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REMEDIAL ACTION PLAN (RAP)

1400 NORTH ROYAL STREET, ALEXANDRIA, VIRGINIA

RAMBOLL

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APPENDICES

1. INTRODUCTION

This Remedial Action Plan (RAP) has been prepared on behalf of HRP Potomac, LLC (HRP Potomac) in general accordance with 9VAC20-160-70.A.3 for the Site located at 1400 North Royal Street in Alexandria, Virginia (the "Site") (**Figure 1**). The Site has been enrolled into the Virginia Department of Environmental Quality (VDEQ) Voluntary Remediation Program (VRP) and has been assigned Site ID VRP00783.

The objective of the RAP is to identify proposed remedies to address risks identified in a preliminary Site-specific human health risk assessment (HHRA), prepared by Ramboll (Ramboll, 2024), which identified potentially unacceptable risk for a child resident or trespasser exposed to Site soil based on current Site conditions. Based on the preliminary calculations, further evaluation and/or remediation is appropriate prior to use of the Site for mixed use, residential use, or recreational use. In addition, this RAP provides an updated conceptual Site model (CSM) for the Site based on data collected to date. This RAP may be updated subsequent to collection of additional data, as appropriate.

An historical release of petroleum from two former 25,000-gallon underground storage tanks (USTs) (VDEQ Pollution Complaint (PC) No. 2013-3154) is being addressed under the oversight of the Virginia Petroleum Storage Tank Program. A Corrective Action Plan Addendum for the petroleum release was approved by VDEQ on September 22, 2021. Although the petroleum release is being addressed under a separate program, this RAP incorporates information from the CAP Addendum to provide in a holistic understanding of Site conditions and approach to Site risk assessment, remedial decision-making and remediation. Data collected in conjunction with monitoring and evaluation of the petroleum release, subsequent to initial remedial actions, was incorporated into the preliminary human health risk assessment. An additional CAP Addendum will be prepared for the site which addresses the planned future use of the site and establishes appropriate remedial endpoints; the CAP Addendum will be submitted to VDEQ for review and approval.

Section 2 of this RAP provides an overview of the Site background and Section 3 of this RAP provides an updated CSM. Remedial objectives, which were developed based on the preliminary HHRA, are presented in Section 4. Section 5 outlines the selected Site-specific remedy for the Site, and Section 6 includes an overview of requisite permits needed to initiate and complete remedial activities. Specific design plans for the selected remedial strategy will be developed in conjunction with Site redevelopment (i.e., construction) plans and will be incorporated into an addendum.

2. SITE BACKGROUND

The Site consists of 18.8 acres of land located at 1400 North Royal Street in Alexandria, Virginia at the intersection of Bashford Lane and North Royal Street. Site conditions are being evaluated under two programs with oversight by the VDEQ. An historical release of petroleum (PC No. 2013-3154) associated with two former 25,000-gallon fuel oil USTs is being addressed pursuant to the VDEQ Petroleum Storage Tank Program. Separately, the overall Site is being evaluated under the Virginia VRP.

Additional information on Site background is included in a CAP Addendum (CAPA or the "2021 CAPA"), approved by VDEQ in September 2021 (Ramboll, 2021) and in a Preliminary SCR (the "2022 Preliminary SCR"), submitted to VDEQ in the Spring of 2022 (Ramboll, 2022). A high-level summary is provided below:

2.1 Site History

The Site was developed as a coal-fired power-generating facility in the 1940s. Prior to the generation station, the Site was mostly vacant but was occupied circa the 1920s to 1940s at the northern end by the Potomac River Clay Works and at the southern end by the American Chlorophyll Company and Green Colors Manufacturing. From the 1940s to 2000, the generating station was operated by various entities as a coal-fired power plant. The Site ceased operations in October 2012. HRP Potomac acquired the Site in the fall of 2020 and plans to redevelop the property for mixed-used development.

There are no active USTs at the Site, however, several USTs were formerly closed in place or located at the Site. The USTs formerly operated at the Site are discussed in the table below and depicted on **Figure 2**. Known information regarding the investigation and remediation of the former USTs with regulatory closure is summarized below.

Underground Storage Tanks					
Number and Size (gal.)	**Location**	**Contents**	**Key Dates**	**Regulatory Closure Granted**	**Notes**
Decommissioned/Closed-in-Place/Removed					
1 x 2,000	In the vicinity of the breaker house and bulldozer shed; West of former coal storage area	Kerosene	Installed 1972; removed in 1987 and replaced with 4,000-gallon UST	Yes	Closed following (unspecified) remediation.
1 x 4,000	West of former coal storage area	Kerosene	Installed in 1987; removed in 2013.	Yes PC No. 1992-2342	According to the 2020 Phase I ESA report, total petroleum hydrocarbons (TPH) were detected in soil at a

Underground Storage Tanks					
Number and Size (gal.)	**Location**	**Contents**	**Key Dates**	**Regulatory Closure Granted**	**Notes**
				and PC No. 2013-3128	concentration of 390 milligrams per kilogram (mg/kg) during construction of a soil vapor monitoring well. A groundwater recovery system was installed near the UST to recover residual oils, and VDEQ granted closure for PC No. 1992-2342 in April 1999 when TPH was not detected in nearby groundwater samples. Subsequently, during tank removal in 2013, TPH was detected in soil; several groundwater monitoring wells were installed and sampled in March 2014; petroleum compounds were not identified in groundwater at concentrations of concern and thus, VDEQ granted closure with no further action to PC No. 2013-3128.
1 x 3,500	In the vicinity of the breaker house and bulldozer shed	Diesel	Installed in 1972; closed in place in 1996.	Yes PC No. 1996-3199	According to documentation included as Appendix E to the 2020 Phase I ESA report, petroleum hydrocarbon impacted soils exhibiting low levels of TPH (110 mg/kg were identified during removal of the UST). VDEQ granted closure after subsequent groundwater sampling did not detect petroleum constituents in groundwater at concentrations exceeding regulatory criteria.
2 x 25,000	Open Bay Area	No. 2 fuel (heating) oil	Installation dates approximately 1949 and 1954; closed in place in 2013.	No PC No. 2013-3154	Petroleum hydrocarbon contamination detected in soils during removal of USTs. Impacts are being addressed under Pollution Complaint No. PC 2013-2145.

Current Site conditions are being evaluated under two programs with oversight by the VDEQ. Under the VDEQ Petroleum Storage Tank Program (PC No. 2013-3154), GenOn (the prior facility owner)

conducted investigation and remediation activities to address the presence of petroleum hydrocarbons in soil and groundwater near the former 25,000-gallon heating oil USTs. At least 56 wells (26 shallow and 30 deep) have been installed in the area of the petroleum release. An initial corrective action plan (CAP) was submitted to VDEQ in September 2014 and a CAP-Part II (GES and Geosyntec, 2014) was submitted to the VDEQ in December 2014, approved by VDEQ in March 2015 and subsequently implemented at the Site. Corrective action activities included the following:

- Implementation of total phase extraction (TPE) to remove light non-aqueous phase liquid (LNAPL) in the shallow groundwater zone and from overlying soils in and near the smear zone.
- Installation and operation of a pump and treat (P&T) system to remove LNAPL and remediate the dissolved phase plume in deep groundwater in the area of the source zone.
- Installation and operation of a biosparging system to address the dissolved phase plume downgradient of the source area.
- Sealing of six seeps observed at the bulkhead adjacent the Potomac River.

On September 29, 2019, the VDEQ approved the discontinuation of active remediation, and the Site transitioned to post-remediation monitoring. A CAP Addendum (CAPA) was approved by VDEQ in September 2021 which specified a network of 30 wells for post-remediation monitoring and semi-annual sampling (Ramboll, 2021). Groundwater monitoring results for the second quarter of 2023 were documented in the Corrective Action Monitoring Report submitted to VDEQ on August 22, 2023. The results from recent groundwater monitoring events indicate that the groundwater conditions are stable, and the concentrations of constituents of concern (COCs) in groundwater at the point of discharge to the Potomac River are less than the remediation goals and the DC DOEE Surface Water Quality Standards. However, Site data indicate the presence of residual LNAPL within soil pore space in the area of the USTs. LNAPL has been identified in several wells situated near the USTs at thicknesses up to 0.20-foot over the past two years.

Under the Virginia VRP, a separate evaluation of Site-wide conditions is being performed. Preliminary VRP Site characterization activities were conducted in October 2021, and a Preliminary SCR was submitted to VDEQ in the Spring of 2022 (Ramboll, 2022). Certain areas of the Site, which are not currently accessible due to the locations of Site buildings and structures, will be evaluated concurrent with or subsequent to demolition of the structures.

2.2 Site Description and Current Site and Surrounding Area Use

HRP Potomac acquired the Site in the fall of 2020 and plans to redevelop the property as mixed-used development, including both commercial and residential uses. The former generating station is no longer operating and will be deconstructed in coordination with redevelopment of the Site. Current Site uses are limited to routine property maintenance and assessment activities in preparation for deconstruction and redevelopment.

The Site is currently improved with a multi-story main power plant building constructed with a basement (Main Plant Building); a covered utility corridor (historically referred to as the "Precipitator Area"); and five coal-fired steam boilers and turbine generators. Supporting features include air emissions equipment, a former (unlined) coal pile area, a clay-lined sediment basin, a rail yard, water treatment facilities, one bottom ash and two fly ash silos, administration offices, an analytical laboratory, and storage facilities and ancillary buildings, which include a maintenance area (**Figure 2**). The Site is secured with a perimeter fence to prevent trespassing.

The Site is located in an area of mixed residential and commercial land use. Surrounding property uses include an inactive railroad spur and residential and commercial development to the south and west, a Pepco switchyard and parking lot to the northwest, Slaters Lane and a condominium building to the north, and the National Park System (NPS) Mount Vernon Trail and Potomac River to the east. Groundwater at and in the vicinity of the Site is not utilized as a source of potable water.

3. UPDATED CONCEPTUAL SITE MODEL (CSM)

An updated conceptual Site model (CSM) encompassing current conditions for the entire Site is provided below with a summary of currently understood contaminant sources and distribution.

3.1 Nature and Extent of Contamination

The nature and extent of impacts at the Site by chemicals of concern (COCs) is summarized below. Ramboll anticipates further evaluation will be conducted in conjunction with future Site redevelopment activities to gather more detailed information to assist in decision making. During preliminary Site characterization investigation activities, exceedances of potentially applicable VDEQ screening levels were identified in Site soil and groundwater (see **Figure 3** for an overview of sample locations).

3.1.1 Site Soil Conditions

For the purposes of preliminary Site investigation, analytes of potential concern for Site soils included the following parameters, based on the potential area of concern being evaluated: volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), pH, target analyte list (TAL) metals (aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, selenium, silver, sodium, thallium, vanadium, and zinc), cyanide, and total petroleum hydrocarbons – diesel range organics (TPH-DRO), – gasoline range organics (GRO), and – oil range organics (ORO).

A comparison of Site data to generic risk-based VDEQ Tier II and Tier III screening levels indicated one or more exceedances of applicable screening levels for a number of constituents including various metals, SVOCs, and VOCs. As such, a preliminary Site-wide human health risk assessment was performed to evaluate potential human health risks associated with the detected concentrations of constituents in Site soil. Preliminary Site-wide risk assessment identified a potential unacceptable risk for exposure of a hypothetical resident child or child recreator exposed to Site soils. The risk assessment is described further in Section 3.2. The anticipated maximum areal extent of impacted non-hazardous soils is depicted on **Figure 4**; further sampling is anticipated in conjunction with Site redevelopment to further refine the extent of impacted soils at the site.

3.1.1.1 Petroleum Impacted Soils

An area of petroleum-affected soils has been identified in the area of the former 25,000-gallon heating oil USTs located beneath the High Bay of the main Site building.

Initial soil data in the area of the fuel oil release were collected in December 2013, prior to Site remediation activities. The initial investigation included the advancement of a total of 27 laser-induced fluorescence (LIF) borings and 5 direct-push soil borings. Severity of impacts were found to decrease with distance from the source area. The most heavily impacted areas observed with LIF technology were in close proximity to the former USTs (primarily to the north and northeast of the tanks, at depths between 20 and 30 ft bgs[1]). Data suggested that adsorbed phase impacts decrease rapidly with distance from the tanks.

In conjunction with the 2013 LIF survey, nine soil samples collected from five direct-push soil borings were analyzed for TPH-DRO. Concentrations of TPH-DRO ranging between 10.4 milligrams per kilogram (mg/kg) and 2,490 mg/kg were detected in five of the nine samples.

[1] No sampling of soils beneath the tanks has been performed since the tanks were abandoned in place.

In February 2023, Ramboll conducted additional investigation activities using LIF to supplement existing information regarding the extent of residual LNAPL in soils in the vicinity of the former USTs. A total of 12 LIF borings were advanced using direct push drilling methods to depths of approximately 20 to 37 ft bgs. LIF results indicate that there are an estimated maximum of 5,200 s.f. of petroleum-saturated soils in the vicinity of the former UST basin. Results of the 2023 LIF investigation were shared with VDEQ in July 2023; the memo is included as **Appendix B** to this report.

3.1.2 Site Groundwater Conditions

For the purposes of preliminary Site investigation, analytes of potential concern for Site groundwater included the following parameters, based on the potential area of concern being evaluated: VOCs, SVOCs, PCBs, sulfate, ammonia (as N), total and dissolved TAL metals (aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, selenium, silver, sodium, thallium, vanadium, and zinc) plus glycols, hydrazine, and TPH-DRO, TPH-GRO, and TPH-ORO. To evaluate potential human health risks associated with exposure to Site groundwater, a preliminary Site-wide human health risk assessment was performed. Preliminary Site-wide risk assessment did not identify unacceptable risk to human receptors associated with exposure to Site groundwater. The risk assessment is described further in Section 3.2.

As described above, an area of petroleum-affected groundwater has been identified in the area of the former 25,000-gallon heating oil USTs located beneath the High Bay of the main Site building and extending east from the USTs. The area of petroleum impacted groundwater has been delineated on-Site and dissolved phase concentrations at downgradient monitoring wells meet remedial endpoints.

Free-phase petroleum LNAPL has been detected in several wells in the vicinity of the former USTs at thicknesses up to 0.20-foot based on the past two years of data. The nature and extent of dissolved phase petroleum constituents and petroleum LNAPL are discussed further below.

3.1.2.1 Dissolved Phase Petroleum

Recent data for dissolved phase TPH-DRO and naphthalene in both the shallow and deep groundwater zones are presented in the 2023 Annual CAP Implementation Monitoring Report (Ramboll 2024). A summary of recent dissolved phase conditions is provided below.

Measured concentrations of TPH-DRO in shallow wells during the most recent sampling event (November 2023) ranged from 1,000 to 19,000 µg/L with the greatest concentrations identified at RW-116S and RW-05S, located immediately to the west and within 25 feet south of the former USTs, respectively (**Figure 5**). Measured concentrations of TPH-DRO in deep wells ranged from non-detect to 8,900 µg/L at MW-25 (located within 25 feet east of the former USTs). Concentrations of TPH-DRO in Site groundwater typically decrease with distance from the source area. During 2023, naphthalene was detected in one well (MW-107R) at a concentration of 9.3 µg/L in November 2023.

The CAP Addendum established several remedial goals relating to dissolved phase petroleum hydrocarbons including:

- Prevent migration of LNAPL to the Potomac River as demonstrated by four subsequent observation events spaced over 6 to 12 months indicating no observed seeps of LNAPL from the riverbank.
- Demonstrate that groundwater at the downgradient Site boundary meets VPDES Discharge Limits by documenting that the average concentrations of TPH, naphthalene, and pH in the downgradient wells (TW-2 to TW-7 and TW-14) meet the following discharge criteria for two

consecutive monitoring events and demonstrating stable to decreasing concentration trends for TPH-DRO and naphthalene in the target wells.

- Demonstrate that the DCDOEE Surface Water Discharge Criteria are met by documenting two successive monitoring events with concentrations at or below the DCDOEE Surface Water Discharge Criteria presented in Appendix B of the CAP Addendum for groundwater monitoring wells located nearest the Potomac River (TW-02 to TW-07 and TW-14), and documenting stable to decreasing groundwater concentration trends for the monitored constituents at these wells.
- Remove and recover LNAPL to the maximum extent practicable as demonstrated via the absence of recoverable free product in Site monitoring wells included as a part of the routine monitoring events over a duration of one year.

Measured concentrations of TPH-DRO and naphthalene during 2022 and 2023 were below the VPDES limits of 15,000 µg/L and 8.9 µg/L, respectively, for downgradient target wells (TW-02 through TW-07 and TW-14). The mean pH value for downgradient target wells (TW-02 through TW-07 and TW-14) over 2023 was within the target range for pH of 6 to 9 standard units (SU) over the two most recent consecutive monitoring events.

Concentrations of naphthalene and TPH-DRO in the target downgradient wells appear to indicate stable to decreasing trends. Concentrations of TPH-DRO and naphthalene in the target downgradient wells have been less than the discharge limits since March 2021 and June 2018, respectively.

Concentrations of naphthalene in sentinel wells at the downgradient Site boundary adjacent the Potomac River (TW-02 through TW-07 and TW-14R) were compared to the calculated Site-specific Surface Water Discharge Standard for naphthalene established in accordance with DCDOEE procedures (600 µg/L); no exceedances of the Surface Water Discharge Standard were measured. Prior monitoring events performed by others demonstrated that concentrations of remaining constituents of concern are well below the calculated DCDOEE discharge standards.

