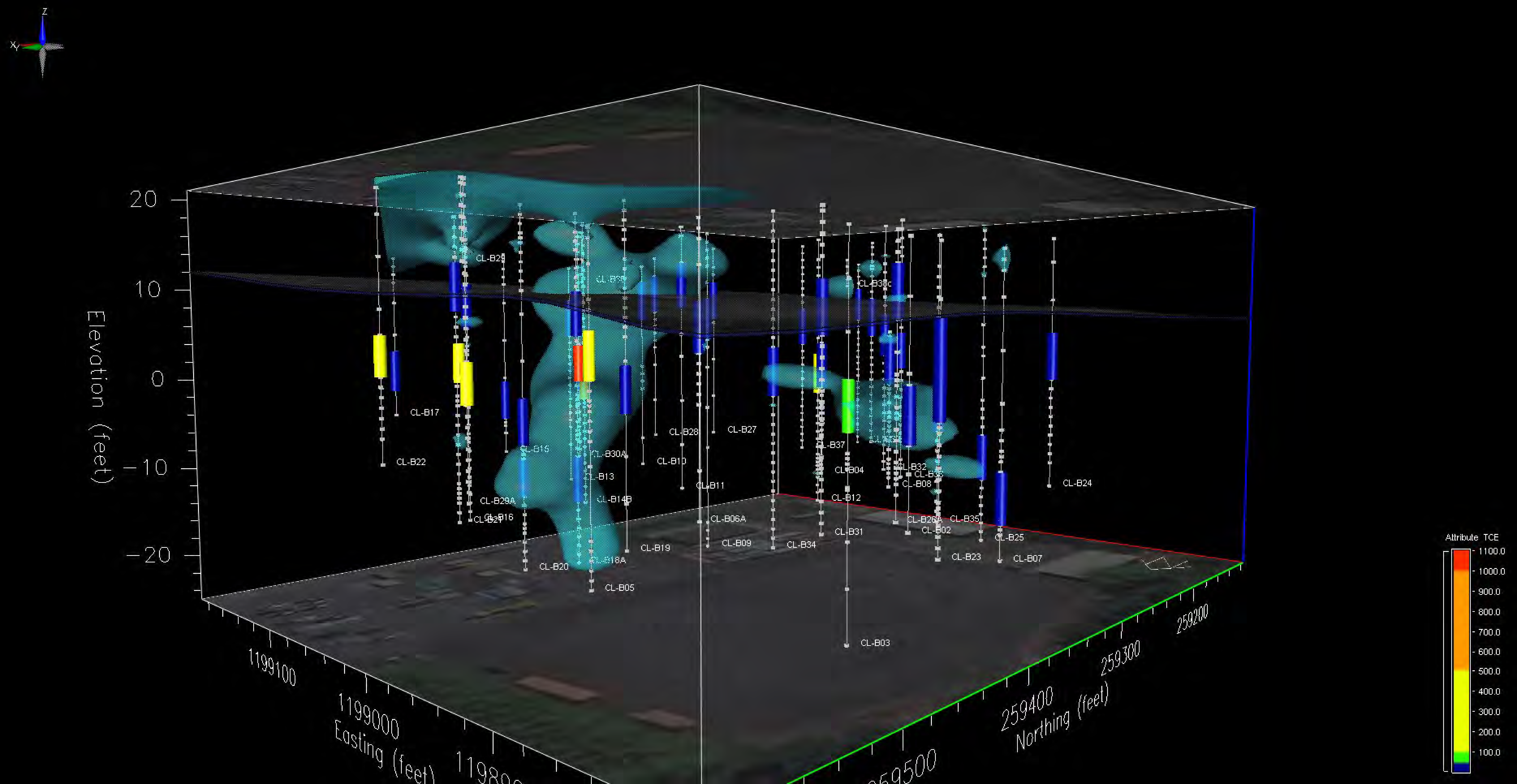
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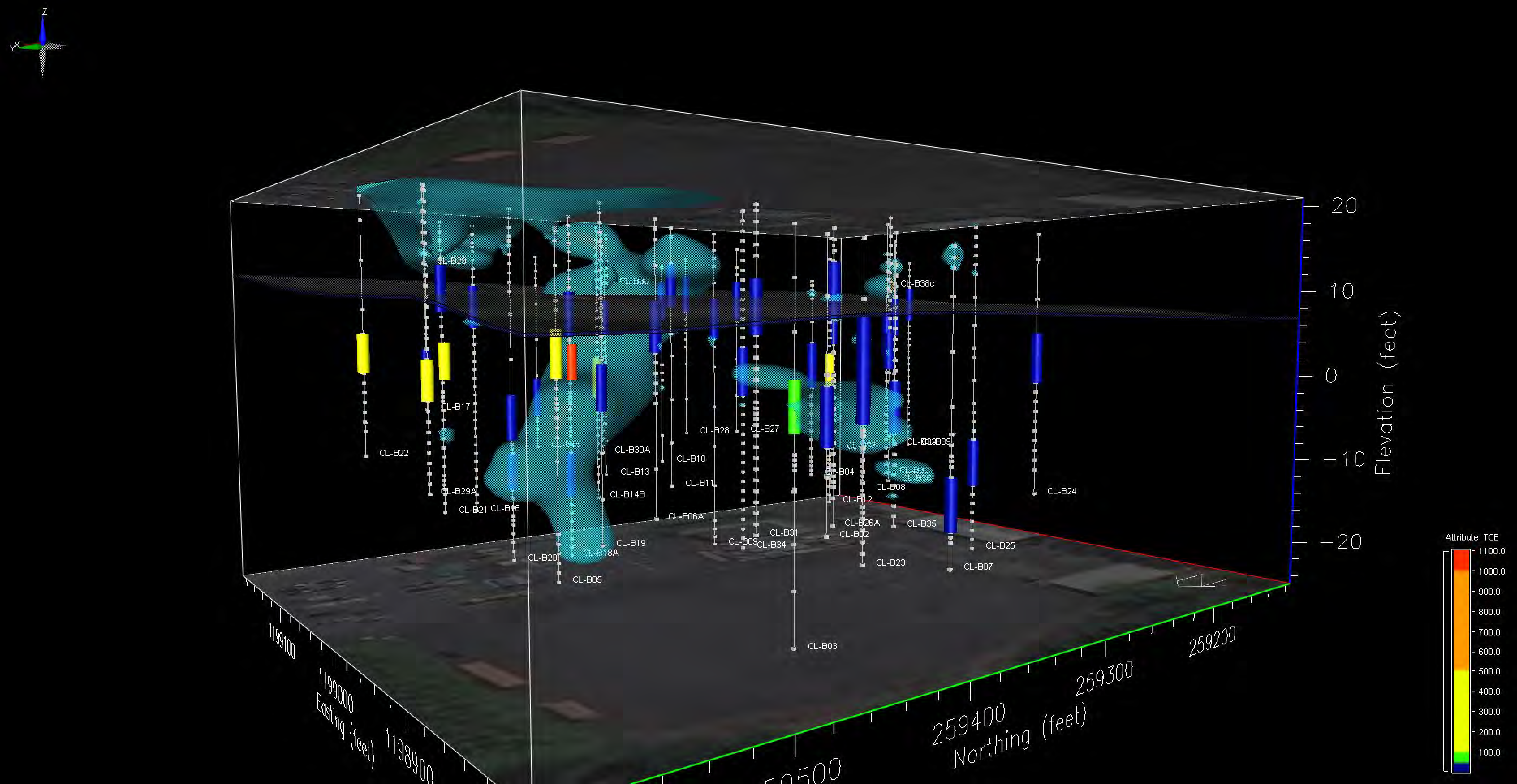
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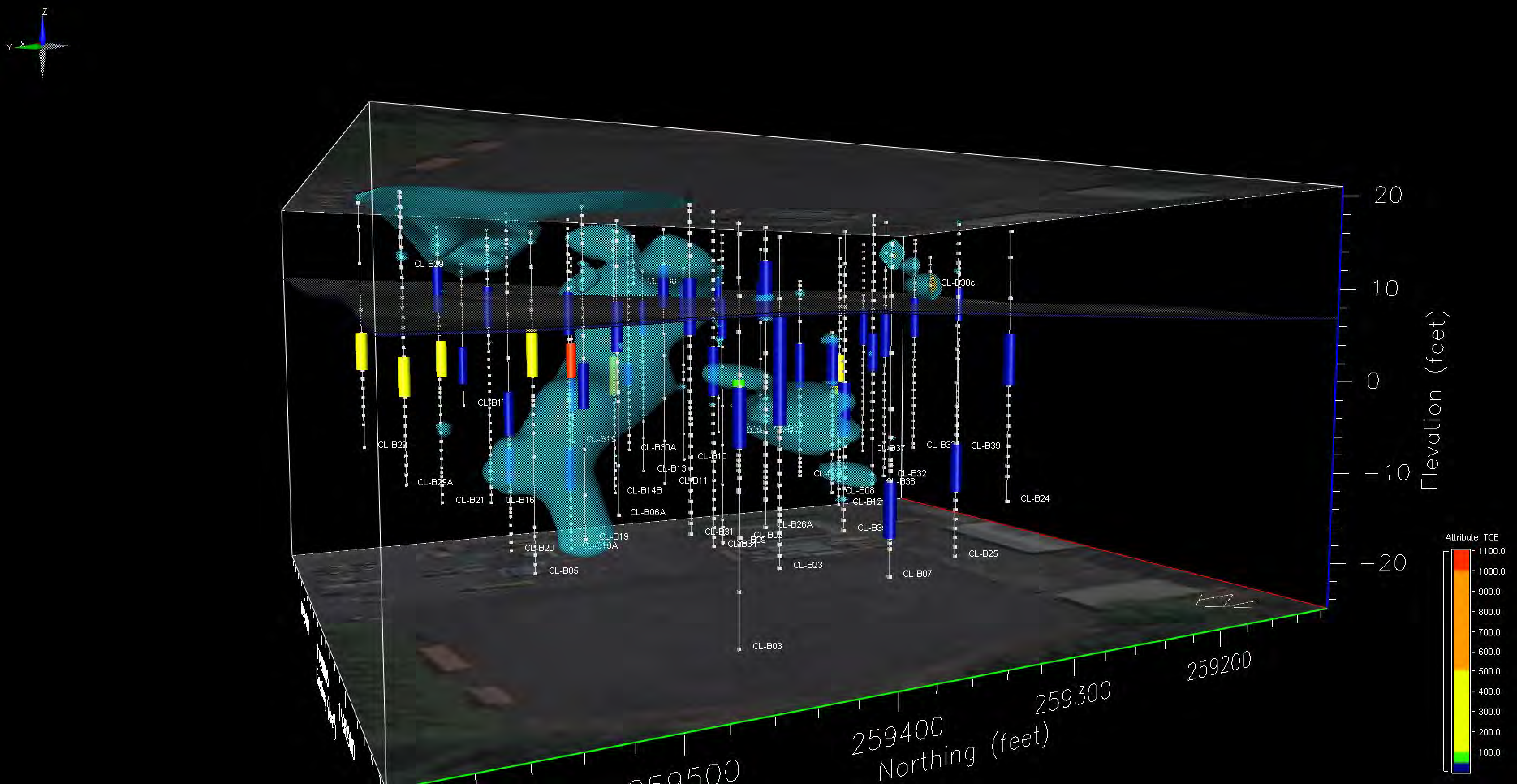
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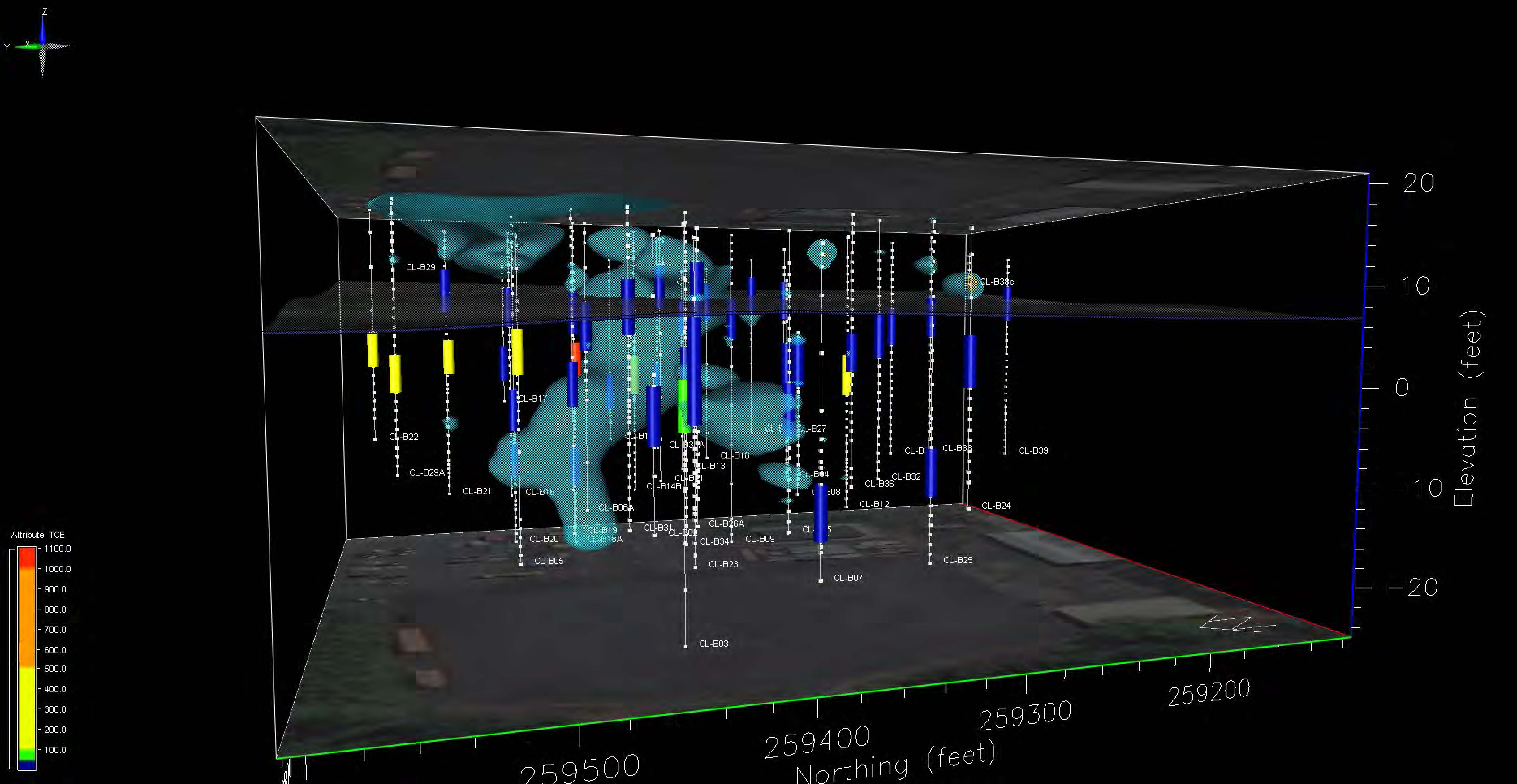
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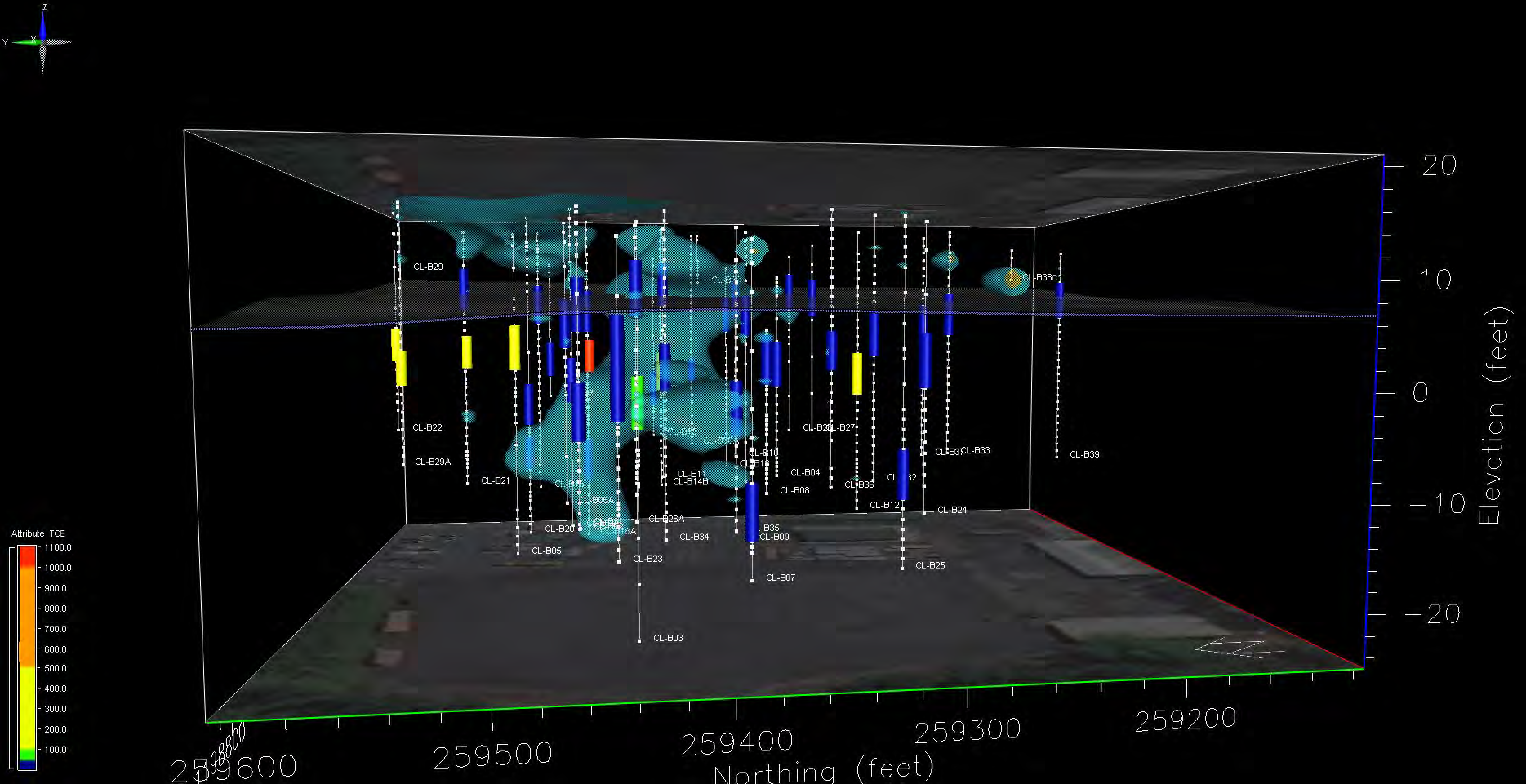
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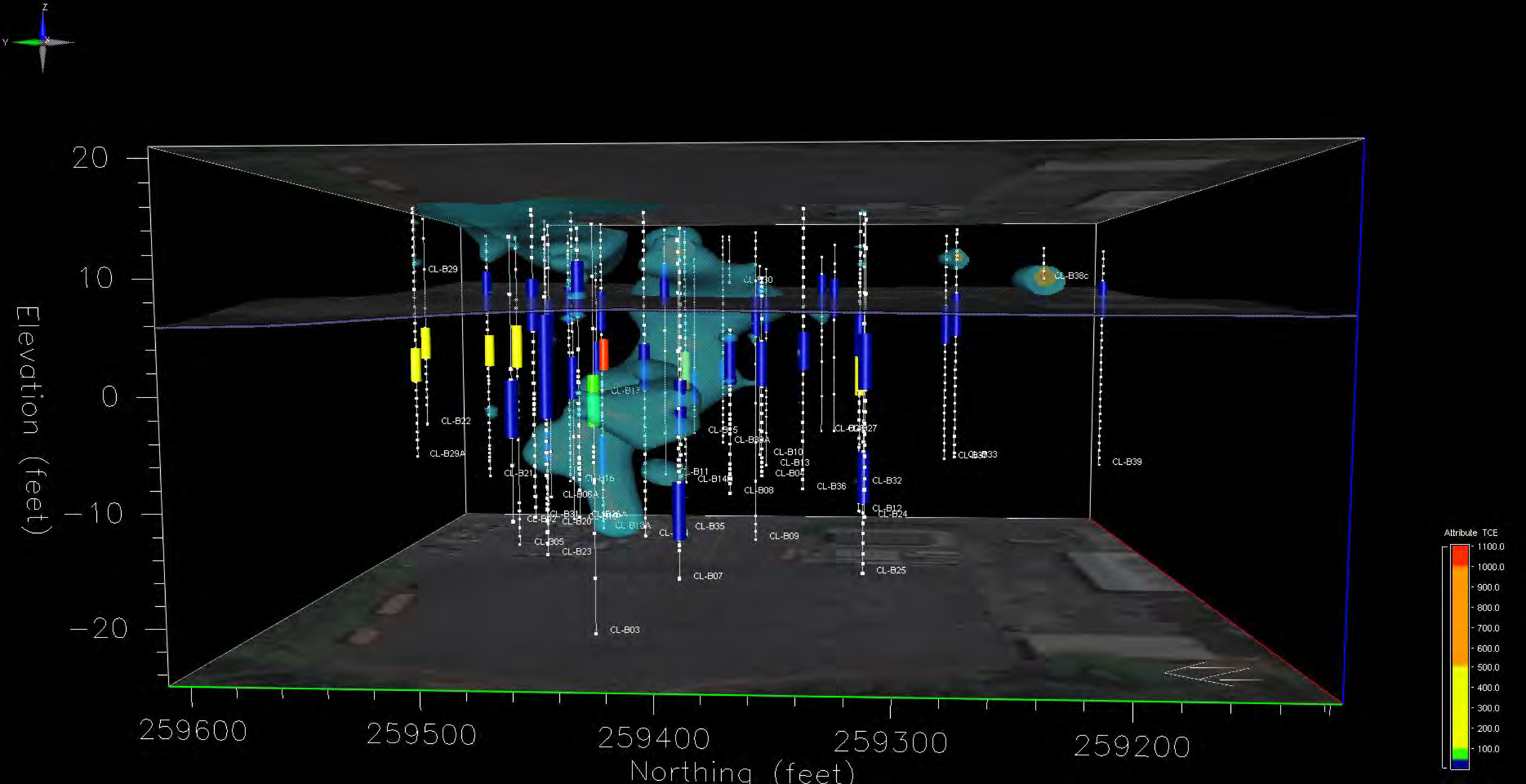
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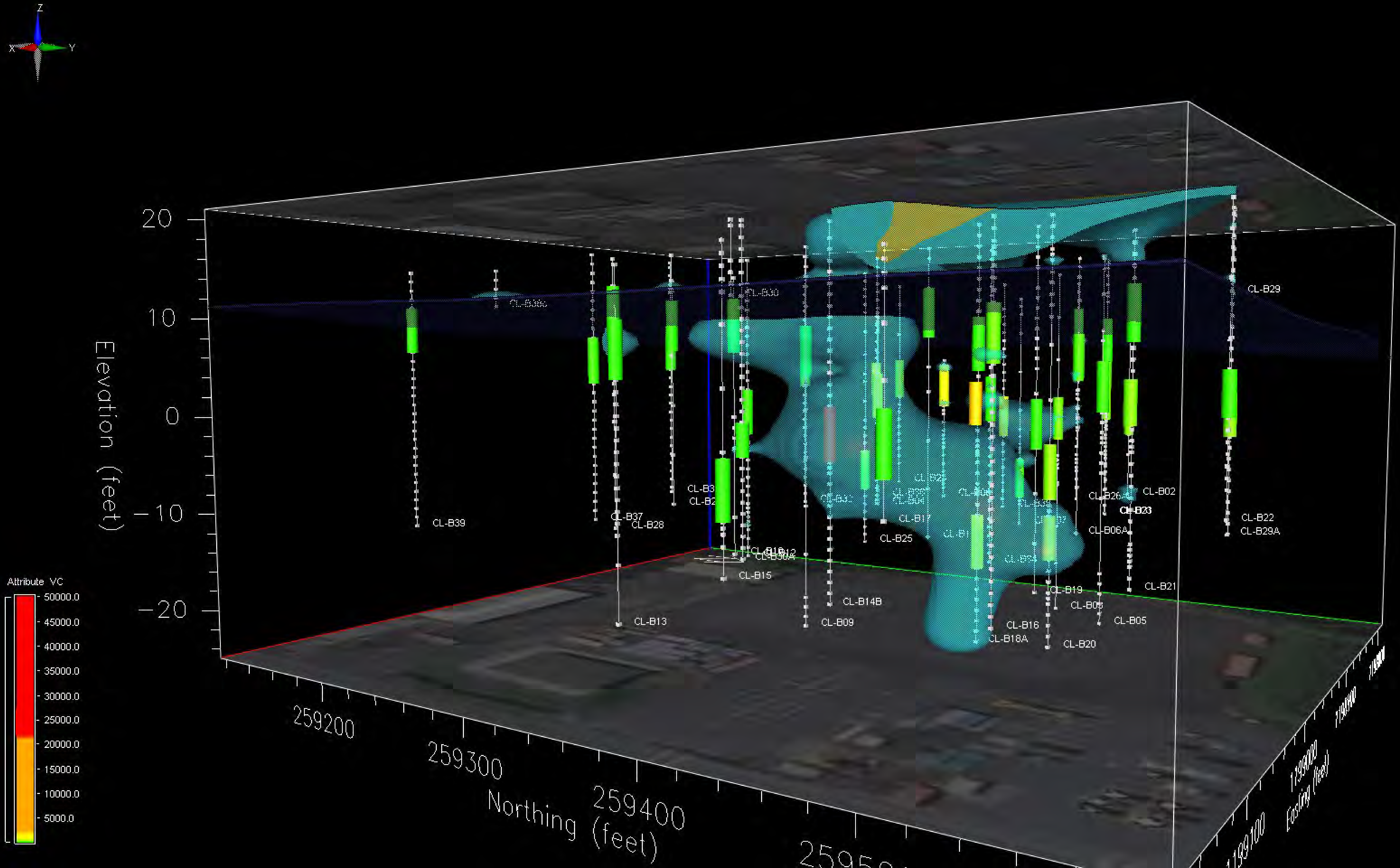
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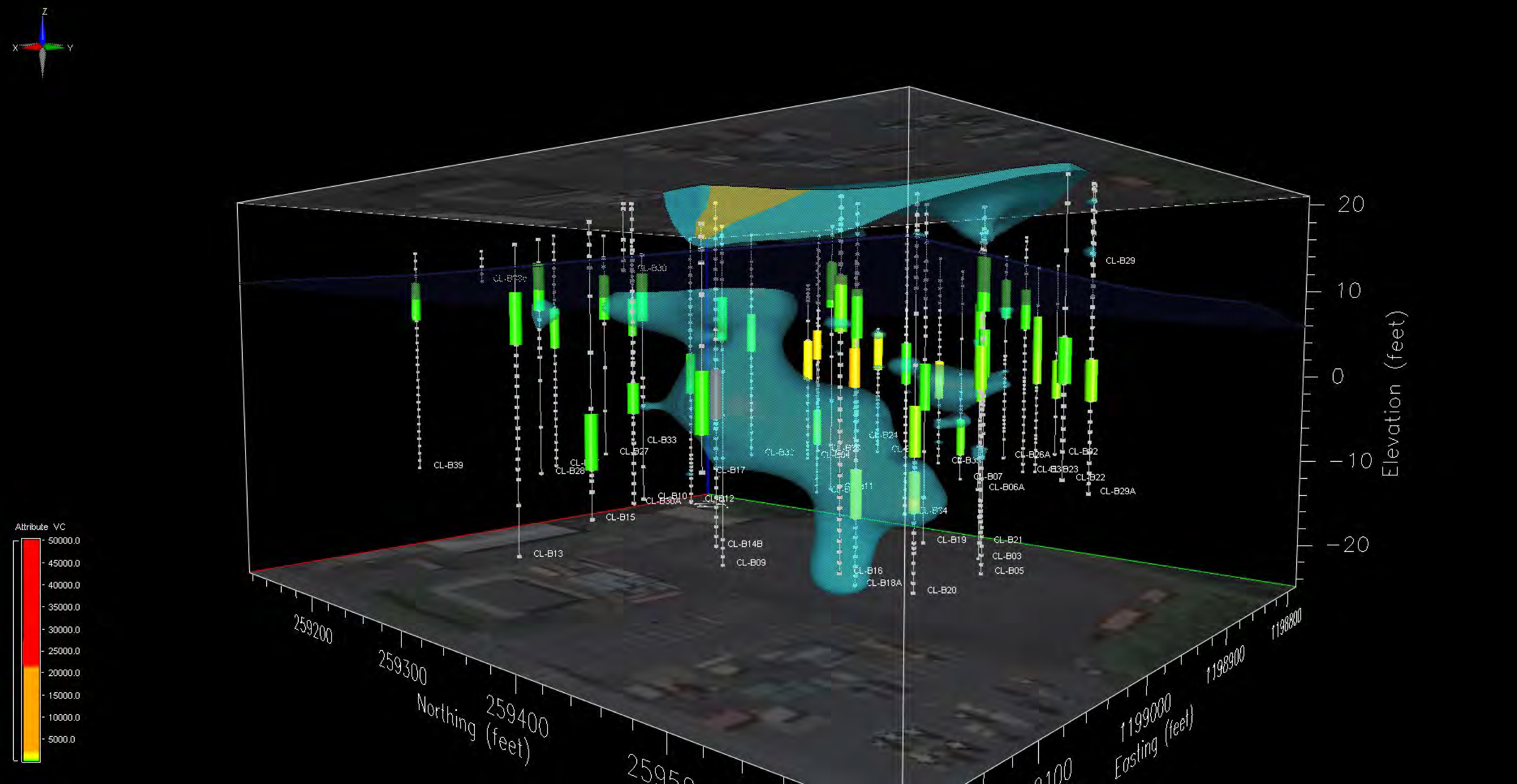
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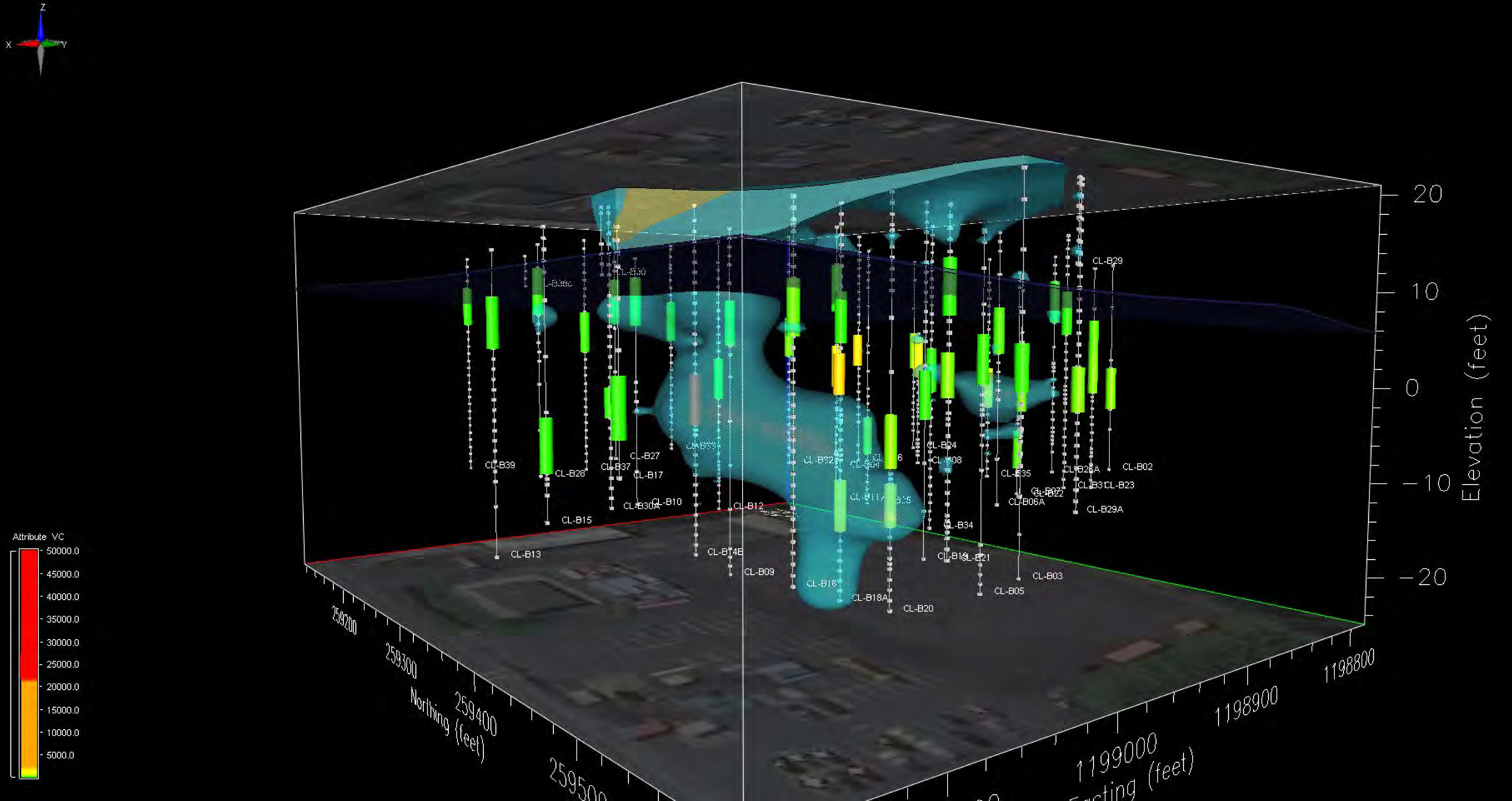
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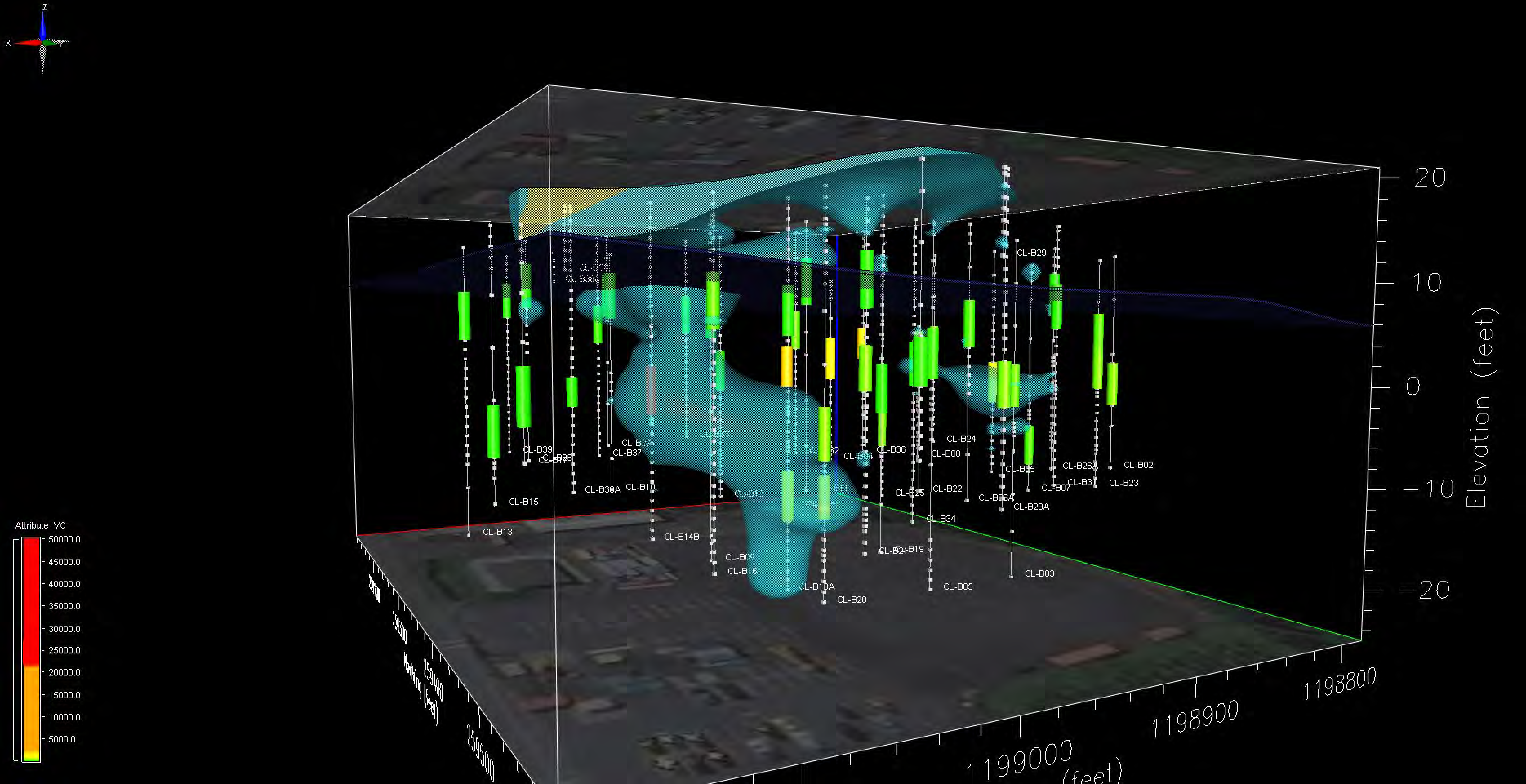
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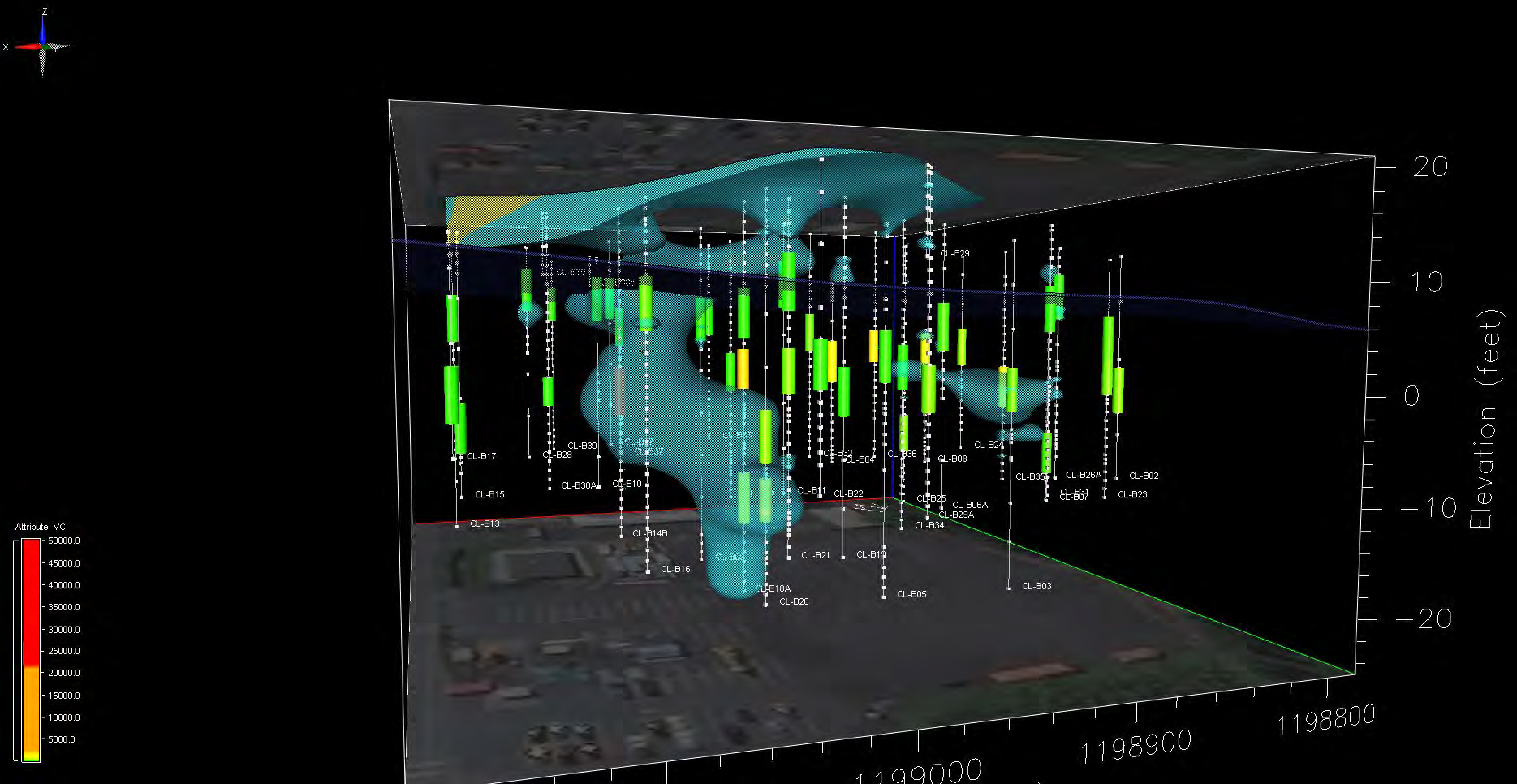
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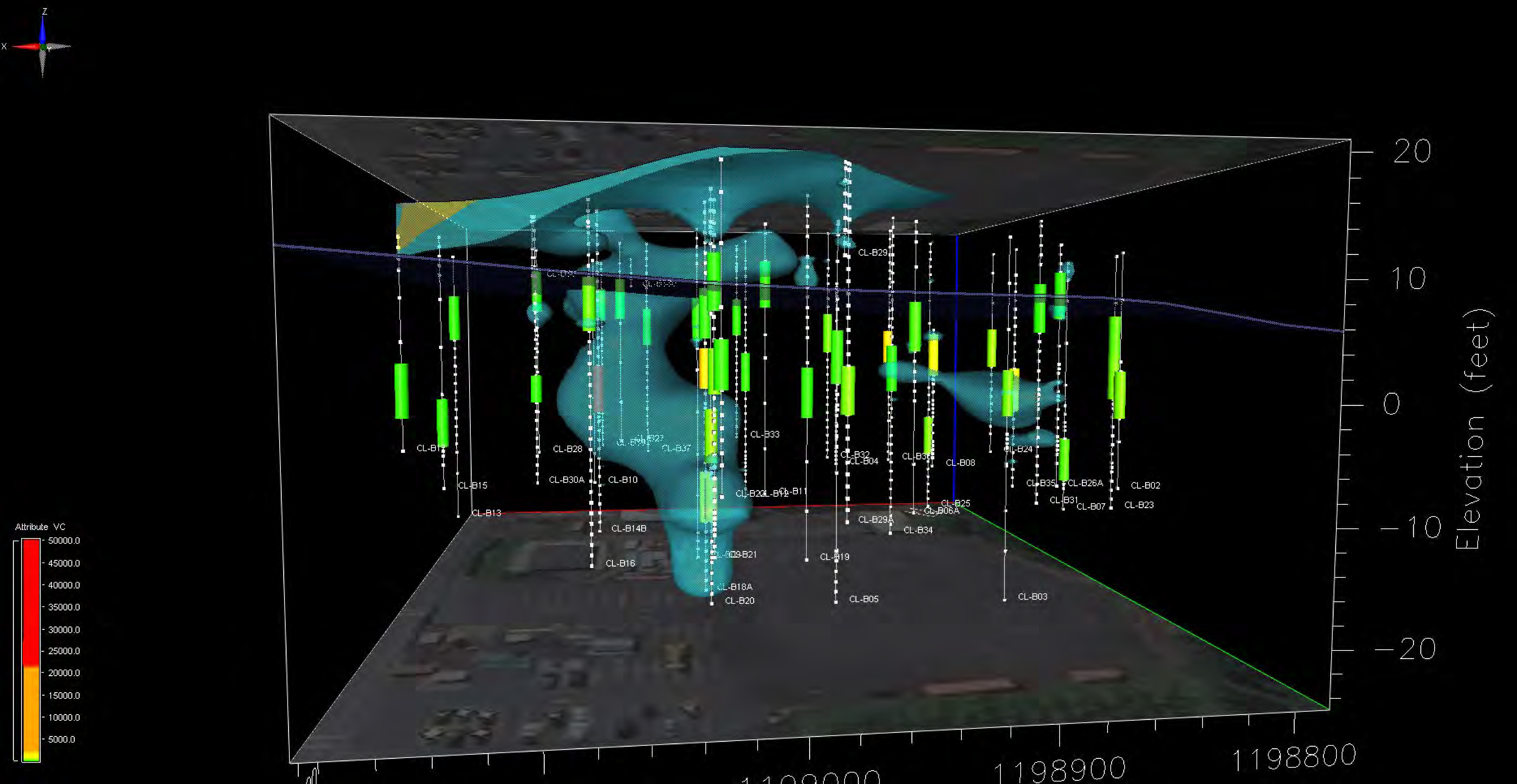
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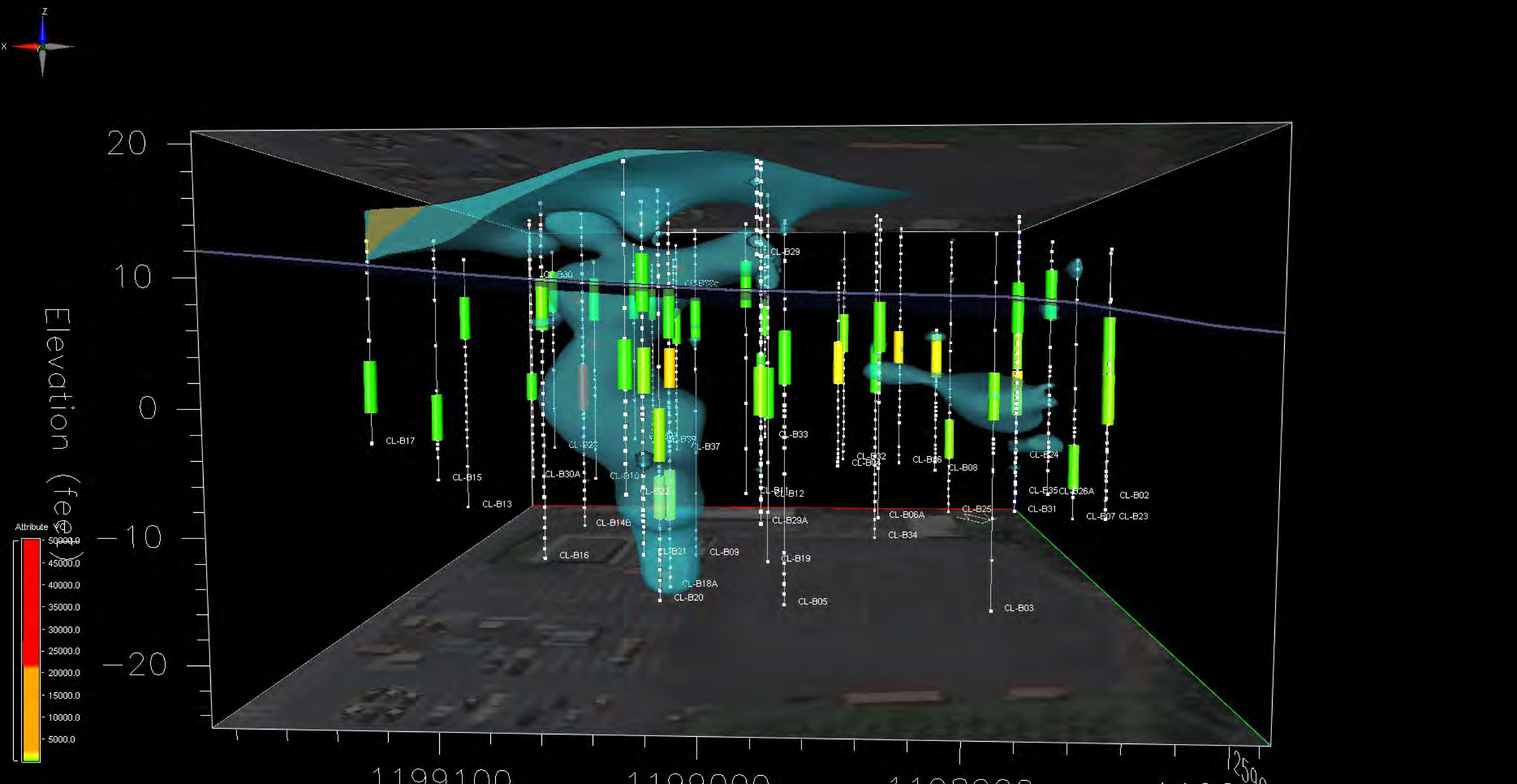
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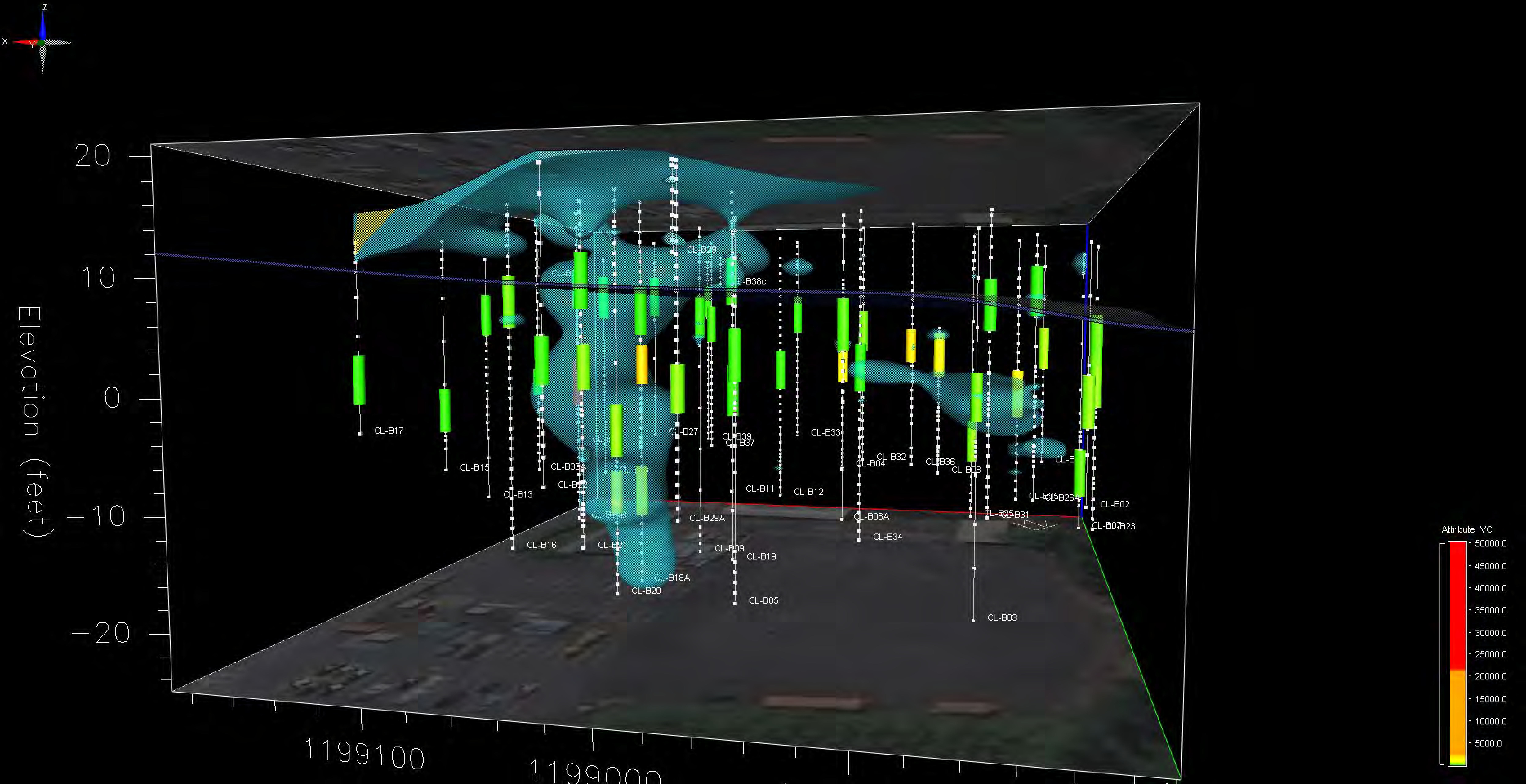

