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January 29, 2015

ARCADIS Project No.:
B0064607.2014

Subject:
2013/2014 LNAPL Investigation Technical Memorandum – RACER Trust, Pontiac North Campus

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ARCADIS of Michigan, LLC (ARCADIS) prepared this light non-aqueous phase liquid (LNAPL) Investigation Technical Memorandum on behalf of Revitalizing Auto Communities Environmental Response (RACER) Trust presenting the results of the LNAPL investigation conducted in 2013 and 2014 at the Pontiac North Campus facility located in Pontiac, Michigan (the Site). The Site location and areas of focus are shown on Figures 1 and 2, respectively. This LNAPL evaluation, as well as the ongoing polychlorinated byphenol (PCB) investigation, is being conducted to further refine the conceptual Site model (CSM). The refined CSM will further support the soil and groundwater remedial alternatives proposed for the Site in the Corrective Measures Proposal (CMP).

Objectives

ARCADIS completed Site investigation activities in 2013 and 2014 to assess the extent, mobility, and recoverability of LNAPL at the Site in accordance with the 2013 LNAPL Characterization Work Plan – MWM2-29 and MWW8-65. The specific objectives of the Site investigation activities were to:

- Delineate the lateral and vertical extent of LNAPL in Areas Of Interest (AOIs) M-2 and W-8.

- Evaluate the nature (type), physical properties, and composition of LNAPL present in AOIs M-2 and W-8.

- Assess the potential for future LNAPL migration in AOIs M-2 and W-8.

- Determine the extent to which LNAPL is recoverable in AOIs M-2, M-16, W-1, W-8, and W-10.

The activities completed included a laser-induced fluorescence (LIF) investigation; field LNAPL transmissivity testing; and LNAPL mobility modeling following ASTM International (ATSM), Interstate Technology and Regulatory Council (ITRC), and American Petroleum Institute (API) methods. Results presented on LNAPL mobility and migration potential for AOIs M-2 and W-8 are intended to be complementary to previous evaluations of LNAPL mobility in AOIS W-1, W-8, and W-10 (Encore 2007). These activities were performed in accordance with objectives, sampling methodologies, and analytical procedures in the Field Sampling Plan (FSP; Encore 2001a) and Quality Assurance Project Plan (QAPP; Encore 2001b).

LNAPL Characteristics and Distribution

LNAPL Delineation in AOIs M-2 and W-8

The lateral and vertical extents of LNAPL at AOIs M-2 and W-8 were further delineated using LIF in August through September 2013. A total of 48 LIF soundings were completed at AOI M-2 (M2-01 through M2-48), and nine soundings were completed at AOI W-8 (W8-01 through W8-09), as shown in Figure 3. LIF logs for AOIs M-2 and W-8 are included in Attachment 1.

A total of nine monitoring wells were installed within the LNAPL footprints at AOIs M-2 (TWM2-01 through 07) and W-8 (TWW8-01 and TWW8-02) following the delineation of the LNAPL using LIF to define stratigraphy of subsurface soils and assess whether LNAPL would collect in wells at these locations. LNAPL and water level measurements were collected from these new wells, along with previously installed wells where LNAPL has historically been observed, to confirm LNAPL conditions with respect to stratigraphy and determine whether field LNAPL transmissivity testing would be feasible at these locations.

LNAPL Type/Characteristics

In August 2013, LNAPL samples were collected from wells MWM2-29 (AOI M-2) and MWW8-65 (AOI W-8). LNAPL samples were submitted to Zymax Laboratory in Escondido, California for the following forensic analyses:

- Individual volatile hydrocarbons of five classes: paraffins, isoparaffins, aromatics, naphthenes, and olefins (PIANO compounds).

- Total hydrocarbons by a gas chromatography with flame ionization detection (GC/FID) method that produced a gas chromatogram (whole oil analysis).

LNAPL samples from monitoring wells MWM2-29 and MWW8-65 were also submitted to TestAmerica Laboratories in North Canton, Ohio for the following analyses:

- Volatile organic compounds (VOCs) by U.S. Environmental Protection Agency (USEPA) Method 5035/8260B.

- Semi-volatile organic compounds (SVOCs) by USEPA Method 8270C.

- Polychlorinated biphenyls (PCBs) by USEPA Method 8082

Monitoring Well MWM2-29

PIANO results for the LNAPL sample collected at monitoring well MWM2-29 indicates that LNAPL most closely resembles a heavy-end refined petroleum product (consistent with a lubricating oil) with a small amount of moderately weathered diesel. The LNAPL sample also contained PCBs (Aroclor 1242 at 2,000 milligrams per kilogram [mg/kg]), as well as a number of VOCs and SVOCs (Table 1). Laboratory analytical results from TestAmerica are presented in Attachment 2, and the results from Zymax are presented in Attachment 3.

LNAPL and groundwater were also collected from monitoring well MWM2-29 and sent to PTS Laboratories in Santa Fe Springs, California for physical properties analysis, including density (ASTM D1481), viscosity (ASTM D445), and interfacial tension pairs (ASTM D971). Fluid properties tests were performed at groundwater temperatures of 55 degrees Fahrenheit ([°F]; 13 degrees Celsius [°C]). The results indicated that LNAPL from well MWM2-29 has a viscosity of 120 centipoise (cP) and a specific gravity of 0.8926. The analytical results for MWM2-29 were used as representative LNAPL properties in LNAPL mobility calculations discussed below for AOI M-2. The fluid physical properties used for this analysis are presented in Table 2, and laboratory analytical reports are included in Attachment 4.

Monitoring Well MWW8-65

Based on PIANO results for the LNAPL sample collected at MWW8-65, only two compounds (1,2,3,5-tetramethylbenzene and 2-methylnaphthalene) were detected in the C3-C11 range. The whole oil chromatogram indicates that the MWM8-65 LNAPL is composed of a diesel-range material that is

moderately weathered and relatively more weathered than the MWM2-29 LNAPL. The LNAPL sample also contained SVOCs (consistent with the interpretation of the LNAPL as primarily a mid-distillate/diesel) and small concentrations of VOCs and PCBs (Aroclor 1248 at 2.1 mg/kg and Aroclor 1260 at 1.2 mg/kg; Table 1). Laboratory analytical results from TestAmerica are presented in Attachment 2, and the results from Zymax are presented in Attachment 3.

LNAPL and groundwater were also collected from MWW8-65 and sent to PTS Laboratories in Santa Fe Springs, California for physical properties analysis, including density (ASTM D1481), viscosity (ASTM D445), and interfacial tension pairs (ASTM D971). Fluid properties tests were performed at groundwater temperatures of 55 degrees °F (13 °C). The results indicated that LNAPL from well MWM8-65 has a viscosity of 15.5 cP and a specific gravity of 0.8623. The analytical results for MWM8-65 were used as representative LNAPL properties in LNAPL mobility calculations discussed below for AOI W-8. The fluid physical properties used for this analysis are presented in Table 2, and laboratory analytical reports are included in Attachment 4.

LNAPL Mobility and Recoverability Assessment Background

Terminology

The ITRC and Michigan Department of Environmental Quality (MDEQ) identify three different conditions that characterize the potential for NAPL movement in the subsurface (ITRC 2009; MDEQ 2014). The MDEQ definitions are presented below:

- Residual NAPL Saturation: The range of NAPL saturations greater than zero NAPL saturation up to the NAPL saturation at which NAPL capillary pressure equals pore-entry pressure and includes the maximum NAPL saturation, below which NAPL is discontinuous and immobile under the applied gradient.

- Mobile NAPL: NAPL that exceeds residual saturation and includes migrating NAPL, but not all mobile NAPL is migrating NAPL.

- Migrating NAPL: NAPL observed to spread or expand laterally or vertically or otherwise result in an increased volume of the NAPL extent, usually indicated by time series data or observation. Migrating NAPL does not include NAPL that appears in a well within the historical extent of the NAPL due to a fluctuating water table.

Assessment Methodology

A comprehensive LNAPL mobility assessment uses multiple lines of evidence to determine LNAPL mobility and the potential for future LNAPL migration. The following lines of evidence were used to assess LNAPL mobility and recoverability at the Site:

- Field LNAPL transmissivity testing.
- Soil petrophysical properties.
- Comparison of laboratory-determined LNAPL field and residual saturations.
- LNAPL pore velocity potential calculations.
- LNAPL pore-entry pressure calculations.

These complimentary lines of evidence have an inherent logic used to determine whether LNAPL is residual, mobile, recoverable, or has the potential to migrate in the future. The following sections summarize the results of the assessment.

Field LNAPL Transmissivity Testing Results

LNAPL transmissivity represents the volumetric rate of LNAPL flow through a unit width of porous media per unit time under a unit hydraulic gradient. LNAPL transmissivity is an ideal parameter for assessing LNAPL recoverability, inherently accounting for the combined effects of aquifer matrix permeability, LNAPL physical properties, and the relative proportion of pore space occupied by LNAPL within a specified vertical interval of aquifer material.

In April and September 2014, ARCADIS gauged fluid levels in all of the wells located within the extent of LNAPL impacts (as defined by recent and historical investigation activities), and a minimum in-well accumulation of 0.2 foot was established as a threshold value for determining whether or not transmissivity testing would provide useful data (consistent with recommendations in ASTM International 2013). A total of 18 monitoring wells and temporary wells, which were installed during field activities in June through August 2014, were selected for LNAPL transmissivity testing (LNAPL baildown testing):

- Three wells tested in AOI M-2: MWM2-29,TWM2-07, SB-07A-14.
- One well tested in AOI M-16: MWM4-06R.

- Five wells tested in AOI W-1: TW01-01, SB-04-14, SB-43-14, SB-46-14, and SB-57-14.
- Five wells tested in AOI W-8: MWW8-65, MWW8-48, RWW8-133, TWW8-01, and TW11-01.
- Four wells tested in AOI W-10: MWW10-01, MWW10-05, SB-25-14, and SB-08-14.

LNAPL baildown test data were analyzed using Bouwer and Rice (1976)/Bouwer (1989), the Cooper & Jacob (1946)/Jacob & Lohman (1952), and the Cooper, Bredehoeft, and Papadopulos (1967) methods provided in the API LNAPL Transmissivity Workbook (API 2012). Early-time data representative of discharge from filter pack materials were excluded from the dataset to ensure that LNAPL transmissivity estimates were representative of LNAPL conditions in the formation, where appropriate. LNAPL transmissivity results for each of the LNAPL baildown tests completed at the Site are summarized in Table 3.

LNAPL transmissivity is increasingly being applied as a quantitative indicator of LNAPL recoverability that can be used to focus and optimize LNAPL recovery efforts and, in the absence of risk-based LNAPL concerns, can be used to establish realistic LNAPL recovery end-points (ITRC 2009). The ITRC put forward a range of values of 0.1 to 0.8 square feet (ft^2)/day as the practical lower limit of LNAPL recoverability using pumping, skimming, and similar conventional hydraulic recovery methods. In line with ITRC, the MDEQ has established a lower limit LNAPL transmissivity value of 0.5 ft^2/day to define recovery to the maximum extent practicable (MDEQ 2014), permitting the use of LNAPL transmissivity as a quantitative recoverability metric in the State of Michigan in the absence of risk-based LNAPL concerns. The LNAPL transmissivity values measured at the Site range from approximately 0.001 to 2.3 ft^2/day. Of the five areas where LNAPL transmissivity tests were completed, two areas' tests, AOI M-2 and AOI M-16 were all within or below the range of practical recoverability put forth by the ITRC as well as below the draft MDEQ threshold. In AOI W-8, LNAPL transmissivity estimated for the 1st of two tests completed at well RWW8-133 exceeded the value being considered by the MDEQ, however, repeat testing at RWW8-133 indicated that LNAPL transmissivity was below the draft MDEQ threshold (see Table 3). In AOI W-1, only one well, SB-43-14, exceeded both the ITRC recoverability range and the MDEQ threshold. In AOI W-10, two locations, SB-08-14 and SB-25-14, exceeded the MDEQ and/or ITRC recoverability thresholds.

Soil Petrophysical Properties

Soil core samples were collected from five locations in AOI M-2 and two locations in AOI W-8 using thin-walled steel tubes (Shelby tubes) advanced with a hydraulic piston sampler during installation of wells TWM2-01, TWM2-03 through TWM2-05, TWM2-07, TWW8-01, and TWW8-02 in November 2013. Based on known subsurface information at each location (LIF data and soil boring logs), a target depth interval was identified for soil core collection. Soil core samples were collocated with LIF sounding and monitoring well locations; the LIF ID was used when collecting soil cores. Upon retrieval, soil core samples were capped and flash-frozen in their in-situ vertical orientation using dry ice and shipped to PTS laboratory in

Santa Fe Springs, California. The cores were cut lengthwise into 0.25 by 0.75-inch sections using a band saw with a diamond segmented blade, cooled by liquid nitrogen vent gas to prevent volatilization of pore fluids. After slabbing, soil cores were photographed under natural (white) and ultraviolet (UV) light to facilitate visual analysis of soil features and apparent hydrocarbon distribution.

The natural light photographs show the soil structure, while the UV photographs show LNAPL distribution in the soil cores because polycyclic aromatic hydrocarbon compounds in the LNAPL fluoresce within the visible light spectrum when exposed to UV light (brighter fluorescence generally indicates higher LNAPL saturation zones). Photographs were reviewed and sub-sample locations for petrophysical analyses, including grain size analysis, field and residual LNAPL and water saturations, and capillarity testing, were selected based on the photographs.

Sub-samples were selected from areas that appeared to be representative of the highest degree of LNAPL impact (i.e., LNAPL saturation) present within each core sample based on the relative fluorescence intensity observed. The petrophysical test methods used are summarized below.

- Free Product Mobility – Centrifuge Method (FPM-C), Methods API RP 40 and ASTM D425M.
- Air-Water Capillary Pressure Drainage (AWCD), Method ASTM D6836, centrifugal method.
- Particle Size Analysis, Method ASTM D422 and ASTM D4464M.

LNAPL and water saturations, along with aquifer matrix characteristics resulting from petrophysical laboratory tests, are presented in Table 4. Soil core photographs are presented in Attachment 5.

LNAPL Field and Residual Saturations

At a site with LNAPL impacts, the relative saturations of three matrices: air, LNAPL, and groundwater, must be considered when evaluating fluid mobility. Of primary interest is the mobility of the LNAPL and the related fluid saturations where LNAPL is mobile or immobile. LNAPL is mobile where there is continuity between LNAPL-filled soil pores that allows for lateral LNAPL movement. The LNAPL saturation at which LNAPL is discontinuous to the extent that it cannot flow is termed residual saturation.

Table 4 shows the results of the laboratory LNAPL saturations for AOIs M-2 and W-8. LNAPL field and residual saturations were measured at a total of nine sample intervals collected from seven locations (five in AOI M-2, two in AOI W-8). LNAPL was at residual saturation in four of the sample intervals (M2-01_39-40.5 at 39.3 ft. below ground surface (bgs), M2-21_17-19 at 17.4 ft. bgs, W8-02_12-14 at 12.1 ft. bgs, and W8-02_28-30 at 28.2 ft. bgs) indicating that LNAPL is immobile at these locations. Field saturations exceeded residual saturation in five of the samples analyzed, demonstrating that a fraction (approximately 0.8 to 60 percent) of the LNAPL in the samples analyzed is theoretically recoverable. This finding

indicates that LNAPL is mobile at the pore scale, but not necessarily migrating at the plume scale. Hydraulic gradient, aquifer permeability, and LNAPL viscosity are a few factors that influence whether the LNAPL above residual saturation is capable of migrating. The LNAPL pore velocity calculations described in the following section consider these additional factors. The soil core collected from W8-05_23.5-25.5 at 24.0 ft. bgs exhibited the highest field and residual saturations measured (initial saturation of 43.3 %pore volume [%Pv]) and residual saturation of 20.0 %Pv). The higher saturations observed in this sample are likely attributable to the fact that the LNAPL is present under confined conditions at this location (i.e., the LNAPL is trapped below the water table, beneath a layer of soil that limits upward movement). Under unconfined conditions, water table fluctuations will act to "smear" LNAPL vertically across a portion of an aquifer, increasing the percentage of the LNAPL that is trapped at residual saturation in the vadose zone and saturated zone, and reducing the overall volume of mobile LNAPL. Under confined LNAPL conditions, the interval of mobile LNAPL remains constant beneath the confining layer contact (assuming no reduction in LNAPL saturation due to remediation, lateral migration, or leakage through the confining soil layer), limiting the vertical re-distribution effects of water table fluctuations that are commonly observed for unconfined LNAPL.

The location of the confining layer contact is apparent in the soil boring log for TWW8-01 (Attachment 6) at 23.3 ft. bgs, which is roughly consistent with the LIF results obtained at this location (UVOSTW8-05). Those results show a fluorescence response at a depth of approximately 23.2 to 26.5 ft. bgs (see Attachment 1).The confining layer contact is also indicated on the hydrograph for TWW8-01, along with the locations of the air-LNAPL and LNAPL-water interfaces. The hydrograph for TWW8-01 is provided in Attachment 7.

LNAPL Pore Velocity Potential

There is potential for LNAPL movement in the subsurface at the pore scale wherever measured field LNAPL saturations exceed residual. LNAPL seepage velocity was calculated at four locations (M2-05_18-20, M2-16_6-9, M2-42_13-15 [at two separate depths], and W8-05_23.5-25.5) where field saturation was greater than residual based on mathematical relationships provided in API technical documents, predominantly API LNAPL Distribution and Recovery Model - Volume 1: Distribution and Recovery of Petroleum Hydrocarbon Liquids in Porous Media (API 2007). LNAPL velocities at laboratory-measured field saturation ranged from 1.3×10^{-8} to 9.7×10^{-6} in AOI M-2, and 3.2×10^{-7} centimeters per second (cm/s) in AOI W-8. Results are presented in Table 5, and additional details (including calculation inputs and results) are summarized in Attachment 8.

ASTM's E2531-06e1 Standard Guide for Development of Conceptual Site Models and Remediation Strategies for Light Non-Aqueous Phase Liquids (ASTM 2006) suggests that an LNAPL velocity potential of less than 1×10^{-6} cm/s indicates that LNAPL in the formation is functionally immobile. Based on this criterion, LNAPL present at saturations exceeding residual in AOI W-8 is functionally immobile. LNAPL present at saturations exceeding residual in AOI M-2 is also functionally immobile at locations M2-05 and M2-16;

however, LNAPL velocity potential calculated for both sample intervals collected at M2-42 slightly exceed the 1 x 10^{-6} cm/s threshold. However, it should be noted that LNAPL pore velocity calculations represent a potential rate of LNAPL movement and alone are not indicative of LNAPL plume expansion. Mobile LNAPL is able to move at the pore scale (i.e., redistribution within the source zone), but LNAPL bodies as a whole are not typically observed to expand after reaching equilibrium with threshold LNAPL pore entry pressures and/or natural loss rates at the boundaries of the LNAPL body. A discussion of LNAPL pore entry pressure is presented below.

LNAPL Pore-Entry Pressure

LNAPL migration into pristine soils occurs when there is sufficient LNAPL head pressure present in the subsurface at the fringe of the LNAPL plume to displace groundwater from the soil pores. For LNAPL present under unconfined conditions, LNAPL pore entry pressure can be expressed as an equivalent critical LNAPL thickness for comparison to LNAPL thickness accumulations in monitoring wells to determine whether there is a potential for future LNAPL migration.

The critical head pressure required for plume expansion expressed in LNAPL thickness ranges from 0.38 to 0.88 foot for locations where soil cores were collected at AOI M-2 and approximately 1.5 to 2.75 feet where soil cores were collected in AOI W-8 (Table 5). Critical LNAPL thicknesses were compared to recent LNAPL thicknesses observed in monitoring wells closest to the soil core locations in AOIs M-2 and W-8. The critical head pressure required for plume expansion expressed in critical LNAPL thickness ranges from 0.38 foot to 2.75 feet for all locations near the center and perimeter of the LNAPL bodies where soil cores were collected (Table 5). LNAPL thicknesses measured between December 2013 and April 2014 at these monitoring wells ranged from non-existent to 5.75 feet (see Table 6). All of these measurements are below the critical LNAPL thicknesses, indicating that there is no potential for further LNAPL plume expansion into unaffected soils, with the exception of two locations. Critical LNAPL thickness is exceeded in well TWM2-07 and TWW8-01. However, as indicated above, LNAPL at these locations appears to be present under confined conditions, suggesting that LNAPL entry pressures are likely larger than the values calculated for general unconfined conditions.

Summary and Conclusions

LNAPL Delineation

The lateral and vertical extents of LNAPL at AOIs M-2 and W-8 were delineated using LIF in August through September 2013. A total of 48 LIF soundings were completed at AOI M-2 (M2-01 through M2-48), and nine soundings were completed at AOI W-8 (W8-01 through W8-09) as shown on Figure 3. LIF logs for AOIs M-2 and W-8 are included in Attachment 1. The extent of LNAPL impacts in LNAPL Areas 1/7, 2A, 2B, 9, 10, and 11 was delineated using LIF technology during previous efforts at the Site (Encore 2007).

LNAPL Mobility

Data collected in 2013 and 2014, along with the previous LNAPL investigations at the Site, suggest that LNAPL is mobile within the interior of LNAPL bodies in AOIs M-2 and W-8. This finding is supported by the following lines of evidence:

- Measurable accumulations of LNAPL are present in wells installed in these areas.

- Petrophysical testing of undisturbed soil cores collected at the Site demonstrated that field saturations exceeded residual saturations at select soil core collection locations M2-05, M2-16, and M2-42 (located at AOI M2), and at W8-05 in AOI W-8.

These observations demonstrate that, per ITRC and MDEQ definitions cited previously, LNAPL is mobile in these areas, meaning that LNAPL can redistribute vertically and horizontally within the existing LNAPL footprint. However, the mobile LNAPL is stable and not migrating. This finding is supported by the following lines of evidence:

- LNAPL velocity potentials were calculated using LNAPL relative permeability from API equations at five soil core locations where field saturation exceeded residual saturation. Four of the five calculated LNAPL velocity potentials were less than 1.0×10^{-6} cm/s, indicating that LNAPL is functionally immobile at these locations per the velocity criterion suggested by ASTM (2006). At the location where calculated velocity potential slightly exceeded the ASTM criterion, a well was installed for additional testing (TWM2-05). To date, the well has not exhibited gauged LNAPL thicknesses greater than 0.1 foot, which is not sufficient to support additional field LNAPL transmissivity testing per MDEQ guidance (MDEQ 2014).

- LNAPL pore entry pressure analysis demonstrates that LNAPL thicknesses observed at the perimeter of the LNAPL bodies in both AOI M-2 and LNAPL Area No. 11 are below the threshold values required for LNAPL to migrate into soils not previously affected by LNAPL with the exception of monitoring wells TWM2-07 and TWW8-01. It should be noted, however, that LNAPL in both of these wells is likely present under confined conditions, and entry pressure is being calculated using a model that is appropriate for unconfined settings. This is likely resulting in underestimated values for entry pressure.

- Operations associated with LNAPL Area No. 11 at the Site were halted and the buildings were decommissioned and demolished between 1995 and 1997. Therefore, all LNAPL releases to the subsurface occurred (at a minimum) 17 years ago. Demolition of buildings in AOI M-2 took place between 2008 and 2009; therefore, any LNAPL releases would have ceased at a minimum of 5 years ago. LNAPL bodies typically stabilize 2 to 5 years after the release has stopped (ITRC 2012).

LNAPL Recoverability

Evaluation of LNAPL recoverability through field LNAPL transmissivity testing indicates that LNAPL recovery efforts (through hydraulically based remediation methods) will not result in a beneficial reduction in overall LNAPL mass at the Site in most AOIs. LNAPL transmissivity values calculated from baildown testing at the Site ranged from approximately 0.001 to 2.3 ft^2/day. Results from 14 wells where LNAPL transmissivity tests were completed were below the threshold for practical recoverability established by MDEQ (MDEQ 2014) and within or below the range of practical recoverability put forth by the ITRC (ITRC 2009; see Table 3). Results from 4 wells (SB-08-14, SB-25-14, SB-43-14, and RWW8-133) where LNAPL transmissivity tests were completed exceeded the thresholds for practical recoverability established by MDEQ and/or the ITRC. LNAPL recovery efforts in these specific areas have the potential to result in a reduction in overall LNAPL mass at the Site, but not a reduction in the three dimensional extent of LNAPL. Corrective measures for these areas will be evaluated in the Corrective Measures Proposal. Further investigation of LNAPL mobility and recoverability is not recommended at this time.

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3 Laboratory analytical data – Zymax
4 Laboratory analytical data – PTS Laboratories
5 Soil Core Photographs
6 Soil Boring Logs
7 TWW8-01 hydrograph
8 LNAPL Mobility Calculation Worksheets

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Tables

Table 1
LNAPL Analytical Results

RACER Trust - Pontiac North Campus
Pontiac, Michigan

Location Code: / Sample Code: / Matrix: / Sample Date:	Units	MWM2-29 MWM2-29_LNAPL N 8/19/2013	MWW8-65 N 8/18/2011
PCBs			
Aroclor-1016 (PCB-1016)	µg/kg	< 510000 U	< 960 U
Aroclor-1221 (PCB-1221)	µg/kg	< 510000 U	< 960 U
Aroclor-1232 (PCB-1232)	µg/kg	< 510000 U	< 960 U
Aroclor-1242 (PCB-1242)	µg/kg	2000000	< 960 U
Aroclor-1248 (PCB-1248)	µg/kg	< 510000 U	2100
Aroclor-1254 (PCB-1254)	µg/kg	< 510000 U	< 960 U
Aroclor-1260 (PCB-1260)	µg/kg	< 510000 U	1200
Metals			
Antimony	mg/kg	< 0.98 U	NA
Arsenic	mg/kg	8.7	NA
Barium	mg/kg	8.9 JB	NA
Beryllium	mg/kg	< 0.49 U	NA
Cadmium	mg/kg	0.10 J	NA
Chromium	mg/kg	3.7	NA
Cobalt	mg/kg	< 4.9 U	NA
Copper	mg/kg	10	NA
Lead	mg/kg	4.7	NA
Manganese	mg/kg	0.53 JB	NA
Mercury	mg/kg	< 0.10 U	NA
Nickel	mg/kg	9.1	NA
Selenium	mg/kg	< 0.49 U	NA
Silver	mg/kg	< 0.49 U	NA
Thallium	mg/kg	< 0.98 U	NA
Vanadium	mg/kg	0.39 J	NA
Zinc	mg/kg	2.8	NA
Volatile Organic Compounds			
1,1,1-Trichloroethane	µg/kg	< 1100 U	< 2300 U
1,1,2,2-Tetrachloroethane	µg/kg	< 1100 U	< 2300 U
1,1,2-Trichloroethane	µg/kg	< 1100 U	< 2300 U
1,1-Dichloroethane	µg/kg	18000	< 2300 U
1,1-Dichloroethene	µg/kg	< 1100 U	< 2300 U
1,2,4-Trichlorobenzene	µg/kg	< 1100 U	< 2300 U
1,2-Dibromo-3-chloropropane (DBCP)	µg/kg	< 1100 U	< 2300 U
1,2-Dibromoethane (Ethylene dibromide)	µg/kg	< 1100 U	< 2300 U
1,2-Dichlorobenzene	µg/kg	2100	< 2300 U
1,2-Dichloroethane	µg/kg	< 1100 U*	< 2300 U
1,2-Dichloropropane	µg/kg	< 1100 U	< 2300 U
1,3-Dichlorobenzene	µg/kg	< 1100 U	< 2300 U
1,4-Dichlorobenzene	µg/kg	< 1100 U	< 2300 U
2-Butanone (Methyl ethyl ketone) (MEK)	µg/kg	< 4500 U	< 9300 U
2-Hexanone	µg/kg	< 4500 U	< 9300 U
4-Methyl-2-pentanone (Methyl isobutyl ketone) (MIBK)	µg/kg	< 4500 U	< 9300 U
Acetone	µg/kg	< 4500 U	3000 JB
Benzene	µg/kg	380 J	< 2300 U
Bromodichloromethane	µg/kg	< 1100 U	< 2300 U
Bromoform	µg/kg	< 1100 U	< 2300 U
Bromomethane (Methyl bromide)	µg/kg	< 2300 U	< 4700 U
Carbon disulfide	µg/kg	< 1100 U	< 2300 U
Carbon tetrachloride	µg/kg	< 1100 U	< 2300 U
Chlorobenzene	µg/kg	< 1100 U	< 2300 U
Chloroethane	µg/kg	< 2300 U	< 4700 U
Chloroform (Trichloromethane)	µg/kg	< 1100 U	< 2300 U
Chloromethane (Methyl chloride)	µg/kg	< 2300 U	< 4700 U
cis-1,2-Dichloroethene	µg/kg	740 J	< 2300 U
cis-1,3-Dichloropropene	µg/kg	< 1100 U	< 2300 U
Cyclohexane	µg/kg	< 2300 U	< 4700 U
Dibromochloromethane	µg/kg	< 1100 U	< 2300 U
Dichlorodifluoromethane (CFC-12)	µg/kg	< 2300 U	< 4700 U
Ethylbenzene	µg/kg	7800	890 J
Isopropyl benzene	µg/kg	6000	1400 J
Methyl acetate	µg/kg	< 2300 U	< 4700 U
Methyl cyclohexane	µg/kg	7800	1100 J
Methyl tert butyl ether (MTBE)	µg/kg	< 4500 U	< 9300 U
Methylene chloride	µg/kg	510 J	< 2300 U
Styrene	µg/kg	< 1100 U	< 2300 U
Tetrachloroethene	µg/kg	3000	870 J
Toluene	µg/kg	16000 B	< 2300 U
trans-1,2-Dichloroethene	µg/kg	< 1100 U*	< 2300 U
trans-1,3-Dichloropropene	µg/kg	< 1100 U	< 2300 U
Trichloroethene	µg/kg	390 J	< 2300 U
Trichlorofluoromethane (CFC-11)	µg/kg	< 2300 U	< 4700 U
Trifluorotrichloroethane (Freon 113)	µg/kg	32000	< 4700 U
Vinyl chloride	µg/kg	1000 J	< 4700 U
Xylene (total)	µg/kg	26000	4600 J

Table 1
LNAPL Analytical Results

RACER Trust - Pontiac North Campus
Pontiac, Michigan

Location Code: / Sample Code: / Matrix: / Sample Date:	Units	MWM2-29 MWM2-29_LNAPL N 8/19/2013	MWW8-65 N 8/18/2011
Semivolatile Organic Compounds			
2,2'-Oxybis(1-chloropropane) (bis(2-Chloroisopropyl) ether)	µg/kg	< 400000 U	< 1900000 U
2,4,5-Trichlorophenol	µg/kg	< 400000 U	< 1900000 U
2,4,6-Trichlorophenol	µg/kg	< 400000 U	< 1900000 U
2,4-Dichlorophenol	µg/kg	< 400000 U	< 1900000 U
2,4-Dimethylphenol	µg/kg	< 400000 U*	< 1900000 U
2,4-Dinitrophenol	µg/kg	< 1900000 U	< 9300000 U
2,4-Dinitrotoluene	µg/kg	< 400000 U	< 1900000 U
2,6-Dinitrotoluene	µg/kg	< 400000 U	< 1900000 U
2-Chloronaphthalene	µg/kg	< 400000 U	< 1900000 U
2-Chlorophenol	µg/kg	< 400000 U	< 1900000 U
2-Methylnaphthalene	µg/kg	240000 J	270000 J
2-Methylphenol	µg/kg	< 400000 U	< 1900000 U
2-Nitroaniline	µg/kg	< 1900000 U	< 9300000 U
2-Nitrophenol	µg/kg	< 400000 U	< 1900000 U
3,3'-Dichlorobenzidine	µg/kg	< 1900000 U	< 9300000 U
3-Nitroaniline	µg/kg	< 1900000 U	< 9300000 U
4,6-Dinitro-2-methylphenol	µg/kg	< 1900000 U	< 9300000 U
4-Bromophenyl phenyl ether	µg/kg	< 400000 U	< 1900000 U
4-Chloro-3-methylphenol	µg/kg	< 400000 U	< 1900000 U
4-Chloroaniline	µg/kg	< 400000 U	< 1900000 U
4-Chlorophenyl phenyl ether	µg/kg	< 400000 U	< 1900000 U
4-Methylphenol	µg/kg	< 800000 U	< 3900000 U
4-Nitroaniline	µg/kg	< 1900000 U	< 9300000 U
4-Nitrophenol	µg/kg	< 1900000 U	< 9300000 U
Acenaphthene	µg/kg	44000 J	< 1900000 U
Acenaphthylene	µg/kg	< 400000 U	< 1900000 U
Acetophenone	µg/kg	< 400000 U	< 1900000 U
Anthracene	µg/kg	140000 J	< 1900000 U
Atrazine	µg/kg	< 400000 U	< 1900000 U
Benzaldehyde	µg/kg	< 400000 U	< 1900000 U*
Benzo(a)anthracene	µg/kg	33000 J	< 1900000 U
Benzo(a)pyrene	µg/kg	< 400000 U	< 1900000 U
Benzo(b)fluoranthene	µg/kg	< 400000 U	< 1900000 U
Benzo(g,h,i)perylene	µg/kg	< 400000 U	< 1900000 U
Benzo(k)fluoranthene	µg/kg	< 400000 U	< 1900000 U
Biphenyl (1,1-Biphenyl)	µg/kg	20000 J	110000 J
bis(2-Chloroethoxy)methane	µg/kg	< 400000 U	< 1900000 U
bis(2-Chloroethyl)ether	µg/kg	< 400000 U	< 1900000 U
bis(2-Ethylhexyl)phthalate (DEHP)	µg/kg	< 400000 U	< 1900000 U
Butyl benzylphthalate (BBP)	µg/kg	< 400000 U	< 1900000 U
Caprolactam	µg/kg	< 400000 U	< 1900000 U
Carbazole	µg/kg	< 400000 U	< 1900000 U
Chrysene	µg/kg	22000 J	< 1900000 U
Dibenz(a,h)anthracene	µg/kg	< 400000 U	< 1900000 U
Dibenzofuran	µg/kg	< 400000 U	< 1900000 U
Diethyl phthalate	µg/kg	< 400000 U	< 1900000 U
Dimethyl phthalate	µg/kg	< 400000 U	< 1900000 U
Di-n-butylphthalate (DBP)	µg/kg	< 400000 U	< 1900000 U
Di-n-octyl phthalate (DnOP)	µg/kg	< 400000 U	< 1900000 U
Fluoranthene	µg/kg	140000 J	< 1900000 U
Fluorene	µg/kg	260000 J	360000 J
Hexachlorobenzene	µg/kg	< 400000 U	< 1900000 U
Hexachlorobutadiene	µg/kg	< 400000 U	< 1900000 U
Hexachlorocyclopentadiene	µg/kg	< 1900000 U	< 9300000 U
Hexachloroethane	µg/kg	< 400000 U	< 1900000 U
Indeno(1,2,3-cd)pyrene	µg/kg	< 400000 U	< 1900000 U
Isophorone	µg/kg	< 400000 U	< 1900000 U
Naphthalene	µg/kg	91000 J	< 1900000 U
Nitrobenzene	µg/kg	< 400000 U	< 1900000 U
N-Nitrosodi-n-propylamine	µg/kg	< 400000 U	< 1900000 U
N-Nitrosodiphenylamine	µg/kg	< 400000 U	< 1900000 U
Pentachlorophenol	µg/kg	< 400000 U	< 1900000 U
Phenanthrene	µg/kg	800000	840000 J
Phenol	µg/kg	< 400000 U	< 1900000 U
Pyrene	µg/kg	210000 J	< 1900000 U
Miscellaneous			
Specific gravity	none	NA	0.83

Table 1
LNAPL Analytical Results

RACER Trust - Pontiac North Campus
Pontiac, Michigan

Footnote:

*	LCS or LCSD exceeds the control limits.

Acronyms and Abbreviations:

B	Compound was found in the blank and sample.
J	Result is lower than the reporting limit but higher than or equal to the method detection limit and the concentration is an approximate value.
LCS	Laboratory control samples
LCSD	Laboratory control samples, duplicates
LNAPL	Light non-aqueous phase liquid
mg/kg	Milligram per kilogram
N	NAPL (non-aqueous phase liquid)
NA	Not analyzed
PCBs	Polychlorinated biphenyls
U	Indicates the analyte was analyzed for but not detected.
µg/kg	Microgram per kilogram

Table 2
Laboratory Fluid Properties Summary

RACER - Pontiac North Campus
Pontiac, Michigan

Parameter	Units	Temperature (ºF)	MWM2-29 (AOI M2)	MWW8-65 (AOI W-8)
LNAPL Density	g/cm^3	55	0.8921	0.8618
LNAPL Viscosity	cP	55	120	15.5
LNAPL Specific Gravity	unitless	55	0.8926	0.8623
Groundwater Density	g/cm^3	55	1.001	--
Groundwater Viscosity	cP	55	1.26	--
Groundwater Specific Gravity	unitless	55	1.001	--
Air-Groundwater Interfacial (Surface) Tension	Dyne/cm	75	71.8	--
Air-LNAPL Interfacial Tension	Dyne/cm	75	30.8	29.4
LNAPL-Water Interfacial Tension	Dyne/cm	75	7.8	13.5

Notes:

g/cm^3	grams per cubic centimeter
cP	Centiopoise
Dyne/cm	Dynes per centimeter
--	Not Analyzed
LNAPL	Light non-aqueous phase liquid
AOI	Area of Interest
ºF	degrees Fahrenheit

Table 3
LNAPL Baildown Testing and Analysis Results

RACER - Pontiac North Campus
Pontiac, Michigan

Well ID	Date	Test	Initial LNAPL Thickness (ft)	Test Duration (min)	Final LNAPL Thickness (ft)	LNAPL Transmissivity, T_n (ft^2/day)				Notes/Comments
						B&R	C&J	CB&P	Mean	
AOI M-2										
MWM2-29	4/9/2014	Test 1	0.97	11,683	1.01	0.02	NA	NA	0.02	NAPL-water interface could not be determined for initial 2 to 60 minutes of test due to equipment limitations.
	4/17/2014	Test 2	1.01	1,187	0.76	0.01	0.12	NA	0.07	
TWM2-07	4/9/2014	Test 1	1.85	10,285	0.71	NA	NA	NA	NA	NAPL-water interface could not be determined for initial 160 minutes of test due to equipment limitations.
	4/17/2014	Test 2	0.59	1,185	0.52	0.01	0.06	NA	0.04	
SB-07A-14	9/18/2014	Test 1	0.79	1,060	0.26	NA	NA	NA	NA	Data could not be analyzed quantitatively. Very little LNAPL recharge observed, and no change in LNAPL drawdown after initiating test.
AOI W-10										
MWW10-01	4/9/2014	Test 1	8.78	12,930	5.96	0.07	0.26	NA	0.17	
MWW10-05	4/9/2014	Test 1	6.35	12,903	4.02	0.03	0.22	NA	0.13	
SB-08-14	9/17/2014	Test 1	9.96	2,760	9.53	**2.1**	**1.8**	**2.3**	**2.1**	
SB-25-14	9/18/2014	Test 1	0.36	1,216	0.28	0.28	**0.96**	0.80	**0.68**	Very little LNAPL recharge observed following test initiation. Results are likely representsative of filter pack drainage; and the reported value should thus be regarded as an upper limit estimate of LNAPL transmissivity.
AOI W-1										
TW-01-01	4/11/2014	Test 1	3.7	5,745	2.81	0.06	0.11	NA	0.085	
	4/15/2014	Test 2	2.81	4,355	1.8	0.01	0.04	NA	0.025	
SB-04-14	9/16/2014	Test 1	0.97	4,125	0.42	0.32	0.50	0.50	0.44	Unable to analyze data collected after the 1st hour of recharge monitoring due to interference from background water table fluctuations. Results are based on analysis of early-time data, and are likely representative of filter pack drainage. The reported value(s) should thus be regarded as an upper limit estimate of LNAPL transmissivity.
SB-43-14	9/18/2014	Test 1	2.58	75	2.55	**1.7**	**1.6**	**1.1**	**1.4**	
SB-46-14	9/16/2014	Test 1	2.09	4,060	0.75	0.0040	0.010	0.020	0.011	
SB-57-14	9/16/2014	Test 1	4.14	4,155	0.29	0.10	0.16	0.14	0.13	Likely a transcription error in field resulting in all negative drawdown; Used skimming drawdown equation[1] to estimate likely drawdown with field data
AOI M-16										
MWM4-06R	4/10/2014	Test 1	1.05	9,834	0.21	0.0010	0.0020	NA	0.0015	Data analysis complicated due to fluctuating water table during test.
	4/17/2014	Test 2	0.21	1,590	0.32	NA	NA	NA	NA	Data analysis complicated due to fluctuating water table during test. Qualitatively, LNAPL transmissivity appears very low (limited LNAPL recharge over a long period of time).
AOI W-8										
TW11-01	4/10/2014	Test 1	1.88	10,125	0.21	NA	NA	NA	NA	LNAPL-water interface above top of well screen when test was initiated. LNAPL column in the well was hydraulically isolated from the formation for the duration of the test.
	4/17/2014	Test 2	0.21	1,408	0.3	NA	NA	NA	NA	LNAPL-water interface above top of well screen when test was initiated. LNAPL column in the well was hydraulically isolated from the formation for the duration of the test.
RWW8-133	4/11/2014	Test 1	1.1	5,845	1.1	0.66	0.63	NA	0.65	Analysis focused on early time data due to fluctuating water table conditions observed after the initial 5 hours of the test. Results likely reflect some filter pack drainage.
	4/15/2014	Test 2	1.39	4,299	1.39	0.15	0.24	NA	0.20	
MWW8-48	4/11/2014	Test 1	7.56	10,191	2.65	0.02	0.01	NA	0.02	
TWW8-01	4/10/2014	Test 1	5.74	11,422	4.59	0.003	0.004	NA	0.0035	Little to no groundwater recharge observed over the course of nearly 8 days.
MWW8-65	4/10/2014	Test 1	2.85	11,510	1.6	0.001	0.001	NA	0.0010	Little to no groundwater recharge observed over the course of nearly 8 days.

General Notes:
All analyses completed using American Petroleum Institute (API) LNAPL Transmissivity Workbook (API 2012).
Bold - Exceeds 0.1 to 0.8 ft^2/day lower criterion range to produce sufficient LNAPL recoverability (ITRC 2009).
Shaded - Exceeds 0.5 ft^2/day lower limit LNAPL transmissivity value defining recovery to the maximum extent practicable (MDEQ 2014).

Acronyms and Abbreviations:
AOI = Area of interest
ft = feet
LNAPL = light non-aqueous phase liquid
min = minute
NA = not analyzed
B&R = Method based on Bouwer & Rice (1976) method for analysis of groundwater slug tests in unconfined aquifers.
C&J = Method based on Cooper & Jacob (1946)/Jacob & Lohman (1952) methods for groundwater flow to a well under constant drawdown or constant discharge conditions
CB&P = Method based on Cooper, Bredehoeft and Papadopulos (1967) method for analysis of groundwater slug tests in confined aquifers.

[1] LNAPL drawdown estimated based on maximum skimming drawdown equation for unconfined conditions (ASTM International 2013; Equation 17).

Table 4
Summary of Soil Core Petrophysical Test Information

RACER - Pontiac North Campus
Pontiac, Michigan

Parameter	Units	AOI M2						AOI W-8			Source
		M2-01_39-40.5 (39.3 ft bgs)	M2-05_18-20 (19.5 ft bgs)	M2-16_6-9 (6.5 ft bgs)	M2-21_17-19 (17.4 ft bgs)	M2-42_13-15 (13.5 ft bgs)	M2-42_13-15 (14.1 ft bgs)	W8-02_12-14 (12.1 ft bgs)	W8-02_28-30 (28.2 ft bgs)	W8-05_23.5-25.5 (24.0 ft bgs)	
Geology / Soil Description	none	Coarse Sand	Medium Sand	Fine Sand	Fine Sand	Fine Sand	Fine Sand	Silt	Fine Sand	Fine Sand	Grain size analysis
Porosity (n)	(ratio)	0.196	0.304	0.373	0.341	0.453	0.398	0.334	0.345	0.358	FPM-C Results
van Genuchten "N"	none	1.11	1.11	1.11	1.82	2.5	2.5	1.91	1.11	1.11	AWCD Results and RETC analysis
van Genuchten "α"	(cm^{-1})	8.0×10^{-3}	8.0×10^{-3}	8.0×10^{-3}	2.1×10^{-2}	1.3×10^{-2}	1.3×10^{-2}	4.0×10^{-3}	8.0×10^{-3}	8.0×10^{-3}	
Hydraulic Conductivity (K_w)	(cm/s)	2.3×10^{-6}	2.3×10^{-6}	2.3×10^{-6}	1.3×10^{-3}	4.5×10^{-3}	4.5×10^{-3}	6.8×10^{-7}	2.3×10^{-6}	2.3×10^{-6}	AWCD Results
Irreducible water saturation (S_{wr})	(ratio)	0.452	0.406	0.511	0.150	0.060	0.092	0.648	0.551	0.248	FPM-C Results
Field LNAPL Saturation (S_{ni})	(ratio)	0.085	0.246	0.125	0.028	0.202	0.319	0.035	0.017	0.433	FPM-C Results
Residual LNAPL saturation (S_{nr})	(ratio)	0.085	0.109	0.124	0.028	0.104	0.127	0.035	0.017	0.200	FPM-C Results

Notes:
AOI = Area of interest
ft bgs = feet below ground surface
FPM-C = Free product mobility test - centrifuge method (API RP40 and ASTM D425M)
AWCD = Air-water capillary pressure drainage test (ASTM D6836)
RETC = Retention curve fitting software used to calculate van Genuchten parameters from AWCD data
LNAPL = light non-aqueous phase liquid
cm/s = centimeters per second

Table 5
Petrophysical Modeling Results

RACER - Pontiac North Campus
Pontiac, Michigan

Location ID	Soil Core Sub-Sample Depth (ft bgs)	Field LNAPL Saturation (%Pv)	Residual LNAPL Saturation (%Pv)	Fraction of Recoverable LNAPL (%)	Mean Hydraulic Conductivity[(1)] (cm/sec)	LNAPL Velocity Potential (cm/sec)	Critical LNAPL Thickness[(2)] (ft)
AOI M2							
M2-01_39-40.5	39.3	8.5	8.5	0.0	2.3×10^{-6}	NA	0.88
M2-05_18-20	19.5	24.6	10.9	55.7	2.3×10^{-6}	2.3×10^{-8}	0.88
M2-16_6-9	6.5	12.5	12.4	0.8	2.3×10^{-6}	1.3×10^{-8}	0.88
M2-21_17-19	17.4	2.8	2.8	0.0	1.3×10^{-3}	NA	0.38
M2-42_13-15	13.5	20.2	10.4	48.5	4.5×10^{-3}	4.6×10^{-6}	0.58
M2-42_13-15	14.1	31.9	12.7	60.2	4.5×10^{-3}	9.7×10^{-6}	0.58
AOI W-8							
W8-02_12-14	12.1	3.5	3.5	0.0	6.8×10^{-7}	NA	2.75
W8-02_28-30	28.2	1.7	1.7	0.0	2.3×10^{-6}	NA	1.50
W8-05_23.5-25.5	24.0	43.3	20.0	53.8	2.3×10^{-6}	3.2×10^{-7}	1.50

Notes:

AOI	Area of interest
cm/sec	centimeters per second
ft bgs	feet below ground surface
NA	Not applicable; LNAPL is at residual saturation
%Pv	Percent pore volume
LNAPL	Light non-aqueous phase liquid
(1)	Hydraulic conductivity values from air-water capillary pressure drainage test results (ASTM D6836) not fully analyzed due to rapid response and disagreement between expected and observed initial displacements.
(2)	Critical LNAPL thickness is the critical head pressure required for plume expansion expressed in LNAPL thickness.