3.1.2.2 Biogeochemical Conditions

Over the last two years of monitoring data from October 2021 through November 2023, dissolved oxygen (DO) measurements ranged from 0.0 to 10.23 milligrams per liter (mg/L) and oxidation-reduction potential (ORP) readings ranged from -208 millivolts (mV) to 362 mV within the contaminant plume. Both parameters generally increased toward the eastern boundary of the plume near the Potomac River. These measurements suggest more aerobic conditions along the eastern boundary of the plume near the Potomac River and a transition between anaerobic and aerobic conditions in the upgradient portion of the plume near the residual source zone.

3.1.2.3 LNAPL Occurrence, Mobility, and Recovery

As part of ongoing monitoring efforts conducted in accordance with the 2021 CAPA, LNAPL has been detected in Site wells periodically. LNAPL was not detected in Site wells between August 2018 and February 2022. Measurable free product has been encountered periodically in three (3) wells (MW-51, MW-14, TW-03) at thicknesses ranging from 0.02 to 0.20 feet since February 2022. MW-51 is adjacent east of the former UST basin and MW-14 is approximately 30 feet north of the former UST basin, while TW-03 is approximately 140 feet northeast of the former UST basin.[2] Intermittent sheens have been encountered periodically at 11 wells (MW-05, RW-05S, MW-25, MW-25S, MW-51S, MW-100S, RW-116S, RW-117S, TW-05, TW-06, TW-07). It appears that minor seasonal fluctuations of the

[2] TW-03 is located adjacent an existing stormwater line, which may act as a conduit for enhanced migration.

shallow and deep water tables at the Site, which are also tidally influenced, may contribute to observed fluctuations in recorded LNAPL sheens and layers at the Site as free product entrained in interstitial pore space may enter the well screen with fluctuating water levels. These LNAPL gauging observations suggest that there is some localized mobility of LNAPL in the vicinity of the former UST basin. As described above, data indicate the presence of an estimated 5,200 s.f. of residually petroleum-LNAPL impacted soils in the vicinity of the former UST basin.

Based on studies completed to date and lines of evidence including historic concentration data and gauging of LNAPL in monitoring wells, the estimated remaining residual LNAPL appears to be largely immobile with the exception of limited mobility in the immediate vicinity of the former tanks, which were abandoned in place. The anticipated approximate extent of remaining petroleum-LNAPL at the site, based on multiple lines of evidence is depicted on **Figure 6**. Additional evidence supporting LNAPL stability includes recorded %RE from LIF borings; high LNAPL viscosity (4.49 to 4.98 centistokes or 3.91 to 4.35 centipoise), specific density (mean of 0.9280 grams per cubic centimeter [g/cc]; range of 0.8497 g/cc to 0.9990 g/cc), and a transmissivity (0.10 square feet per day [ft^2/d]) at the low end of the practical range of recoverability (0.1 ft^2/d to 0.8 ft^2/d)[3]. Smaller pore spaces resulting from finer grained soil and the presence of a thicker smear zone also inhibit the mobility of the LNAPL due to the greater interstitial pressures associated with fine-grained sediment and the reduction in oil saturation that occurs within a smear zone.

The CAP Addendum established several remedial goals relating to petroleum LNAPL including:

- Prevent migration of LNAPL to the Potomac River as demonstrated by four subsequent observation events spaced over 6 to 12 months indicating no observed seeps of LNAPL from the riverbank.
- Remove and recover LNAPL to the maximum extent practicable as demonstrated via the absence of recoverable free product in Site monitoring wells included as a part of the routine monitoring events over a duration of one year.

No seeps of LNAPL have been observed along the riverbank adjacent the Site since at least 2019. Residual petroleum-LNAPL remains in the area of the USTs as described above; further action is warranted to address residual LNAPL.

3.2 Preliminary HHRA Results

Ramboll completed a preliminary HHRA for the Site, which has been prepared under separate cover (Ramboll 2024a). Per VDEQ guidance, the 2024 Preliminary HHRA utilizes the Virginia Unified Risk Assessment Model (VURAM) to calculate cumulative Site risk based on data collected to-date. Site specific concentration data were imported into VURAM, which relies on USEPA generic risk-based regional screening levels (RSLs) using a cumulative target cancer risk (TR) of 1E-04 and a hazard index (HI) of 1. Preliminary HHRA results indicate a HI that exceeds 1 for exposure to soil by a resident child or child recreator; no unacceptable risk was indicated for remaining exposure pathways and receptors (see Table 1 of Preliminary HHRA, included below).

[3] Values for LNAPL viscosity, density and transmissivity are taken from Corrective Action Plan – Part II, Potomac River Generating Station, 1400 N. Royal Street, Alexandria, VA, prepared by Groundwater & Environmental Services and Geosyntec Consultants, Inc. and dated December 2014. Data are based on LNAPL characterization and bail down tests performed on MW-05 and MW-25. The range of practical LNAPL recovery was taken from ITRC 2018.

Table 1. Risk Summary

Receptor	Soil		Groundwater		Total	
	Risk	HI	Risk	HI	Risk	HI
Resident	2.06-05	3.01E-01	NA	NA	2.06E-05	3.01E-01
Resident – Child Only	NA	**2.52E+00**	NA	NA	NA	**2.52E+00**
Construction Worker	3.21E-07	2.43E-01	1.96E-06	7.55E-01	2.28E-06	9.99E-01
Composite Worker	3.65E-06	1.82E-01	NA	NA	3.65E-06	1.82E-01
Recreator	1.10E-05	1.33E-01	NA	NA	1.10E-05	1.33E-01
Recreator– Child Only	NA	**1.37E+00**	NA	NA	NA	**1.37E+00**
Trespasser	1.35E-06	1.63E-02	NA	NA	1.35E-06	1.63E-02
Trespasser – Child Only	NA	1.68E-01	NA	NA	NA	1.68E-01

Note: Cumulative risks calculated above the cumulative cancer risk of or 1E-04 and HI of 1 are bolded.

More specifically, the preliminary HHRA identified iron, cobalt, arsenic, and aluminum as the primary drivers of noncancer risk for resident and child recreators. The concentrations of these metals detected in soil samples from the Site may be consistent with background concentrations; however, these constituents were conservatively retained for quantitative evaluation in this risk assessment. Accordingly, the noncancer risks presented in this risk assessment may overestimate actual risk. The Site is currently unoccupied; is fully fenced with a locking gate to prevent access to the Site by trespassers; groundwater at and in the vicinity of the Site is not utilized as a source of drinking water; and any workers performing duties on Site are conducting work under an appropriate safety program. As such, no currently complete unacceptable exposures have been identified. Further, the preliminary HHRA results indicate no unacceptable risks to future construction workers at the Site during redevelopment. Based on the preliminary calculations, further evaluation and/or remediation of Site soil is appropriate in conjunction with the redevelopment of the Site. The preliminary HHRA does not include an evaluation of risk posed by vapor intrusion because it is anticipated that Site soils will be redistributed across the Site during future construction; as such, the potential for vapor intrusion to indoor air will be evaluated following Site grading.

4. REMEDIATION LEVELS ESTABLISHED PER RISK ASSESSMENT

Based on the updated CSM and preliminary HHRA results, remedial action is warranted at the Site prior to a change in use that includes residential and recreational uses. Remedial goals for the Site were developed to be protective of human health and the environment under both current and potential future land uses. The following areas have been identified for remediation:

- **Petroleum Release Area Impacts.** Located beneath the Open Bay Area of the former Main Building of the power plant are two previously abandoned 25,000-gal No. 2 heating oil USTs. Free phase petroleum hydrocarbons have been detected in Site soils and groundwater in the vicinity of these former USTs as described in Section 3 above.
- **Site-Wide Soil Impacts.** As described in Section 3.2 above, preliminary HHRA results identified potentially unacceptable risk for a child resident or trespasser exposed to Site soil; no unacceptable risk was indicated for remaining exposure pathways and receptors, including construction workers.

Corrective action will be performed at the Site to achieve the following remedial objectives (RO) established per the HHRA:

- *RO-1: Mitigate exposure risks associated with Site soils for future Site occupants based on the planned future Site use as a mixed-use property*. If future evaluation of the vapor intrusion pathway indicates a vapor intrusion concern, remedial action objectives will also include the mitigation of vapor intrusion risk.
- *RO-2: Remove and recover LNAPL to the maximum extent practicable.* Achievement of this goal may be documented via the absence of recoverable free product in Site monitoring wells included as part of the routine monitoring events over a duration of one year. The demonstration of attainment may also be supplemented by additional lines of evidence supporting LNAPL removal "to the maximum extent practicable." Additional lines of evidence may include:
  - Reduction of LNAPL mass.
  - Evidence of decreasing dissolved phase concentrations in the source zone.
  - Other lines of evidence.[4]
- *RO-3: Prevent migration of LNAPL to the Potomac River.* The previously identified seeps along the River were plugged as part of corrective action activities and LNAPL has not been observed discharging from the seeps since that time. Visual observations for possible seepage of LNAPL to the Potomac River will be made from land during each future groundwater monitoring or well gauging event. Attainment of this objective will be demonstrated based on four subsequent observation events spaced over 6 to 12 months indicating no observed seeps of LNAPL from the riverbank.

[4] These lines of evidence and others for documenting LNAPL to the maximum extent practicable are well accepted and are discussed further (for example) in LNAPL Site Management: LCSM Evolution, Decision Process, and Remedial Technologies (ITRC 2018).

- *RO-4: DCDOEE Surface Water Discharge Criteria.* Maximum allowable groundwater concentrations at the point of discharge have been calculated per DCDOEE Directives. The calculated Surface Water Discharge Criteria will be met at groundwater monitoring wells located nearest the Potomac River (TW-02 to TW-07 and TW-14). Achievement of this remedial goal will be documented by two successive monitoring events documenting concentrations at or below the DCDOEE Surface Water Discharge Criteria presented in Appendix B to the 2021 CAPA, and documentation of stable to decreasing groundwater concentration trends for the monitored constituents. The methodology for calculation of the maximum allowable groundwater concentrations is presented in Appendix B to the 2021 CAPA. Historic monitoring of remaining constituents of concern indicate that concentrations are well below the calculated DCDOEE discharge standards (Ramboll 2024b).

5. PROPOSED REMEDIATION ACTIVITIES

It is anticipated that Site redevelopment activities will involve substantial earth work as part of demolition and construction events, which will include the installation of sub-grade parking structures to depths of up to approximately 45 ft bgs. As such, remedies have been selected to coordinate with soil movement and management activities during Site redevelopment. Known environmental impacts encountered during Site redevelopment and implementation of these remedies will be managed in accordance with the SGMP.

5.1 Control or Elimination of Sources

The proposed remedies described in Section 5.1.1 and 5.1.2 below will control or eliminate sources of contamination to the Site. Soil excavation in the petroleum release area will result in source-mass reduction and improved groundwater quality, and site-wide soil re-use in accordance with the SGMP will prevent future exposure of residents, site workers, and recreators to soils not meeting residential use requirements.

5.1.1 Soil Excavation in Petroleum Release Area

The proposed remedy for residual LNAPL is excavation and off-Site disposal of LNAPL-impacted soil. This excavation will be coordinated with the excavation of a subsurface garage that is anticipated to overlap, at least partially, with the area where residual LNAPL may be present. Design plans for this remedial excavation will be prepared and submitted under separate cover along with a CAP Addendum for the petroleum release, after Site development plans are finalized. Based on data collected to date, the anticipated maximum areal extent of petroleum-LNAPL affected soils is depicted on **Figure 4**. Post-excavation groundwater monitoring will be conducted at the Site in accordance with the 2021 CAPA.

This excavation is expected to achieve remedial objectives RO-2, RO-3, and RO-4.

5.1.2 Soil Re-Use in Accordance with SGMP

As outlined in the SGMP, it is anticipated that soils outside the petroleum-impacted area that may be reused on site will be segregated into two categories: Category 1: Soils Meeting Residential Use Criteria and Category 2: Impacted Non-Hazardous Soils.

In accordance with the SGMP, Site soils will undergo further soil characterization prior to or concurrent with redevelopment to evaluate suitability of soils for on-Site re-use. Based on the additional characterization sampling, volumes of soil will be identified for unrestricted on-Site re-use (Category 1), restricted on-Site re-use (Category 2), or off-Site disposal (Category 3 or 4). Soils requiring off-Site disposal will be disposed at an appropriately qualified disposal facility.

Soils will be managed on Site in accordance with the SGMP so that at the completion of redevelopment only Category 1 soils will be present in the top 3 feet of landscaped or vegetated areas. Soils other than Category 1 soils will be either covered with impervious surfaces or 3 feet of Category 1 soils. Based on the results of the risk assessment, site soils do not present an unacceptable risk to construction or utility workers; accordingly, no specific actions to remediate utility corridors are warranted. Site soils are safe for use within future subsurface utility corridors.

Management of soil in accordance with the SGMP is expected to achieve remedial objective RO-1.

5.2 Proposed Land Use Controls

Engineering controls including a Sitewide cap comprised of an impervious surface (e.g., buildings, roadways, paved parking surfaces), or at least 3 feet of clean fill in unpaved areas will be implemented in accordance with the SGMP. Institutional controls will also include maintenance and repair of the cap and implementation of a groundwater use restriction for the Site. If future evaluation of vapor intrusion indicates a potential human health risk, a vapor intrusion mitigation measures will be implemented and documented in an institutional control.

Implementation of engineering and institutional controls will maintain remedial objective RO-1 during future use of the Site.

5.3 Design Plans and O&M Manuals

HRP Potomac plans to redevelop the property as mixed-used development, including both commercial and residential uses. The former generating station is no longer operating and will be deconstructed in coordination with redevelopment of the Site. It is anticipated that the proposed remediation activities described above will occur coincident with Site redevelopment activities. Specific design plans and operations and maintenance (O&M) manuals, as applicable, for the selected remedial strategy will be developed in conjunction with Site redevelopment (i.e., construction) plans and will be incorporated into an addendum.

6. PERMITS REQUIRED

The following permits and approvals have been identified as pertinent to the activities described herein.

6.1 Access to National Park Service Land Adjacent the Site

HRP Potomac has executed an access agreement with the National Park Service allowing access to adjacent National Park Service property for the purposes of monitoring the petroleum release. The access agreement will be updated to address Site construction activities, as appropriate.

6.2 Coordination of Construction activities with Pepco

Pepco owns and operates the electrical switch station situated adjacent to the north of the main Site building. An electrical right-of-way for high voltage subsurface electrical lines runs beneath the western portion of the Site. Construction activities will be coordinated with Pepco, as appropriate.

6.3 Additional Permits and Approvals in Support of Redevelopment

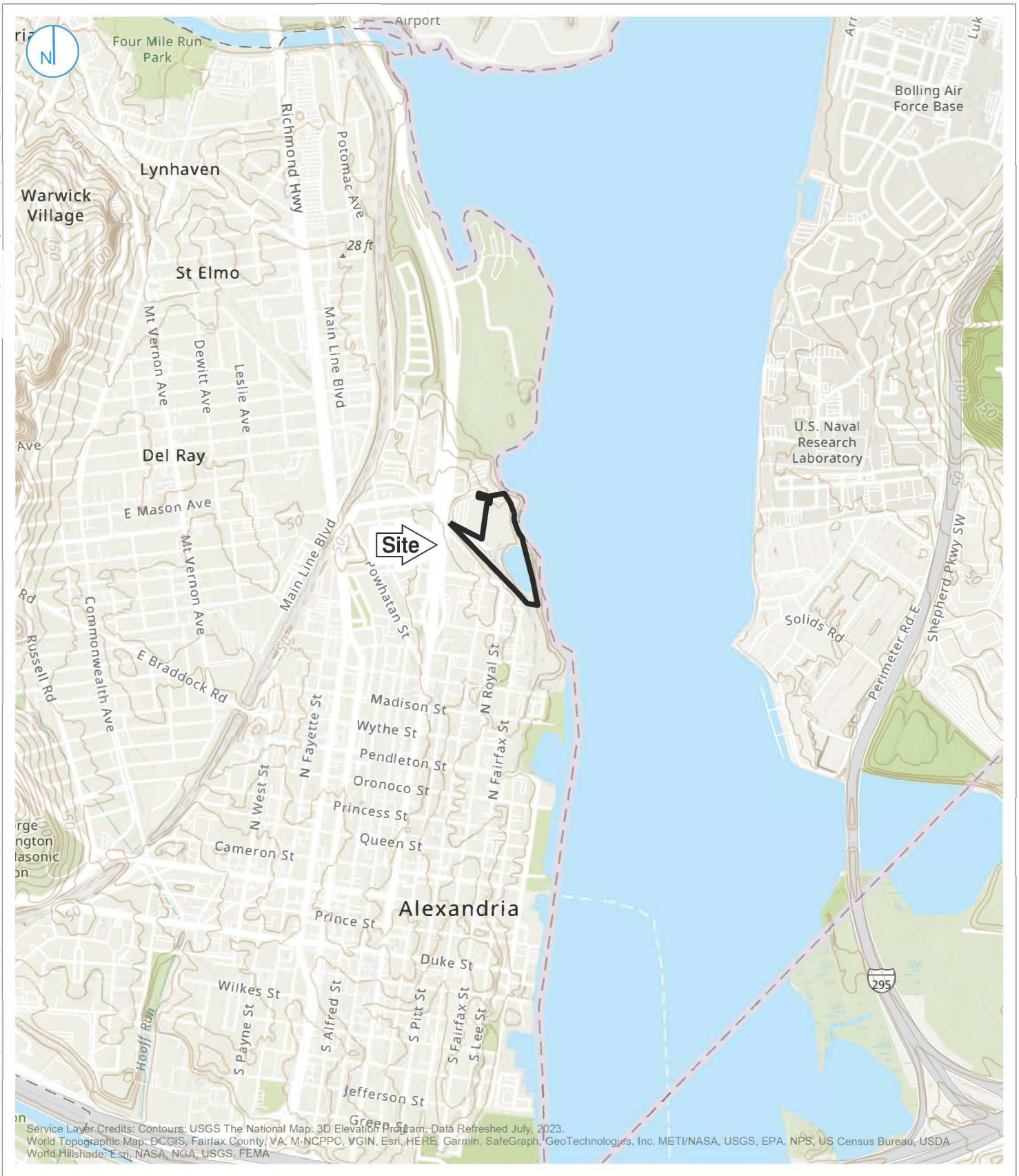
Additional permits and approvals will be required in support of future Site redevelopment, which may include the following:

- General VPDES Permit for Discharges of Stormwater from Construction Activities; a Stormwater Pollution Prevention Plan (SWPPP) and Erosion and Sediment Control Plan (ESCP) will also be required. Dewatering fluids generated during construction activities will be managed in accordance with the Site Construction SWPPP.
- Various construction-related permits and approvals.
- Demolition permit.