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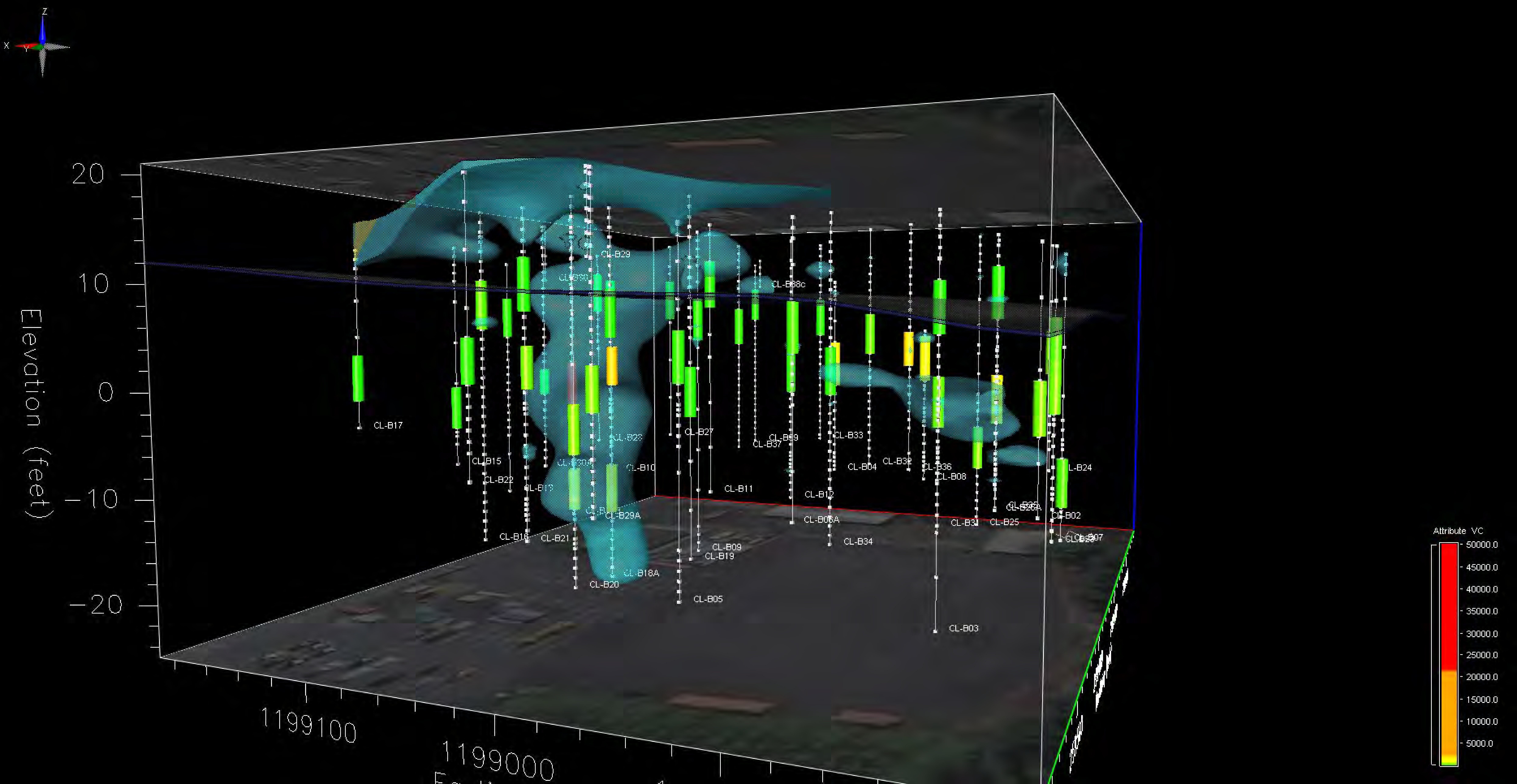
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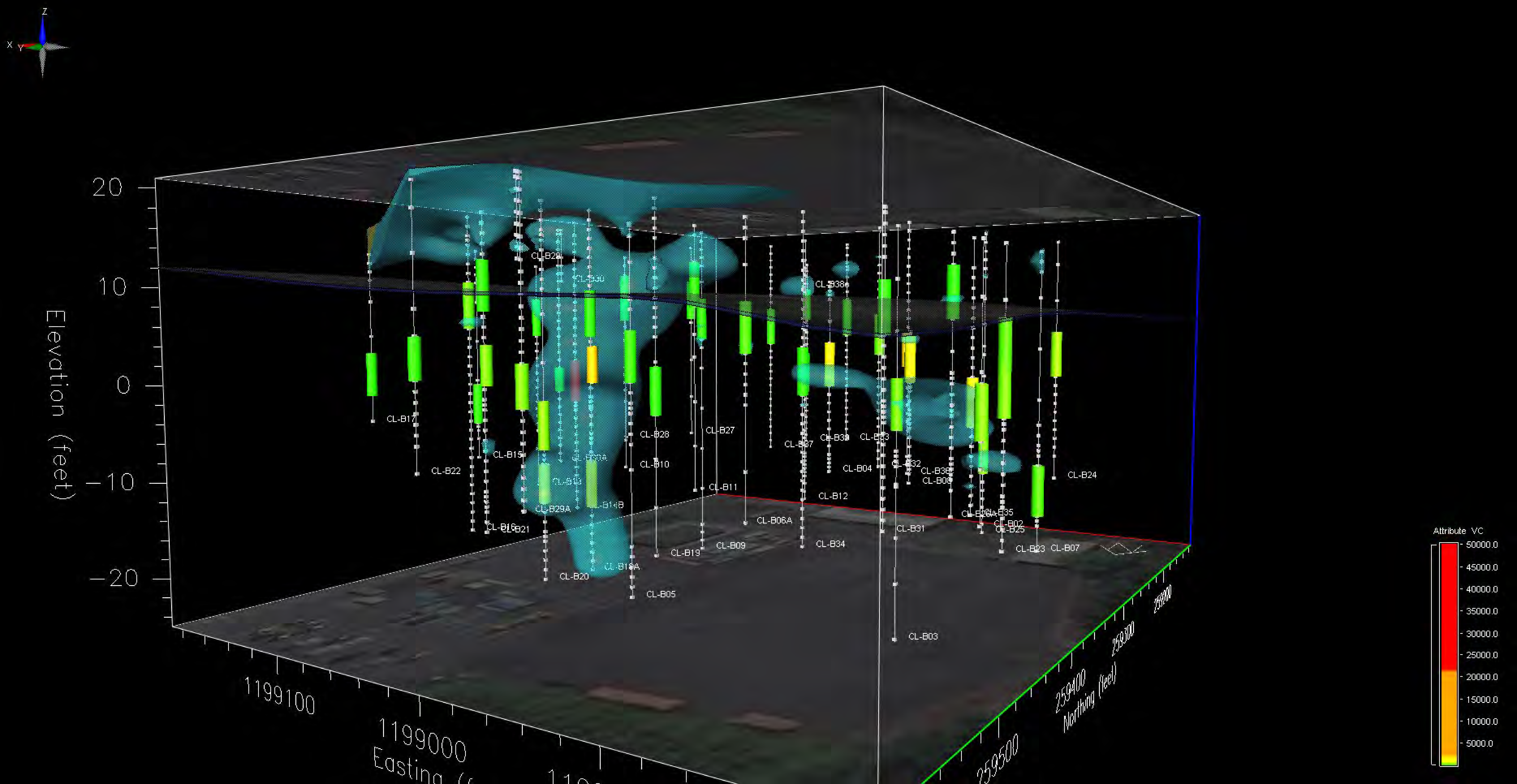
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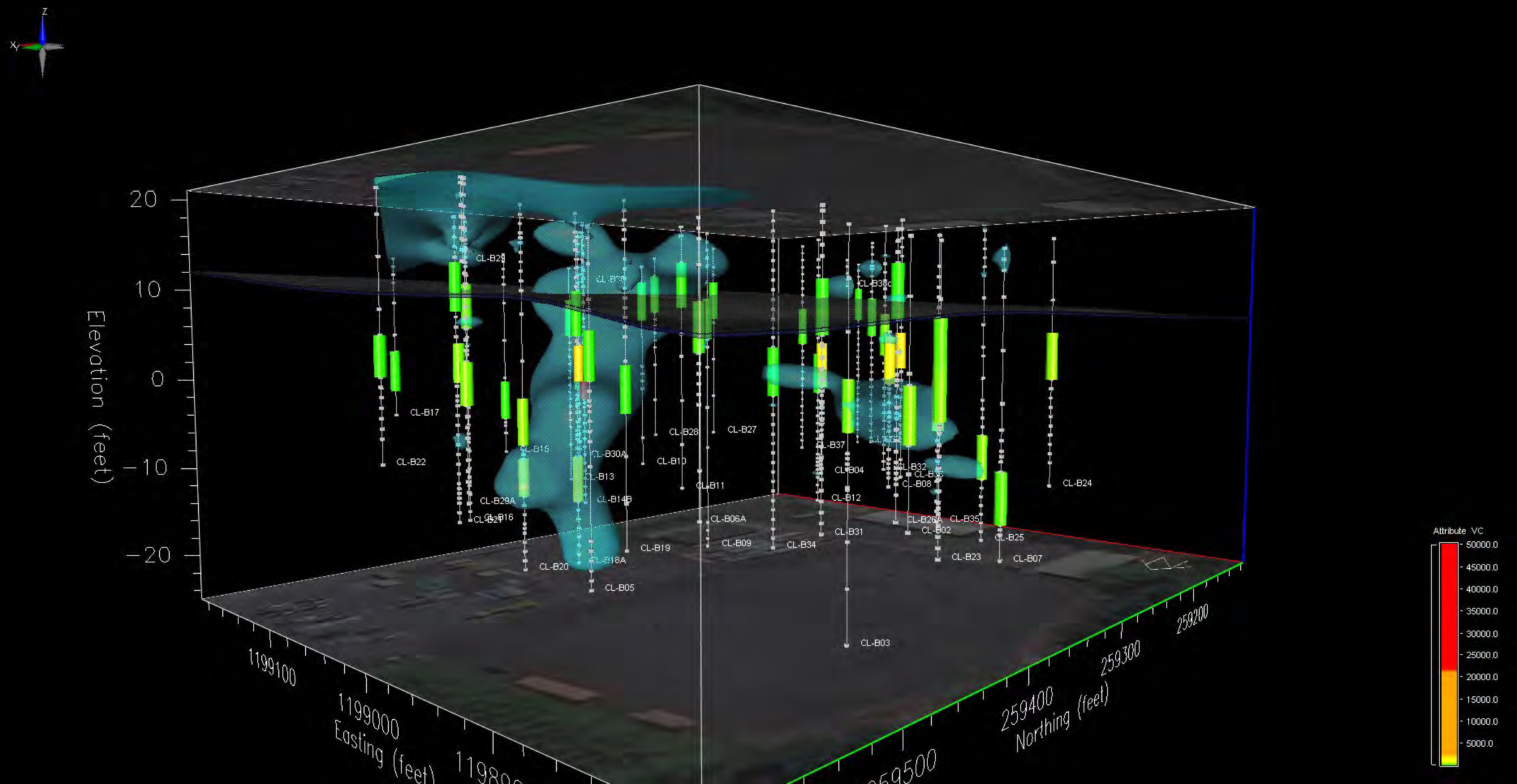
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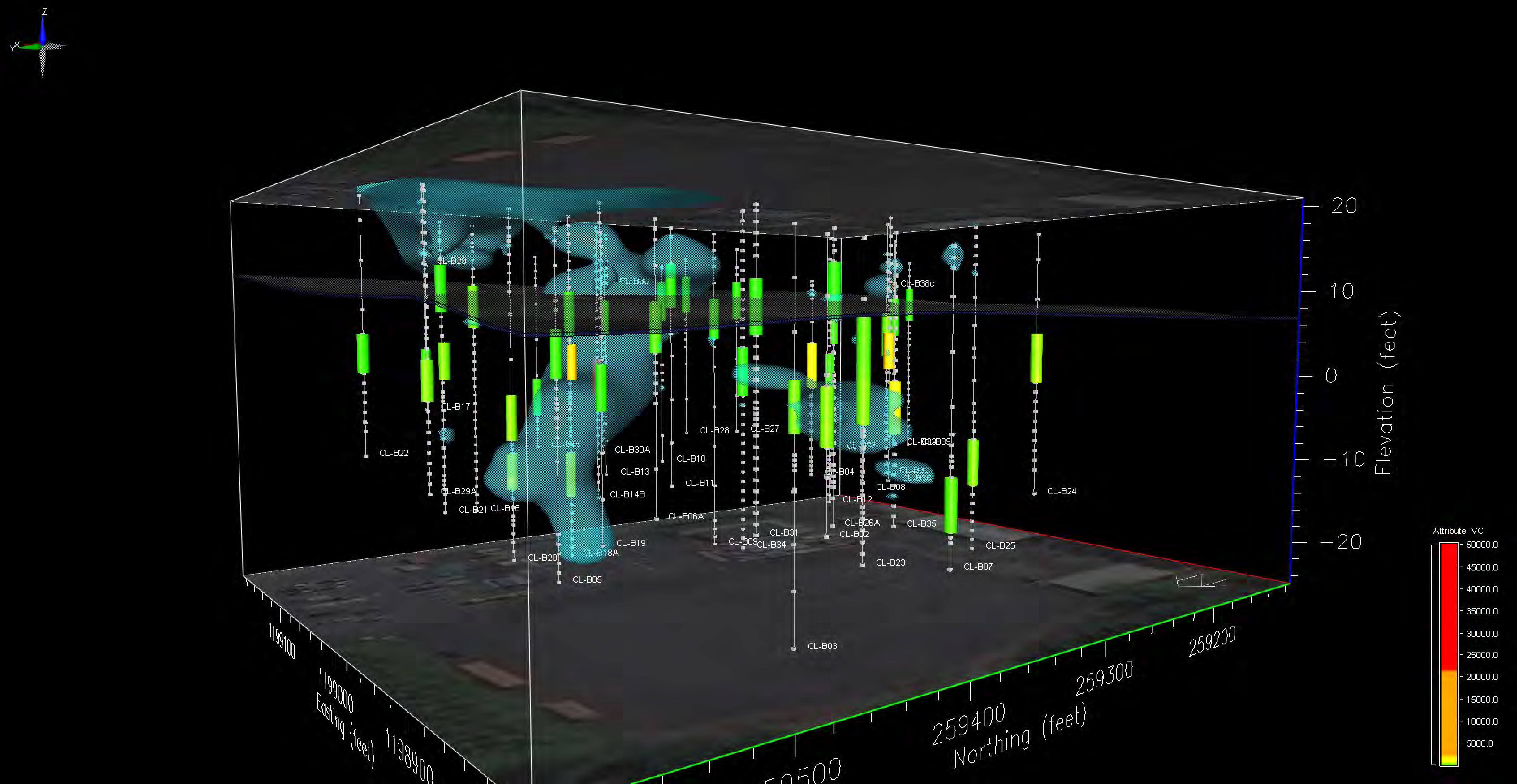
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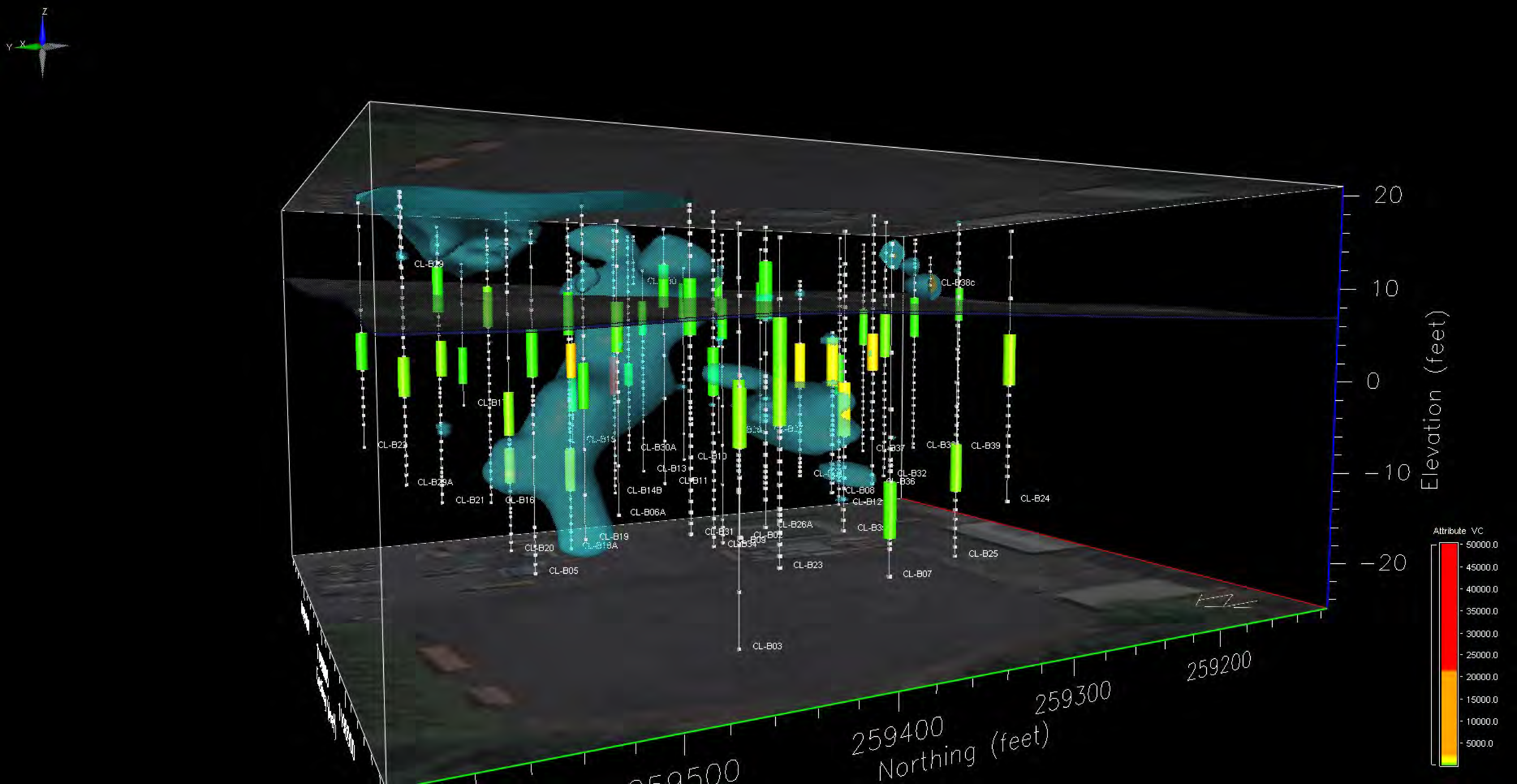

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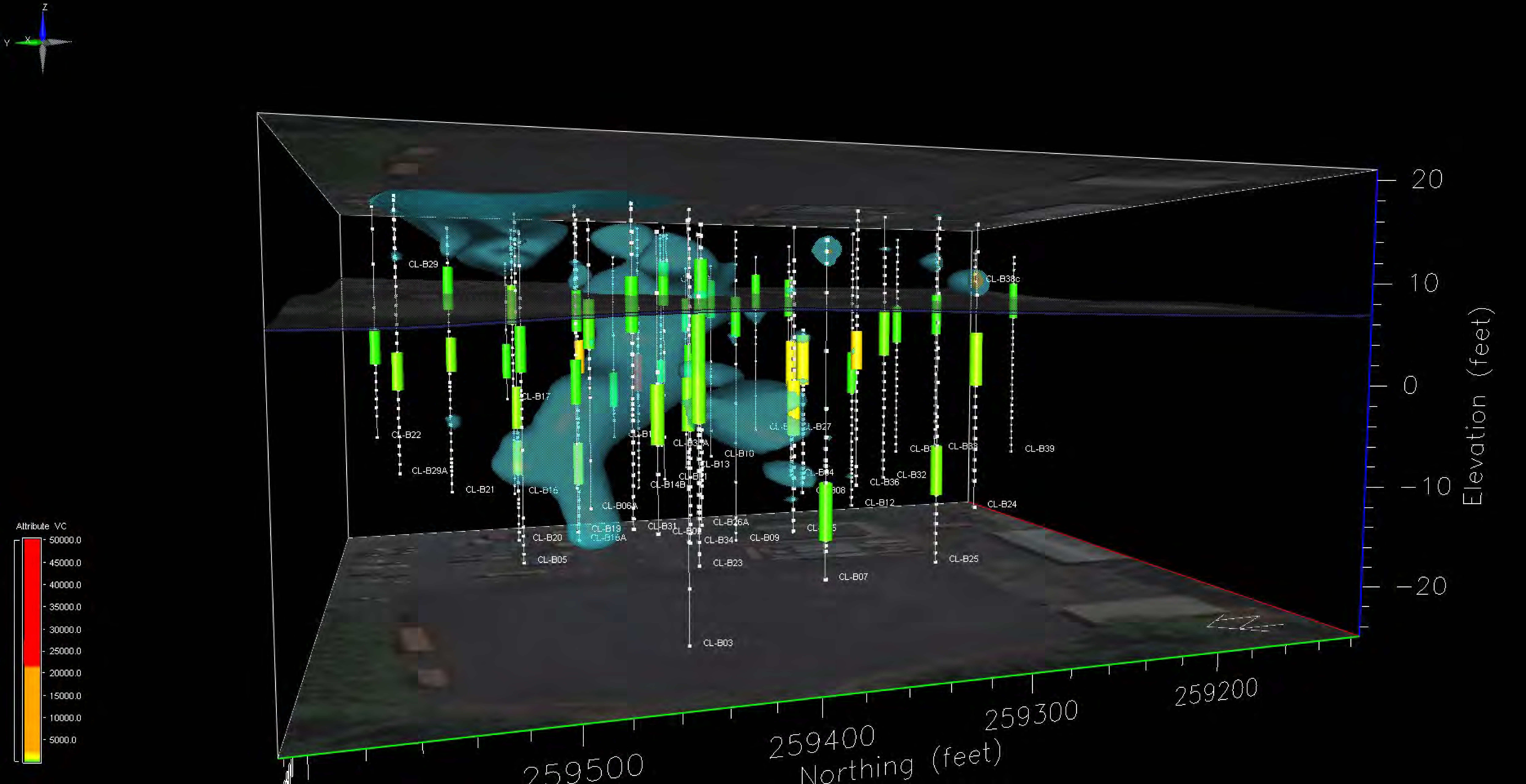