Table 6
Fluid Level Gauging Results

RACER - Pontiac North Campus
Pontiac, Michigan

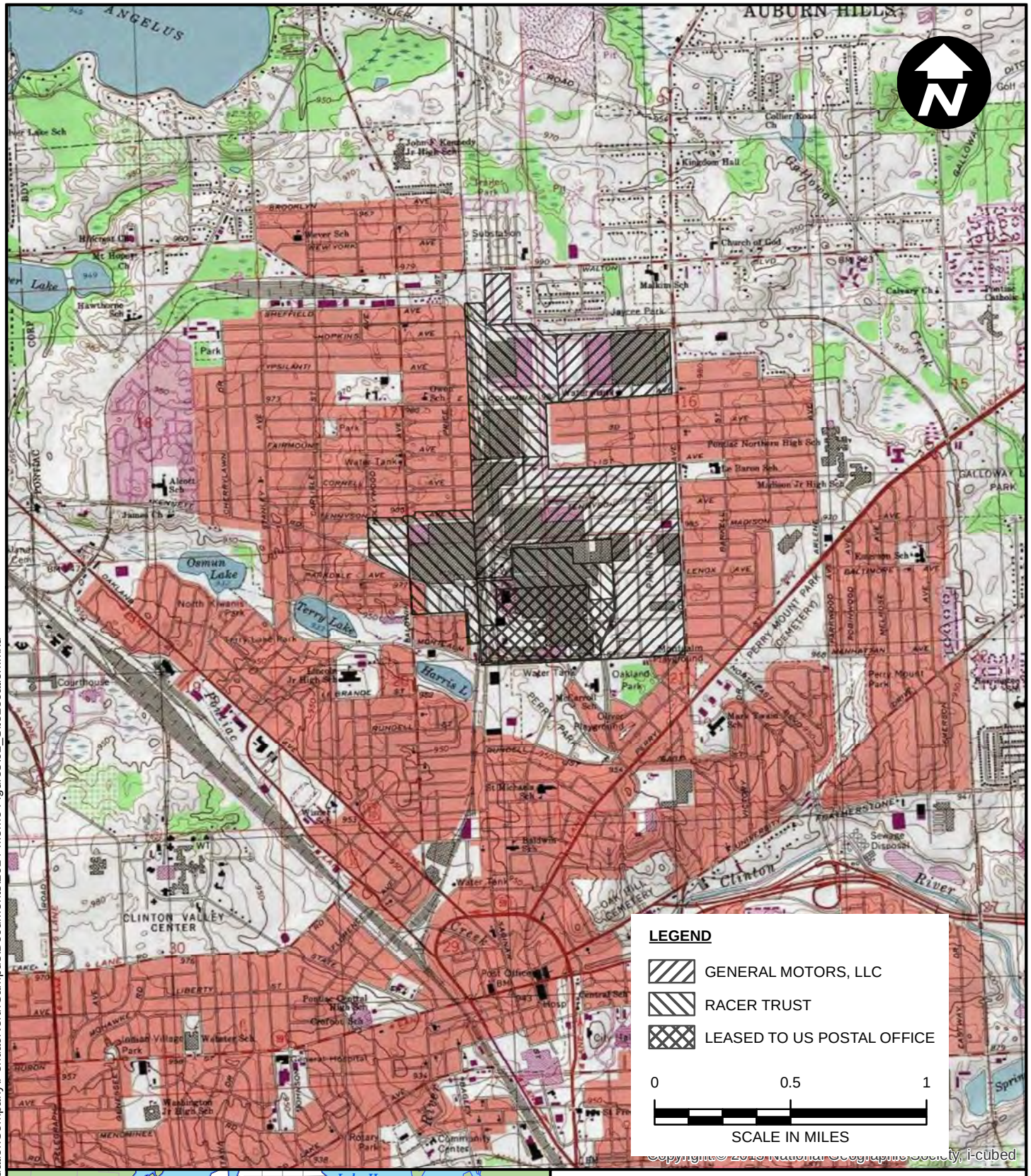
Well ID	Associated LIF Boring	Screened Interval	Reference Elevation (TOC)	Ground Surface Elevation	Well Depth (ft below GSE)	Total Well Depth (ft below TOC) [Calculated]	Date Collected	Total Well Depth (ft below TOC)	Depth to Water (ft below TOC)	Depth to NAPL (ft below TOC)	NAPL thickness (ft)	Groundwater Elevation (msl)	Corrected Groundwater Elevation (msl)	Comments
AOI M2														
TWM2-03	M2-01	34.0-44.0	967.76	968.08	44.00	43.68	12/2/2013		NA	NND	0.00	NA	NA	Dry
							4/7/2014	44.10	NA	NND	0.00	NA	NA	Dry
TWM2-01	M2-05	2.5-15.5	967.23	968.08	15.50	14.65	8/1/2013		7.11	NND	0.00	960.12	NA	
							12/2/2013		6.8	NND	0.00	960.43	NA	
							4/7/2014	24.57	0.70	NND	0.00	966.53	NA	
TWM2-04	M2-16	3.0-13.0	967.64	968.13	13.00	12.51	12/2/2013		3.41	NND	0.00	964.23	NA	
							4/7/2014	12.54	5.72	NND	0.00	961.92	NA	
TWM2-07	M2-21	15.0-25.0	967.59	968.05	25.00	24.54	12/2/2013		15.8	15.22	0.58	951.79	952.31	
							4/7/2014		15.95	14.10	1.85	951.64	953.29	
TWM2-05	M2-42	10.0-20.0	967.69	968.03	20.00	19.66	12/2/2013		10.25	10.15	0.1	957.44	957.53	
							4/7/2014		8.22	8.21	0.01	959.47	959.48	
MWM2-04	NA	11.0-21.0	967.68	968.00*	21.00	NA	1/2/2002		NA	16.02	0.06	951.59	951.65	
							12/2/2013		15.49	NND	0.00	952.19	952.19	
MWM2-06	NA	15.0-25.0	967.72	967.90	25.00	24.82	11/1/2002		NA	16.81	0.71	950.91	951.51	
							5/19/2003		NA	16.70	1.32	949.70	950.82	
							12/10/2003		NA	16.95	0.09	950.68	950.76	
							5/3/2004		NA	17.08	0.1	950.54	950.62	
							5/12/2013		15.26	NND	0.00	952.46	952.46	
							10/17/2013		15.79	NND	0.00	951.93	951.93	
							11/22/2013		NA	NA	0.00	NA	NA	Submerged; unable to gauge
							12/1/2013		15.66	NND	0.00	952.06	952.06	
							4/7/2014		14.98	NND	0.00	952.74	952.74	
MWM2-29	NA	15-25	967.60	967.96	25.00	24.64	5/12/2013		23.50	18.65	4.85	944.10	948.42	
							8/2/2013		22.63	17.10	5.53	944.97	949.89	
							10/17/2013		19.71	NND	0.00	947.89	947.89	
							11/22/2013		NA	NA	0.00	NA	NA	Submerged; unable to gauge
							12/1/2013		21.40	NND	0.00	946.20	NA	
							4/7/2014		22.97	22.00	0.97	944.63	945.49	
AOI W-8														
TWW8-02	W8-02	24.0-34.0	968.57	968.80	34.00	33.77	12/2/2013		17.53	17.45	0.08	951.04	951.11	
							4/7/2014		13.71	13.61	0.1	954.86	954.95	
TWW8-01	W8-05	20.0-30.0	969.37	966.90	30.00	32.47	12/2/2013		NA	NND	0.00	NA	NA	Dry
							4/7/2014		32.50	26.75	5.75	936.87	941.64	
MWW8-65	NA	25.0-35.0	969.62	970.19	23.00	22.43	11/2/2010		NA	31.21	3.34	935.07	937.91	
							9/20/2011		NA	31.07	3.48	935.07	938.03	
							2/18/2013		NA	32.10	2.36	935.16	937.17	
							2/22/2013		34.16	33.90	0.26	935.46	935.68	
							3/1/2013		34.01	32.96	1.05	935.61	936.49	
							3/15/2013		34.30	33.45	0.85	935.32	936.03	
							4/6/2013		34.13	33.61	0.52	935.49	935.93	
							4/22/2013		35.10	33.71	1.39	934.52	935.68	
							4/23/2013		35.11	33.81	1.3	934.51	935.59	
							5/3/2013		35.01	34.62	0.39	934.61	934.94	
							6/24/2013		35.08	34.66	0.42	934.54	934.89	
							8/2/2013		35.05	34.79	0.26	934.57	934.79	
							10/17/2013		35.03	34.40	0.63	934.59	935.12	
							11/22/2013		35.01	34.56	0.45	934.61	934.99	
							12/1/2013		35.15	NND	0.00	934.47	NA	
							4/7/2014		34.61	31.73	2.88	935.01	937.40	
TW-11-01	NA	9.4-19.4	969.28	969.53	19.40	19.15	10/4/2012		7.41	NND	0.00	961.87	NA	
							11/20/2012		8.32	8.11	0.21	960.96	961.14	
							1/7/2013		9.68	NND	0.00	959.60	NA	
							2/18/2013		10.62	10.41	0.21	958.66	958.84	
							2/22/2013		9.15	9.11	0.04	960.13	960.16	
							4/22/2013		8.60	6.68	1.92	960.68	962.31	
							4/23/2013		8.38	6.33	2.05	960.90	962.64	
							5/3/2013		9.72	9.60	0.12	959.56	959.66	
							6/24/2013		9.80	9.61	0.19	959.48	959.64	
							8/2/2013		10.07	9.91	0.16	959.21	959.35	
							10/17/2013		10.49	10.40	0.09	958.79	958.87	
							11/22/2013		10.60	10.46	0.14	958.68	958.80	
							12/2/2013		11.11	9.87	1.24	958.17	959.22	
							2/17/2014		10.44	10.41	0.03	958.84	958.87	
							4/7/2014		8.52	6.01	2.51	960.76	962.89	

Notes:

*	Estimated elevation
ft	Feet
GSE	Ground Surface Elevation
LIF	Laser-induced fluorescence
msl	mean sea level
NA	Not applicable/available
NAPL	Non-aqueous phase liquid
NND	No NAPL detected
TOC	Top of Casing

ARCADIS

Figures



RACER TRUST
PONTIAC NORTH CAMPUS
PONTIAC, MICHIGAN

SITE LOCATION

ARCADIS

FIGURE
1

PROJECT NUMBER: B0064411.0001.00145
CITY:NOVI DIV/GROUP:ENV DB: PIC: PM: TM: TR:
Path: D:\GIS\Project Files\MotorsLiquidationCompany\PontiacNorthCampus\Documents\2014-Memo Figures\01_SiteLocation.mxd

M-4
MWM4-07
MWM 4-06R
MWM16-19
M-16
MWM16-18
M-5
MWM16-07
M-25
LNAPL AREA #5
M-13
M-26
M-21
M-1
M-2
MWM2-31
MWM2-17
MWM2-19
MWM2-05
MWM2-06
MWM2-29
TWM2-03
MWM2-03
MWM2-04
MWM2-02
MWM8
MWM2-08
MWM2-22
TWM2-01
TWM2-02
AOI M-2
TWM2-07
TWM2-04
MWM2-28
TWM2-05
MWM2-26
M-2 area wasn't included in the 2007 study
M-19
MWM2-32
W-5
GROUNDWATER FLOW DIRECTION
P-11
M-9
P-10
M-7
Glenwood Ave
F-7
F-15
F-12
W-3
W-6
MWW10-06
MWW10-04
MWW10-01
SB-08-14
LNAPL #2A
MWW10-05
MWW10-03
W-13
MWW1-01
W-11
LNAPL #2B
SB-25-14
MWW10-SEN01
TW-01-01
W-10
MWW10-SEN02
MWW10-SEN03
MW-40-99
MWW1-04
TWW8-01
TWW8-02
MWW8-65
LNAPL #11
TW-11-02
TW-11-01
TW-09-01
LNAPL #9
W-8
MWW8-48
RWW8-133
TW-10-02
LNAPL #10
MWW10-SEN05
TW-01-03
W-1
SB-46-14
SB-57-14
SB-04-14
SB-43-14
LNAPL #1/7
MWW10-SEN04
W-9
Owens
Wing
Portland
E Montcalm
Edison
E N Glenwood
SWDF
LNAPL AREA #5
M-5
M-31
M-26
F-17
F-16
M-1
M-2
P-9
W-5
W-8
W-1
W-9
LNAPL AREA #1/7, #2, #10, #11
SITE LAYOUT
LEGEND
TEMPORARY MONITORING WELLS
MONITORING WELL
LIF LOCATION (PRE 2013)
ABANDONED SEWER BULKHEAD LOCATION
ABANDONED SEWER
PROPERTY BOUNDARY
EXTENT OF LIF RESPONSE > 25% BASED ON 2007 MOBILITY STUDY
AREAS OF INTEREST
AOI - AREA OF INTEREST
LIF - LASER-INDUCED FLUORESCENCE
LNAPL - LIGHT NON-AQUEOUS PHASE LIQUID
NOTE:
1. LNAPL REMOVAL WAS PERFORMED IN LNAPL AREA 9/10 (AOI W-8) IN 2006.
2. HIGHLIGHTED LOCATIONS ARE REFERENCED IN THE 2013/2014 LNAPL INVESTIGATION MEMO.
N
0
120
240
SCALE IN FEET
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar

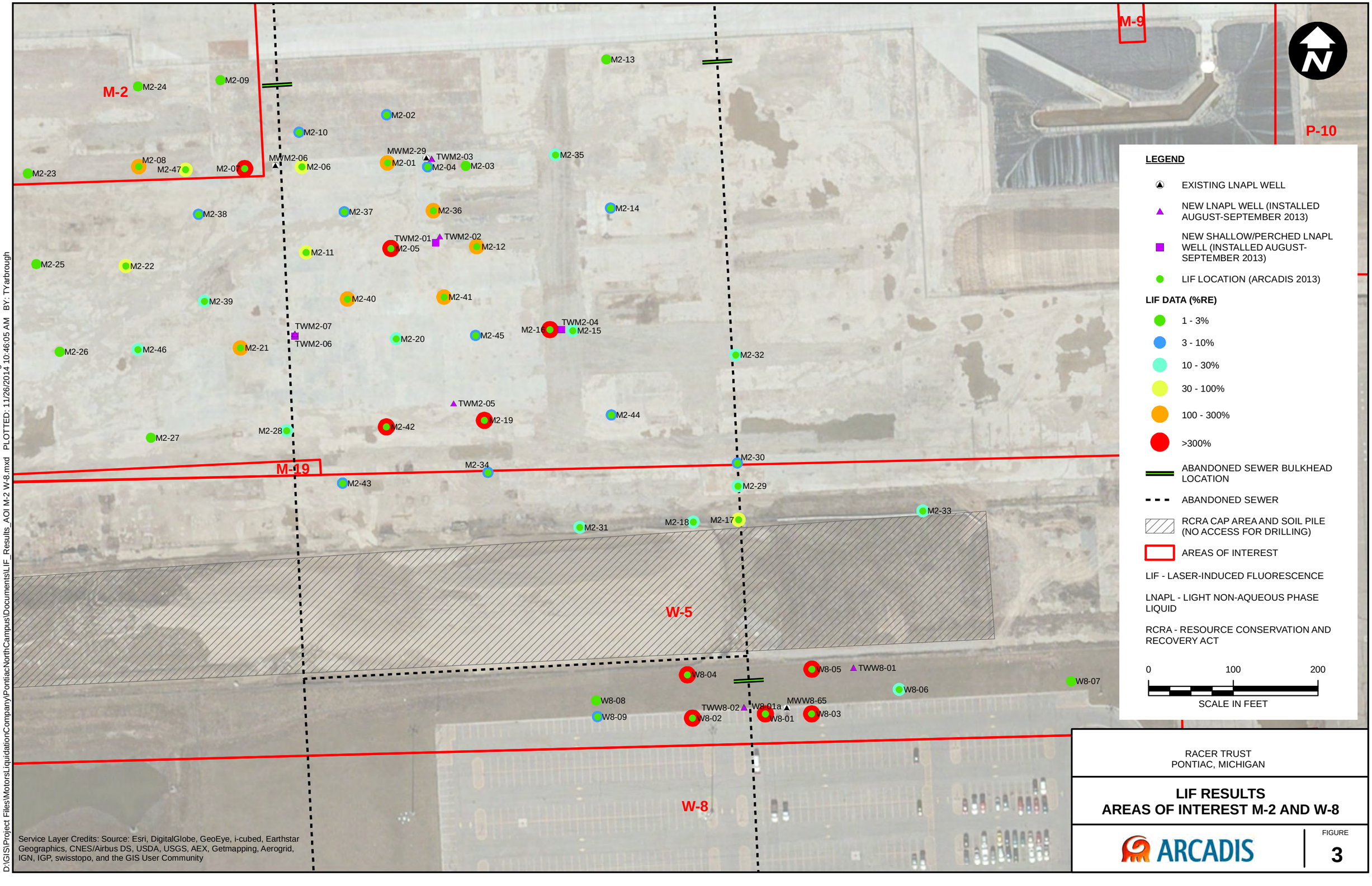
RACER TRUST
PONTIAC, MICHIGAN

SITE LAYOUT

ARCADIS

FIGURE 2

CITY: Novi DIV: ENV DB: TRY PIC: PM: TM: TR: PROJECT NUMBER: COORDINATE SYSTEM: NAD 1983 StatePlane Michigan South FIPS 2113 Feet
D:\GIS\Project Files\MotorsLiquidationCompany\PontiacNorthCampus\Documents\LNAPL Mobility_SiteLayout.mxd PLOTTED: 12/5/2014 5:45:12 PM BY: TYarbrough



LEGEND

- EXISTING LNAPL WELL
- NEW LNAPL WELL (INSTALLED AUGUST-SEPTEMBER 2013)
- NEW SHALLOW/PERCHED LNAPL WELL (INSTALLED AUGUST-SEPTEMBER 2013)
- LIF LOCATION (ARCADIS 2013)

LIF DATA (%RE)

- 1 - 3%
- 3 - 10%
- 10 - 30%
- 30 - 100%
- 100 - 300%
- >300%
- ABANDONED SEWER BULKHEAD LOCATION
- ABANDONED SEWER
- RCRA CAP AREA AND SOIL PILE (NO ACCESS FOR DRILLING)
- AREAS OF INTEREST

LIF - LASER-INDUCED FLUORESCENCE

LNAPL - LIGHT NON-AQUEOUS PHASE LIQUID

RCRA - RESOURCE CONSERVATION AND RECOVERY ACT

0 100 200

SCALE IN FEET

RACER TRUST
PONTIAC, MICHIGAN

LIF RESULTS
AREAS OF INTEREST M-2 AND W-8

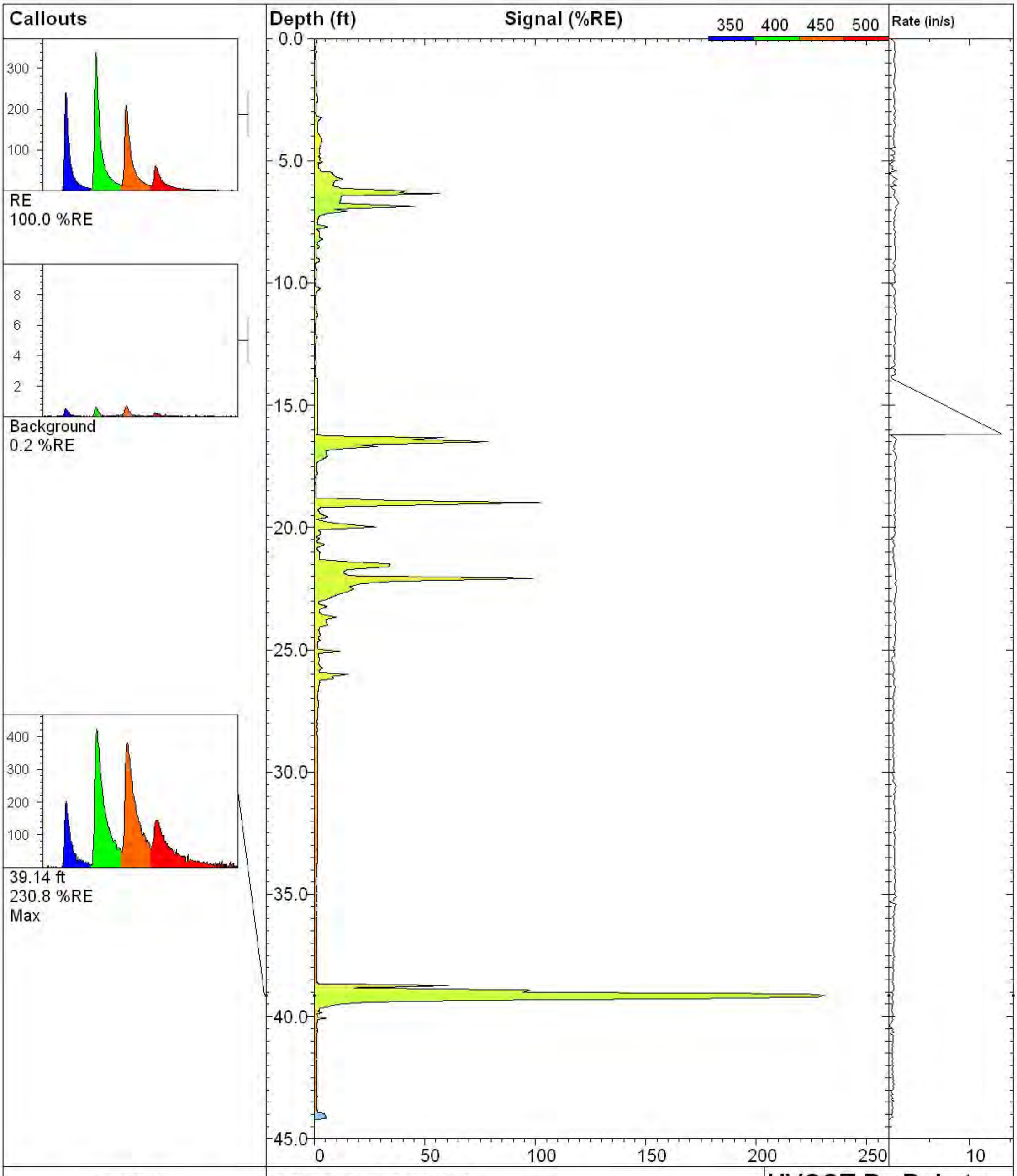
ARCADIS

FIGURE
3

CITY: Novi DIV: ENV DB: TRY PIC: PM: TM: TR: PROJECT NUMBER: COORDINATE SYSTEM: NAD 1983 StatePlane Michigan South FIPS 2113 Feet
D:\GIS\Project Files\MotorsLiquidationCompany\PontiacNorthCampus\Documents\LIF_Results_AOI M-2 W-8.mxd PLOTTED: 11/26/2014 10:46:05 AM BY: TYarbrough

Attachment 1

LIF Logs



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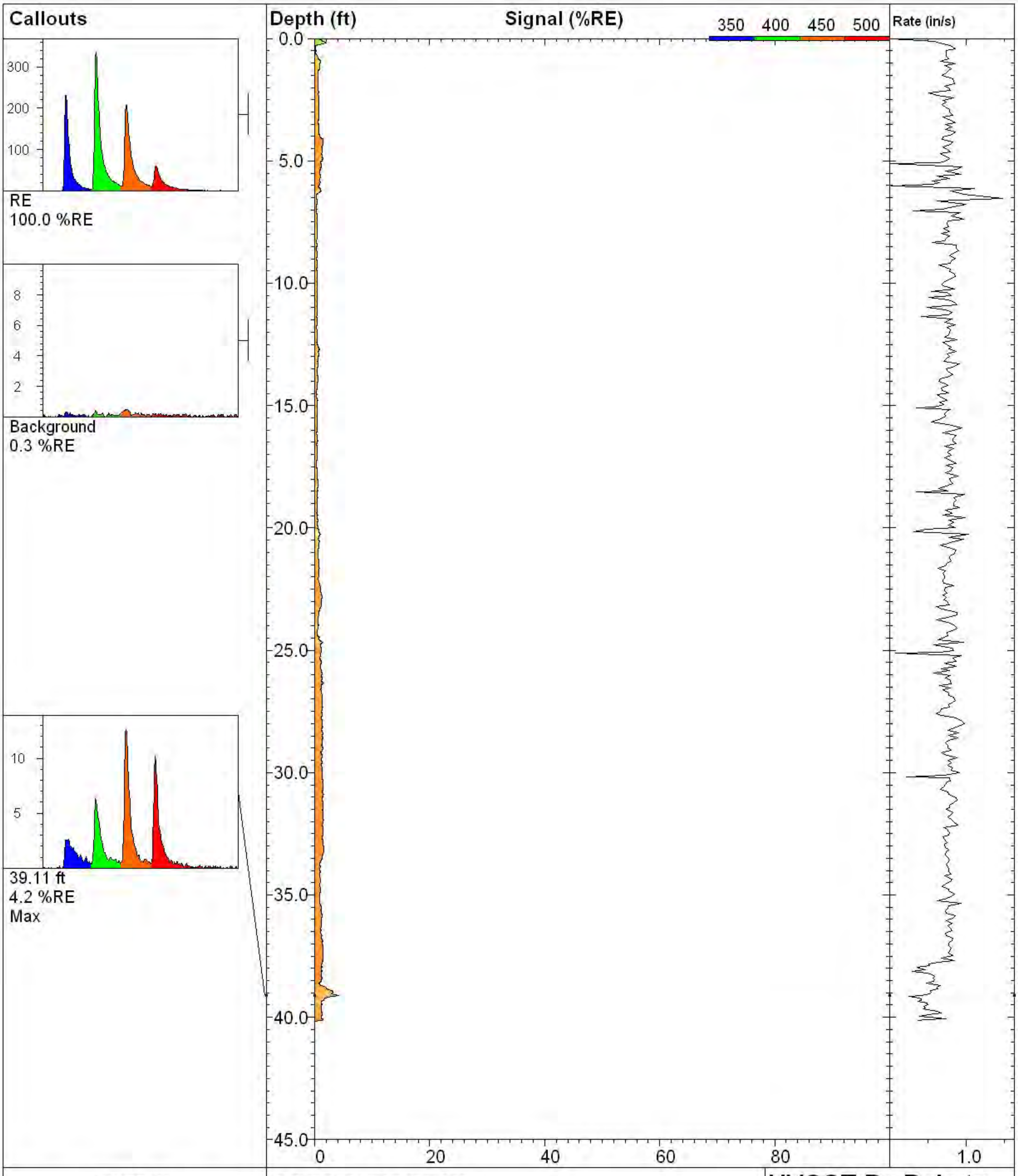
Site: **Racer Pontiac North Campus**	*Y Coord.(Lat-N) / System:* **312298 / UTM**	*Final depth:* **44.21 ft**
Client / Job: **Arcadis /**	*X Coord.(Lng-E) / Fix:* **4725820 /**	*Max signal:* **230.8 %RE @ 39.13 ft**
Operator / Unit: **Jonathan W. / UVOST1021**	*Elevation:* **Unavailable**	*Date & Time:* **2013-08-22 09:27 EDT**



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UVOSTM2-02

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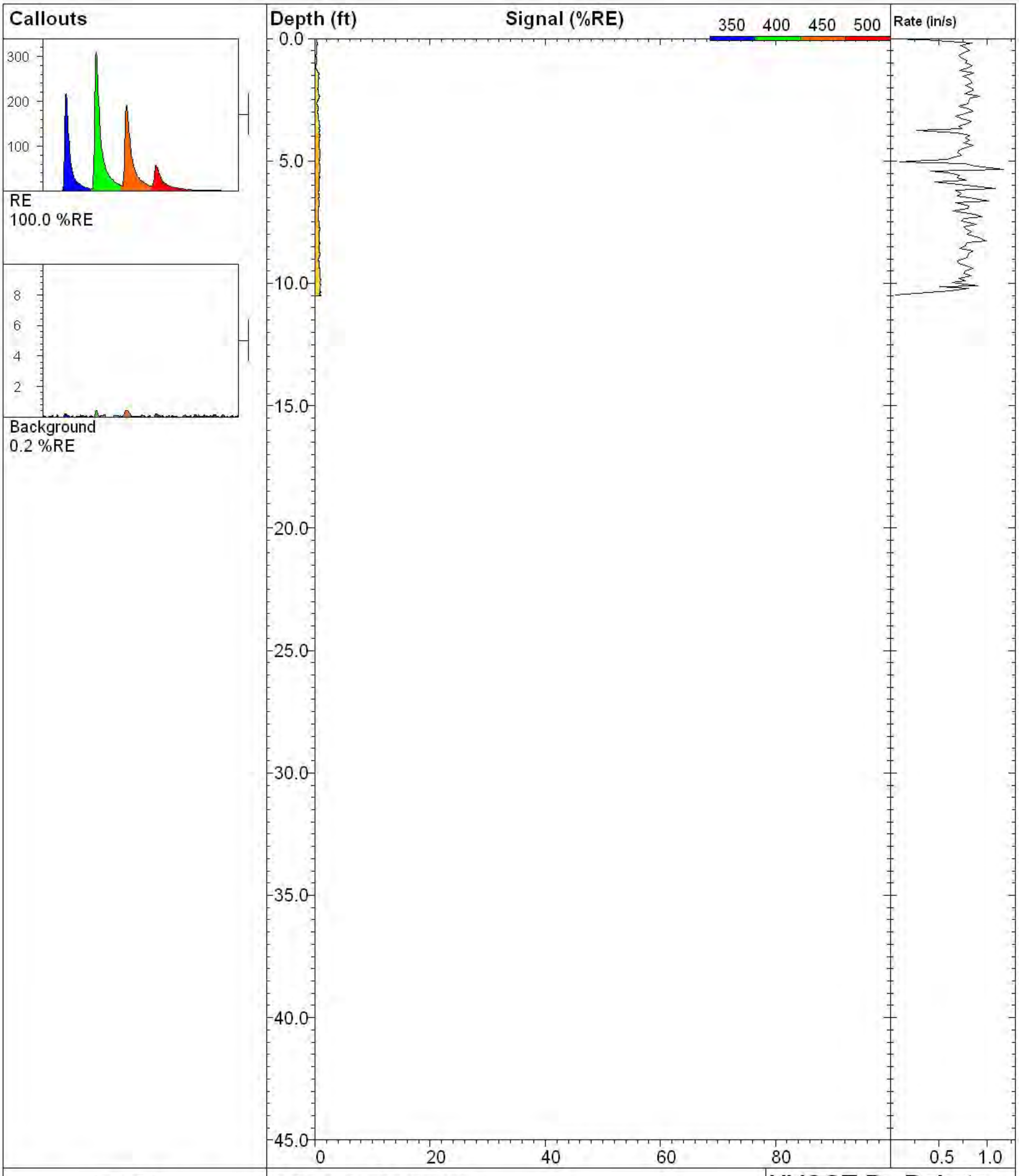
Site: **RACER Pontiac North Campus**	*Y Coord.(Lat-N) / System:* **312293 / UTM**	*Final depth:* **40.15 ft**
Client / Job: **Arcadis /**	*X Coord.(Lng-E) / Fix:* **4725827 /**	*Max signal:* **4.2 %RE @ 39.11 ft**
Operator / Unit: **Jonathan W. / UVOST1021**	*Elevation:* **Unavailable**	*Date & Time:* **2013-08-22 12:04 EDT**



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UVOSTM2-03

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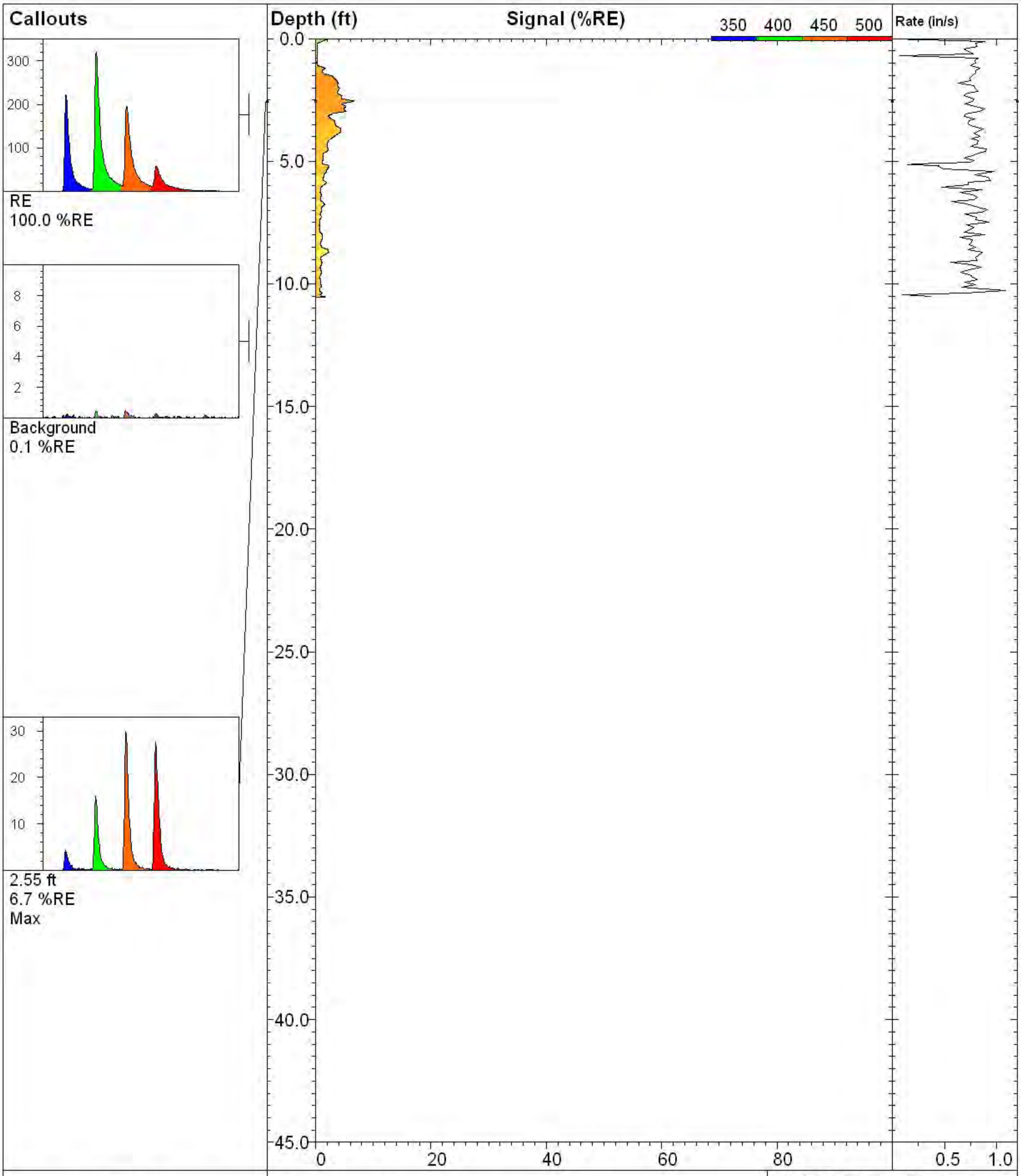
Site: **RACER Pontiac North Campus**	*Y Coord.(Lat-N) / System:* **312325 / UTM**	*Final depth:* **10.50 ft**
Client / Job: **Arcadis /**	*X Coord.(Lng-E) / Fix:* **4725814 /**	*Max signal:* **1.0 %RE @ 10.49 ft**
Operator / Unit: **Jonathan W. / UVOST1021**	*Elevation:* **Unavailable**	*Date & Time:* **2013-08-22 13:00 EDT**



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UVOSTM2-04

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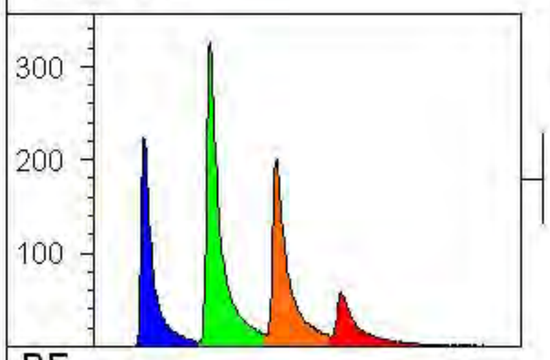
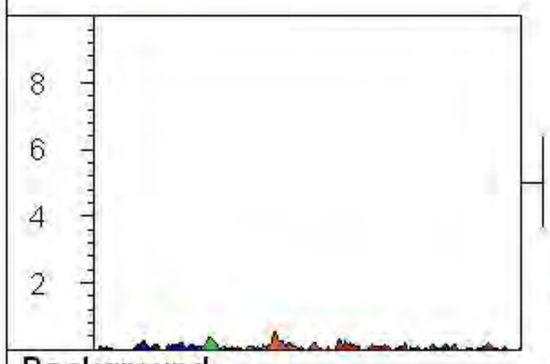
Site: **RACER Pontiac North Campus**	*Y Coord.(Lat-N) / System:* **312308 / UTM**	*Final depth:* **10.53 ft**
Client / Job: **Arcadis /**	*X Coord.(Lng-E) / Fix:* **4725813 /**	*Max signal:* **6.7 %RE @ 2.55 ft**
Operator / Unit: **Jonathan W. / UVOST1021**	*Elevation:* **Unavailable**	*Date & Time:* **2013-08-22 14:00 EDT**

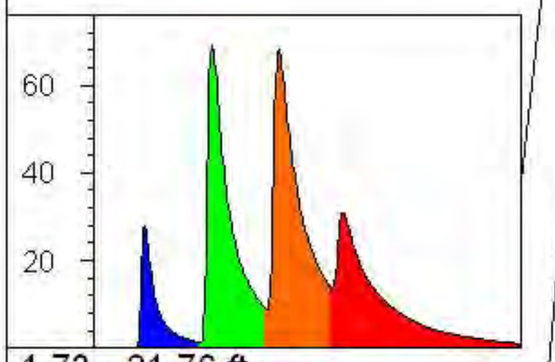
Callouts



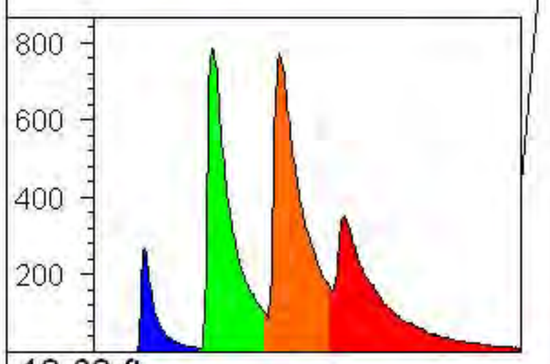
RE
100.0 %RE



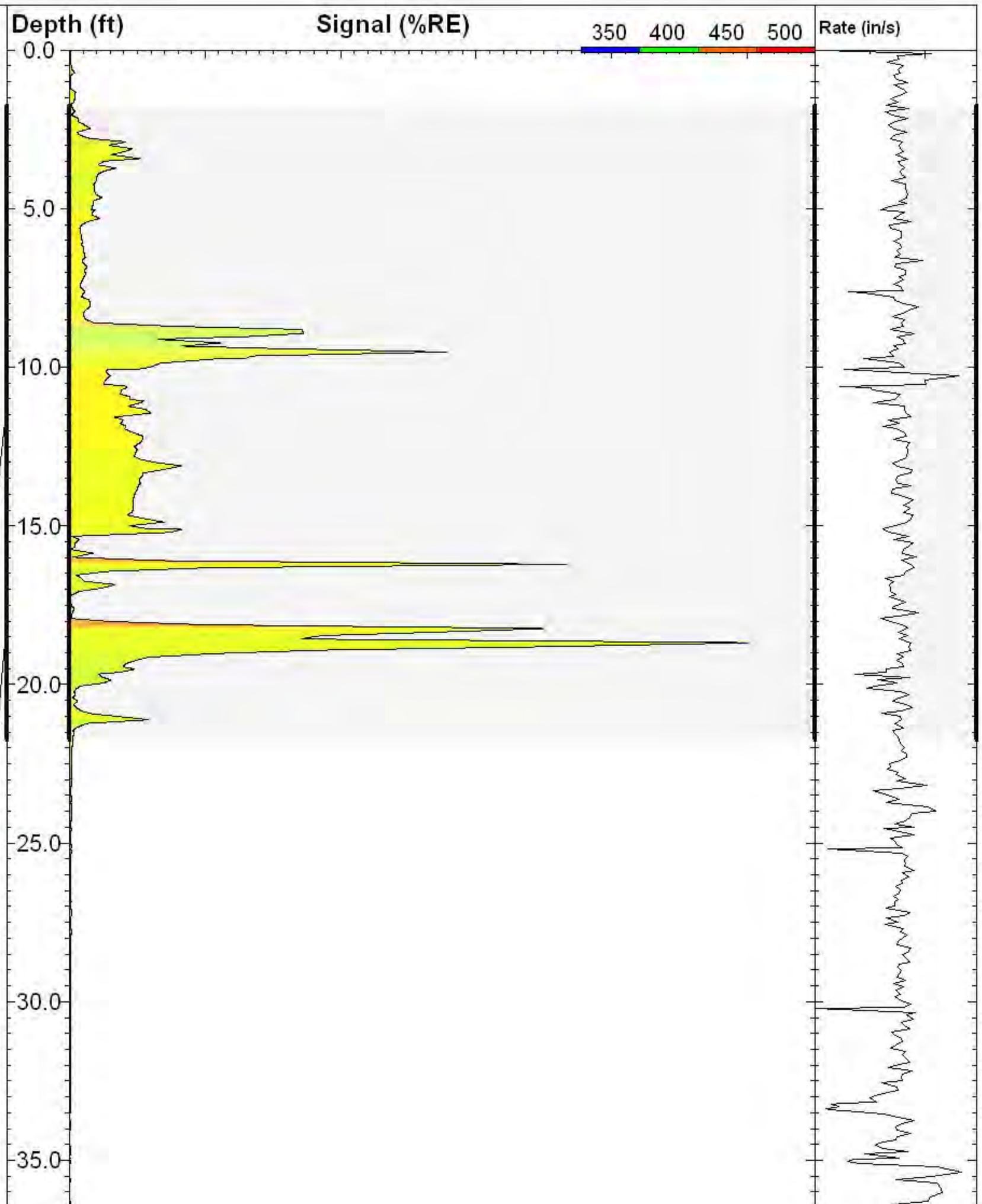
Background
0.2 %RE



1.73 - 21.76 ft
44.4 %RE (s 65.8)



18.68 ft
504.2 %RE
Max



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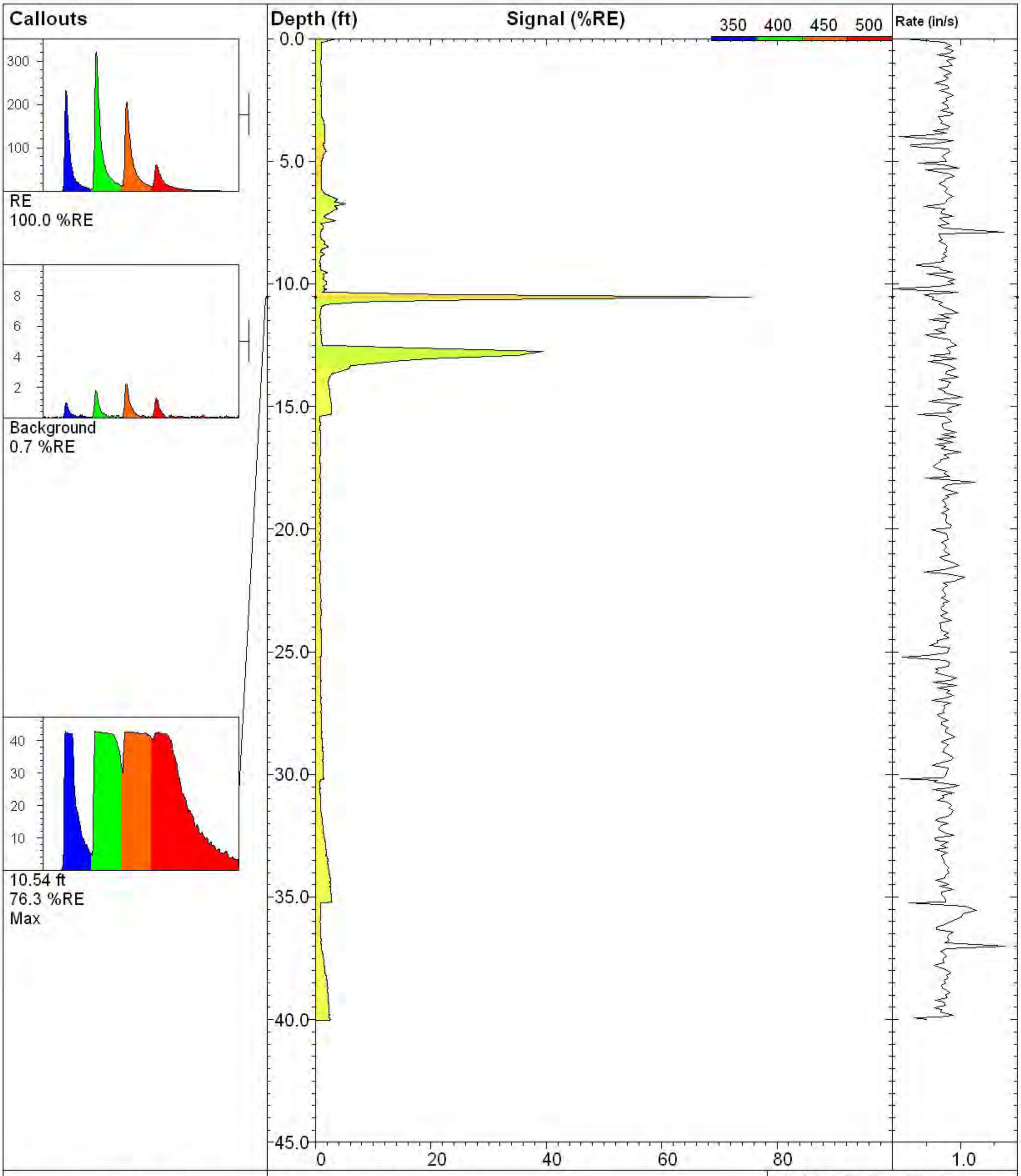
Site: **RACER Pontiac North Campus**	*Y Coord.(Lat-N) / System:* **312304 / UTM**	*Final depth:* **40.00 ft**
Client / Job: **Arcadis /**	*X Coord.(Lng-E) / Fix:* **4725775 /**	*Max signal:* **504.2 %RE @ 18.68 ft**
Operator / Unit: **Jonathan W. / UVOST1021**	*Elevation:* **Unavailable**	*Date & Time:* **2013-08-22 14:33 EDT**



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UVOSTM2-06

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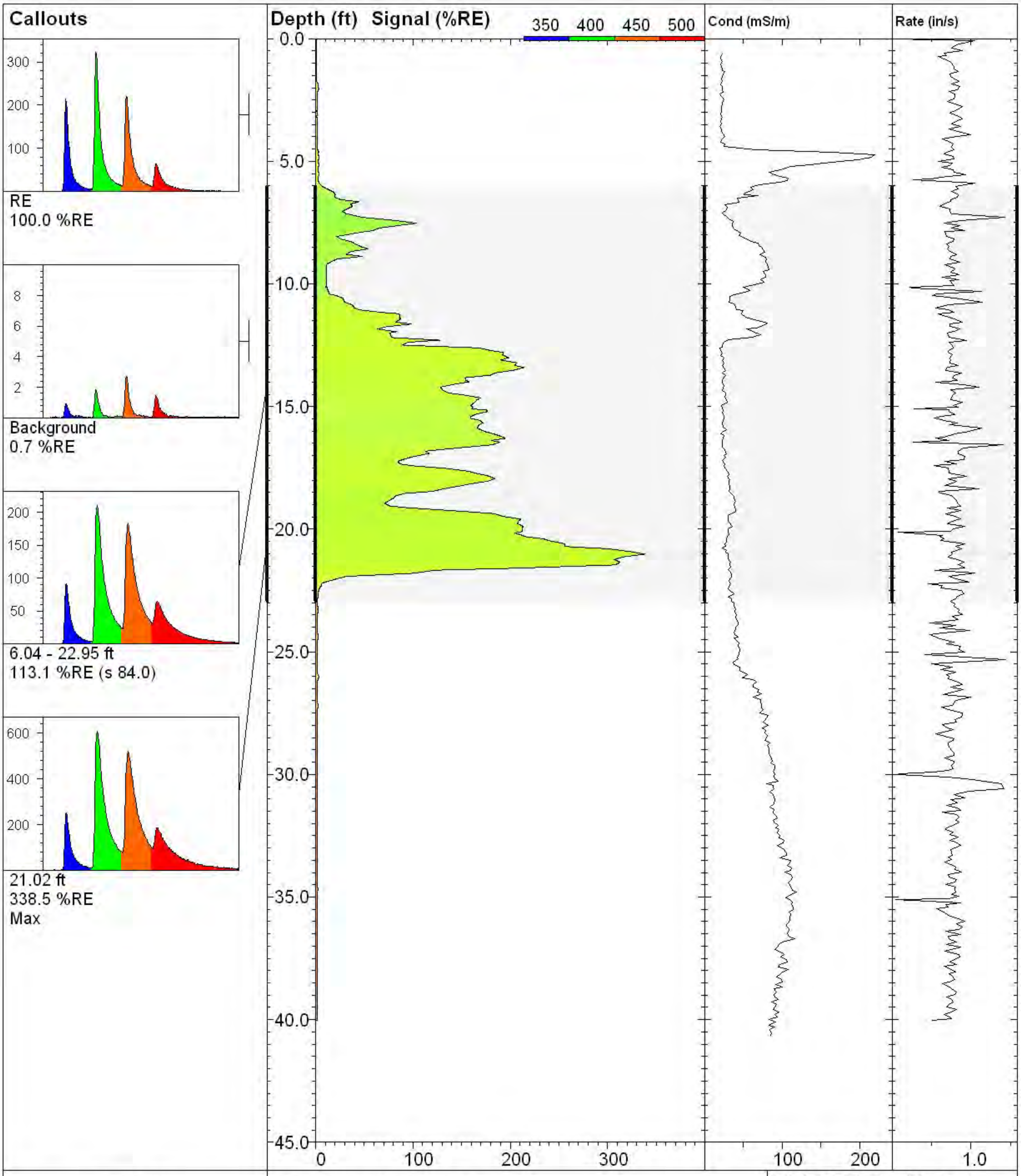
Site: **RACER Pontiac North Campus**	*Y Coord.(Lat-N) / System:* **312257 / UTM**	*Final depth:* **40.02 ft**
Client / Job: **Arcadis /**	*X Coord.(Lng-E) / Fix:* **4725807 /**	*Max signal:* **76.3 %RE @ 10.54 ft**
Operator / Unit: **Jonathan W. / UVOST1021**	*Elevation:* **Unavailable**	*Date & Time:* **2013-08-22 15:36 EDT**



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UVOSTM2-07

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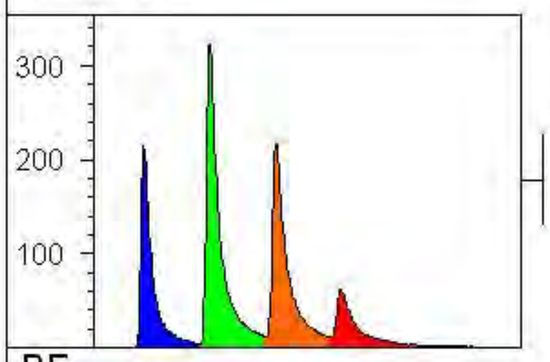
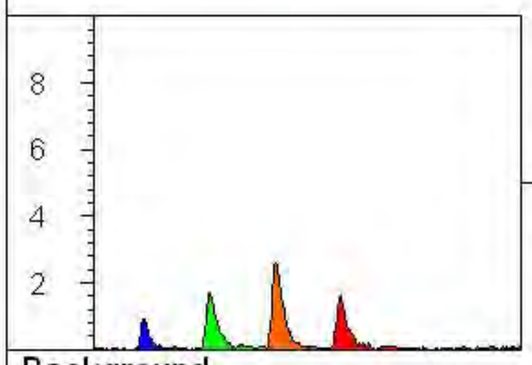
Site: **RACER Pontiac North Campus**	*Y Coord.(Lat-N) / System:* **312241 / UTM**	*Final depth:* **40.04 ft**
Client / Job: **Arcadis /**	*X Coord.(Lng-E) / Fix:* **4725807 /**	*Max signal:* **338.5 %RE @ 21.02 ft**
Operator / Unit: **Jonathan W. / UVOST1021**	*Elevation:* **Unavailable**	*Date & Time:* **2013-08-22 17:00 EDT**

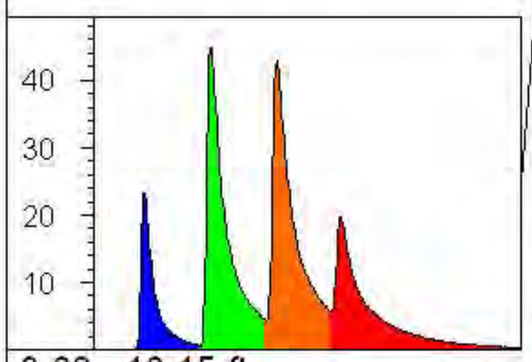
Callouts



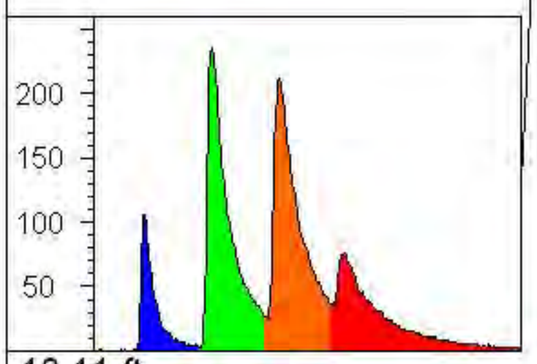
RE
100.0 %RE



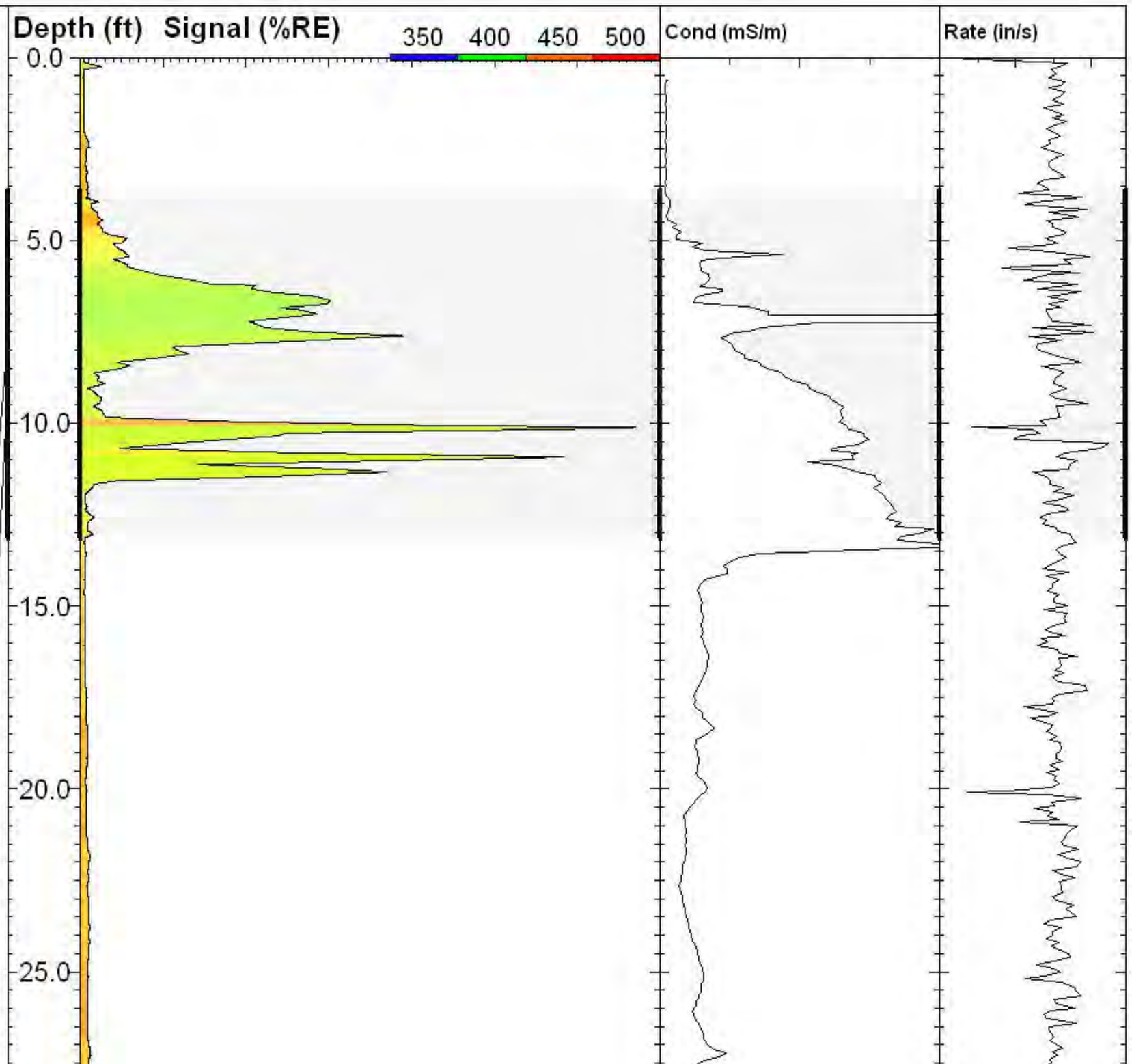
Background
0.7 %RE



3.62 - 13.15 ft
24.0 %RE (s 30.0)



10.11 ft
134.0 %RE
Max



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UVOSTM2-08

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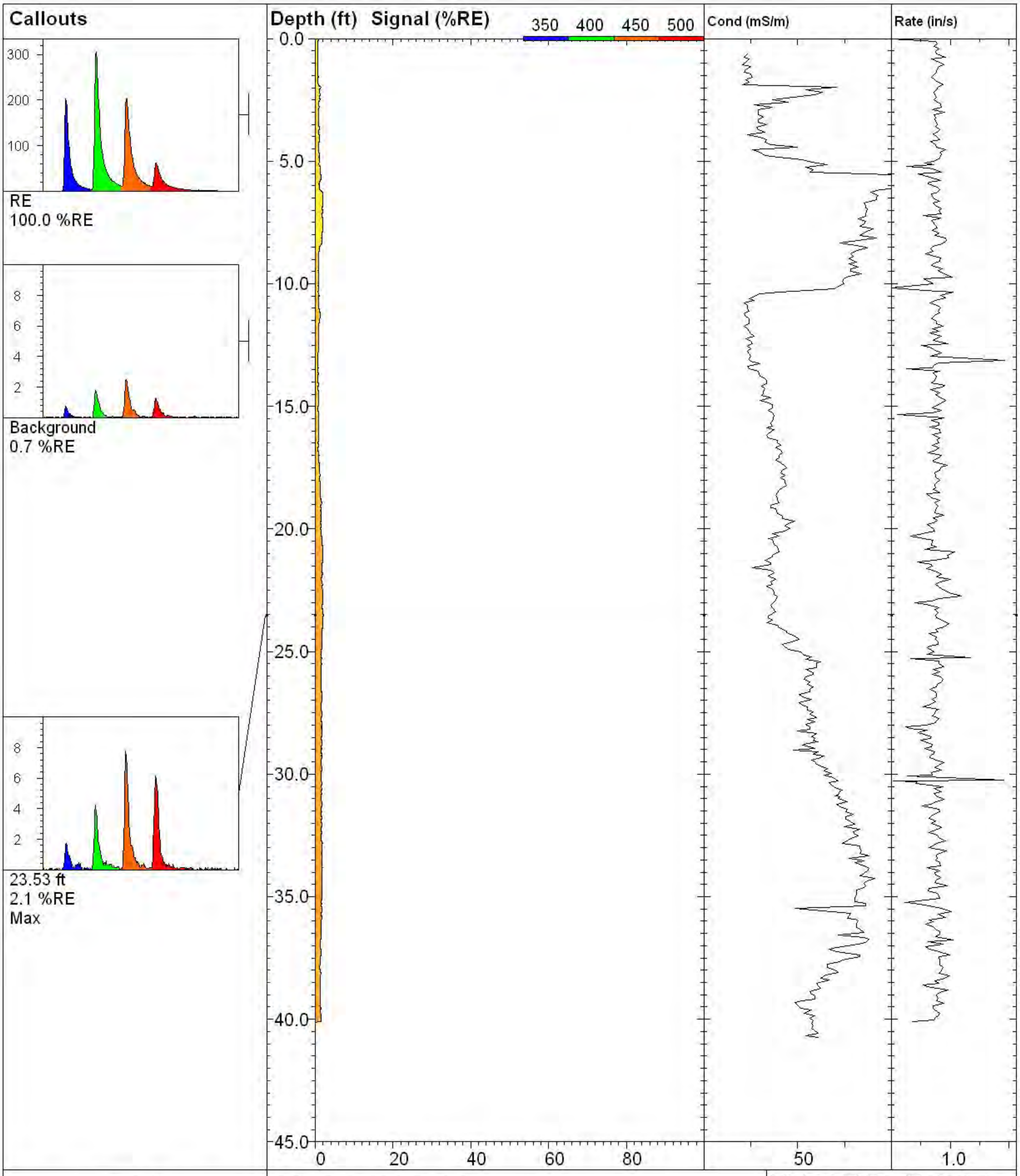
Site: **RACER Pontiac North Campus**	*Y Coord.(Lat-N) / System:* **312197 / UTM**	*Final depth:* **40.08 ft**
Client / Job: **Arcadis /**	*X Coord.(Lng-E) / Fix:* **4725818 /**	*Max signal:* **134.0 %RE @ 10.11 ft**
Operator / Unit: **Jonathan W. / UVOST1021**	*Elevation:* **Unavailable**	*Date & Time:* **2013-08-23 10:10 EDT**