7. SCHEDULE

At the time of writing, redevelopment plans for the Site have not yet been finalized. It is anticipated that the proposed remediation activities described above will occur coincident with Site redevelopment activities. As such, this RAP, including a description of the proposed implementation schedule, may be updated as development plans are refined.

FIGURES



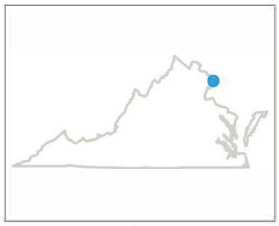
Service Layer Credits: Contours: USGS The National Map: 3D Elevation Program. Data Refreshed July, 2023.
World Topographic Map: DCGIS, Fairfax County, VA, M-NCPPC, VGIN, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA
World Hillshade: Esri, NASA, NGA, USGS, FEMA

Map Scale: 1:24,000 | Map Center: 77°2'26"W 38°49'4"N

PROJECT: 1690022371 | DATED: 10/4/2023 | DESIGNER: MBAUER
C:\Users\MBAUER\Documents\GIS\HRP PRGS Alexandria Power Plant Redevelopment Project Package.aprx\1_Ramboll_SiteLocationMap

SITE LOCATION MAP

FIGURE 1



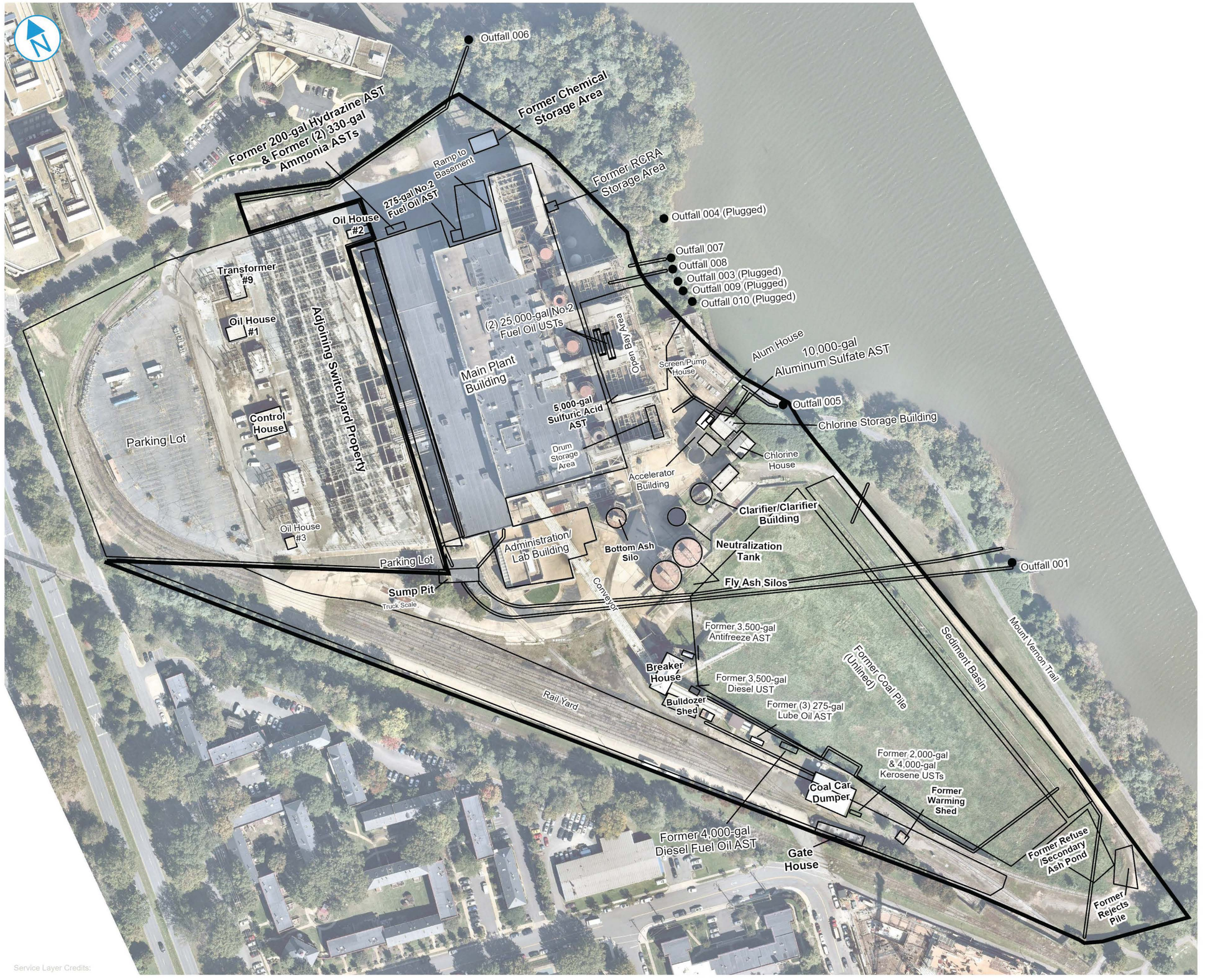
KEY MAP (not to scale)

0 500 1,000 Feet

Former Potomac River Generating Station
1400 North Royal Street
Alexandria, Virginia 22314

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.
A RAMBOLL COMPANY

RAMBOLL



Site Features
Outfall Locations
Site Boundary

0 200 400 Feet

SITE LAYOUT MAP

Former Potomac River Generating Station
1400 North Royal Street
Alexandria, VA 22314

FIGURE 2

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A RAMBOLL COMPANY

Notes

This figure depicts sample locations advanced and/or utilized by Ramboll during site characterization and corrective action monitoring field events at the site. Additional sample points have been advanced by prior consultants that are not depicted herein, which can be found in historic site reports.

Ramboll notes that available aerial imagery is slightly oblique over this site, causing building structures to tilt slightly northward from the principal viewing point. No sample locations (i.e., SB-222) have been advanced inside building structures; all locations depicted are based on survey data.

RAMBOLL HISTORIC SAMPLING LOCATIONS

FIGURE 3

Former Potomac River Generating Station
1400 North Royal Street
Alexandria, VA 22314

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.
A RAMBOLL COMPANY

PROJECT: 1690022371 | DATED: 1/8/2024 | DESIGNER: SOSTERTAG C:\Users\sostertag\OneDrive - Ramboll\Documents\GIS Projects\1690022371_HRP_PRGS\GIS\HRP PRGS DMP HHRA EMP RAP SEP Reports.aprx\Ramboll_SGMP Anticipated Maximum Aeral Extent of Soil Categories

Notes

The maximum anticipated areal extent of each soil Category is depicted herein based on multiple lines of evidence. This is a preliminary, conservative estimate, therefore no Category 1 soils are depicted. It is anticipated that additional pre-development and pre-excavation soil characterization sampling will be completed to assist in the preparation of a Soil Excavation Plan, which will provide further horizontal and vertical delineation of the extent of each soil Category. Once additional sampling is completed, soil Categories will be reviewed and updated, and revised versions of this figure will be prepared in conjunction with the Contractor.

0 100 200 Feet

ANTICIPATED MAXIMUM AREAL EXTENT OF SOIL CATEGORIES

Former Potomac River Generating Station
1400 North Royal Street
Alexandria, VA 22314

FIGURE 4

RAMBOLL AMERICAS
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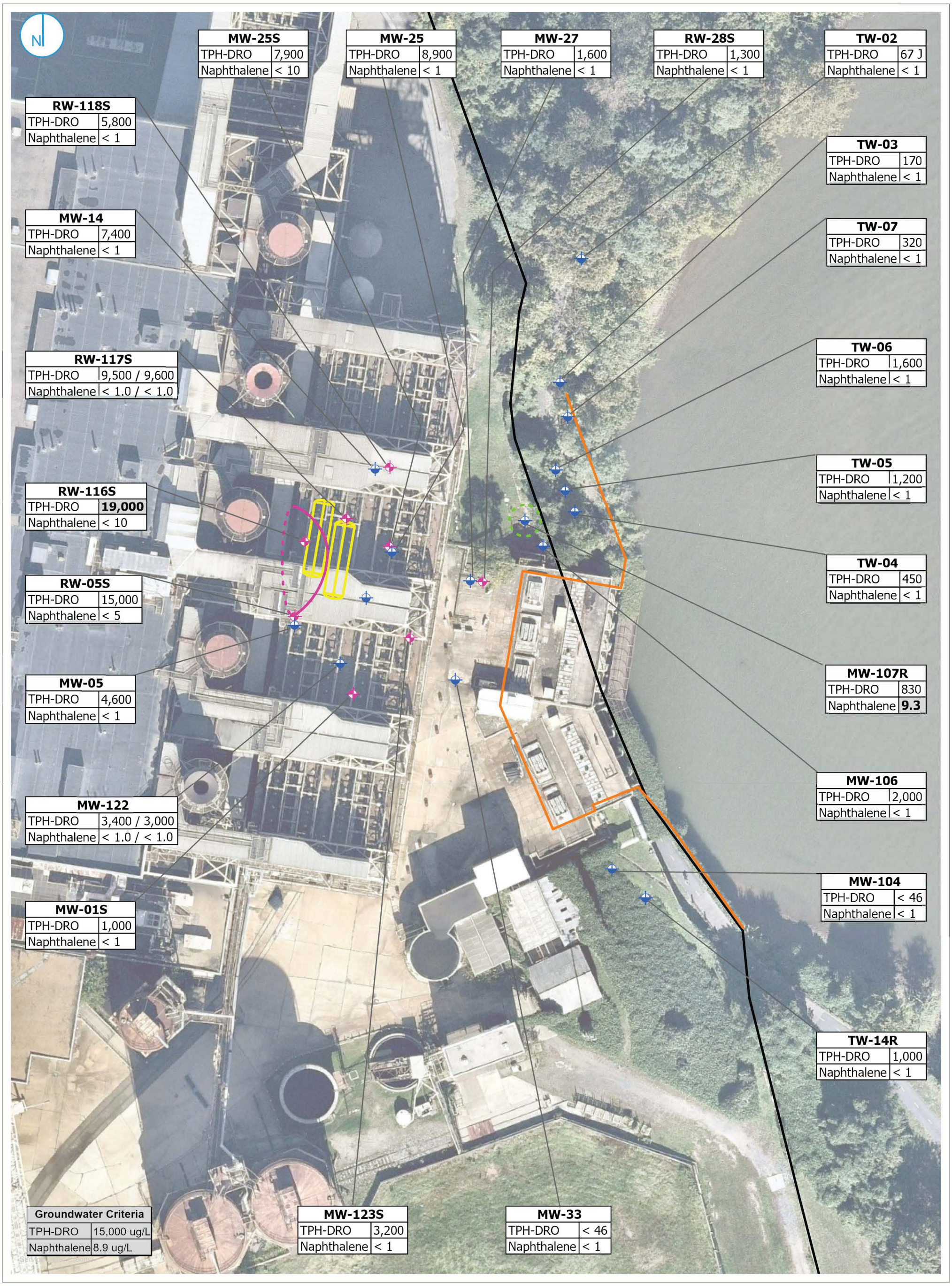
RAMBOLL



Former UST
Sheet Pile Wall
Property Boundary
Shallow Zone Monitoring Well
Deep Zone Monitoring Well
Naphthalene: 8.9 ug/L (Inferred)
TPH-DRO: 15,000 ug/L (Inferred)
TPH-DRO: 15,000 ug/L (VPDES Limit)

0 50 100 Feet

Notes
/ : field duplicate sample.
< : Not detected; result less than the reporting limit shown.
TPH-DRO: total petroleum hydrocarbons - diesel range organics
ug/L: Results are shown in micrograms per liter.
J: Estimated; detected concentration is less than the laboratory reporting limit, but greater than the method detection limit.
RLs for MW-25S and RW-116S (<10) are above the VPDES standard for naphthalene.
See Tables 4-2 and 4-3 of the 2023 Annual Corrective Action Monitoring Report for supporting data and additional notes.

GROUNDWATER RESULTS
NOVEMBER 2023

Former Potomac River Generating Station
1400 North Royal Street
Alexandria, VA 22314

FIGURE 5

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APPROXIMATE EXTENT OF REMAINING LNAPL
BASED ON MULTIPLE LINES OF EVIDENCE

FIGURE 6

Former Potomac River Generating Station
1400 North Royal Street
Alexandria, VA 22314

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.
A RAMBOLL COMPANY

RAMBOLL

APPENDIX A
REFERENCES

1 REFERENCES

GES and Geosyntec. 2014. Corrective Action Plan – Part II, Potomac River Generating Station, 1400 N. Royal Street, Alexandria, VA. December.

ITRC LNAPL Guidance - LNAPL Site Management: LCSM Evolution, Decision Process, and Remedial Technologies (ITRC 2018).

Ramboll. 2021. Corrective Action Plan Addendum (CAPA): Potomac River Generating Station. September 20.

Ramboll. 2022. Preliminary Site Characterization Report: Former Potomac River Generating Station. March 23.

Ramboll. 2024a. Preliminary Human Health Risk Assessment: 1400 North Royal Street, Alexandria, Virginia. January 24.

Ramboll. 2024b. 2023 Annual CAP Implementation Monitoring Report: Former Potomac River Generating Station. January 23.

Weaver Consultants Group (WCG). 2020. Phase I Environmental Site Assessment. August.

APPENDIX B
SUMMARY OF LASER INDUCED FLUORESCENCE (LIF) INVESTIGATION RESULTS

RAMBOLL

ENVIRONMENT
& HEALTH

MEMO

Project name	**Former Potomac River Generating Station (PRGS)**
Project no.	**1690022371**
Client	**HRP Potomac, LLC**
To	**Stefanie Jones (VDEQ), Greyford Hunter (DCDOEE)**
From	**Sarah Stoneking, PG**
Copy to	**HRP Potomac, LLC**
Prepared by	**Sarah Ostertag**
Checked by	**Greg Grose**
Approved by	**Sarah Stoneking**

Summary of Laser Induced Fluorescence (LIF) Investigation Results, Former Potomac River Generating Station (PRGS), Alexandria, Virginia

Date July 6, 2023

On behalf of HRP Potomac, LLC (HRP), Ramboll US Consulting, Inc. (Ramboll) has prepared this memorandum summarizing laser induced fluorescence (LIF) sampling activities completed in February 2023 for the former Potomac River Generating Station (PRGS) located at 1400 North Royal Street in Alexandria, Virginia (the "Site").

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BACKGROUND

Site conditions associated with Pollution Complaint No. 2013-3154 associated with a release from two former 25,000-gallon fuel oil underground storage tanks (USTs) is being addressed pursuant to the Virginia Department of Environmental Quality (VDEQ) Petroleum Storage Tank Program. The USTs were closed in place by the prior owner, and remediation activities were conducted in this area between 2016 and 2019. A separate evaluation of site-wide conditions is being performed pursuant to the Virginia Voluntary Remediation Program (VRP). Preliminary VRP site characterization activities were conducted in October 2021, and a Preliminary Site Characterization Report was submitted to VDEQ and the District of Columbia Department of Energy and Environment (DCDOEE) in the Spring of 2022.

LIF INVESTIGATION ACTIVITIES

Ramboll conducted field investigation activities at the site between February 2 and February 13, 2023 to assist in identifying the extent of residual light non-aqueous phase liquids (LNAPLs) in site soils. With the assistance of Cascade Remediation Service, Inc. (Cascade), a total of 12 LIF borings (B1-B3, B5-B9, B12-B13, B23-B24; see **Figure 1**) were advanced using direct push drilling methods with Geoprobe® optical interface probe-hydraulic profiling tool (OIP-HPT) ultraviolet (UV) sensor tooling to depths of approximately 20 to 37 feet below ground surface (ft bgs) (see **Attachment A**). The total depth of each boring was determined by refusal. LIF borings were advanced using a tiered approach to delineate the extent of the residual LNAPL plume; as such, not all pre-defined boring numbers were selected for advancement.

At each LIF boring location, the OIP-HPT sensor tooling was advanced and the percent fluorescing response (%RE) of the surrounding in situ soil to UV stimulation was continuously recorded along with hydraulic pressure. A series of LIF boring logs were generated for each location by Cascade detailing downhole electrical conductivity (EC), HPT maximum pressure, %RE, and estimated hydraulic conductivity (K). Cascade then input this data into Earth Volumetric Studio (EVS) and generated a 3-dimensional (3D) model with the interpolated LNAPL residual in the subsurface.

LIMITATIONS

The Cascade model used to generate the cross sections (**Attachment B**) and footprints (**Attachment C**) does not include previously collected site-specific data. This model only presents the results of the February 2023 LIF investigation; it does not include site-specific geology, historical well observations, dense subsurface utility networks, building footings, the sheet pile wall, and certain other bounding conditions. As such, caution should be taken when viewing the cross sections and footprint images. Additionally, due to dense subsurface utilities and overhead obstructions, data could not be obtained in the direct vicinity of the former UST basin nor between LIF points shown, thus some data gaps exist in the modelled residual LNAPL plume footprints.