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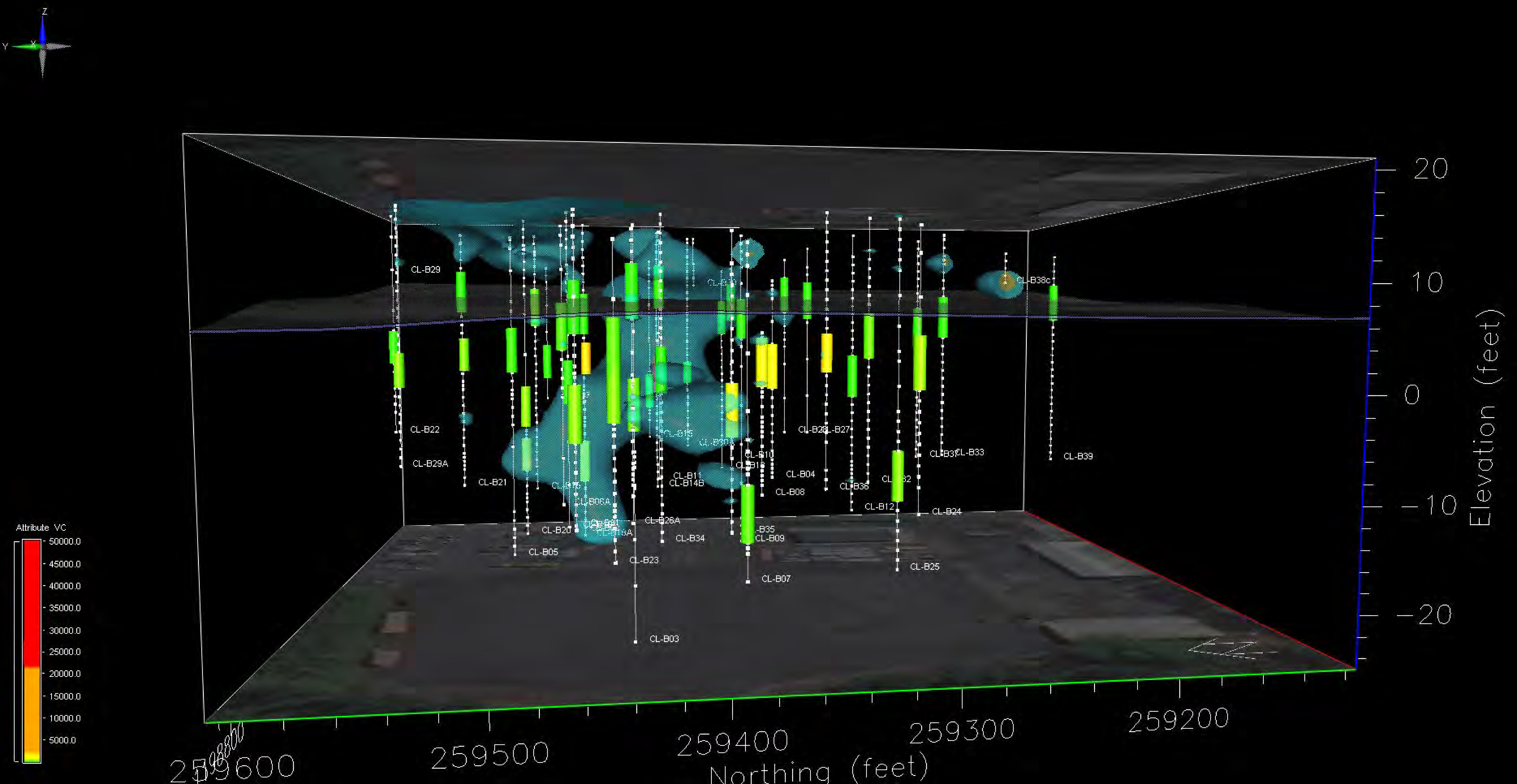
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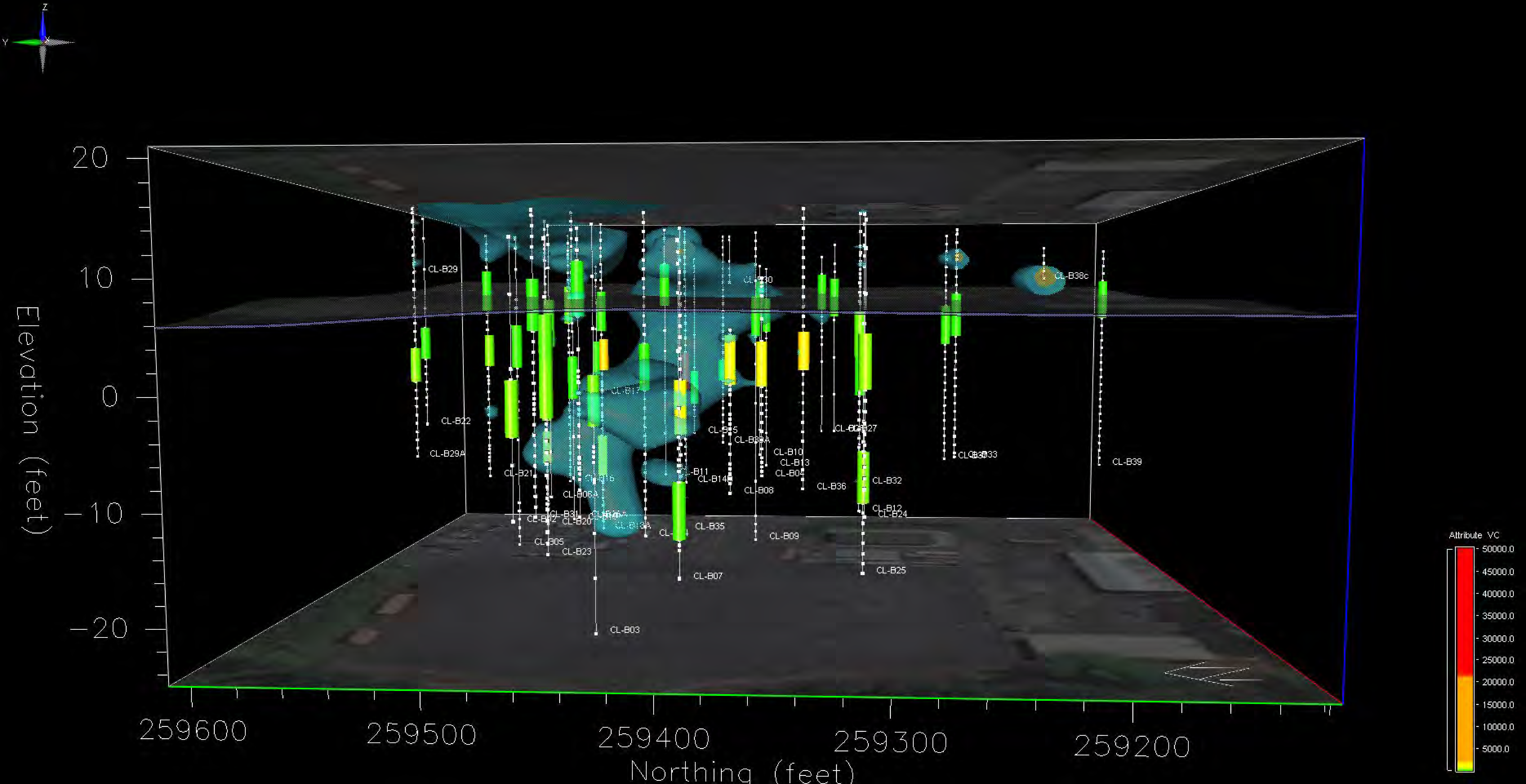
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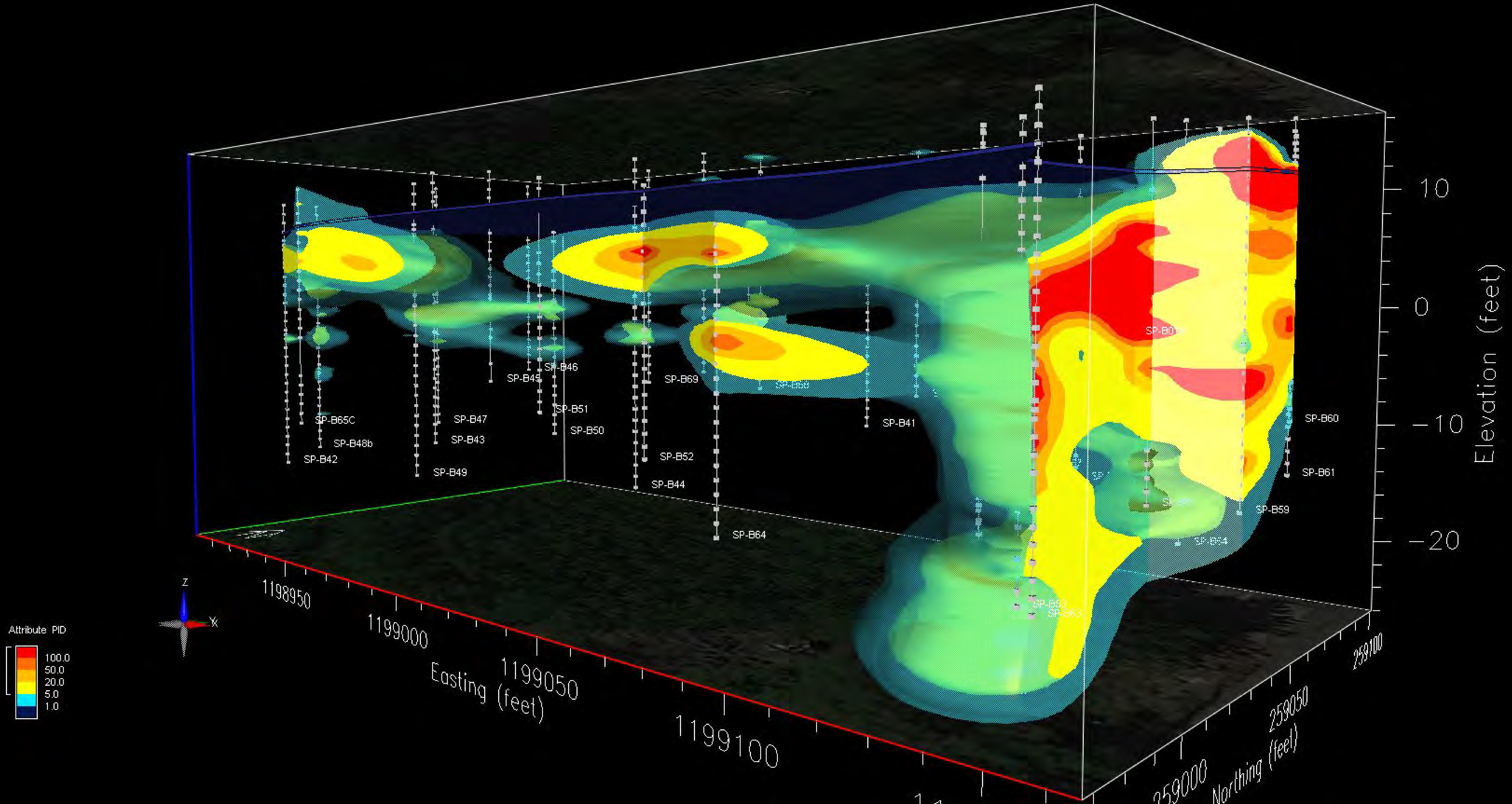
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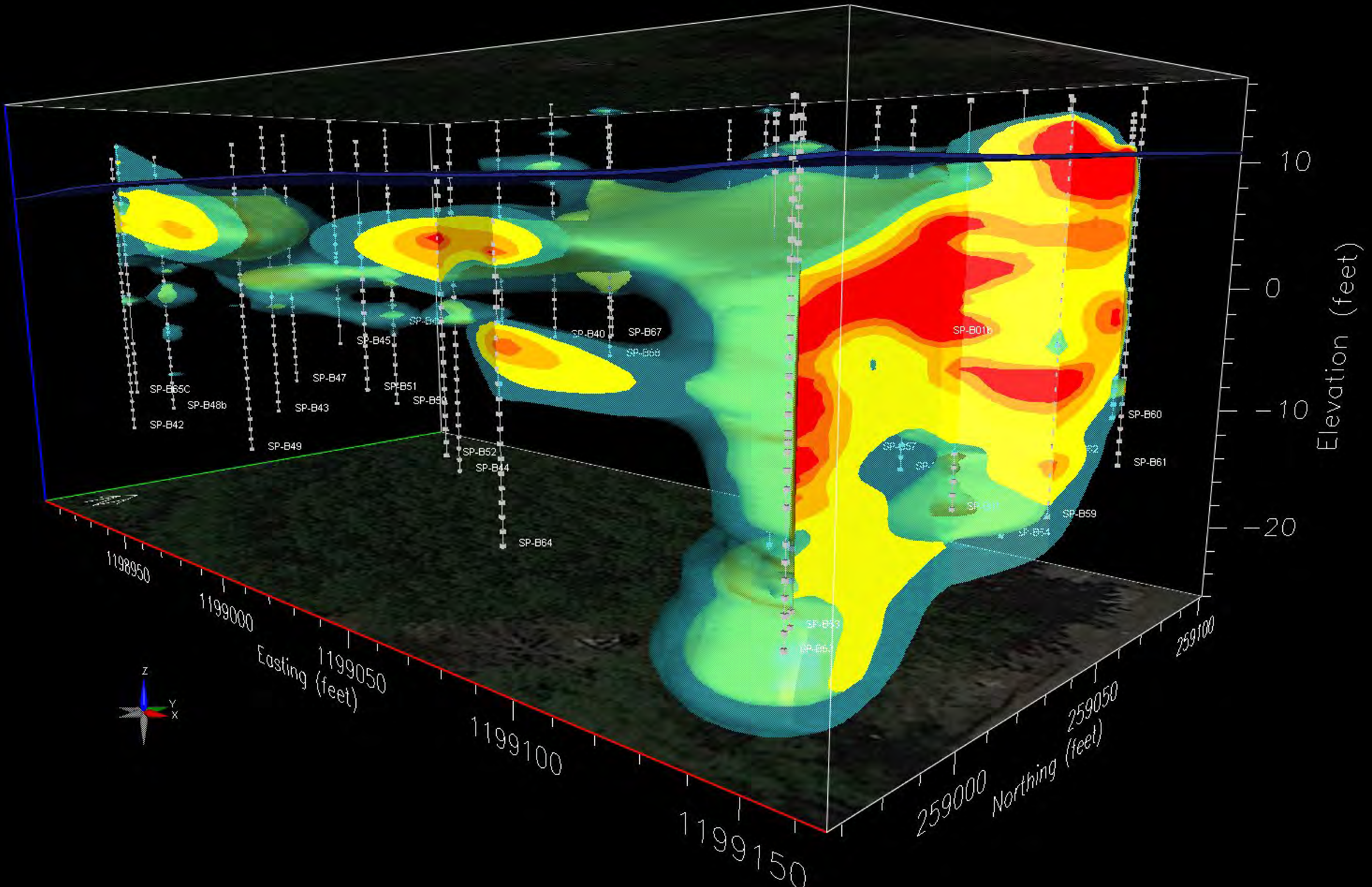
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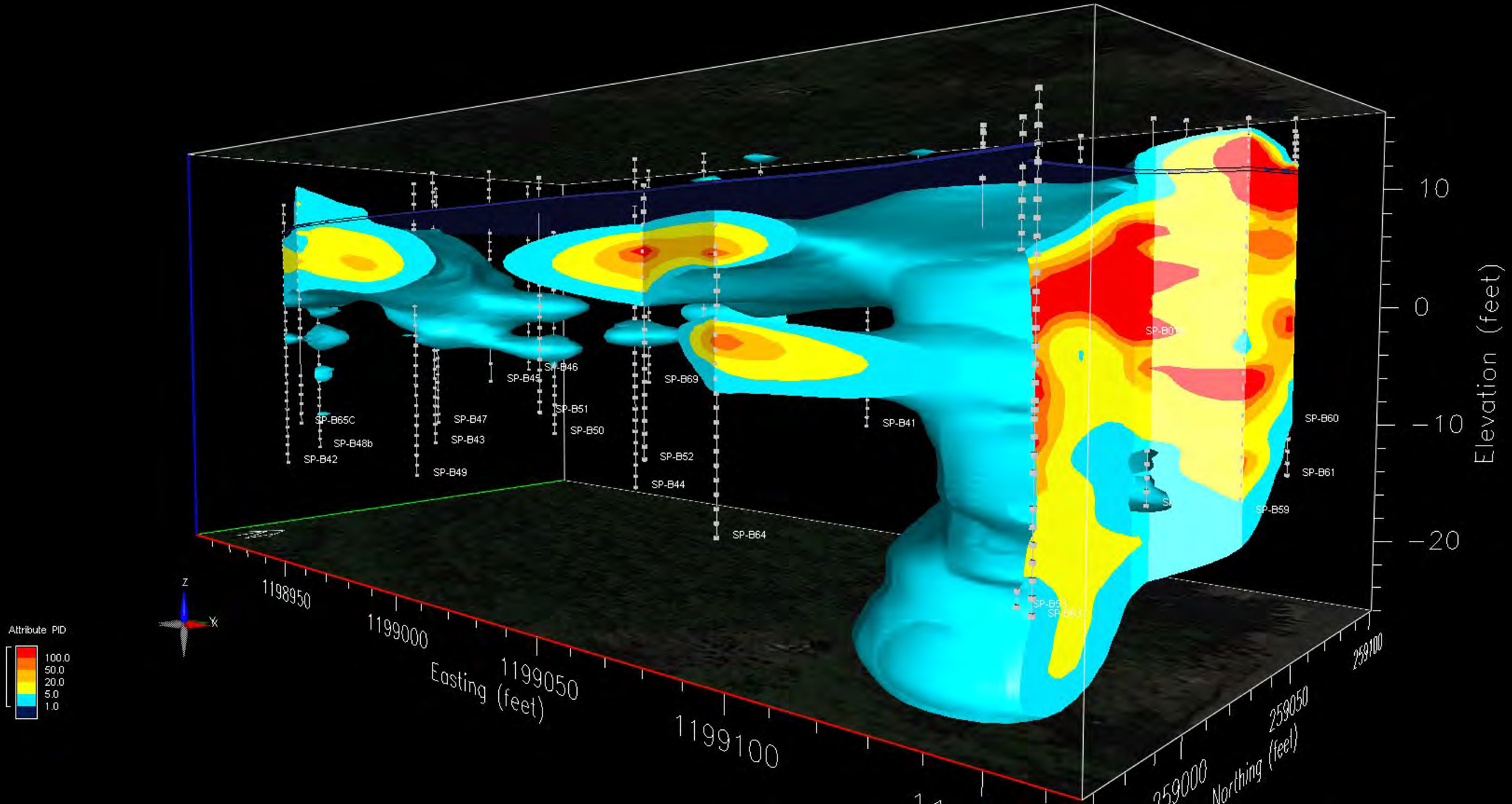

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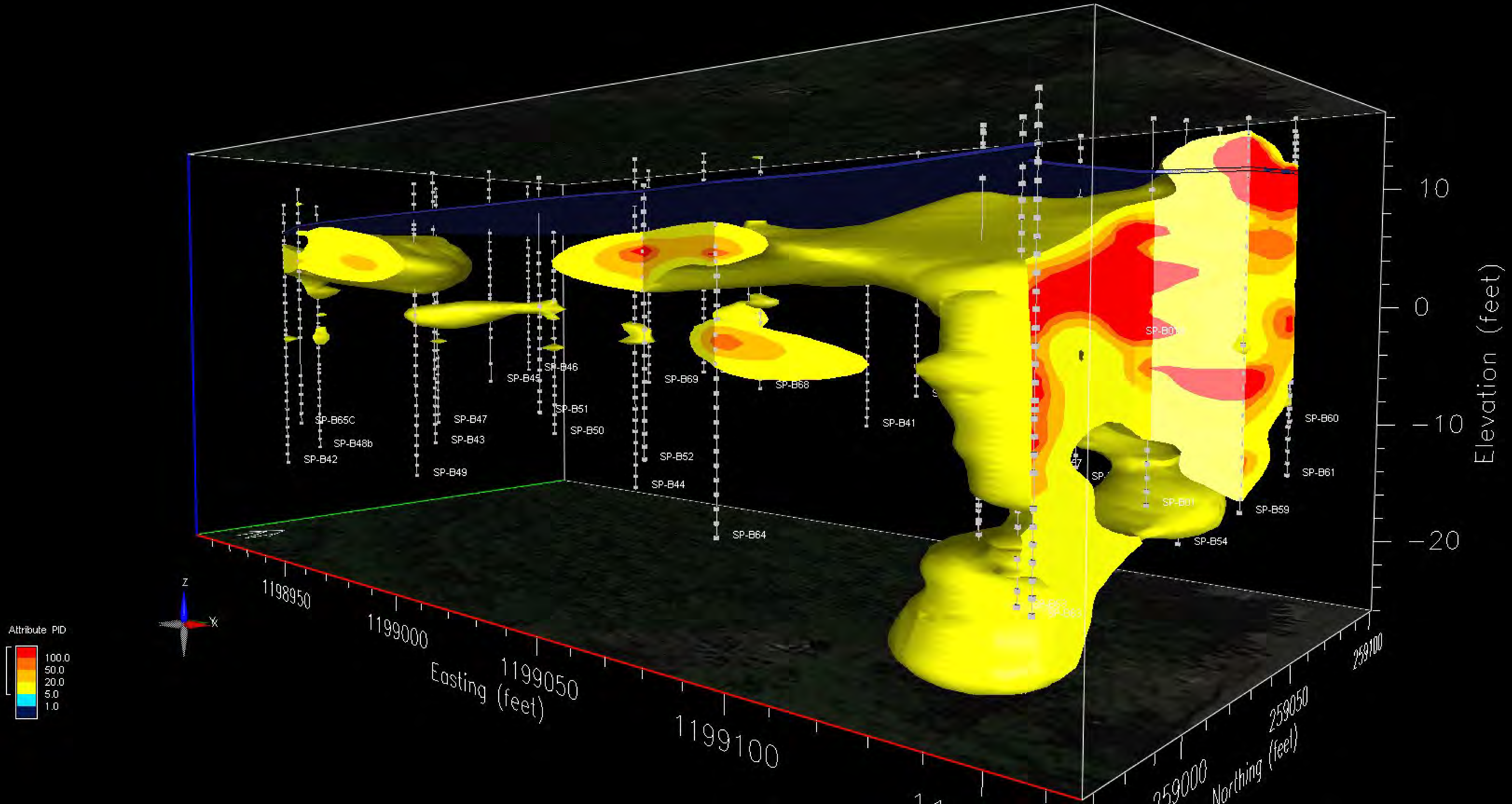