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UVOSTM2-09

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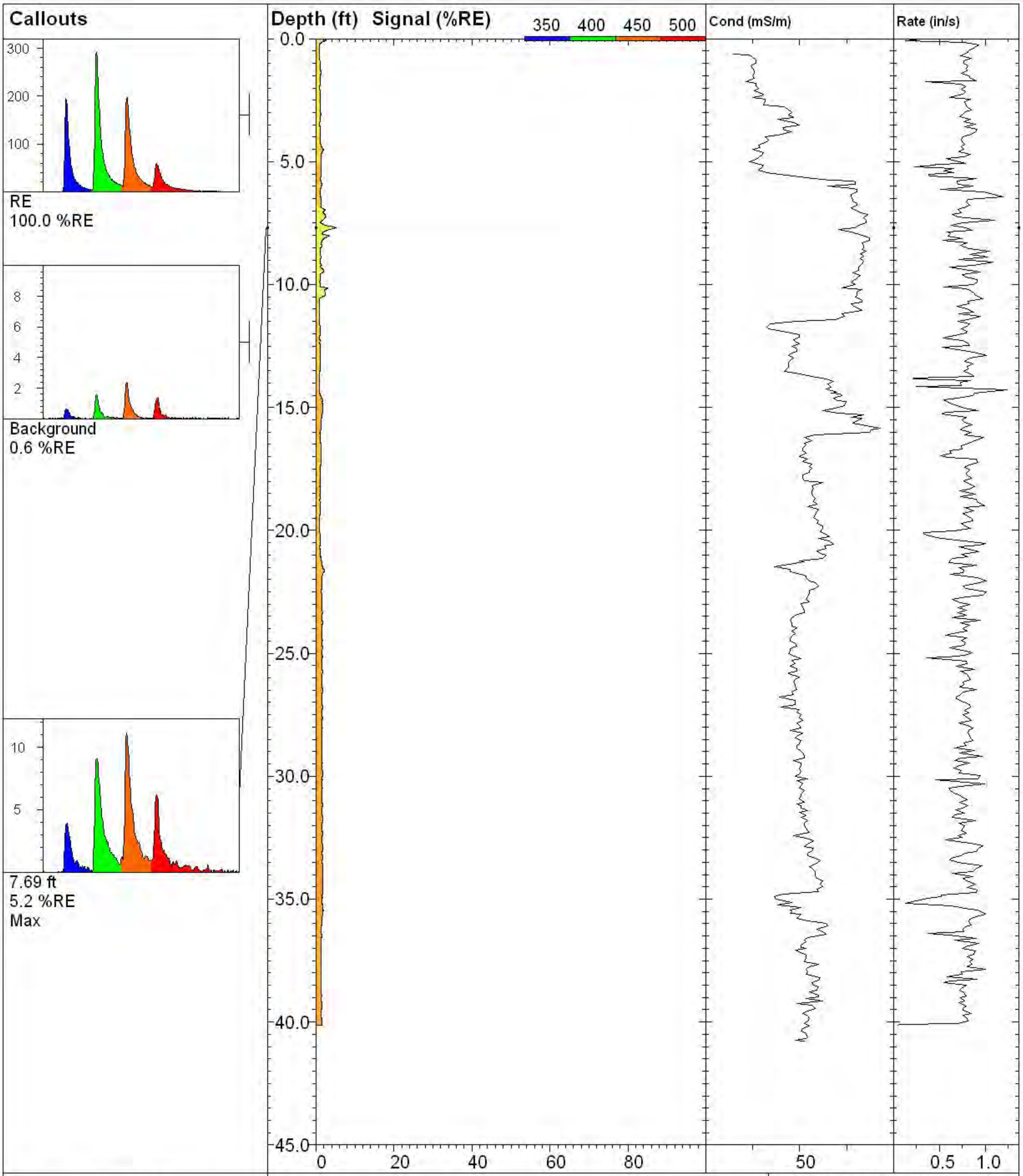
Site: **RACER Pontiac North Campus**	*Y Coord.(Lat-N) / System:* **312235 / UTM**	*Final depth:* **40.11 ft**
Client / Job: **Arcadis /**	*X Coord.(Lng-E) / Fix:* **4725840 /**	*Max signal:* **2.1 %RE @ 23.53 ft**
Operator / Unit: **Jonathan W. / UVOST1021**	*Elevation:* **Unavailable**	*Date & Time:* **2013-08-23 11:25 EDT**



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UVOSTM2-10

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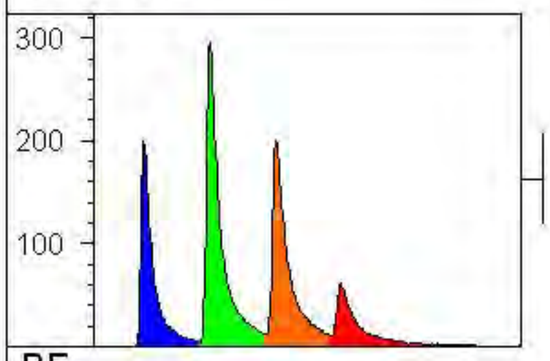
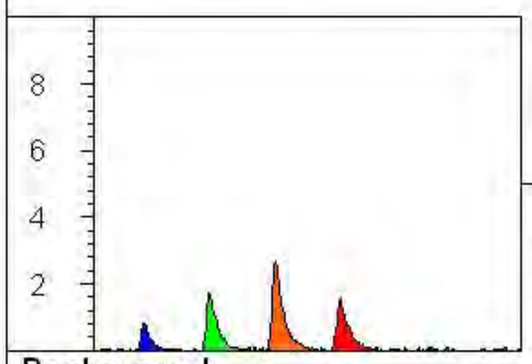
Site: **RACER Pontiac North Campus**	*Y Coord.(Lat-N) / System:* **312259 / UTM**	*Final depth:* **40.14 ft**
Client / Job: **Arcadis /**	*X Coord.(Lng-E) / Fix:* **4725827 /**	*Max signal:* **5.2 %RE @ 7.69 ft**
Operator / Unit: **Jonathan W. / UVOST1021**	*Elevation:* **Unavailable**	*Date & Time:* **2013-08-23 12:46 EDT**

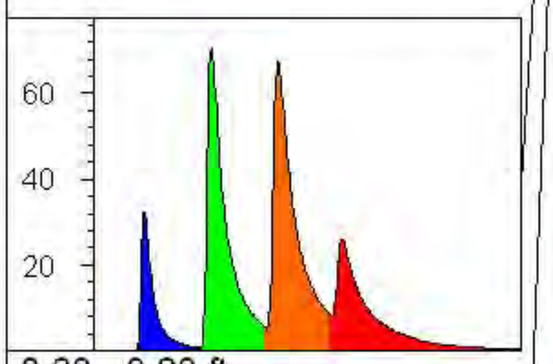
Callouts



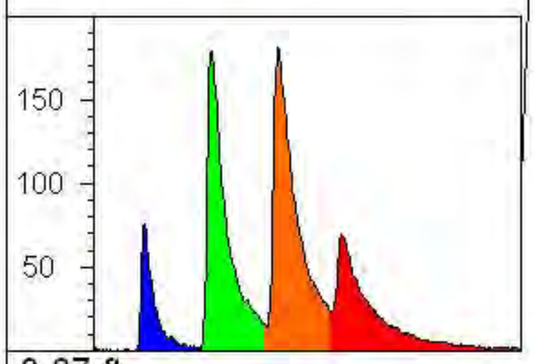
RE
100.0 %RE



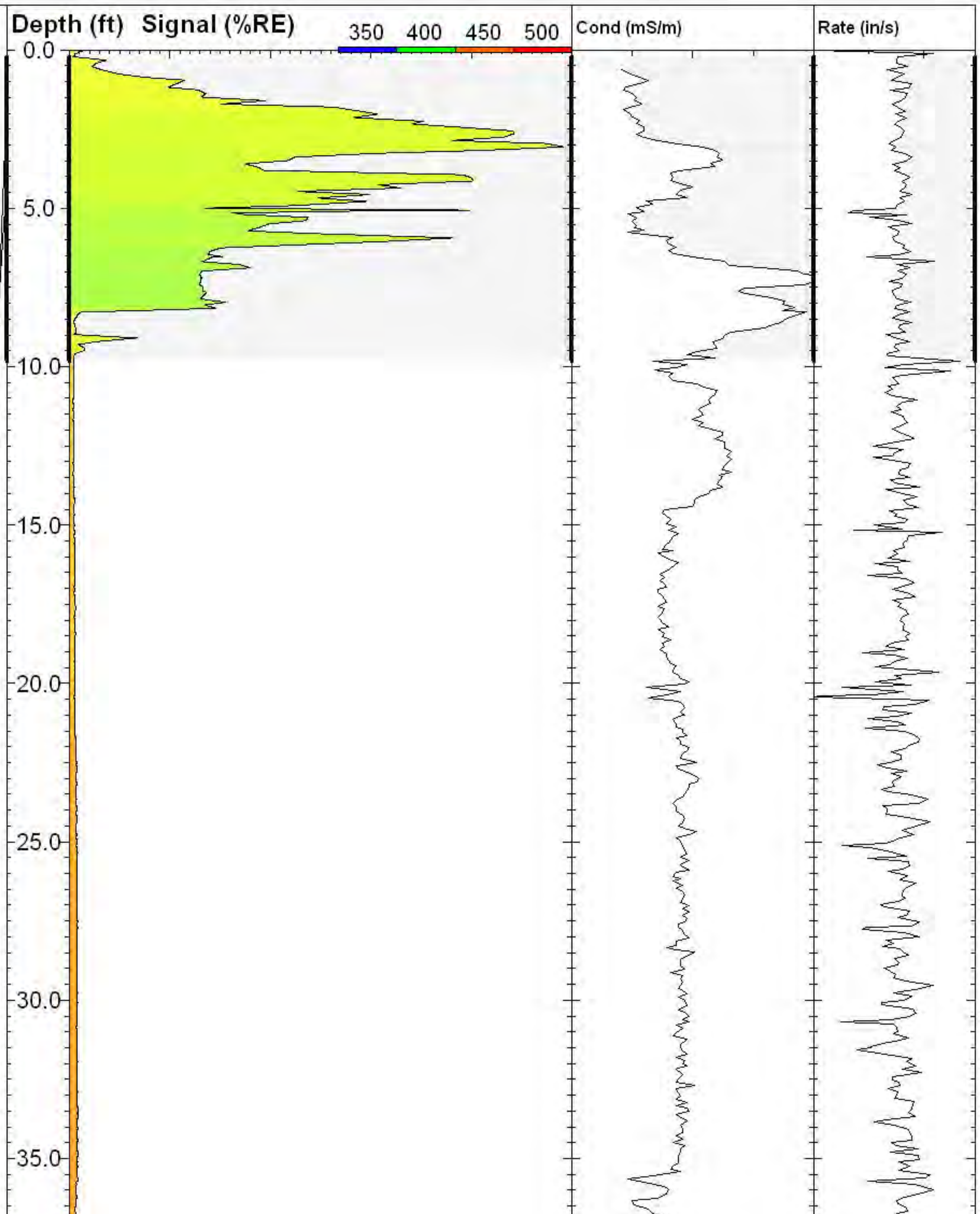
Background
0.7 %RE



0.22 - 9.82 ft
36.8 %RE (s 26.5)



3.07 ft
98.5 %RE
Max



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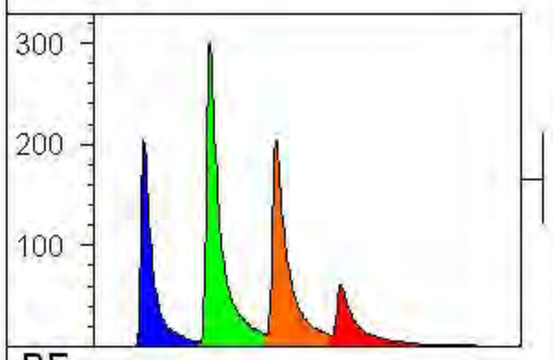
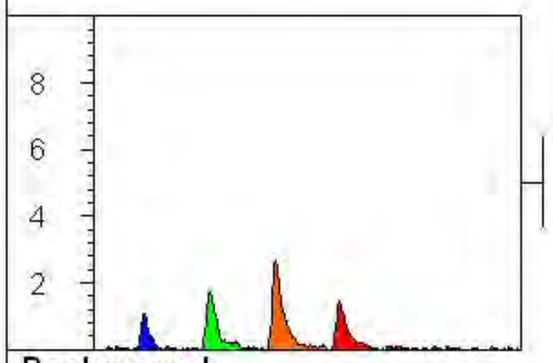
Site: **RACER Pontiac North Campus**	*Y Coord.(Lat-N) / System:* **312257 / UTM**	*Final depth:* **40.11 ft**
Client / Job: **Arcadis /**	*X Coord.(Lng-E) / Fix:* **4725786 /**	*Max signal:* **98.5 %RE @ 3.06 ft**
Operator / Unit: **Jonathan W. / UVOST1021**	*Elevation:* **Unavailable**	*Date & Time:* **2013-08-23 13:43 EDT**

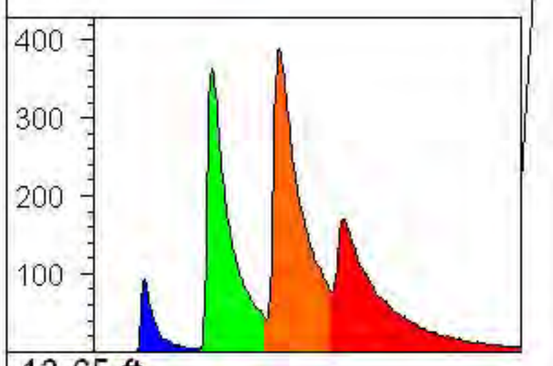
Callouts



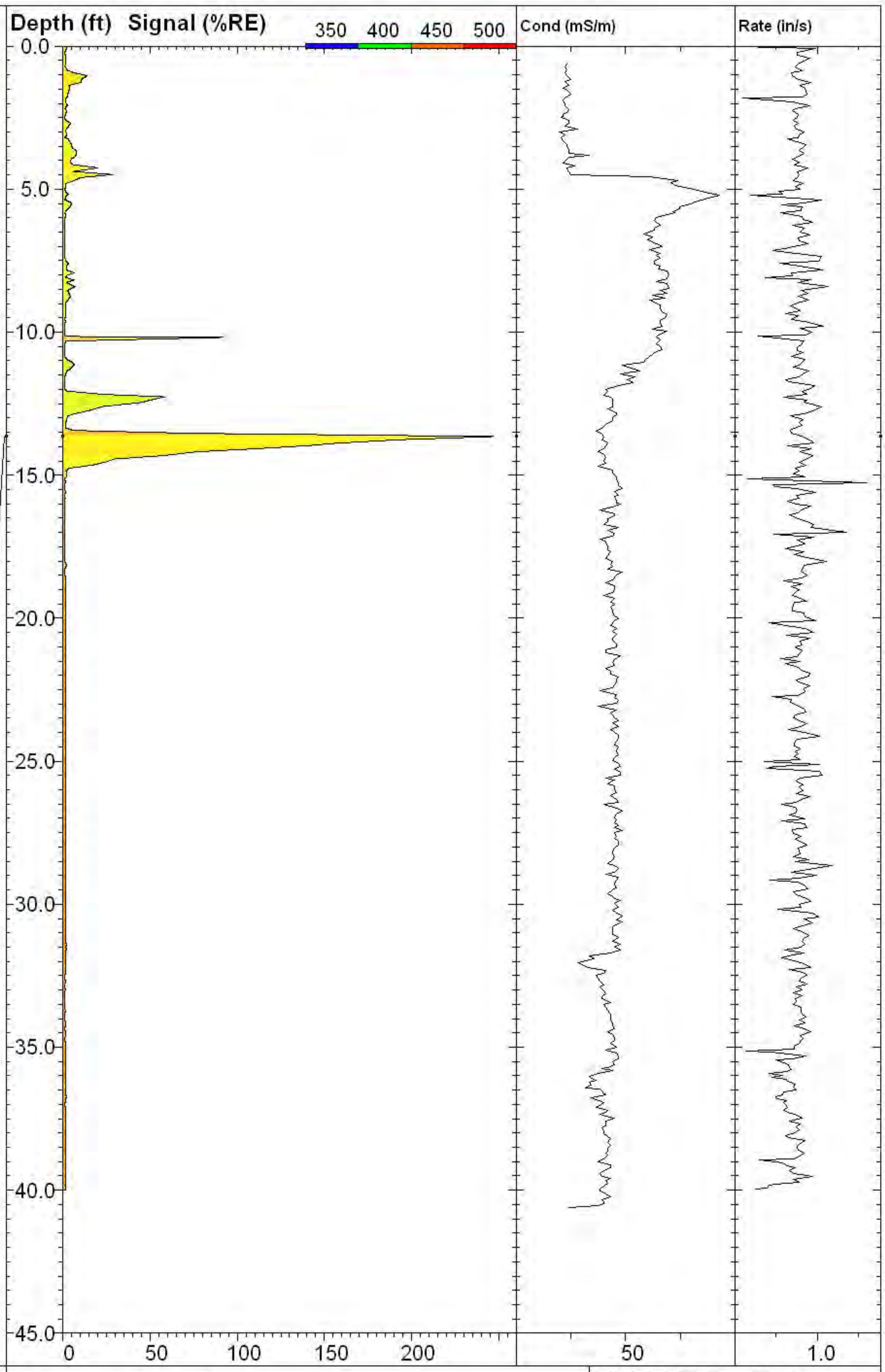
RE
100.0 %RE



Background
0.7 %RE



13.65 ft
247.2 %RE
Max



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Site: **RACER Pontiac North Campus**	*Y Coord.(Lat-N) / System:* **312325 / UTM**	*Final depth:* **40.00 ft**
Client / Job: **Arcadis /**	*X Coord.(Lng-E) / Fix:* **4725779 /**	*Max signal:* **247.2 %RE @ 13.65 ft**
Operator / Unit: **Jonathan W. / UVOST1021**	*Elevation:* **Unavailable**	*Date & Time:* **2013-08-23 14:51 EDT**

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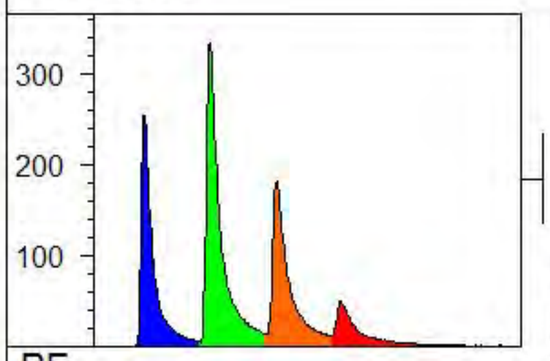
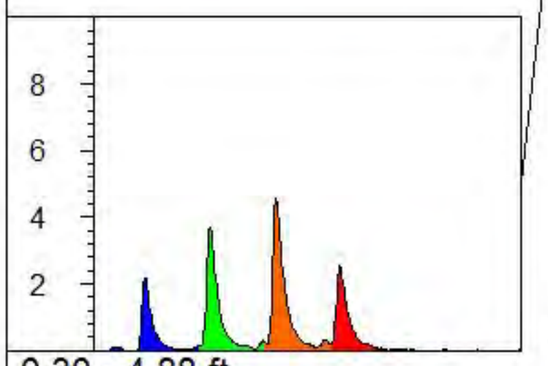
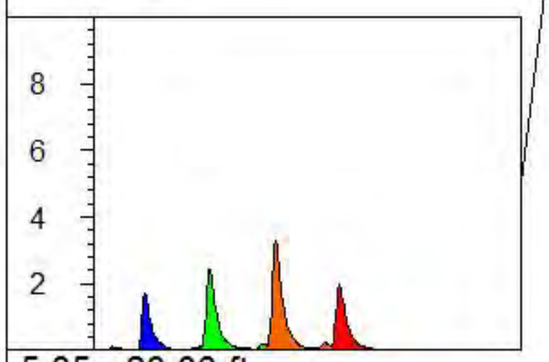


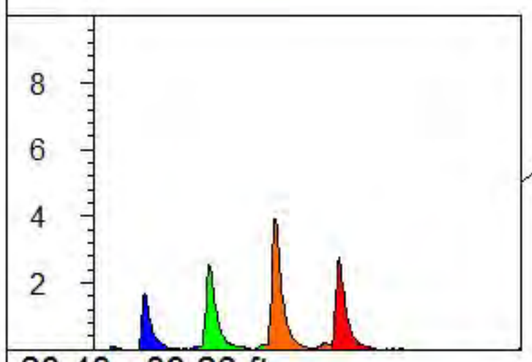
RE
100.0 %RE



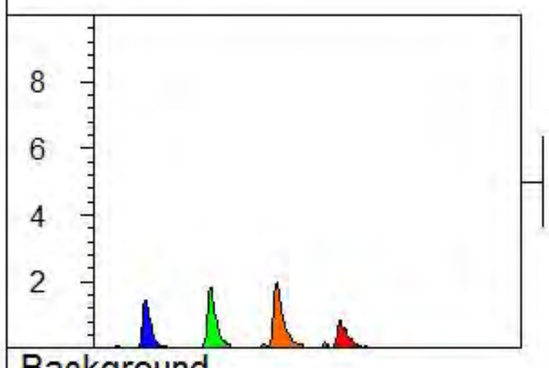
0.30 - 4.88 ft
1.3 %RE (s 0.3)
Hand Auger



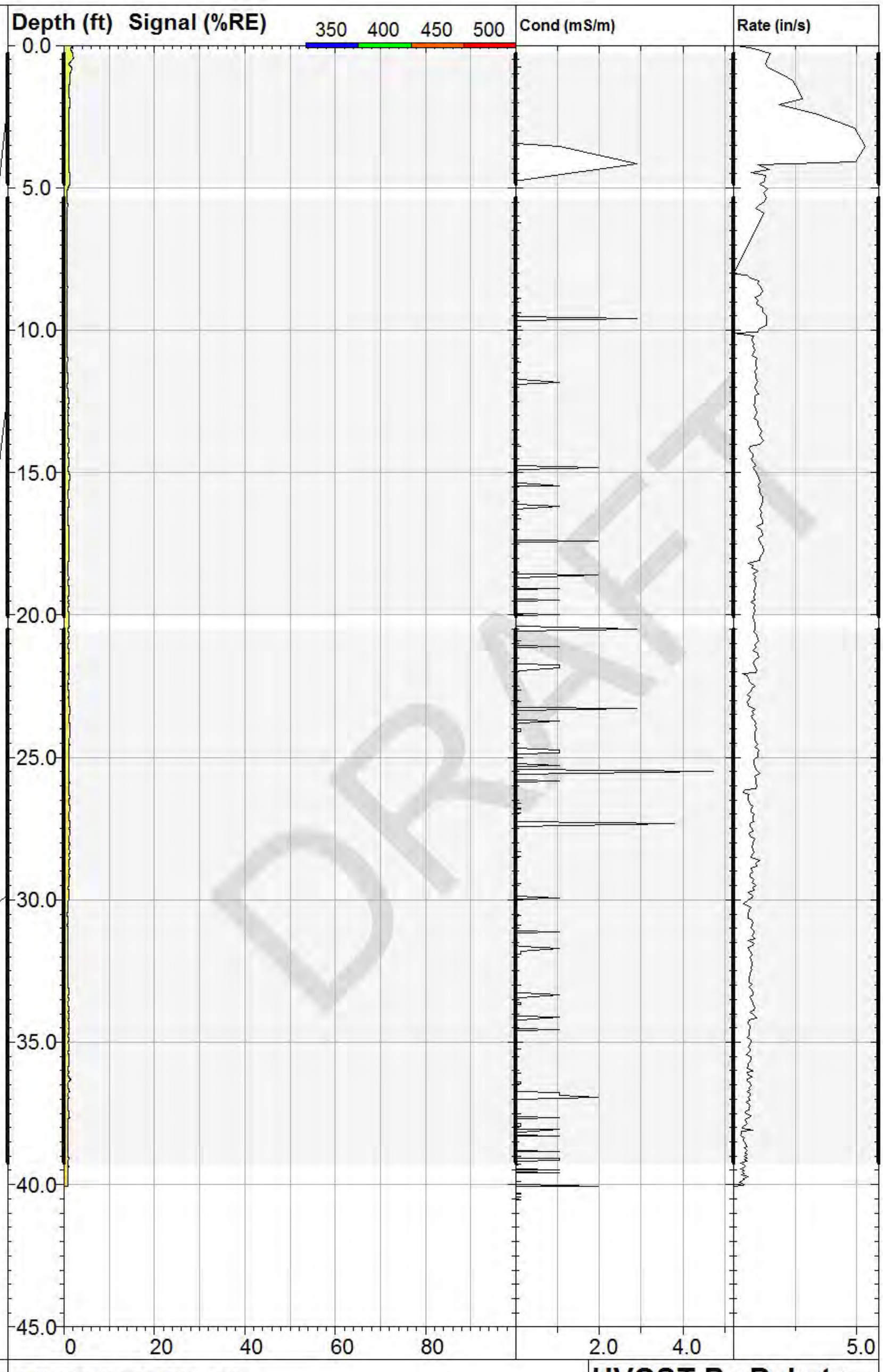
5.35 - 20.06 ft
0.8 %RE (s 0.2)



20.48 - 39.26 ft
1.0 %RE (s 0.1)



Background
0.5 %RE



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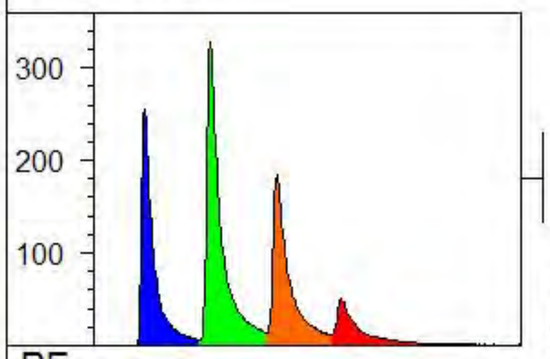
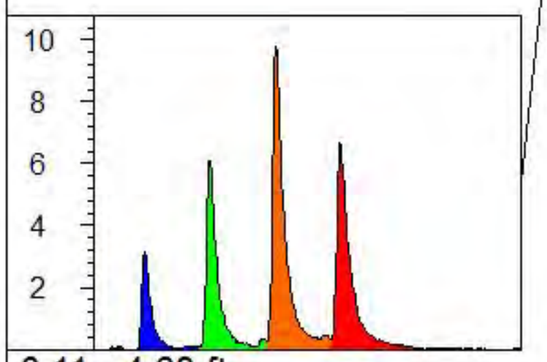
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **40.06 ft**
Client / Job: **ARCADIS /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **2.1 %RE @ 0.46 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-03 10:52 EDT**

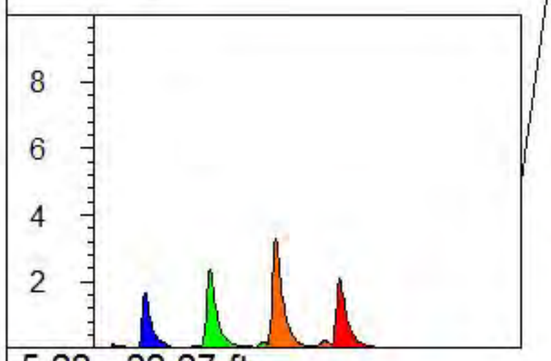
Callouts



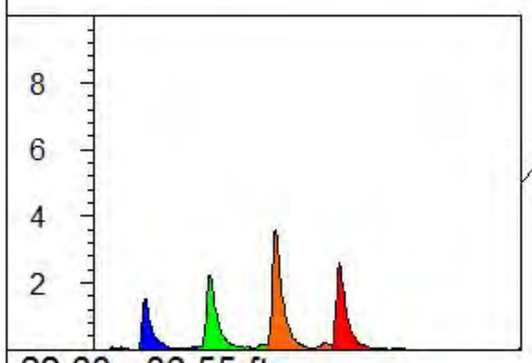
RE
100.0 %RE



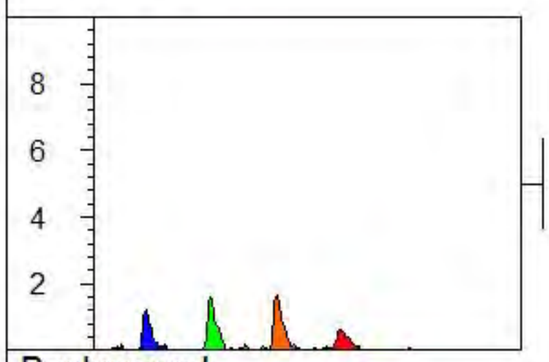
0.11 - 4.68 ft
2.6 %RE (s 1.3)
Hand Auger



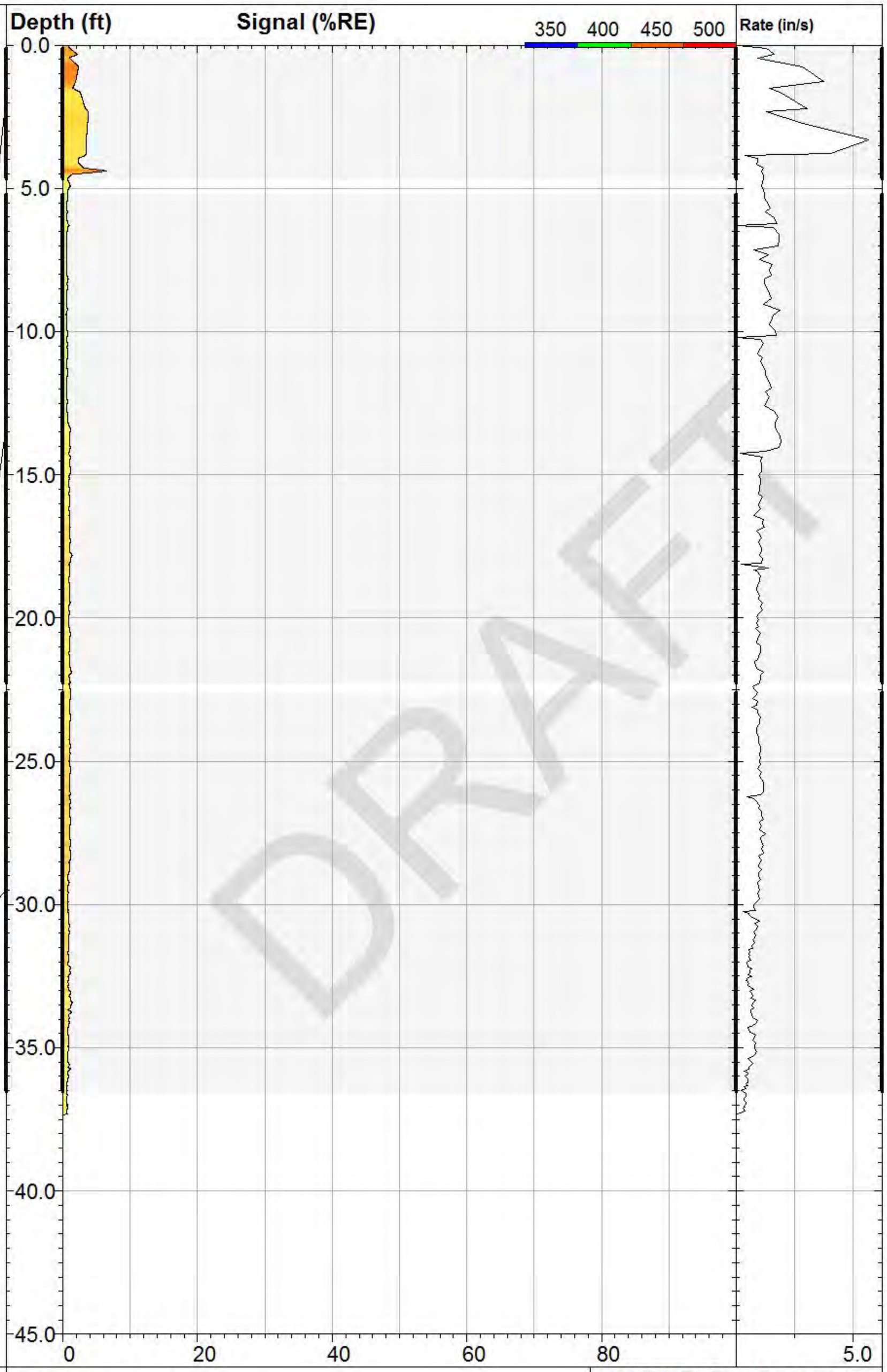
5.22 - 22.27 ft
0.8 %RE (s 0.2)



22.60 - 36.55 ft
0.9 %RE (s 0.2)
Refusal at 37.33'



Background
0.4 %RE



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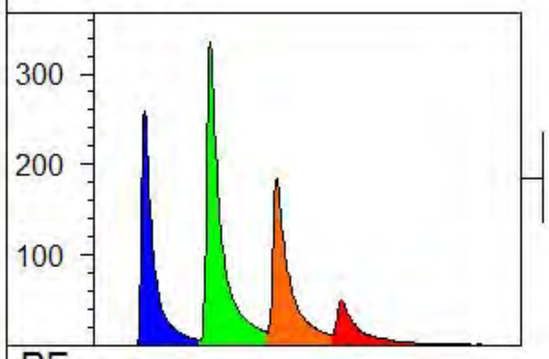
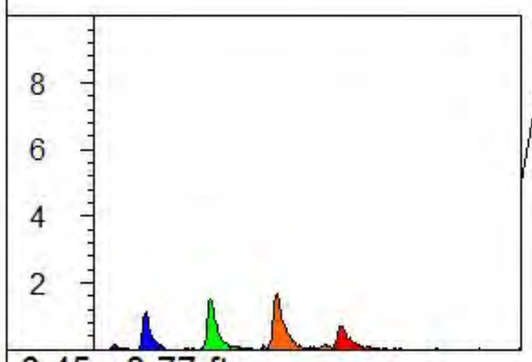
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **37.33 ft**
Client / Job: **ARCADIS /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **6.6 %RE @ 4.39 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-03 11:35 EDT**

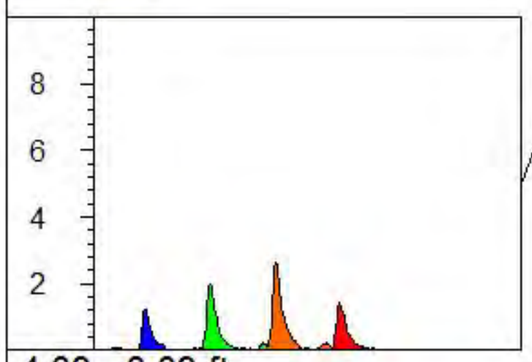
Callouts



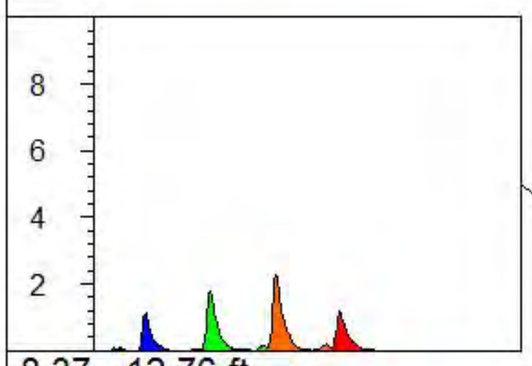
RE
100.0 %RE



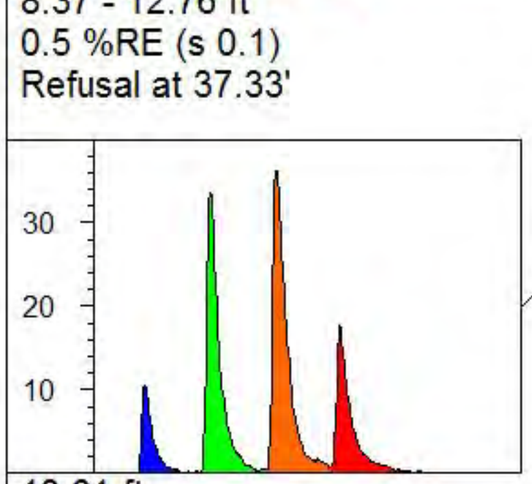
0.45 - 3.77 ft
0.4 %RE (s 0.2)
Hand Auger



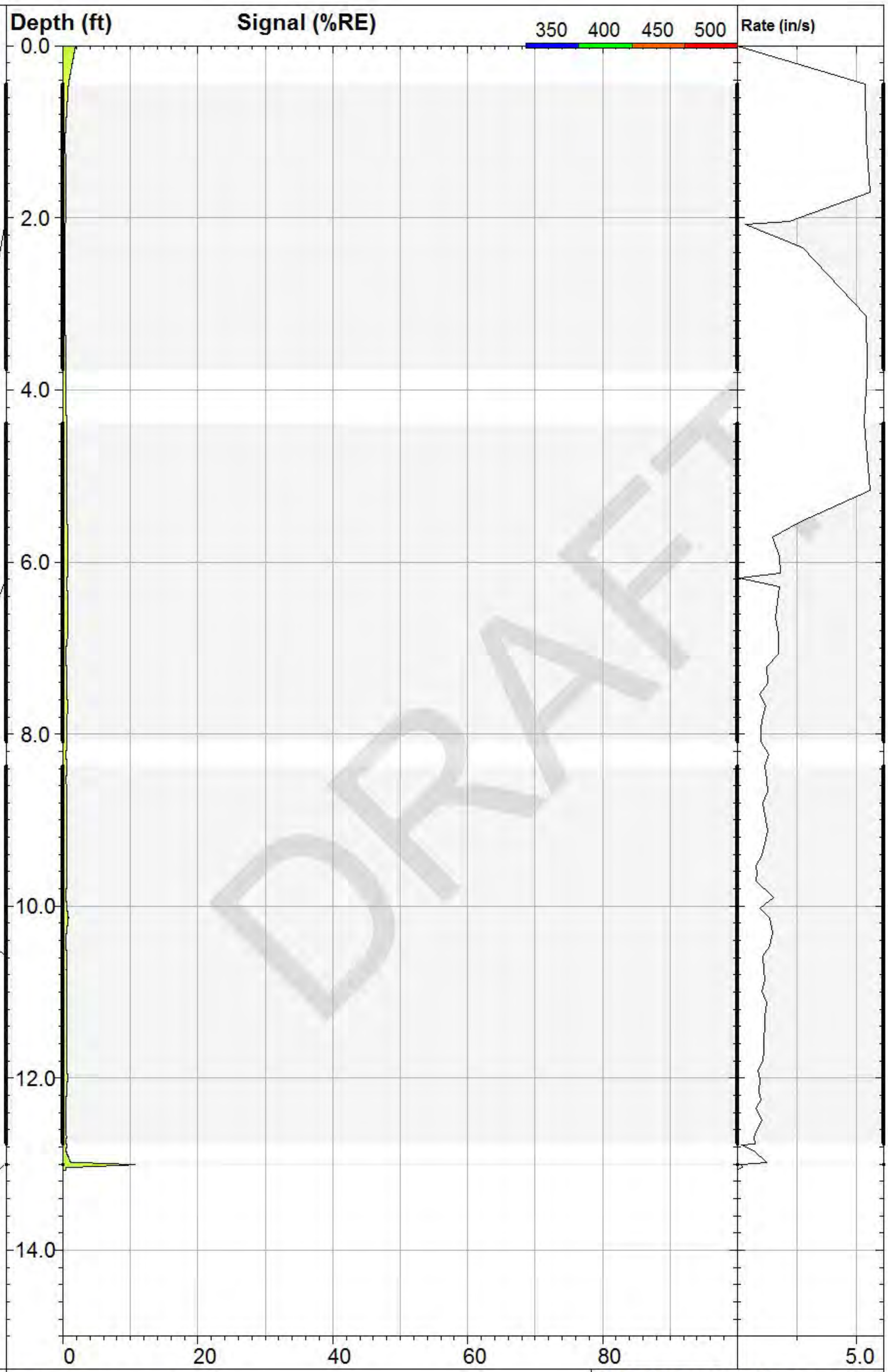
4.39 - 8.09 ft
0.6 %RE (s 0.1)



8.37 - 12.76 ft
0.5 %RE (s 0.1)
Refusal at 37.33'



13.01 ft
10.9 %RE
Refusal at 13.07



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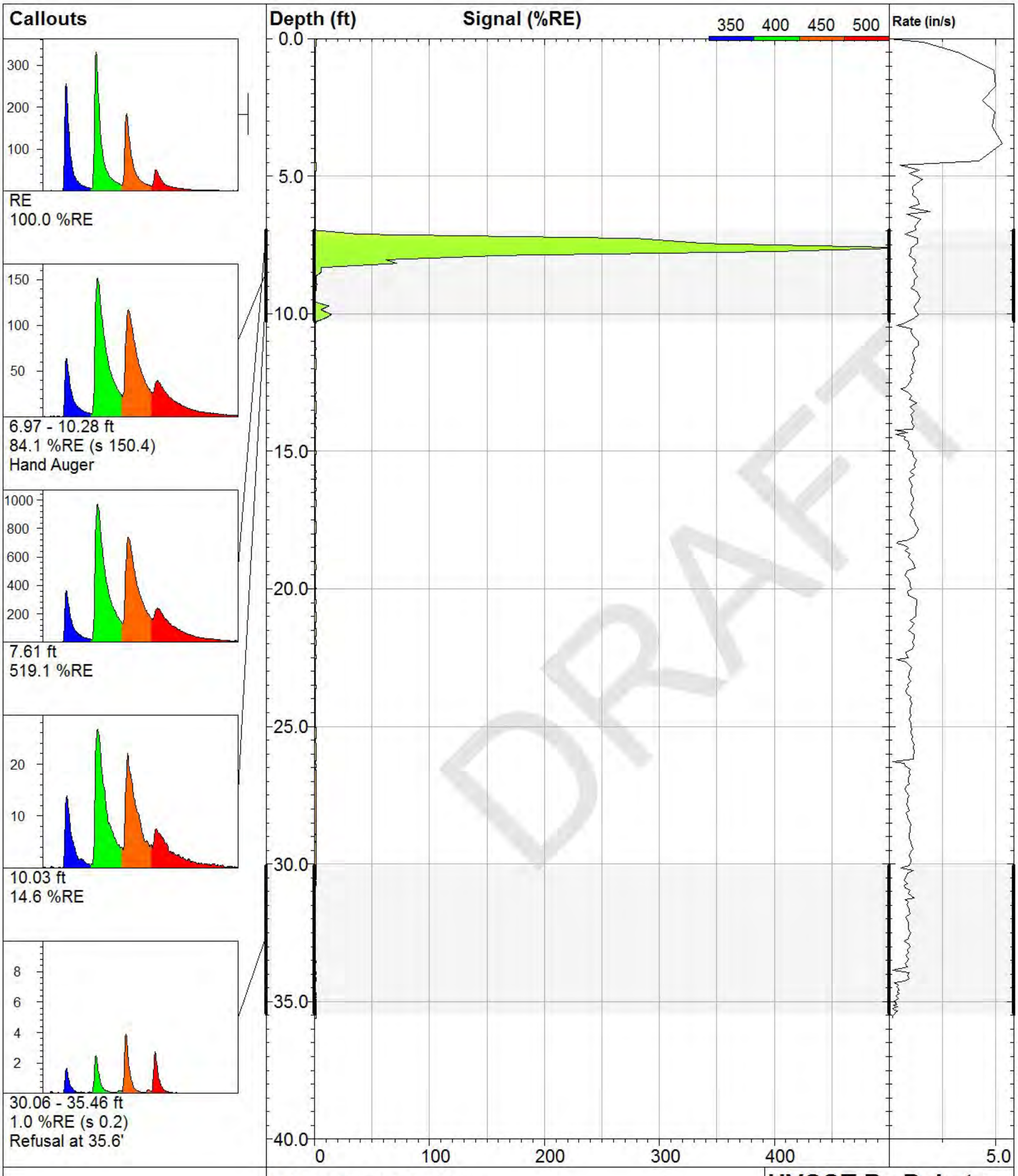
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **13.07 ft**
Client / Job: **ARCADIS /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **10.9 %RE @ 13.00 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-03 12:14 EDT**



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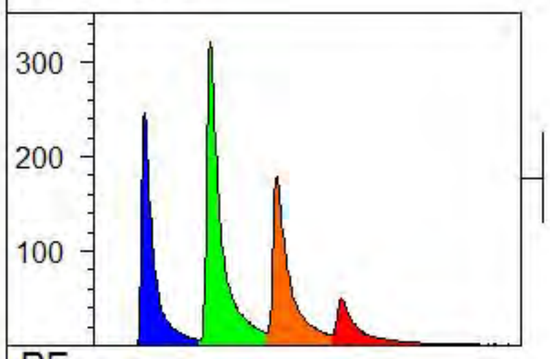
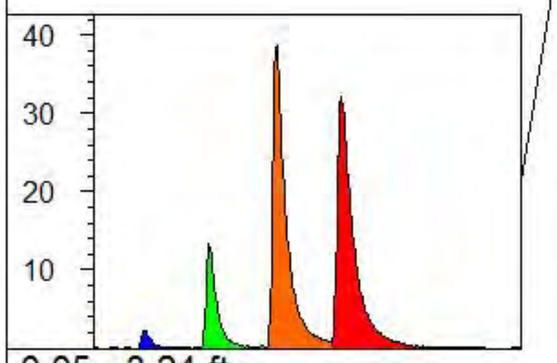
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **35.60 ft**
Client / Job: **ARCADIS /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **519.1 %RE @ 7.61 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-03 13:15 EDT**

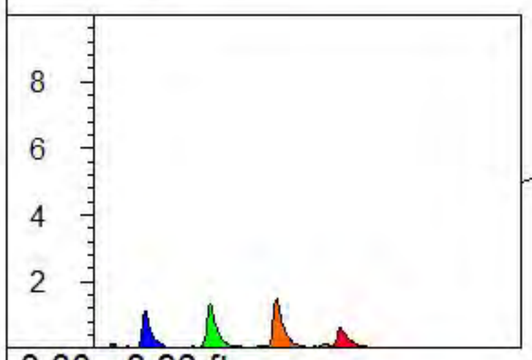
Callouts



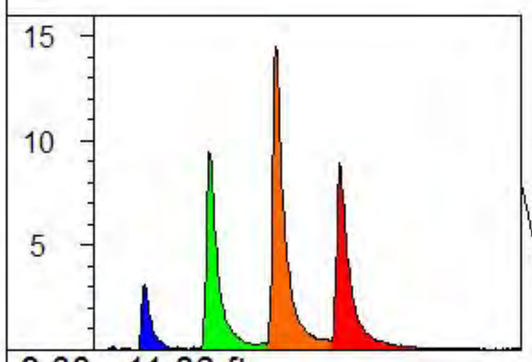
RE
100.0 %RE



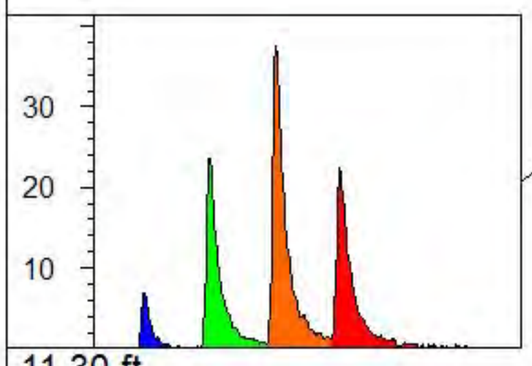
0.05 - 3.24 ft
10.3 %RE (s 11.8)
Hand Auger



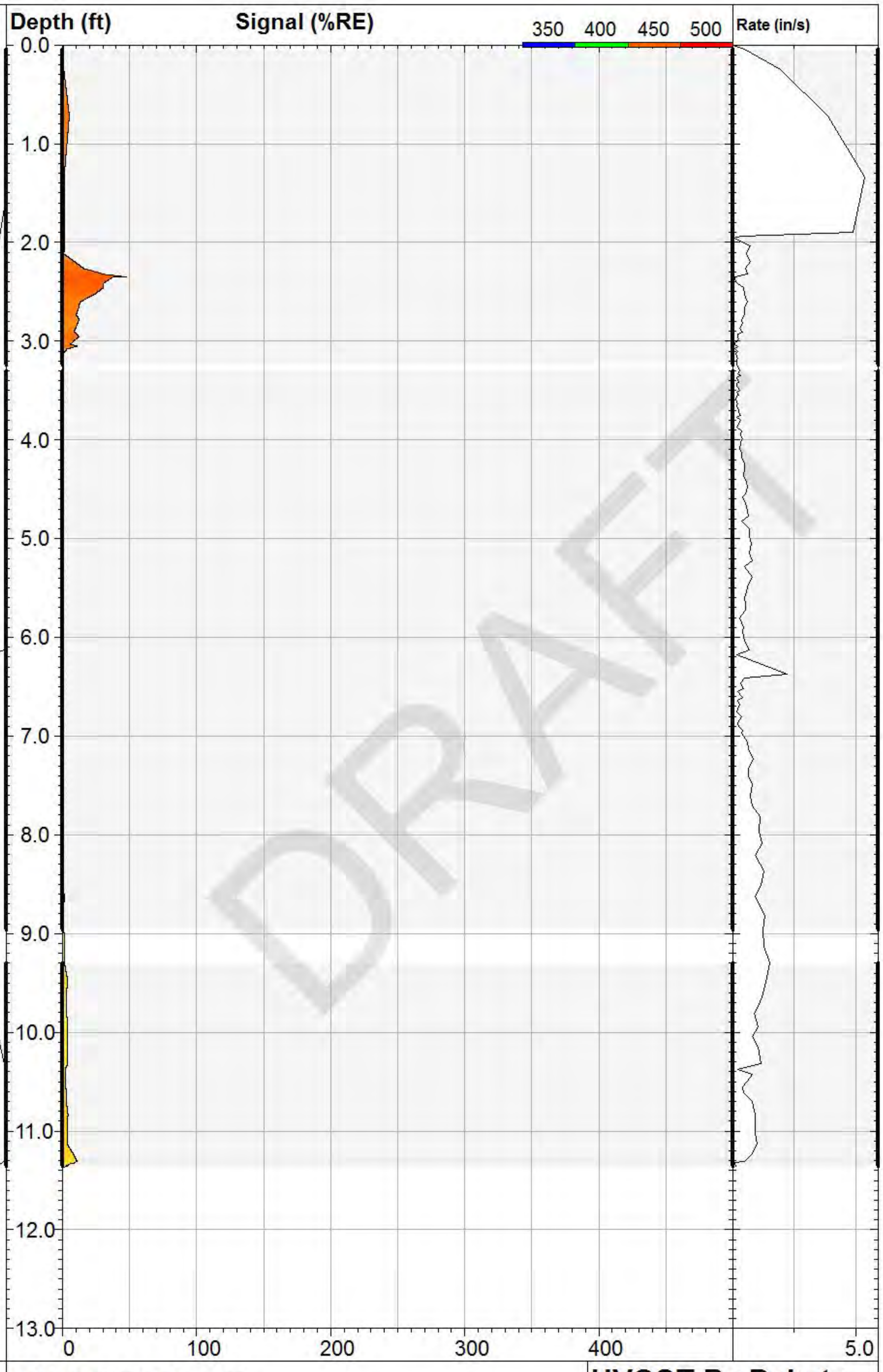
3.30 - 8.96 ft
0.4 %RE (s 0.1)



9.30 - 11.36 ft
3.8 %RE (s 2.1)



11.30 ft
10.5 %RE
Refusal at 11.36'



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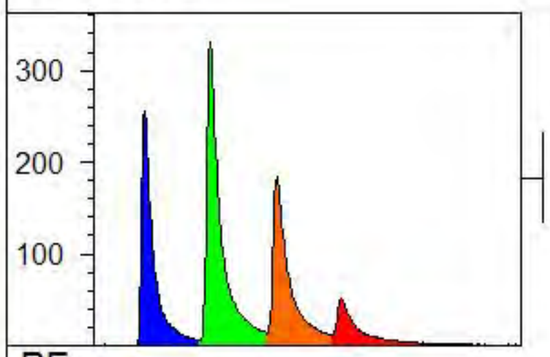
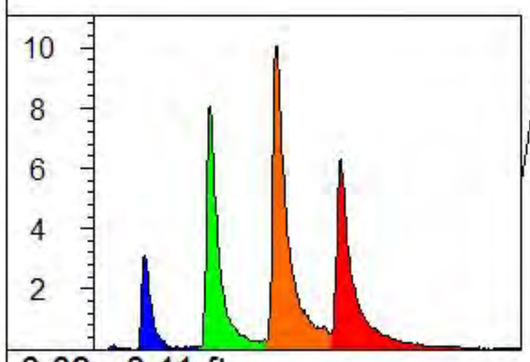
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **11.36 ft**
Client / Job: **ARCADIS /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **48.1 %RE @ 2.35 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-03 14:03 EDT**