Due to the dense subsurface utility network at the site, subsequent to private utility locating activities, each location was cleared to depths of approximately 12 ft bgs using soft dig techniques prior to LIF boring advancement. As a result of air knife clearance, LIF data recorded in the air knifed interval (i.e., the top approximately 12 feet of each borehole) may not be valid as soils in this zone were not in direct contact with the LIF sensor window; it is expected that this data gap does not pose a significant concern as the base of the tanks appears to be situated approximately 16 feet bgs.

INTERPRETATION OF LIF RESULTS

When the OIP-HPT sensor emits UV rays, residual LNAPL particles fluoresce and a %RE is recorded; a %RE greater than or equal to 5% is interpreted to indicate some level of LNAPL impacted soils. The recorded %RE does not include dissolved-phase petroleum constituents but rather LNAPLs entrained in interstitial pore space in the subsurface. The Cascade model includes 1%RE, 3%RE, 5%RE, 10%RE, 30%RE, and 70%RE interpretation thresholds in the footprint images and cross sections; however, the 1%RE and 3%RE can result from "noise" and are generally considered unreliable.

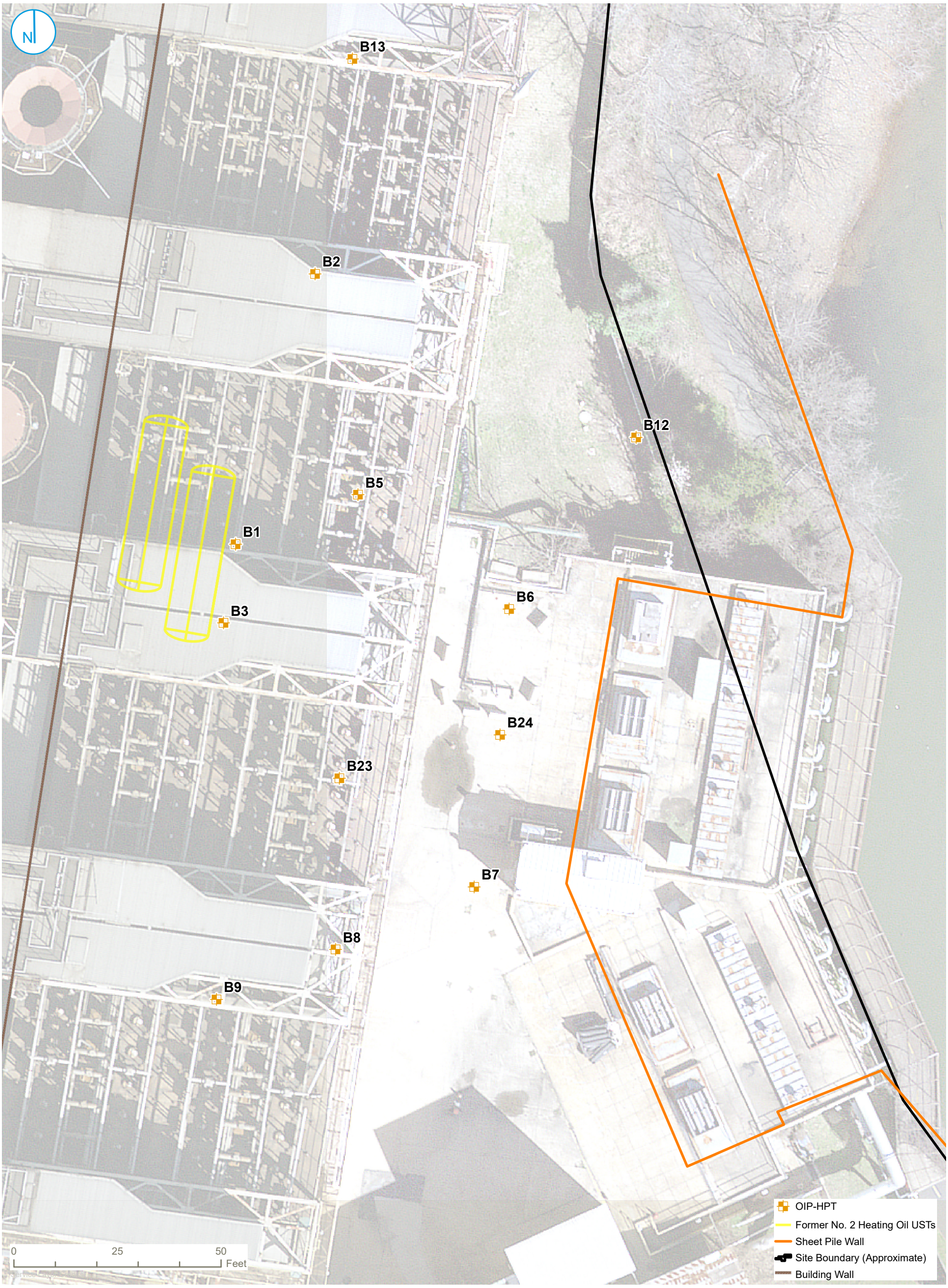
Based on studies completed to date and lines of evidence including historic concentration data and gauging of LNAPL in monitoring wells, the remaining LNAPL appears to be immobile with the exception of limited mobility in the immediate vicinity of the former tanks, which were abandoned in place. LNAPL at the site does not appear to be migrating based on historical well gauging data. While there is not a direct correlation between %RE and LNAPL concentration, a bench test study[1] conducted by Geoprobe® indicates that a log-linear response over approximately an order of magnitude concentration range may be observed for refined fuels, with approximately 5%:200 milligrams per kilogram (mg/kg); 30%:450 mg/kg; 50%:650 mg/kg; 75%:1,000mg/kg; 85%:3,000mg/kg; and 90%:9,500mg/kg for diesel fuel in silica sand. As an approximation, a %RE greater than 90% might be indicative of potentially mobile LNAPL in the subsurface.

HRP Potomac and Ramboll will utilize the results of the LIF study, along with other key site information, to update the conceptual site model. Additional data will be collected, as appropriate, to support remedial decision making.

[1] See Slide 34: https://geoprobe.com/sites/default/files/pdfs/Geoprobe%20OIP%20Introduction_0.pdf

RAMBØLL

FIGURES



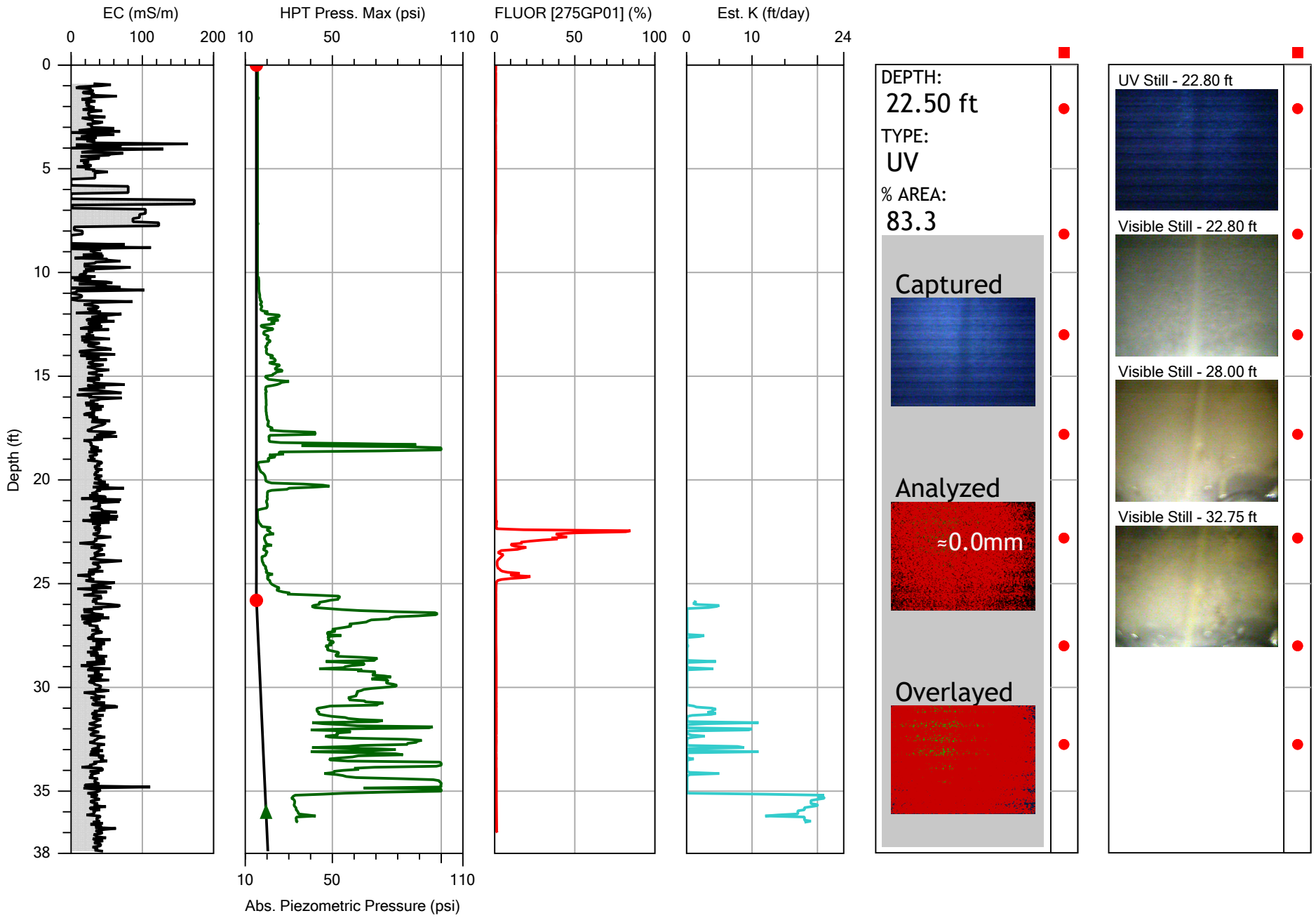
LIF BORINGS

FIGURE 1

Former Potomac River Generating Station
1400 North Royal Street
Alexandria, VA 22314

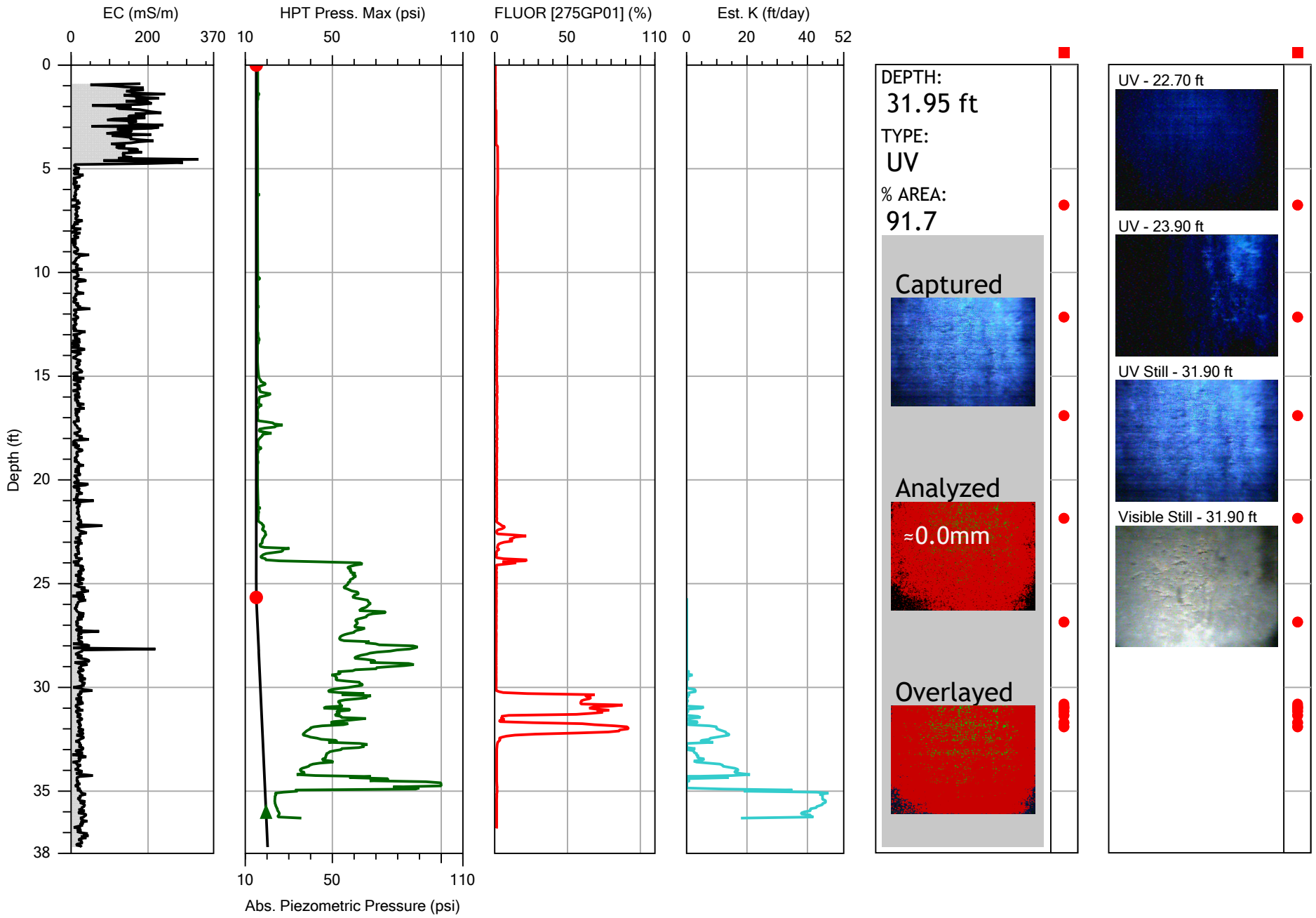
RAMBOLL US CONSULTING, INC.
A RAMBOLL COMPANY

ATTACHMENT A
CASCADE BORING LOGS



CASCADE
DRILLING | TECHNICAL SERVICES

Company: Cascade Remediation Services	Operator: C Dixon	File: B01.OIHP
Project ID: HRP: Former PRGS	Client: Ramboll	Date: 02/08/23
		Location: Alexandria, VA



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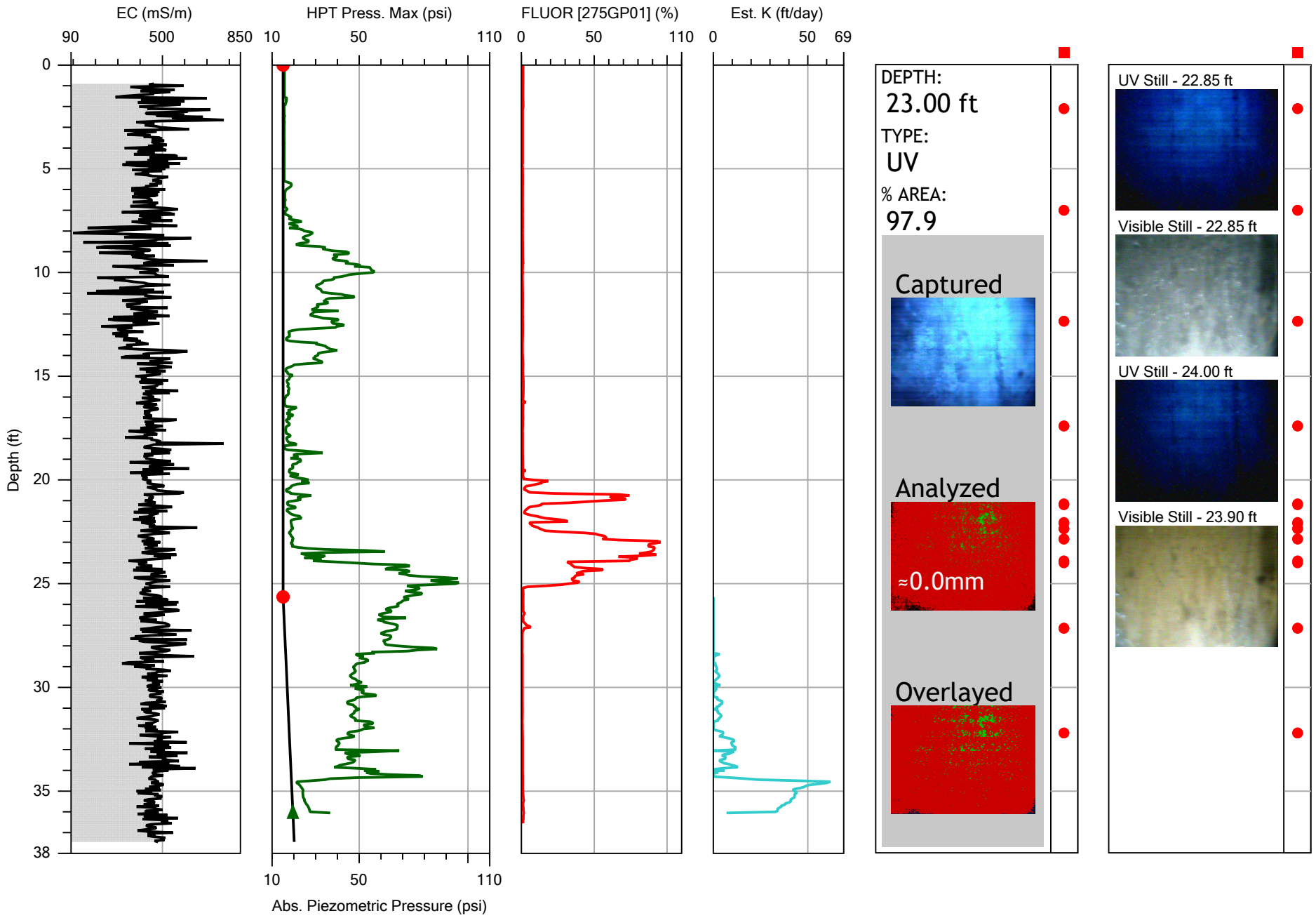