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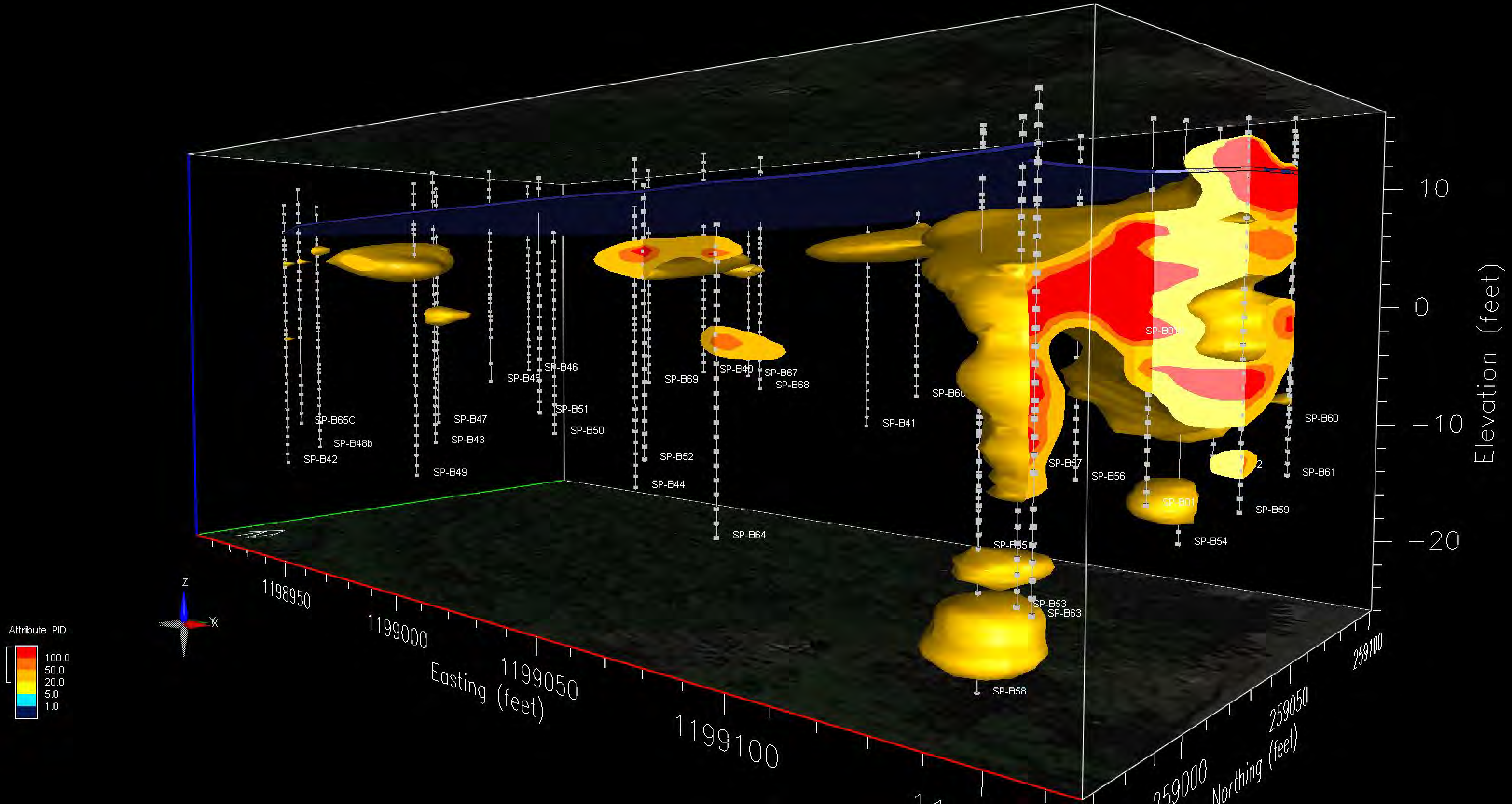
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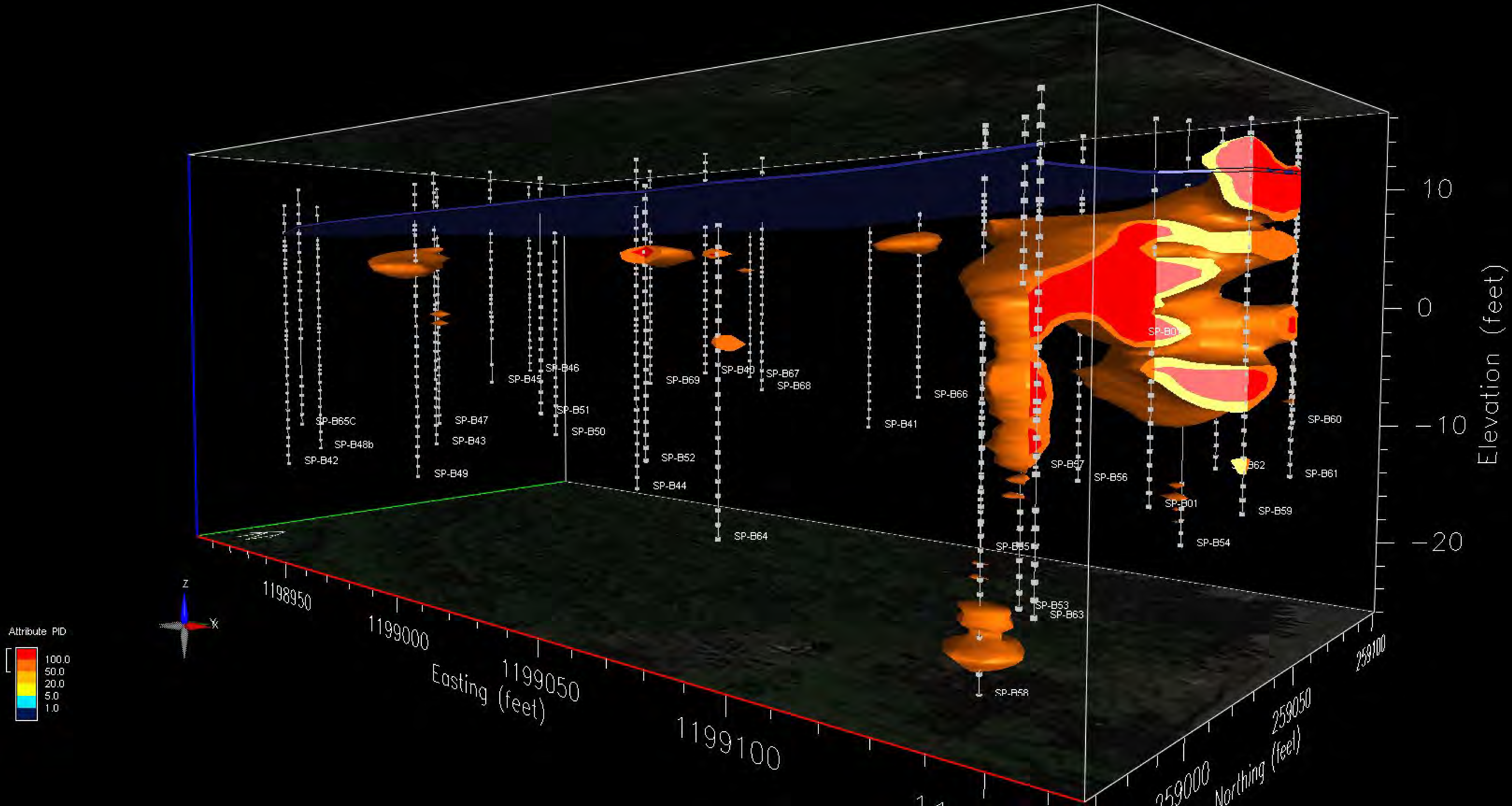
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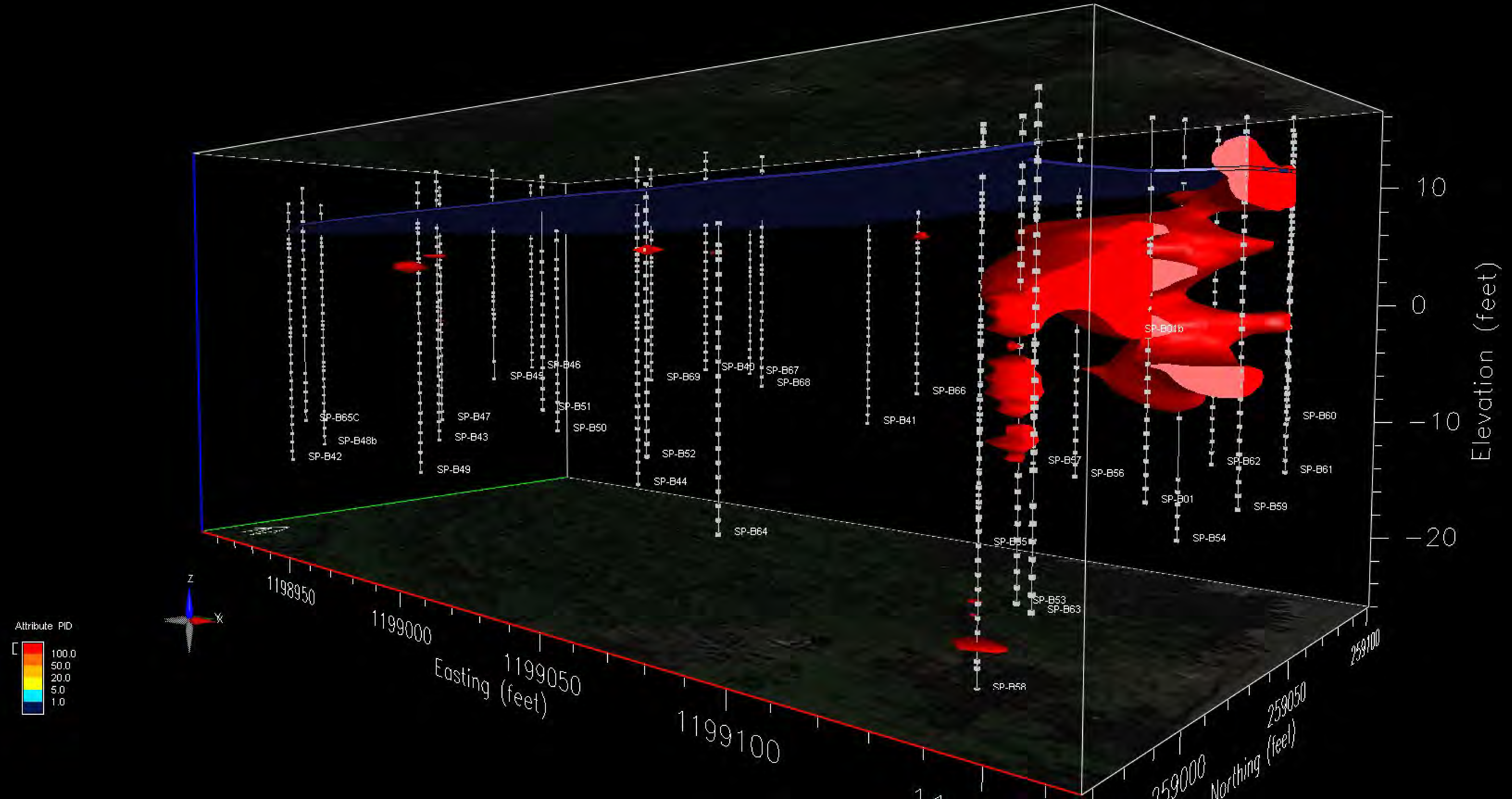
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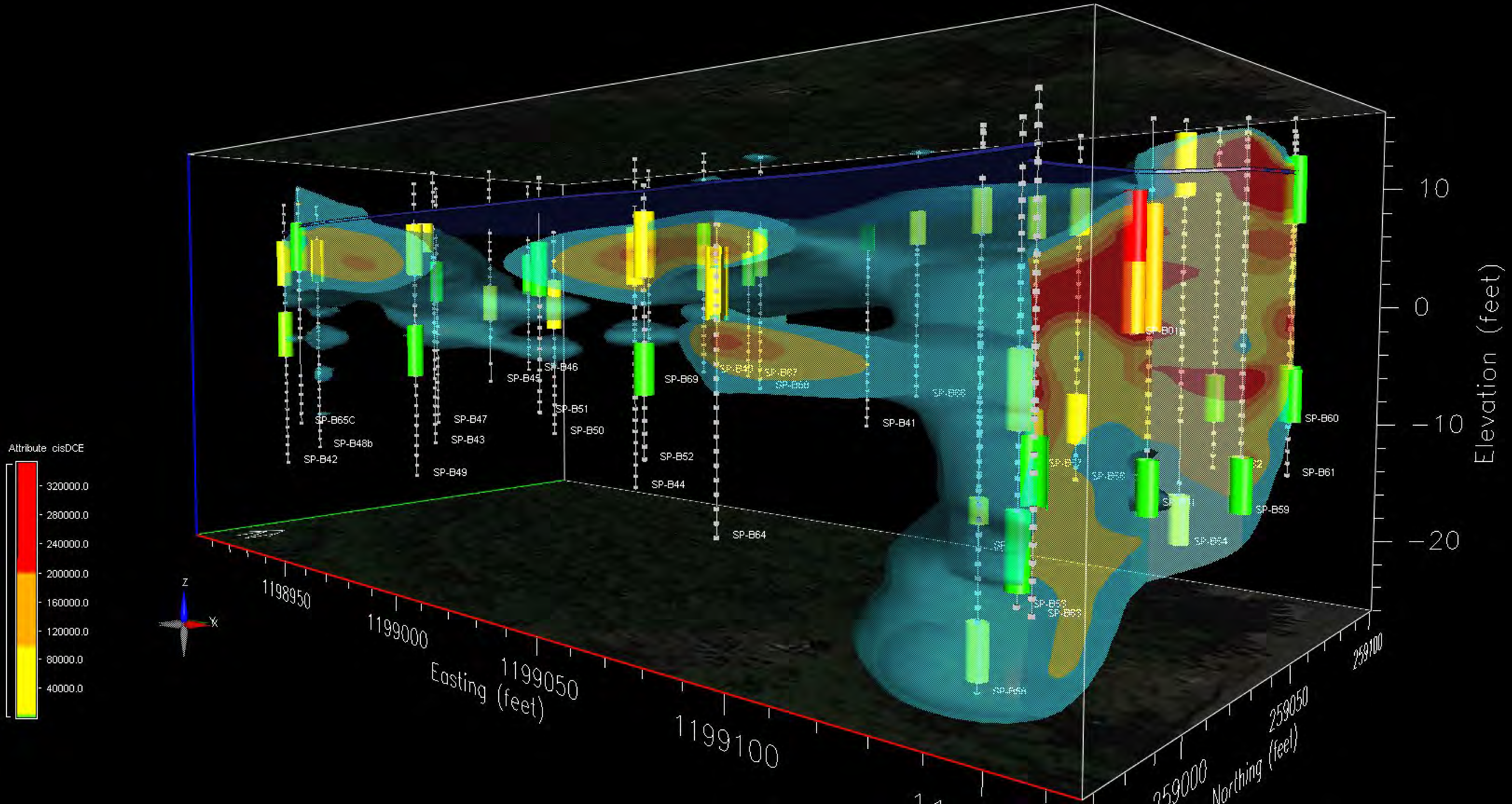
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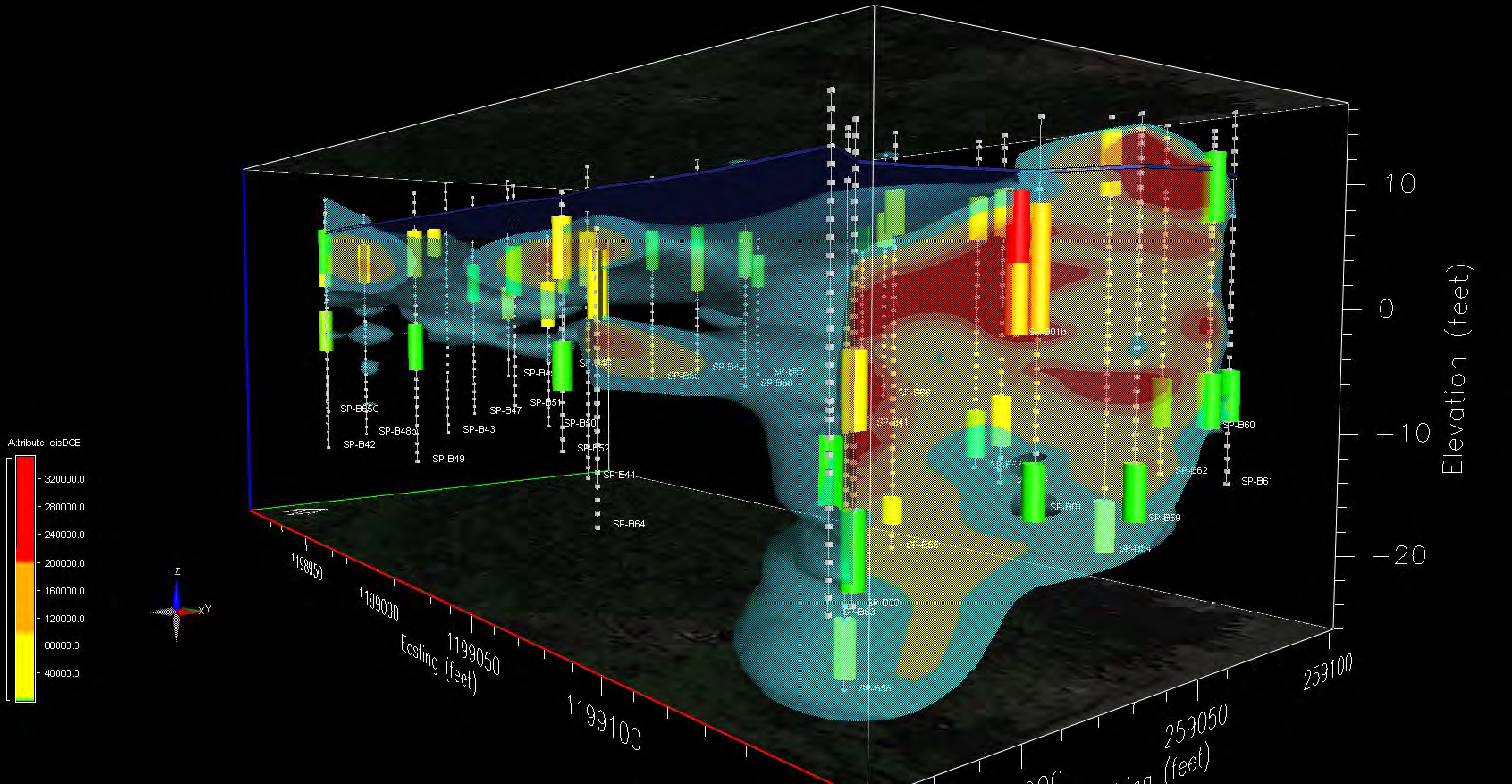
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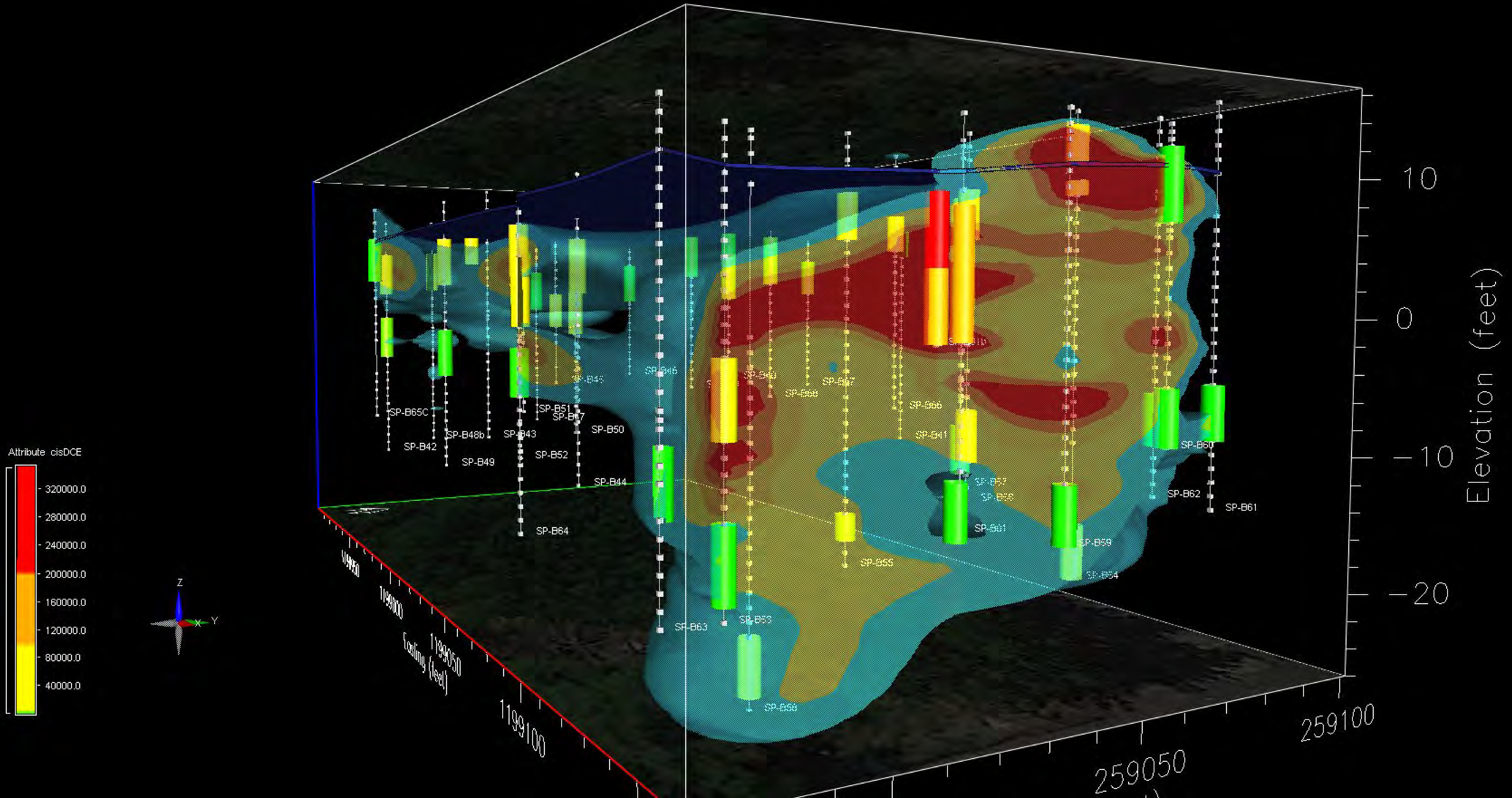
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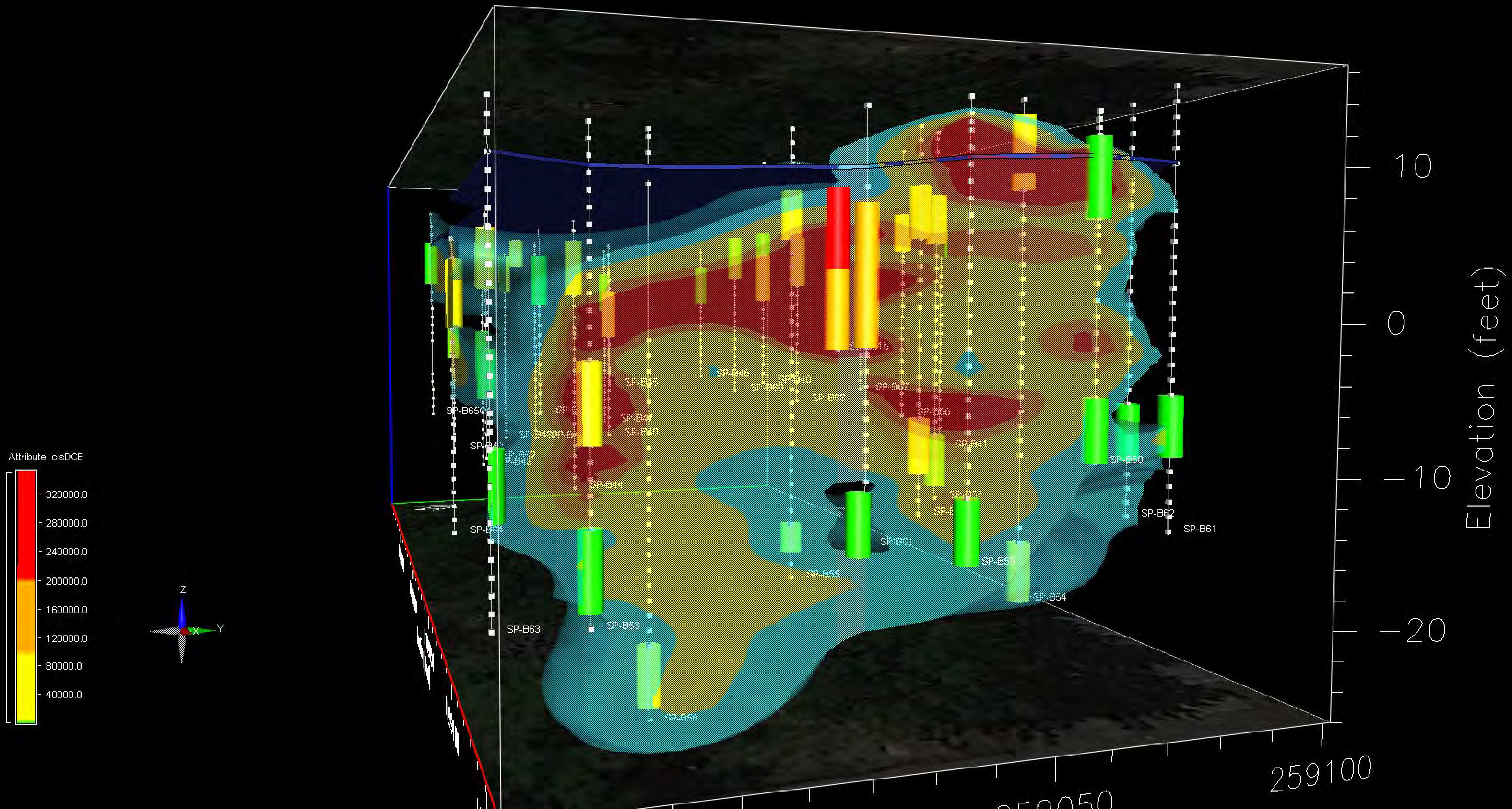
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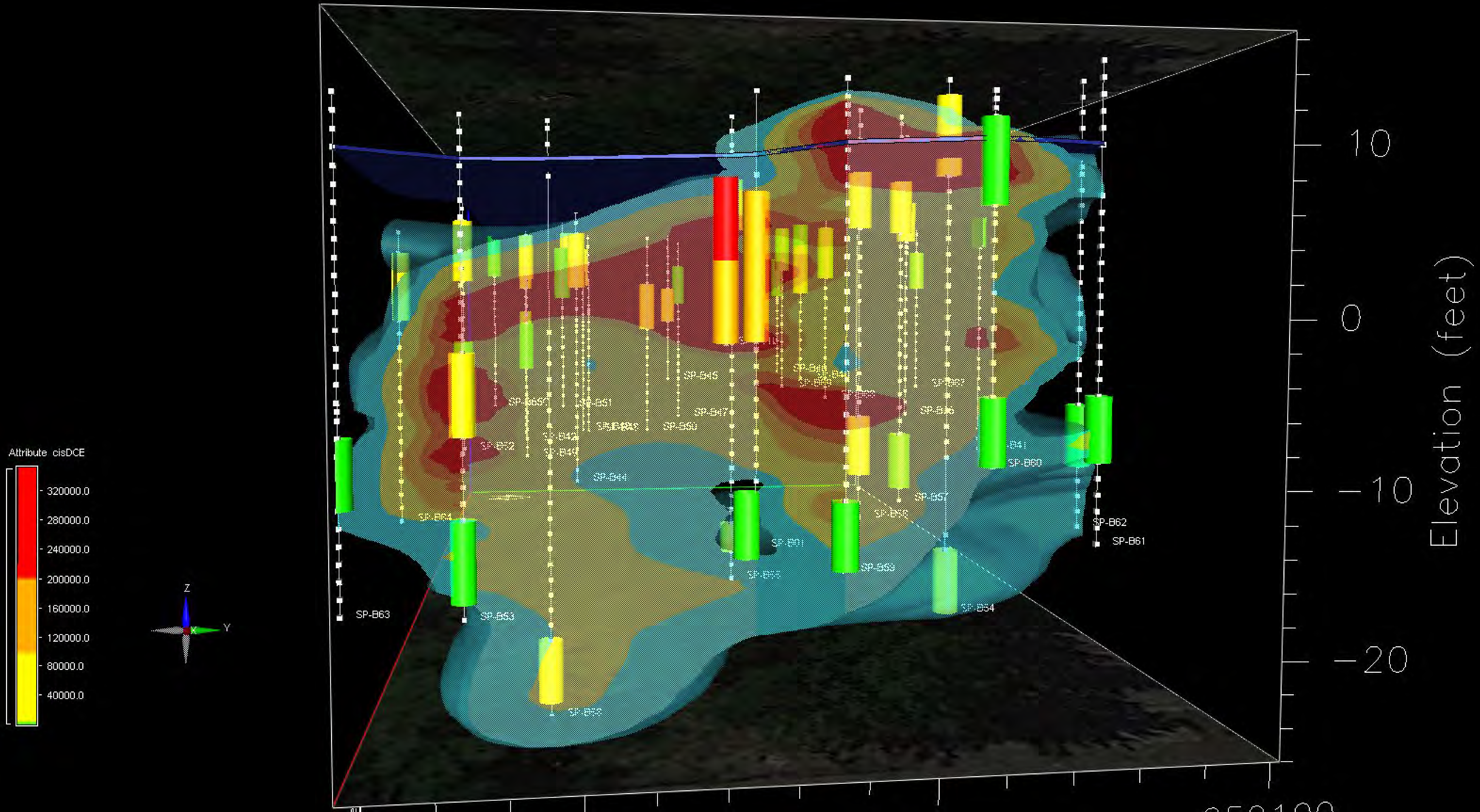
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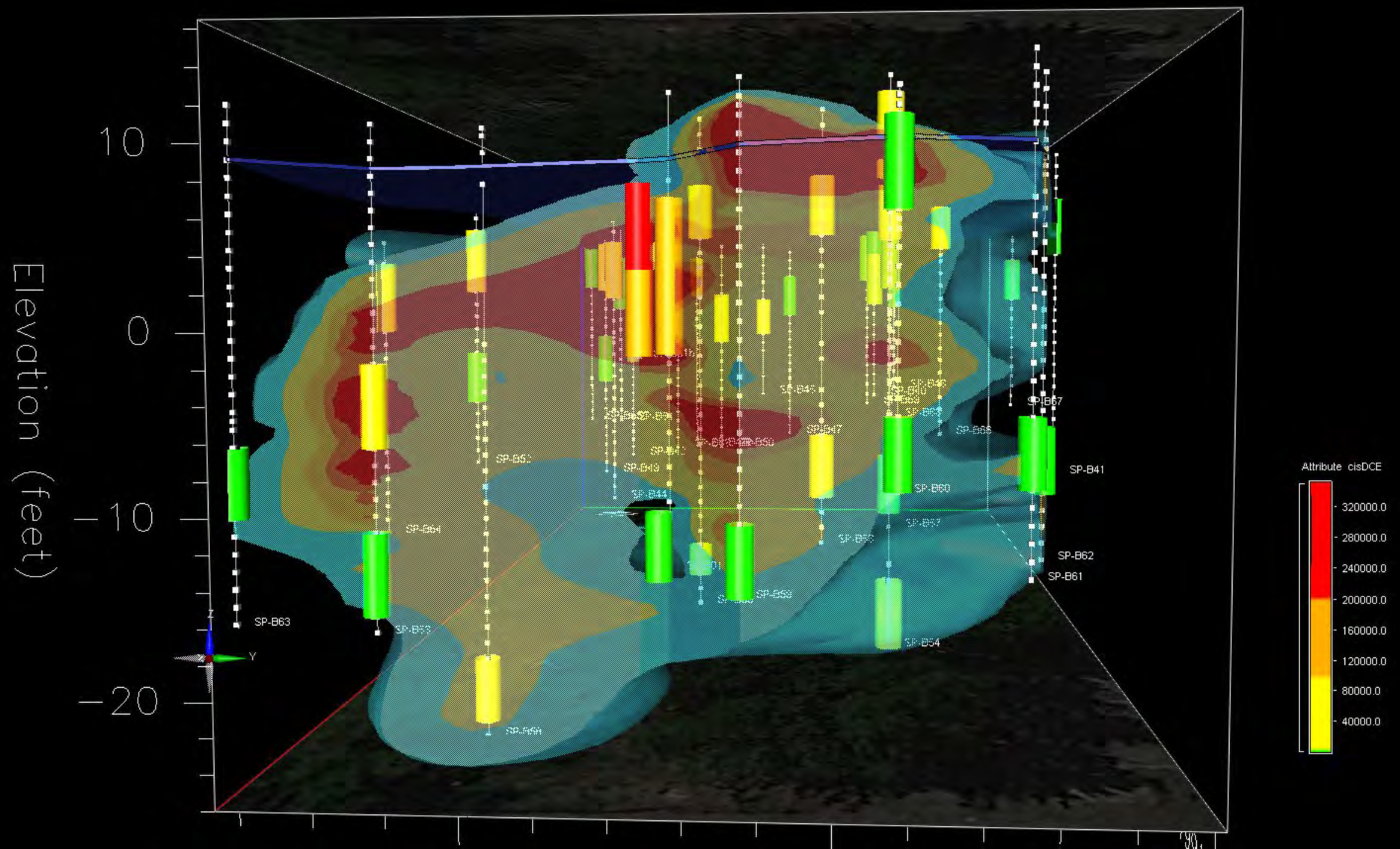
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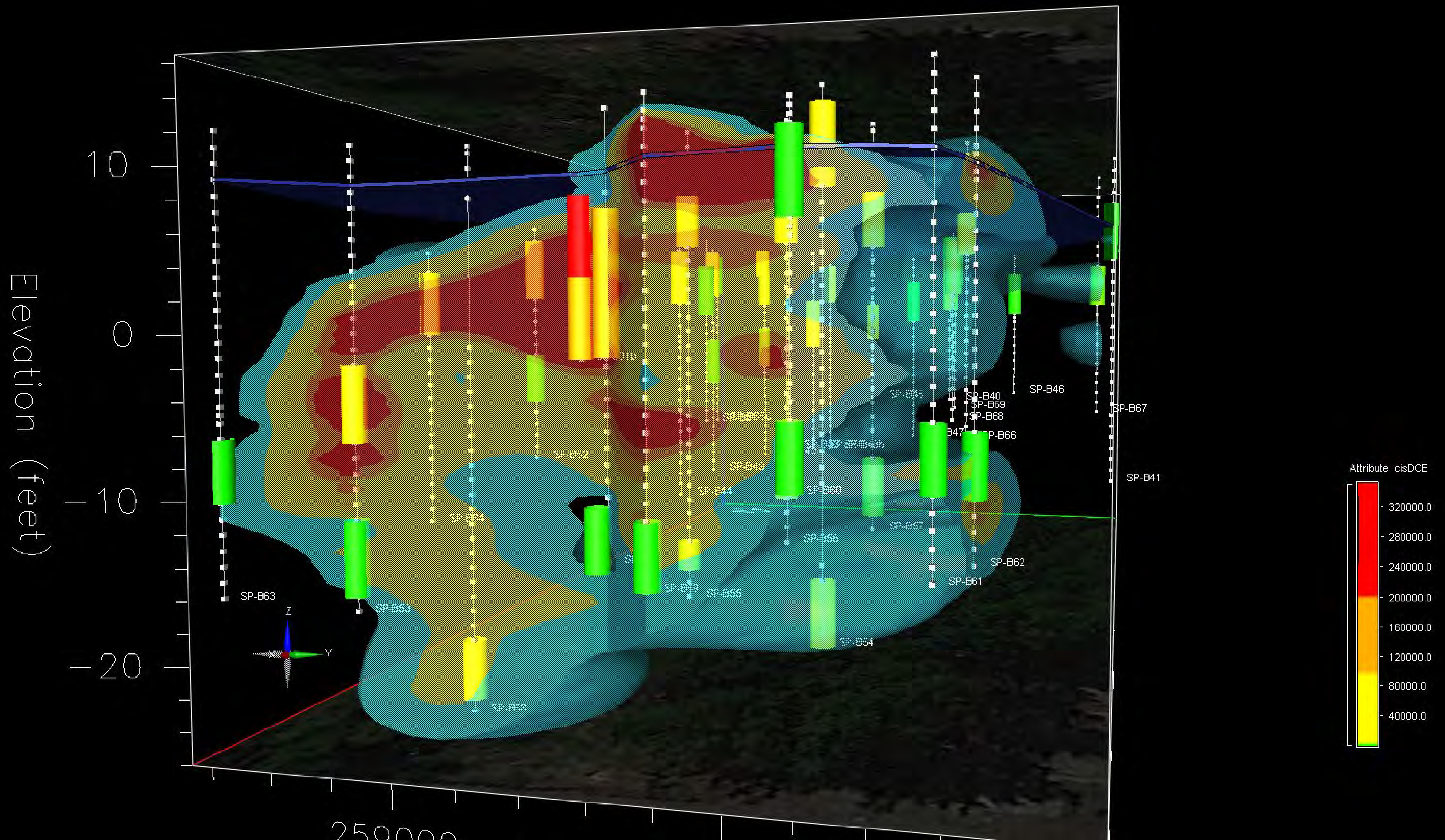
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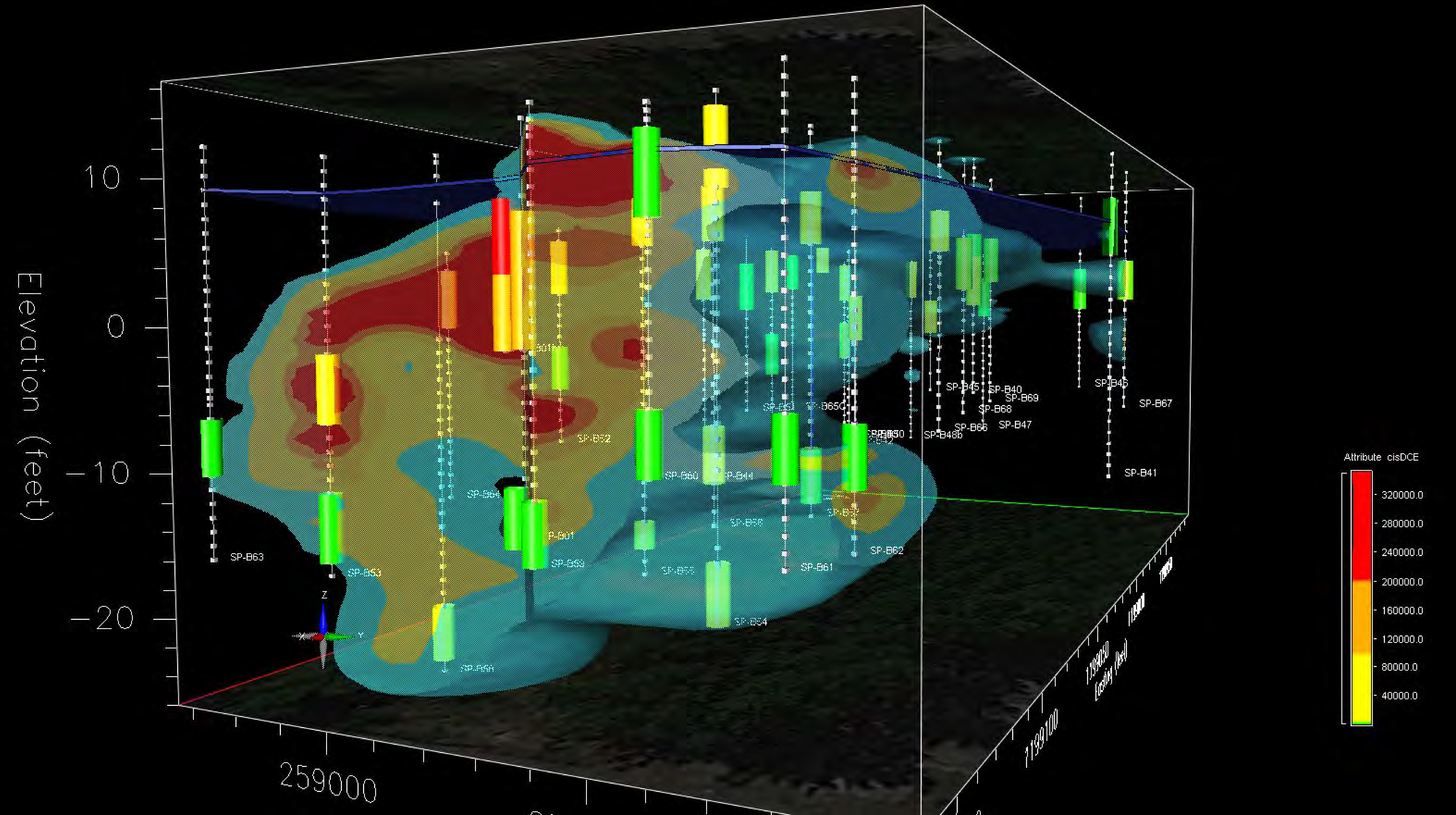
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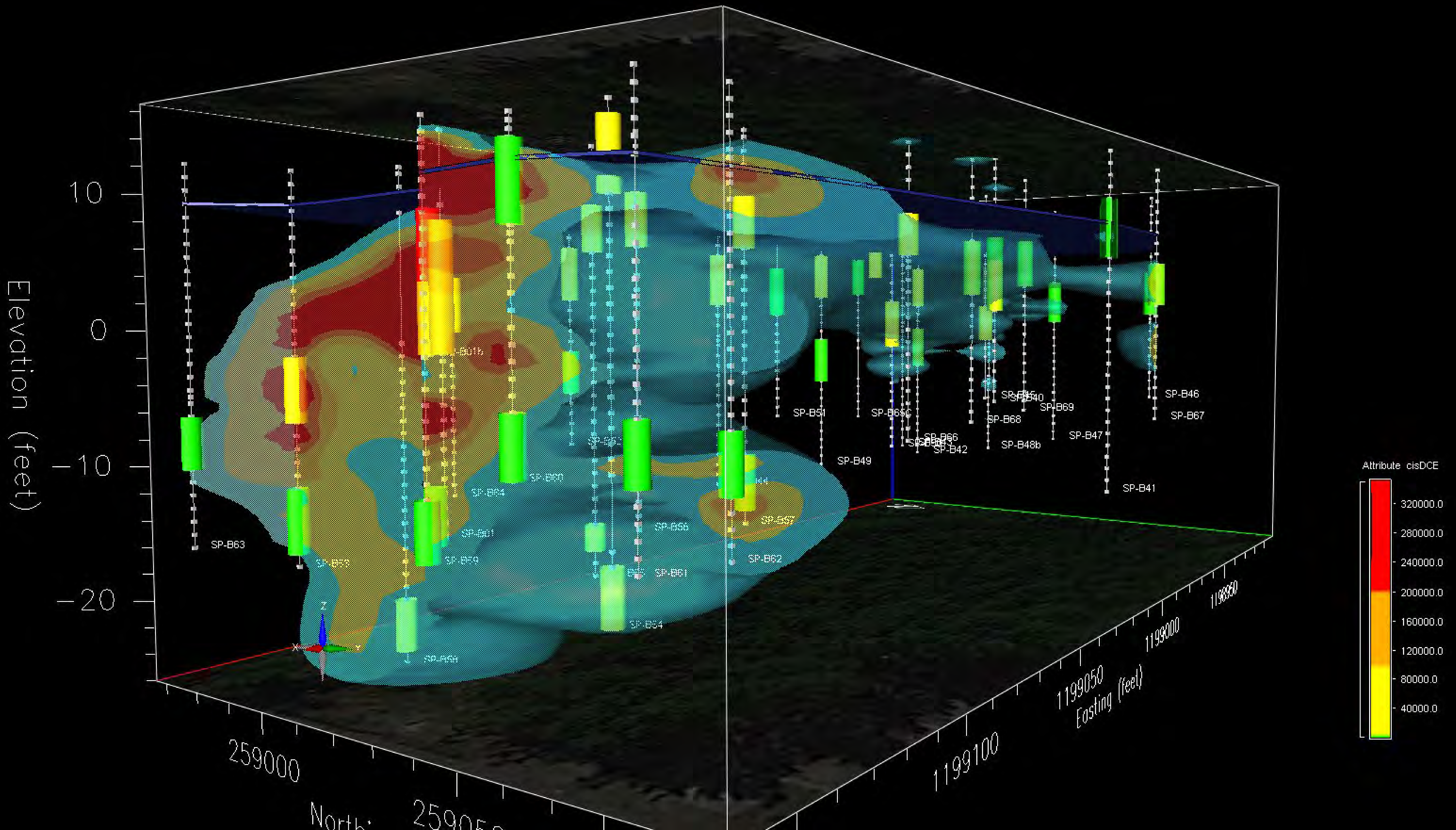
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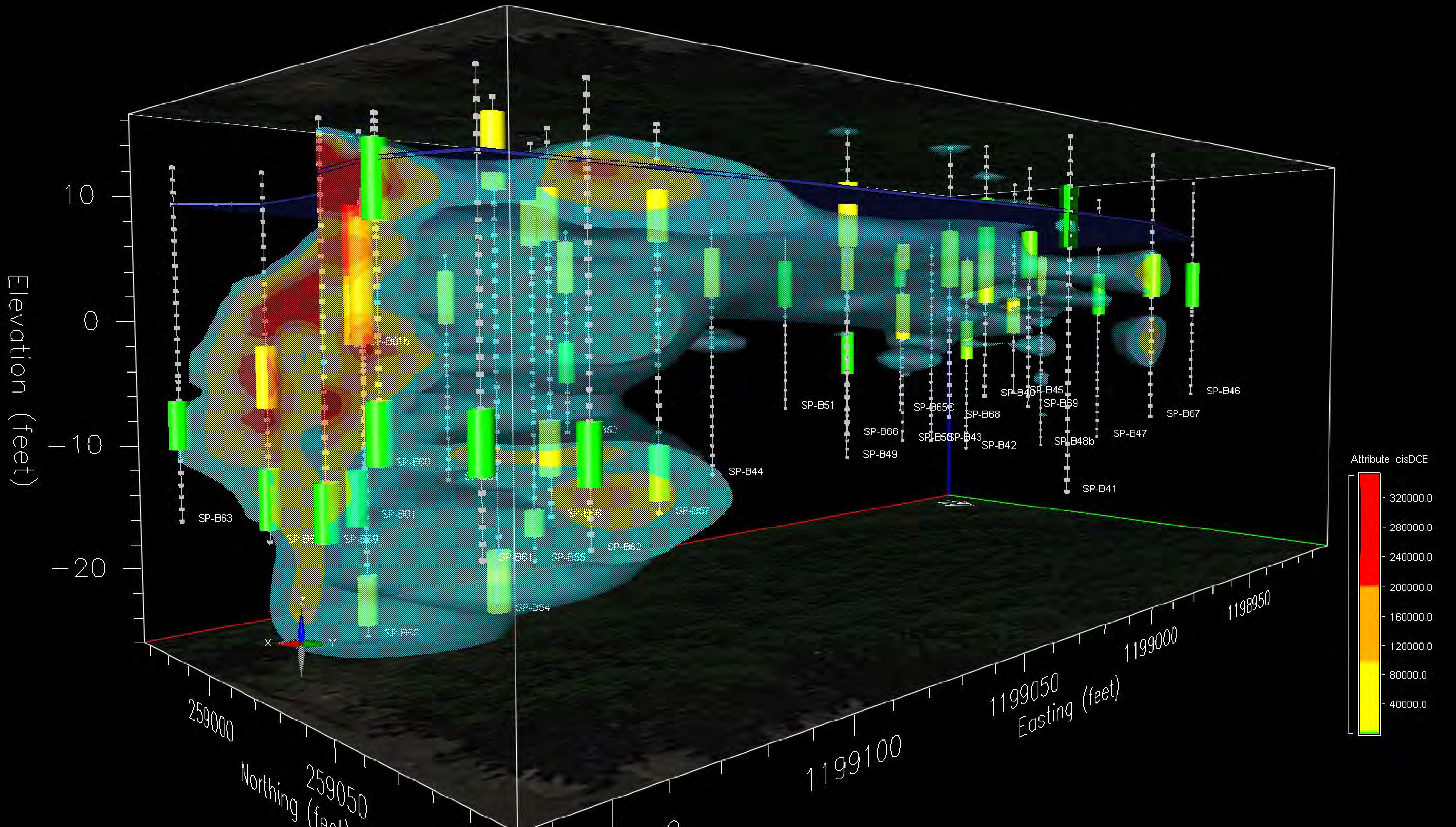