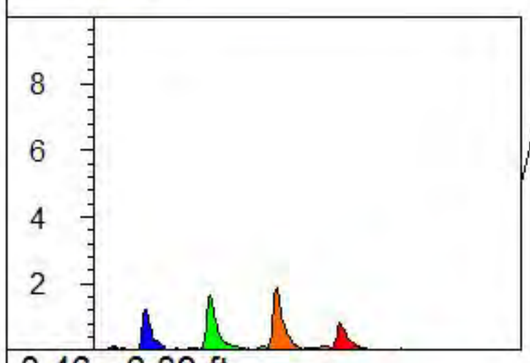
Callouts



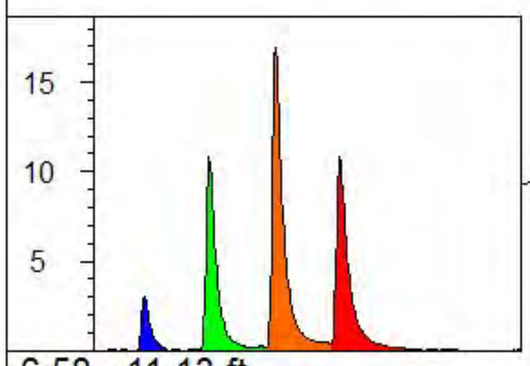
RE
100.0 %RE



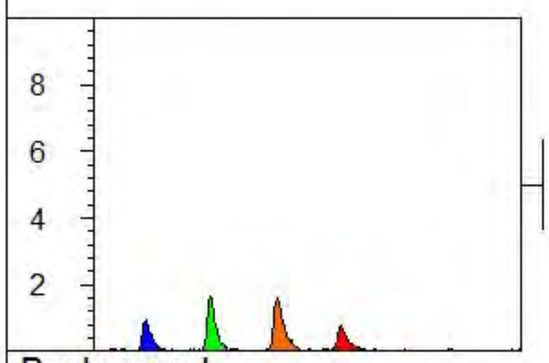
0.09 - 3.11 ft
3.3 %RE (s 5.5)
Hand Auger



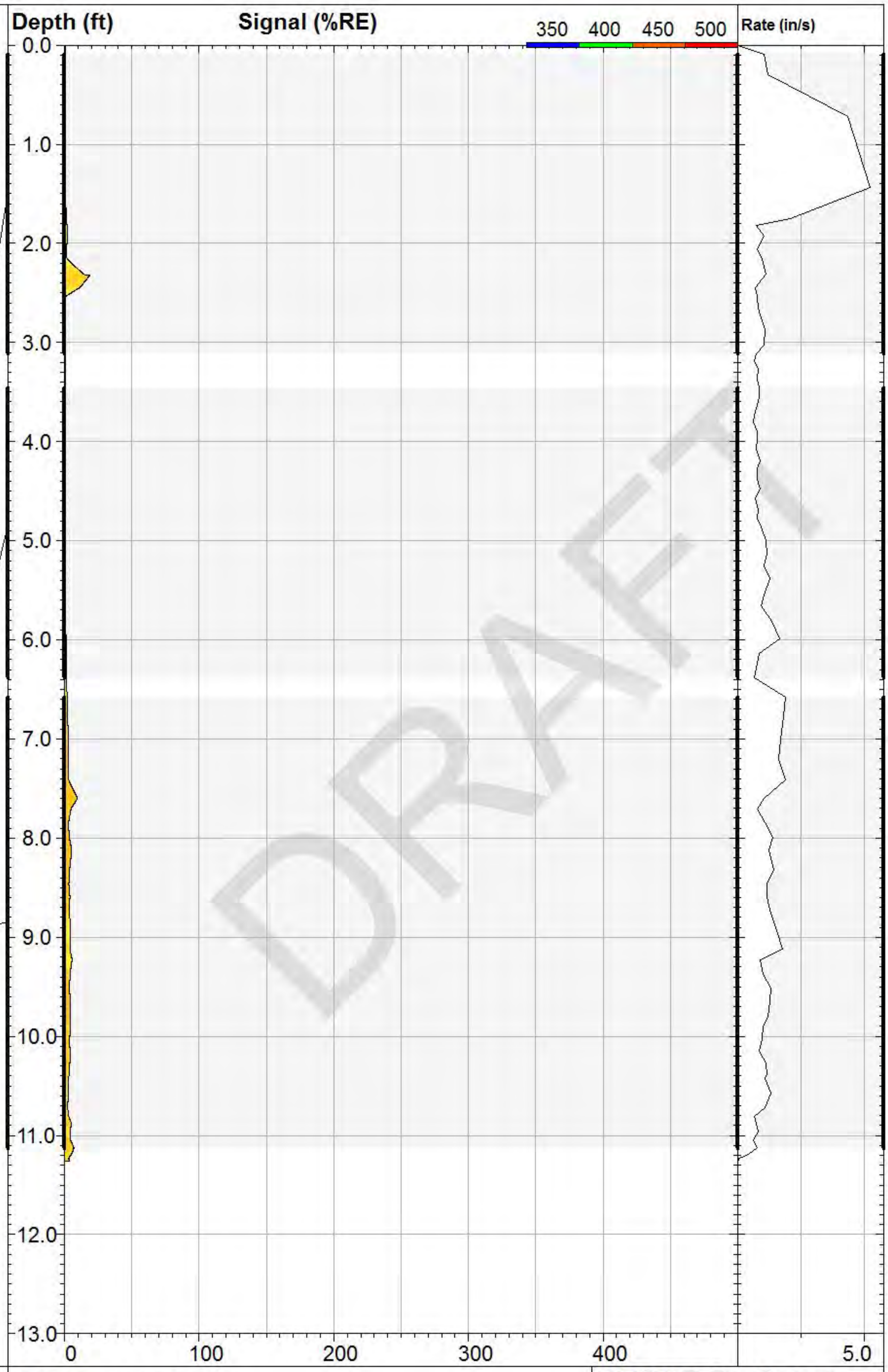
3.46 - 6.39 ft
0.5 %RE (s 0.3)



6.58 - 11.13 ft
4.0 %RE (s 1.5)



Background
0.4 %RE
Refusal at 11.26'



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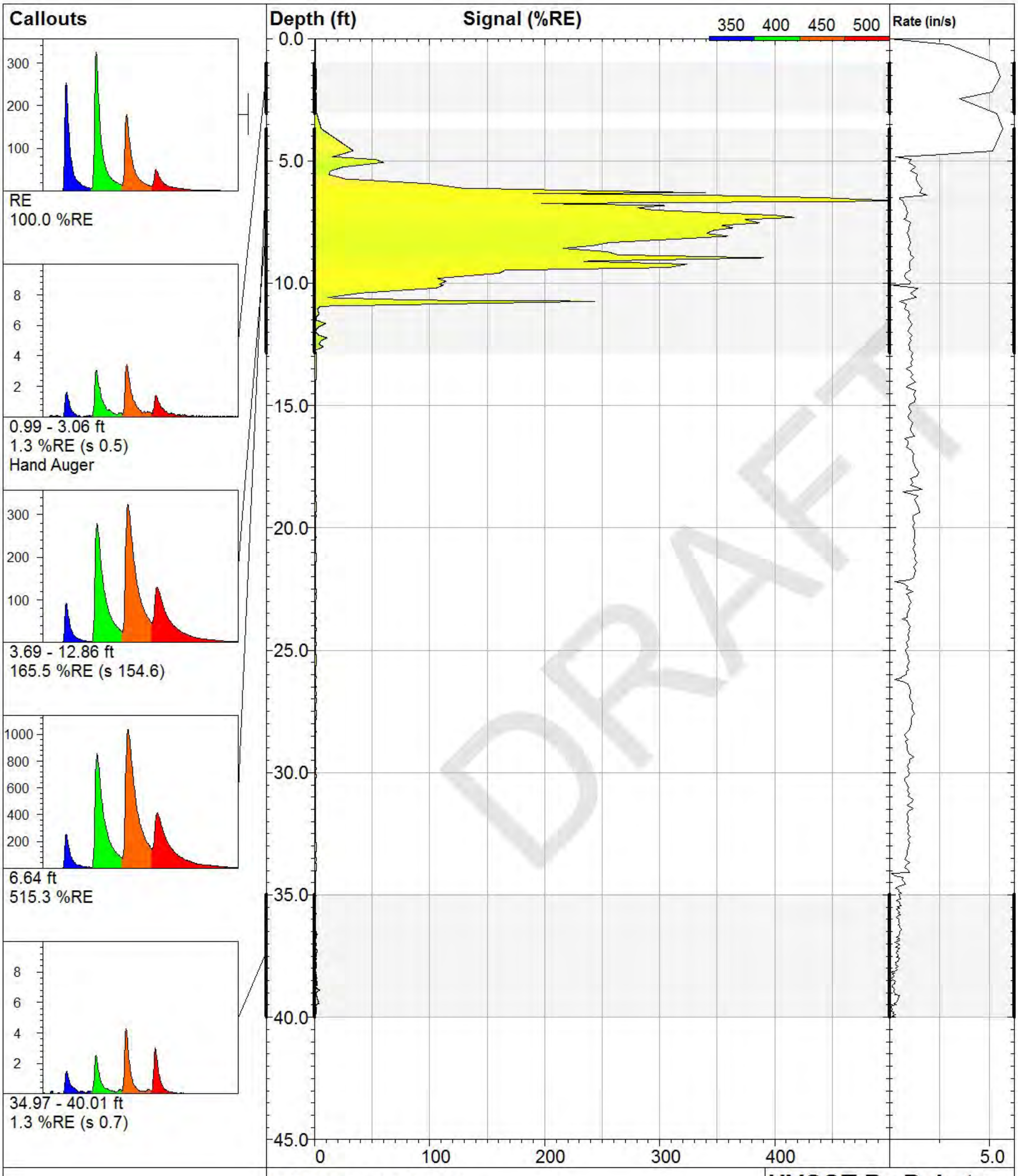
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **11.26 ft**
Client / Job: **ARCADIS /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **18.8 %RE @ 2.32 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-03 14:33 EDT**



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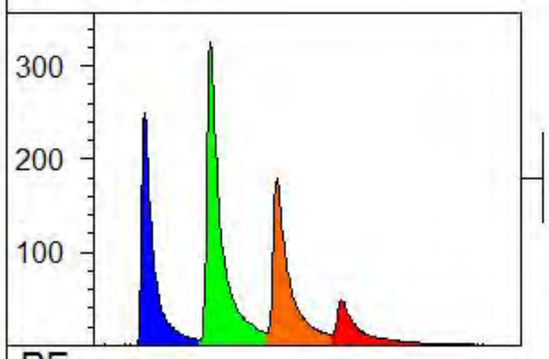
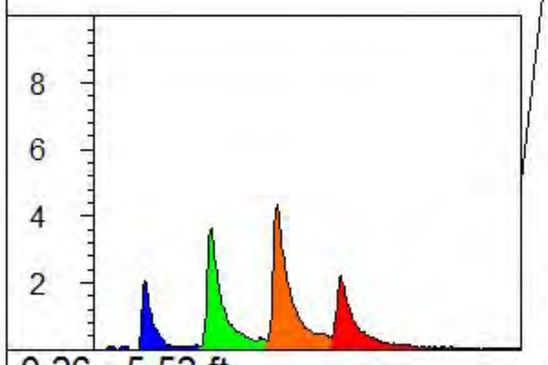
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **40.01 ft**
Client / Job: **ARCADIS /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **515.3 %RE @ 6.64 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-03 14:59 EDT**

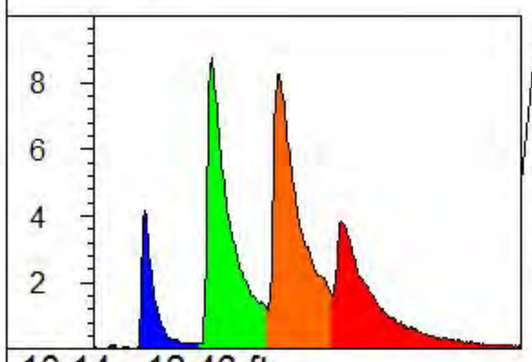
Callouts



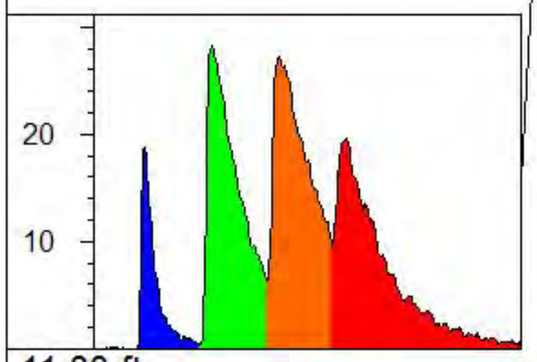
RE
100.0 %RE



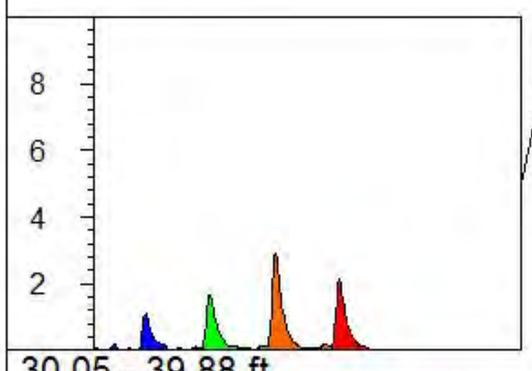
0.26 - 5.52 ft
1.7 %RE (s 1.1)
Hand Auger



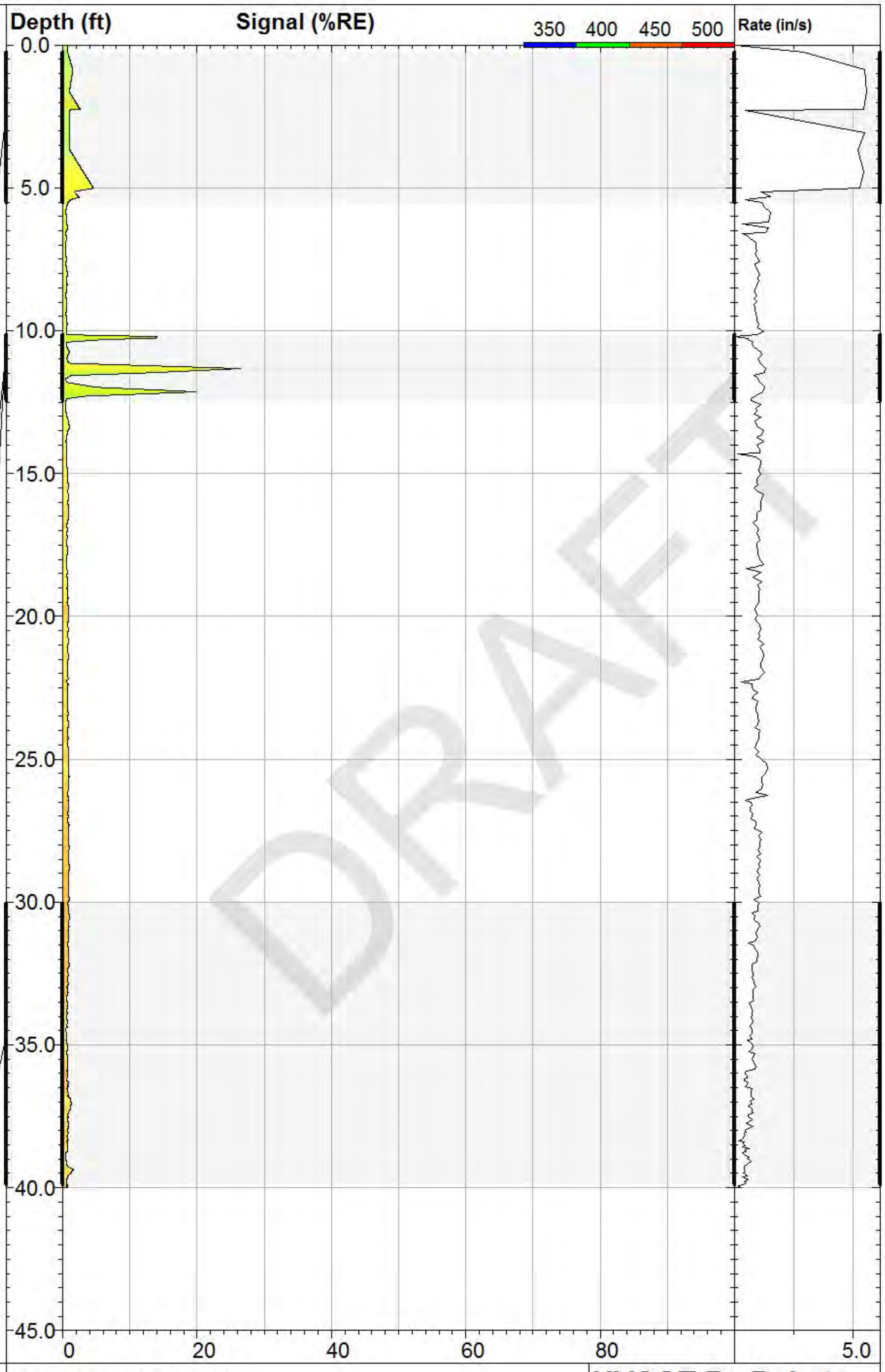
10.14 - 12.46 ft
5.3 %RE (s 7.6)



11.33 ft
26.4 %RE



30.05 - 39.88 ft
0.7 %RE (s 0.2)



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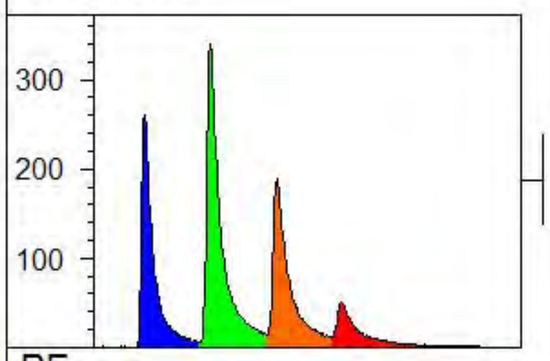
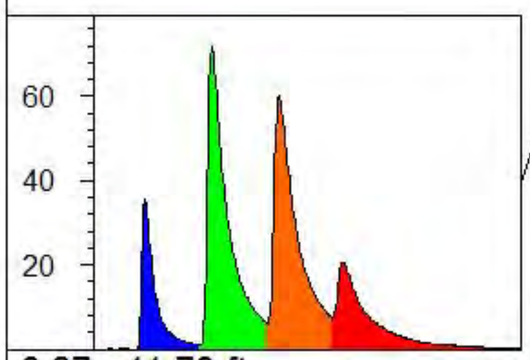
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **40.00 ft**
Client / Job: **ARCADIS /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **26.4 %RE @ 11.33 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-03 15:38 EDT**

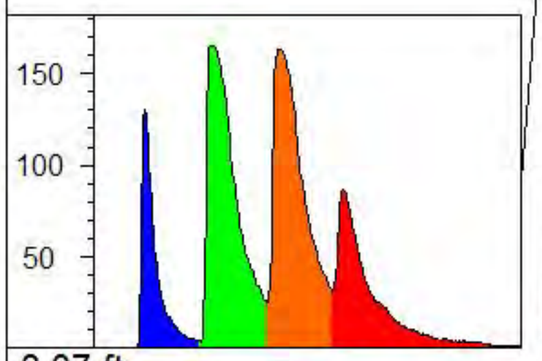
Callouts



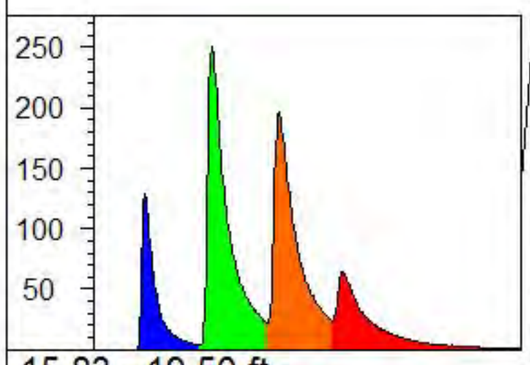
RE
100.0 %RE



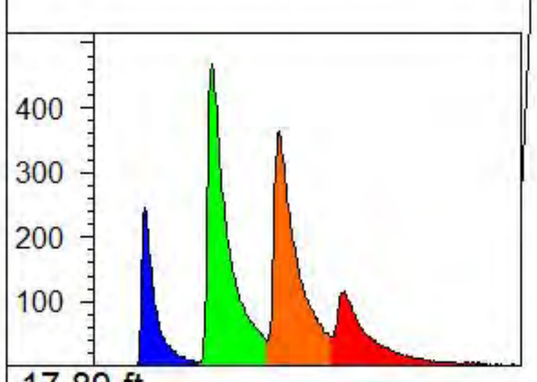
6.27 - 11.78 ft
32.8 %RE (s 44.8)



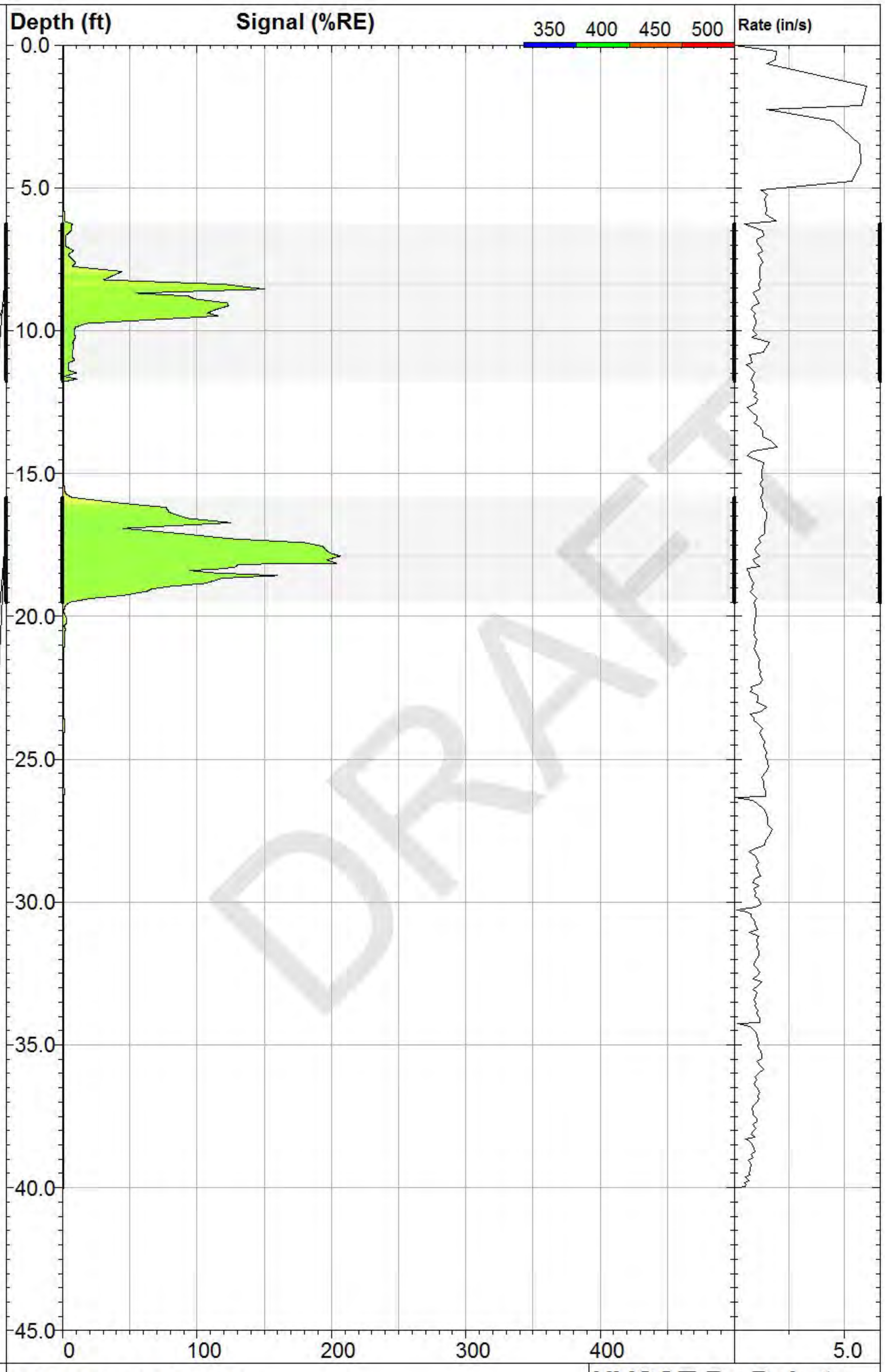
8.37 ft
120.0 %RE



15.83 - 19.50 ft
110.2 %RE (s 59.9)



17.89 ft
206.5 %RE



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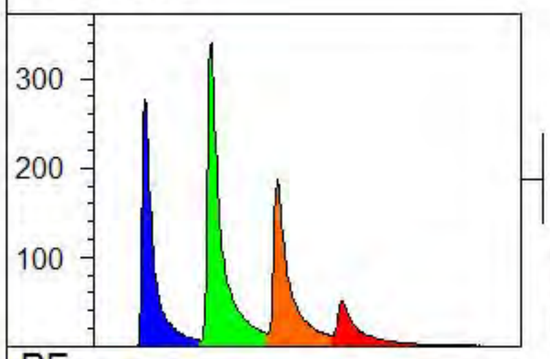
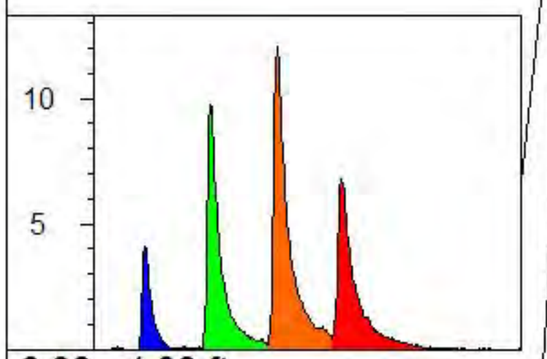
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **40.02 ft**
Client / Job: **ARCADIS /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **206.5 %RE @ 17.89 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-03 16:19 EDT**

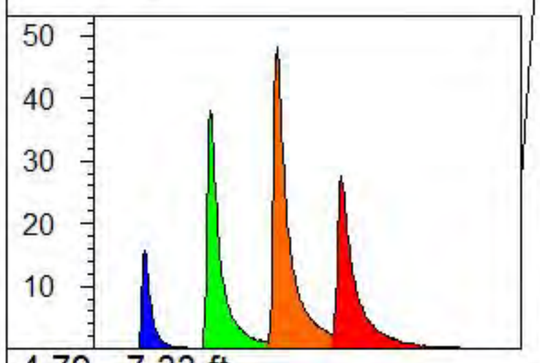
Callouts



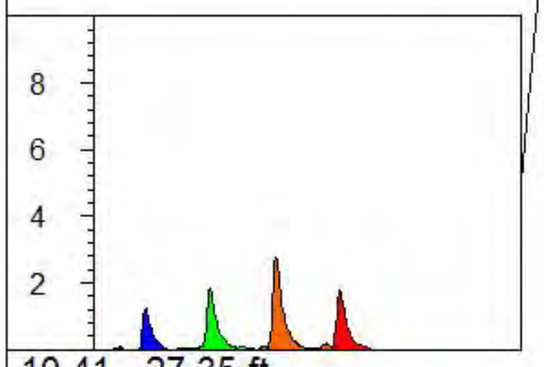
RE
100.0 %RE



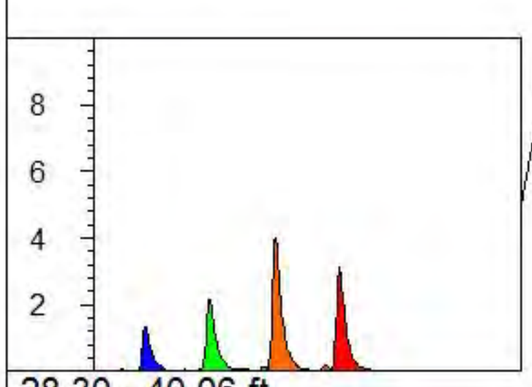
0.36 - 4.36 ft
3.8 %RE (s 1.8)
Hand Auger



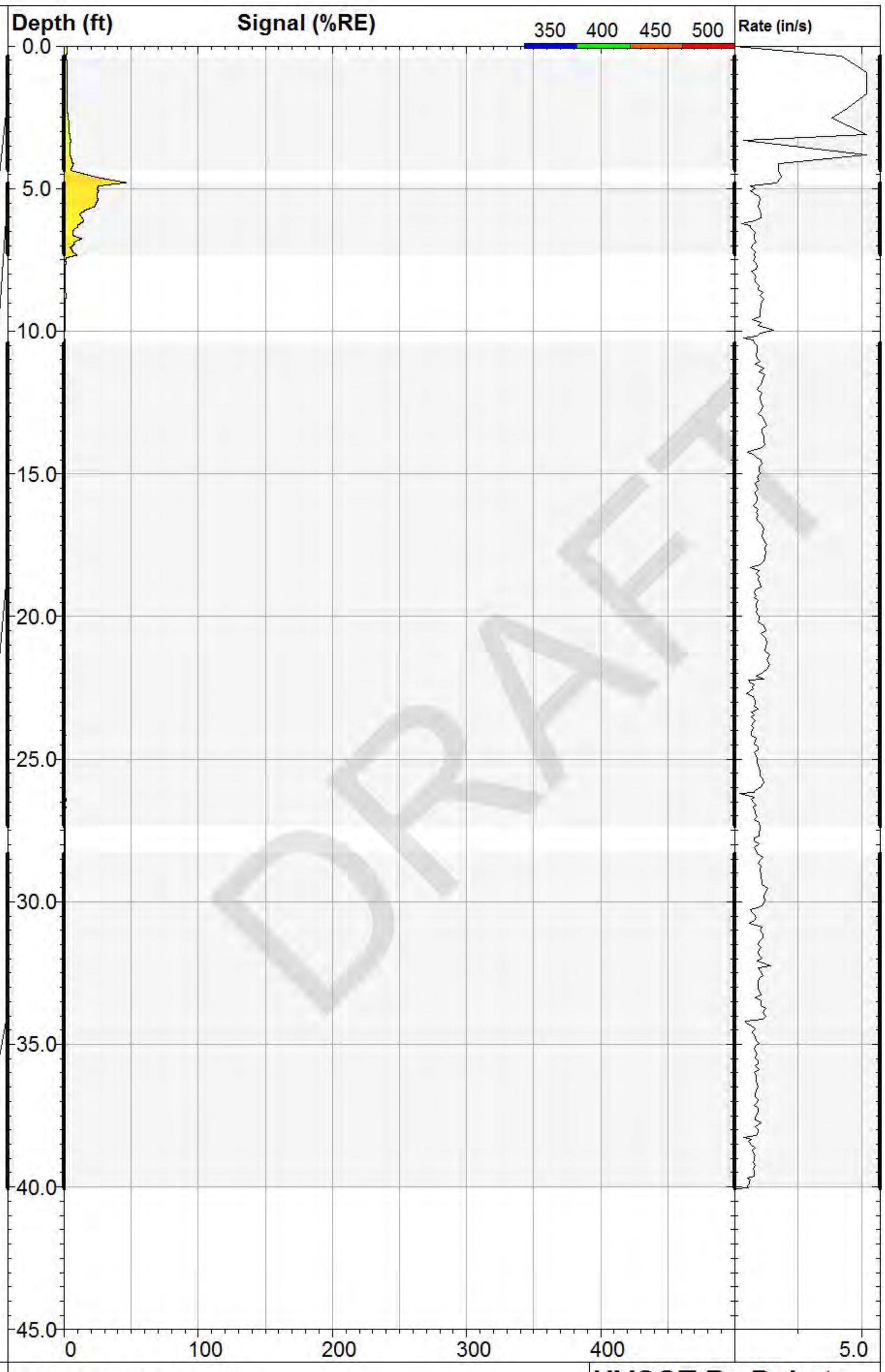
4.79 - 7.33 ft
15.5 %RE (s 9.9)



10.41 - 27.35 ft
0.6 %RE (s 0.2)



28.30 - 40.06 ft
0.8 %RE (s 0.1)



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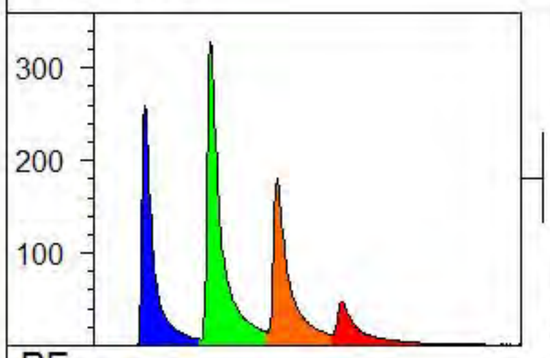
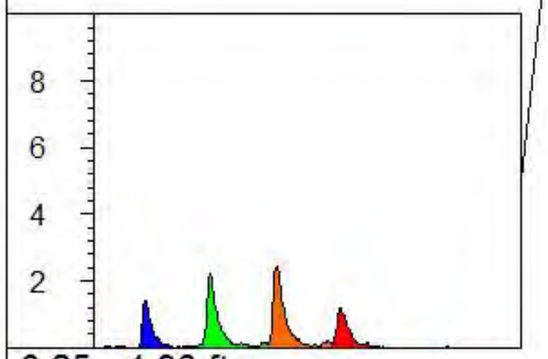
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **40.06 ft**
Client / Job: **ARCADIS /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **46.5 %RE @ 4.79 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-04 08:22 EDT**

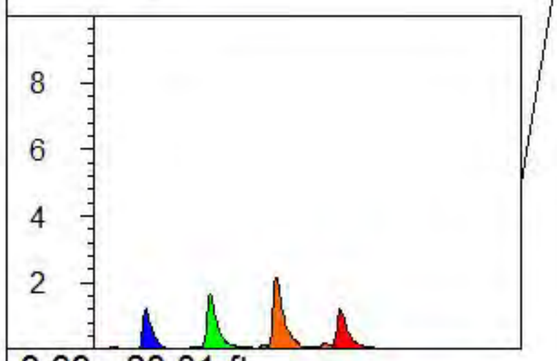
Callouts



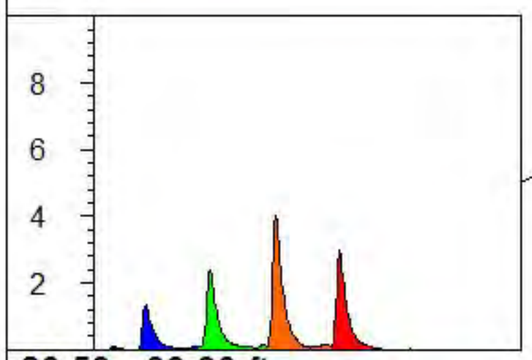
RE
100.0 %RE



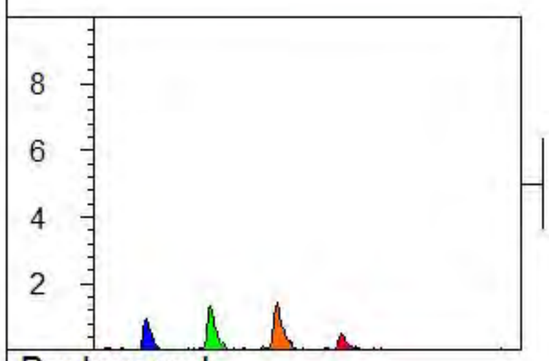
0.25 - 4.96 ft
0.7 %RE (s 0.2)
Hand Auger



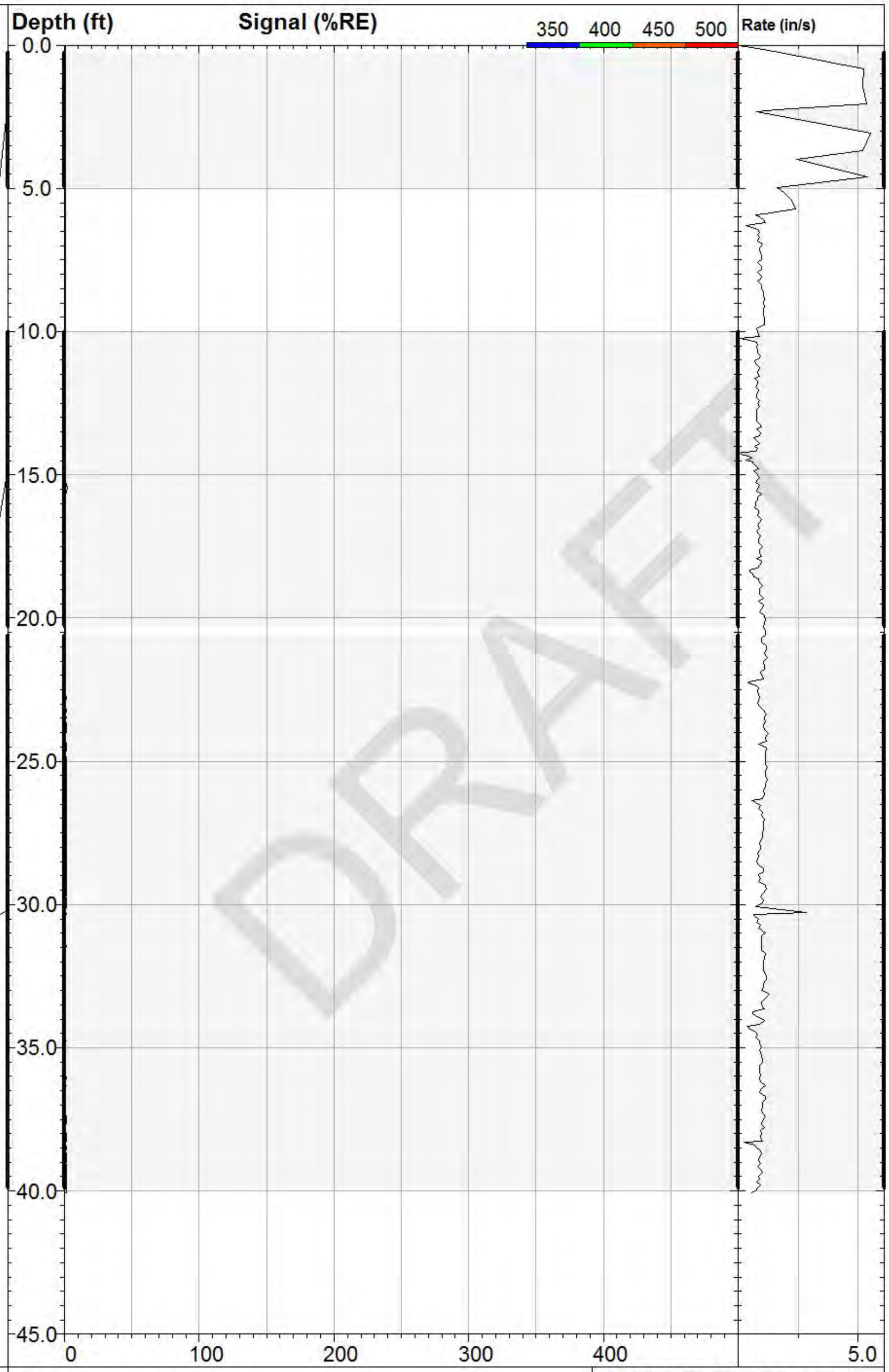
9.99 - 20.31 ft
0.6 %RE (s 0.2)



20.59 - 39.90 ft
1.0 %RE (s 0.2)



Background
0.3 %RE



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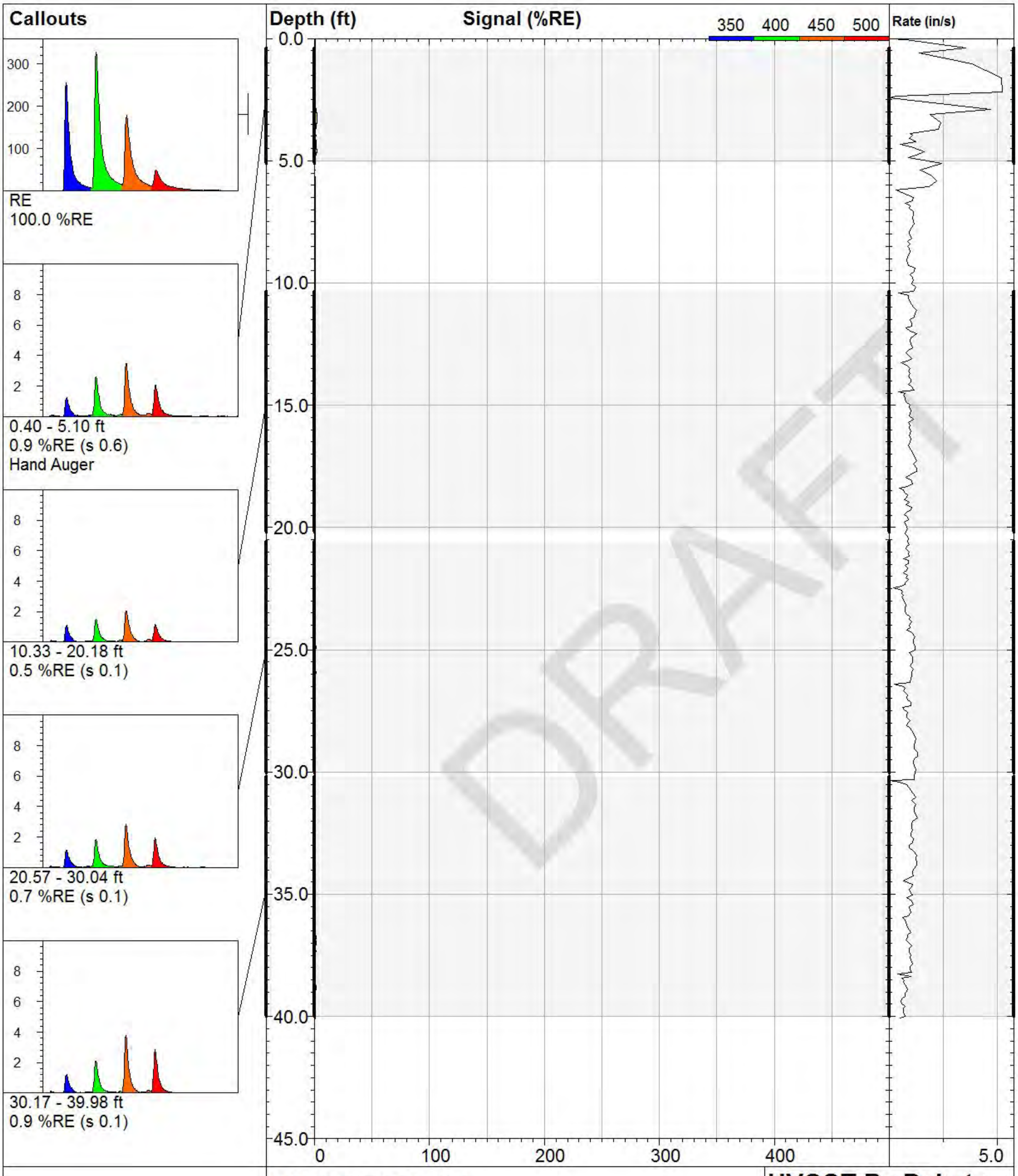
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **40.06 ft**
Client / Job: **ARCADIS /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **2.0 %RE @ 15.48 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-04 09:08 EDT**



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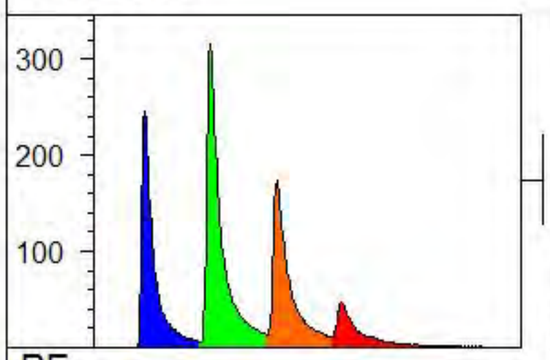
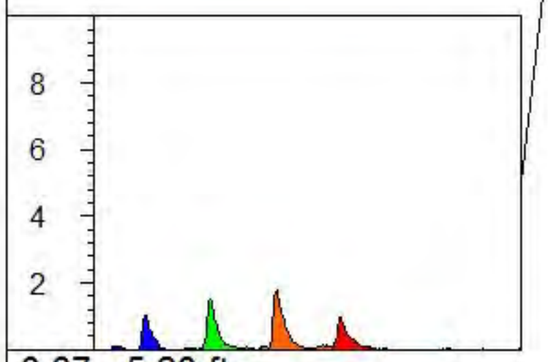
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **40.08 ft**
Client / Job: **ARCADIS /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **2.2 %RE @ 3.12 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-04 09:41 EDT**

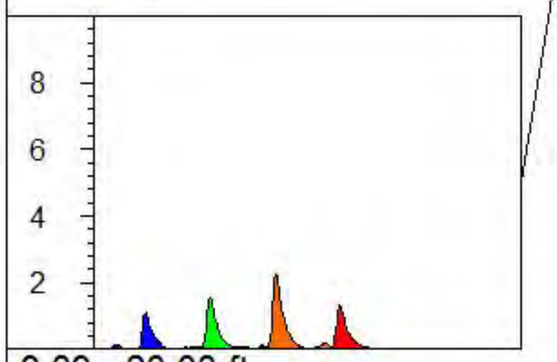
Callouts



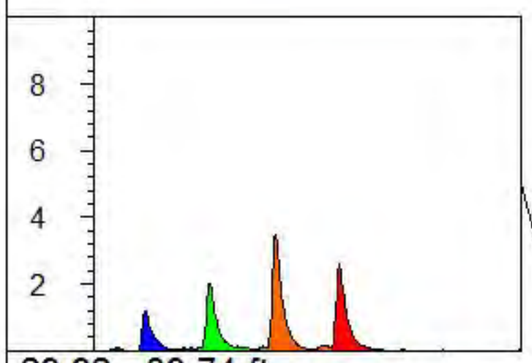
RE
100.0 %RE



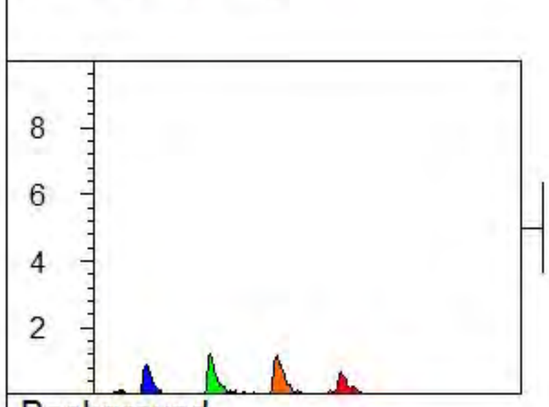
0.67 - 5.20 ft
0.5 %RE (s 0.2)
Hand Auger



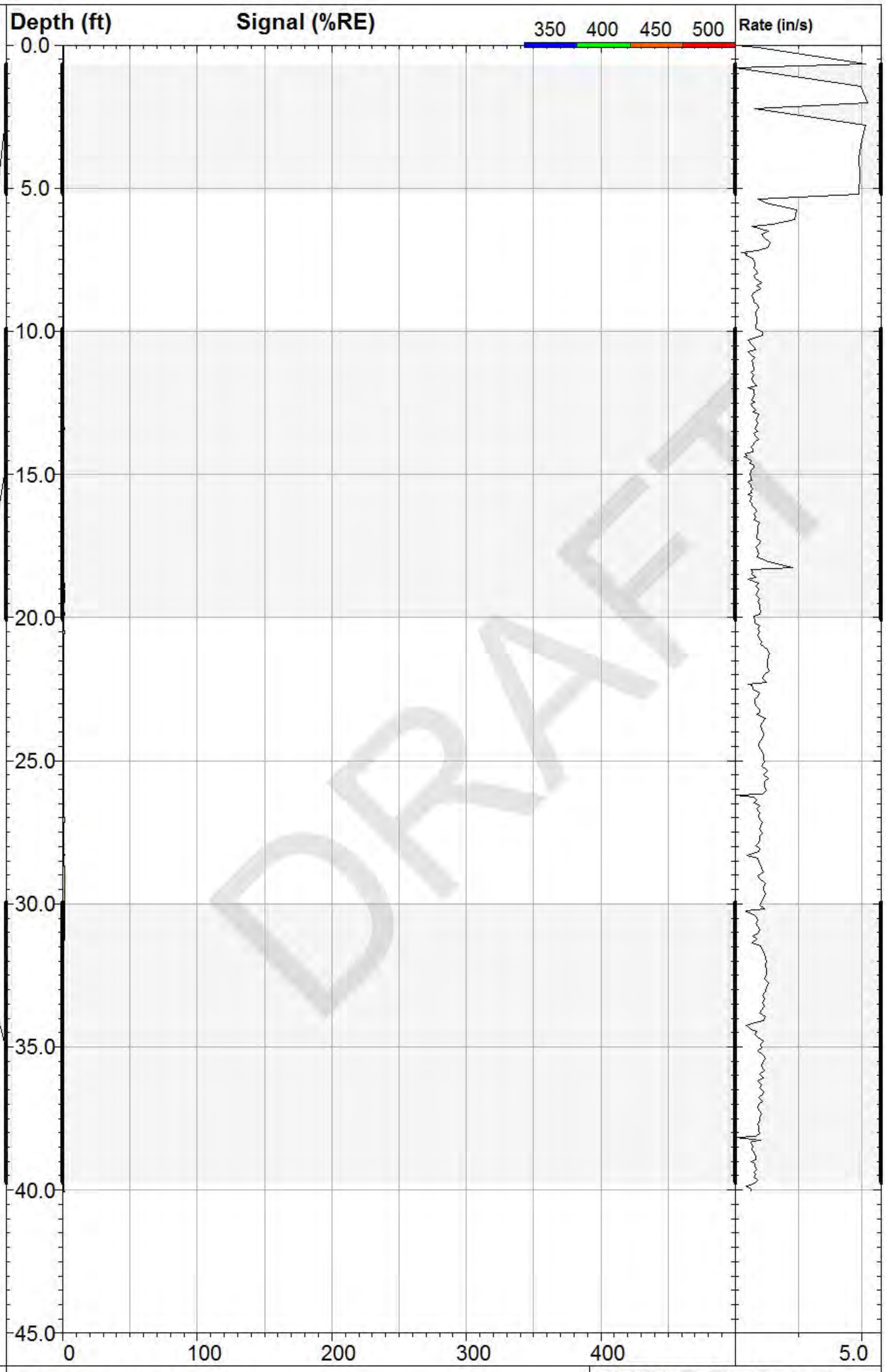
9.89 - 20.08 ft
0.6 %RE (s 0.2)



29.92 - 39.74 ft
0.9 %RE (s 0.2)



Background
0.3 %RE



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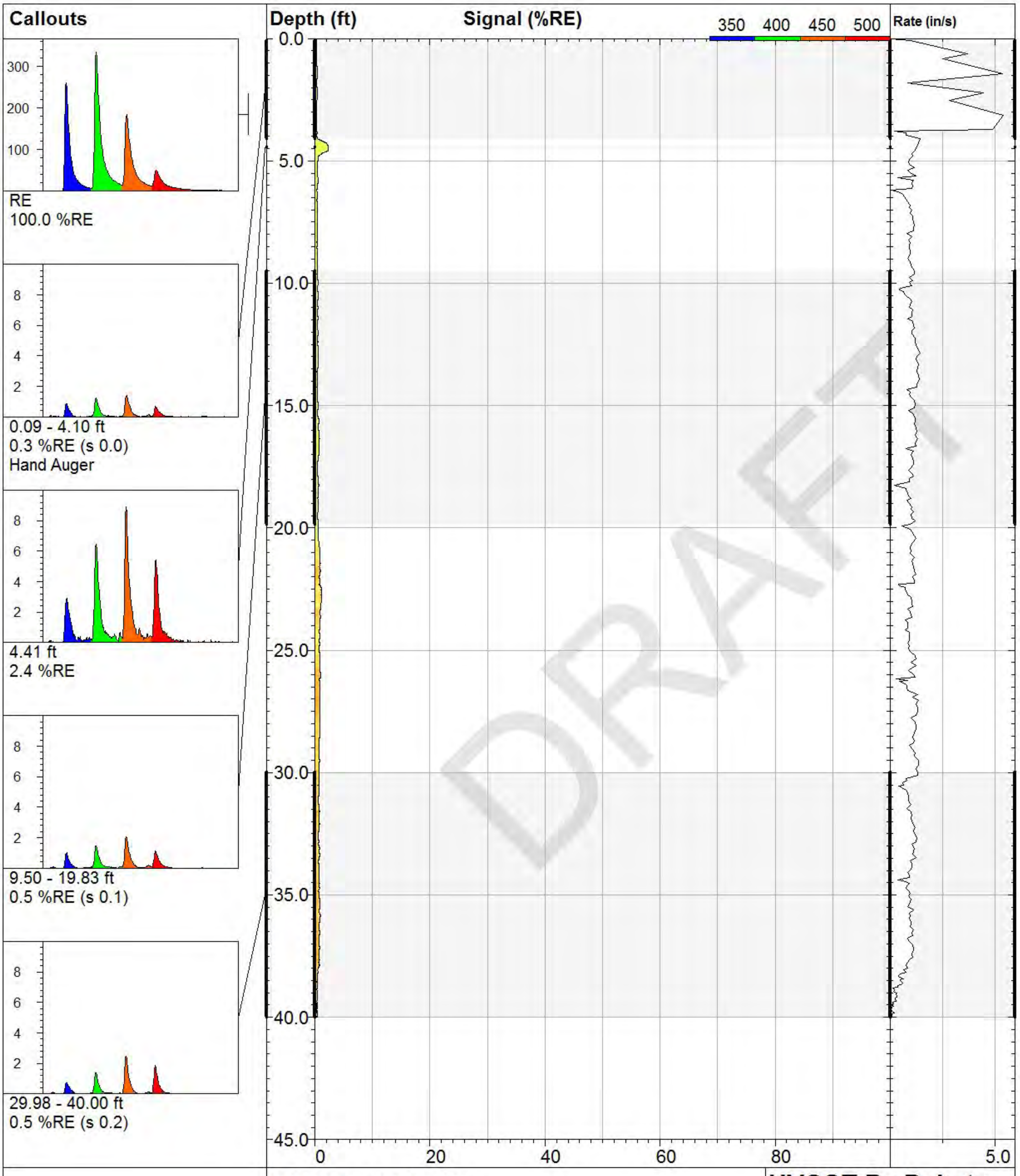
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **40.06 ft**
Client / Job: **ARCADIS /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **1.5 %RE @ 29.51 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-04 10:21 EDT**