CASCADE
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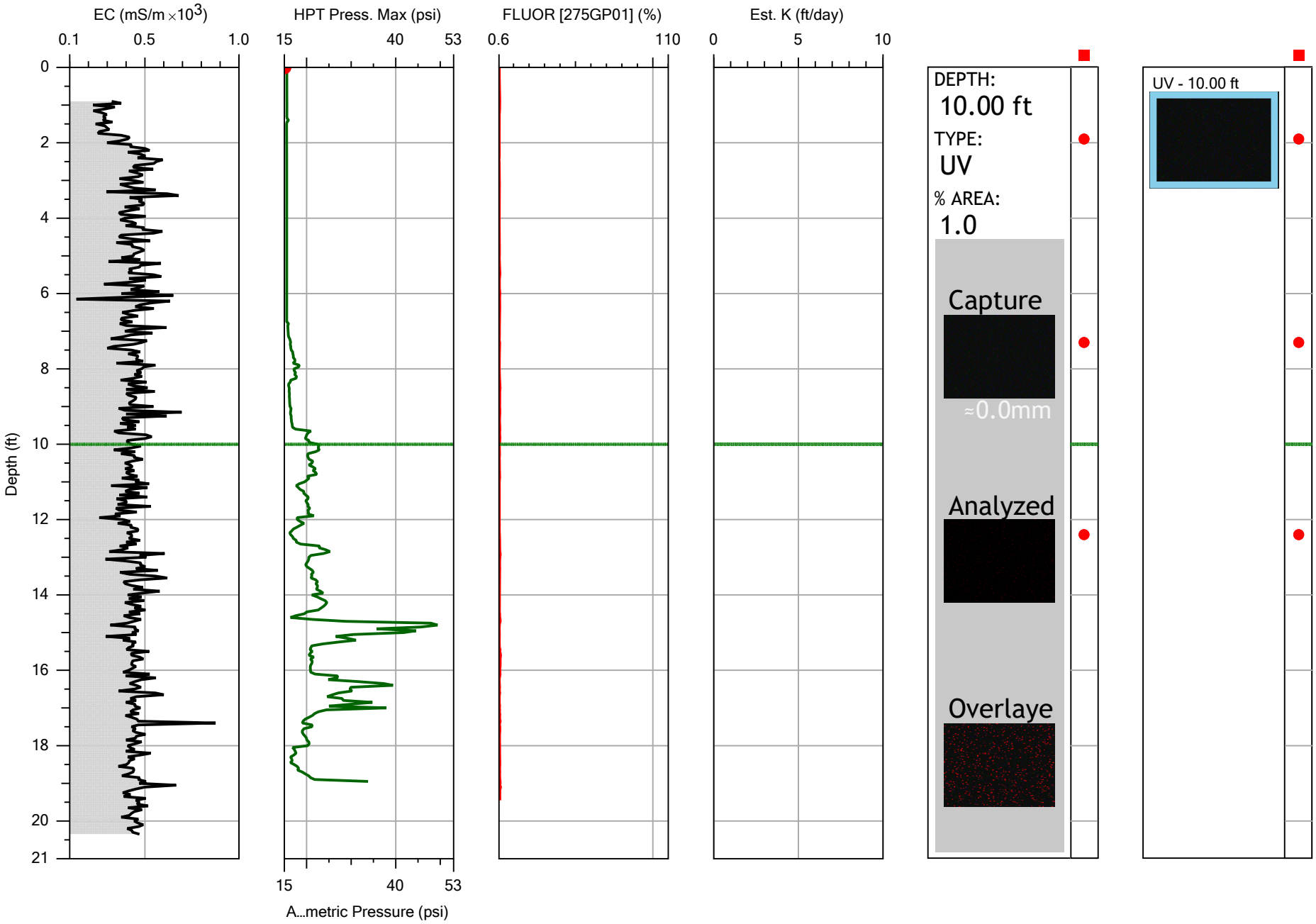
Project ID: HRP: Former PRGS	Client: Ramboll	Location: Alexandria, VA



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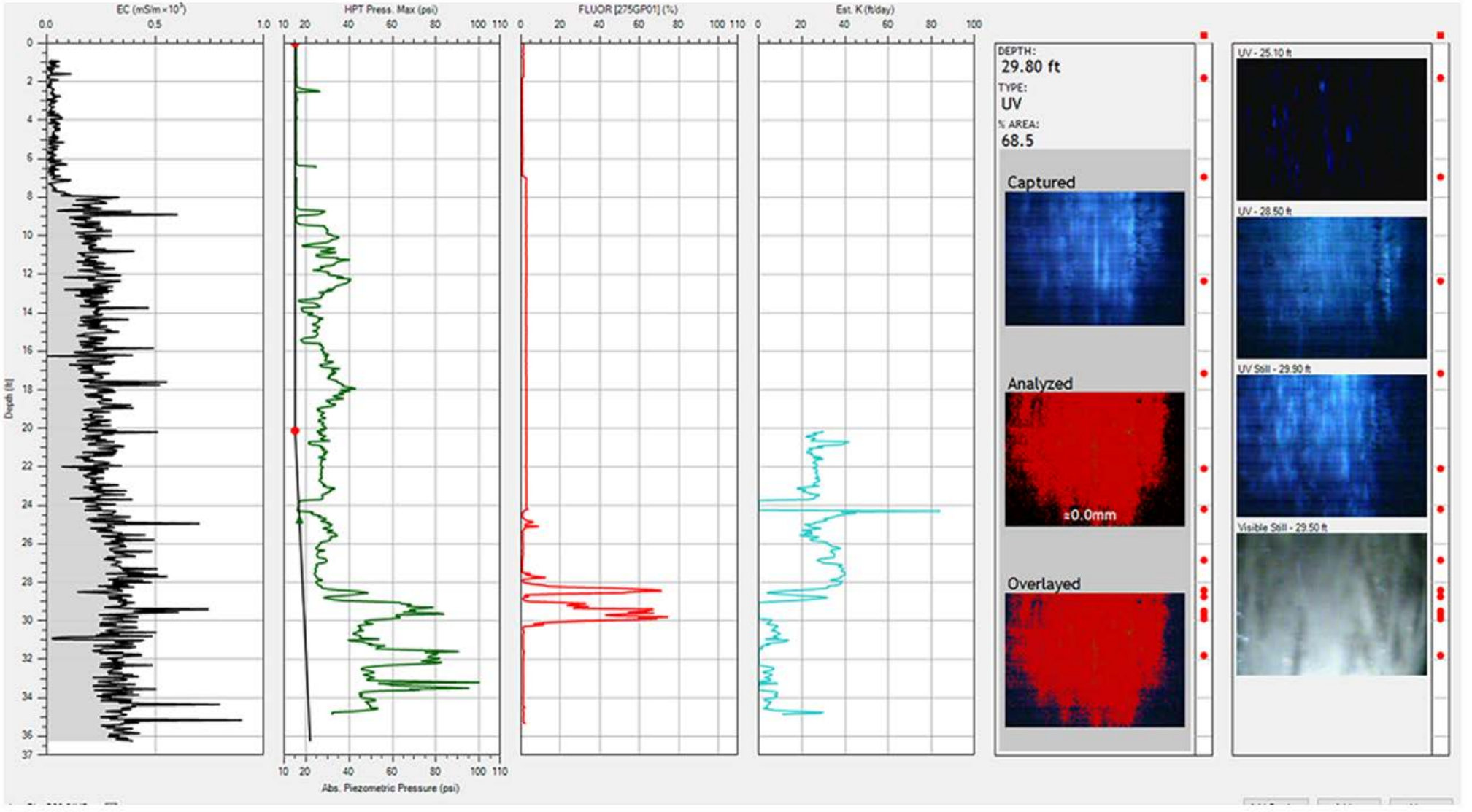
Project ID: HRP: Former PRGS	Client: Ramboll	Location: Alexandria, VA



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DRILLING | TECHNICAL SERVICES

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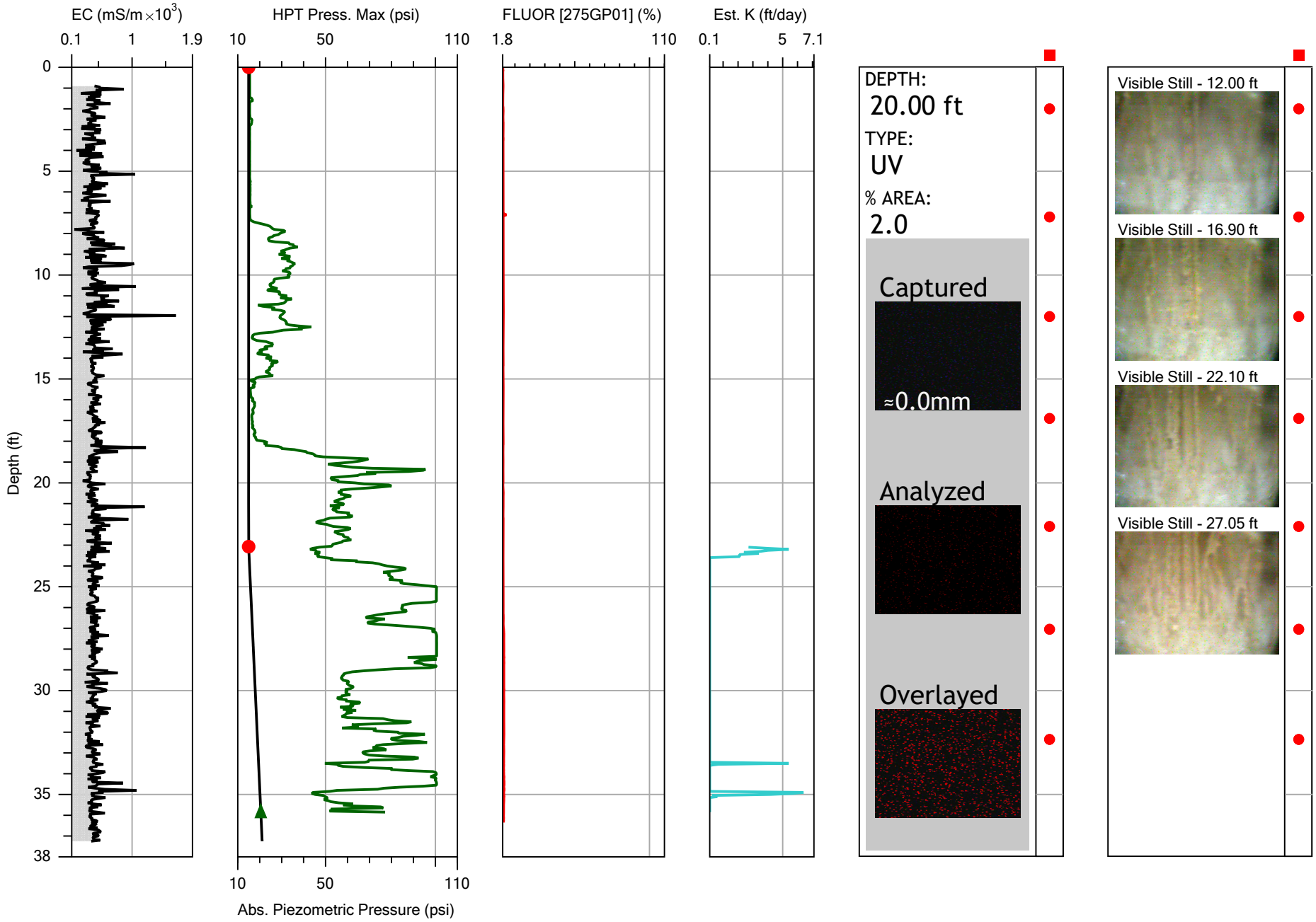
Project ID: HRP: Former PRGS	Client: Ramboll	Location: Alexandria, VA



CASCADE
DRILLING | TECHNICAL SERVICES

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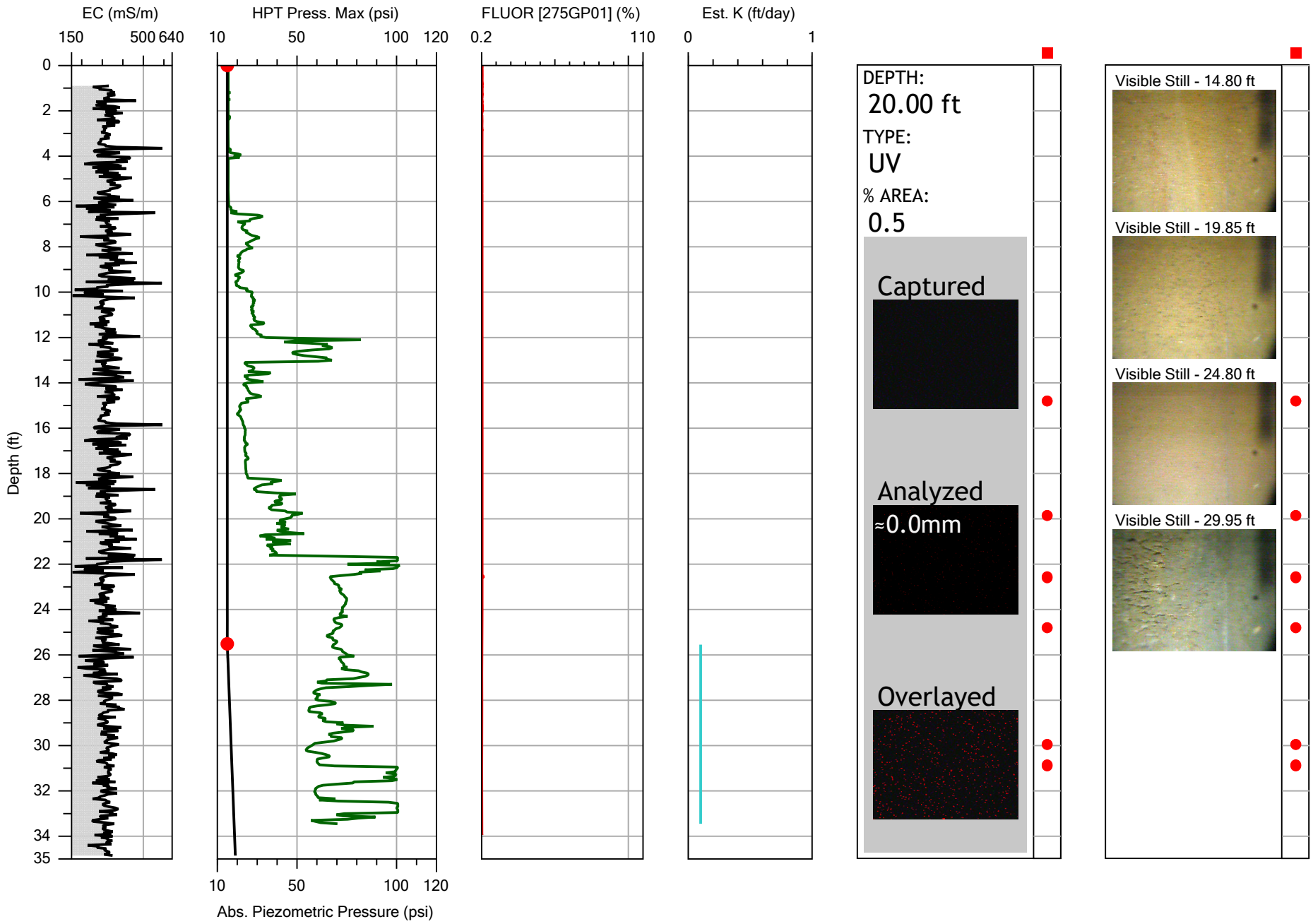
Project ID: HRP: Former PRGS	Client: Ramboll	Location: Alexandria, VA



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DRILLING | TECHNICAL SERVICES