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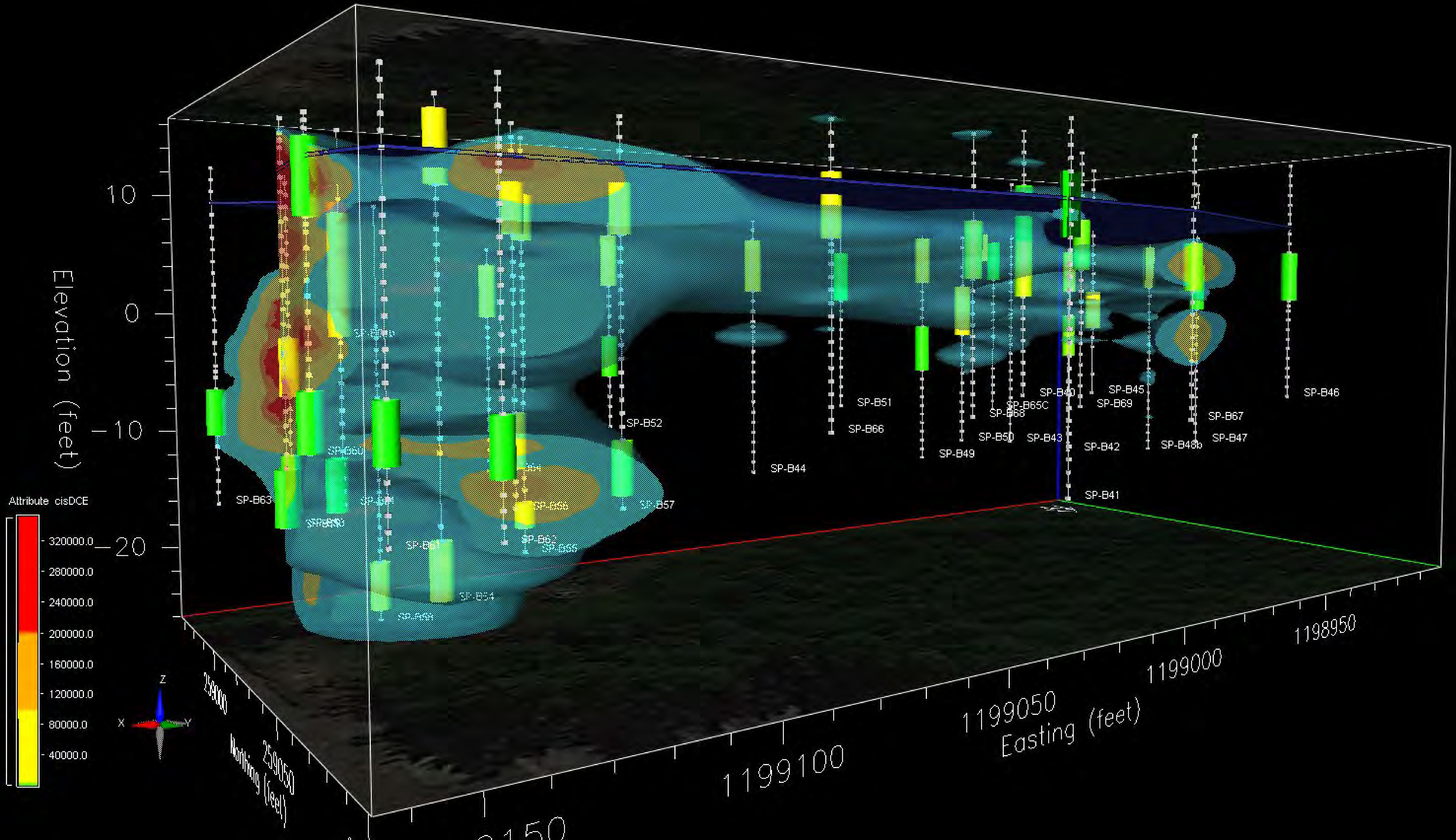
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Easting (feet)
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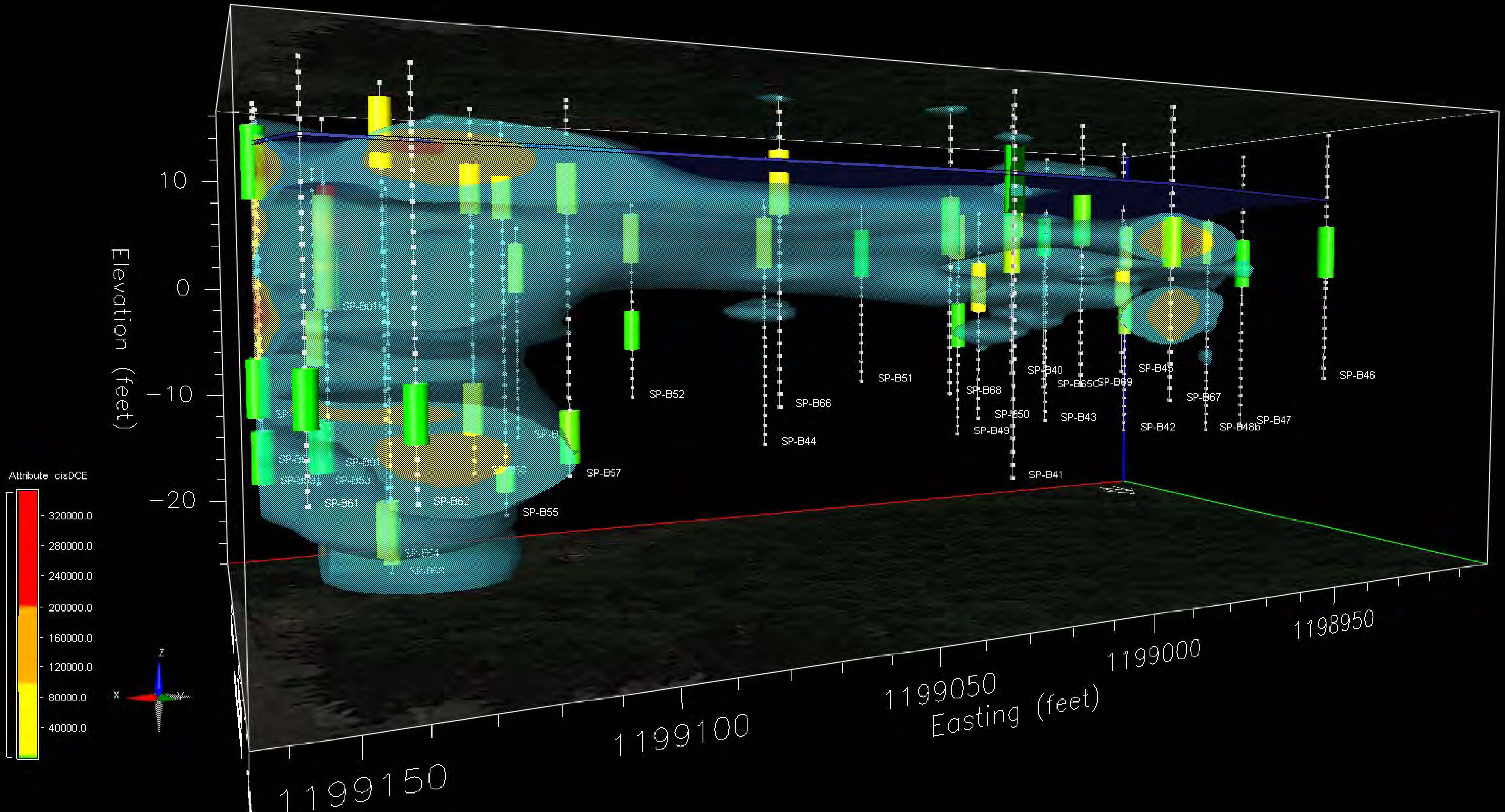
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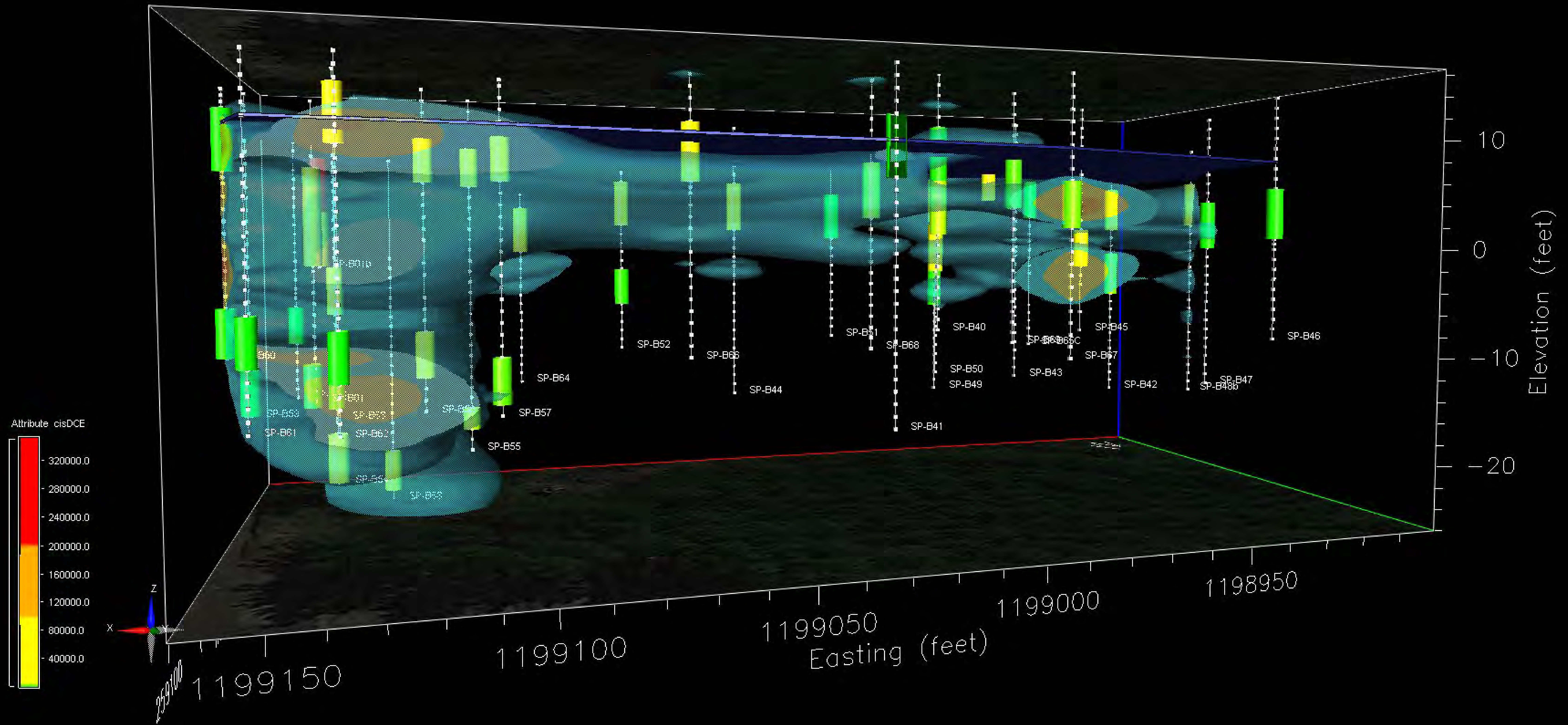
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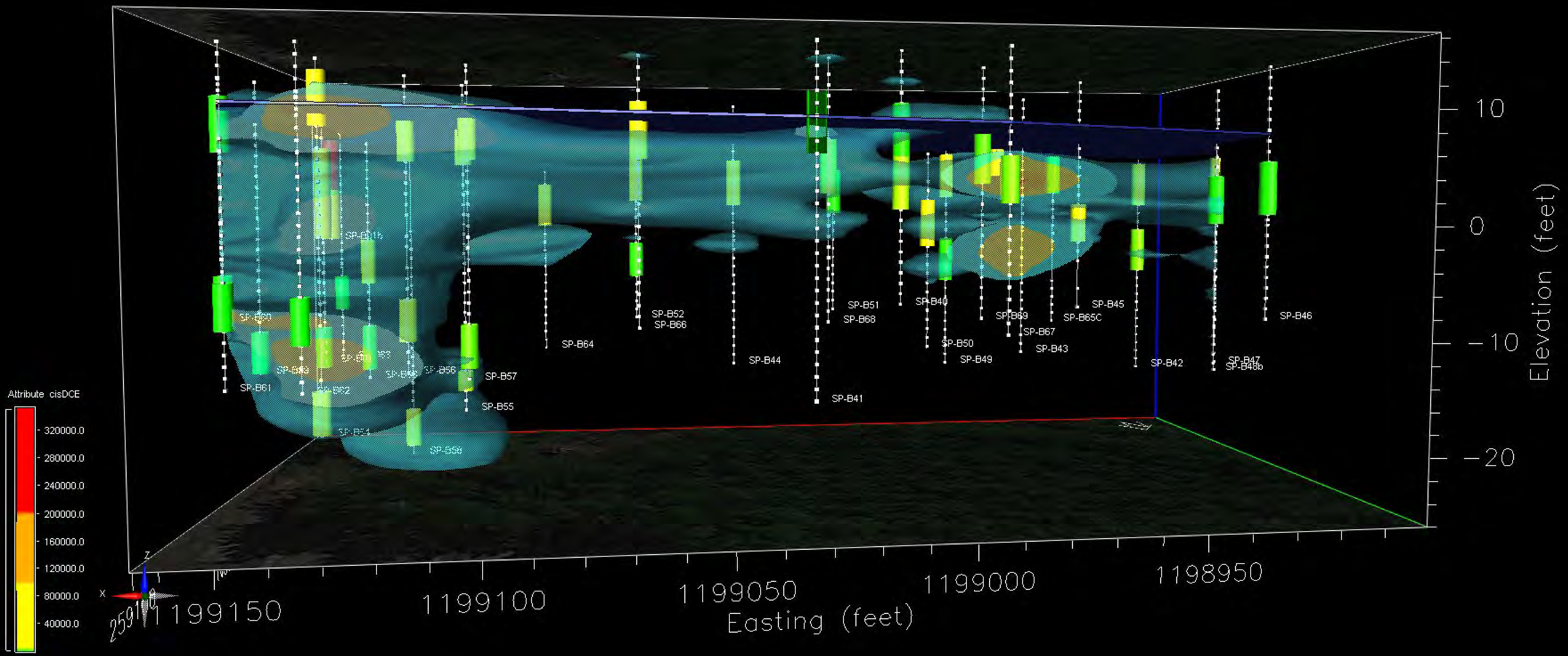
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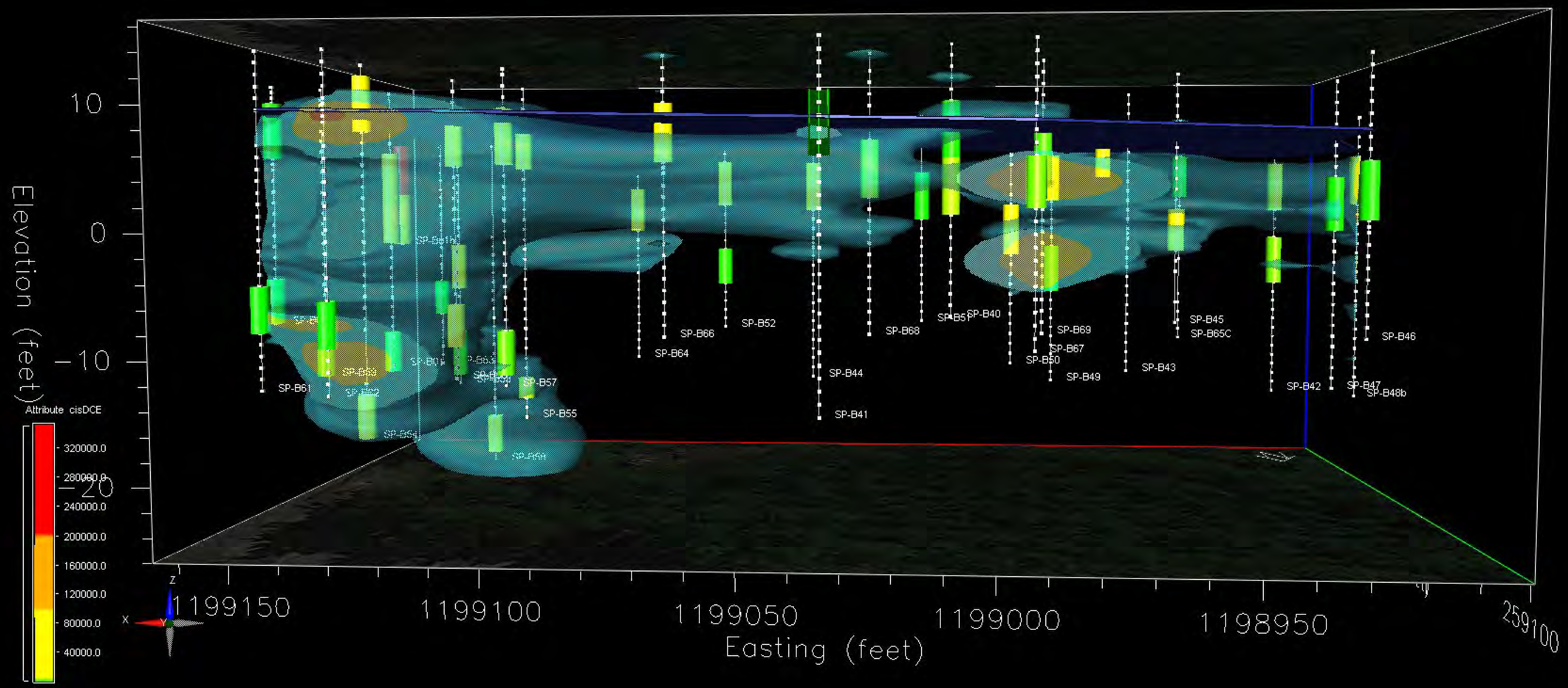