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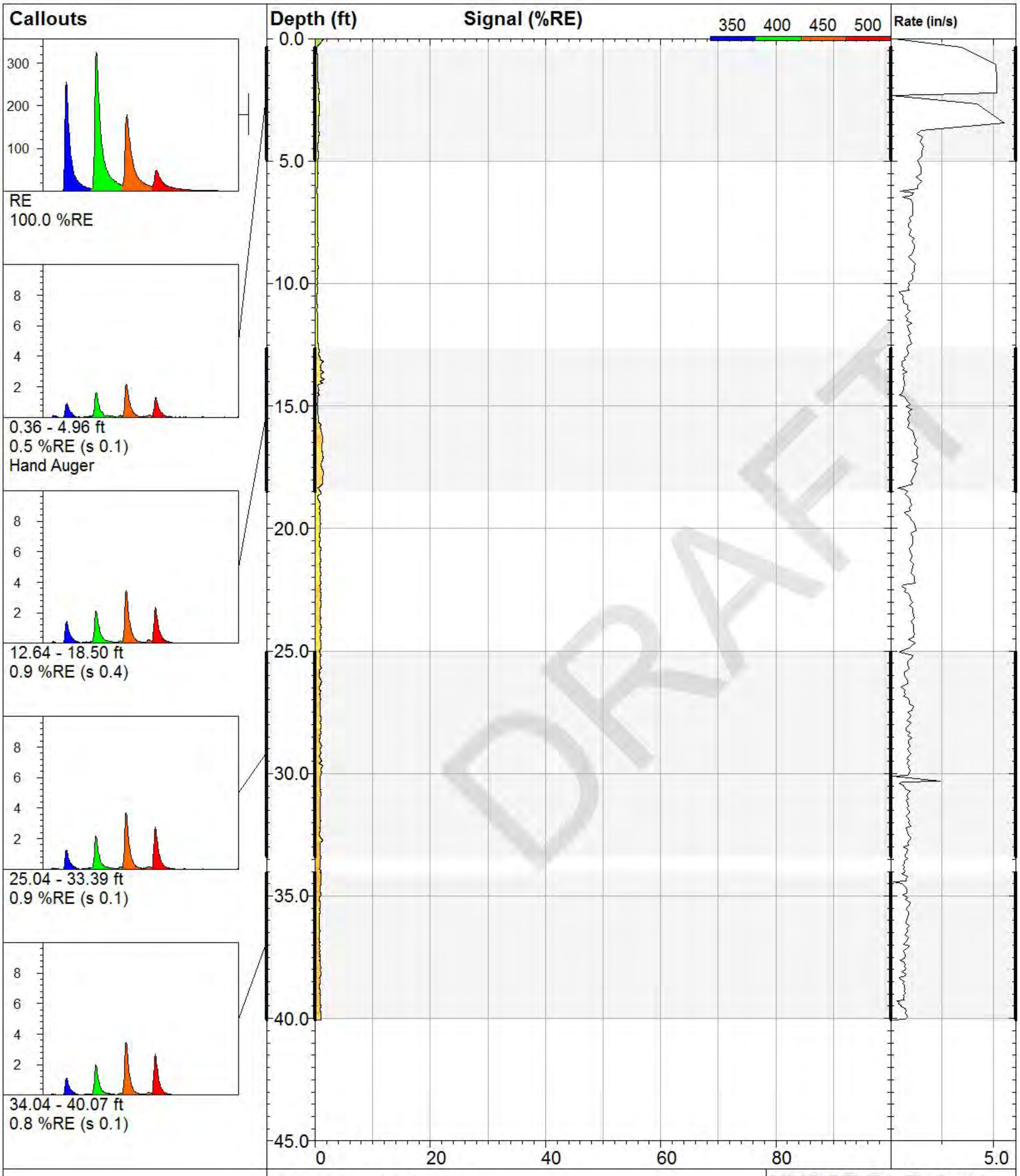
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **40.00 ft**
Client / Job: **ARCADIS /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **2.4 %RE @ 4.41 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-04 10:59 EDT**



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UVOSTM2-27

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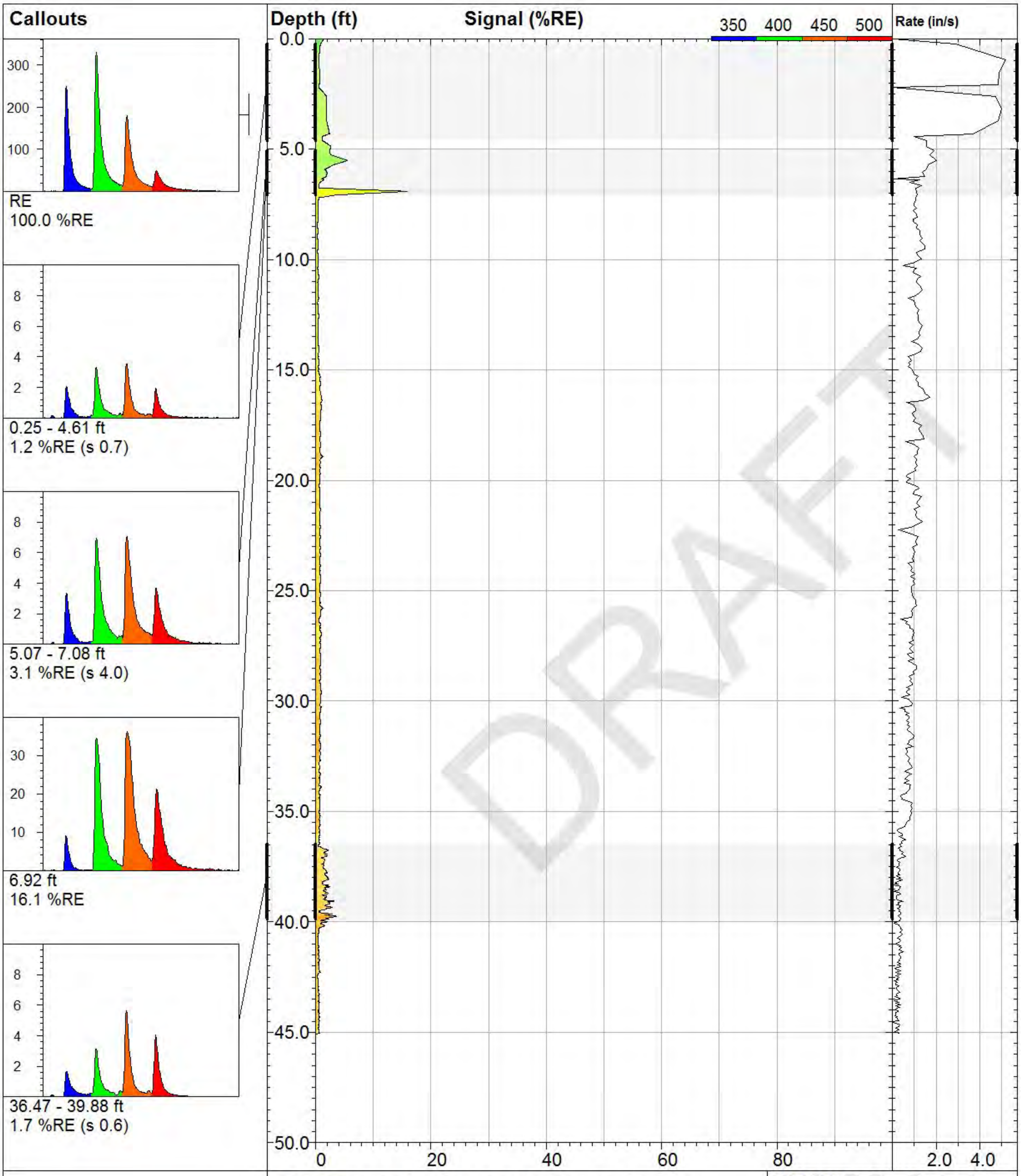
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **40.07 ft**
Client / Job: **ARCADIS /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **1.6 %RE @ 13.90 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-04 11:38 EDT**



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UVOSTM2-28_UVOSTM2-29

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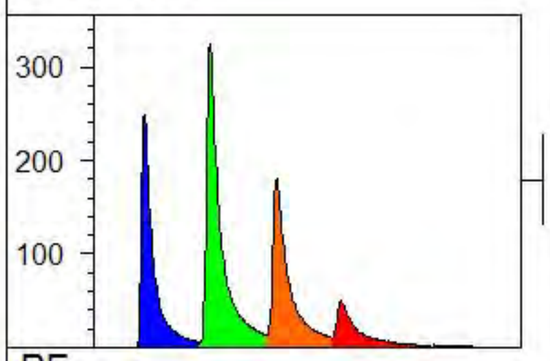
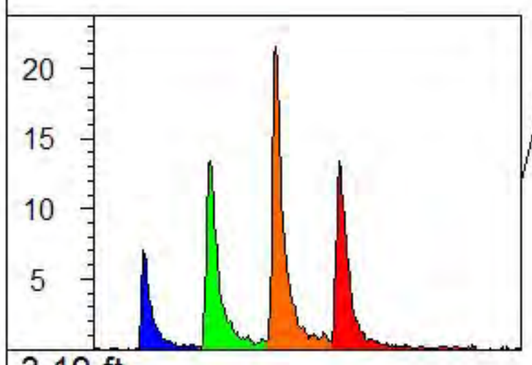
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **45.06 ft**
Client / Job: **ARCADIS /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **16.1 %RE @ 6.92 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-04 13:01 EDT**

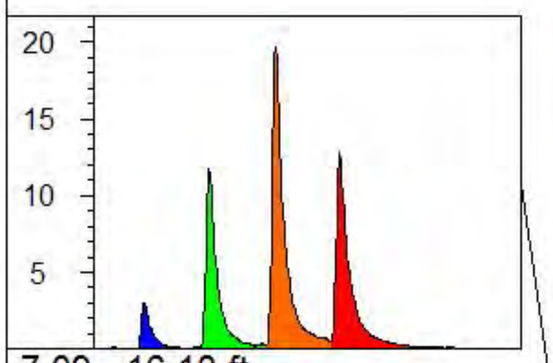
Callouts



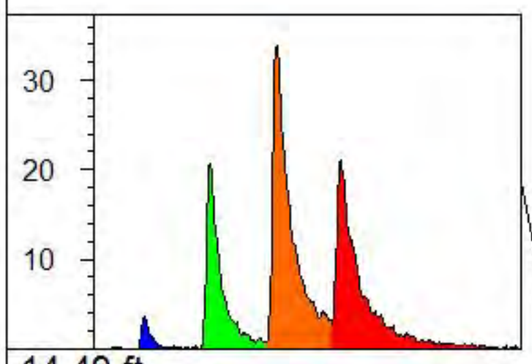
RE
100.0 %RE



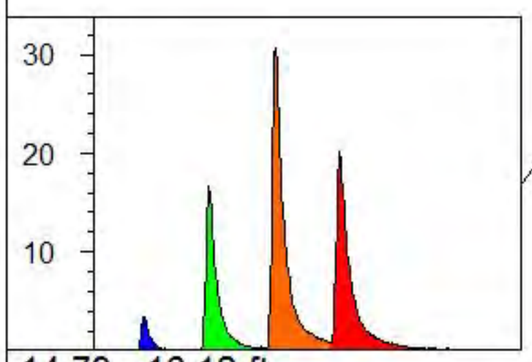
3.19 ft
5.9 %RE



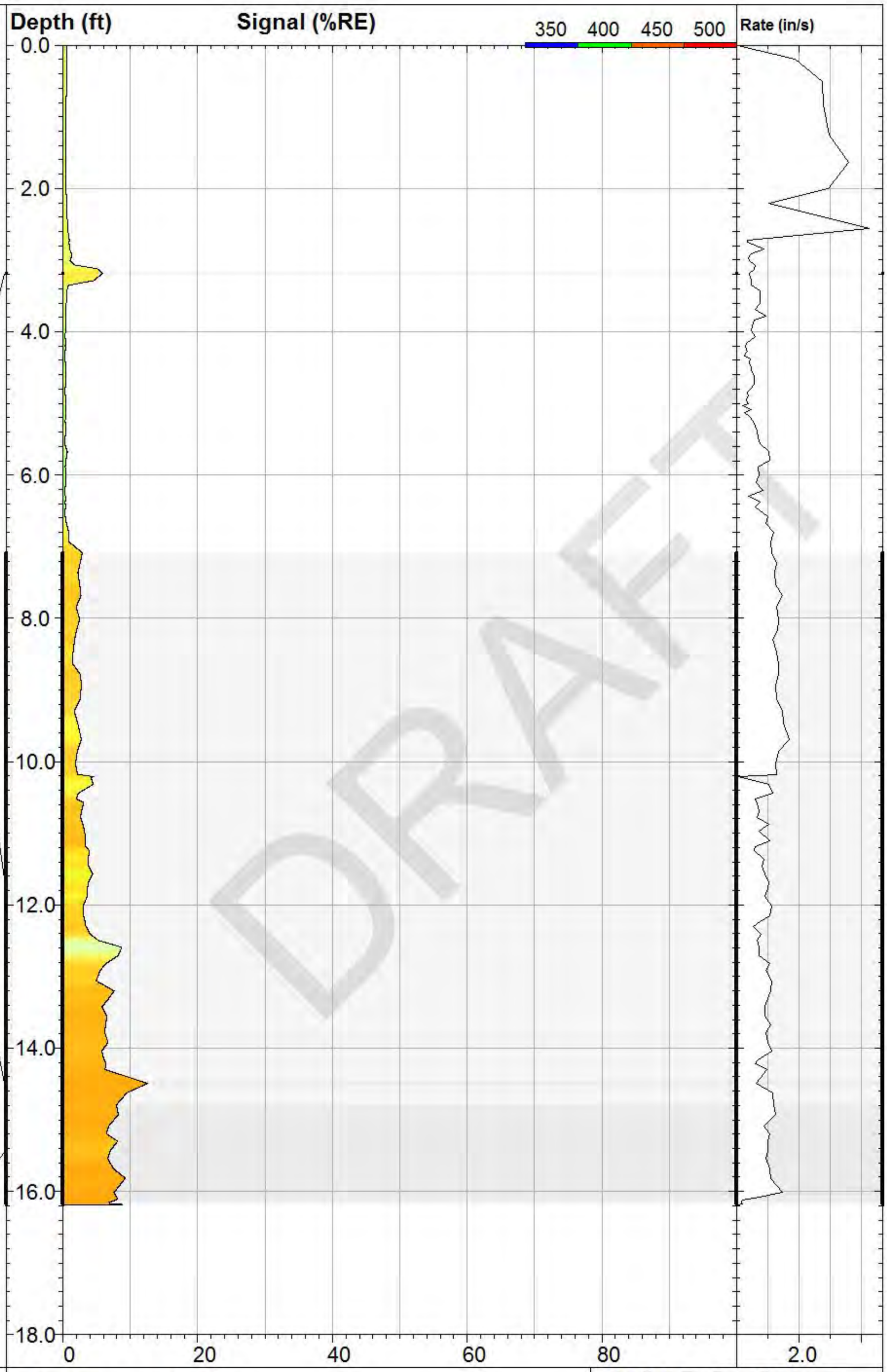
7.09 - 16.18 ft
5.0 %RE (s 2.6)



14.49 ft
12.6 %RE



14.79 - 16.12 ft
7.6 %RE (s 0.8)
Refusal at 16.18'



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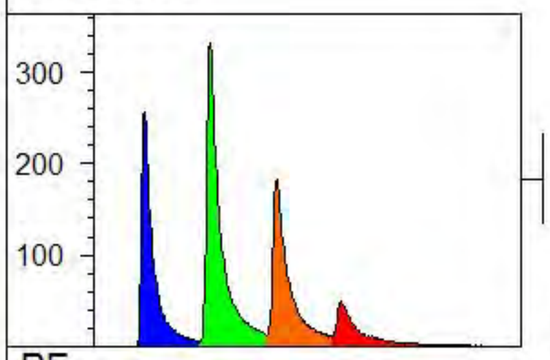
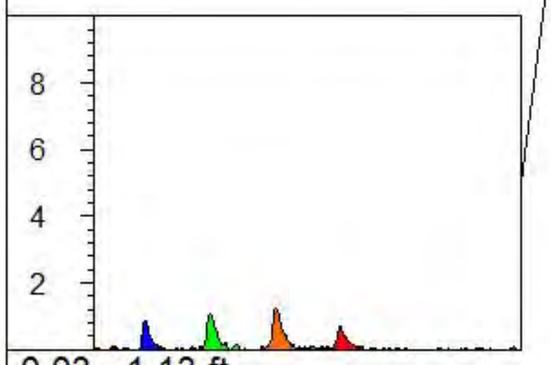
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **16.18 ft**
Client / Job: **ARCADIS /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **12.6 %RE @ 14.49 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-04 13:58 EDT**

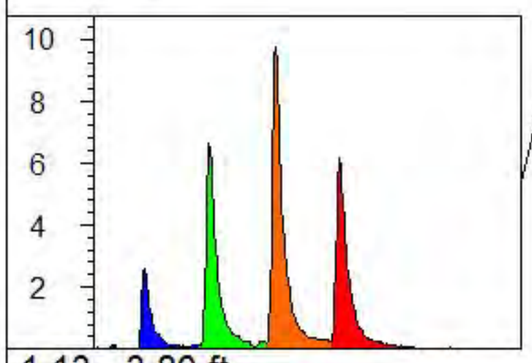
Callouts



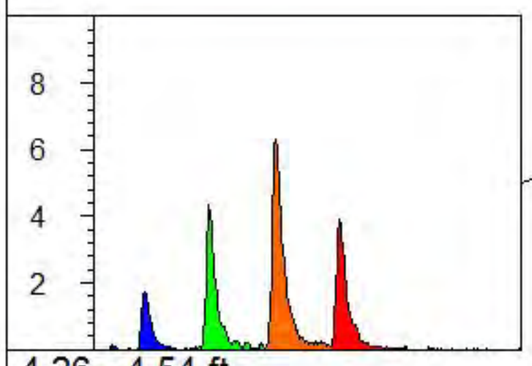
RE
100.0 %RE



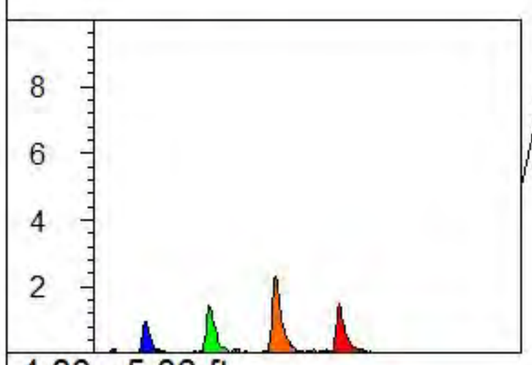
0.03 - 1.13 ft
0.3 %RE (s 0.1)
Hand Auger



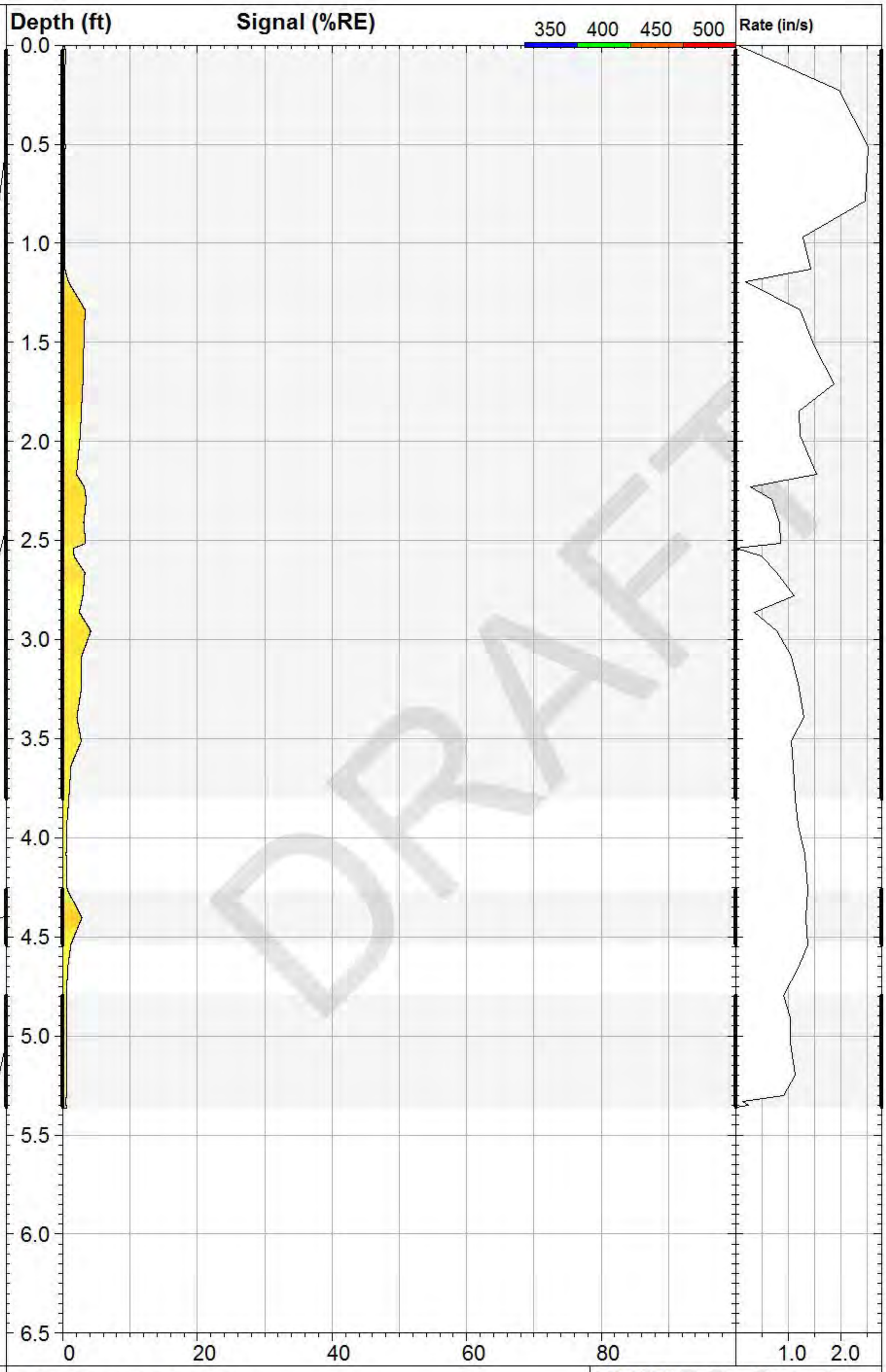
1.13 - 3.80 ft
2.5 %RE (s 1.0)



4.26 - 4.54 ft
1.5 %RE (s 1.1)



4.80 - 5.36 ft
0.5 %RE (s 0.1)
Refusal at 5.36'



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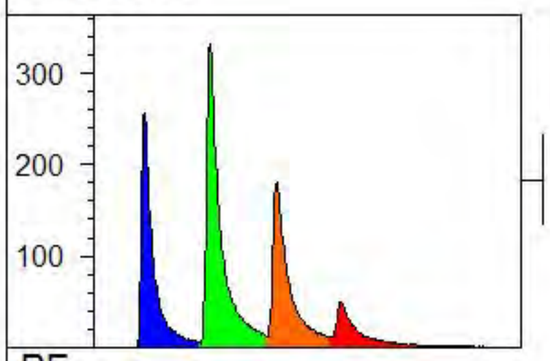
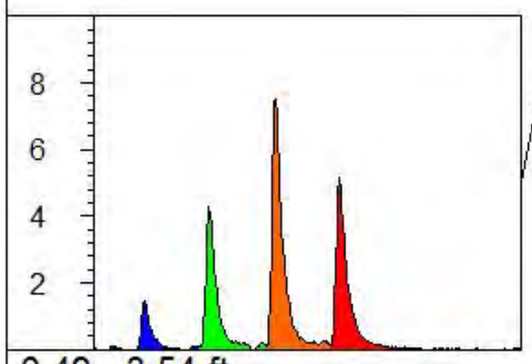
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **5.36 ft**
Client / Job: **ARCADIS /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **4.1 %RE @ 2.96 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-04 14:26 EDT**

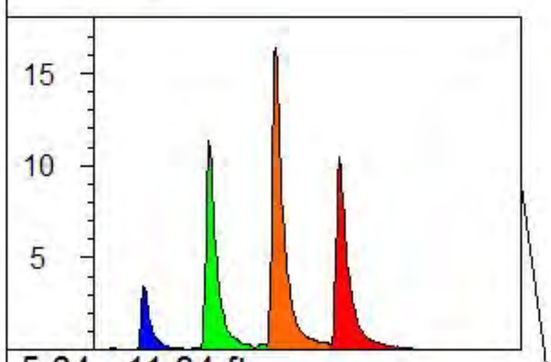
Callouts



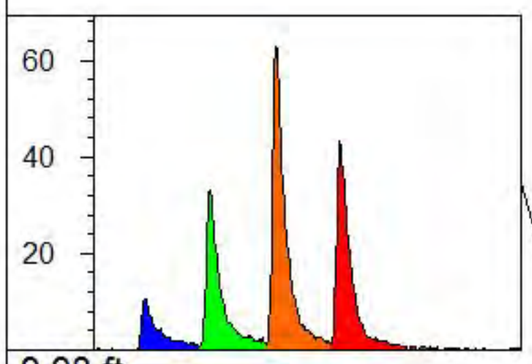
RE
100.0 %RE



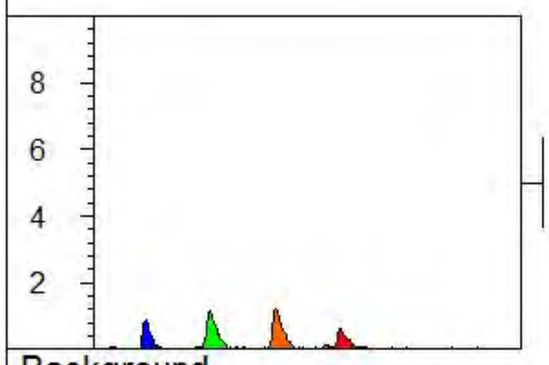
0.49 - 3.54 ft
1.7 %RE (s 0.3)
Hand Auger



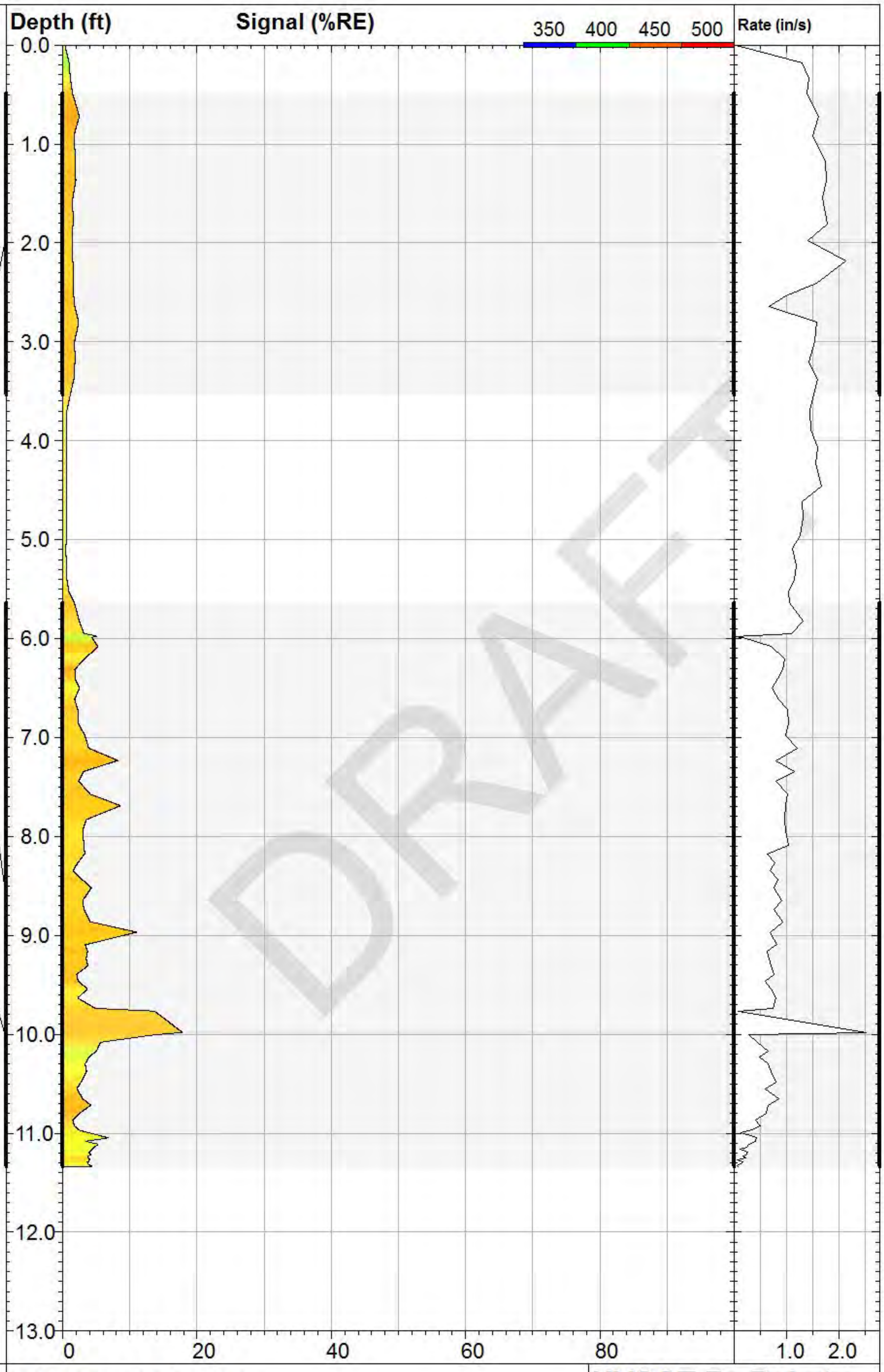
5.64 - 11.34 ft
4.1 %RE (s 2.8)



9.98 ft
17.8 %RE



Background
0.3 %RE
Refusal at 11.34'



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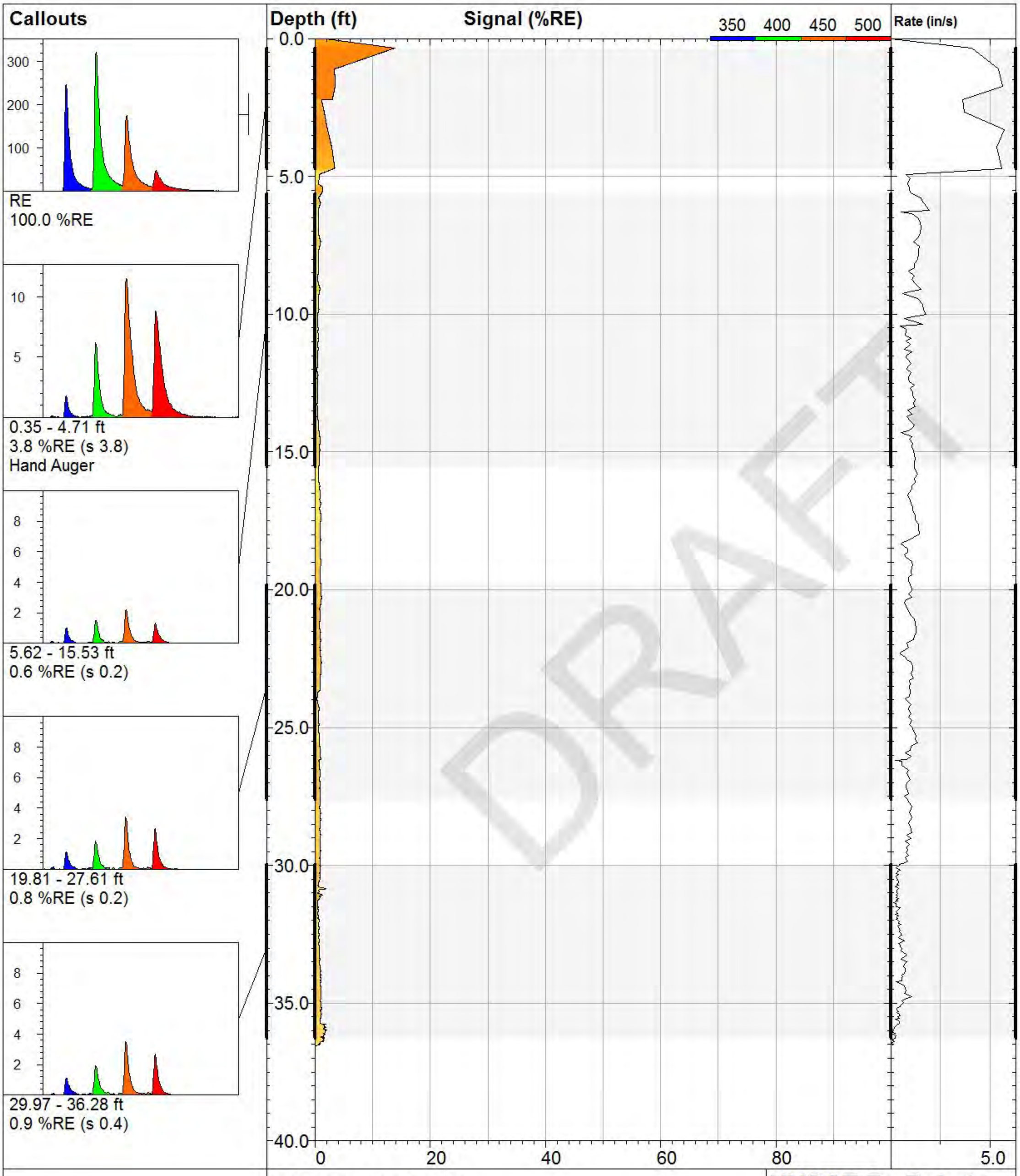
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **11.34 ft**
Client / Job: **ARCADIS /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **17.8 %RE @ 9.98 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-04 14:54 EDT**



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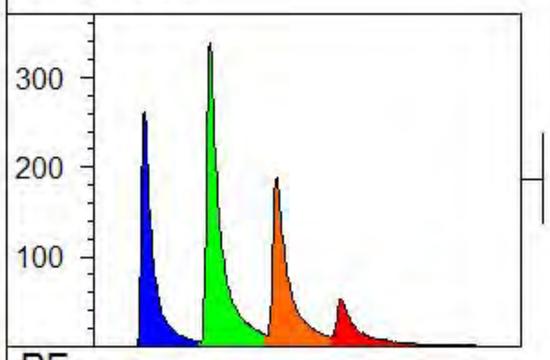
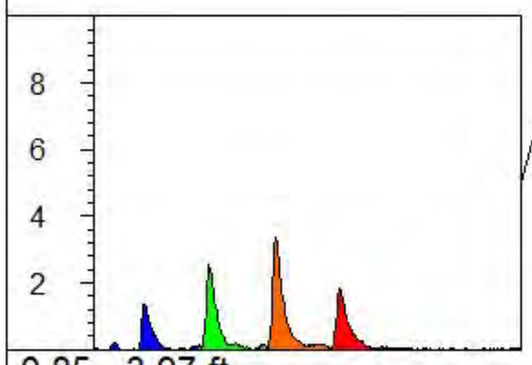
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **36.53 ft**
Client / Job: **ARCADIS /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **13.8 %RE @ 0.35 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-04 15:19 EDT**

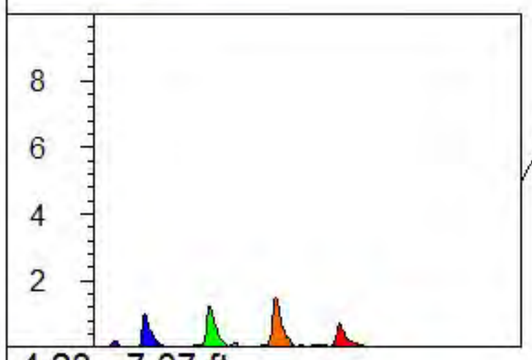
Callouts



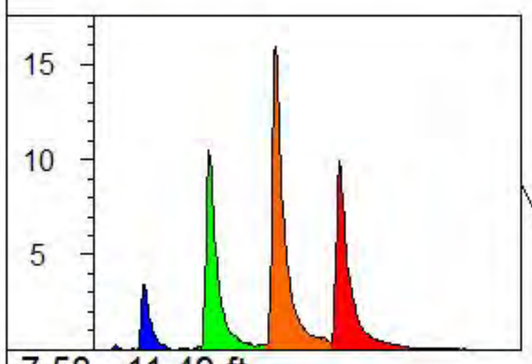
RE
100.0 %RE



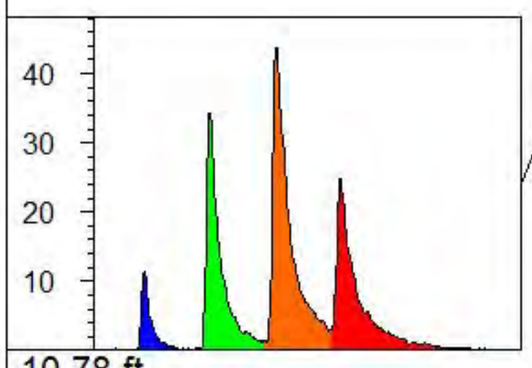
0.85 - 3.97 ft
0.8 %RE (s 0.4)
Hand Auger



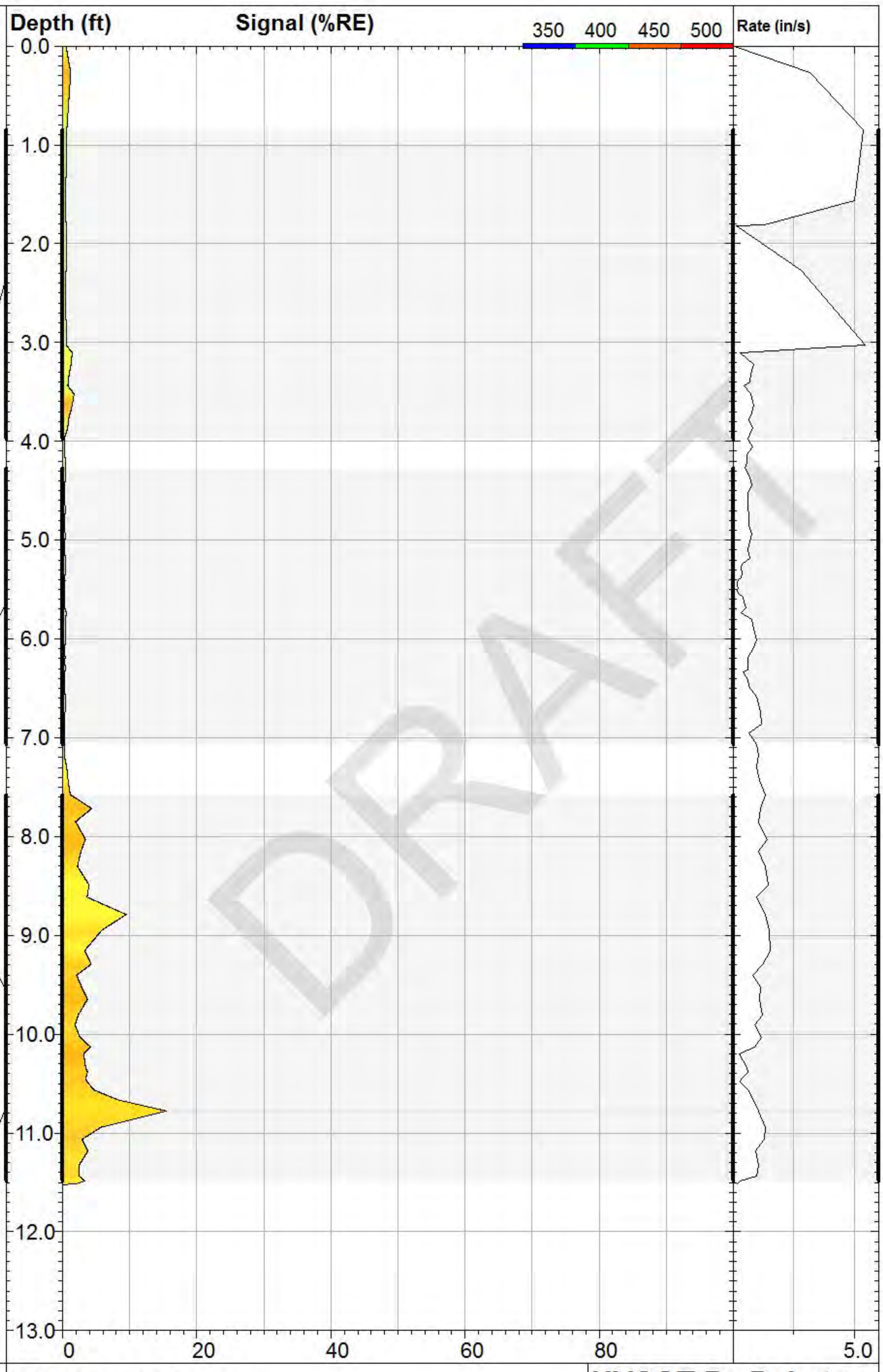
4.28 - 7.07 ft
0.3 %RE (s 0.1)



7.58 - 11.49 ft
4.0 %RE (s 2.7)



10.78 ft
15.4 %RE
Refusal at 11.52'.



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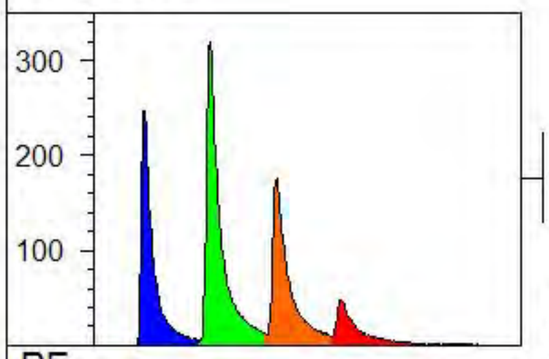
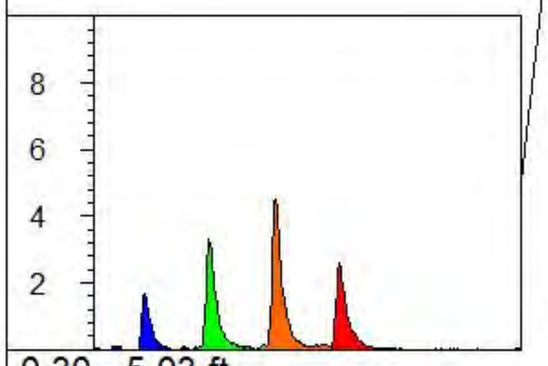
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **11.52 ft**
Client / Job: **ARCADIS /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **15.4 %RE @ 10.78 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-04 15:57 EDT**

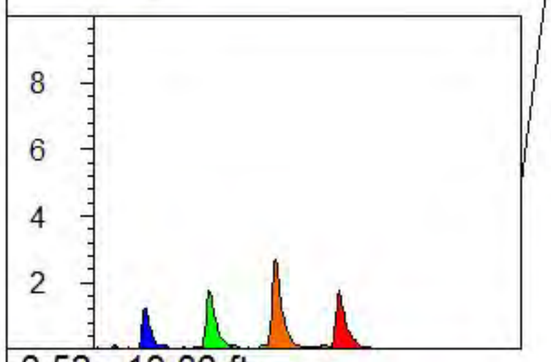
Callouts



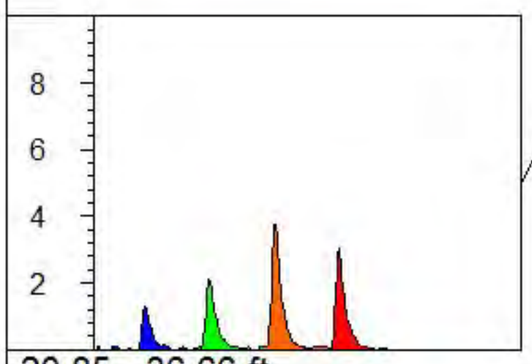
RE
100.0 %RE



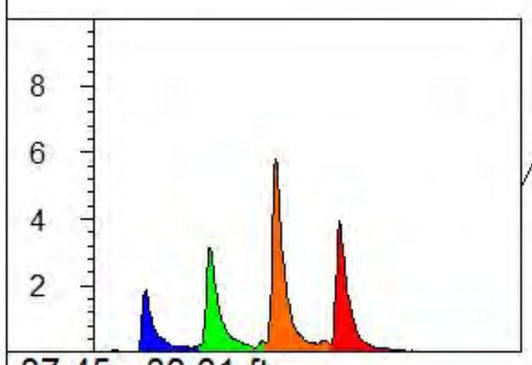
0.30 - 5.03 ft
1.1 %RE (s 0.8)
Hand Auger



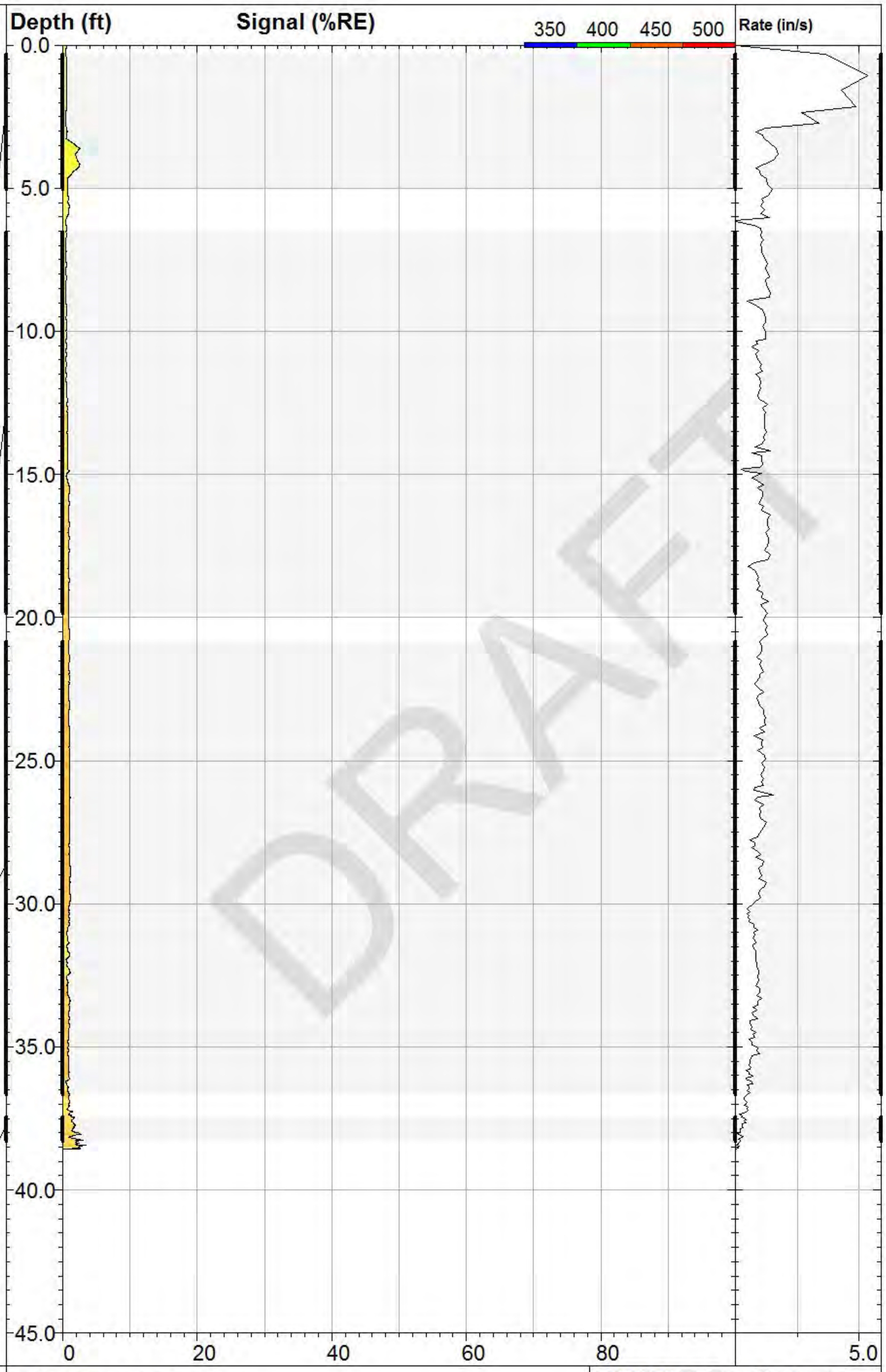
6.52 - 19.86 ft
0.7 %RE (s 0.2)



20.85 - 36.66 ft
0.9 %RE (s 0.1)



37.45 - 38.31 ft
1.8 %RE (s 0.5)
Refusal at 38.58'.



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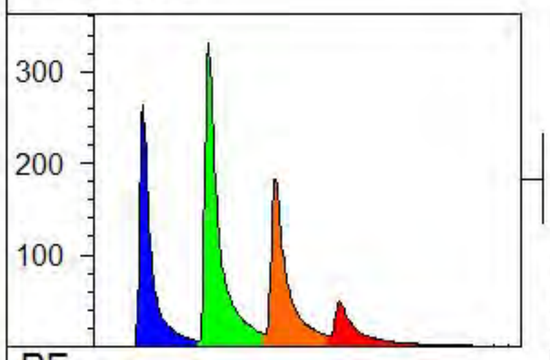
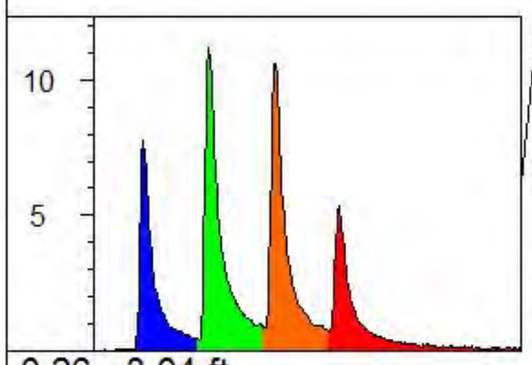
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **38.58 ft**
Client / Job: **ARCADIS /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **3.5 %RE @ 38.44 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-04 16:39 EDT**

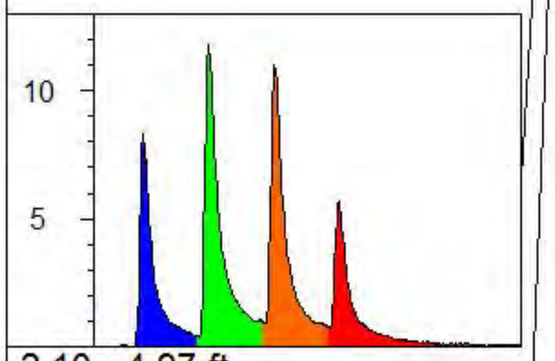
Callouts



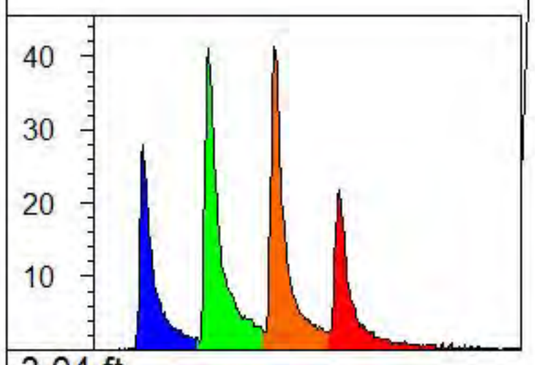
RE
100.0 %RE



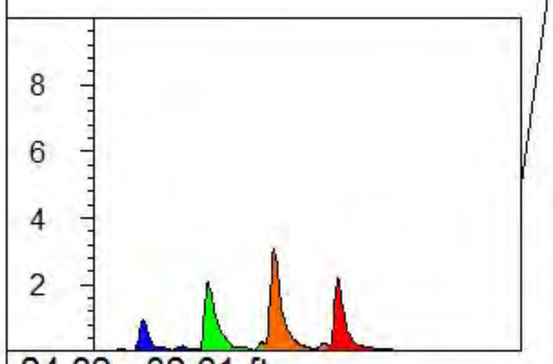
0.26 - 3.04 ft
4.7 %RE (s 5.3)
Hand Auger



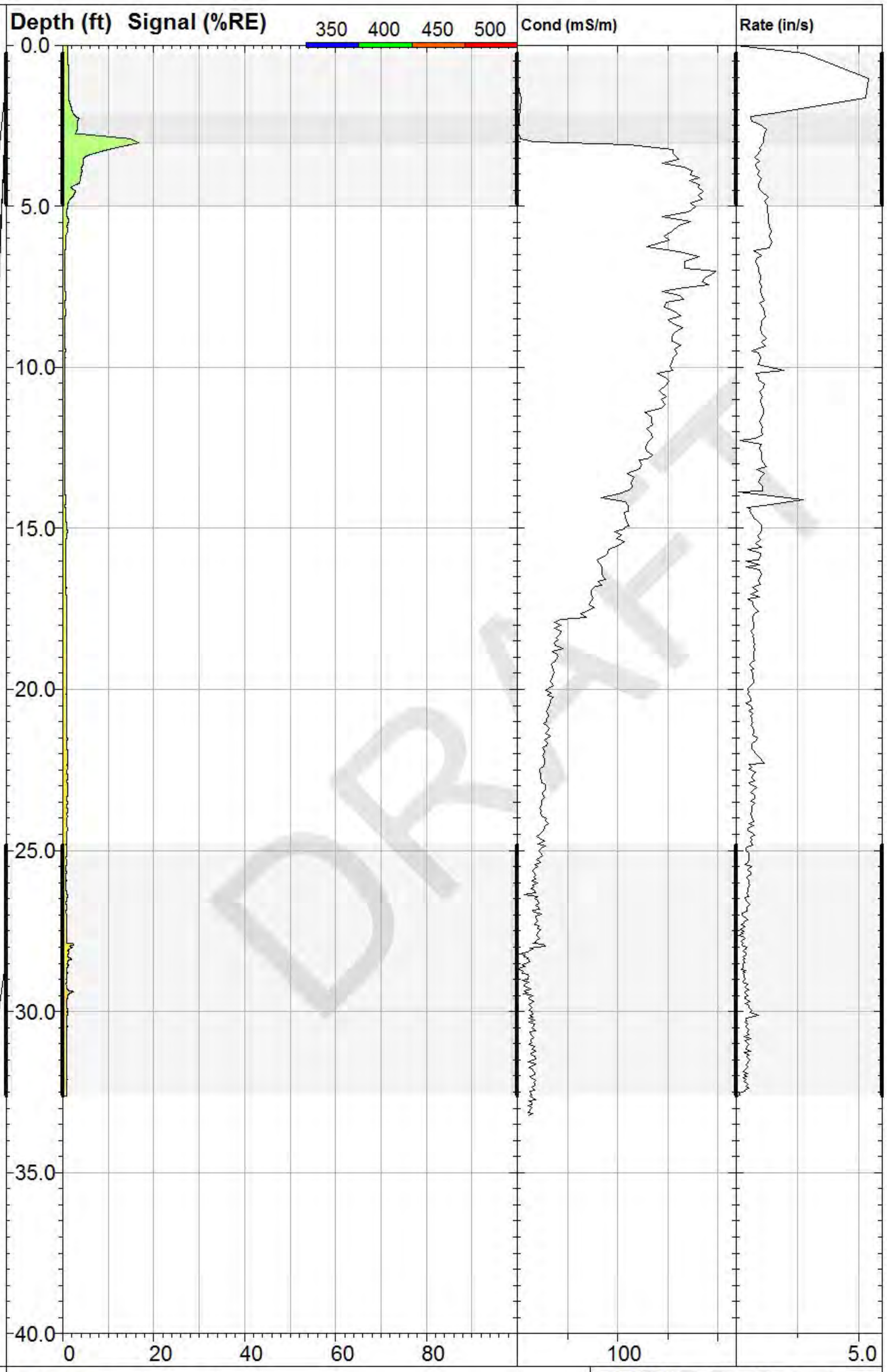
2.10 - 4.97 ft
4.9 %RE (s 4.0)



3.04 ft
16.7 %RE



24.82 - 32.61 ft
0.9 %RE (s 0.3)
Refusal at 32.61'.