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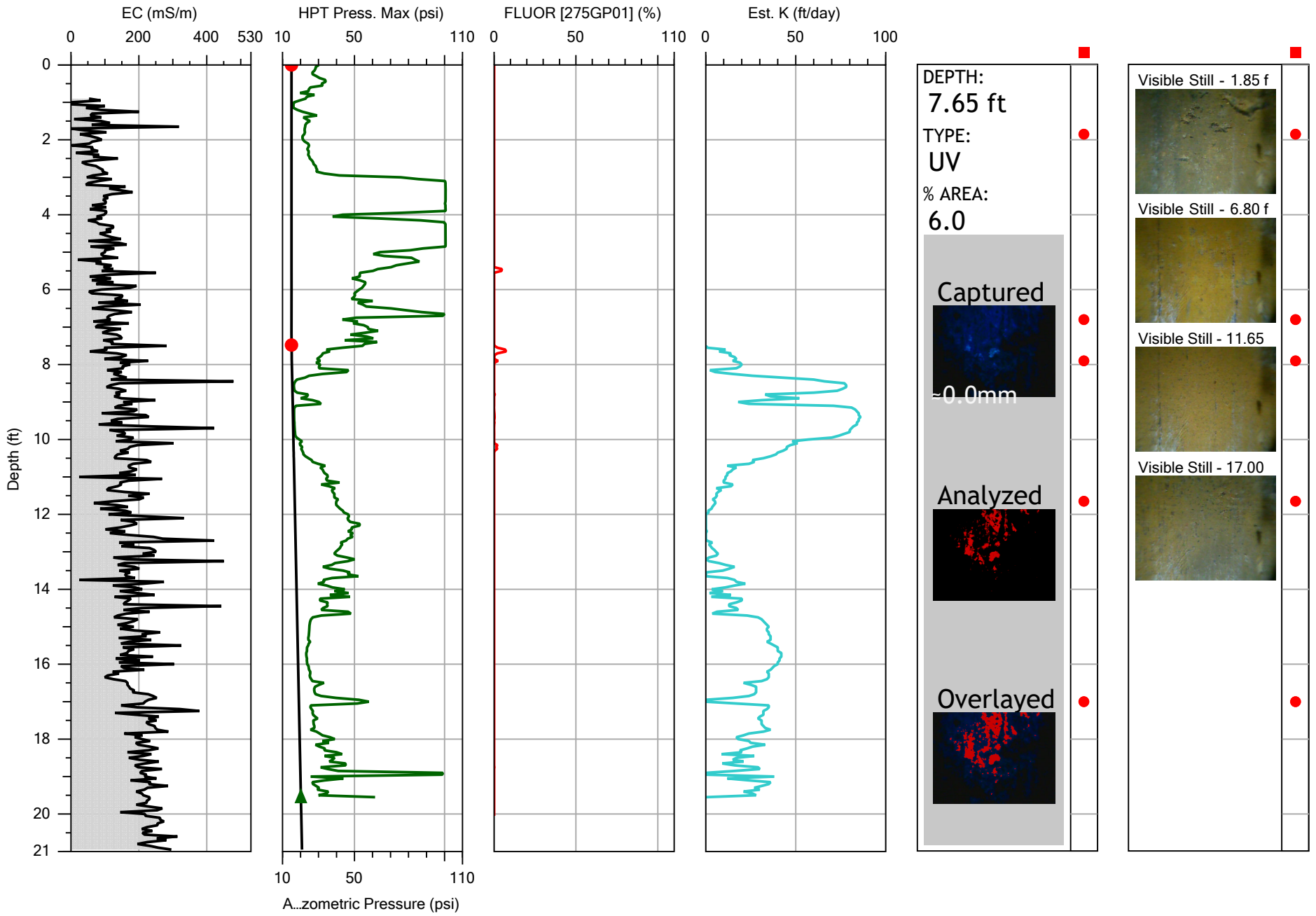

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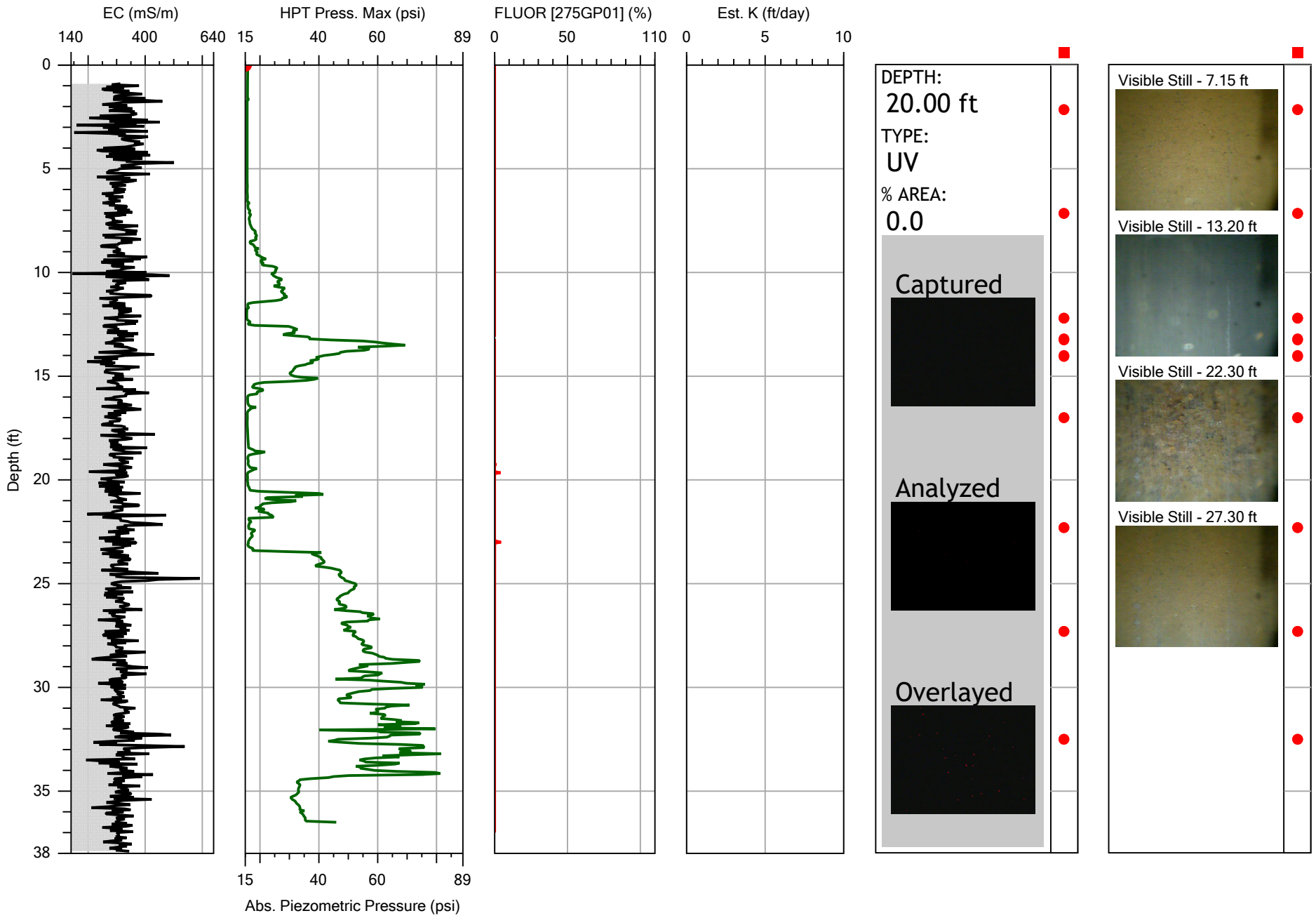

CASCADE
DRILLING | TECHNICAL SERVICES

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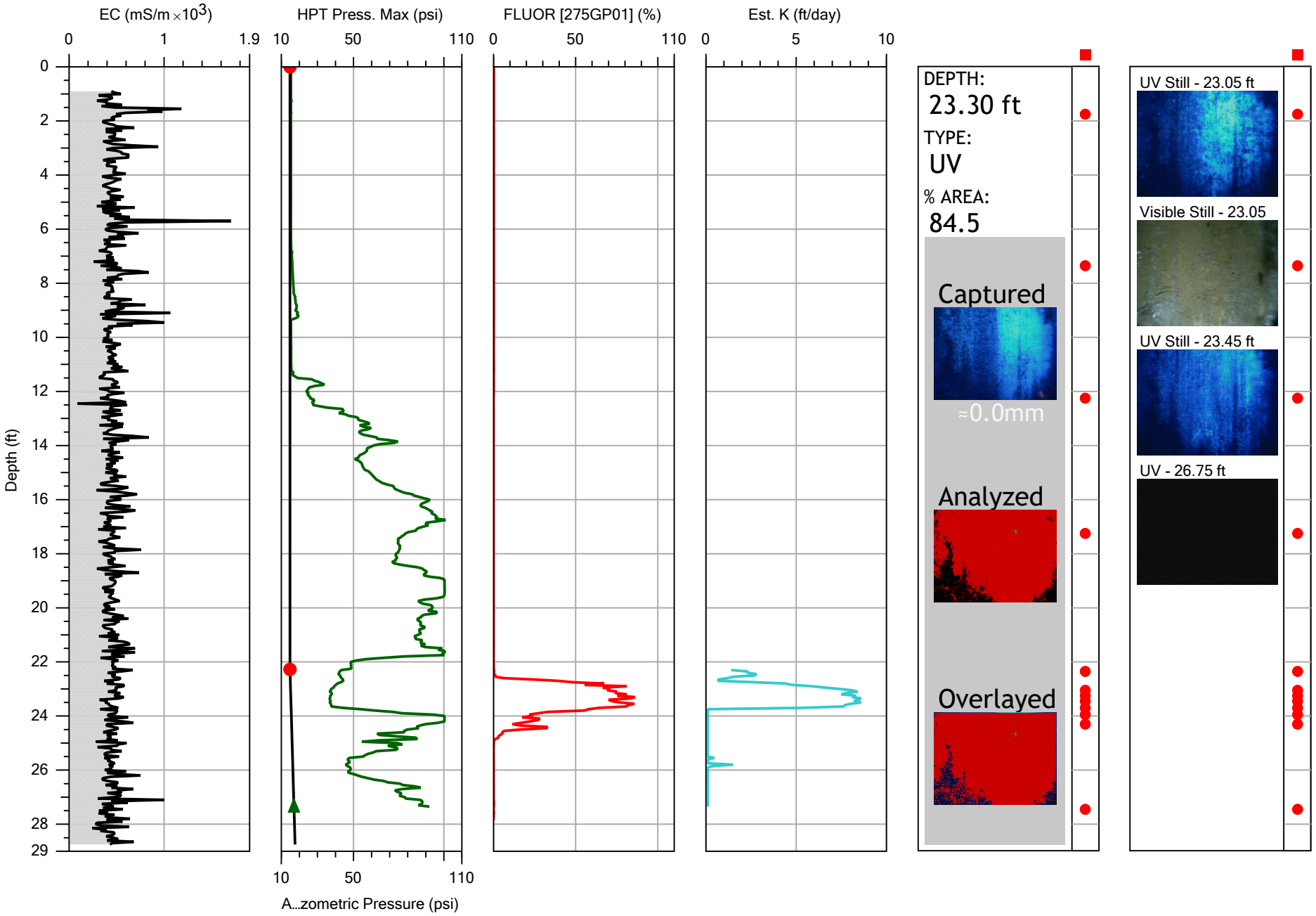
Project ID: HRP: Former PRGS	Client: Ramboll	Date: 02/10/23
		Location: Alexandria, VA



CASCADE
DRILLING | TECHNICAL SERVICES

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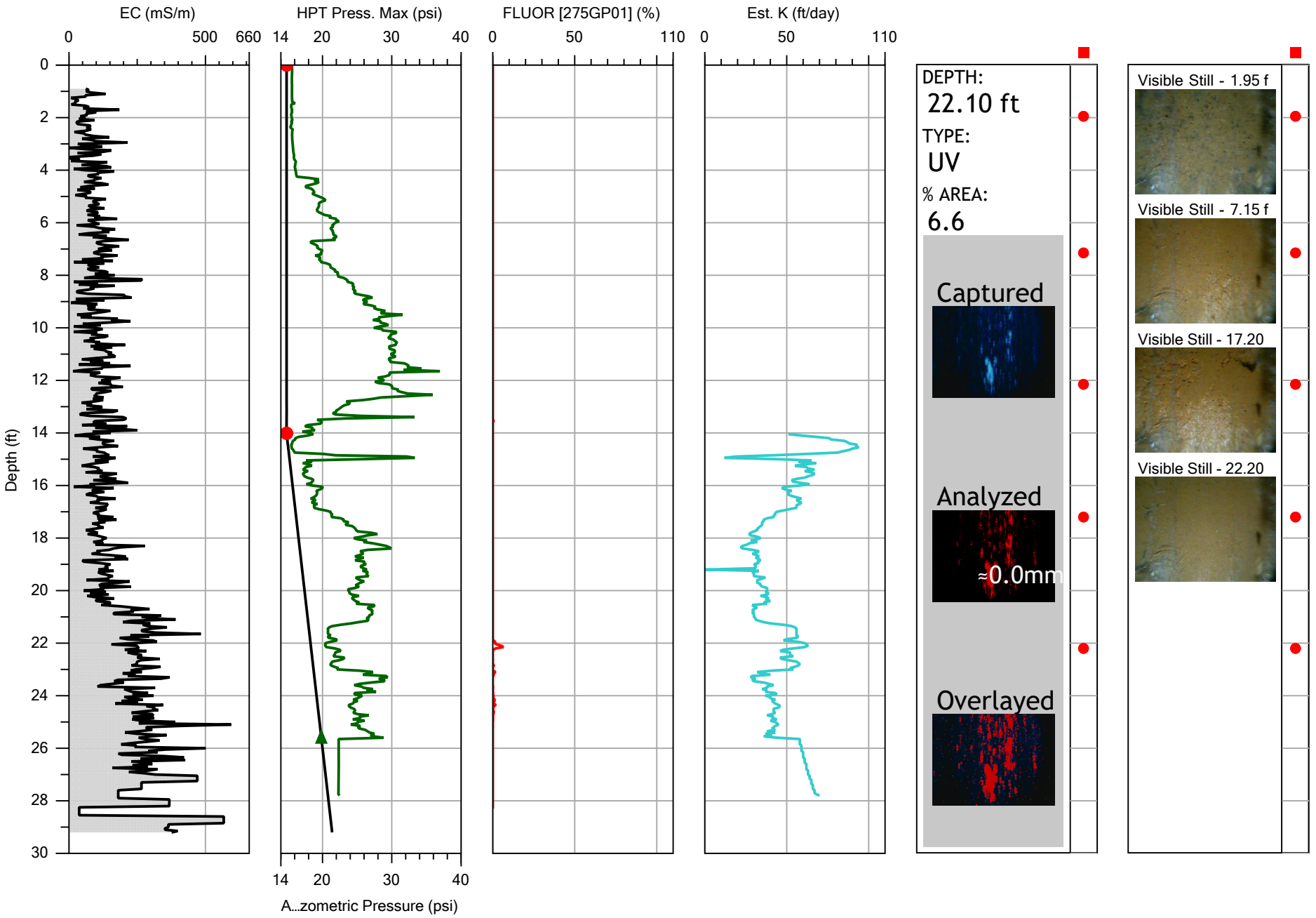
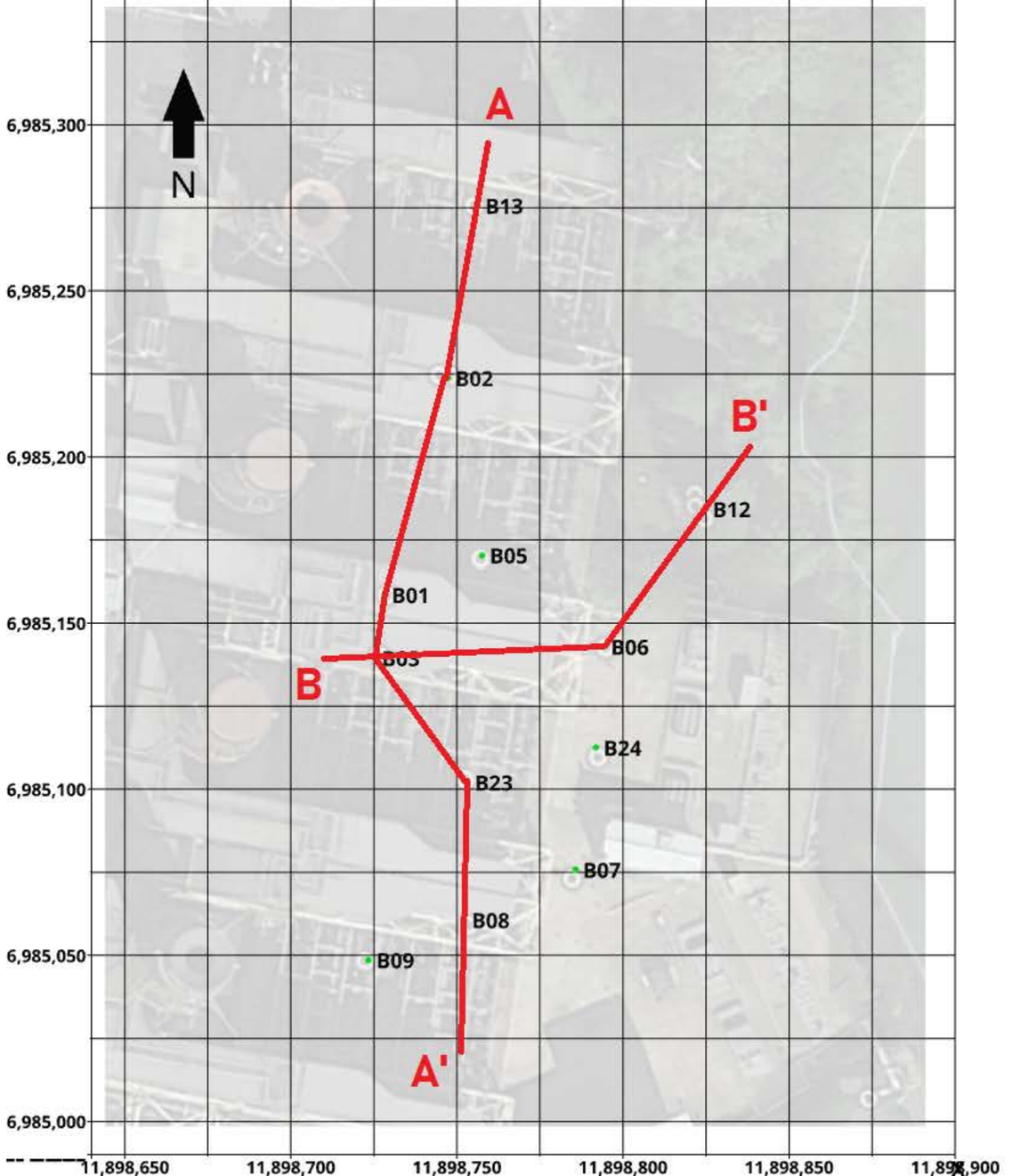
Project ID: HRP: Former PRGS	Client: Ramboll	Date: 02/13/23
		Location: Alexandria, VA