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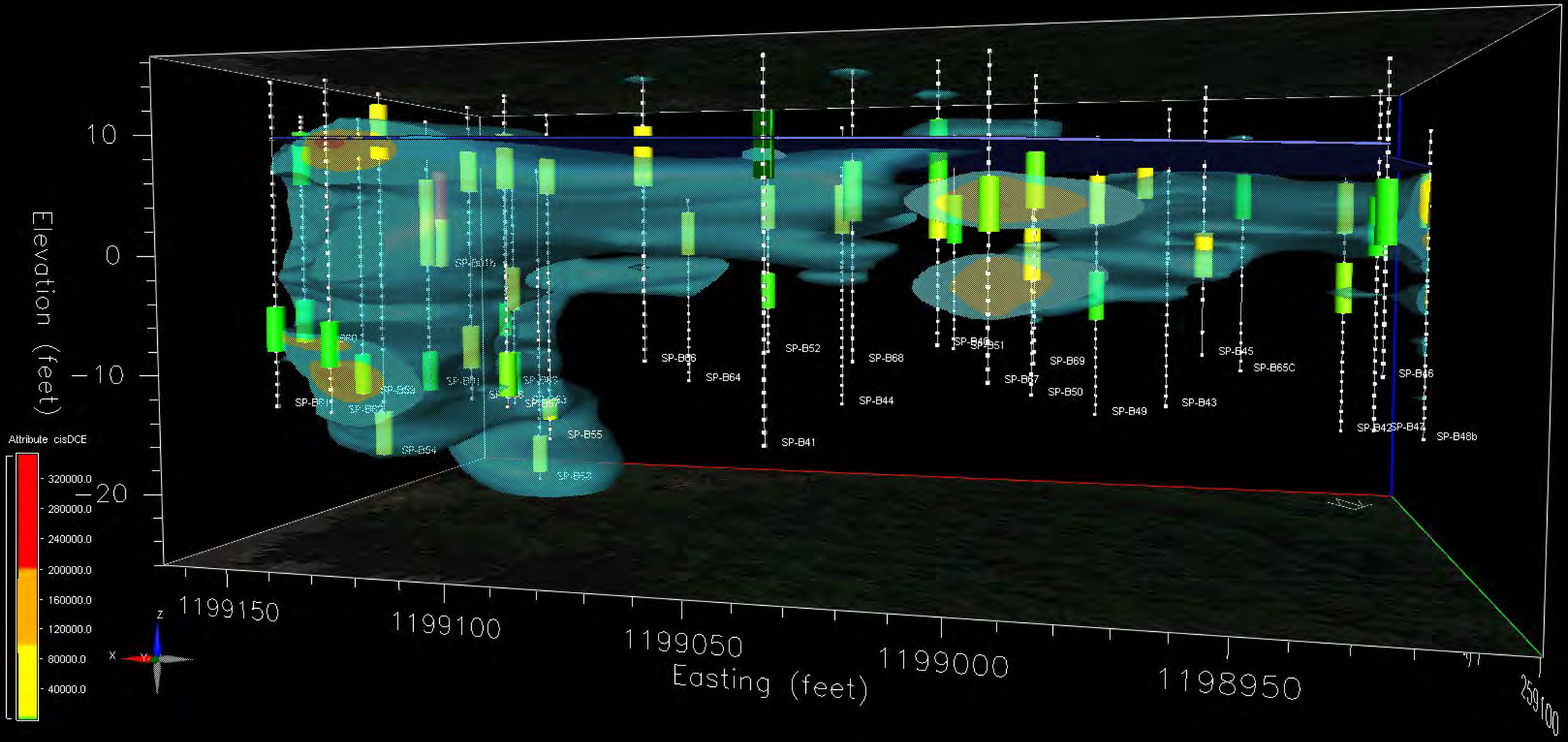
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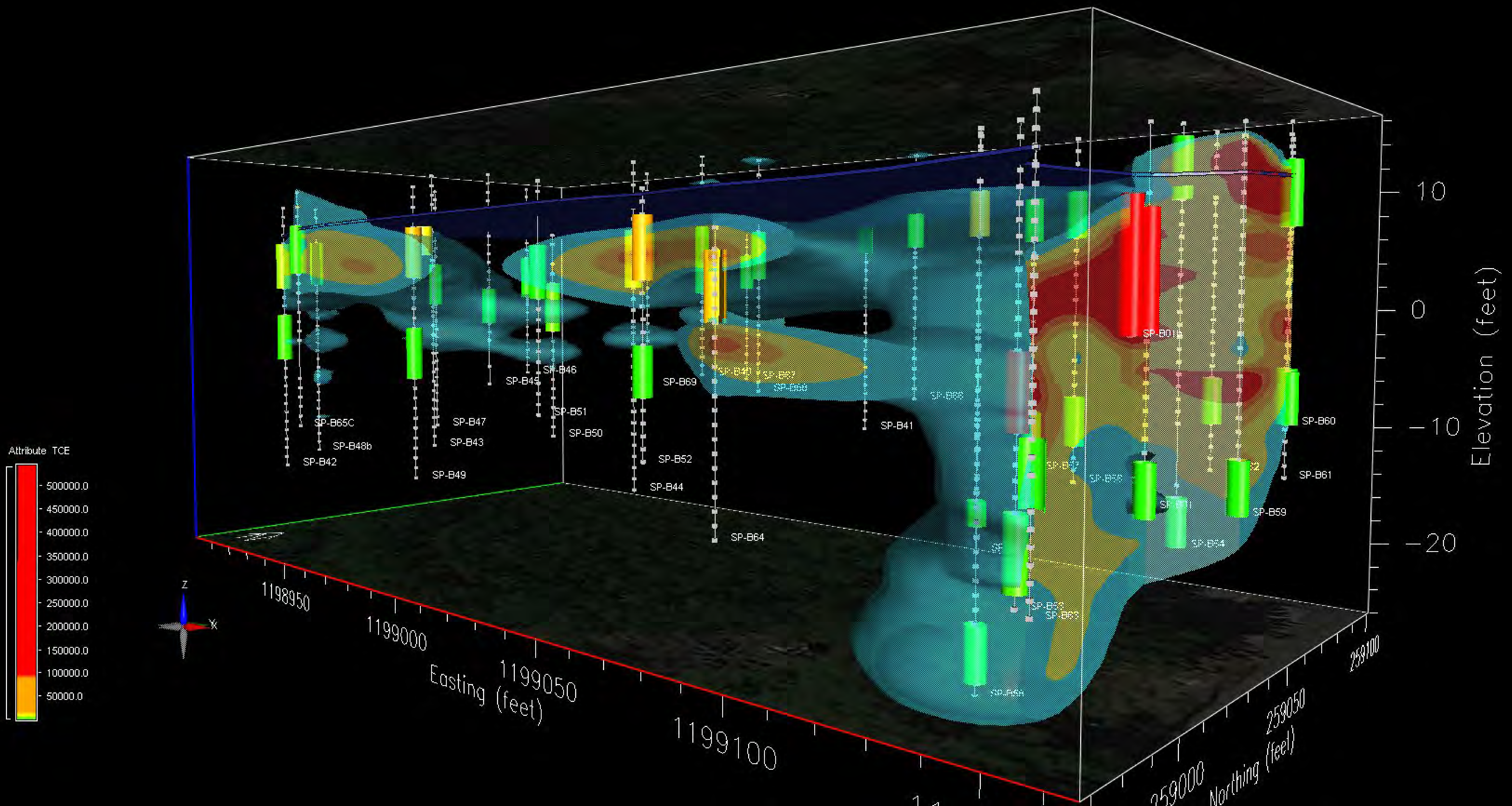
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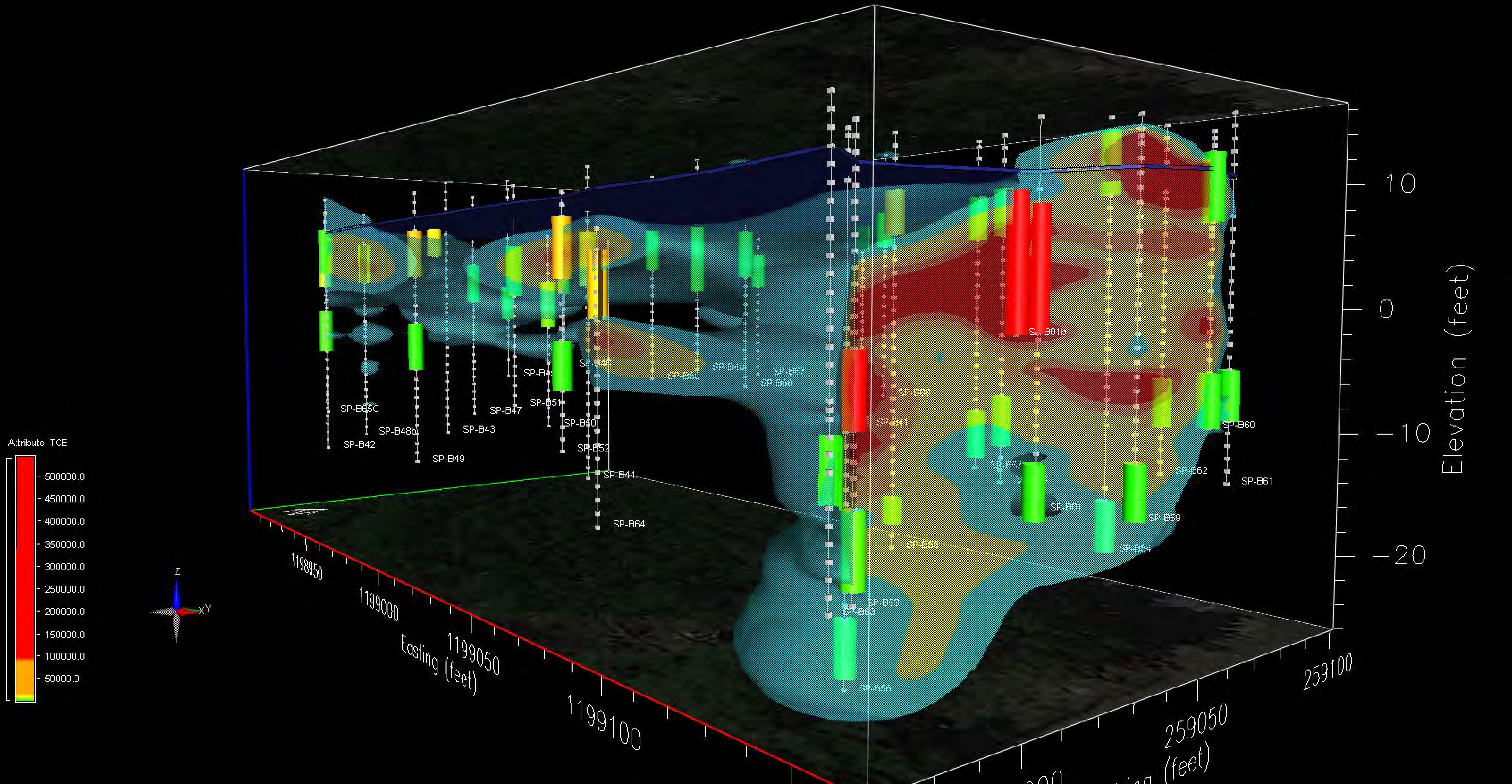
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Easting (feet)
259050
259100
(feet)
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−10
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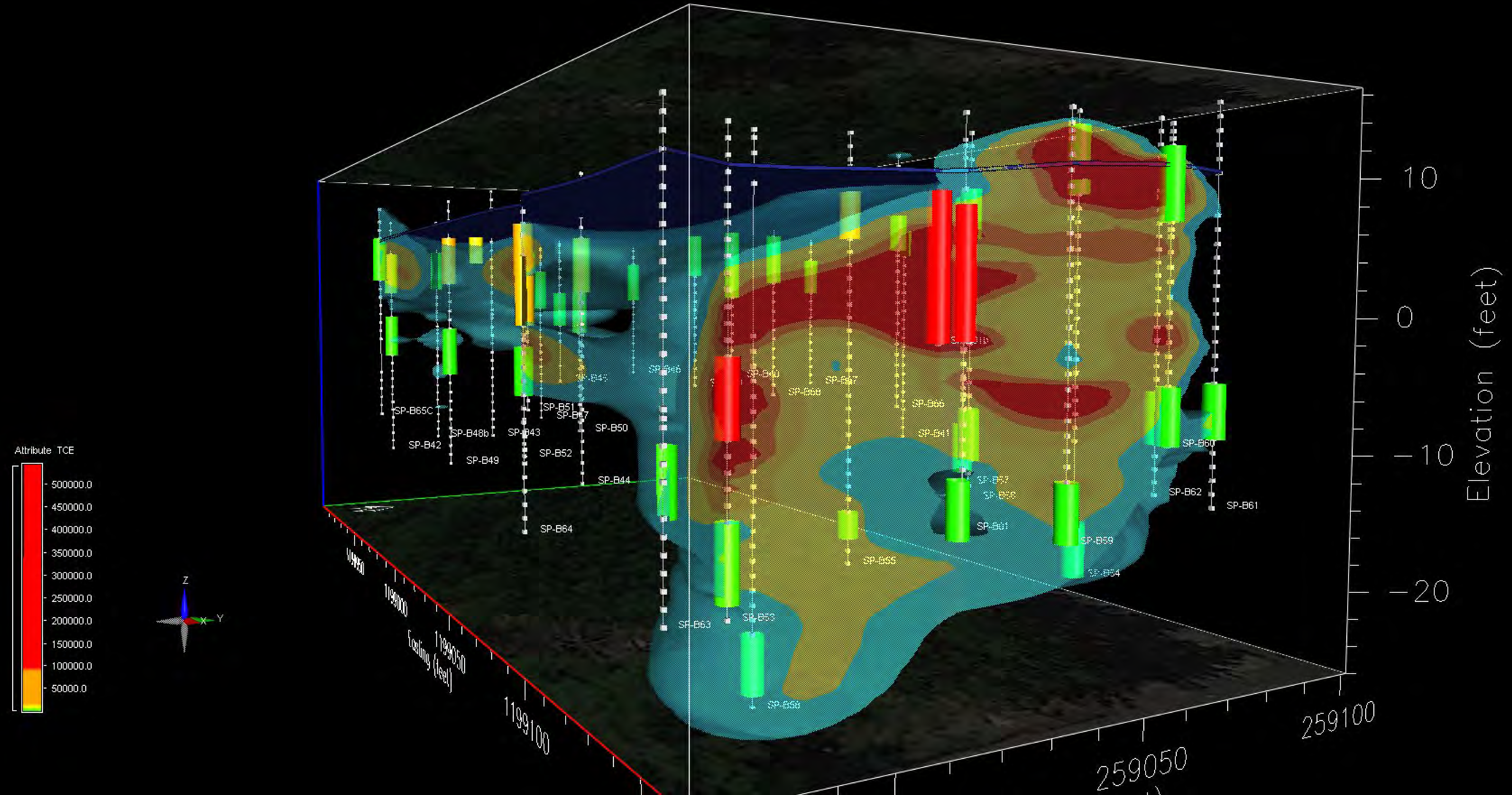
Elevation (feet)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SP-B48b
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SP-B46
SP-B63
SP-B41
SP-B57
SP-B59
SP-B54
SP-B60
SP-B62
SP-B61
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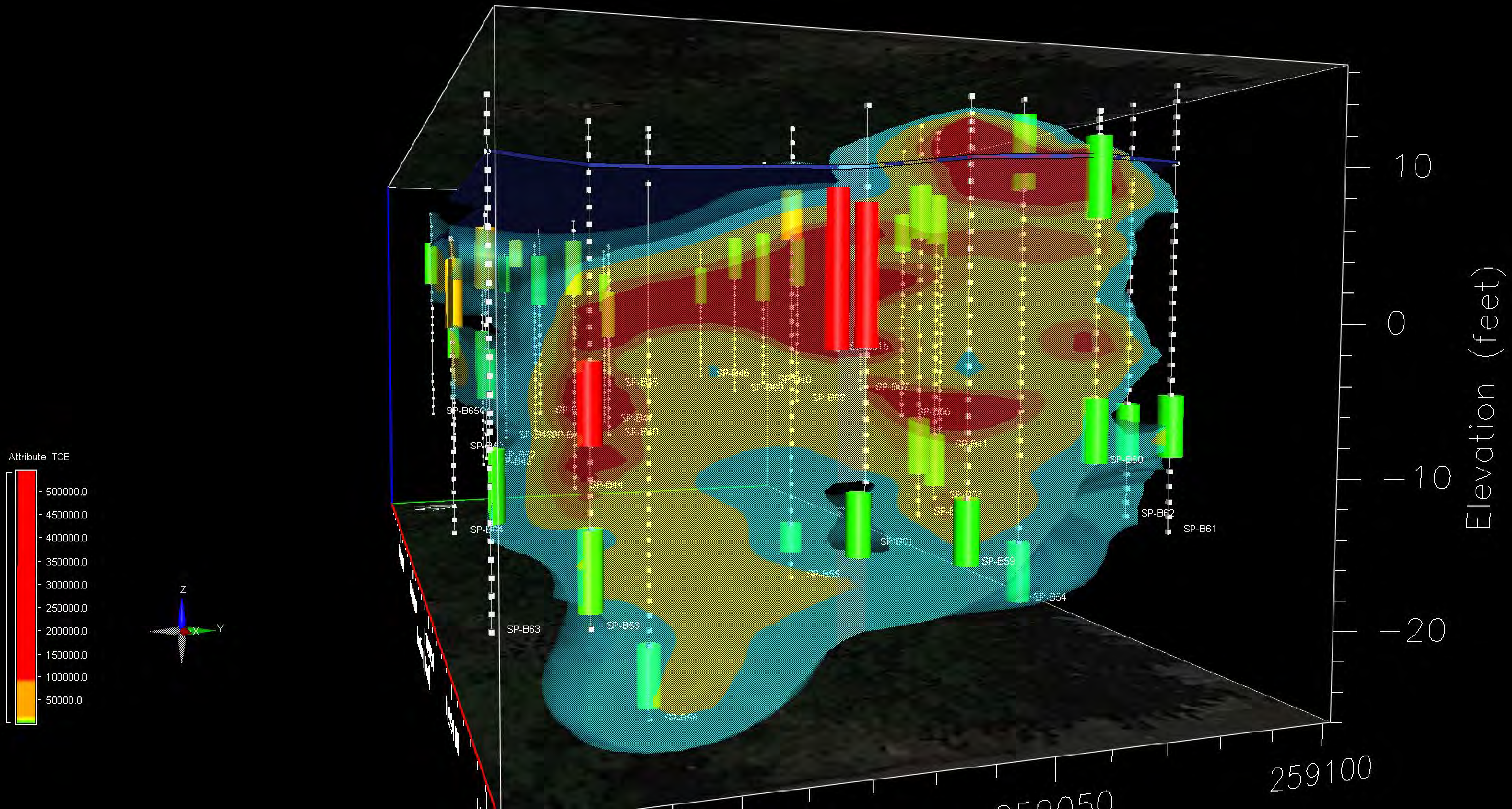
−10
−20
Elevation (feet)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SP-B54
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Elevation (feet)
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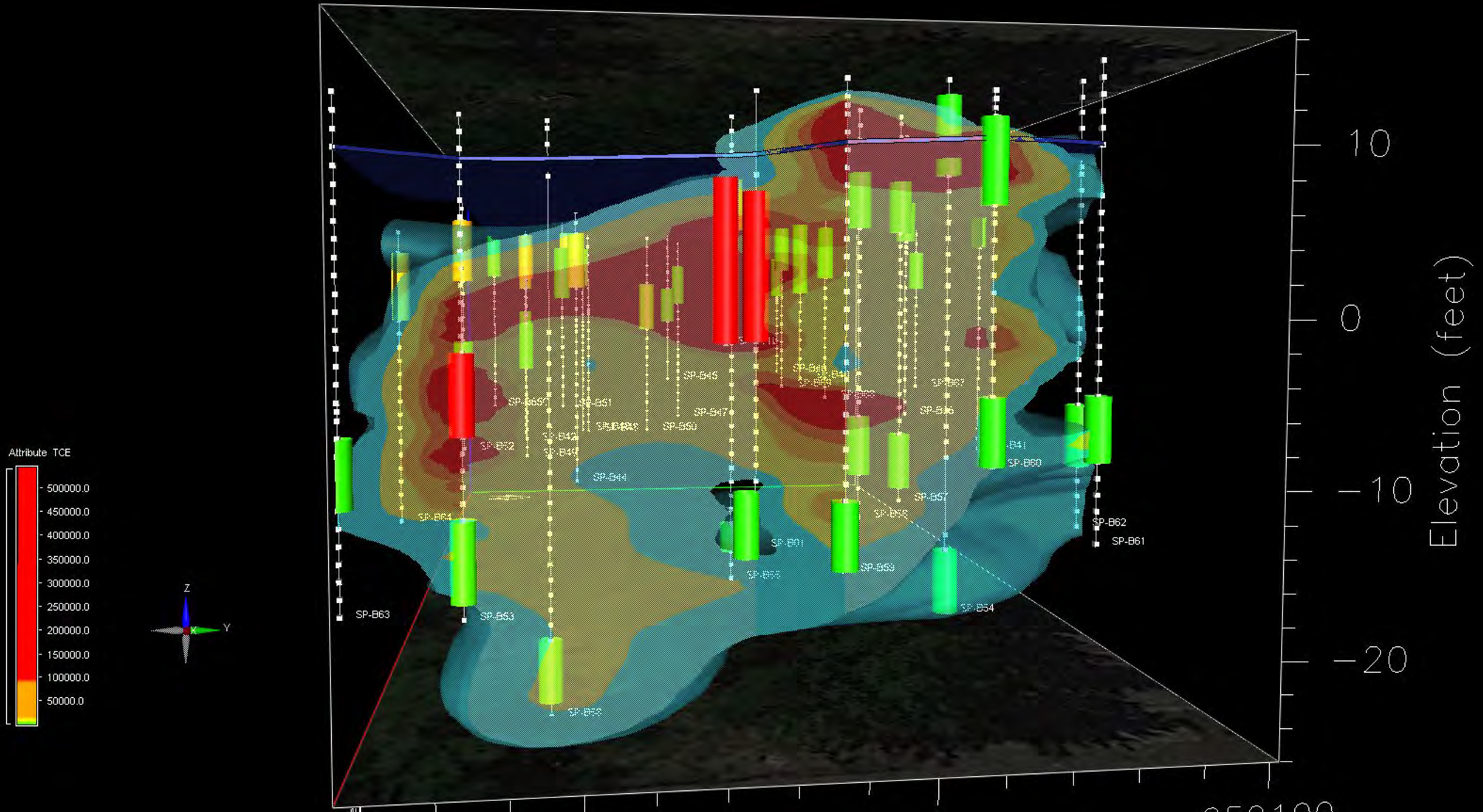
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Y
X
10
0
−10
−20
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SP-B47
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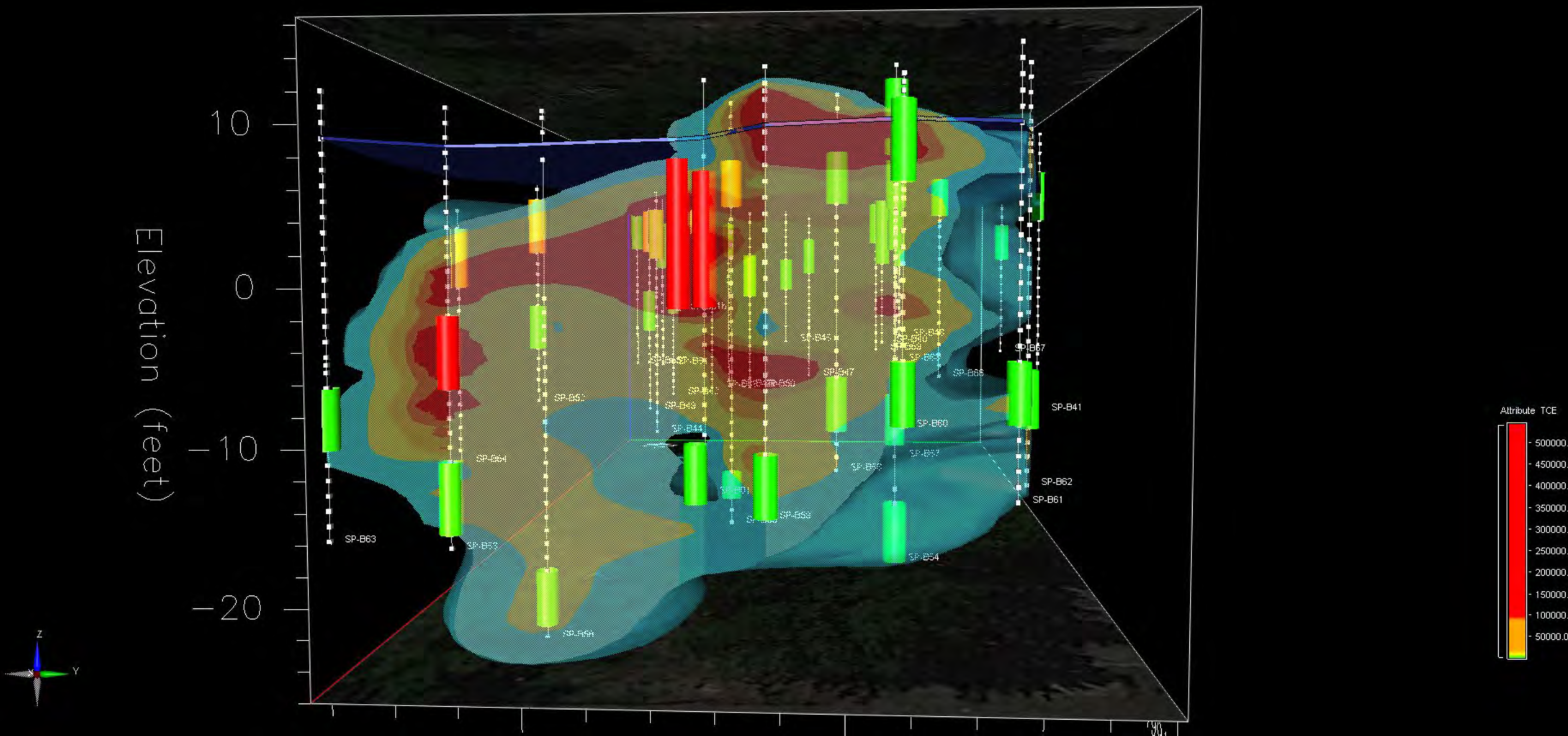
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SP-B47
SP-B44
SP-B49
Z
Y
X
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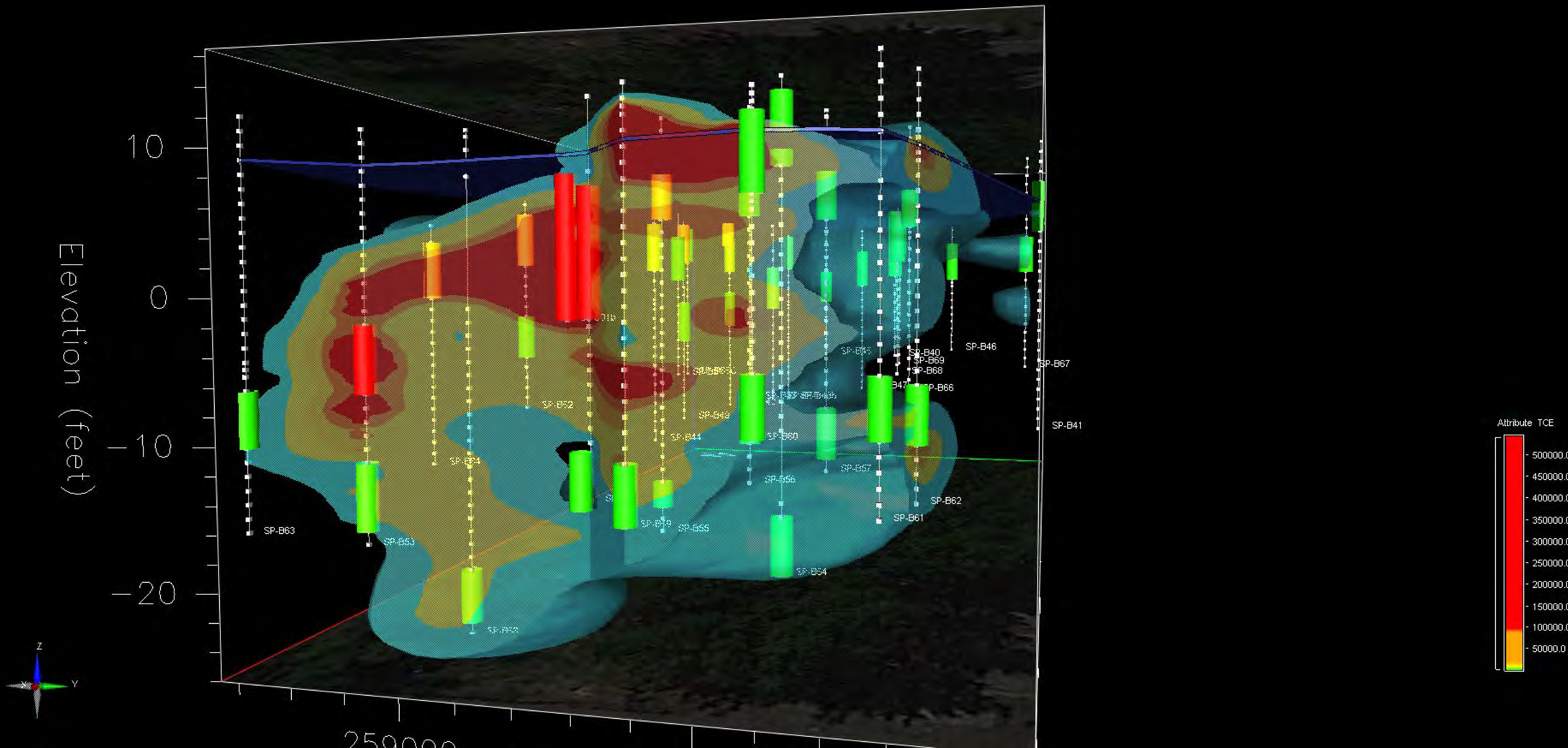
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SP-B68
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SP-B40
SP-B46
SP-B67
SP-B41
B47
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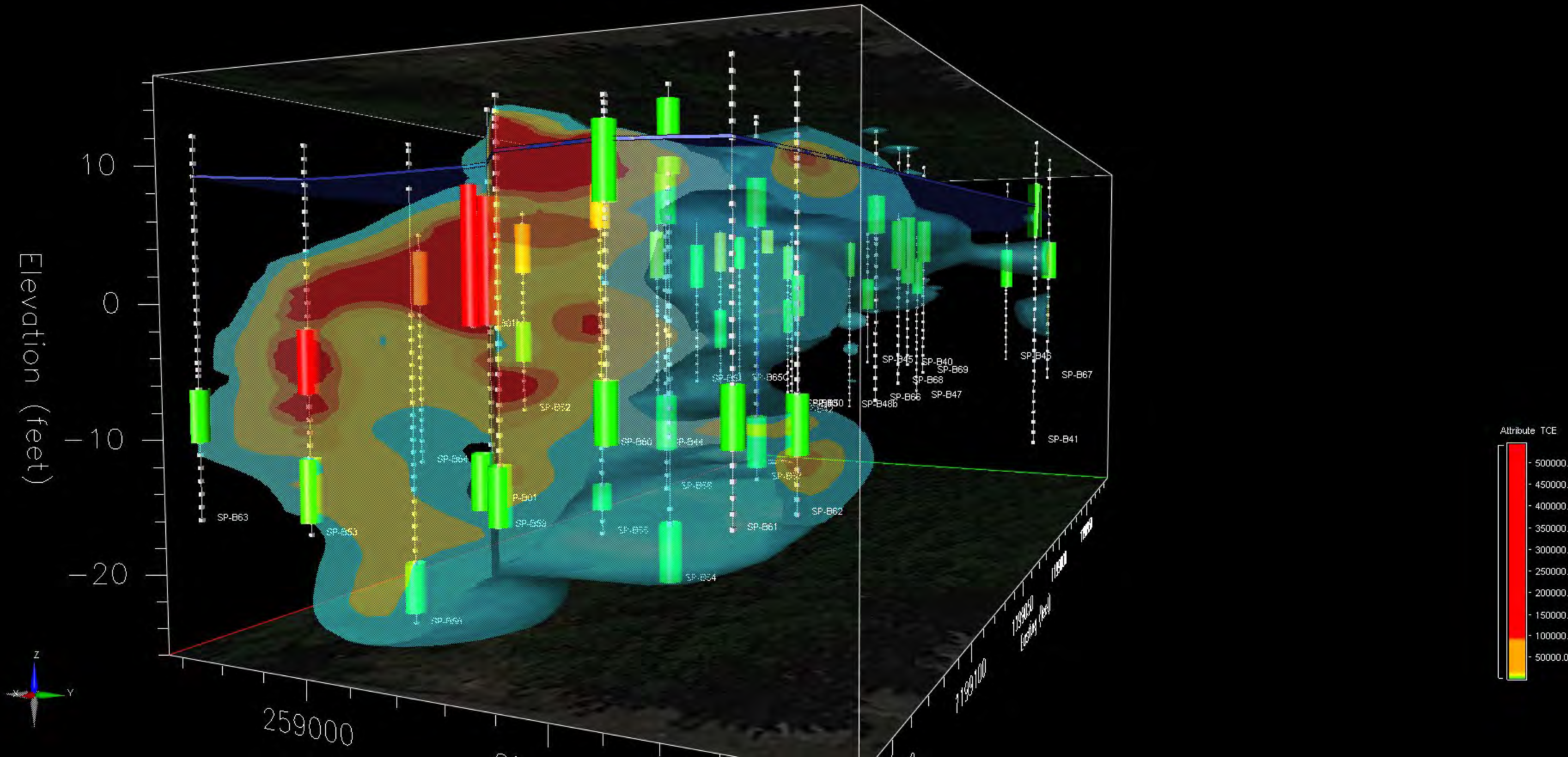
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Easting (feet)
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SP-B67
SP-B41
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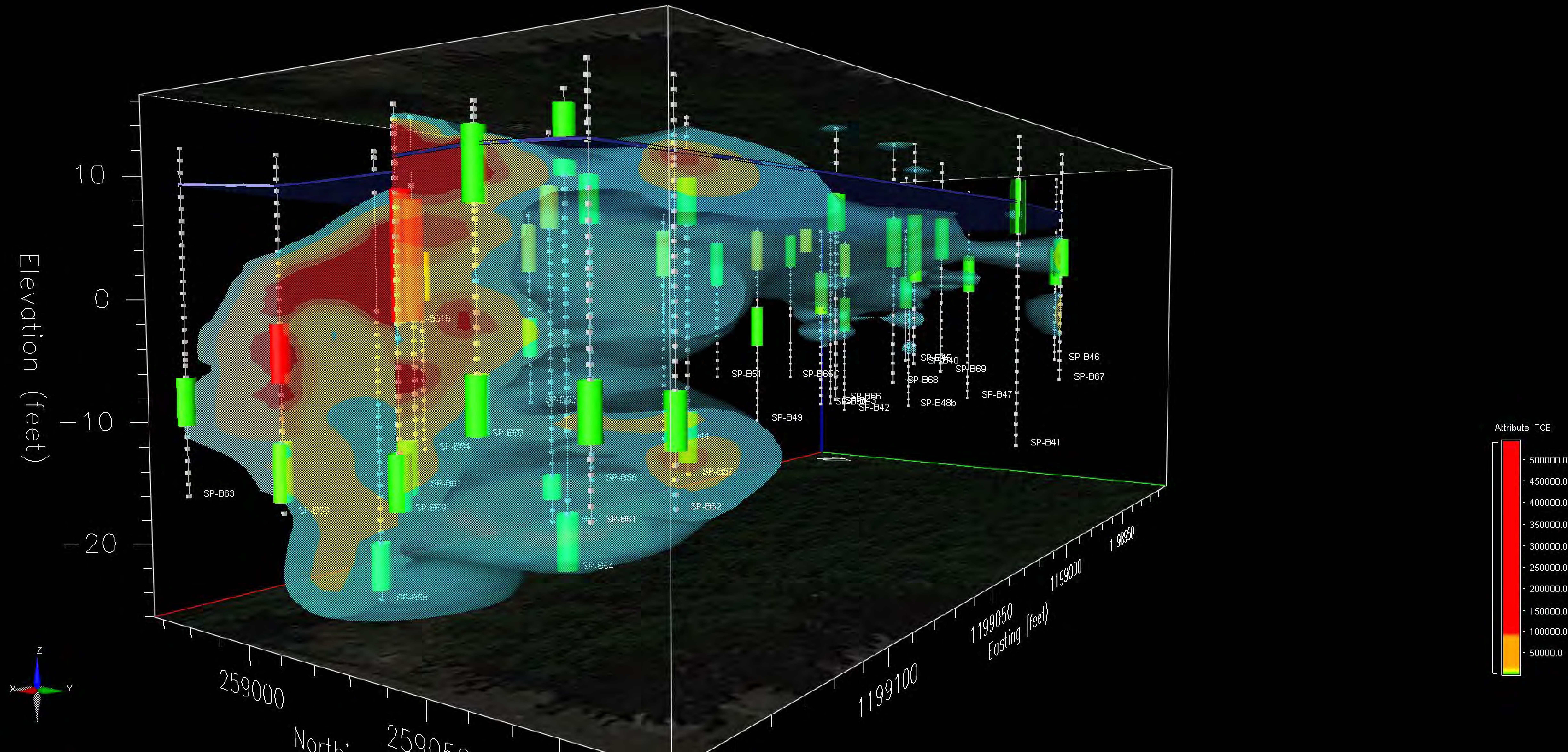
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SP-B67
SP-B41
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North
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1199050
1199000
Easting (feet)
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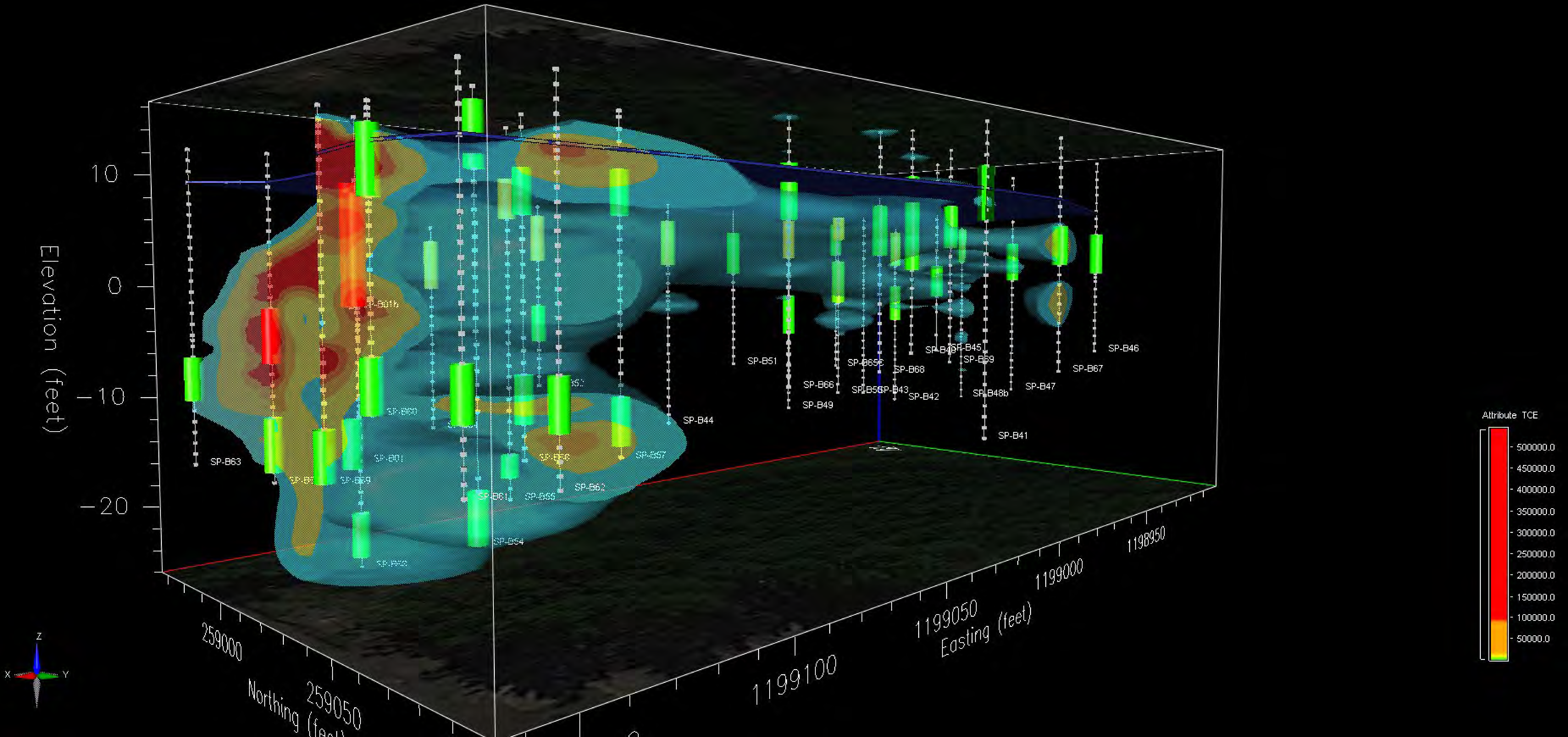
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Easting (feet)
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1199050
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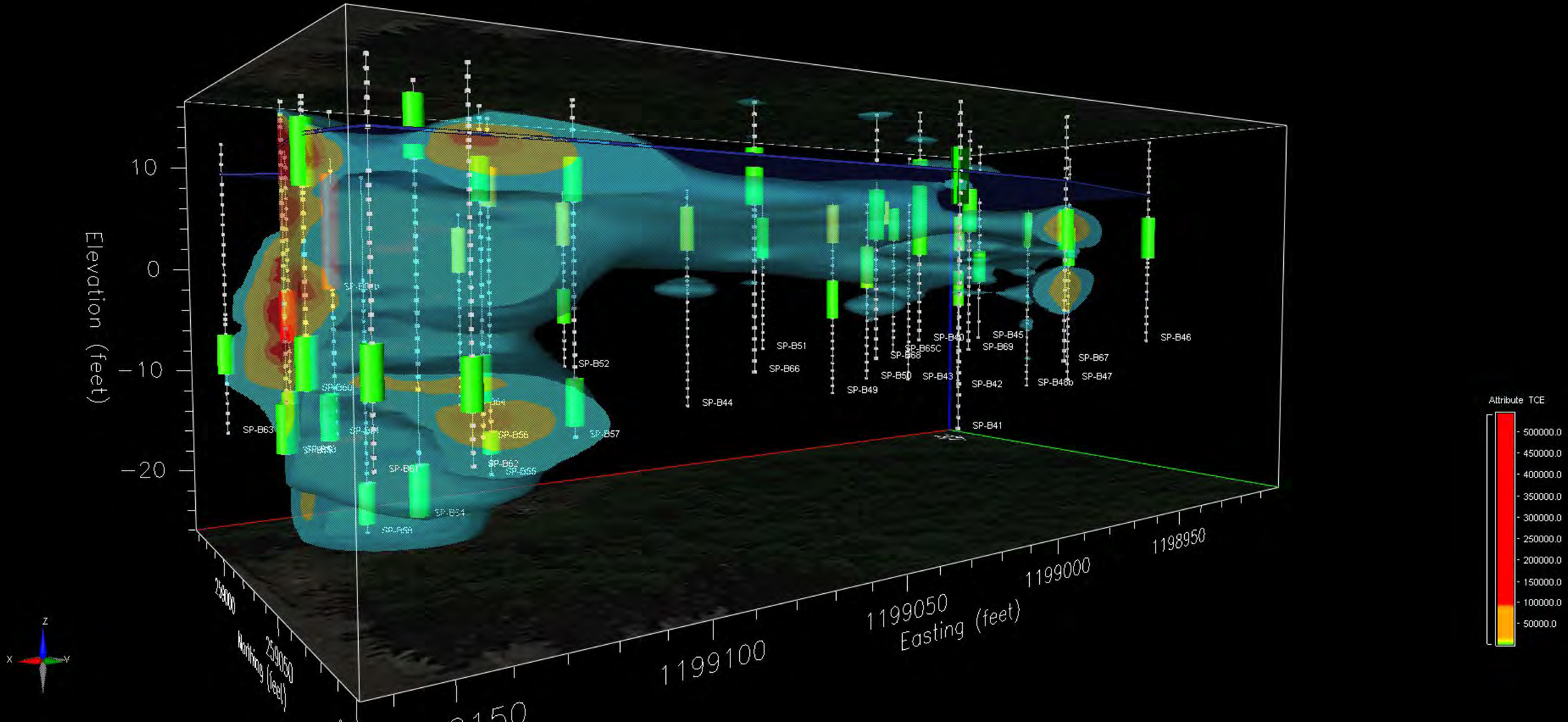
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SP-B46
Northing (feet)
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1199150
1199100
1199050
1199000
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Easting (feet)
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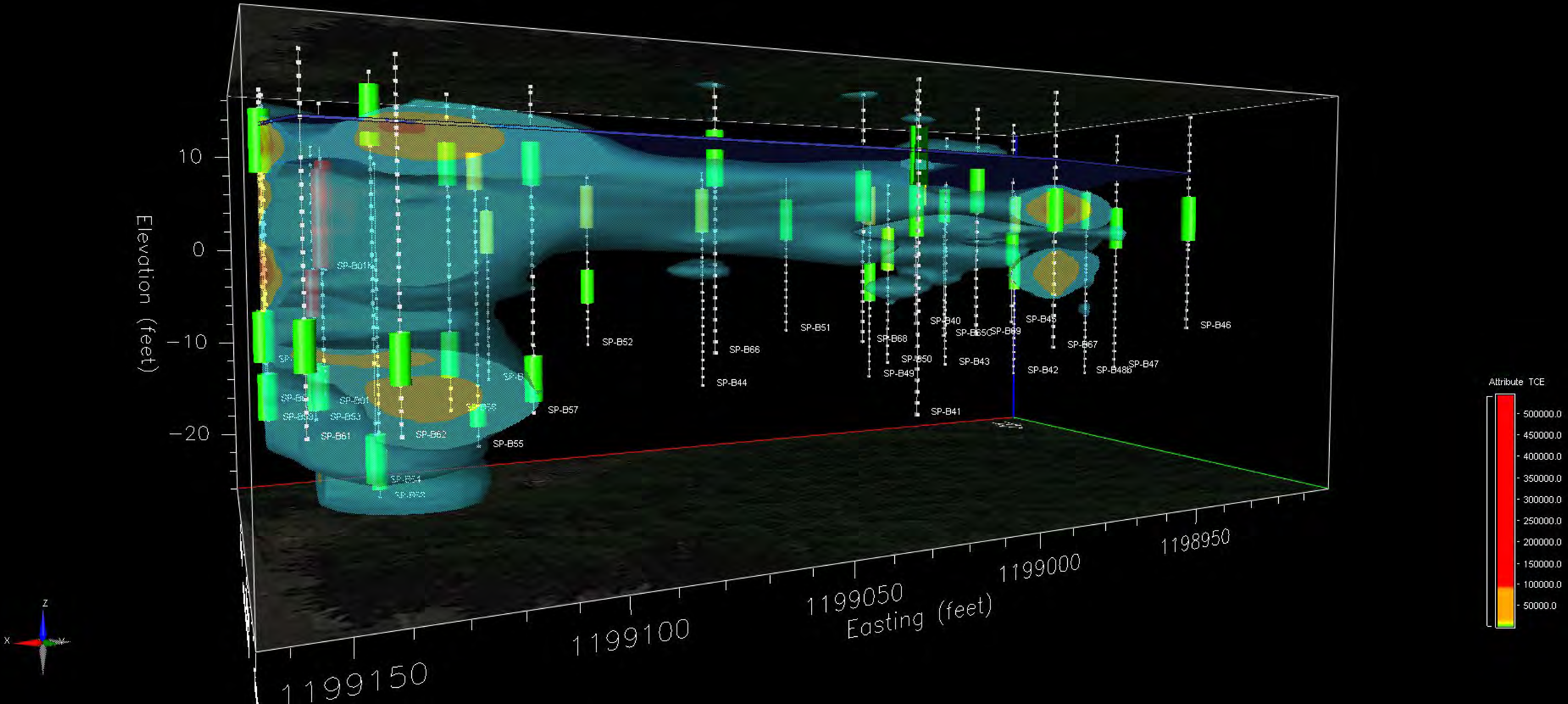
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SP-B54
Easting (feet)
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1199100
1199050
1199000
1198950
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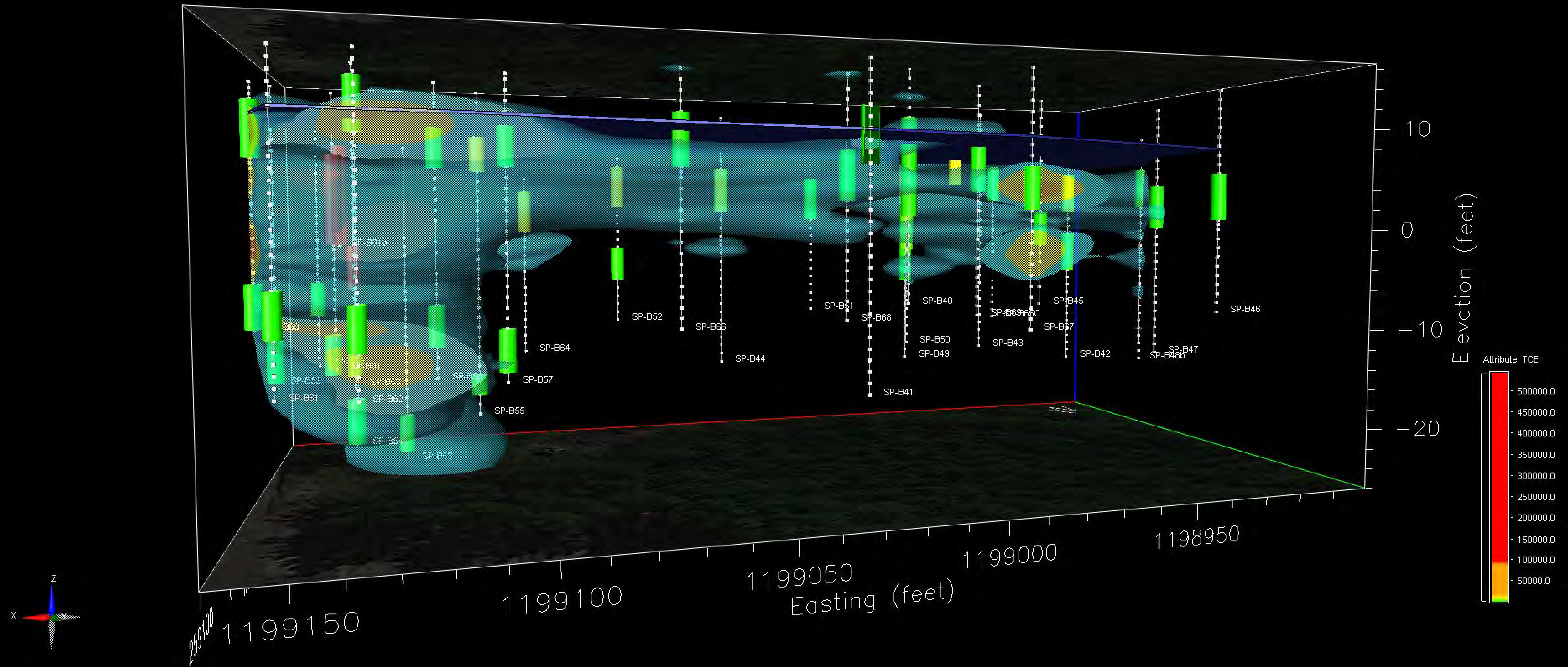
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SP-B48b
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SP-B55
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SP-B62
SP-B53
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−10
−20
Elevation (feet)
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1199100
1199050
1199000
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Easting (feet)
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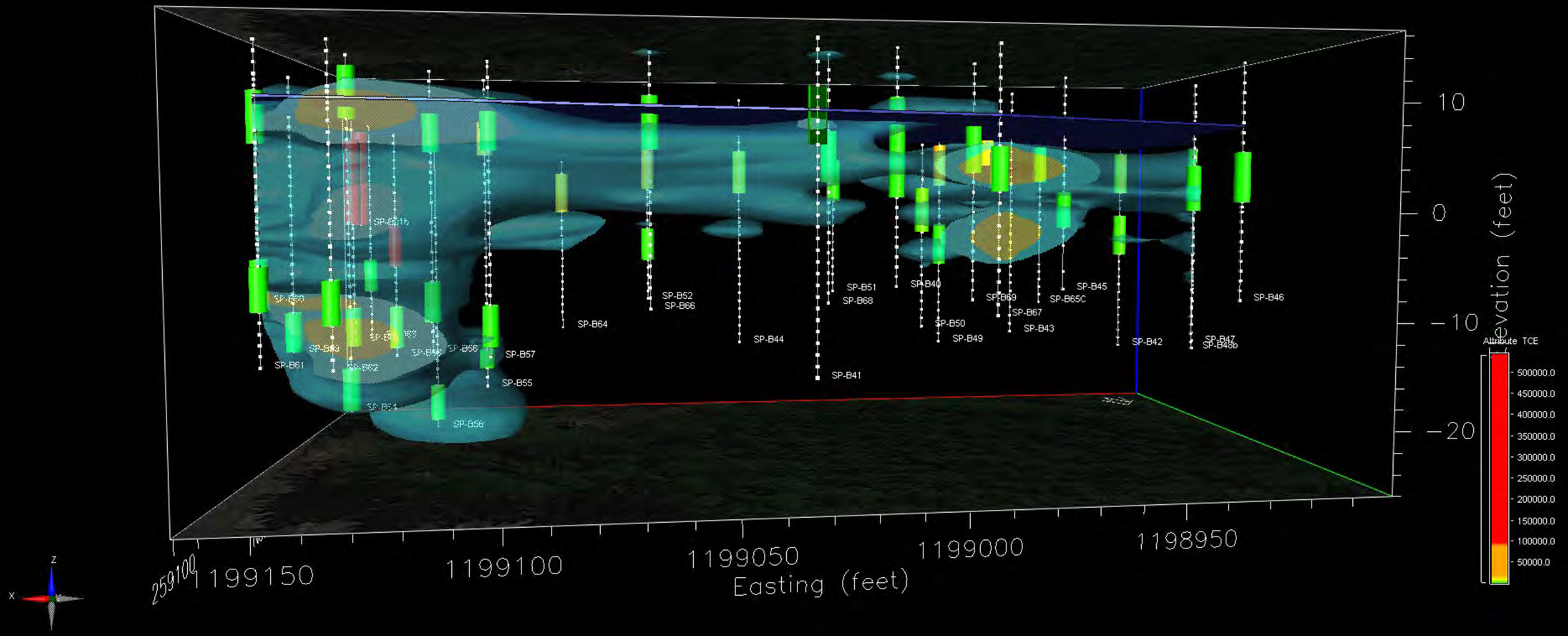
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SP-B48b
SP-B46
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−20
Elevation (feet)
259100
1199150
1199100
1199050
1199000
1198950
Easting (feet)
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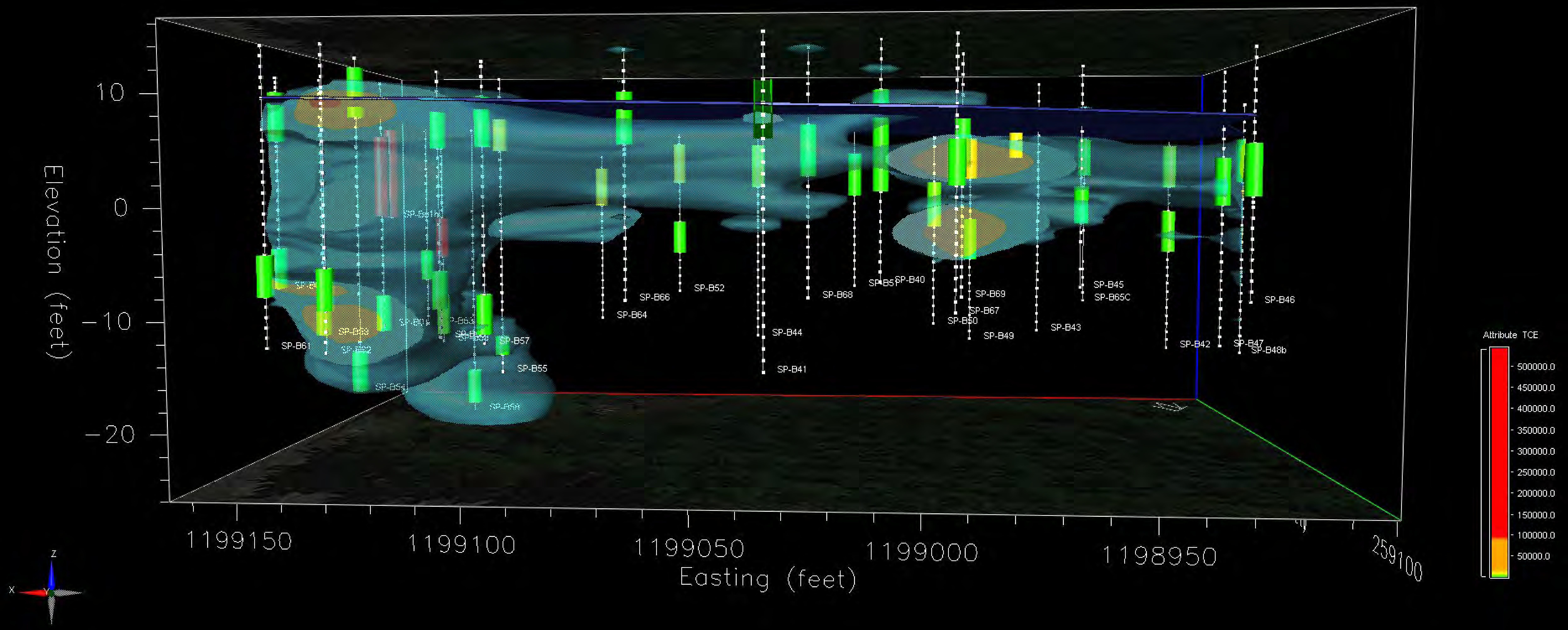
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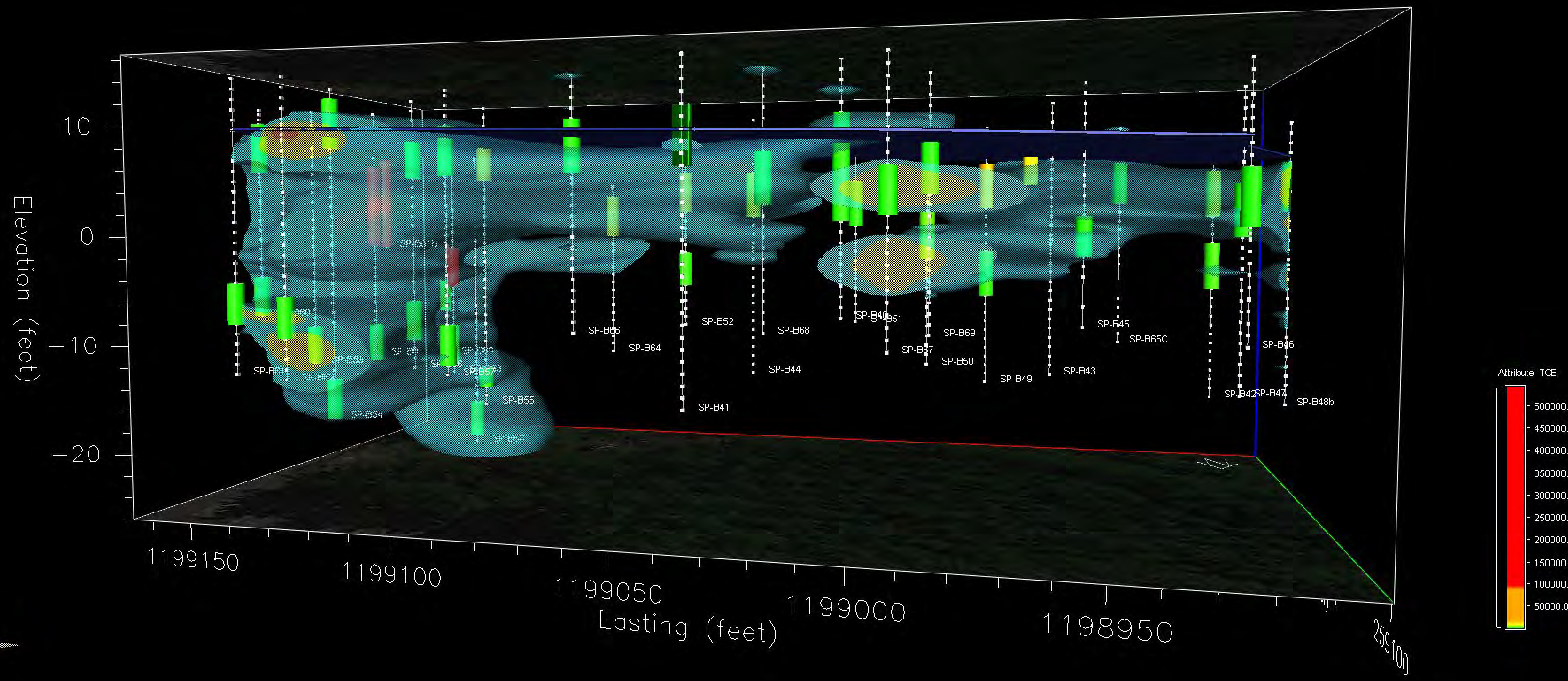
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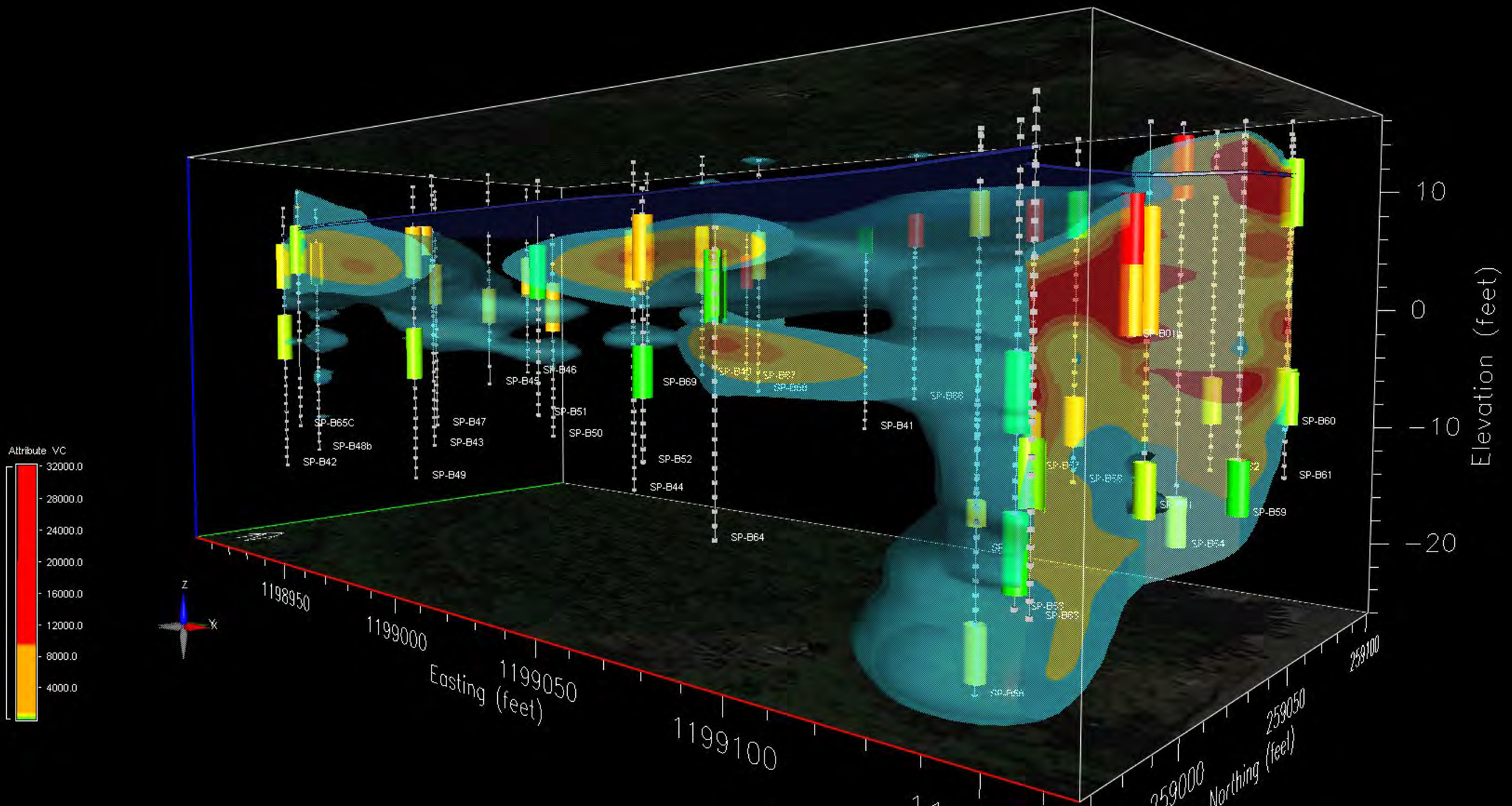
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SP-B54
SP-B63
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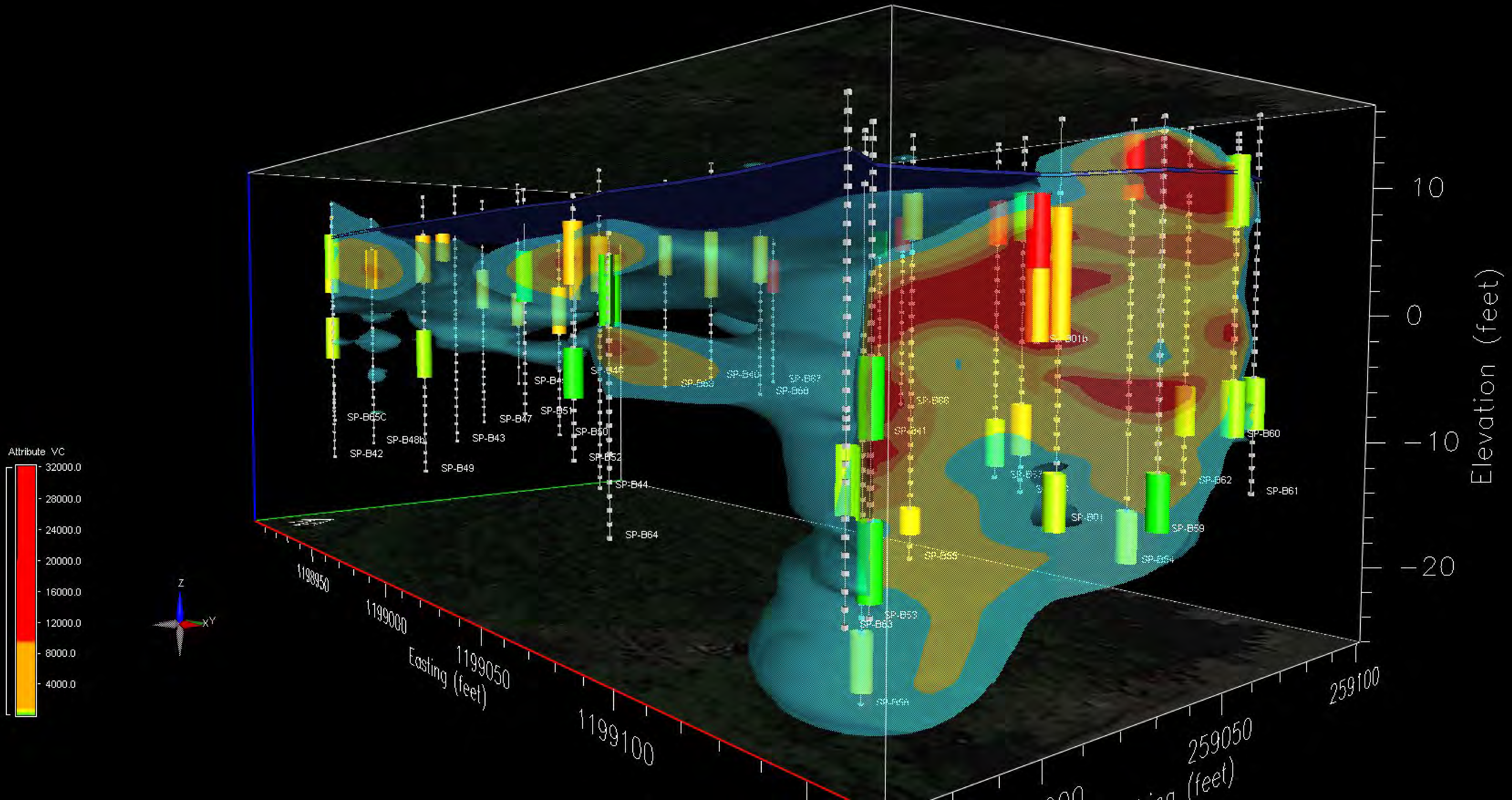
Elevation (feet)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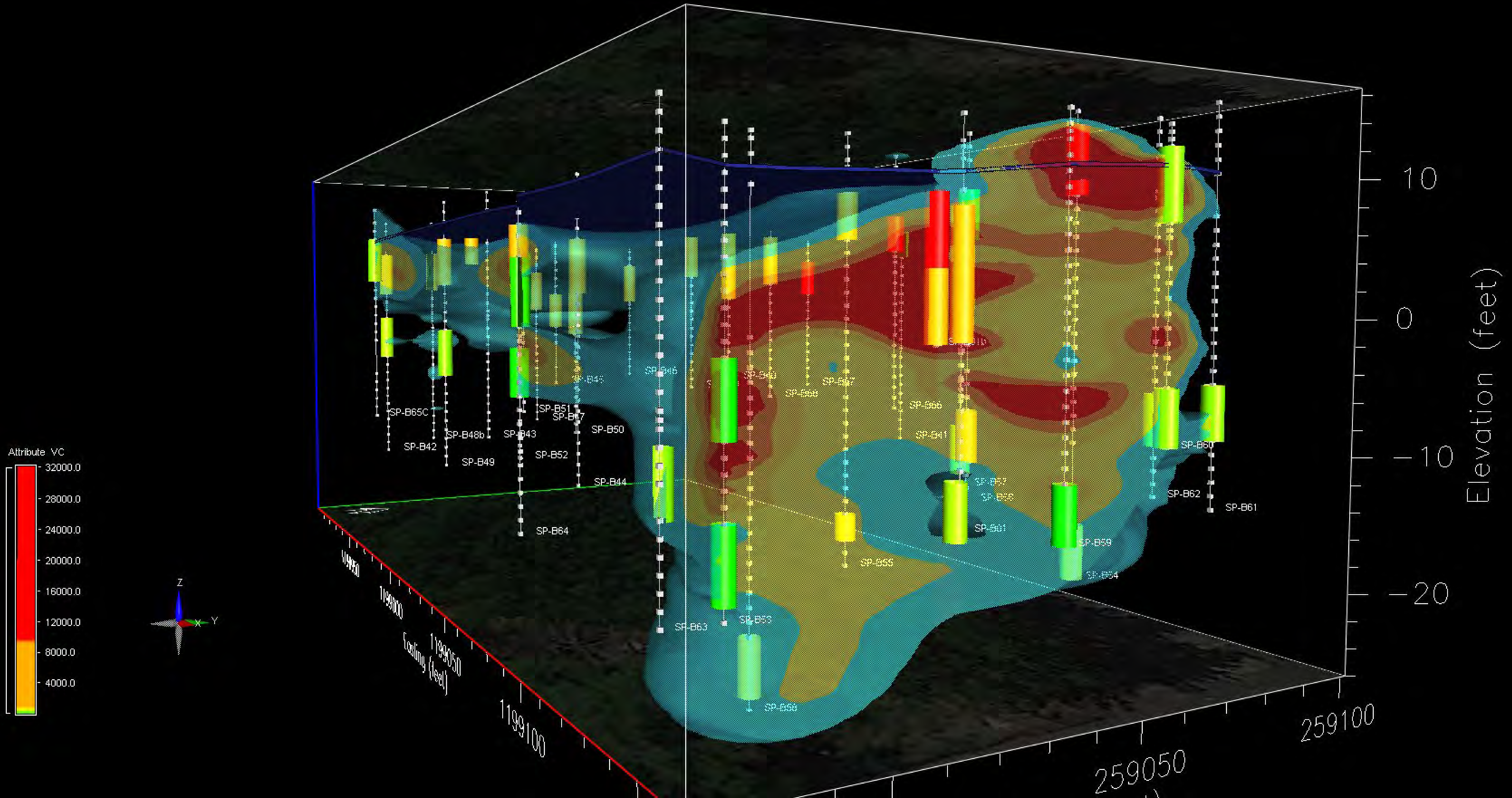
Elevation (feet)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SP-B62
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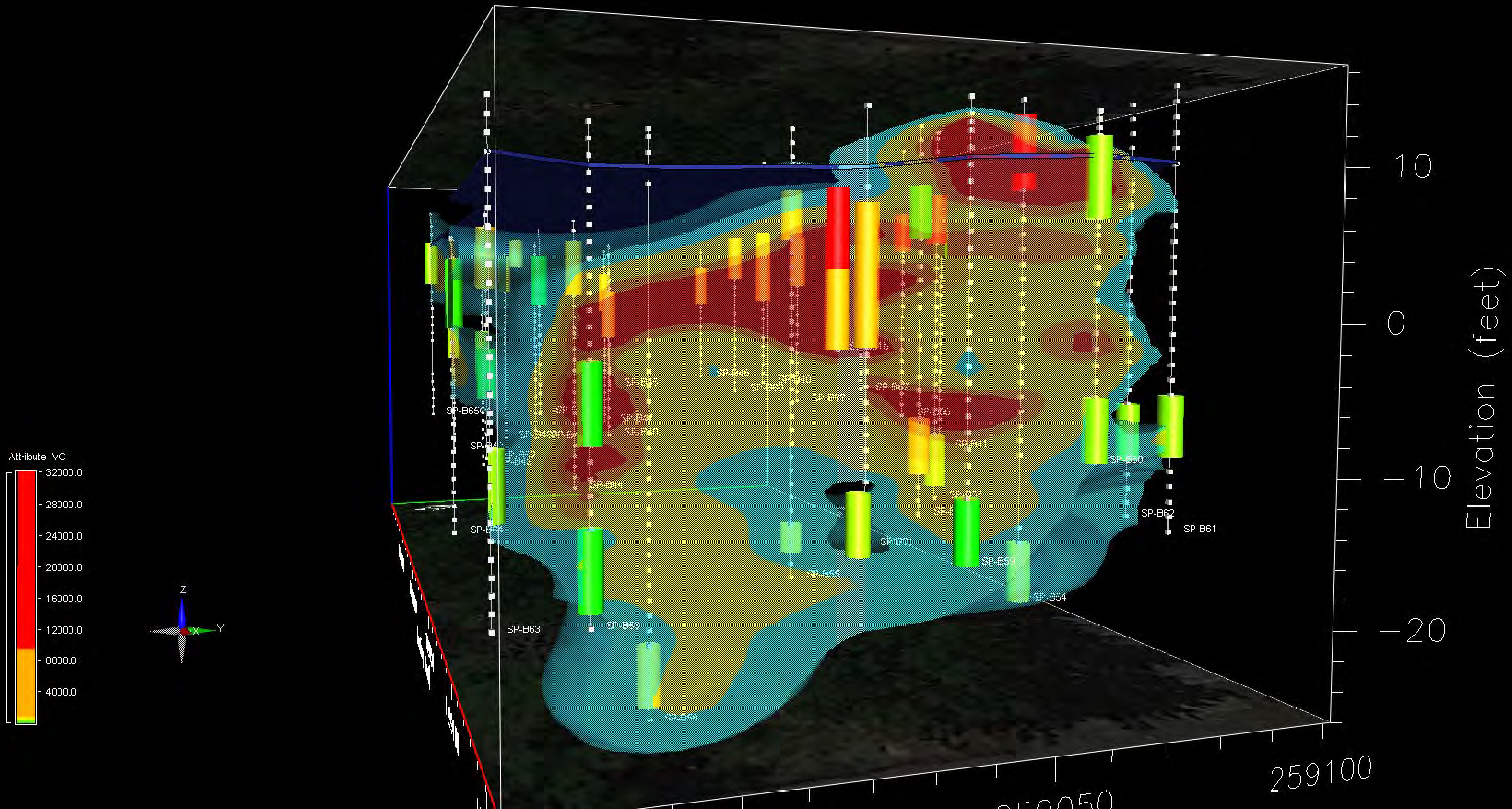
Elevation (feet)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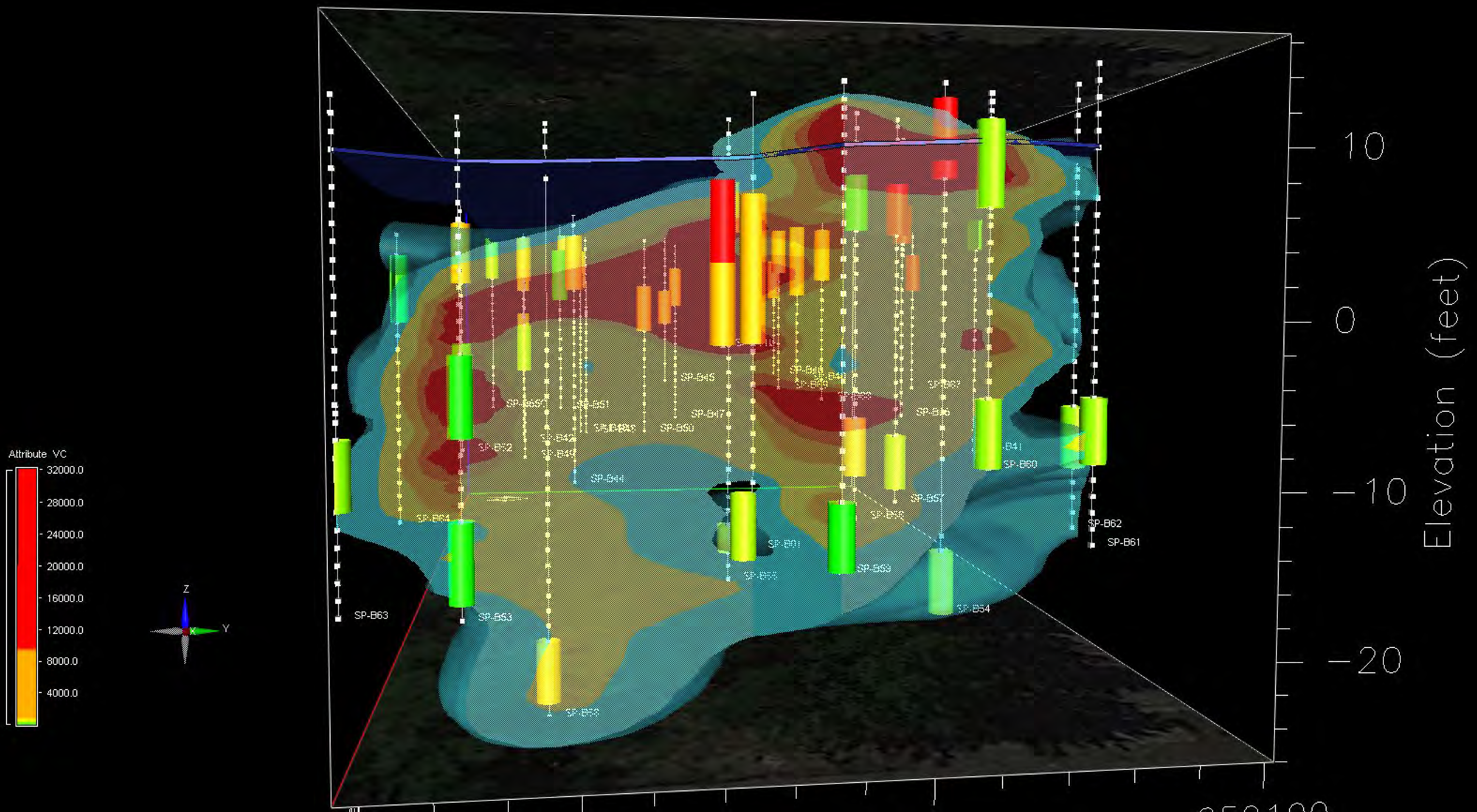
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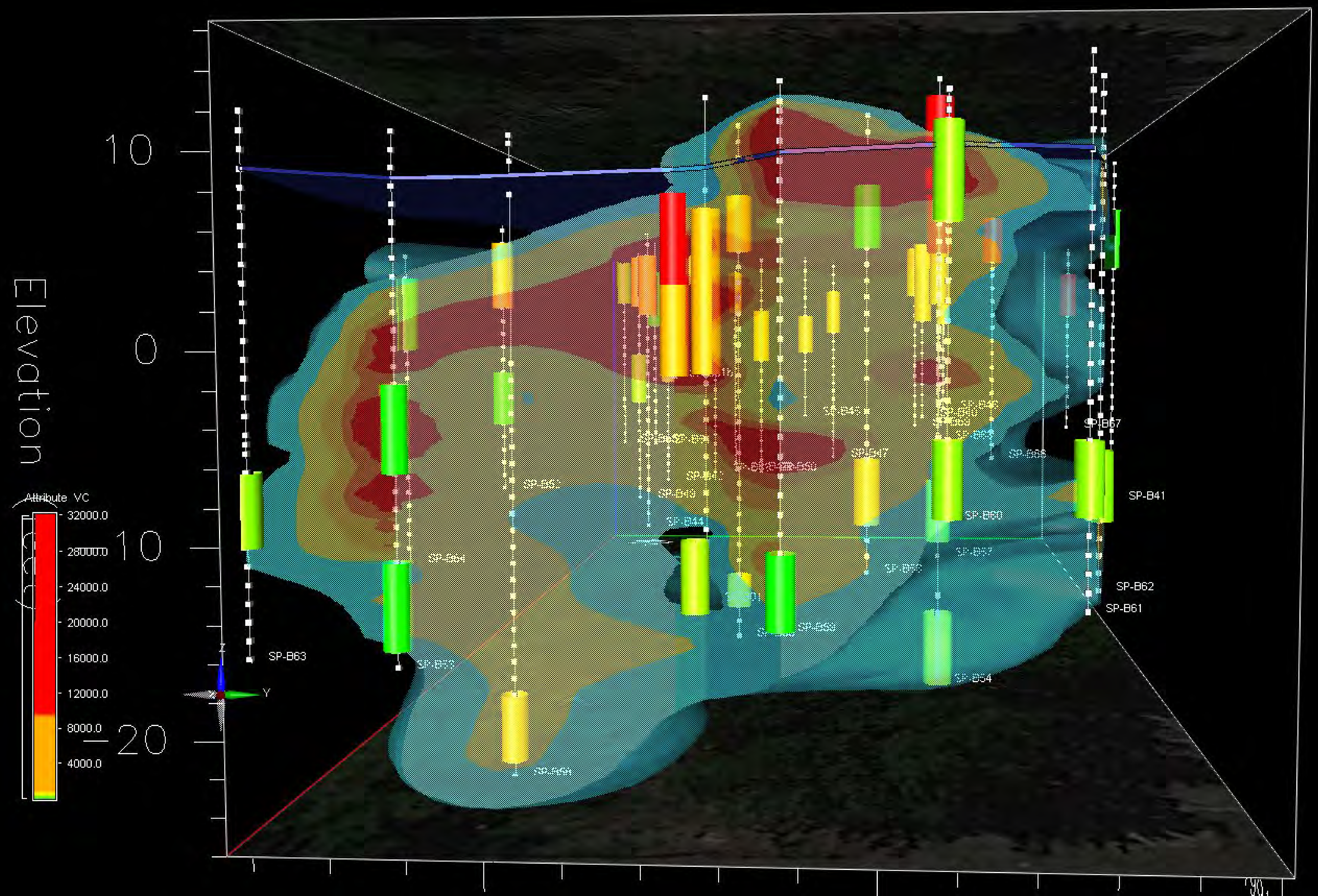
Elevation (feet)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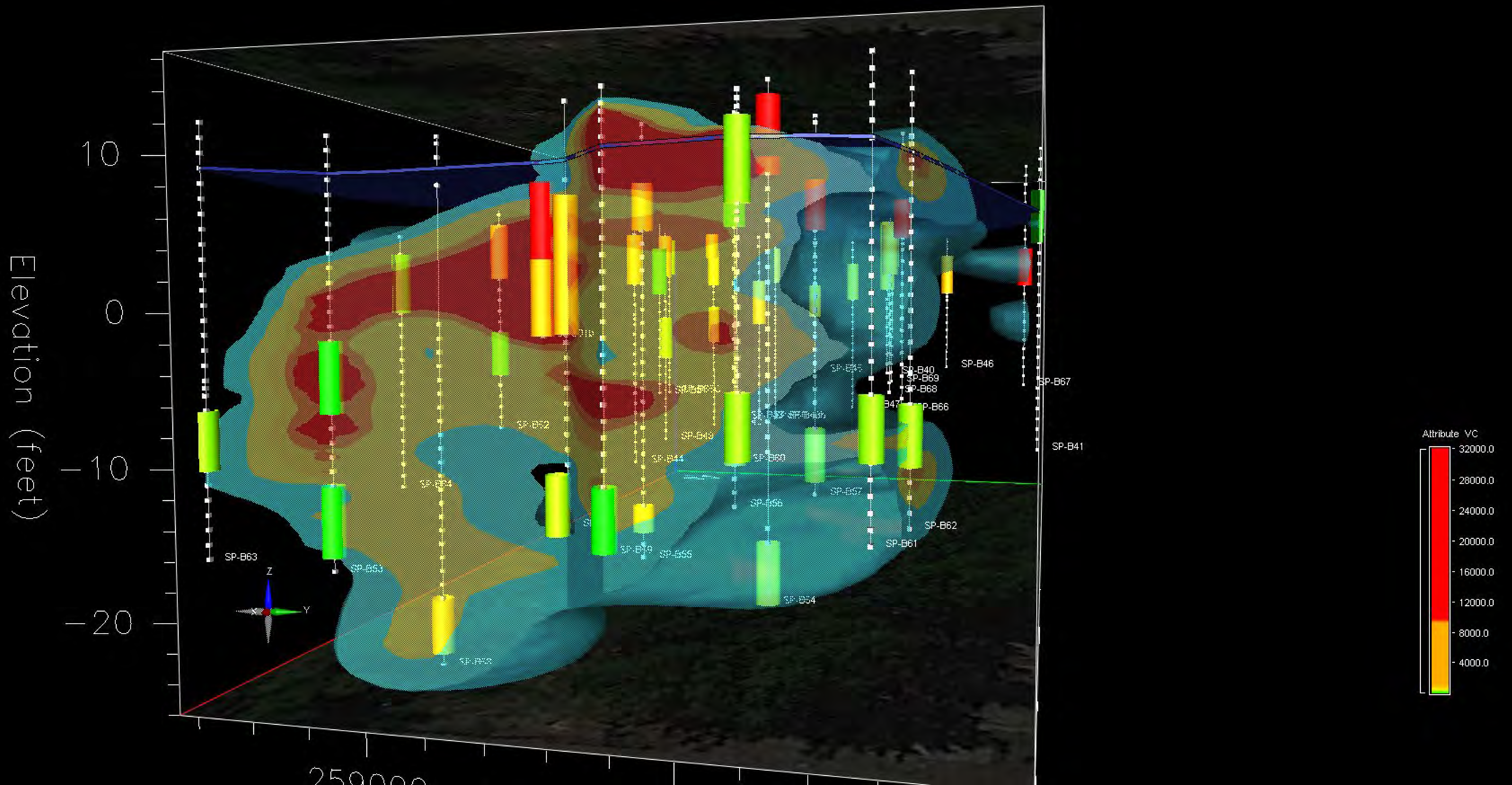
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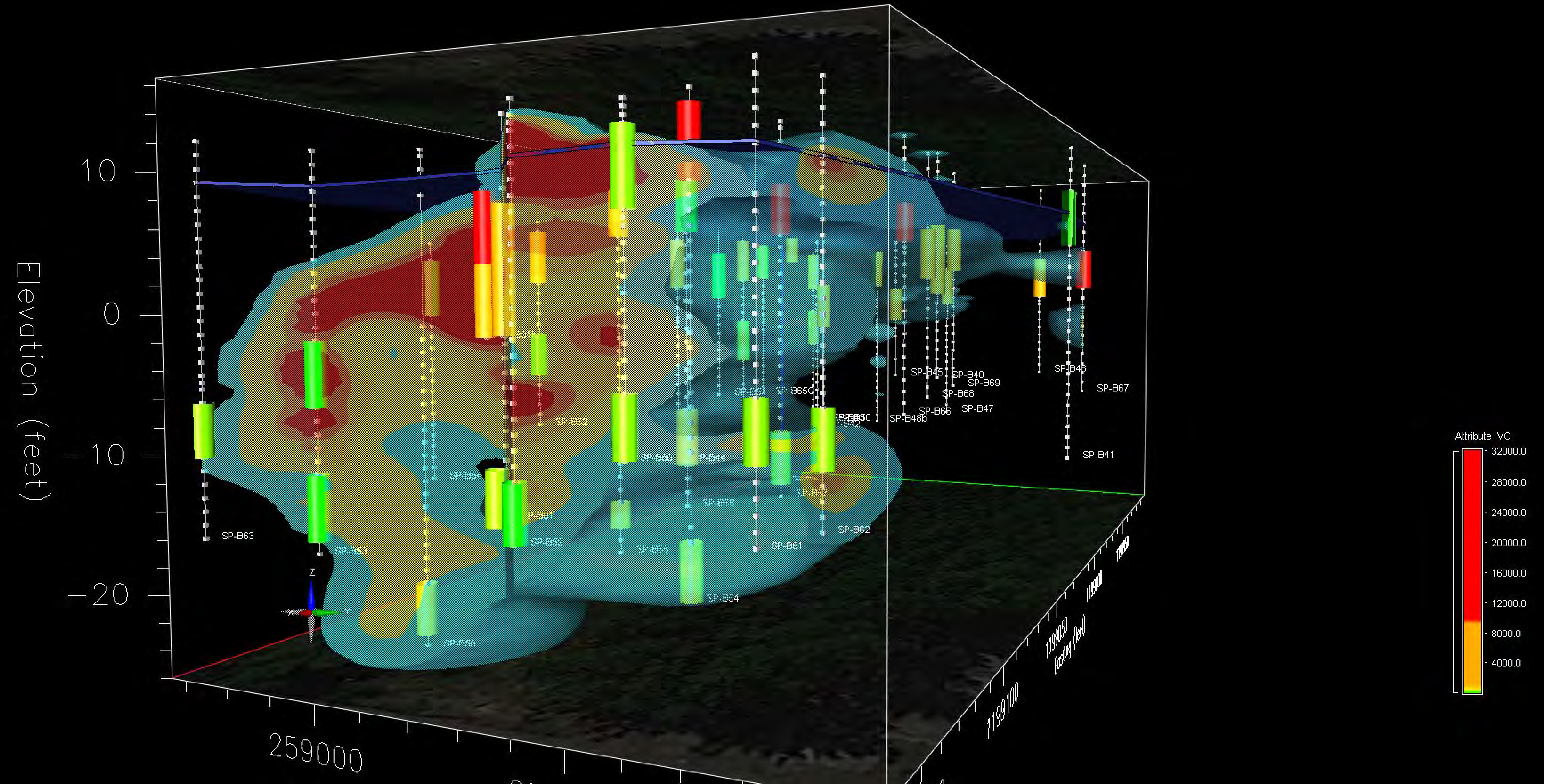
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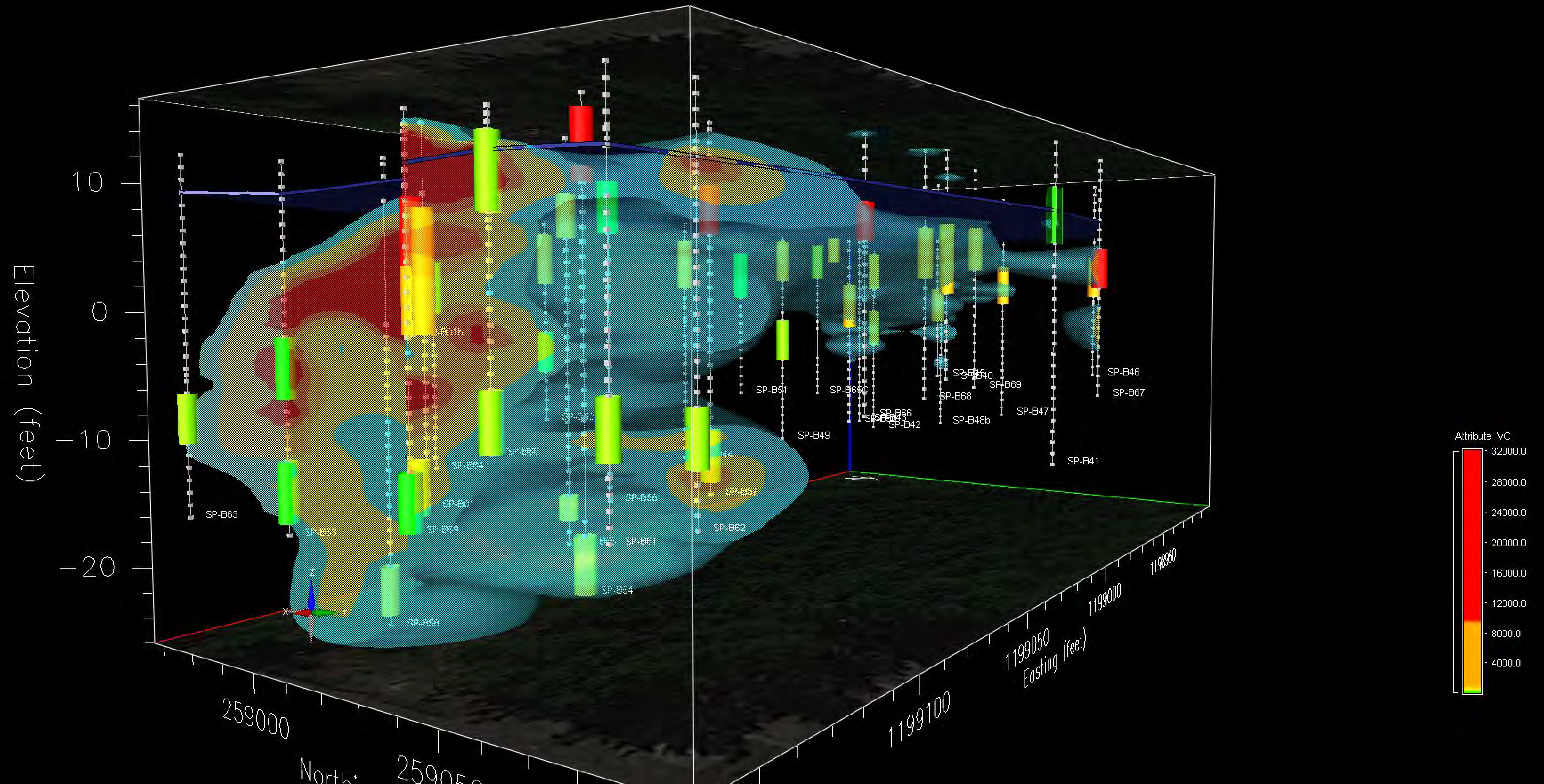
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Easting (feet)
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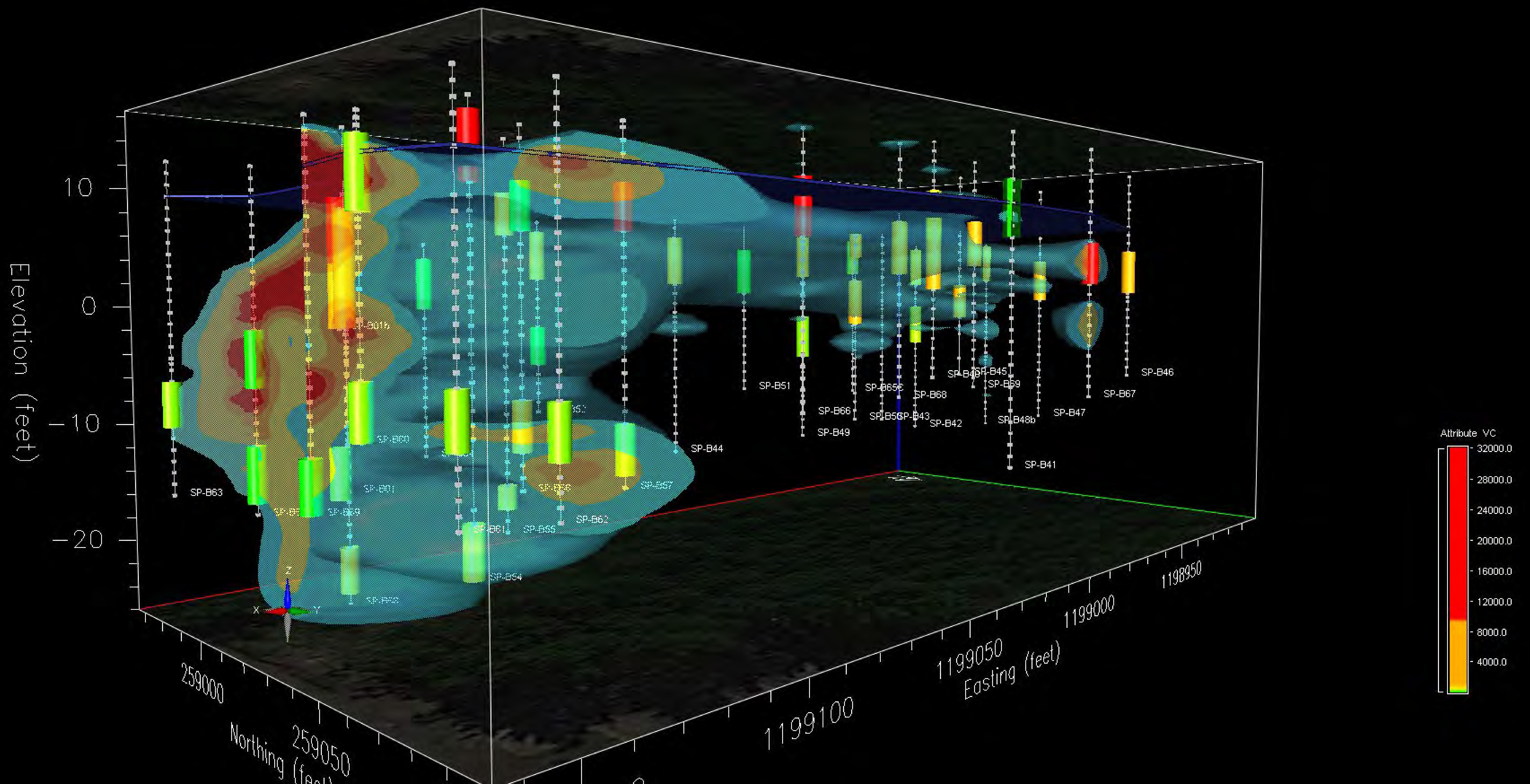
Y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Easting (feet)
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X
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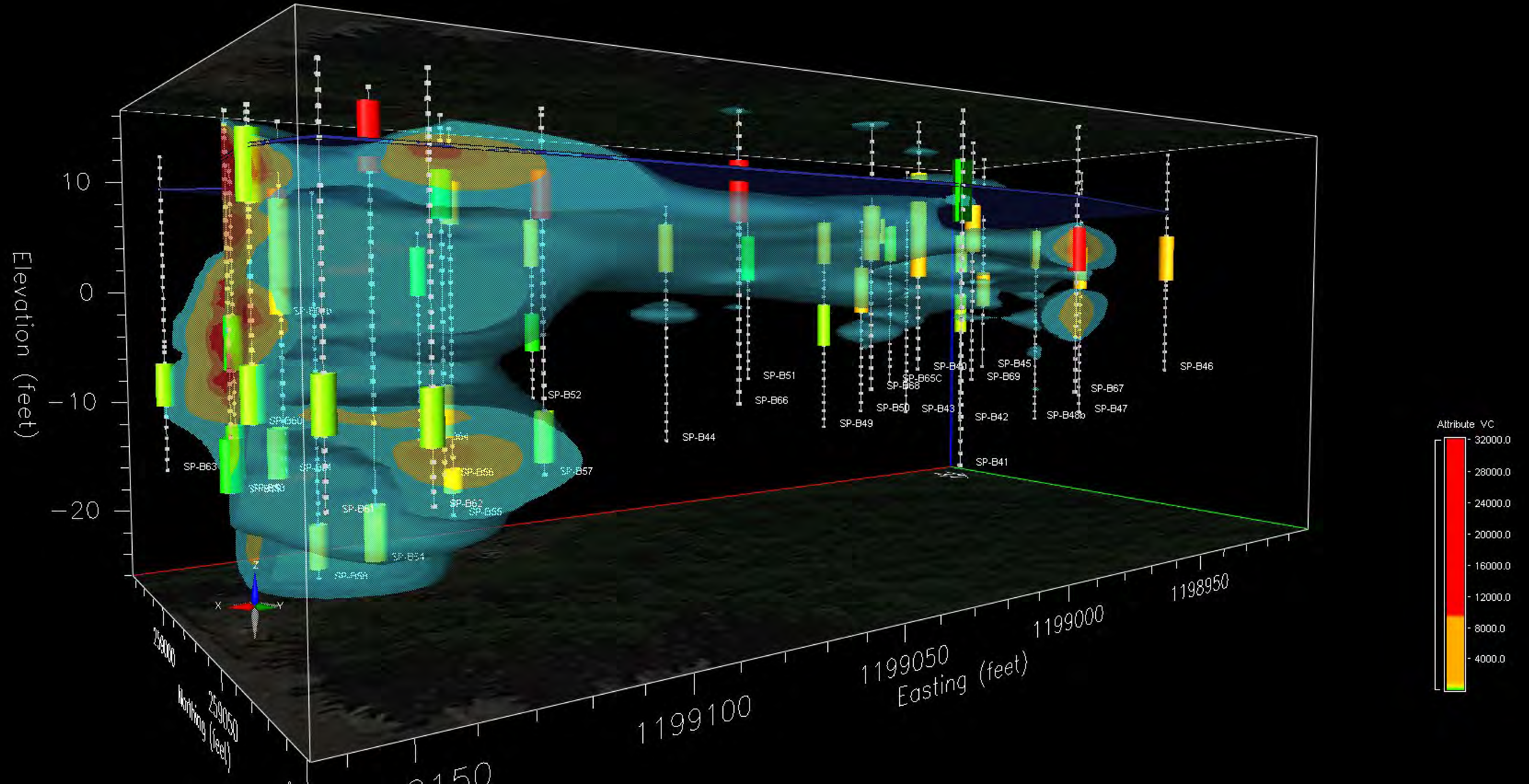
Z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Northing (feet)
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150
X
Y
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SP-B61
SP-B52
SP-B57
SP-B56
SP-B62
SP-B55
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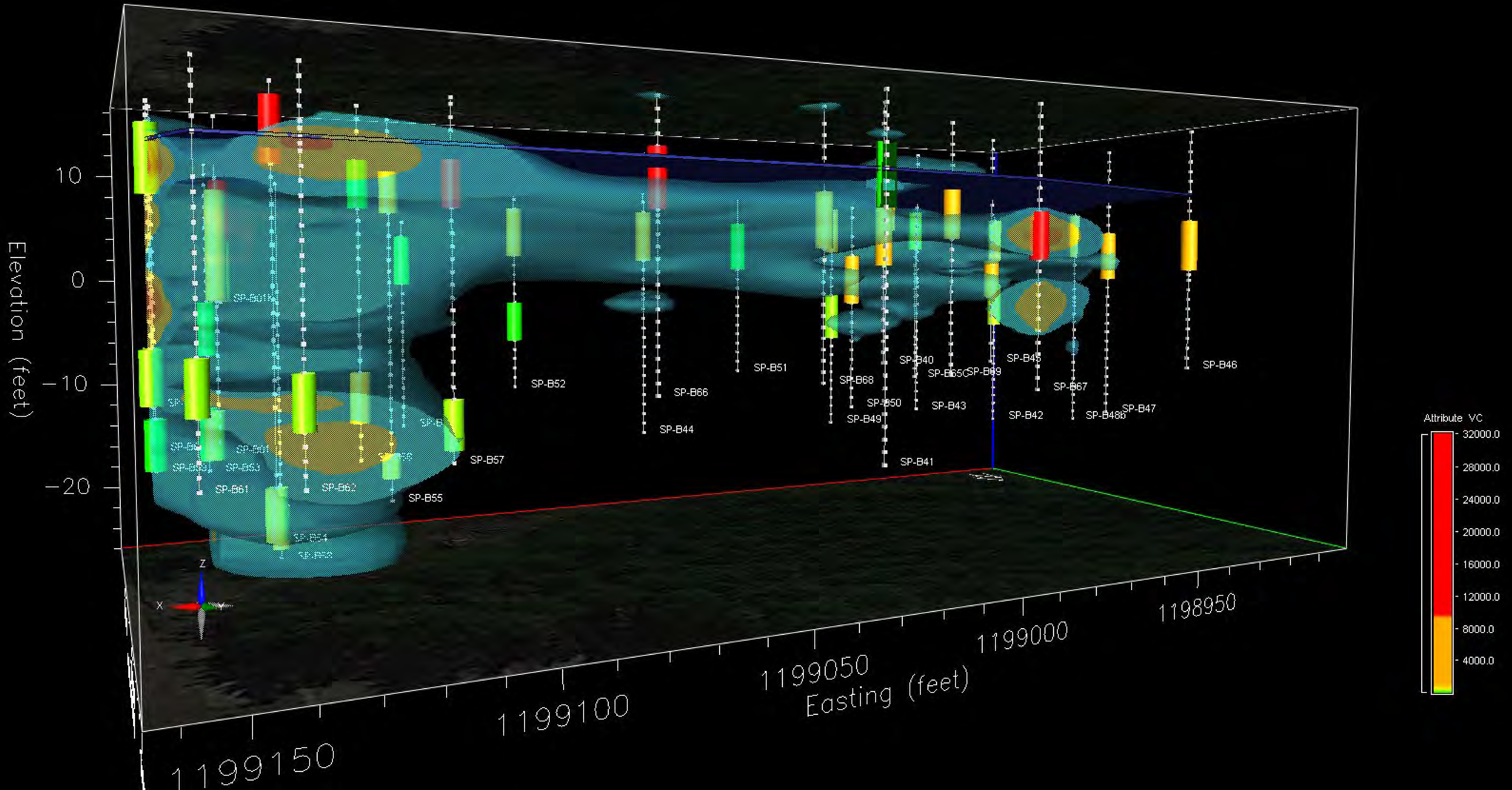
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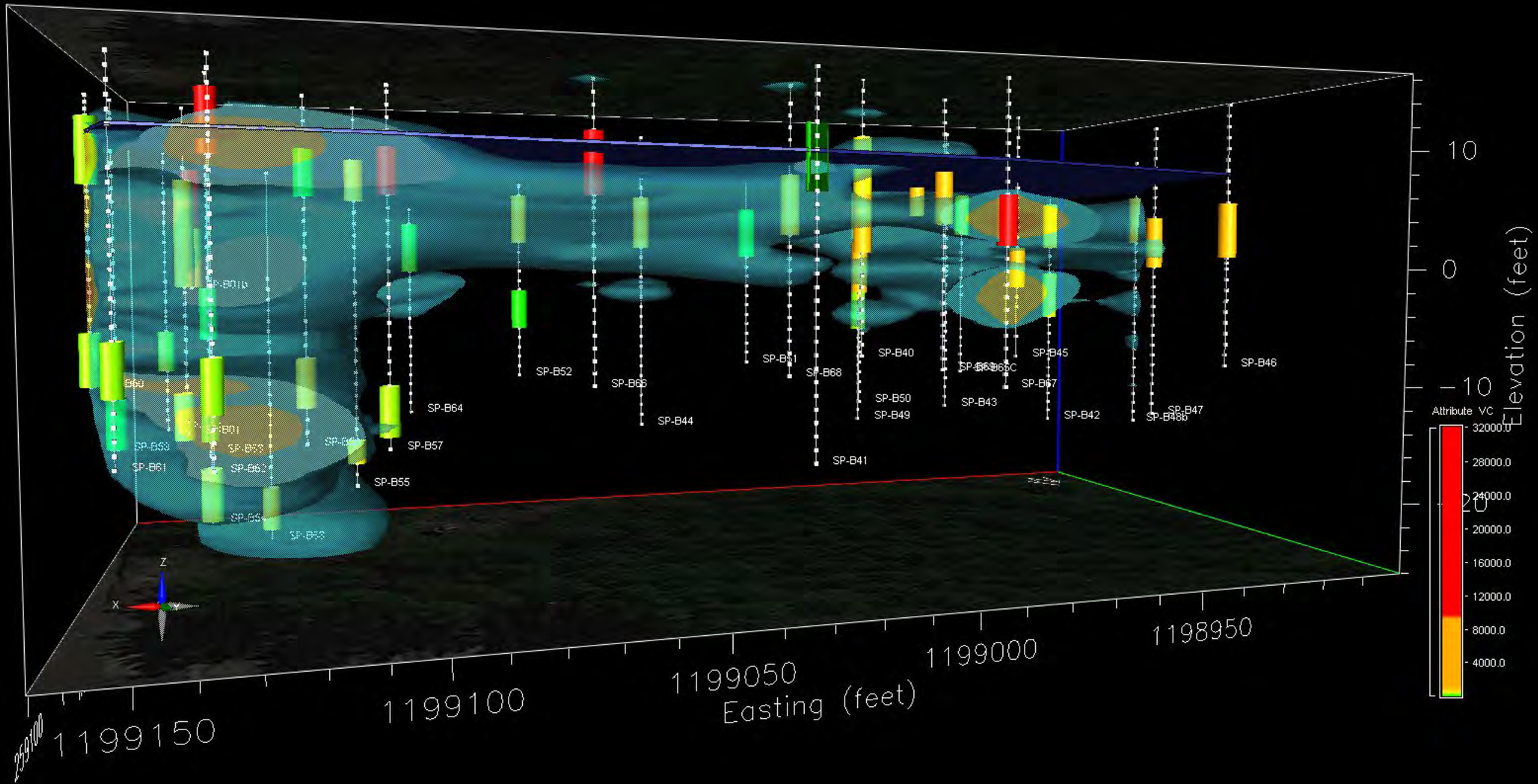
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SP-B47
SP-B48b
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10
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Elevation (feet)
Attribute VC
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28000.0
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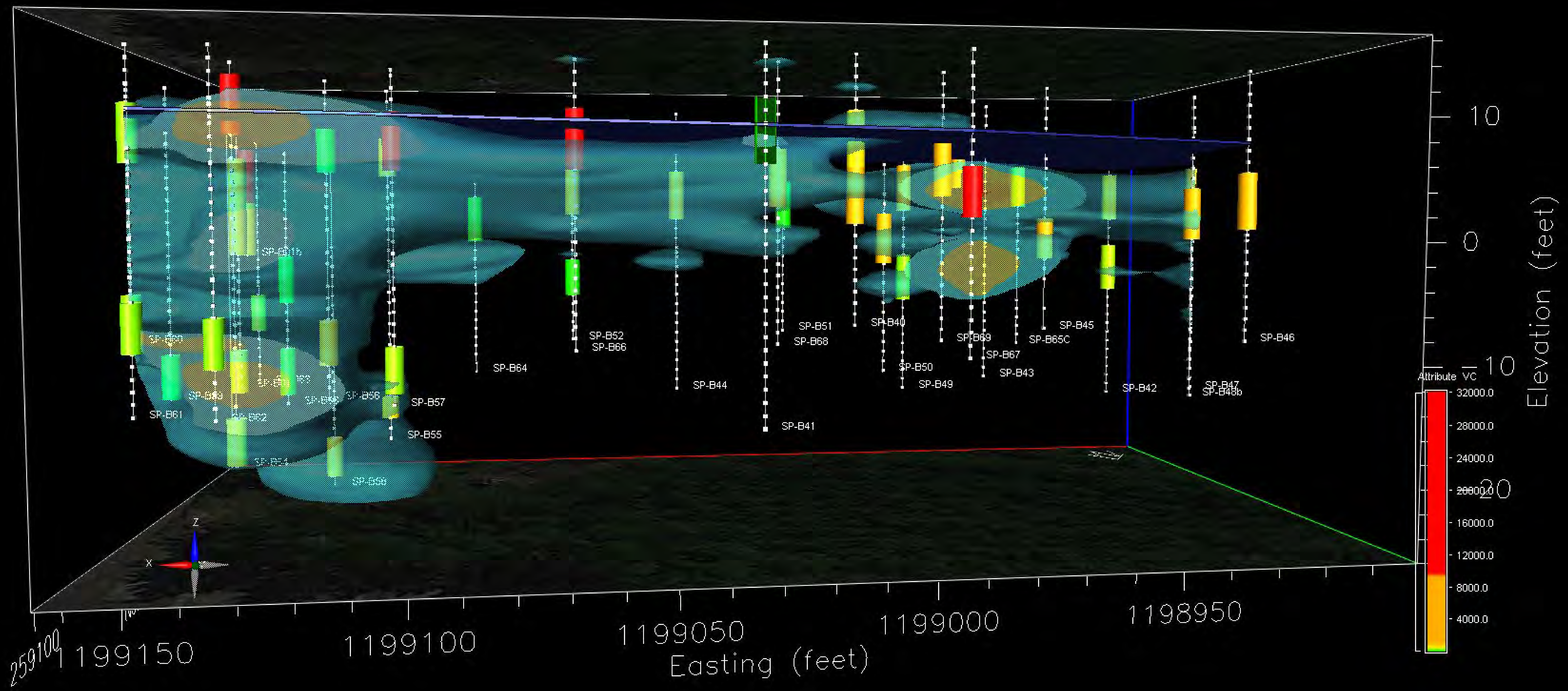
X
Y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SP-B46
Attribute VC
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28000.0
24000.0
20000.0
16000.0
12000.0
8000.0
4000.0
10
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-10
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Elevation (feet)
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1199100
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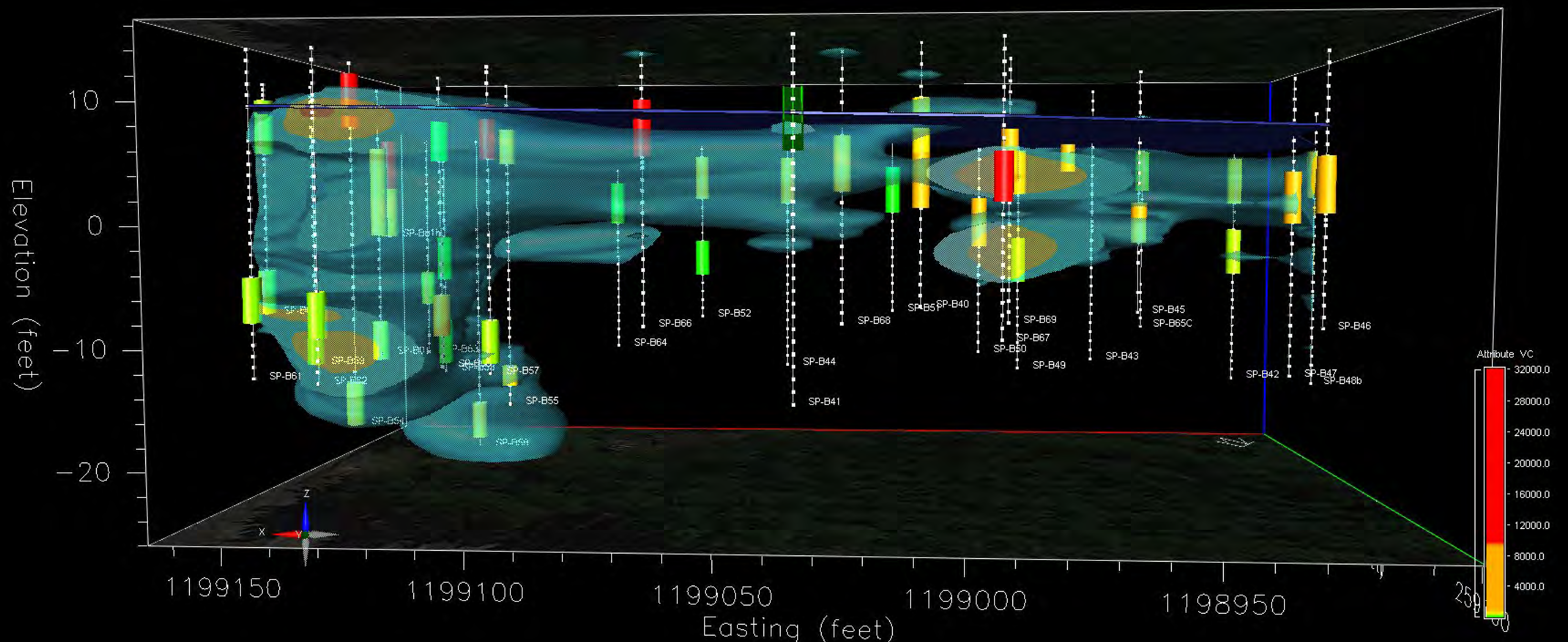
1199000
1198950
Easting (feet)
259100
Z
X