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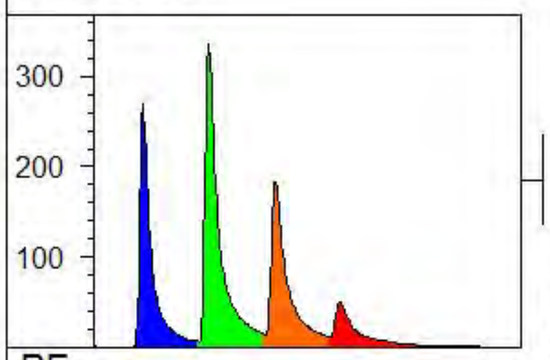
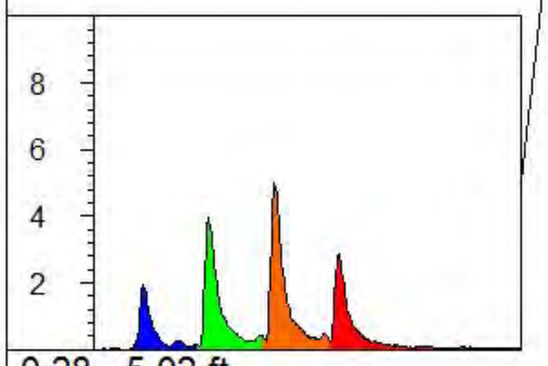
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **32.61 ft**
Client / Job: **Arcadis /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **16.7 %RE @ 3.04 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-05 11:39 EDT**

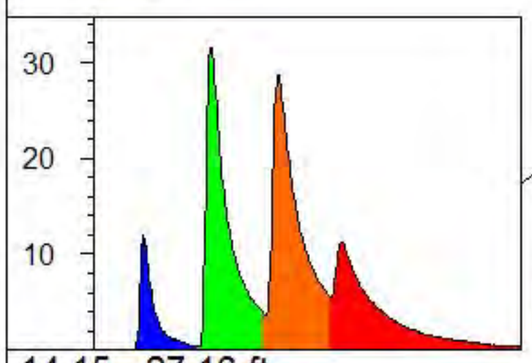
Callouts



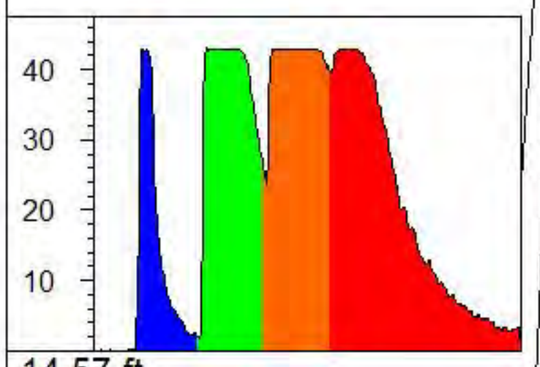
RE
100.0 %RE



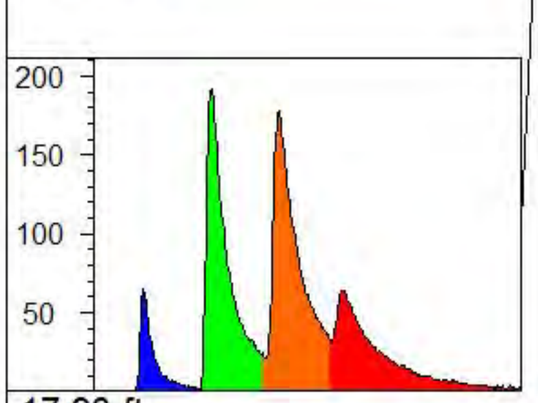
0.28 - 5.02 ft
1.7 %RE (s 1.1)
Hand Auger



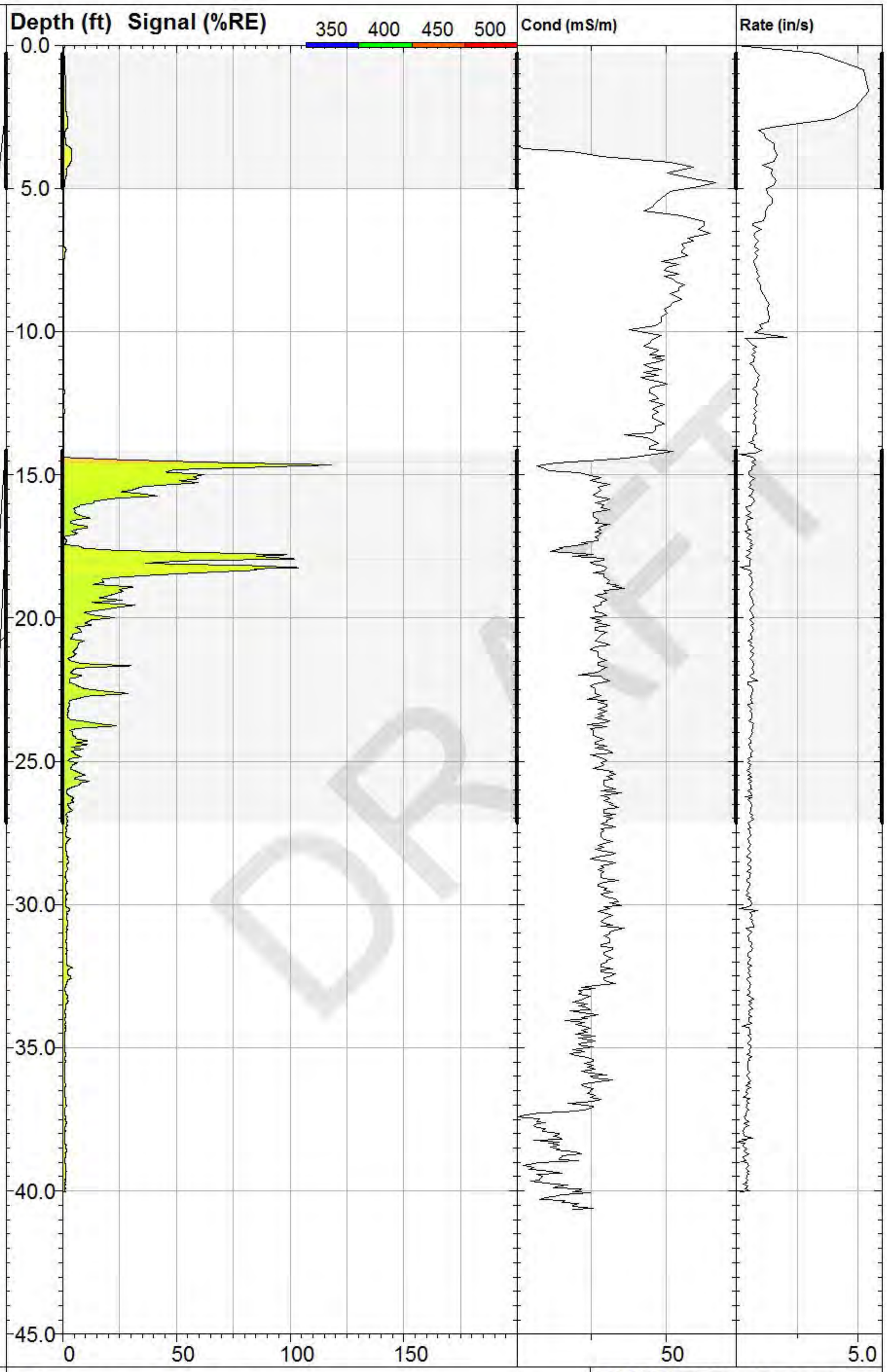
14.15 - 27.16 ft
17.2 %RE (s 24.3)



14.57 ft
68.4 %RE



17.93 ft
102.1 %RE



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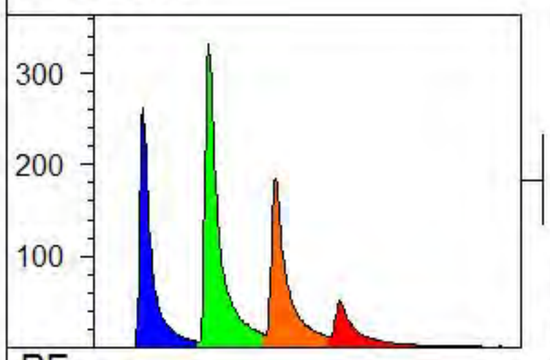
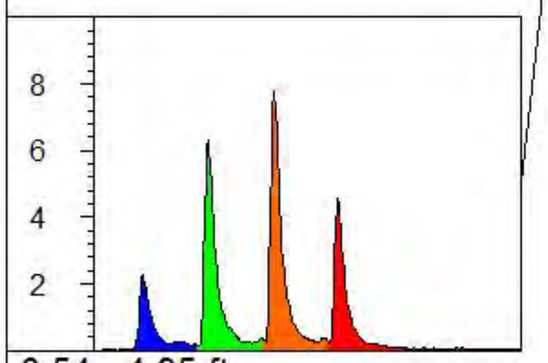
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **40.03 ft**
Client / Job: **Arcadis /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **119.4 %RE @ 14.65 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-05 12:54 EDT**

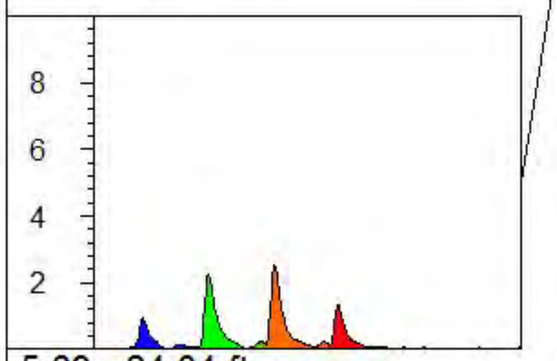
Callouts



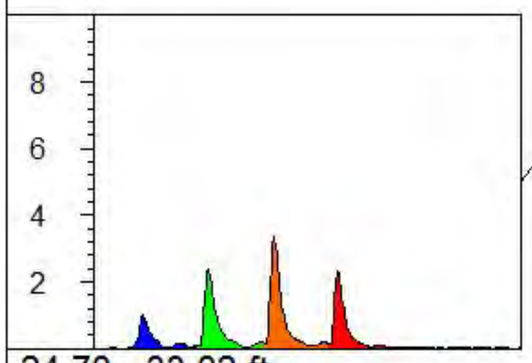
RE
100.0 %RE



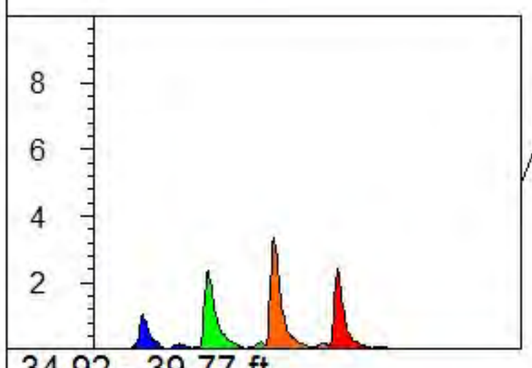
0.54 - 4.95 ft
2.2 %RE (s 1.2)
Hand Auger



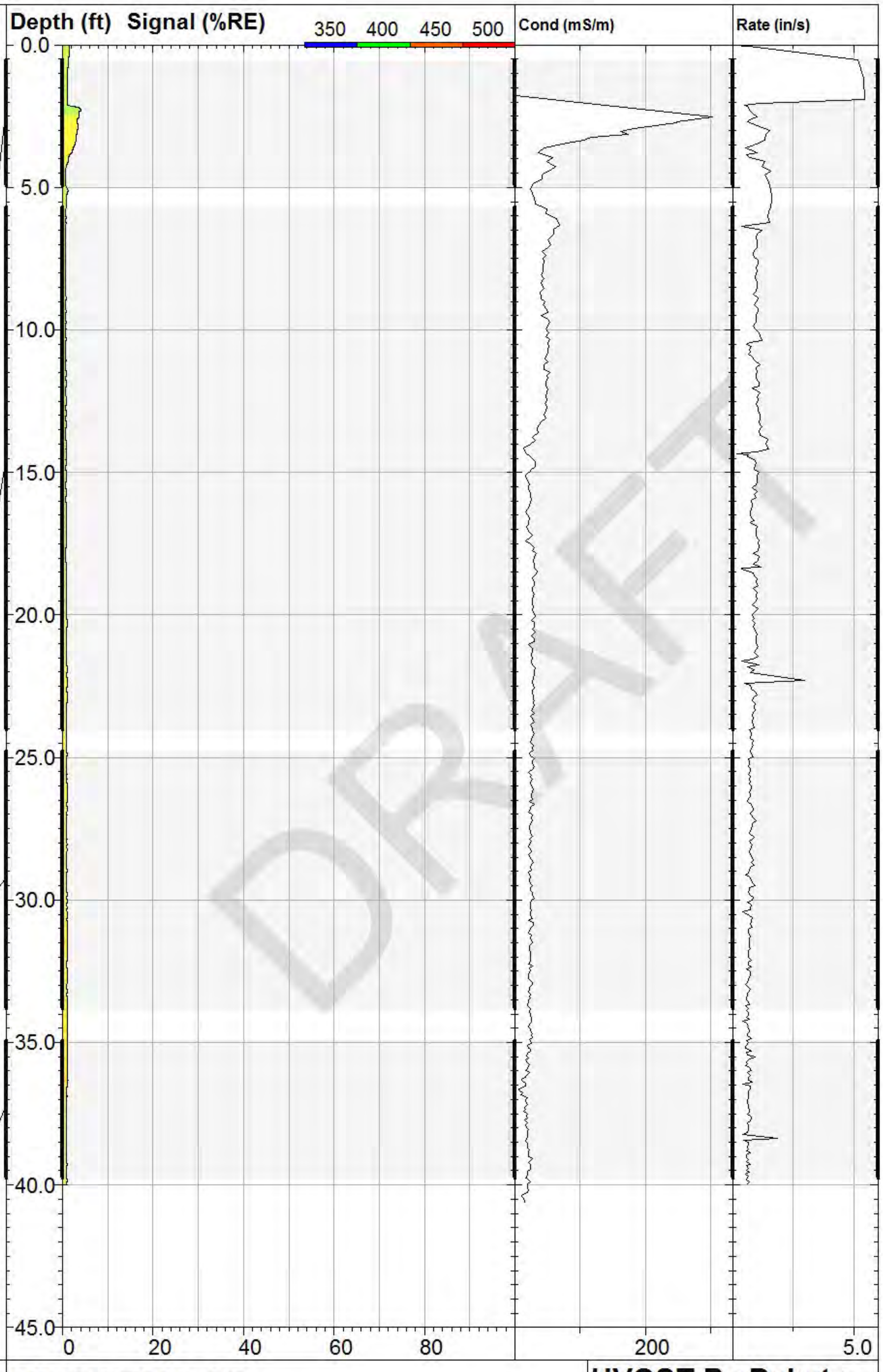
5.69 - 24.04 ft
0.8 %RE (s 0.1)



24.78 - 33.82 ft
0.9 %RE (s 0.1)



34.92 - 39.77 ft
0.9 %RE (s 0.1)



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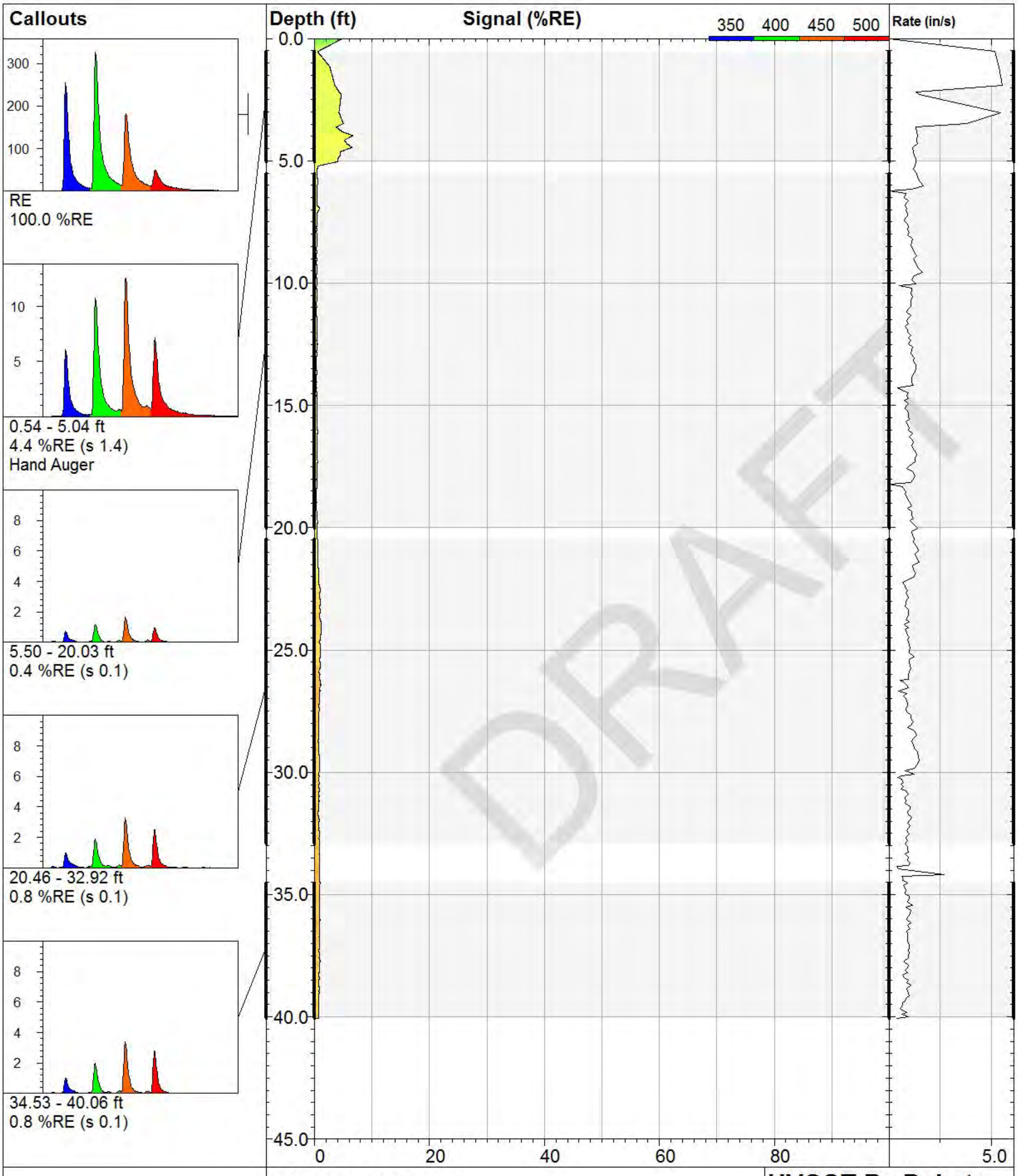
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **40.00 ft**
Client / Job: **Arcadis /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **4.1 %RE @ 2.30 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-05 13:29 EDT**



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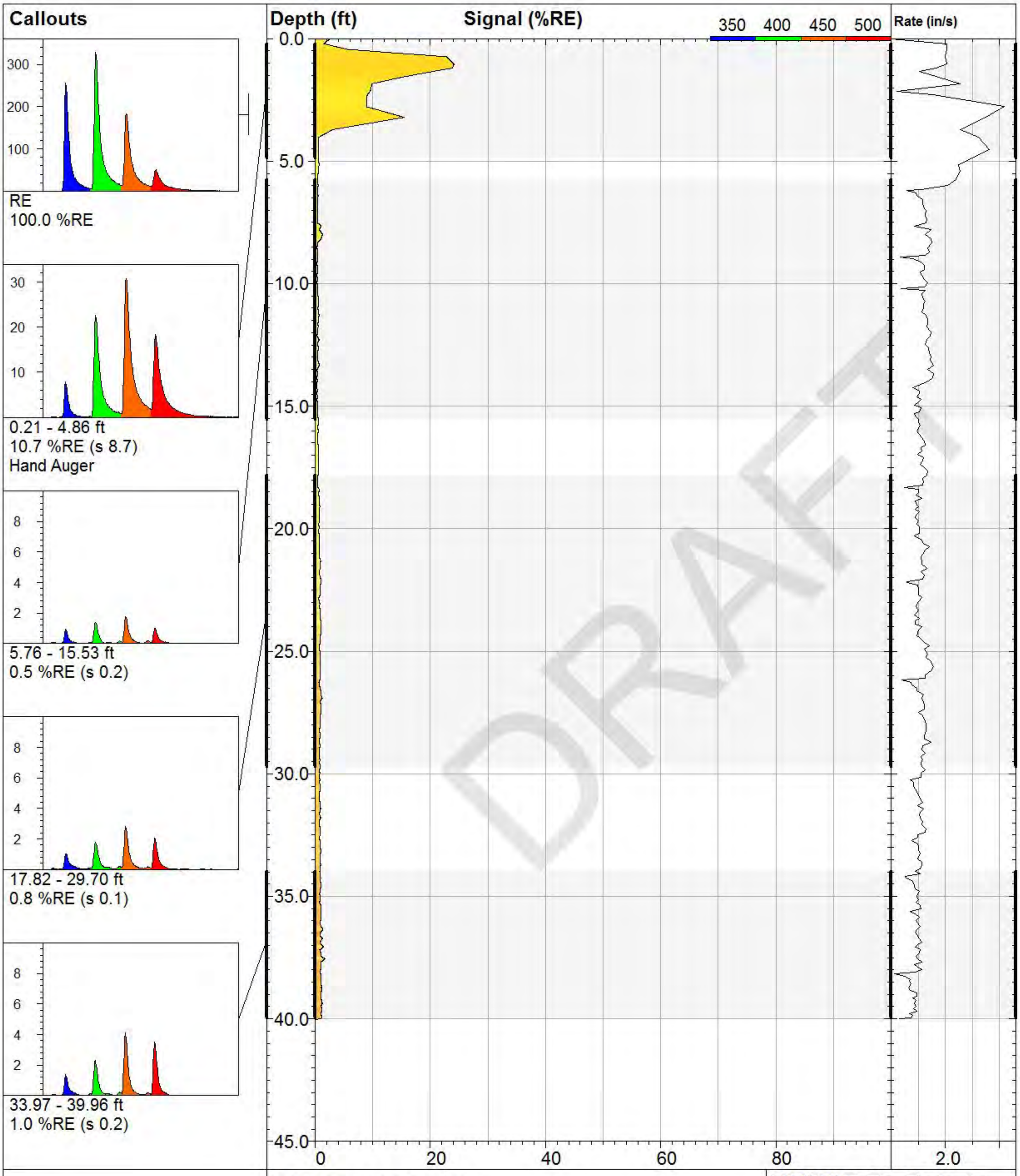
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **40.06 ft**
Client / Job: **Arcadis /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **6.7 %RE @ 3.97 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-05 14:41 EDT**



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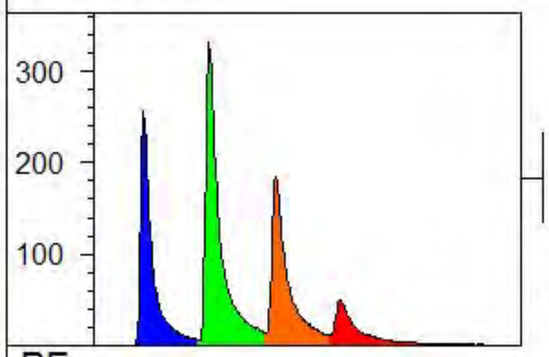
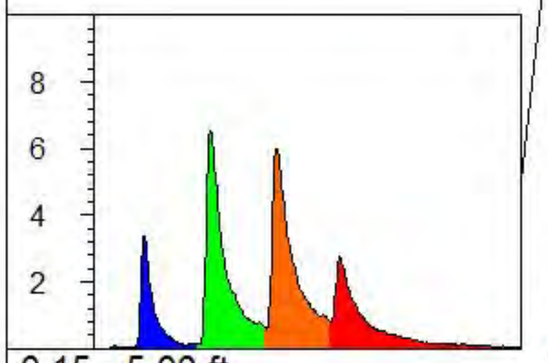
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **40.01 ft**
Client / Job: **Arcadis /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **24.1 %RE @ 1.05 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-05 15:10 EDT**

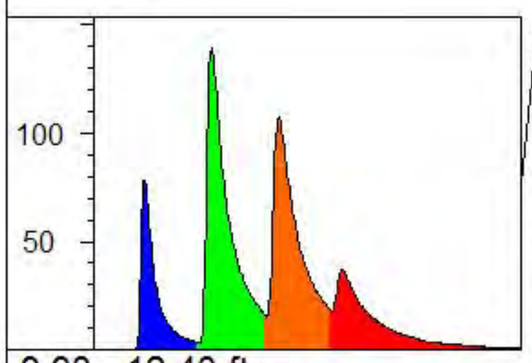
Callouts



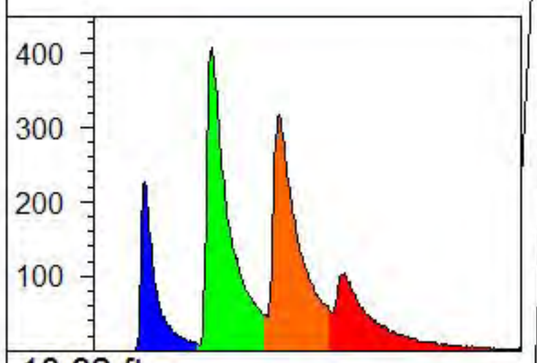
RE
100.0 %RE



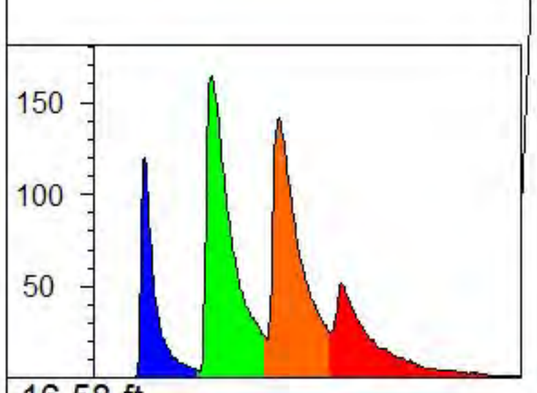
0.15 - 5.00 ft
3.1 %RE (s 2.9)
Hand Auger



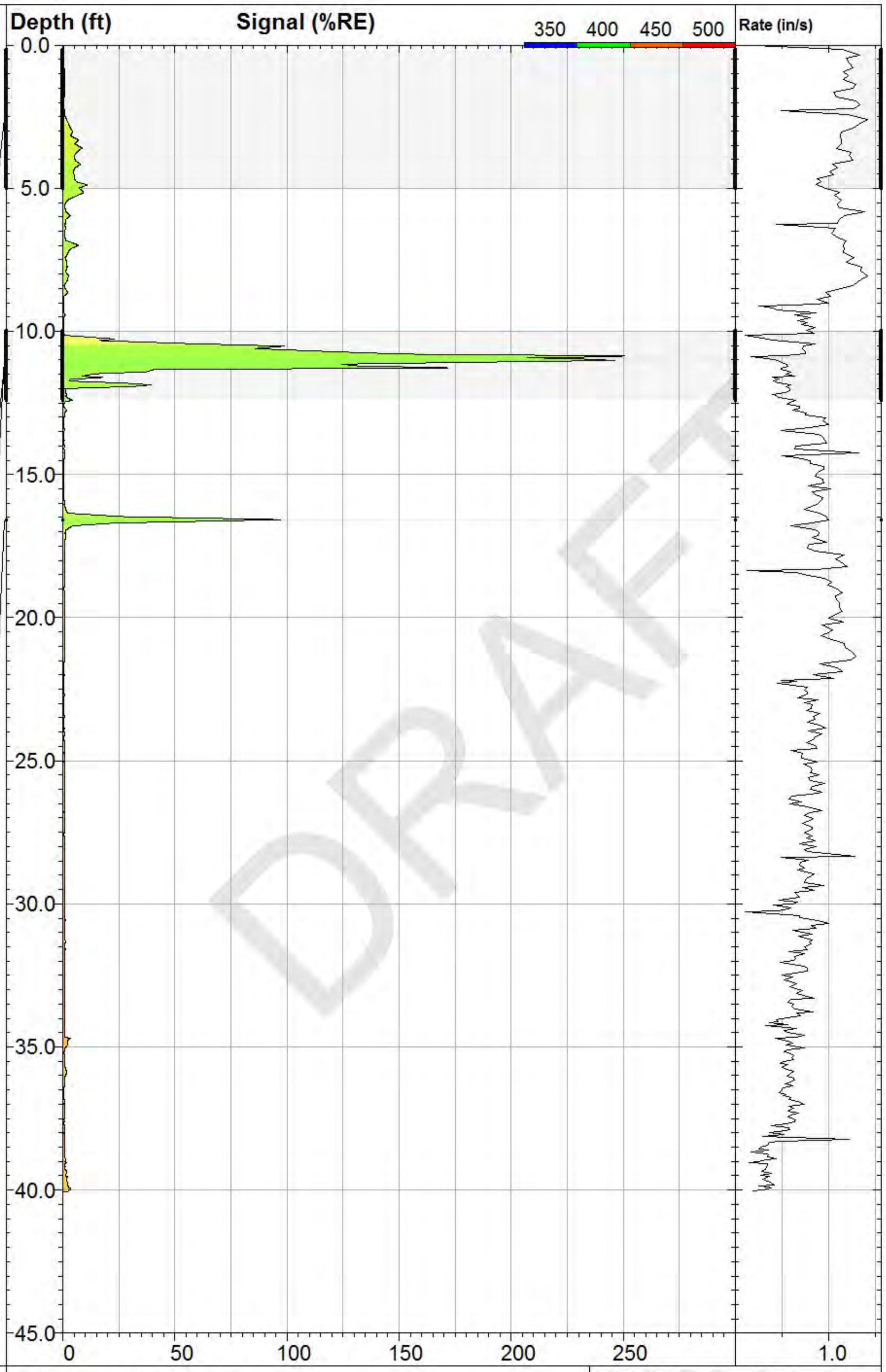
9.98 - 12.40 ft
71.5 %RE (s 85.3)



10.92 ft
205.0 %RE



16.58 ft
98.2 %RE



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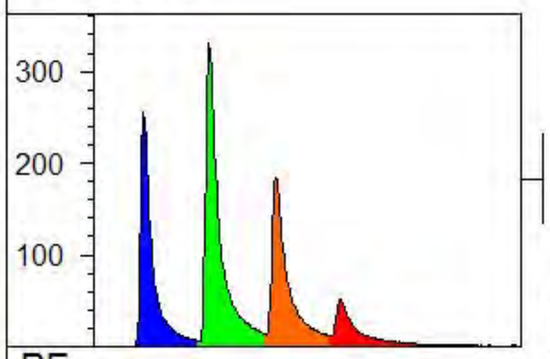
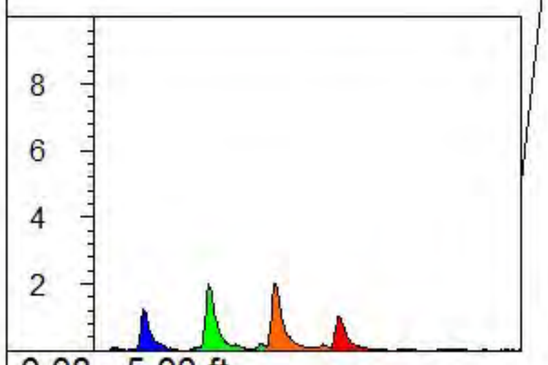
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **40.05 ft**
Client / Job: **Arcadis /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **251.7 %RE @ 10.86 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-05 15:38 EDT**

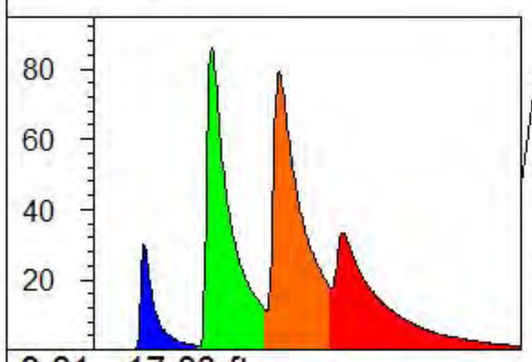
Callouts



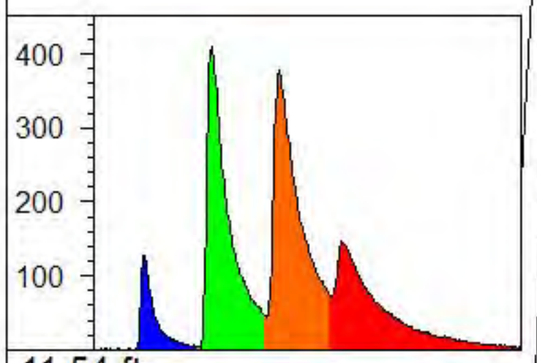
RE
100.0 %RE



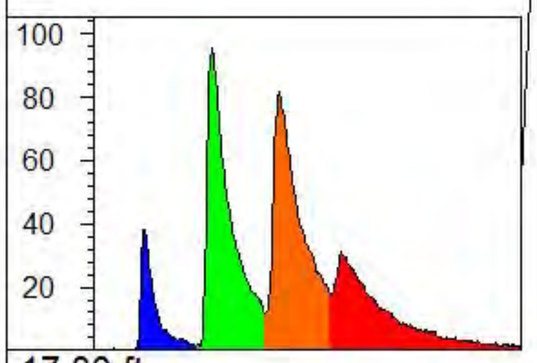
0.08 - 5.00 ft
0.6 %RE (s 0.2)
Hand Auger



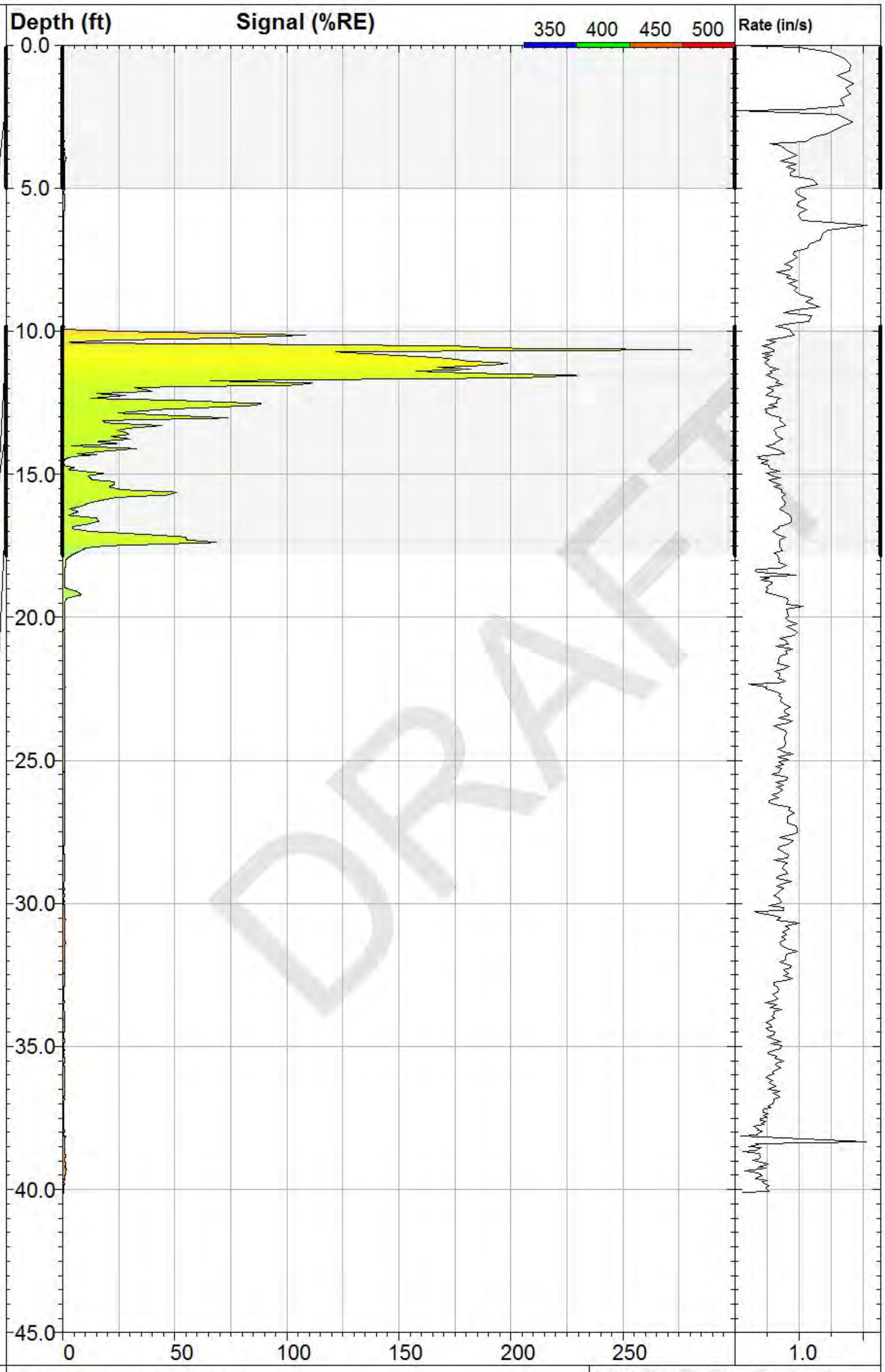
9.81 - 17.83 ft
52.5 %RE (s 64.4)



11.54 ft
230.3 %RE



17.30 ft
55.5 %RE



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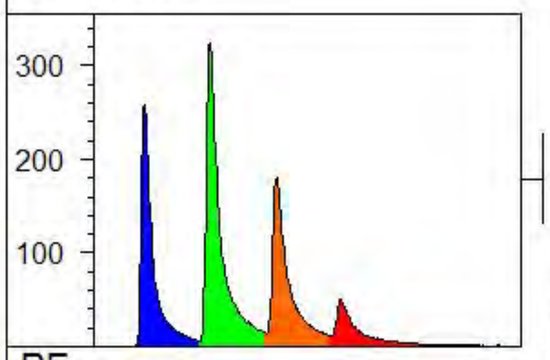
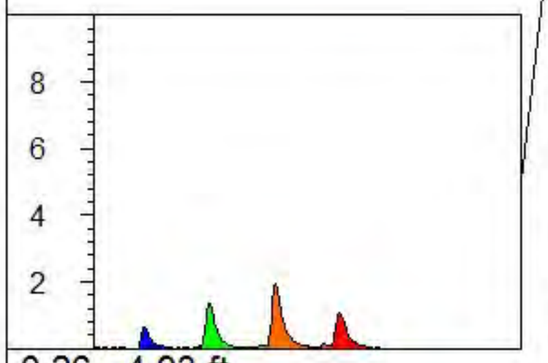
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **40.12 ft**
Client / Job: **Arcadis /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **281.3 %RE @ 10.65 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-05 16:12 EDT**

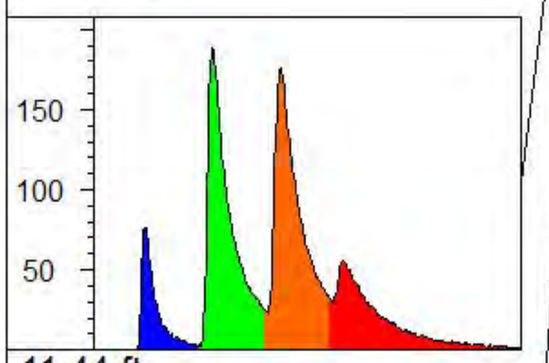
Callouts



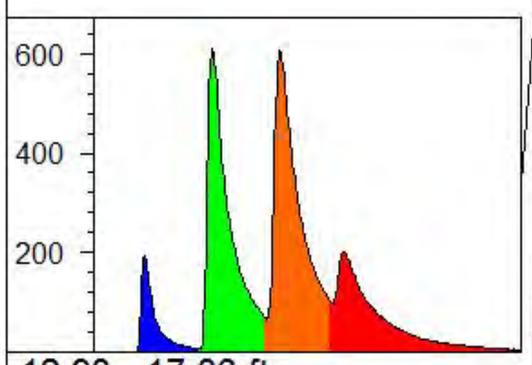
RE
100.0 %RE



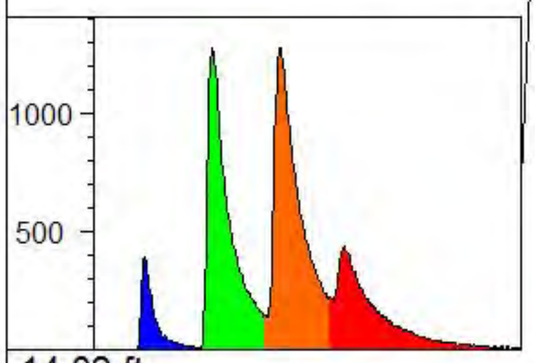
0.26 - 4.93 ft
0.4 %RE (s 0.2)
Hand Auger



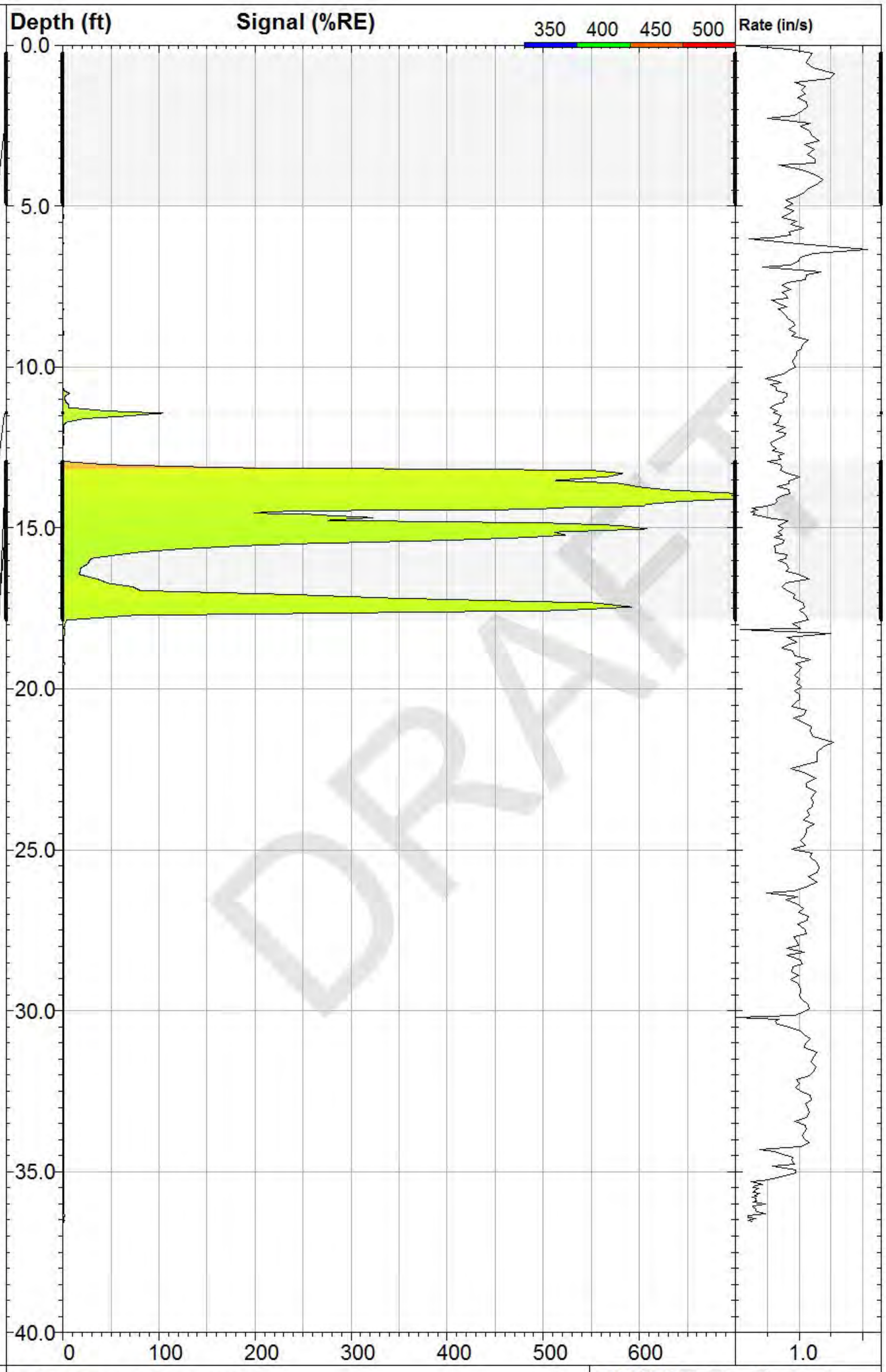
11.44 ft
104.4 %RE



12.93 - 17.86 ft
336.1 %RE (s 240.0)



14.02 ft
703.5 %RE



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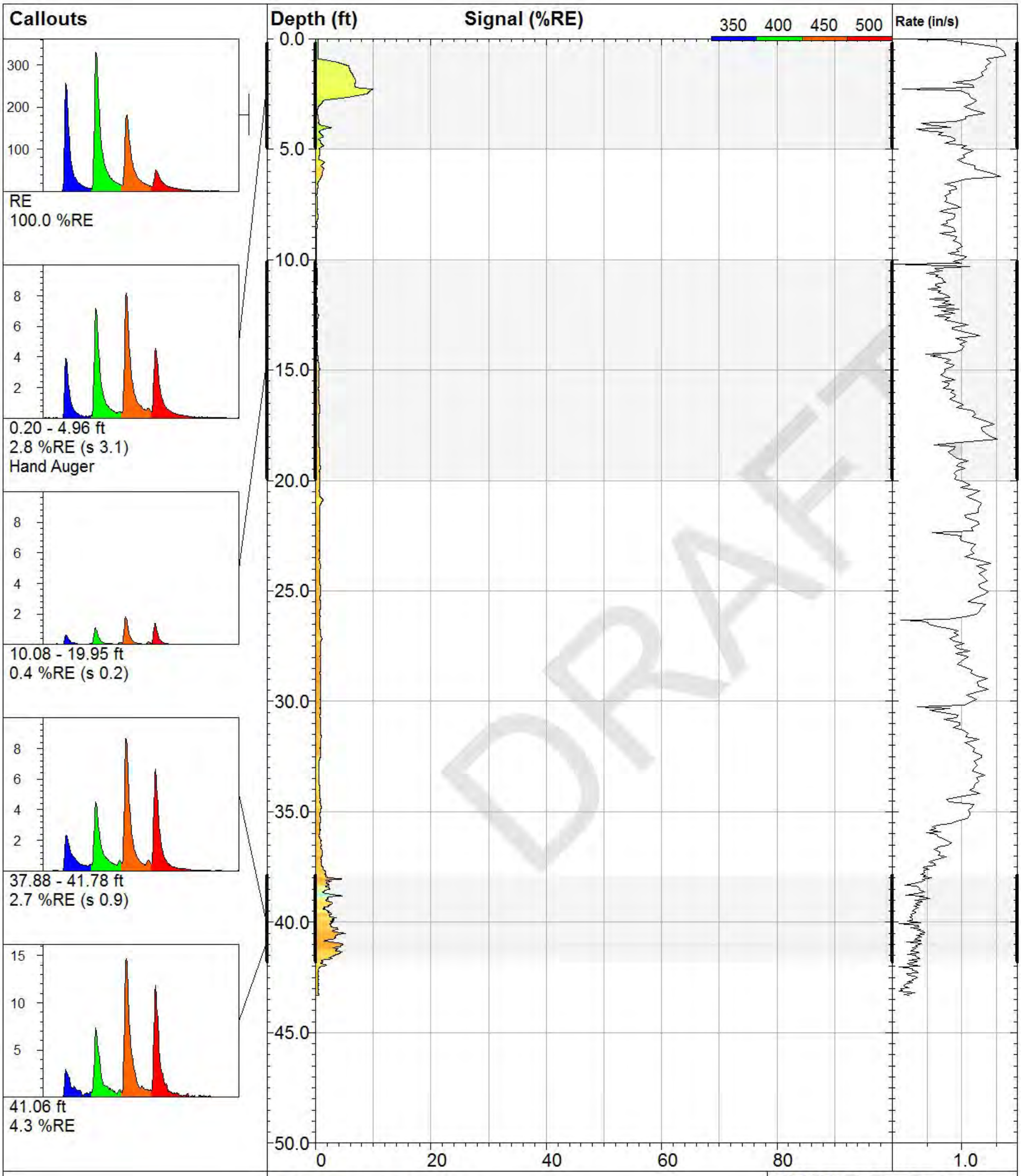
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **36.57 ft**
Client / Job: **Arcadis /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **703.5 %RE @ 14.02 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-06 08:28 EDT**



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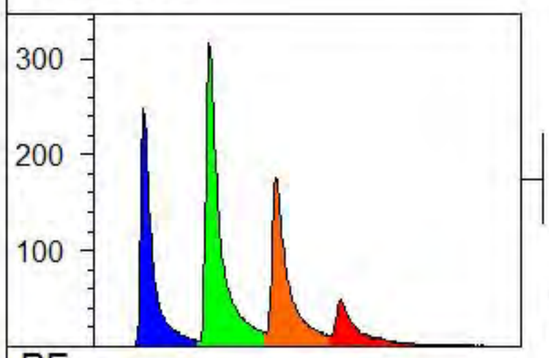
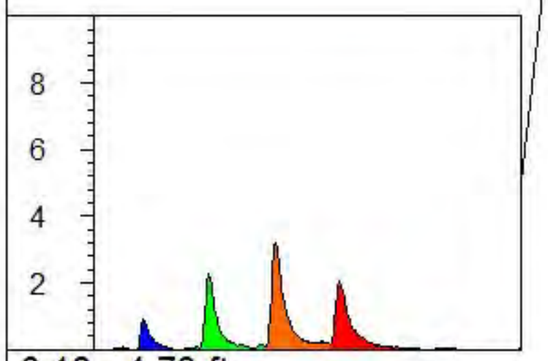
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **43.31 ft**
Client / Job: **Arcadis /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **9.9 %RE @ 2.29 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-06 09:09 EDT**

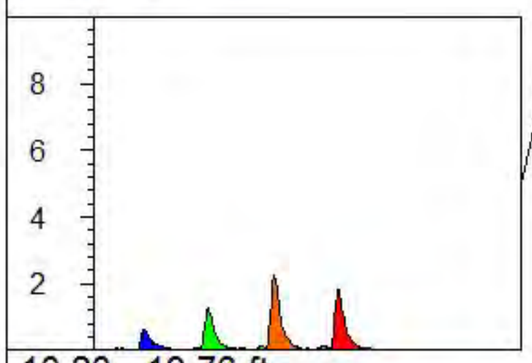
Callouts



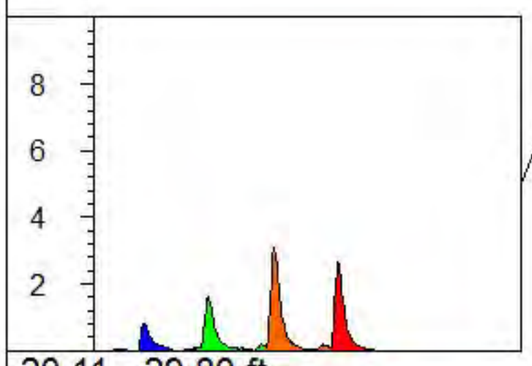
RE
100.0 %RE



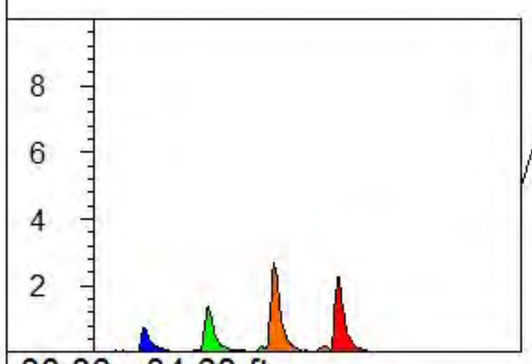
0.18 - 4.73 ft
1.0 %RE (s 1.1)
Hand Auger



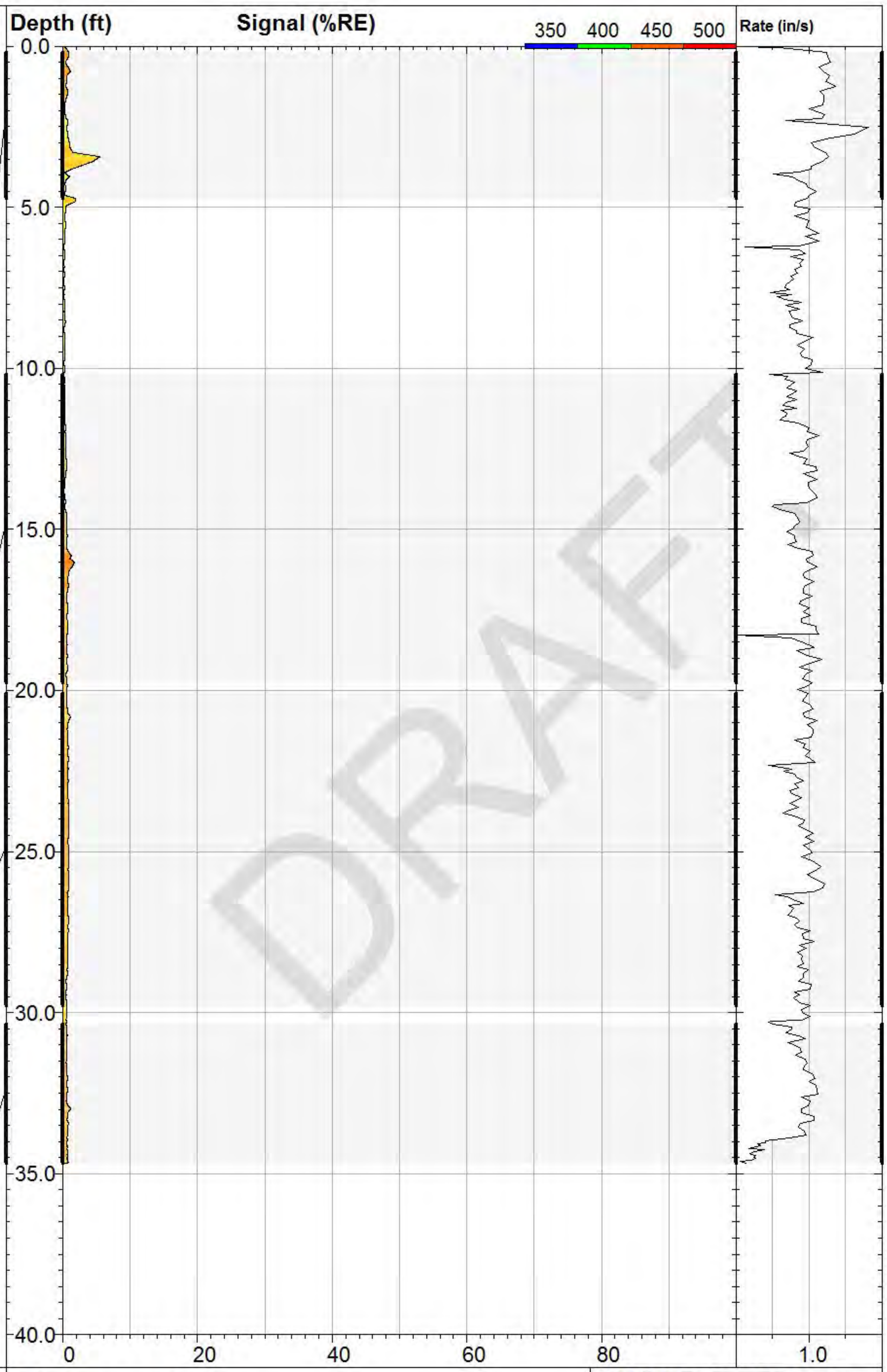
10.20 - 19.76 ft
0.5 %RE (s 0.3)



20.11 - 29.80 ft
0.7 %RE (s 0.1)



30.36 - 34.68 ft
0.6 %RE (s 0.1)
Refusal at 34.68'.