CASCADE
DRILLING | TECHNICAL SERVICES

Company: Cascade Remediation Services	Operator: C Dixon	File: B24.OIHP
Project ID: HRP: Former PRGS	Client: Ramboll	Date: 02/13/23
		Location: Alexandria, VA

ATTACHMENT B
CASCADE CROSS SECTIONS



CASCADE

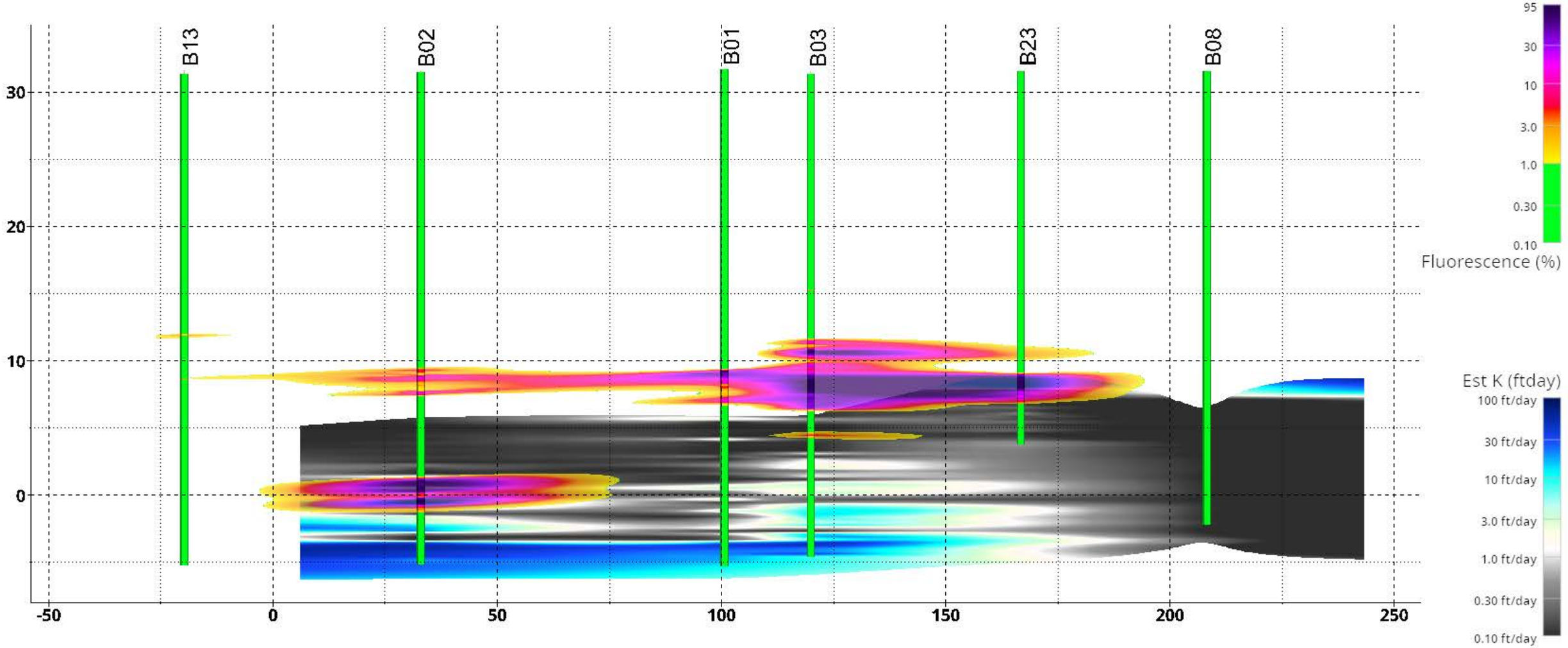
Vertical Exaggeration x3
Elevation in Feet Above Mean Sea Level (Ft AMSL)
Coordinates in State Plane - Virginia - N (US Feet)

Location: Alexandria, Virginia
Datasets: OIP, Corrected HPT Pressure, and Est. K
OIP Response Levels (%): 1, 3, 5, 10, 30, 70

North - A

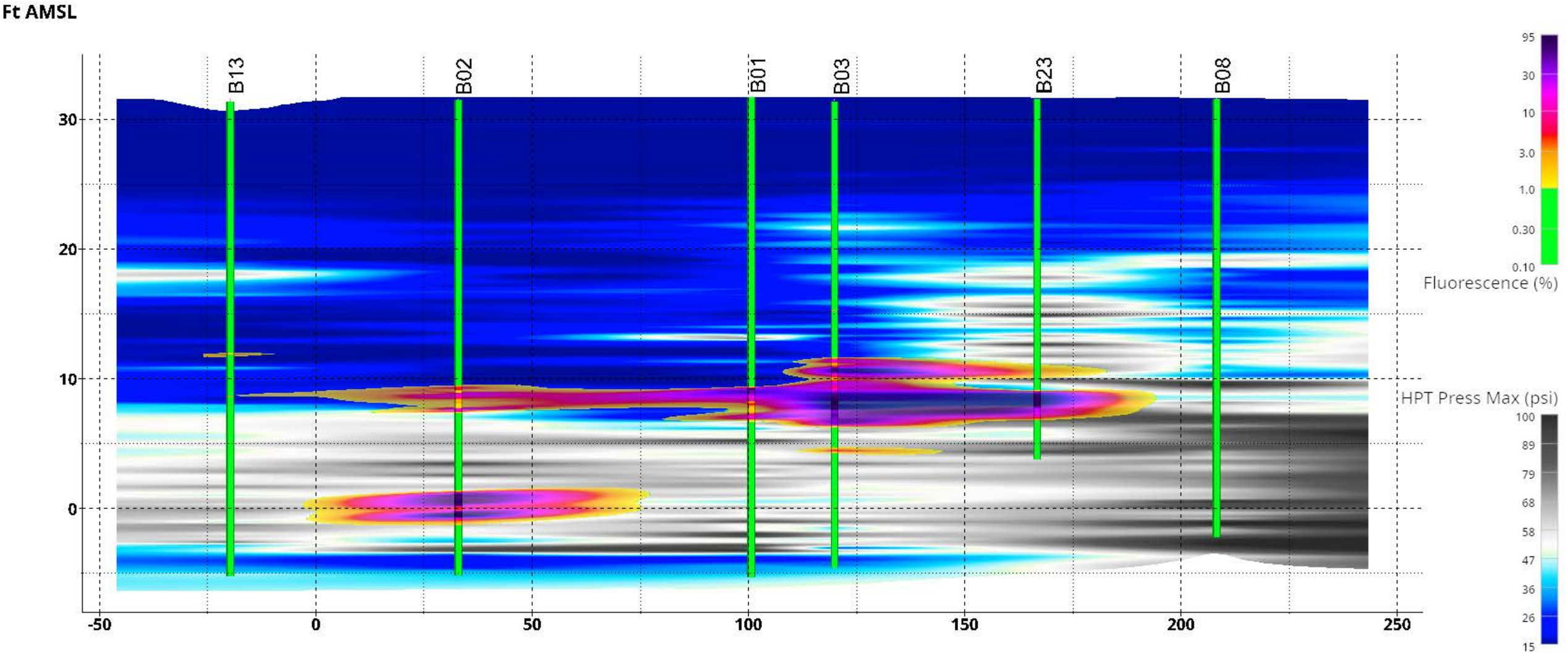
South - A'

Ft AMSL



North - A

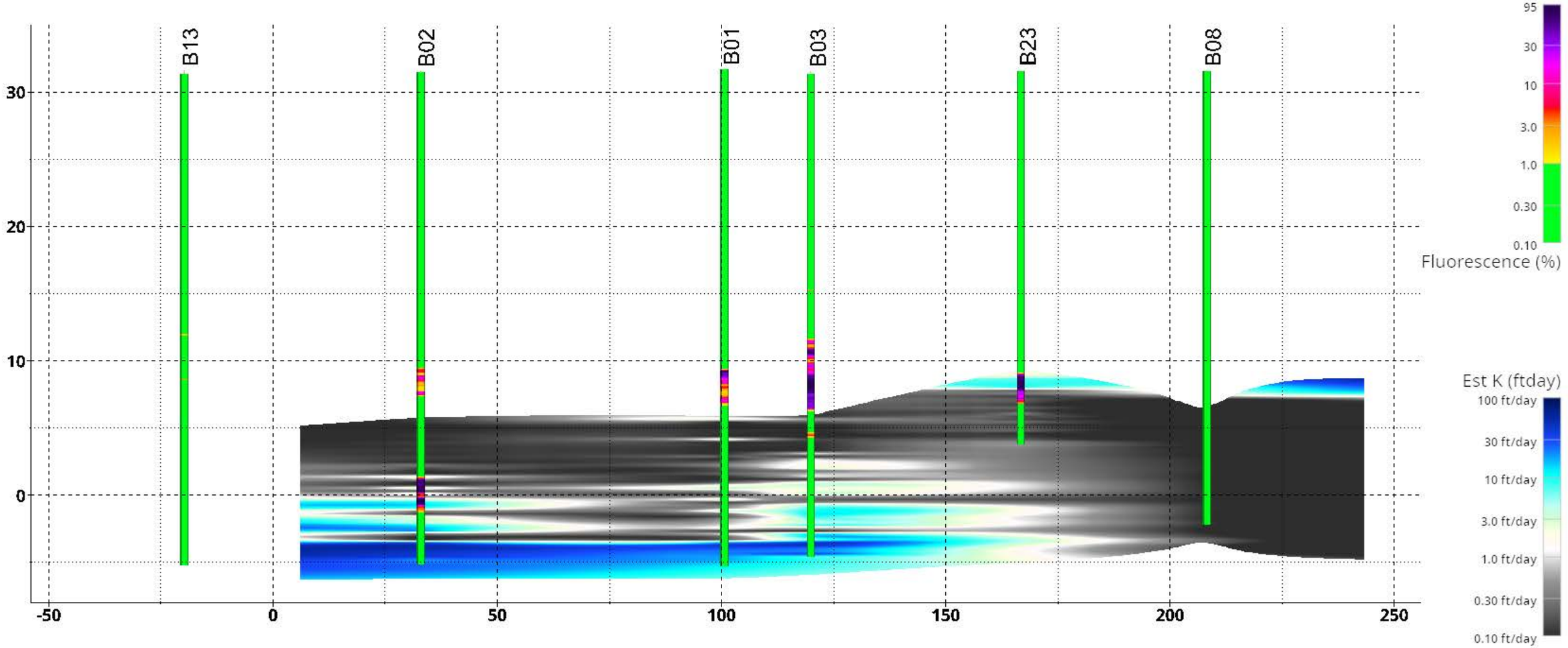
South - A'



North - A

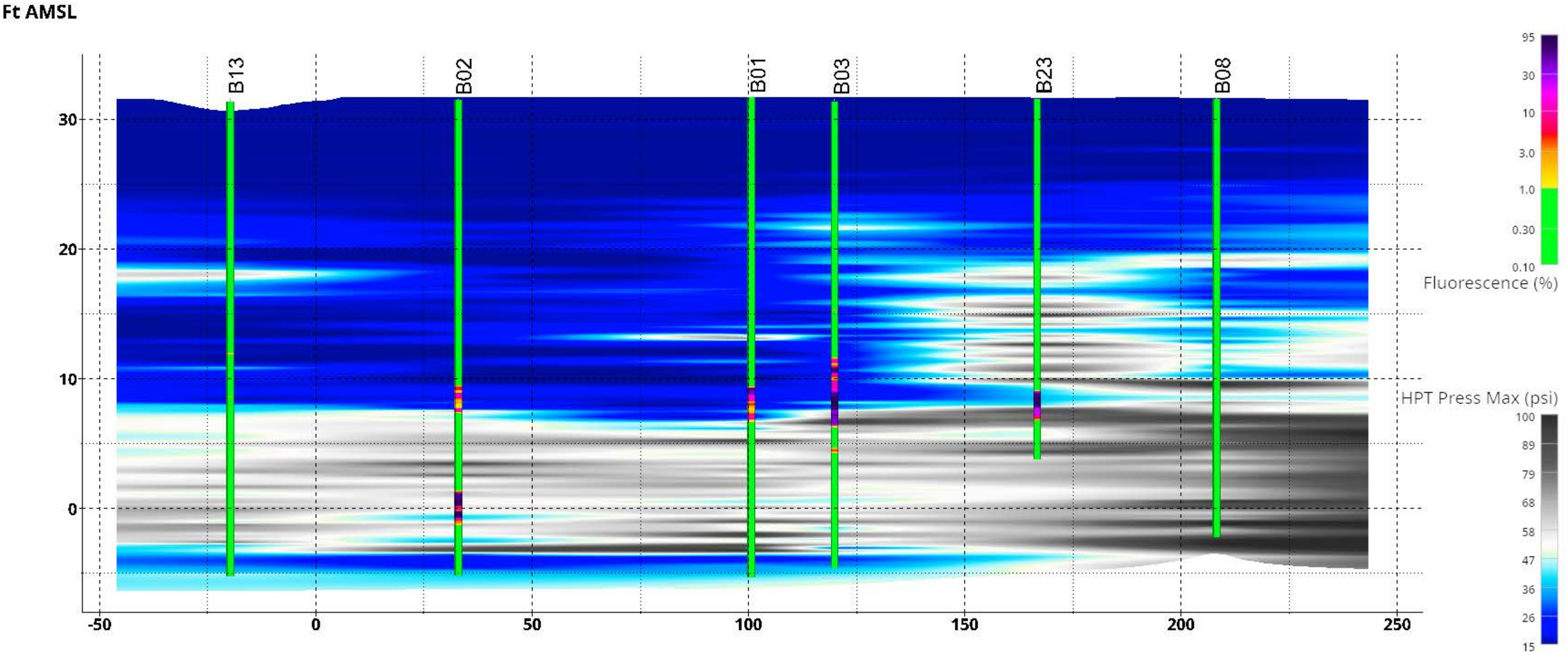
South - A'

Ft AMSL



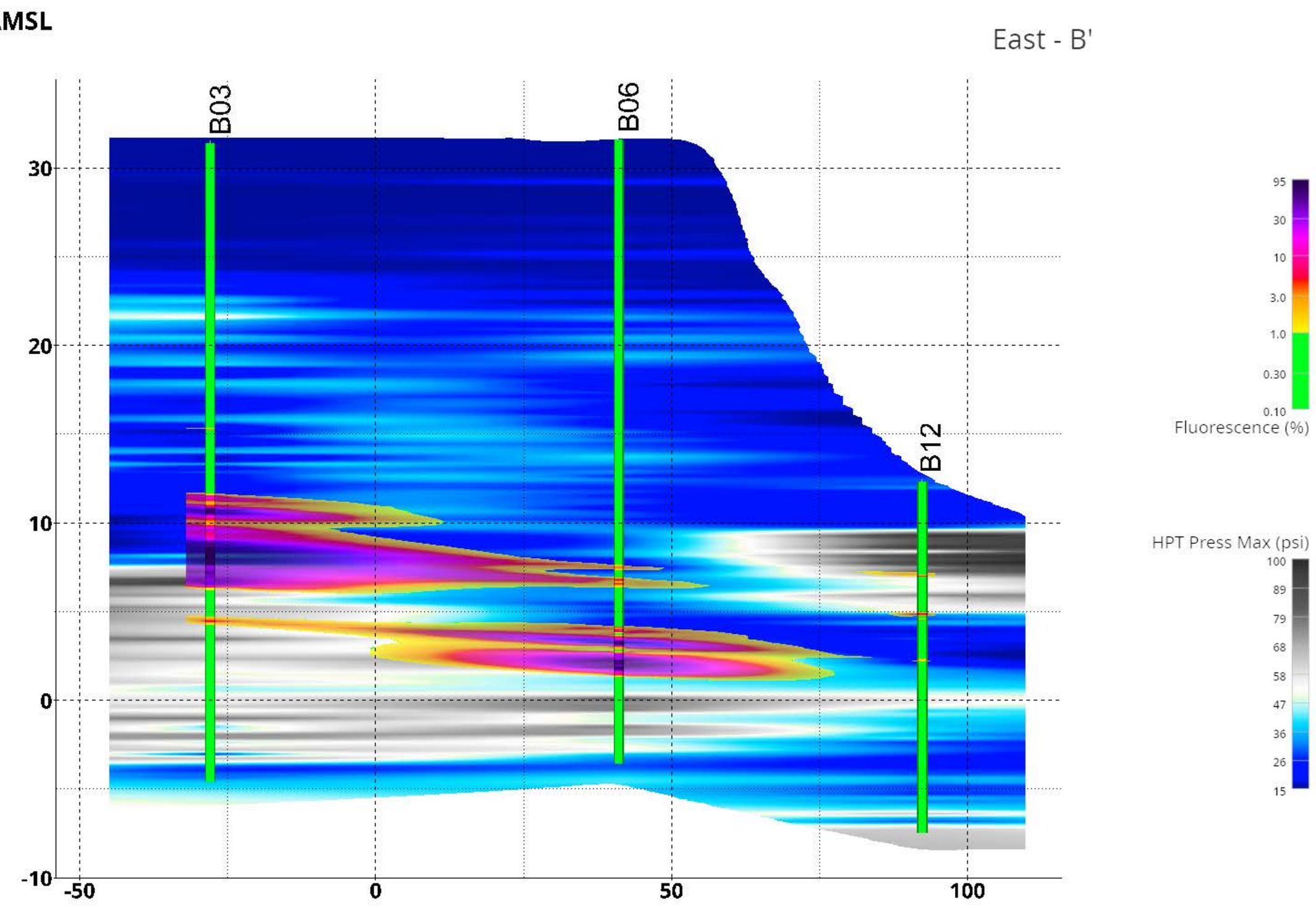
North - A

South - A'