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−10
−20
Easting (feet)
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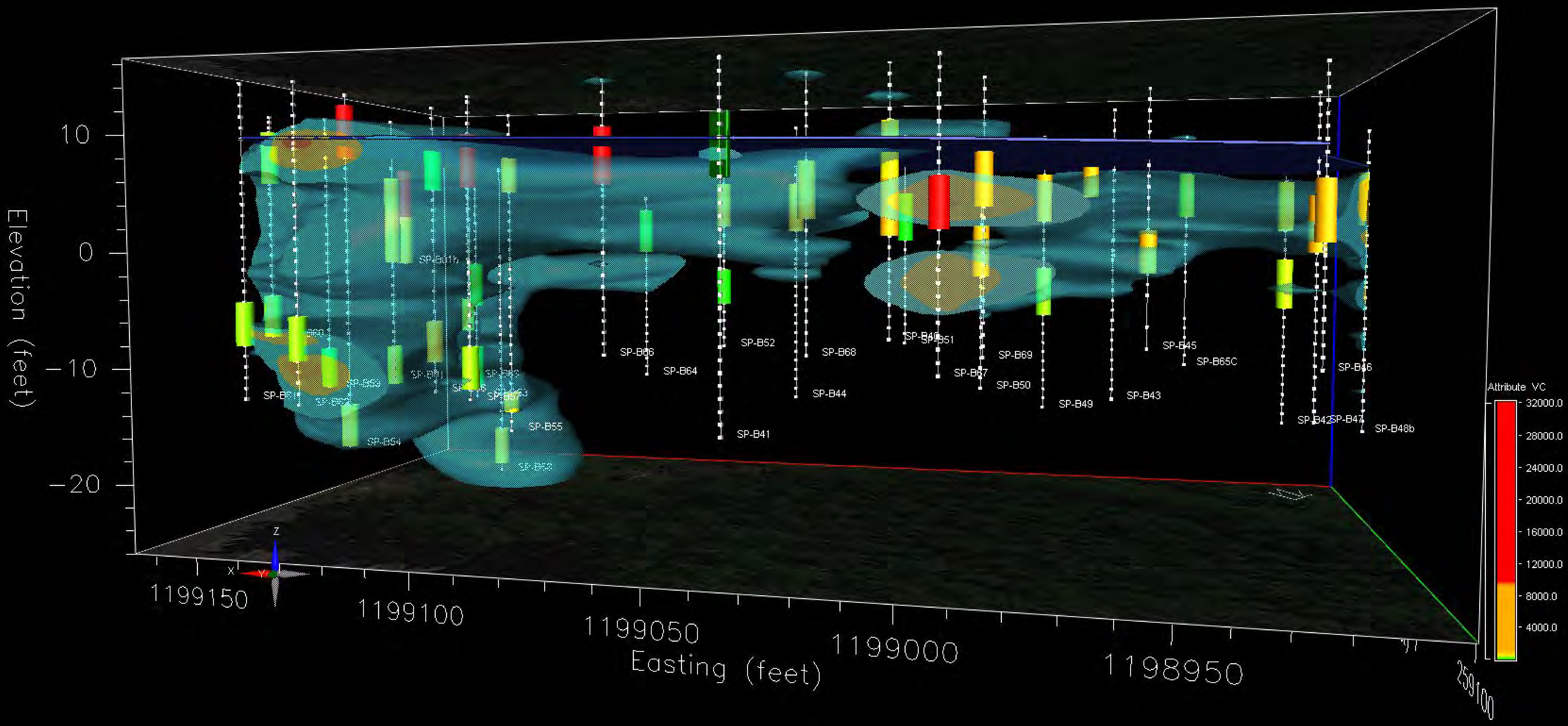
Elevation (feet)
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Easting (feet)
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Z
X
Y
SP-B66
SP-B64
SP-B52
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SP-B67
SP-B69
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SP-B54
SP-B55
Attribute VC
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24000.0
20000.0
16000.0
12000.0
8000.0
4000.0