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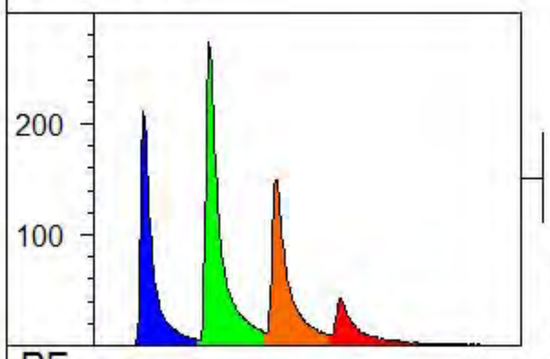
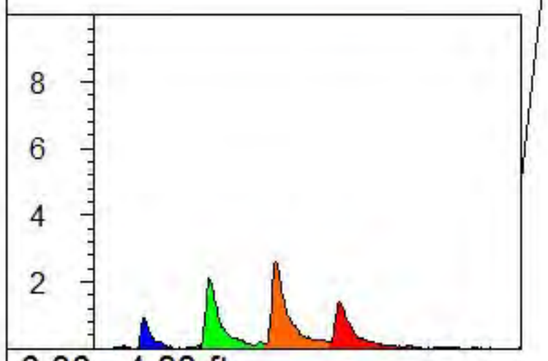
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **34.68 ft**
Client / Job: **Arcadis /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **5.5 %RE @ 3.43 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-06 09:47 EDT**

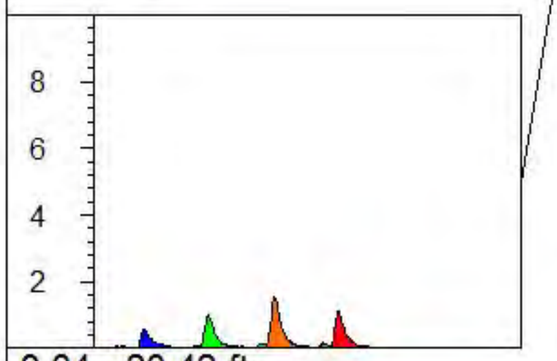
Callouts



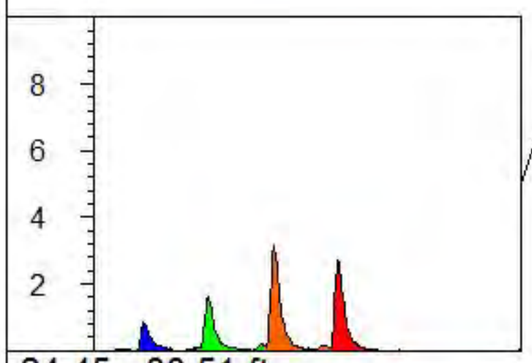
RE
100.0 %RE



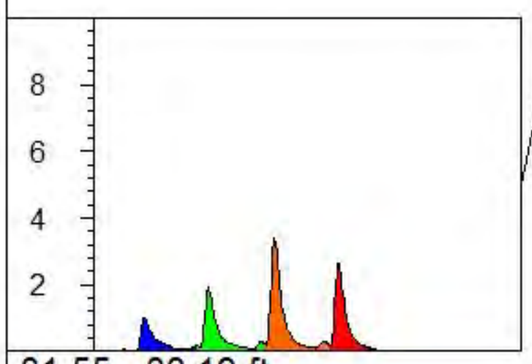
0.30 - 4.88 ft
1.1 %RE (s 1.5)
Hand Auger



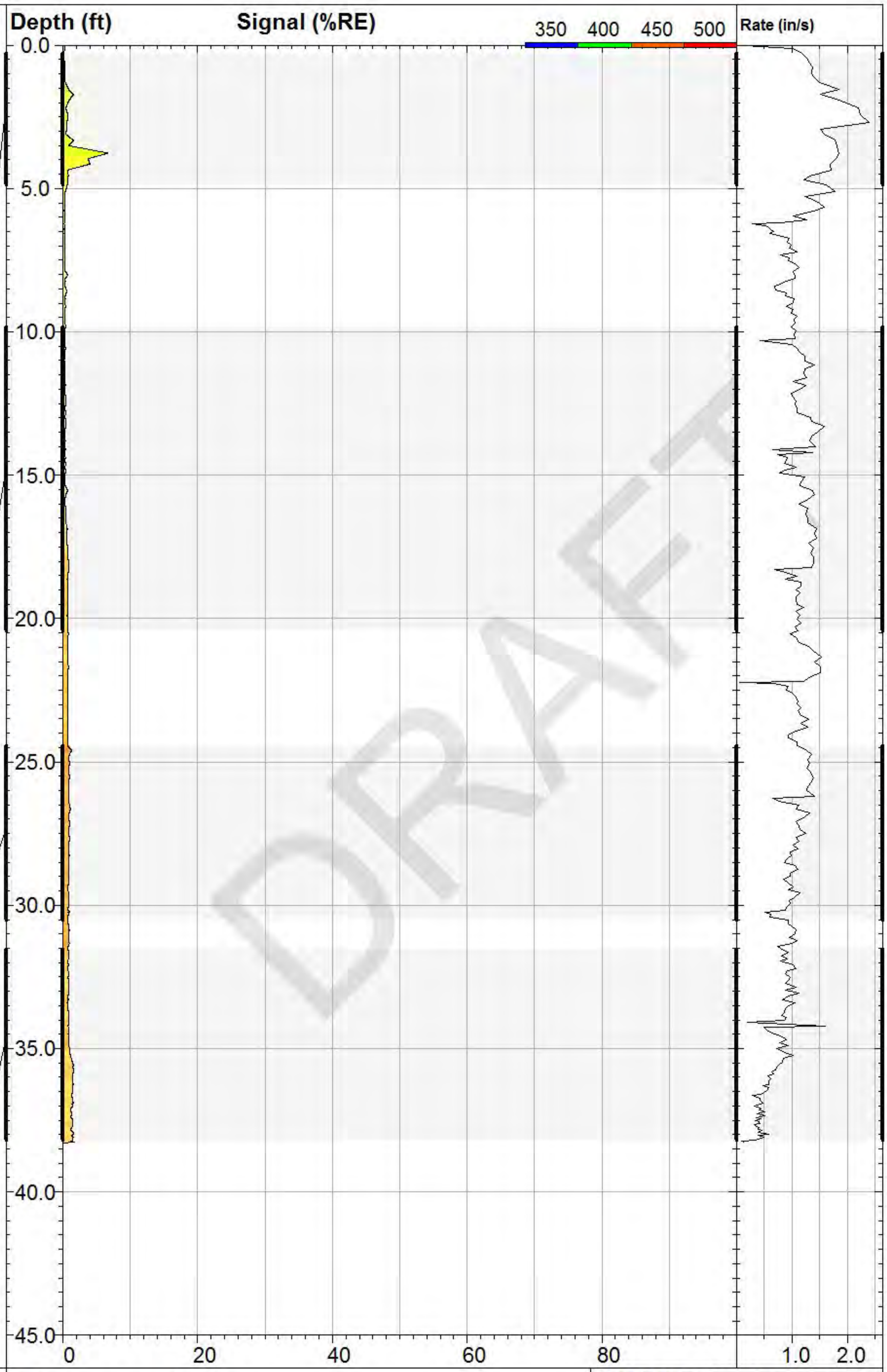
9.84 - 20.42 ft
0.5 %RE (s 0.2)



24.45 - 30.51 ft
0.9 %RE (s 0.1)



31.55 - 38.19 ft
1.1 %RE (s 0.3)
Refusal at 38.28'.



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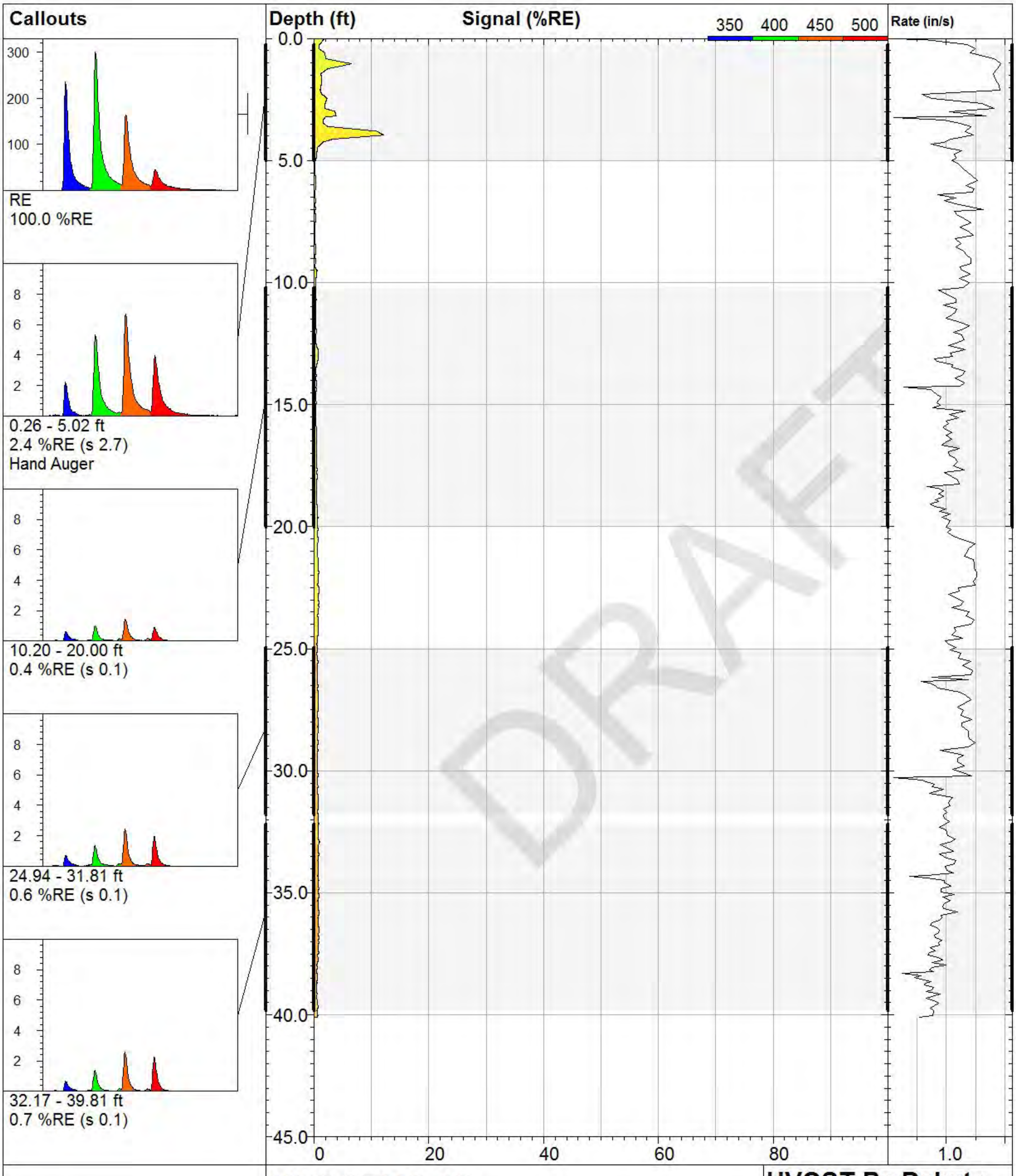
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **38.28 ft**
Client / Job: **Arcadis /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **6.7 %RE @ 3.77 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-06 10:21 EDT**



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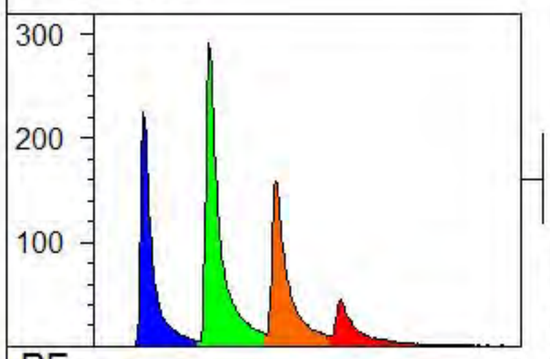
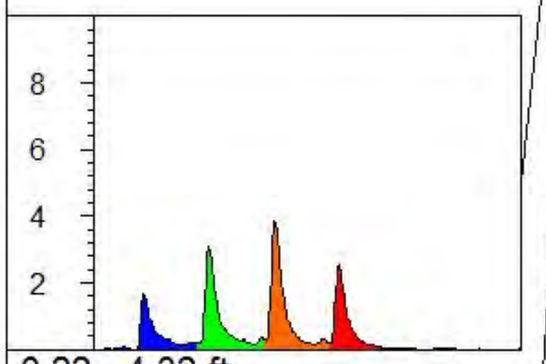
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **40.09 ft**
Client / Job: **Arcadis /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **12.2 %RE @ 3.96 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-06 10:50 EDT**

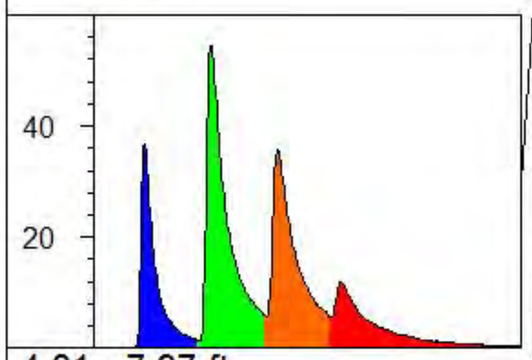
Callouts



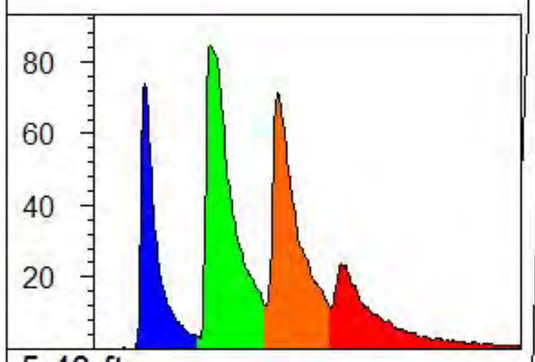
RE
100.0 %RE



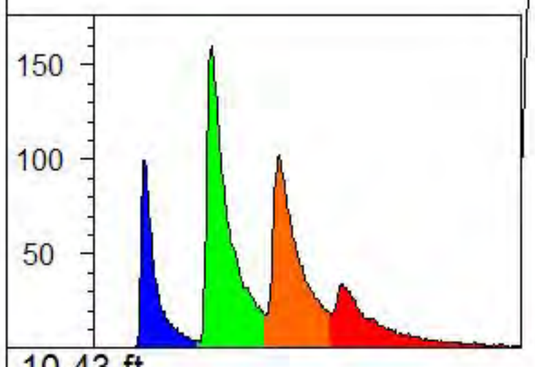
0.22 - 4.32 ft
1.4 %RE (s 1.2)
Hand Auger



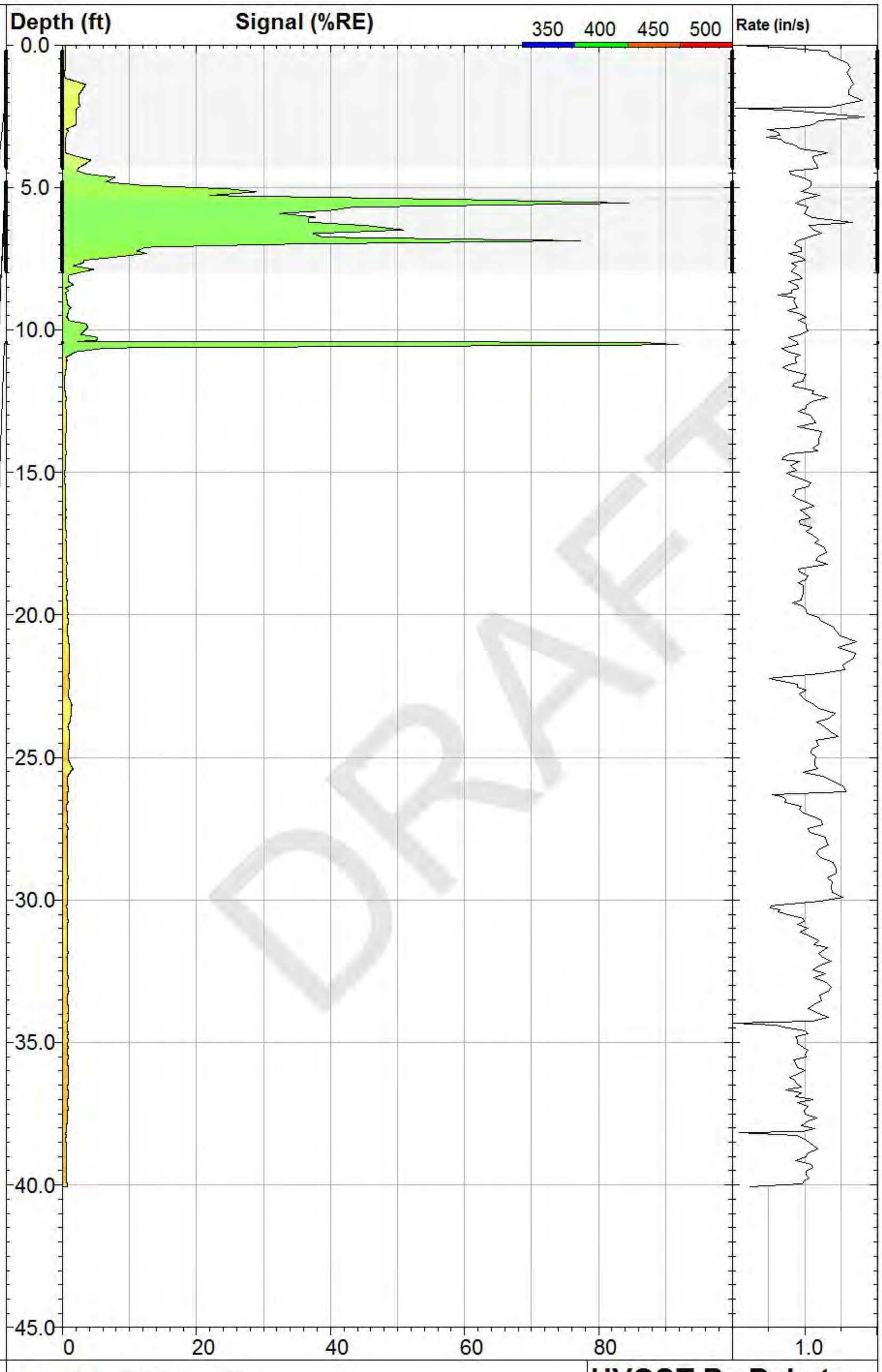
4.81 - 7.97 ft
28.8 %RE (s 22.3)



5.43 ft
60.1 %RE



10.43 ft
86.1 %RE



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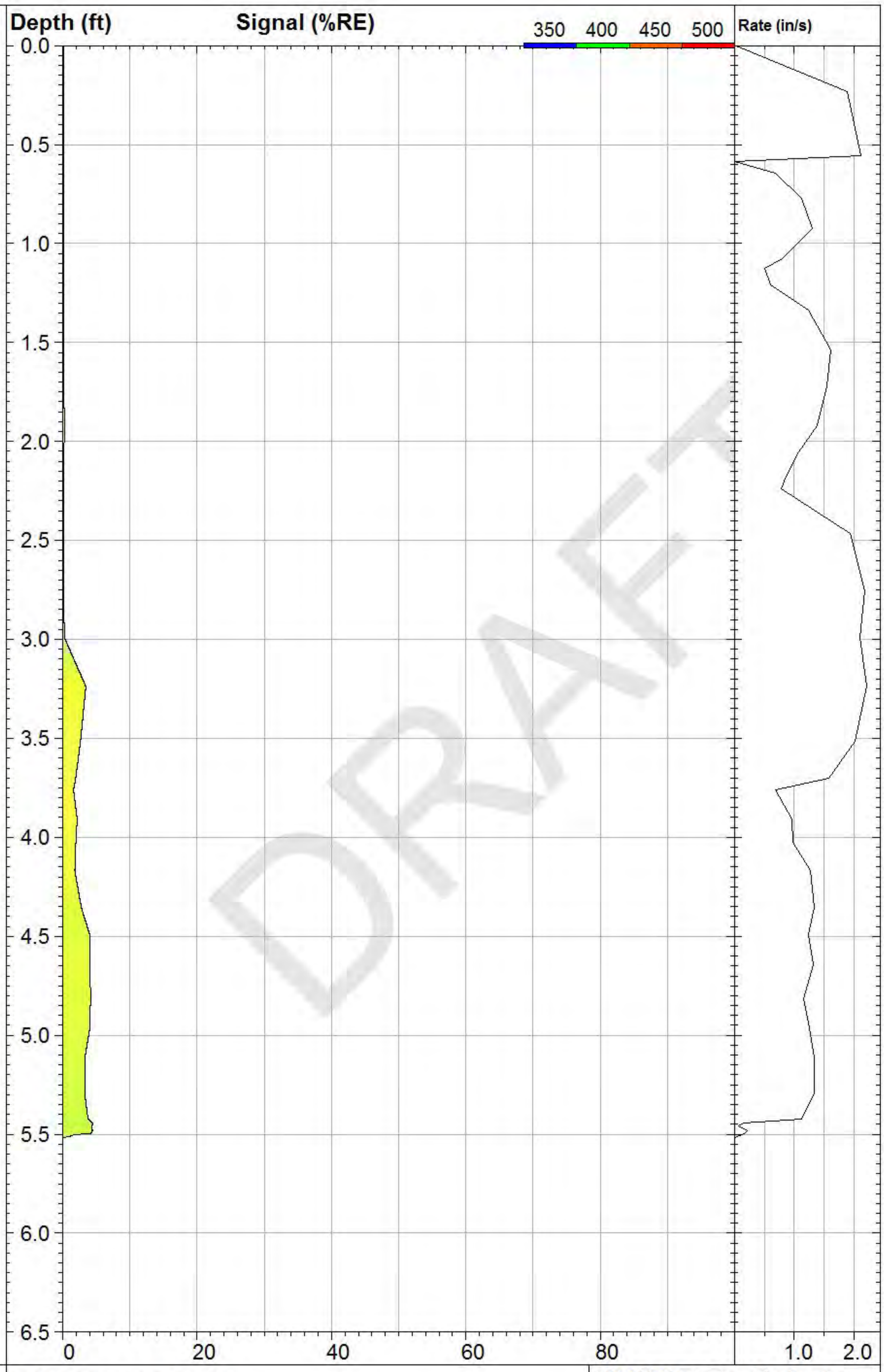
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **40.07 ft**
Client / Job: **Arcadis /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **92.0 %RE @ 10.52 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-06 11:28 EDT**

Callouts

Refusal at 5.51'.



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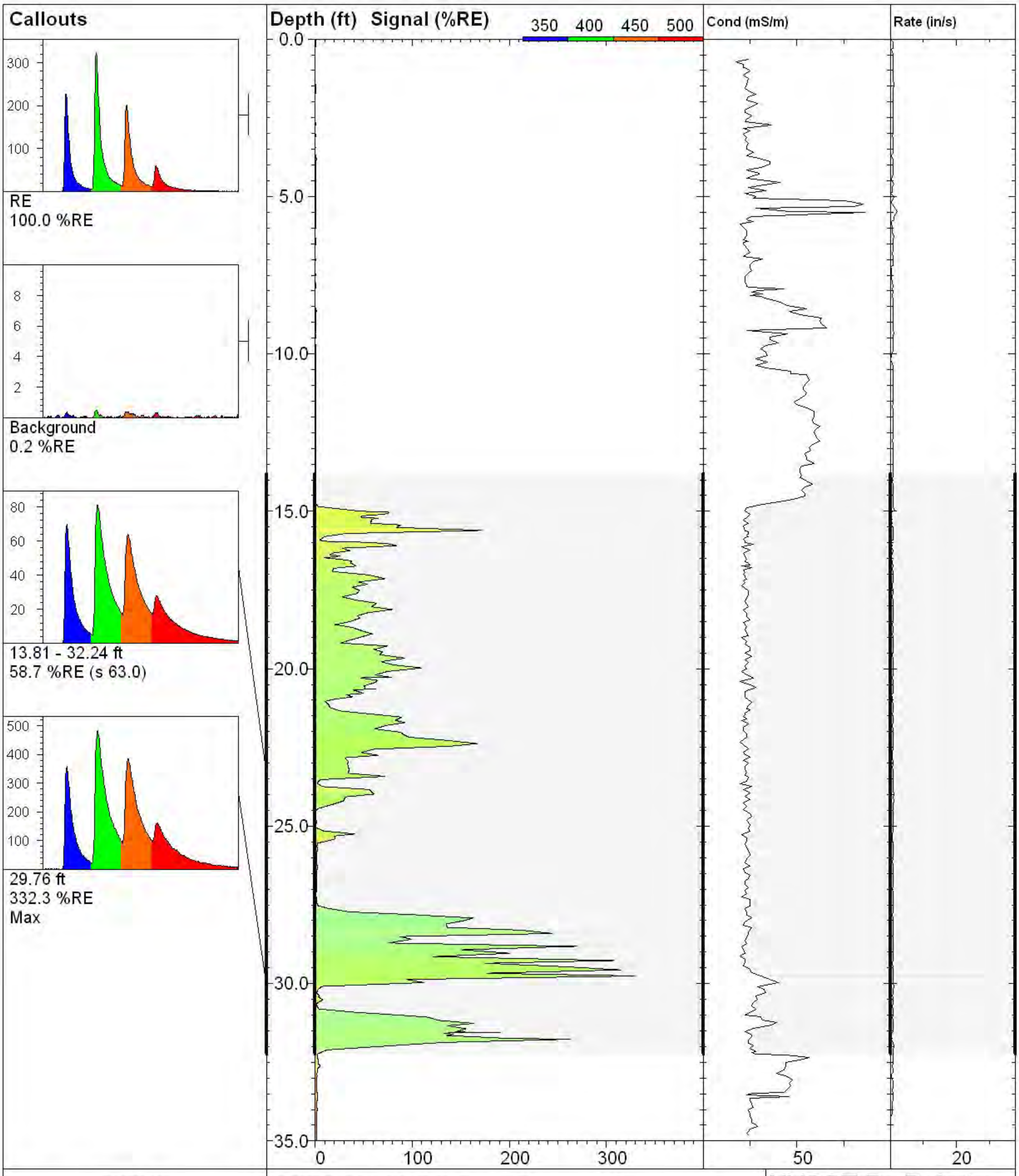
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **5.51 ft**
Client / Job: **Arcadis /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **4.5 %RE @ 5.44 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-06 12:00 EDT**



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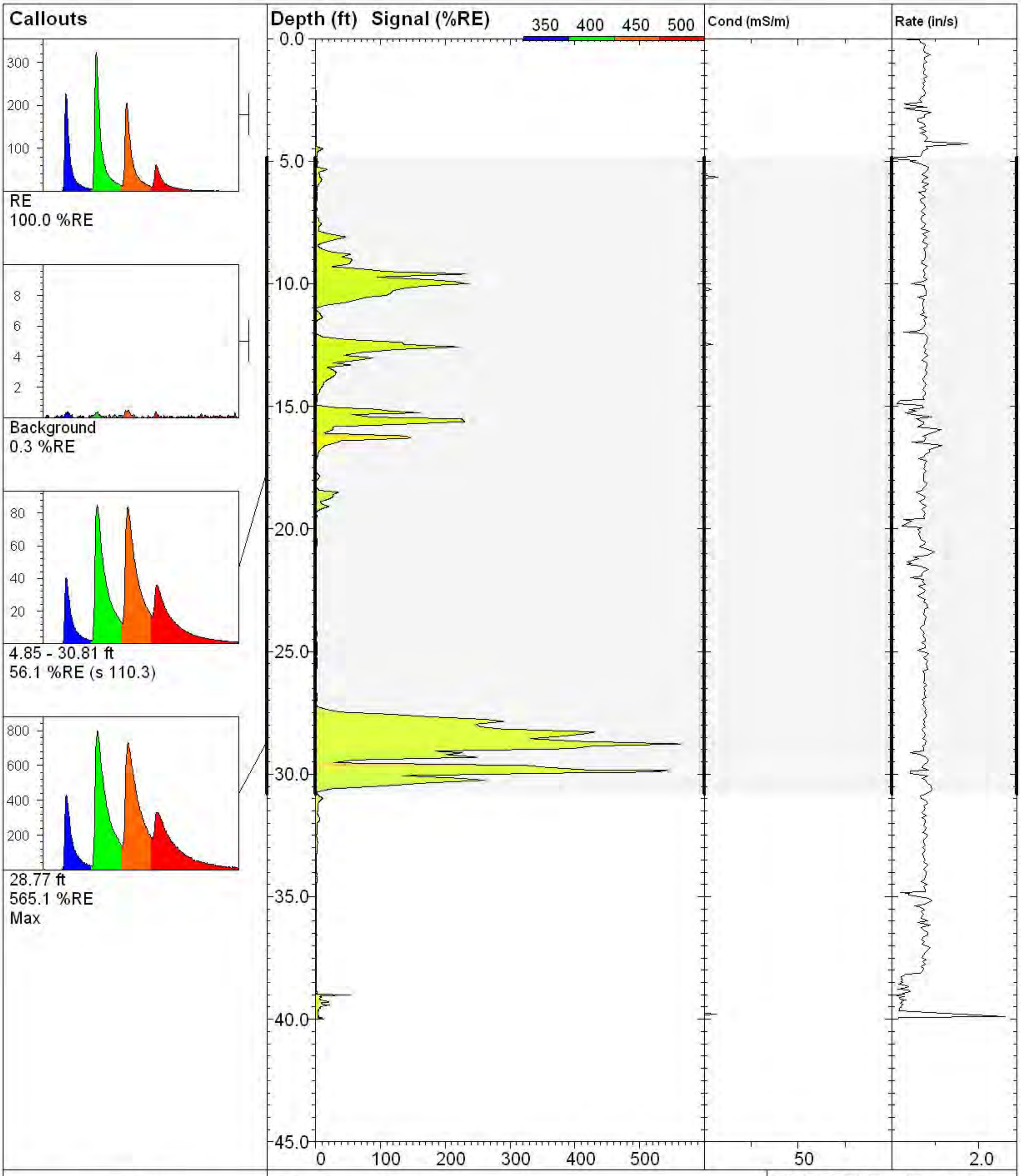
Site: **RACER Pontiac North Campus**	*Y Coord.(Lat-N) / System:* **312421 / UTM**	*Final depth:* **37.70 ft**
Client / Job: **Arcadis /**	*X Coord.(Lng-E) / Fix:* **4725614 /**	*Max signal:* **332.3 %RE @ 29.76 ft**
Operator / Unit: **Jonathan W. / UVOST1021**	*Elevation:* **Unavailable**	*Date & Time:* **2013-08-21 10:18 EDT**



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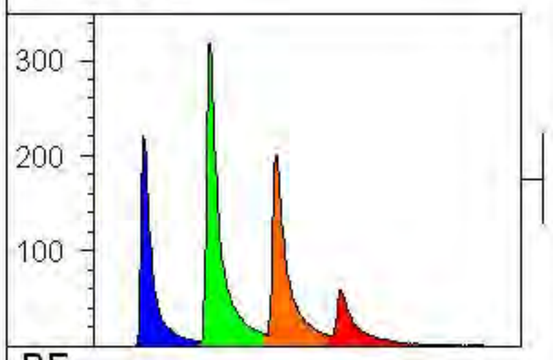
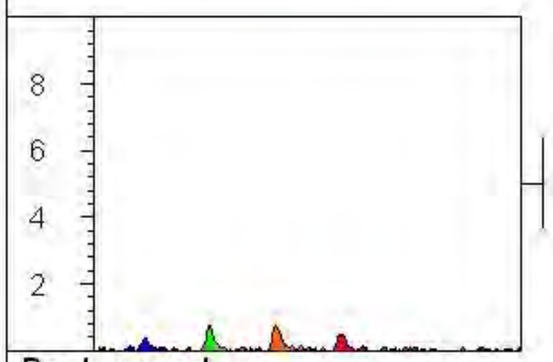
Site: **RACER Pontiac North Campus**	*Y Coord.(Lat-N) / System:* **312395 / UTM**	*Final depth:* **40.01 ft**
Client / Job: **Arcadis /**	*X Coord.(Lng-E) / Fix:* **4725607 /**	*Max signal:* **565.1 %RE @ 28.77 ft**
Operator / Unit: **Jonathan W. / UVOST1021**	*Elevation:* **Unavailable**	*Date & Time:* **2013-08-21 13:09 EDT**

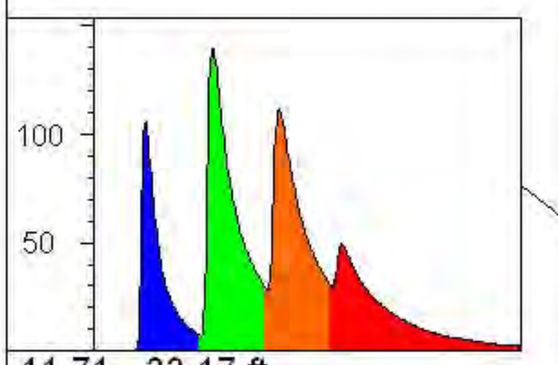
Callouts



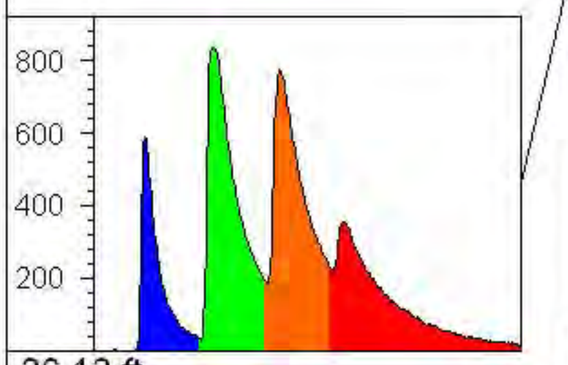
RE
100.0 %RE



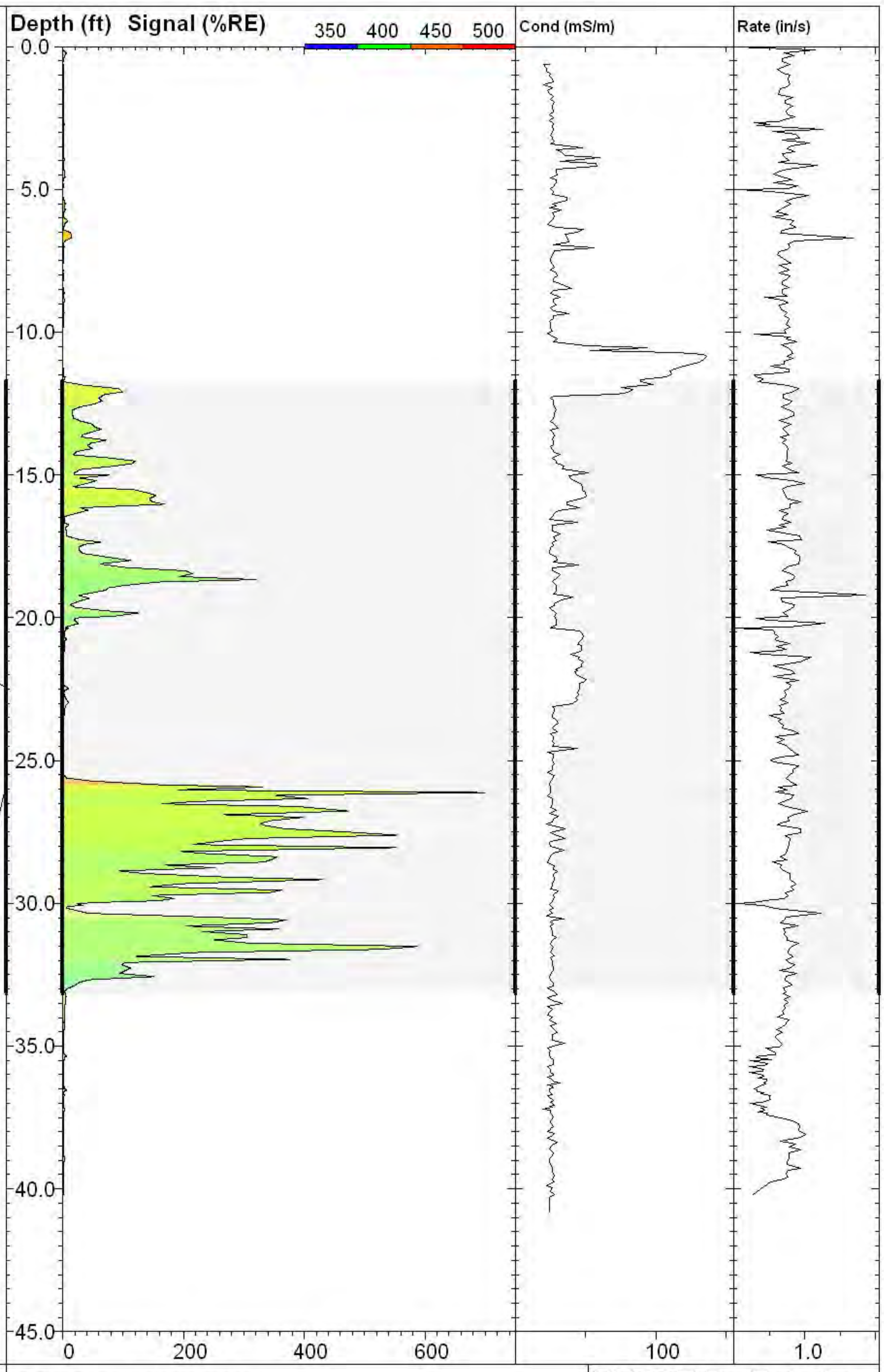
Background
0.2 %RE



11.71 - 33.17 ft
103.7 %RE (s 139.9)



26.12 ft
701.5 %RE
Max



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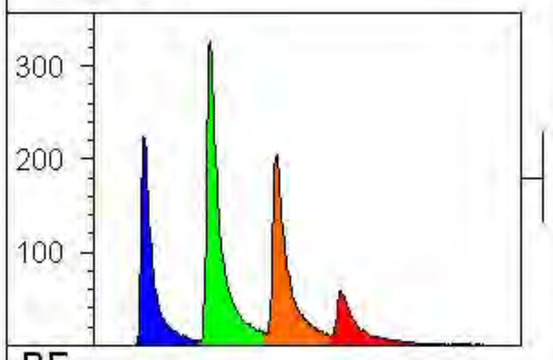
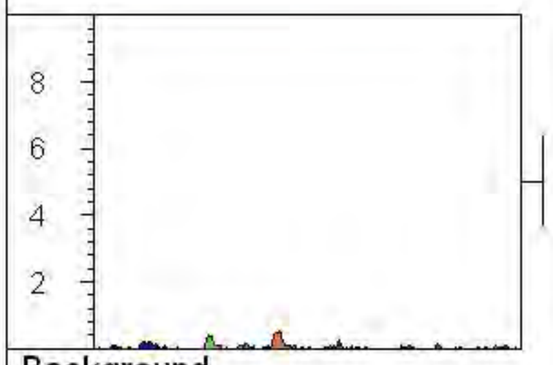
Site: **RACER Pontiac North Campus**	*Y Coord.(Lat-N) / System:* **312427 / UTM**	*Final depth:* **40.20 ft**
Client / Job: **Arcadis /**	*X Coord.(Lng-E) / Fix:* **4725607 /**	*Max signal:* **701.5 %RE @ 26.12 ft**
Operator / Unit: **Jonathan W. / UVOST1021**	*Elevation:* **Unavailable**	*Date & Time:* **2013-08-21 14:14 EDT**

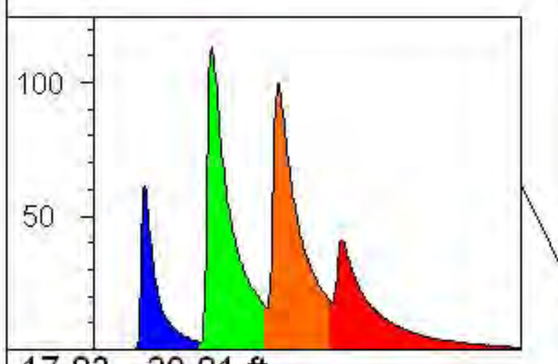
Callouts



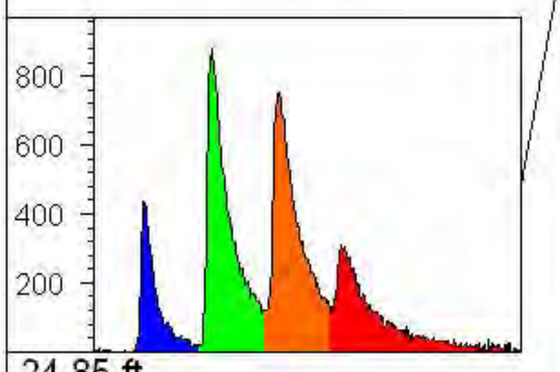
RE
100.0 %RE



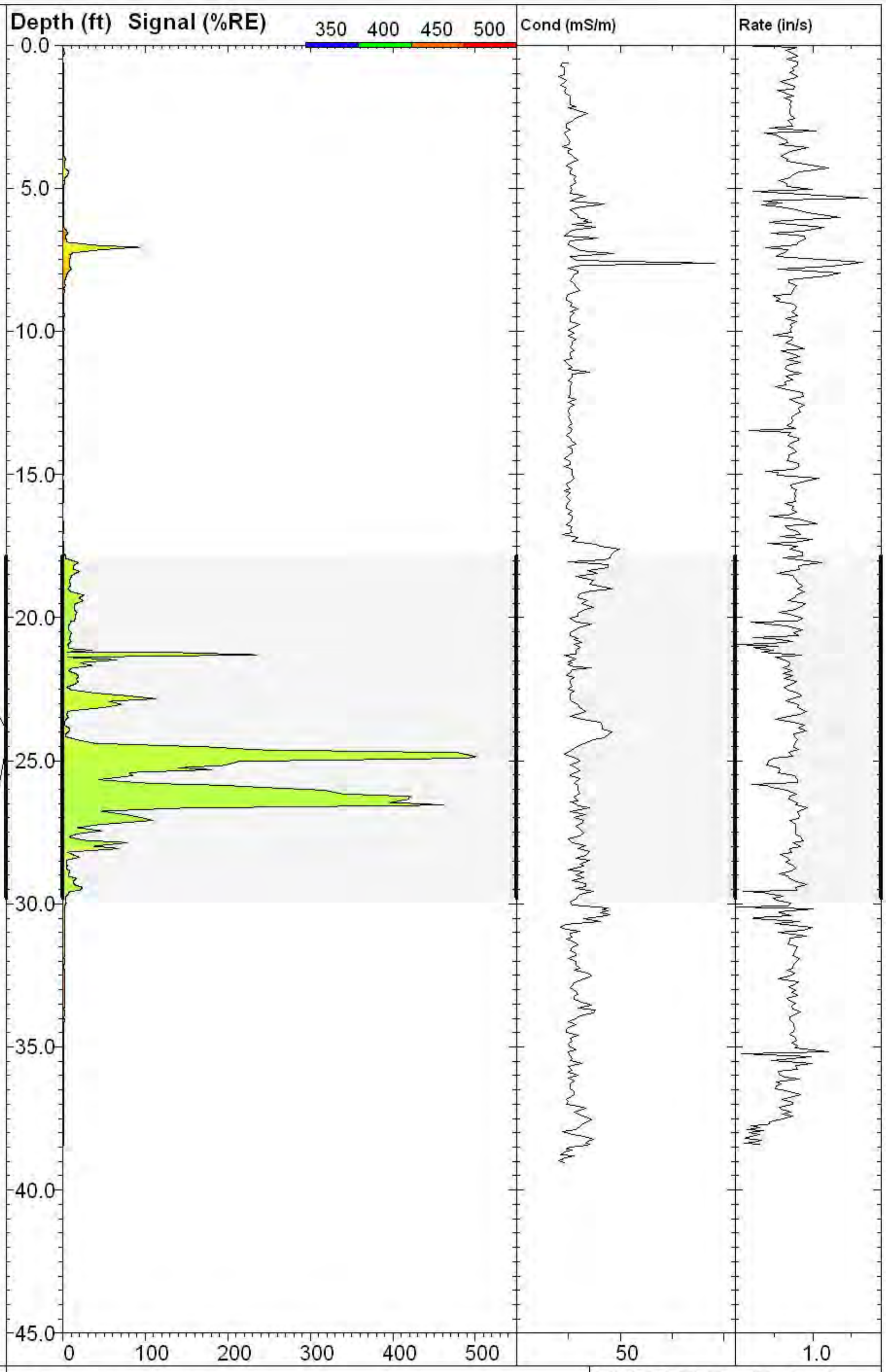
Background
0.1 %RE



17.83 - 29.81 ft
66.9 %RE (s 114.6)



24.85 ft
501.1 %RE
Max



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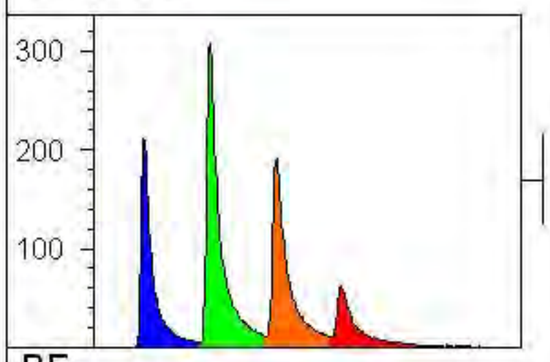
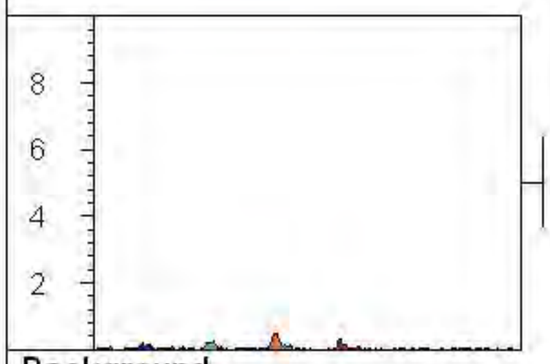
Site: **RACER Pontiac North Campus**	*Y Coord.(Lat-N) / System:* **312395 / UTM**	*Final depth:* **38.42 ft**
Client / Job: **Arcadis /**	*X Coord.(Lng-E) / Fix:* **4725619 /**	*Max signal:* **501.1 %RE @ 24.85 ft**
Operator / Unit: **Jonathan W. / UVOST1021**	*Elevation:* **Unavailable**	*Date & Time:* **2013-08-21 15:21 EDT**

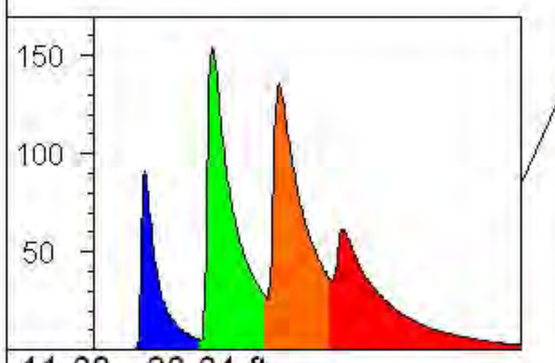
Callouts



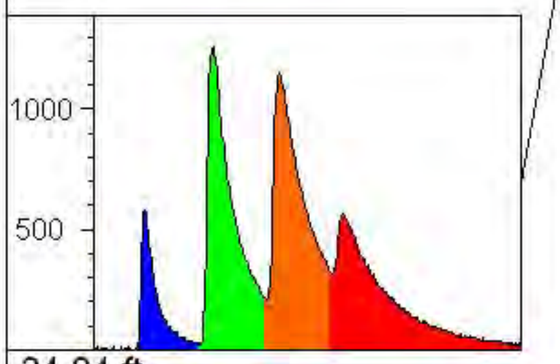
RE
100.0 %RE



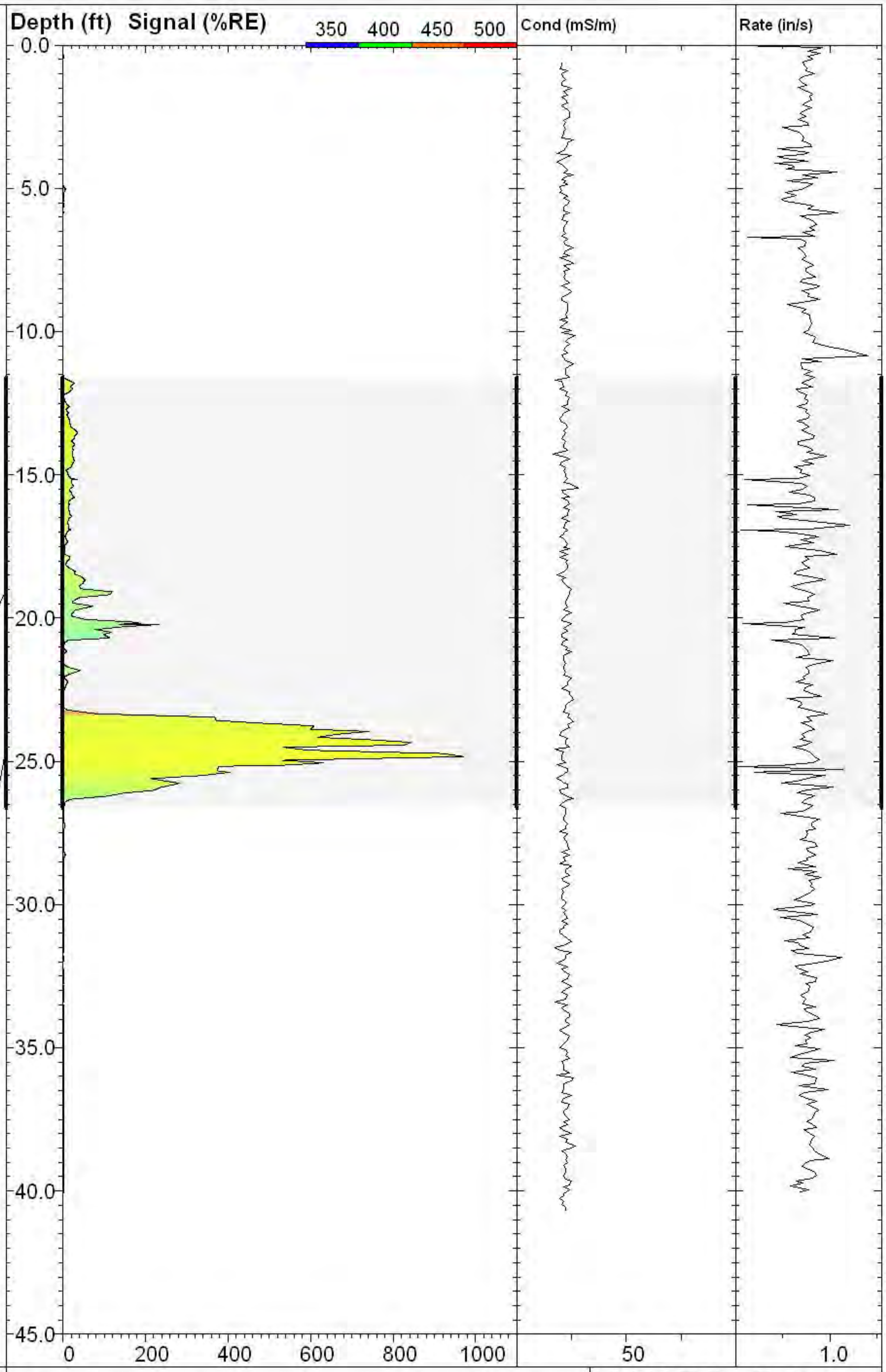
Background
0.1 %RE



11.60 - 26.64 ft
116.3 %RE (s 209.3)