West - B

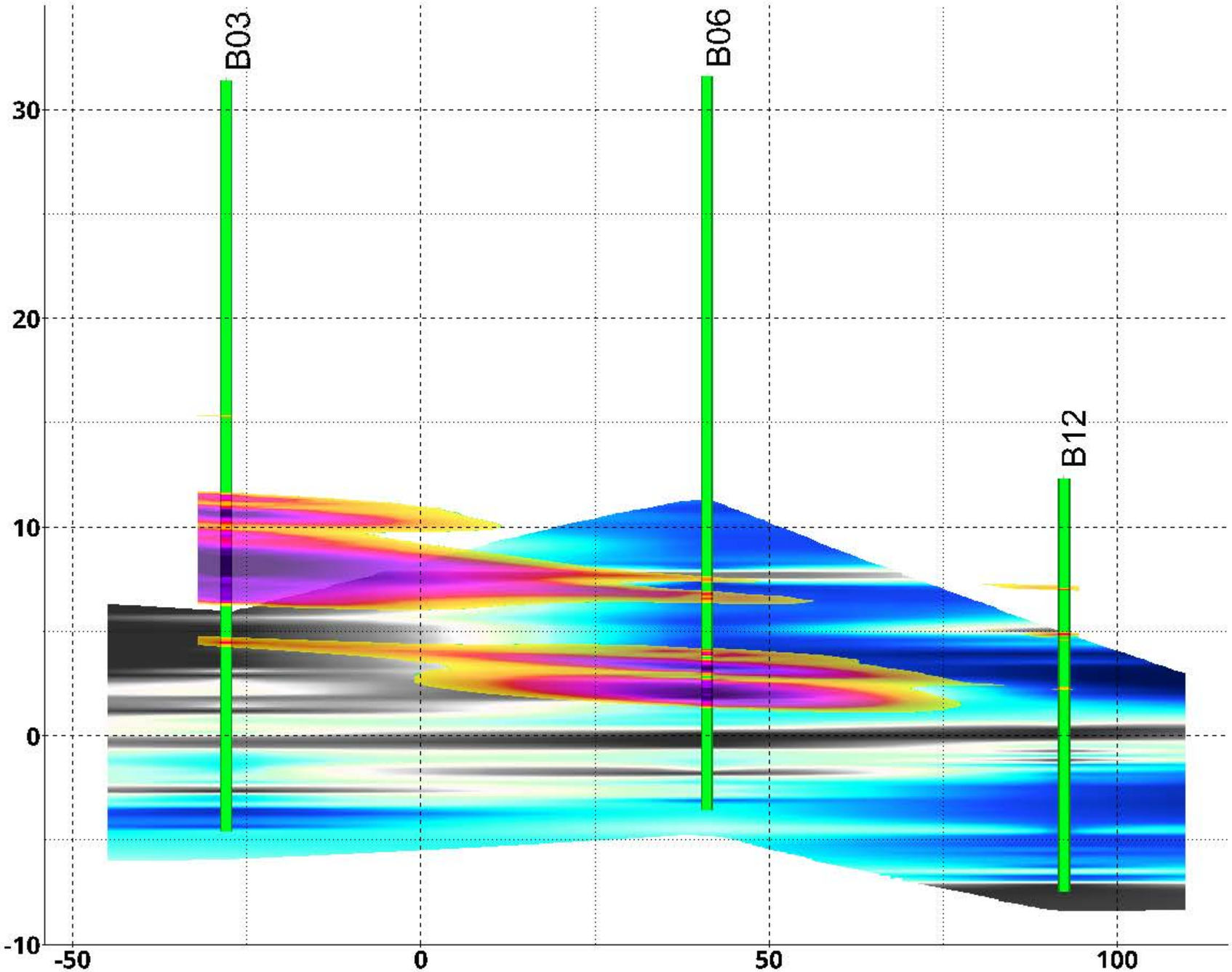
East - B'

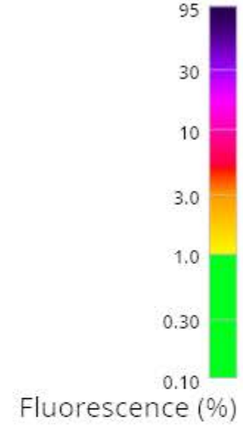

Ft AMSL
B03
B06
B12
30
20
10
0
-10
-50
0
50
100
95
30
10
3.0
1.0
0.30
0.10
Fluorescence (%)
HPT Press Max (psi)
100
89
79
68
58
47
36
26
15

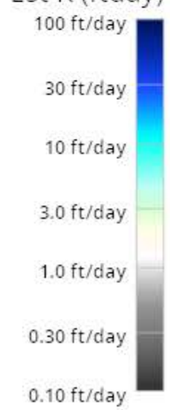
West - B

Ft AMSL

East - B'







West - B

East - B'

Ft AMSL

B03

B06

B12

30

20

10

0

-10

-50

0

50

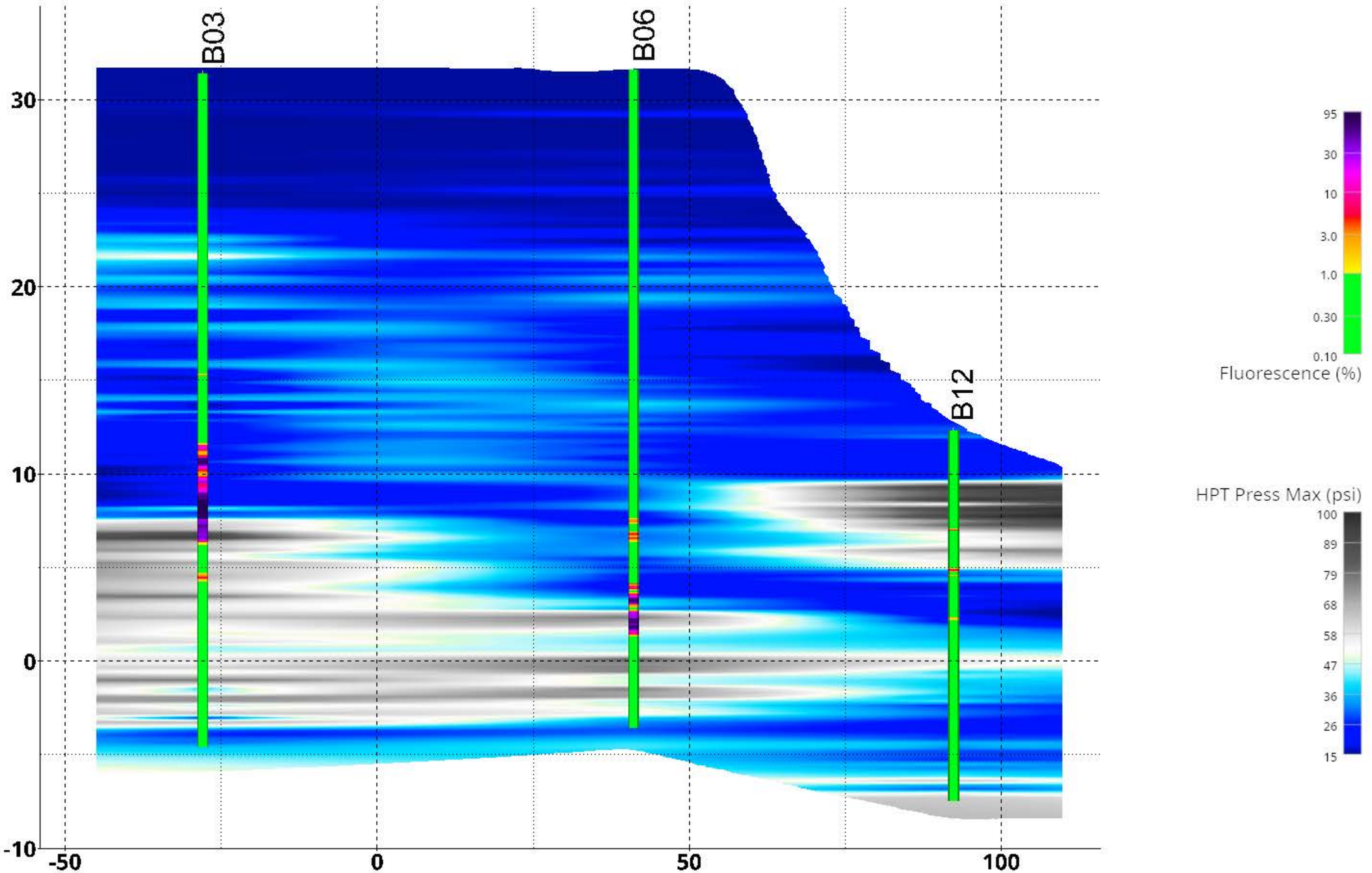
100

95
30
10
3.0
1.0
0.30
0.10
Fluorescence (%)

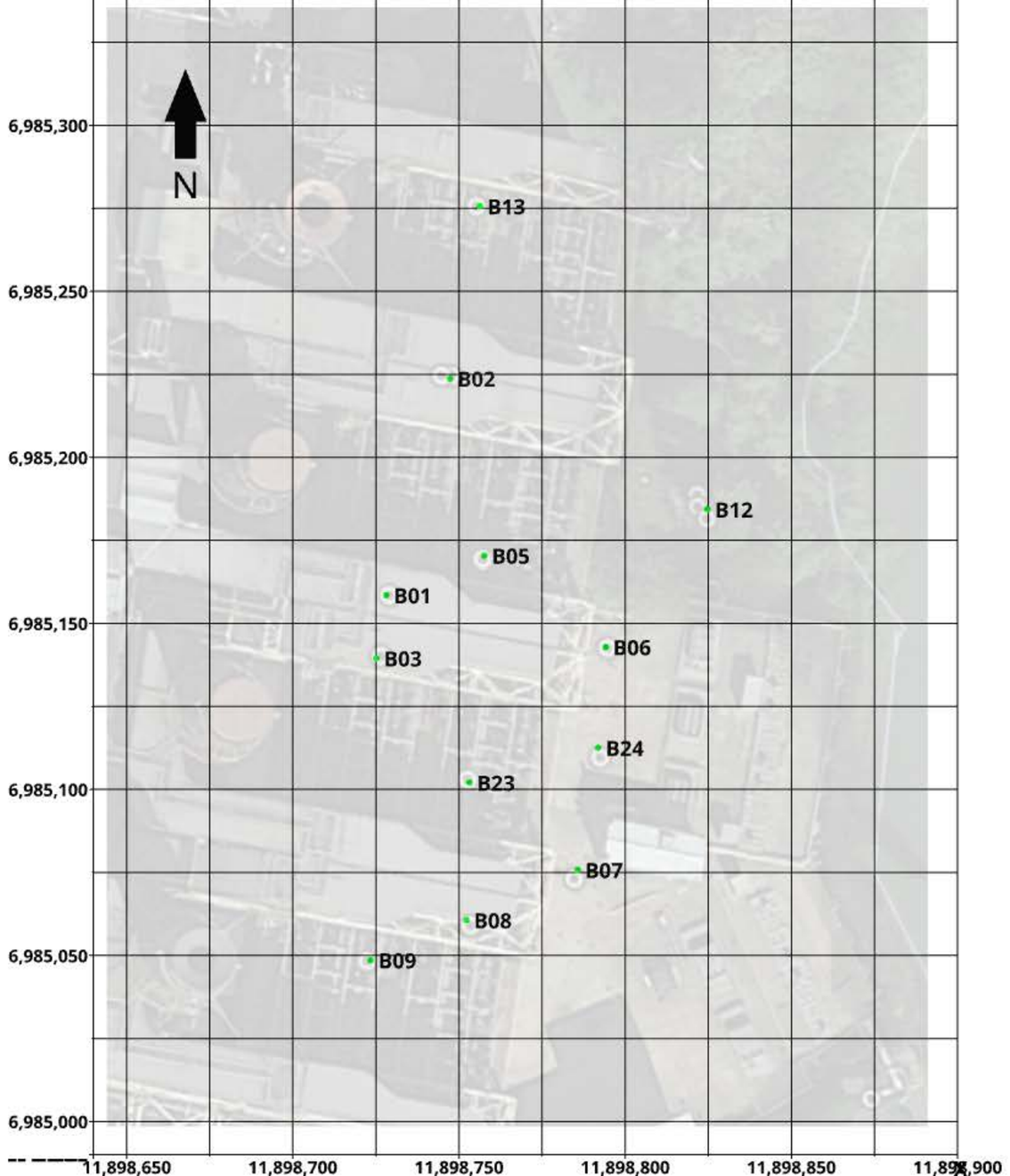
Est K (ftday)
100 ft/day
30 ft/day
10 ft/day
3.0 ft/day
1.0 ft/day
0.30 ft/day
0.10 ft/day

West - B

East - B'


Ft AMSL
B03
B06
B12
30
20
10
0
-10
-50
0
50
100
95
30
10
3.0
1.0
0.30
0.10
Fluorescence (%)
HPT Press Max (psi)
100
89
79
68
58
47
36
26
15

ATTACHMENT C
CASCADE MODEL FOOTPRINTS



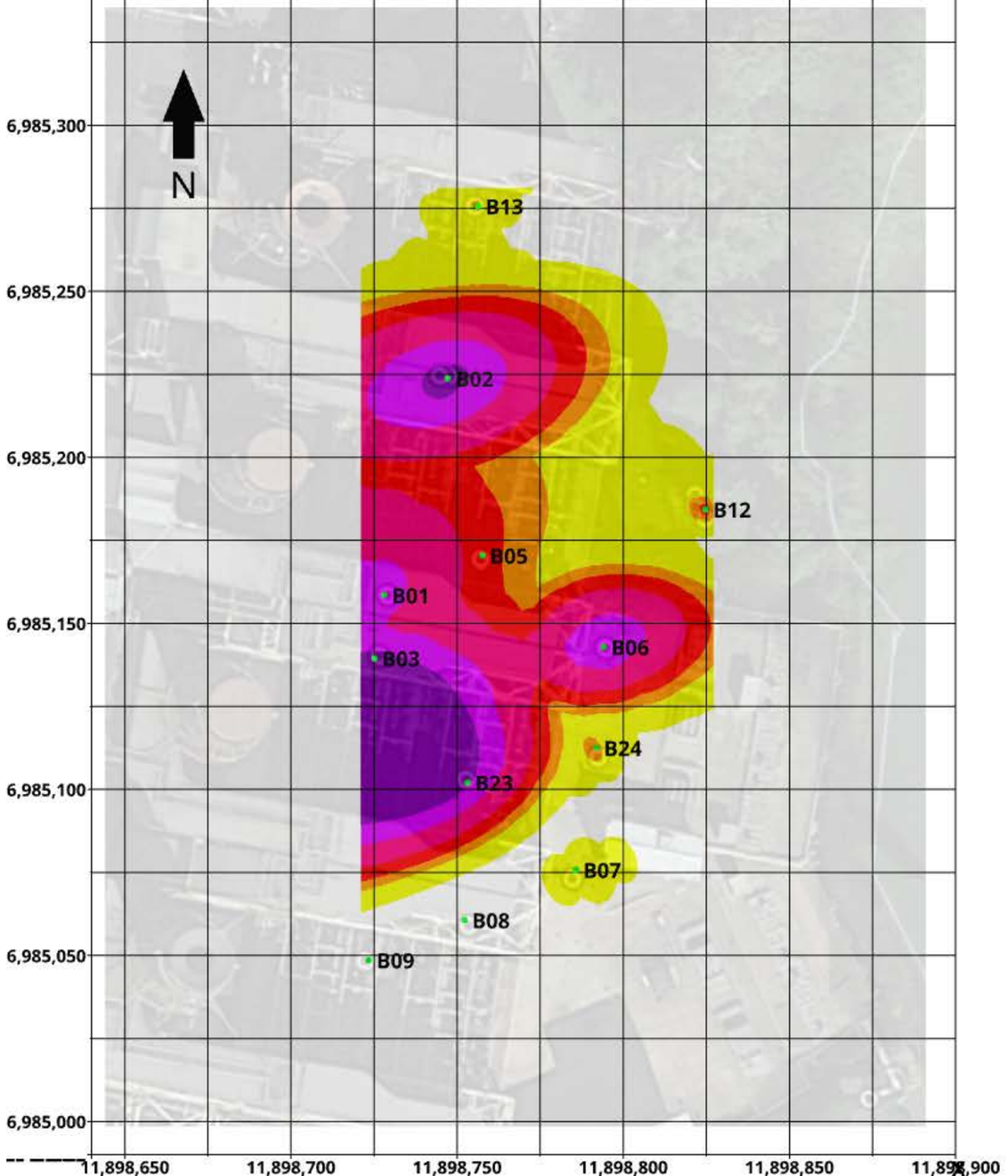
CASCADE

Vertical Exaggeration x3
Elevation in Feet Above Mean Sea Level (Ft AMSL)
Coordinates in State Plane - Virginia - N (US Feet)

Fluorescence (%)
100
30
10
3.0
1.0
0.30
0.10

HPT Press Max (psi)
100
89
79
68
58
47
36
26
15

Location: Alexandria, Virginia
Datasets: OIP, Corrected HPT Pressure, and Est. K
OIP Response Levels (%): 1, 3, 5, 10, 30, 70



CASCADE

Vertical Exaggeration x3
Elevation in Feet Above Mean Sea Level (Ft AMSL)
Coordinates in State Plane - Virginia - N (US Feet)

Fluorescence (%)

100
30
10
3.0
1.0
0.30
0.10

HPT Press Max (psi)

100
89
79
68
58
47
36
26
15

Location: Alexandria, Virginia
Datasets: OIP, Corrected HPT Pressure, and Est. K
OIP Response Levels (%): 1, 3, 5, 10, 30, 70