APPENDIX I

Risk Calculations

EPA Advanced KM TEQ Calculator Version 9.1, issued July 31, 2014

Chemical Sort Order:	18	19	20	21	22	23	24	25	26	27	28	29
WHO 2005 TEFs =	0.0001	0.0003	0.00003	0.00003	0.00003	0.00003	0.1	0.00003	0.00003	0.00003	0.03	0.00003
Sample ID: (must enter on Row A)	PCB 77	PCB 81	PCB 105	PCB 114	PCB 118	PCB 123	PCB 126	PCB 156	PCB 157	PCB 167	PCB 169	PCB 189
MA09: Row A	2.2	0.046 J	19	1.2	58	1	0.085 U	8.1		2.5	0.085 U	0.2
value to use: Row B	2.2	0.046	19	1.2	58	1	0.085	8.1		2.5	0.085	0.2
congener TEC: Row C	0.00022	0.0000138	0.00057	0.000036	0.00174	0.00003	0.0085	0.000243		0.000075	0.00255	0.000006
donor value to use: Row D												
donor TEC: Row E												
MA14: Row A	0.038	0.012 U	0.48	0.022	1.4	0.018	0.012 U	0.2		0.074	0.012 U	0.0081 U
value to use: Row B	0.038	0.012	0.48	0.022	1.4	0.018	0.012	0.2		0.074	0.012	0.0081
congener TEC: Row C	0.0000038	0.0000036	0.0000144	0.00000066	0.000042	0.00000054	0.0012	0.000006		0.00000222	0.00036	0.000000243
donor value to use: Row D												
donor TEC: Row E												
MA14DUP: Row A	0.046	0.012 U	0.69	0.028	1.9	0.036	0.0067 U	0.34		0.12	0.012 U	0.014
value to use: Row B	0.046	0.012	0.69	0.028	1.9	0.036	0.0067	0.34		0.12	0.012	0.014
congener TEC: Row C	0.0000046	0.0000036	0.0000207	0.00000084	0.000057	0.00000108	0.00067	0.0000102		0.0000036	0.00036	0.00000042
donor value to use: Row D												
donor TEC: Row E												
MA19: Row A	0.021	0.013 U	0.26	0.015	0.74	0.011 J	0.013 U	0.096		0.033	0.013 U	0.0028 U
value to use: Row B	0.021	0.013	0.26	0.015	0.74	0.011	0.013	0.096		0.033	0.013	0.0028
congener TEC: Row C	0.0000021	0.0000039	0.0000078	0.00000045	0.0000222	0.00000033	0.0013	0.00000288		0.00000099	0.00039	0.000000084
donor value to use: Row D												
donor TEC: Row E												
SP1-1: Row A	0.023	0.013 U	0.31	0.018	0.86	0.013	0.0037 U	0.13		0.046	0.013 U	0.0047 U
value to use: Row B	0.023	0.013	0.31	0.018	0.86	0.013	0.0037	0.13		0.046	0.013	0.0047
congener TEC: Row C	0.0000023	0.0000039	0.0000093	0.00000054	0.0000258	0.00000039	0.00037	0.0000039		0.00000138	0.00039	0.000000141
donor value to use: Row D												
donor TEC: Row E												
TF-21: Row A	0.066	0.015 U	0.66	0.035	2	0.034	0.0058 U	0.29		0.096	0.015 U	0.0085 U
value to use: Row B	0.066	0.015	0.66	0.035	2	0.034	0.0058	0.29		0.096	0.015	0.0085
congener TEC: Row C	0.0000066	0.0000045	0.0000198	0.00000105	0.00006	0.00000102	0.00058	0.0000087		0.00000288	0.00045	0.000000255
donor value to use: Row D												

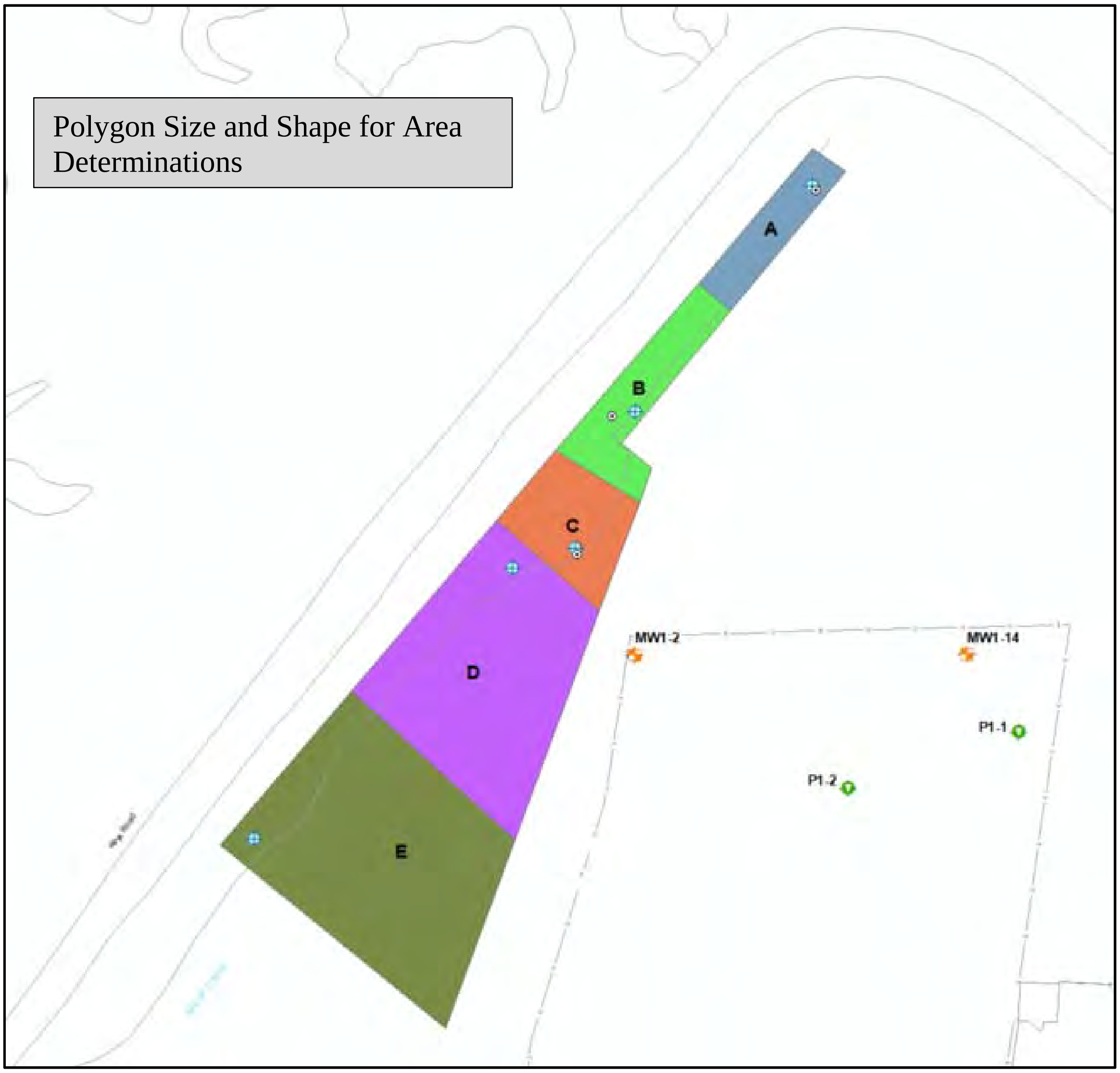
Sample ID: (must enter on Row A)	Summary of Sensitivity Analysis (relative percent difference)	TEQs from Substitution			KM Method				(Quasi) Sensitivity Analysis SECTION 1		(Quasi) Sensitivity Analysis SECTION 2			
									Highest TEC value is a DETECT, and there are no rejected ("R") values		Highest TEC value is a NONDETECT ("U" or "ND"), and there are no rejected ("R") values			
									Treatment 1		Treatment 1: Make highest U value a D		Treatment 2: Substitute comparable "donor" value for highest U	
		U = 0 & sum	U = 1/2 DL & sum	U = DL & sum	"mean"	Sample KM TEQ	Qualifier	Select KM TEQ	KM TEQ	Qualifier and Qualifier Fractions	KM TEQ	Qualifier and Qualifier Fractions	KM TEQ	Qualifier and Qualifier Fractions
MA09	131%	0.0029	0.0085	0.0140	0.0011	0.0118	J	Section 2, Treatment 1			**0.0118** Qualified Dioxin/Furan	J 79%	0.0118 Qualified Dioxin/Furan	J 79%
MA14	184%	0.0001	0.0009	0.0016	0.0001	0.0012	J	Section 2, Treatment 1			**0.0012** Qualified Dioxin/Furan	J 96%	0.0012 Qualified Dioxin/Furan	J 96%
MA14DUP	168%	0.000098	0.0006	0.0011	0.0001	0.0008	J	Section 2, Treatment 1			**0.0008** Qualified Dioxin/Furan	J 91%	0.0008 Qualified Dioxin/Furan	J 91%
MA19	192%	0.000037	0.0009	0.0017	0.0001	0.0012	J	Section 2, Treatment 1			**0.0012** Qualified Dioxin/Furan	J 98%	0.0012 Qualified Dioxin/Furan	J 98%
SP1-1	180%	4.36E-05	0.00042563	0.000808	0.0000	0.0004	J	Section 2, Treatment 1			**0.0004** Qualified Dioxin/Furan	J 95%	0.0004 Qualified Dioxin/Furan	J 95%
TF-21	168%	0.0001	0.00061743	0.001135	0.0001	0.0006	J	Section 2, Treatment 1			**0.0006** Qualified	J 91%	0.0006 Qualified	J 91%

Data List

Line	Sample ID		TEQ Result	Qualifier
Line #1	MA09		0.0118	J
Line #2	MA14		0.0012	J
Line #3	MA14DUP		0.0008	J
Line #4	MA19		0.0012	J
Line #5	SP1-1		0.0004	J
Line #6	TF-21		0.0006	J

Calculation of Area-Weighted Average TEQ in Marsh Creek Sediment

Name		Station ID	Area ft^2	TEQ µg/kg	Area x TEQ ft^2 x µg/kg
Polygon	A	MA14	1165.83	0.0012	1.40
Polygon	B	MA09	1781.16	0.0118	21.02
Polygon	C	SP1-1	1873.95	0.0004	0.75
Polygon	D	MA19	6404.90	0.0012	7.69
Total			11225.83		30.85
Area-Weighted Average				**0.0027**	


Polygon Size and Shape for Area Determinations