24.84 ft
971.7 %RE
Max



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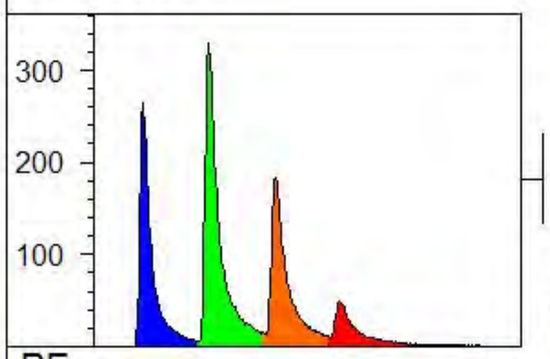
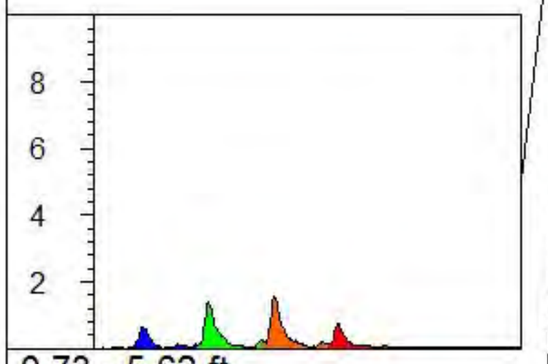
Site: **RACER Pontiac North Campus**	*Y Coord.(Lat-N) / System:* **312431 / UTM**	*Final depth:* **40.06 ft**
Client / Job: **Arcadis /**	*X Coord.(Lng-E) / Fix:* **4725622 /**	*Max signal:* **971.7 %RE @ 24.84 ft**
Operator / Unit: **Jonathan W. / UVOST1021**	*Elevation:* **Unavailable**	*Date & Time:* **2013-08-21 17:01 EDT**

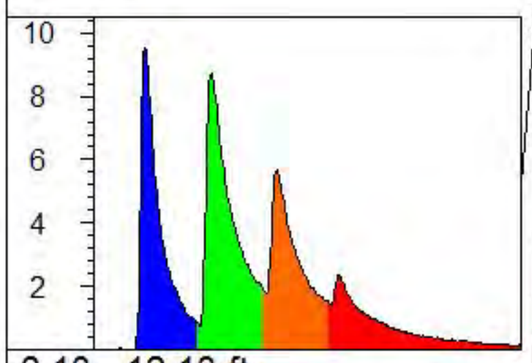
Callouts



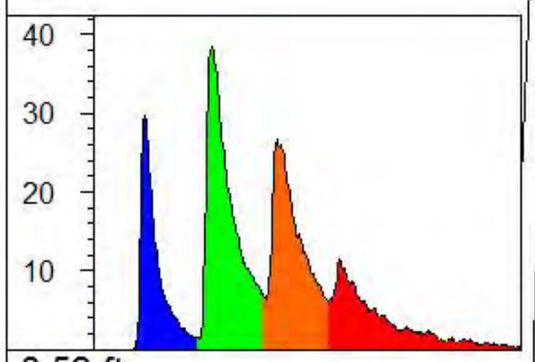
RE
100.0 %RE



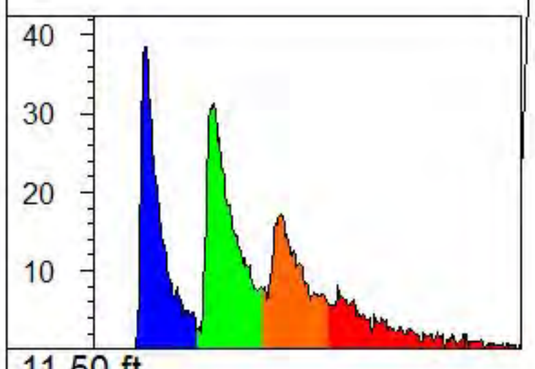
0.73 - 5.62 ft
0.5 %RE (s 0.1)
Air Knife



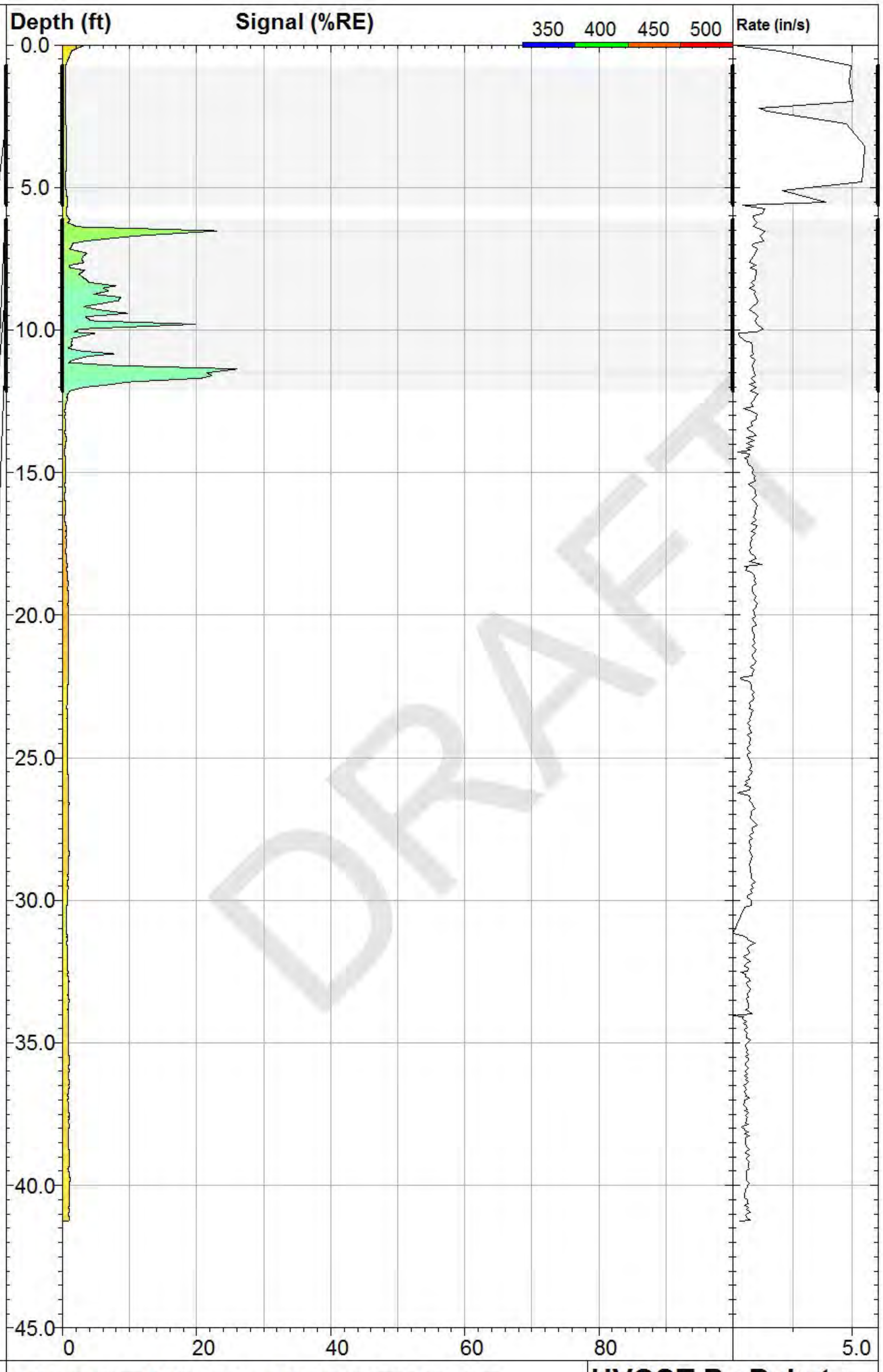
6.13 - 12.13 ft
5.8 %RE (s 6.4)



6.52 ft
23.1 %RE



11.50 ft
21.5 %RE



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UVOSTW8-06_UVOSTW8-07

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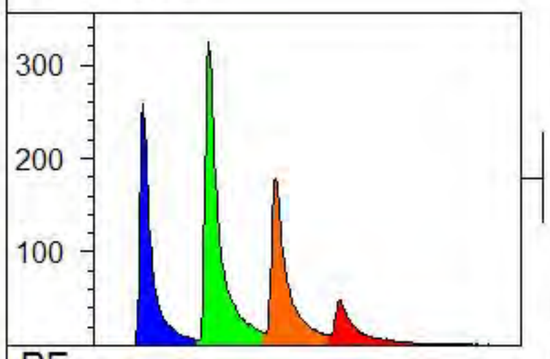
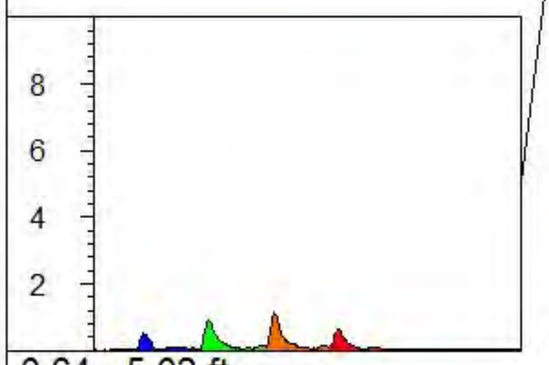
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **41.25 ft**
Client / Job: **Arcadis /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **26.2 %RE @ 11.36 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-05 09:13 EDT**

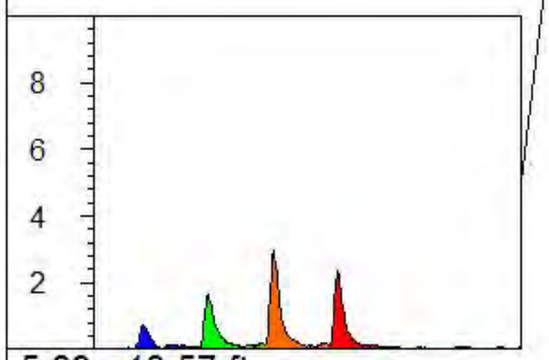
Callouts



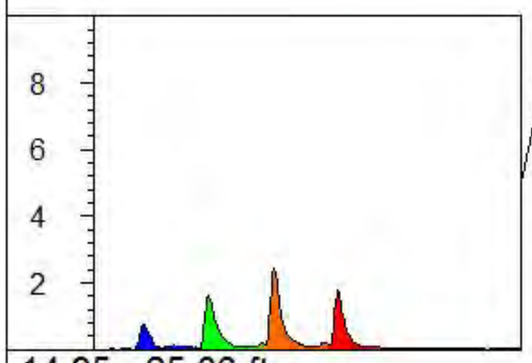
RE
100.0 %RE



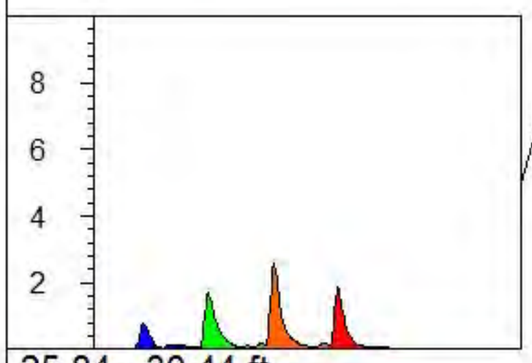
0.64 - 5.02 ft
0.4 %RE (s 0.1)
Air Knife



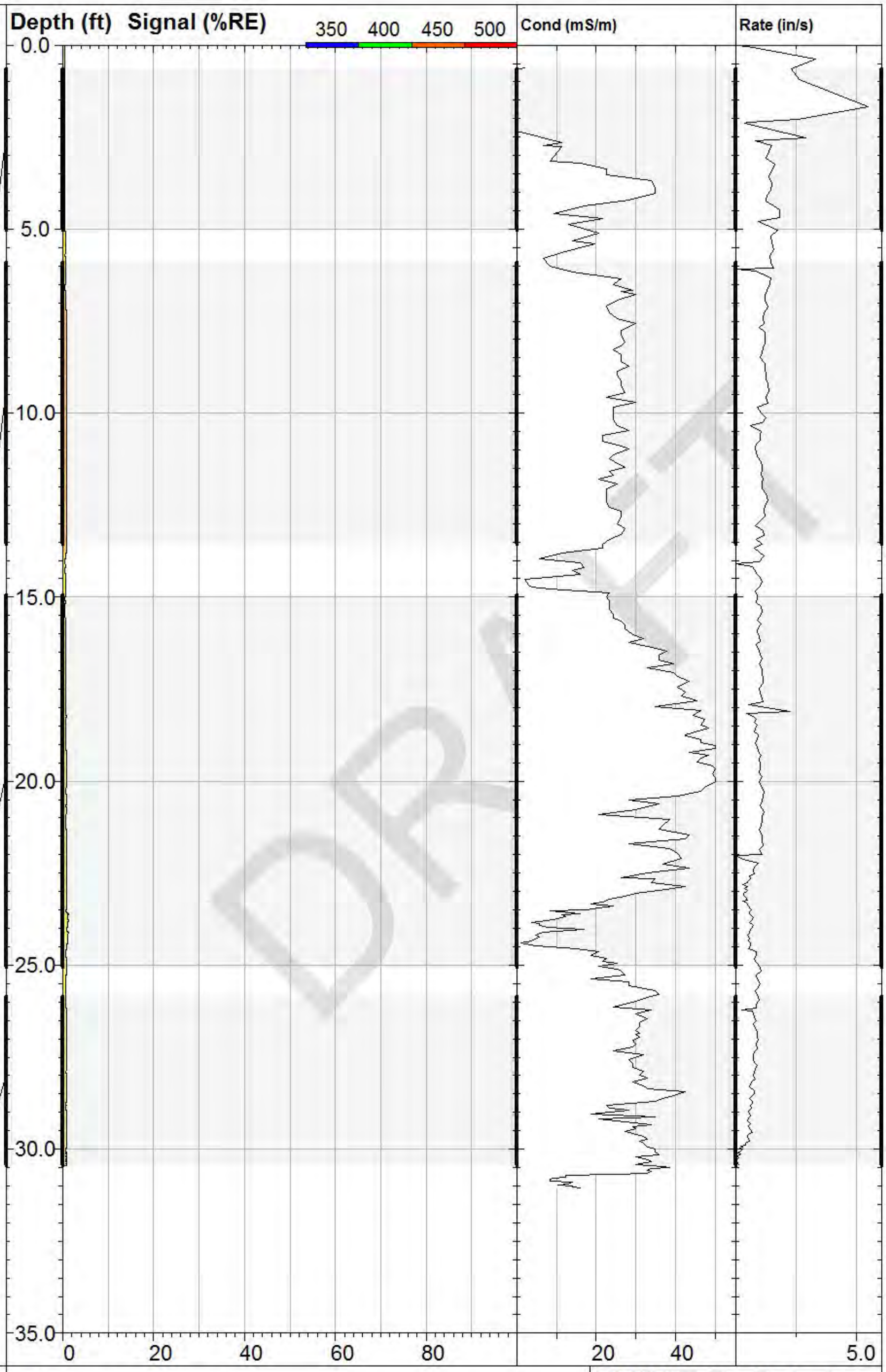
5.89 - 13.57 ft
0.8 %RE (s 0.1)



14.95 - 25.06 ft
0.7 %RE (s 0.1)



25.84 - 30.44 ft
0.8 %RE (s 0.1)
Refusal at 30.44'.



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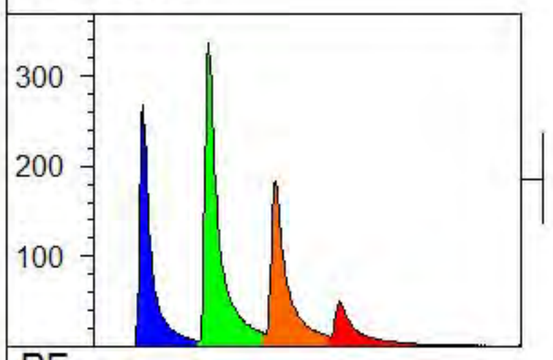
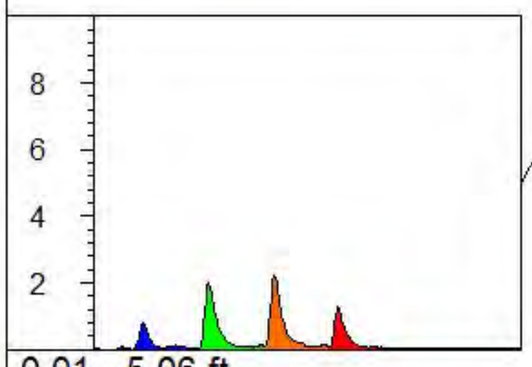
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **30.44 ft**
Client / Job: **Arcadis /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **1.2 %RE @ 23.78 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-05 09:47 EDT**

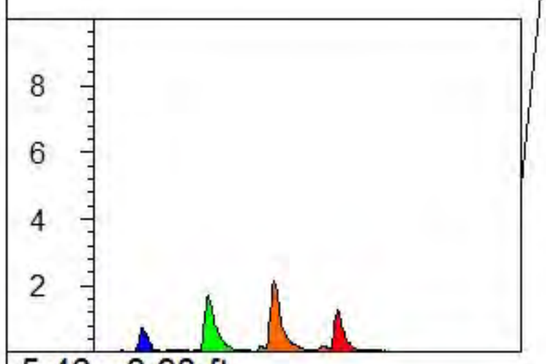
Callouts



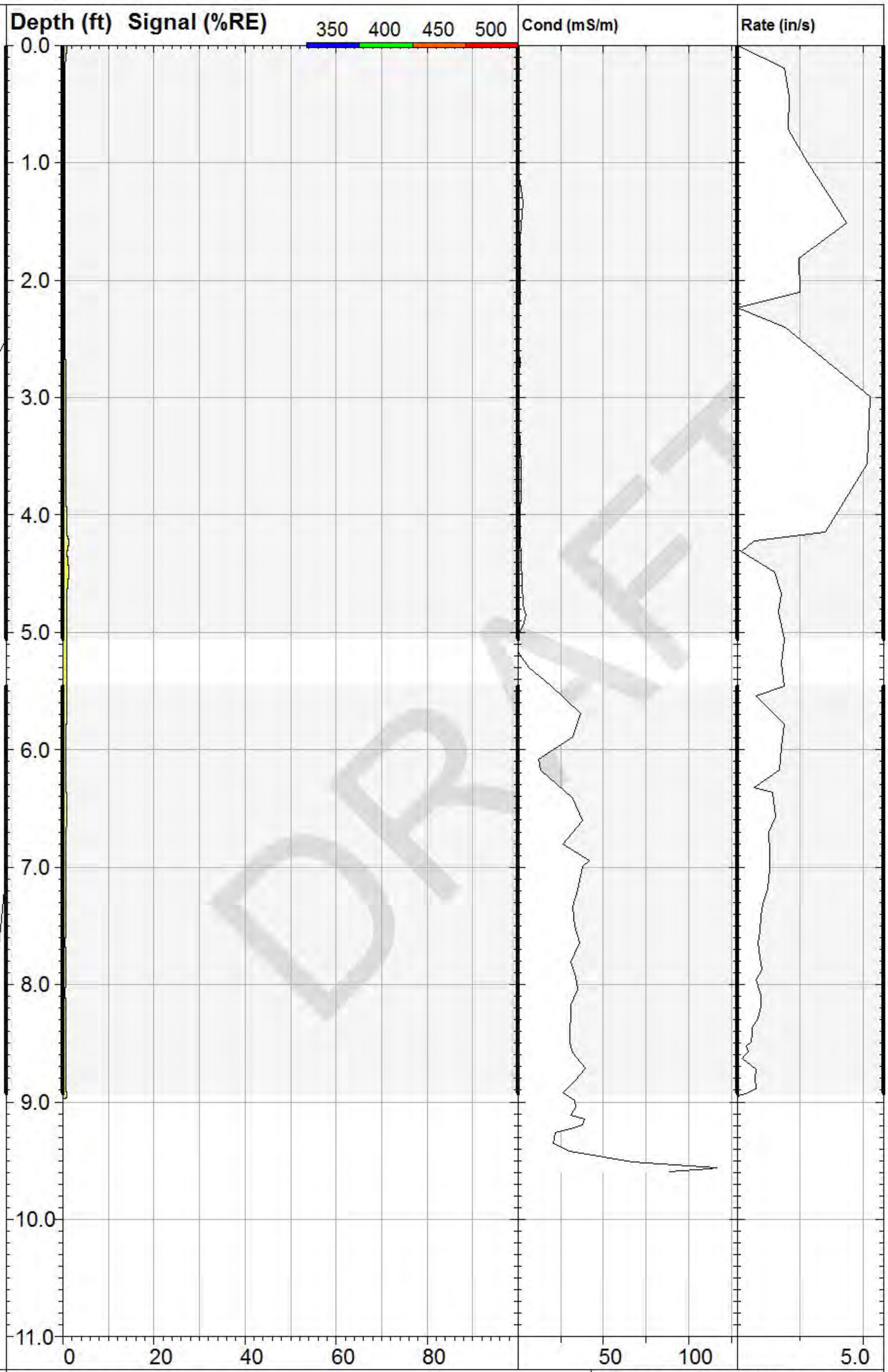
RE
100.0 %RE



0.01 - 5.06 ft
0.7 %RE (s 0.3)
Air Knife



5.46 - 8.93 ft
0.6 %RE (s 0.1)
Refusal at 8.97'.



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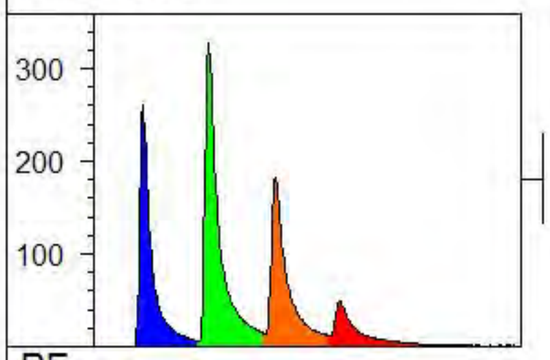
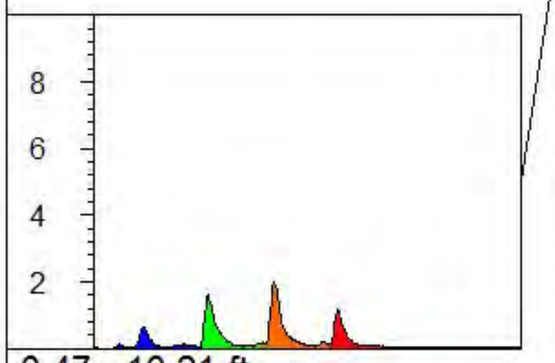
Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **8.97 ft**
Client / Job: **Arcadis /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **1.3 %RE @ 4.22 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-05 10:25 EDT**

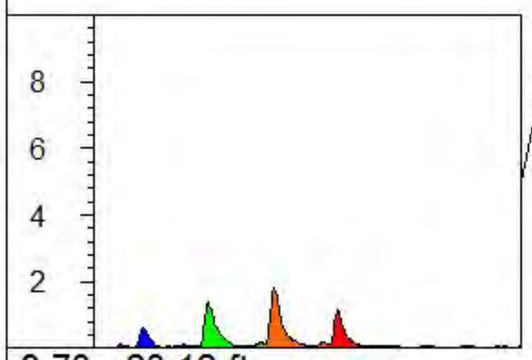
Callouts



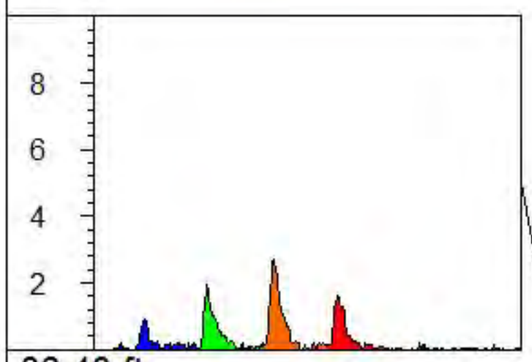
RE
100.0 %RE



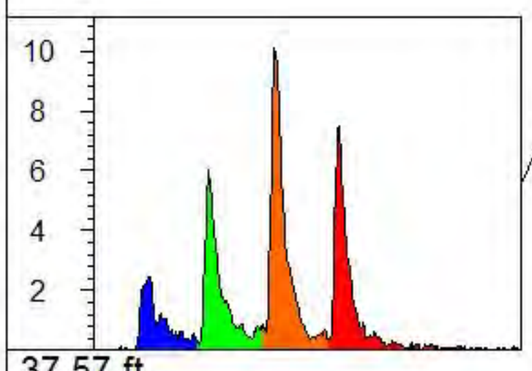
0.47 - 10.21 ft
0.6 %RE (s 0.1)
Cleared



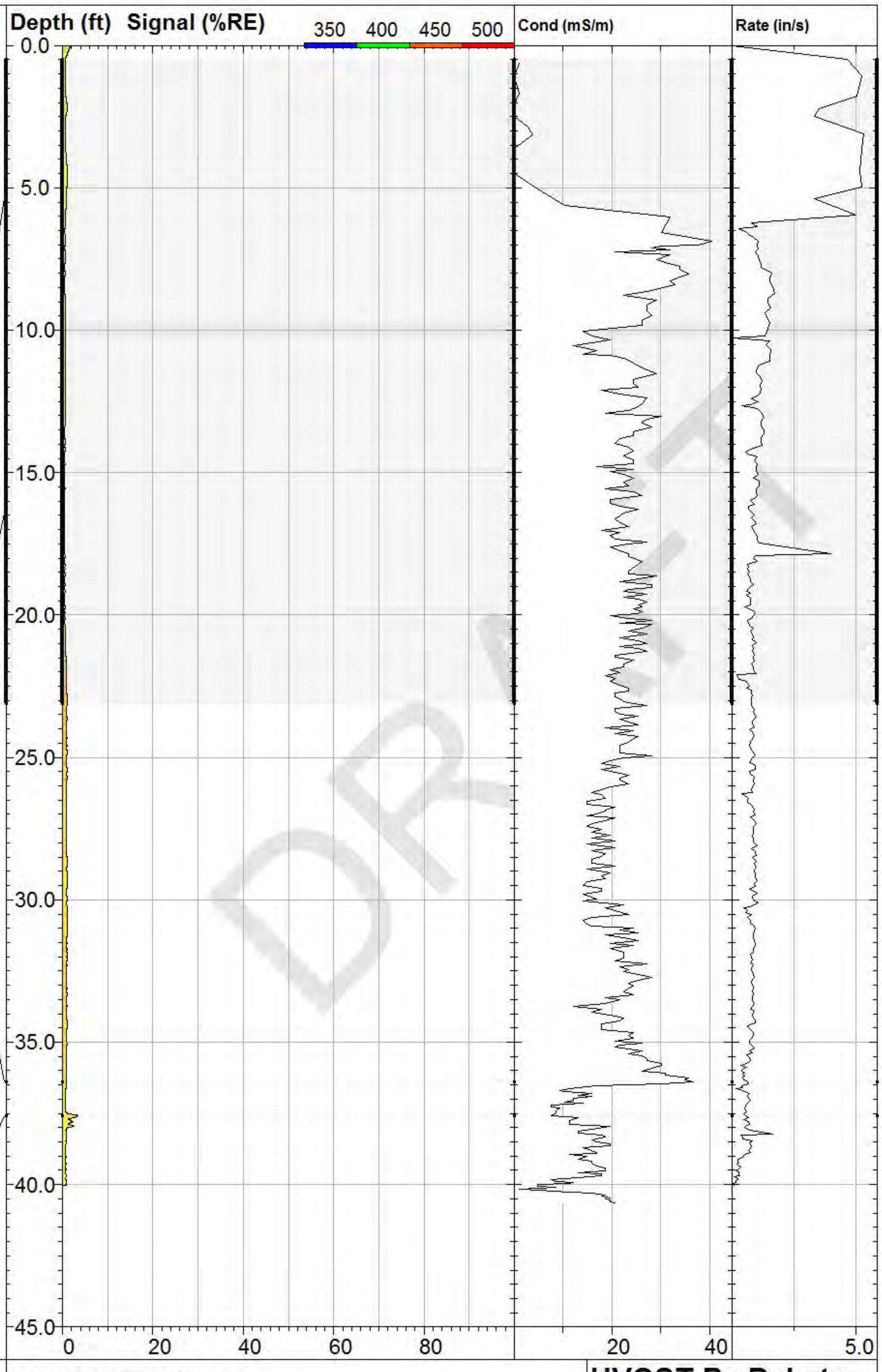
9.73 - 23.12 ft
0.6 %RE (s 0.1)



36.40 ft
0.8 %RE



37.57 ft
3.4 %RE
Refusal at 8.97'.



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Site: **Racer Pontiac**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **40.02 ft**
Client / Job: **Arcadis /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **3.4 %RE @ 37.57 ft**
Operator / Unit: **JTC / UVOST1242**	*Elevation:* **Unavailable**	*Date & Time:* **2013-09-05 10:37 EDT**

Attachment 2

Laboratory analytical data – Test America

TestAmerica

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ANALYTICAL REPORT

TestAmerica Laboratories, Inc.
TestAmerica Canton
4101 Shuffel Street NW
North Canton, OH 44720
Tel: (330)497-9396

TestAmerica Job ID: 240-28188-1
Client Project/Site: Racer PNC Pontiac MI - B0064607.2013

For:
ARCADIS U.S., Inc.
28550 Cabot Drive
Suite 500
Novi, Michigan 48377

Attn: Victoria Stacey

Denise Pohl

Authorized for release by:
8/27/2013 4:43:20 PM

Denise Pohl, Project Manager II
denise.pohl@testamericainc.com

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.

Table of Contents

Qualifiers

GC/MS VOA

Qualifier	Qualifier Description
U	Indicates the analyte was analyzed for but not detected.
*	LCS or LCSD exceeds the control limits
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
B	Compound was found in the blank and sample.

GC/MS Semi VOA

Qualifier	Qualifier Description
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
U	Indicates the analyte was analyzed for but not detected.
*	LCS or LCSD exceeds the control limits
X	Surrogate is outside control limits
F	MS or MSD exceeds the control limits
4	MS, MSD: The analyte present in the original sample is 4 times greater than the matrix spike concentration; therefore, control limits are not applicable.
F	RPD of the MS and MSD exceeds the control limits

GC Semi VOA

Qualifier	Qualifier Description
U	Indicates the analyte was analyzed for but not detected.
X	Surrogate is outside control limits
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
F	RPD of the MS and MSD exceeds the control limits

Metals

Qualifier	Qualifier Description
U	Indicates the analyte was analyzed for but not detected.
B	Compound was found in the blank and sample.
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CNF	Contains no Free Liquid
DER	Duplicate error ratio (normalized absolute difference)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision level concentration
MDA	Minimum detectable activity
EDL	Estimated Detection Limit
MDC	Minimum detectable concentration
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative error ratio
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

Job ID: 240-28188-1

Laboratory: TestAmerica Canton

Narrative

CASE NARRATIVE

Client: ARCADIS U.S., Inc.

Project: Racer PNC Pontiac MI - B0064607.2013

Report Number: 240-28188-1

With the exceptions noted as flags or footnotes, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. In addition all laboratory quality control samples were within established control limits, with any exceptions noted below. Each sample was analyzed to achieve the lowest possible reporting limit within the constraints of the method. In some cases, due to interference or analytes present at high concentrations, samples were diluted. For diluted samples, the reporting limits are adjusted relative to the dilution required.

TestAmerica Canton attests to the validity of the laboratory data generated by TestAmerica facilities reported herein. All analyses performed by TestAmerica facilities were done using established laboratory SOPs that incorporate QA/QC procedures described in the application methods. TestAmerica's operations groups have reviewed the data for compliance with the laboratory QA/QC plan, and data have been found to be compliant with laboratory protocols unless otherwise noted below.

The test results in this report meet all NELAP requirements for parameters for which accreditation is required or available. Any exceptions to NELAP requirements are noted in this report. Pursuant to NELAP, this report may not be reproduced, except in full, without the written approval of the laboratory.

Calculations are performed before rounding to avoid round-off errors in calculated results.

All holding times were met and proper preservation noted for the methods performed on these samples, unless otherwise detailed in the individual sections below.

All solid sample results are reported on an "as received" basis unless otherwise indicated by the presence of a % solids value in the method header.

This laboratory report is confidential and is intended for the sole use of TestAmerica and its client.

RECEIPT

The samples were received on 08/22/2013; the samples arrived in good condition, properly preserved and on ice. The temperature of the cooler at receipt was 5.8 C.

VOLATILE ORGANIC COMPOUNDS (GCMS)

Sample MWM2-29_LNAPL (240-28188-1) was analyzed for volatile organic compounds (GCMS) in accordance with EPA SW-846 Method 8260B. The samples were analyzed on 08/26/2013.

Toluene was detected in method blank MB 240-99013/1-A at a level exceeding the reporting limit. If the associated sample reported a result above the MDL and/or RL, the result has been flagged. Refer to the QC report for details.

1,2-Dichloroethane and trans-1,2-Dichloroethene failed the recovery criteria high for LCS 240-99013/2-A. Refer to the QC report for details.

Method(s) 8260B: The laboratory control sample (LCS) for batch 99013 recovered outside control limits for the following analytes: trans-1,2-dichloroethene, and 1,2-dichloroethane. These analytes were biased high in the LCS and were not detected in the associated samples; therefore, the data have been reported.

Job ID: 240-28188-1 (Continued)

Laboratory: TestAmerica Canton (Continued)

No other difficulties were encountered during the VOCs analysis.

All other quality control parameters were within the acceptance limits.

SEMIVOLATILE ORGANIC COMPOUNDS (GCMS)

Sample MWM2-29_LNAPL (240-28188-1) was analyzed for semivolatile organic compounds (GCMS) in accordance with EPA SW-846 Method 8270C. The samples were prepared on 08/22/2013 and analyzed on 08/26/2013.

Surrogates are added during the extraction process prior to dilution. When the sample is diluted, surrogate recoveries are diluted out and no corrective action is required.

Nitrobenzene-d5 (Surr) failed the surrogate recovery criteria high for MWM2-29_LNAPL (240-28188-1). Nitrobenzene-d5 (Surr) failed the surrogate recovery criteria high for MWM2-29_LNAPLMS (240-28188-1MS). Nitrobenzene-d5 (Surr) failed the surrogate recovery criteria high for MWM2-29_LNAPLMSD (240-28188-1MSD). Refer to the QC report for details.

2,4-Dimethylphenol failed the recovery criteria high for LCS 240-98601/5-A. Refer to the QC report for details.

4,6-Dinitro-2-methylphenol, 4-Nitrophenol, Caprolactam and Hexachlorocyclopentadiene failed the recovery criteria low for the MS of sample MWM2-29_LNAPLMS (240-28188-1) in batch 240-98896. Several analytes failed the recovery criteria high.

For the MSD of sample MWM2-29_LNAPLMSD (240-28188-1) in batch 240-98896, 4,6-Dinitro-2-methylphenol, 4-Nitrophenol, Caprolactam and Hexachlorocyclopentadiene failed the recovery criteria low. Several analytes failed the recovery criteria high. Also, Butyl benzyl phthalate and N-Nitrosodi-n-propylamine exceeded the RPD limit.

The presence of the '4' qualifier in the data indicates analytes where the concentration in the unspiked sample exceeded four times the spiking amount.

Refer to the QC report for details.

Sample MWM2-29_LNAPL (240-28188-1)[20X] required dilution prior to analysis. The reporting limits have been adjusted accordingly.

Method(s) 8270C: The following samples were diluted due to the nature of the sample matrix: (240-28188-1 MS), (240-28188-1 MSD), MWM2-29_LNAPL (240-28188-1). Elevated reporting limits (RLs) are provided.

Method(s) 8270C: The laboratory control sample (LCS) for prep batch 98601, associated with sample MWM2-29_LNAPL (240-28188-1), had a recovery for 2,4-dimethylphenol above acceptance criteria. This analyte was biased high in the LCS and was not detected in the associated sample; therefore, the data have been reported.

No other difficulties were encountered during the SVOCs analysis.

All other quality control parameters were within the acceptance limits.

POLYCHLORINATED BIPHENYLS (PCBS)

Sample MWM2-29_LNAPL (240-28188-1) was analyzed for polychlorinated biphenyls (PCBs) in accordance with EPA SW-846 Method 8082. The samples were prepared on 08/22/2013 and analyzed on 08/23/2013.

Surrogates are added during the extraction process prior to dilution. When the sample dilution is 5X or greater, surrogate recoveries are diluted out and no corrective action is required.

DCB Decachlorobiphenyl and Tetrachloro-m-xylene failed the surrogate recovery criteria low for MWM2-29_LNAPL (240-28188-1). DCB Decachlorobiphenyl and Tetrachloro-m-xylene failed the surrogate recovery criteria low for MWM2-29_LNAPLMS (240-28188-1MS). DCB Decachlorobiphenyl and Tetrachloro-m-xylene failed the surrogate recovery criteria low for MWM2-29_LNAPLMSD (240-28188-1MSD). Refer to the QC report for details.

Aroclor-1260 failed the recovery criteria low for the MS/MSD of sample MWM2-29_LNAPLMS/MSD (240-28188-1) in batch 240-98726.

Job ID: 240-28188-1 (Continued)

Laboratory: TestAmerica Canton (Continued)

Aroclor-1260 exceeded the RPD limit.

Refer to the QC report for details.

Sample MWM2-29_LNAPL (240-28188-1)[500X] required dilution prior to analysis. The reporting limits have been adjusted accordingly.

No other difficulties were encountered during the PCBs analysis.

All other quality control parameters were within the acceptance limits.

TOTAL METALS IN WASTE (ICP)

Sample MWM2-29_LNAPL (240-28188-1) was analyzed for total metals in waste (ICP) in accordance with EPA SW-846 Method 6010B. The samples were prepared on 08/22/2013 and analyzed on 08/23/2013.

Barium and Manganese were detected in method blank MB 240-98541/1-A at levels that were above the method detection limit but below the reporting limit. The values should be considered estimates, and have been flagged. If the associated sample reported a result above the MDL and/or RL, the result has been flagged. Refer to the QC report for details.

No other difficulties were encountered during the metals analysis.

All other quality control parameters were within the acceptance limits.

TOTAL MERCURY

Sample MWM2-29_LNAPL (240-28188-1) was analyzed for total mercury in accordance with EPA SW-846 Method 7471A. The samples were prepared on 08/22/2013 and analyzed on 08/23/2013.

No difficulties were encountered during the mercury analysis.

All quality control parameters were within the acceptance limits.

Method Summary

Client: ARCADIS U.S., Inc.
Project/Site: Racer PNC Pontiac MI - B0064607.2013

TestAmerica Job ID: 240-28188-1

Method	Method Description	Protocol	Laboratory
8260B	Volatile Organic Compounds (GC/MS)	SW846	TAL CAN
8270C	Semivolatile Organic Compounds (GC/MS)	SW846	TAL CAN
8082	Polychlorinated Biphenyls (PCBs) by Gas Chromatography	SW846	TAL CAN
6010B	Metals (ICP)	SW846	TAL CAN
7471A	Mercury (CVAA)	SW846	TAL CAN

Protocol References:

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

TAL CAN = TestAmerica Canton, 4101 Shuffel Street NW, North Canton, OH 44720, TEL (330)497-9396

Sample Summary

Client: ARCADIS U.S., Inc.
Project/Site: Racer PNC Pontiac MI - B0064607.2013

TestAmerica Job ID: 240-28188-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
240-28188-1	MWM2-29_LNAPL	Waste	08/19/13 15:00	08/22/13 09:10

Detection Summary

Client: ARCADIS U.S., Inc.
Project/Site: Racer PNC Pontiac MI - B0064607.2013

TestAmerica Job ID: 240-28188-1

Client Sample ID: MWM2-29_LNAPL

Lab Sample ID: 240-28188-1

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Benzene	380	J	1100	14	ug/Kg	1		8260B	Total/NA
cis-1,2-Dichloroethene	740	J	1100	7.8	ug/Kg	1		8260B	Total/NA
1,2-Dichlorobenzene	2100		1100	9.8	ug/Kg	1		8260B	Total/NA
1,1-Dichloroethane	18000		1100	19	ug/Kg	1		8260B	Total/NA
Ethylbenzene	7800		1100	6.1	ug/Kg	1		8260B	Total/NA
Isopropylbenzene	6000		1100	7.4	ug/Kg	1		8260B	Total/NA
Methylcyclohexane	7800		1100	14	ug/Kg	1		8260B	Total/NA
Methylene Chloride	510	J	1100	88	ug/Kg	1		8260B	Total/NA
Tetrachloroethene	3000		1100	14	ug/Kg	1		8260B	Total/NA
Toluene	16000	B	1100	19	ug/Kg	1		8260B	Total/NA
Trichloroethene	390	J	1100	11	ug/Kg	1		8260B	Total/NA
1,1,2-Trichloro-1,2,2-trifluoroethane	32000		2300	44	ug/Kg	1		8260B	Total/NA
Vinyl chloride	1000	J	2300	20	ug/Kg	1		8260B	Total/NA
Xylenes, Total	26000		2300	7.0	ug/Kg	1		8260B	Total/NA
Acenaphthene	44000	J	400000	1100	ug/Kg	20		8270C	Total/NA
Anthracene	140000	J	400000	2800	ug/Kg	20		8270C	Total/NA
Benzo[a]anthracene	33000	J	400000	1700	ug/Kg	20		8270C	Total/NA
1,1'-Biphenyl	20000	J	400000	8600	ug/Kg	20		8270C	Total/NA
Chrysene	22000	J	400000	1200	ug/Kg	20		8270C	Total/NA
Fluoranthene	140000	J	400000	1100	ug/Kg	20		8270C	Total/NA
Fluorene	260000	J	400000	1600	ug/Kg	20		8270C	Total/NA
2-Methylnaphthalene	240000	J	400000	1200	ug/Kg	20		8270C	Total/NA
Naphthalene	91000	J	400000	1100	ug/Kg	20		8270C	Total/NA
Phenanthrene	800000		400000	1300	ug/Kg	20		8270C	Total/NA
Pyrene	210000	J	400000	1200	ug/Kg	20		8270C	Total/NA
Aroclor-1242	2000000		510000	150000	ug/Kg	500		8082	Total/NA
Arsenic	8.7		0.98	0.29	mg/Kg	1		6010B	Total/NA
Barium	8.9	J B	20	0.070	mg/Kg	1		6010B	Total/NA
Cadmium	0.10	J	0.20	0.035	mg/Kg	1		6010B	Total/NA
Chromium	3.7		0.49	0.20	mg/Kg	1		6010B	Total/NA
Copper	10		2.5	0.73	mg/Kg	1		6010B	Total/NA
Lead	4.7		0.29	0.19	mg/Kg	1		6010B	Total/NA
Manganese	0.53	J B	1.5	0.073	mg/Kg	1		6010B	Total/NA
Nickel	9.1		3.9	0.26	mg/Kg	1		6010B	Total/NA
Vanadium	0.39	J	4.9	0.12	mg/Kg	1		6010B	Total/NA
Zinc	2.8		2.0	0.98	mg/Kg	1		6010B	Total/NA

This Detection Summary does not include radiochemical test results.

Client: ARCADIS U.S., Inc.
Project/Site: Racer PNC Pontiac MI - B0064607.2013

TestAmerica Job ID: 240-28188-1

Client Sample ID: MWM2-29_LNAPL
Date Collected: 08/19/13 15:00
Date Received: 08/22/13 09:10

Lab Sample ID: 240-28188-1
Matrix: Waste

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	4500	U	4500	190	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
Benzene	**380**	**J**	1100	14	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
Bromodichloromethane	1100	U	1100	11	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
Bromoform	1100	U	1100	22	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
Bromomethane	2300	U	2300	33	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
2-Butanone (MEK)	4500	U	4500	49	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
Carbon disulfide	1100	U	1100	14	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
Carbon tetrachloride	1100	U	1100	7.3	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
Chlorobenzene	1100	U	1100	7.3	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
Chloroethane	2300	U	2300	69	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
Chloroform	1100	U	1100	10	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
Chloromethane	2300	U	2300	16	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
cis-1,2-Dichloroethene	**740**	**J**	1100	7.8	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
cis-1,3-Dichloropropene	1100	U	1100	9.0	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
Cyclohexane	2300	U	2300	45	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
Dibromochloromethane	1100	U	1100	14	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
1,2-Dibromo-3-Chloropropane	1100	U	1100	57	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
1,2-Dibromoethane	1100	U	1100	11	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
1,2-Dichlorobenzene	**2100**		1100	9.8	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
1,3-Dichlorobenzene	1100	U	1100	5.5	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
1,4-Dichlorobenzene	1100	U	1100	9.1	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
Dichlorodifluoromethane	2300	U	2300	18	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
1,1-Dichloroethane	**18000**		1100	19	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
1,2-Dichloroethane	1100	U *	1100	11	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
1,1-Dichloroethene	1100	U	1100	20	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
1,2-Dichloropropane	1100	U	1100	9.3	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
Ethylbenzene	**7800**		1100	6.1	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
2-Hexanone	4500	U	4500	23	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
Isopropylbenzene	**6000**		1100	7.4	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
Methyl acetate	2300	U	2300	28	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
Methylcyclohexane	**7800**		1100	14	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
Methylene Chloride	**510**	**J**	1100	88	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
4-Methyl-2-pentanone (MIBK)	4500	U	4500	55	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
Methyl tert-butyl ether	4500	U	4500	8.1	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
Styrene	1100	U	1100	6.4	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
1,1,2,2-Tetrachloroethane	1100	U	1100	10	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
Tetrachloroethene	**3000**		1100	14	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
Toluene	**16000**	**B**	1100	19	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
trans-1,2-Dichloroethene	1100	U *	1100	10	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
trans-1,3-Dichloropropene	1100	U	1100	23	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
1,2,4-Trichlorobenzene	1100	U	1100	8.3	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
1,1,1-Trichloroethane	1100	U	1100	24	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
1,1,2-Trichloroethane	1100	U	1100	14	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
Trichloroethene	**390**	**J**	1100	11	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
Trichlorofluoromethane	2300	U	2300	18	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
1,1,2-Trichloro-1,2,2-trifluoroethane	**32000**		2300	44	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
Vinyl chloride	**1000**	**J**	2300	20	ug/Kg		08/26/13 15:35	08/26/13 22:00	1
Xylenes, Total	**26000**		2300	7.0	ug/Kg		08/26/13 15:35	08/26/13 22:00	1

Client Sample ID: MWM2-29_LNAPL
Date Collected: 08/19/13 15:00
Date Received: 08/22/13 09:10

Lab Sample ID: 240-28188-1
Matrix: Waste

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
4-Bromofluorobenzene (Surr)	*105*		*26 - 141*	*08/26/13 15:35*	*08/26/13 22:00*	*1*
Dibromofluoromethane (Surr)	*97*		*30 - 122*	*08/26/13 15:35*	*08/26/13 22:00*	*1*
1,2-Dichloroethane-d4 (Surr)	*109*		*39 - 128*	*08/26/13 15:35*	*08/26/13 22:00*	*1*
Toluene-d8 (Surr)	*92*		*33 - 134*	*08/26/13 15:35*	*08/26/13 22:00*	*1*

Method: 8270C - Semivolatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acenaphthene	**44000**	**J**	400000	1100	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Acenaphthylene	400000	U	400000	1700	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Acetophenone	400000	U	400000	6600	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Anthracene	**140000**	**J**	400000	2800	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Atrazine	400000	U	400000	13000	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Benzaldehyde	400000	U	400000	8300	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Benzo[a]anthracene	**33000**	**J**	400000	1700	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Benzo[a]pyrene	400000	U	400000	2800	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Benzo[b]fluoranthene	400000	U	400000	2800	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Benzo[g,h,i]perylene	400000	U	400000	2200	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Benzo[k]fluoranthene	400000	U	400000	2800	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
1,1'-Biphenyl	**20000**	**J**	400000	8600	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Bis(2-chloroethoxy)methane	400000	U	400000	19000	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Bis(2-chloroethyl)ether	400000	U	400000	4900	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Bis(2-ethylhexyl) phthalate	400000	U	400000	19000	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
4-Bromophenyl phenyl ether	400000	U	400000	5600	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Butyl benzyl phthalate	400000	U	400000	4400	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Caprolactam	400000	U	400000	9400	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Carbazole	400000	U	400000	11000	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
4-Chloroaniline	400000	U	400000	6200	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
4-Chloro-3-methylphenol	400000	U	400000	61000	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
2-Chloronaphthalene	400000	U	400000	7600	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
2-Chlorophenol	400000	U	400000	4300	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
4-Chlorophenyl phenyl ether	400000	U	400000	4300	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Chrysene	**22000**	**J**	400000	1200	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Dibenz(a,h)anthracene	400000	U	400000	1800	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Dibenzofuran	400000	U	400000	1000	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
3,3'-Dichlorobenzidine	1900000	U	1900000	5900	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
2,4-Dichlorophenol	400000	U	400000	6400	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Diethyl phthalate	400000	U	400000	7400	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
2,4-Dimethylphenol	400000	U *	400000	8200	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Dimethyl phthalate	400000	U	400000	7700	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Di-n-butyl phthalate	400000	U	400000	6000	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
4,6-Dinitro-2-methylphenol	1900000	U	1900000	56000	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
2,4-Dinitrophenol	1900000	U	1900000	49000	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
2,4-Dinitrotoluene	400000	U	400000	6800	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
2,6-Dinitrotoluene	400000	U	400000	7000	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Di-n-octyl phthalate	400000	U	400000	13000	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Fluoranthene	**140000**	**J**	400000	1100	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Fluorene	**260000**	**J**	400000	1600	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Hexachlorobenzene	400000	U	400000	1700	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Hexachlorobutadiene	400000	U	400000	3000	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Hexachlorocyclopentadiene	1900000	U	1900000	3500	ug/Kg		08/22/13 15:34	08/26/13 21:34	20

Client Sample ID: MWM2-29_LNAPL
Date Collected: 08/19/13 15:00
Date Received: 08/22/13 09:10

Lab Sample ID: 240-28188-1
Matrix: Waste

Method: 8270C - Semivolatile Organic Compounds (GC/MS) (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Hexachloroethane	400000	U	400000	5900	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Indeno[1,2,3-cd]pyrene	400000	U	400000	2400	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Isophorone	400000	U	400000	4200	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
2-Methylnaphthalene	**240000**	**J**	400000	1200	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
2-Methylphenol	400000	U	400000	8000	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
3 & 4 Methylphenol	800000	U	800000	24000	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Naphthalene	**91000**	**J**	400000	1100	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
2-Nitroaniline	1900000	U	1900000	6100	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
3-Nitroaniline	1900000	U	1900000	3800	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
4-Nitroaniline	1900000	U	1900000	4300	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Nitrobenzene	400000	U	400000	7700	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
2-Nitrophenol	400000	U	400000	4100	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
4-Nitrophenol	1900000	U	1900000	97000	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
N-Nitrosodi-n-propylamine	400000	U	400000	9100	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
N-Nitrosodiphenylamine	400000	U	400000	4900	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
2,2'-oxybis[1-chloropropane]	400000	U	400000	6200	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Pentachlorophenol	400000	U	400000	54000	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Phenanthrene	**800000**		400000	1300	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Phenol	400000	U	400000	6800	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
Pyrene	**210000**	**J**	400000	1200	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
2,4,5-Trichlorophenol	400000	U	400000	5900	ug/Kg		08/22/13 15:34	08/26/13 21:34	20
2,4,6-Trichlorophenol	400000	U	400000	8200	ug/Kg		08/22/13 15:34	08/26/13 21:34	20

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
2-Fluorobiphenyl (Surr)	*95*		*51 - 112*	*08/22/13 15:34*	*08/26/13 21:34*	*20*
2-Fluorophenol (Surr)	*92*		*18 - 164*	*08/22/13 15:34*	*08/26/13 21:34*	*20*
Nitrobenzene-d5 (Surr)	*141*	*X*	*59 - 122*	*08/22/13 15:34*	*08/26/13 21:34*	*20*
Phenol-d5 (Surr)	*87*		*24 - 153*	*08/22/13 15:34*	*08/26/13 21:34*	*20*
Terphenyl-d14 (Surr)	*116*		*44 - 136*	*08/22/13 15:34*	*08/26/13 21:34*	*20*
2,4,6-Tribromophenol (Surr)	*74*		*23 - 134*	*08/22/13 15:34*	*08/26/13 21:34*	*20*

Method: 8082 - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aroclor-1016	510000	U	510000	97000	ug/Kg		08/22/13 15:19	08/23/13 14:03	500
Aroclor-1221	510000	U	510000	110000	ug/Kg		08/22/13 15:19	08/23/13 14:03	500
Aroclor-1232	510000	U	510000	87000	ug/Kg		08/22/13 15:19	08/23/13 14:03	500
Aroclor-1242	**2000000**		510000	150000	ug/Kg		08/22/13 15:19	08/23/13 14:03	500
Aroclor-1248	510000	U	510000	100000	ug/Kg		08/22/13 15:19	08/23/13 14:03	500
Aroclor-1254	510000	U	510000	61000	ug/Kg		08/22/13 15:19	08/23/13 14:03	500
Aroclor-1260	510000	U	510000	66000	ug/Kg		08/22/13 15:19	08/23/13 14:03	500

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
DCB Decachlorobiphenyl	*0*	*X*	*13 - 185*	*08/22/13 15:19*	*08/23/13 14:03*	*500*
Tetrachloro-m-xylene	*0*	*X*	*29 - 173*	*08/22/13 15:19*	*08/23/13 14:03*	*500*

Method: 6010B - Metals (ICP)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	0.98	U	0.98	0.38	mg/Kg		08/22/13 12:05	08/23/13 17:07	1
Arsenic	**8.7**		0.98	0.29	mg/Kg		08/22/13 12:05	08/23/13 17:07	1
Barium	**8.9**	**J B**	20	0.070	mg/Kg		08/22/13 12:05	08/23/13 17:07	1

Client: ARCADIS U.S., Inc.
Project/Site: Racer PNC Pontiac MI - B0064607.2013

TestAmerica Job ID: 240-28188-1

Client Sample ID: MWM2-29_LNAPL
Date Collected: 08/19/13 15:00
Date Received: 08/22/13 09:10

Lab Sample ID: 240-28188-1
Matrix: Waste

Method: 6010B - Metals (ICP) (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Beryllium	0.49	U	0.49	0.042	mg/Kg		08/22/13 12:05	08/23/13 17:07	1
Cadmium	**0.10**	**J**	0.20	0.035	mg/Kg		08/22/13 12:05	08/23/13 17:07	1
Chromium	**3.7**		0.49	0.20	mg/Kg		08/22/13 12:05	08/23/13 17:07	1
Cobalt	4.9	U	4.9	0.16	mg/Kg		08/22/13 12:05	08/23/13 17:07	1
Copper	**10**		2.5	0.73	mg/Kg		08/22/13 12:05	08/23/13 17:07	1
Lead	**4.7**		0.29	0.19	mg/Kg		08/22/13 12:05	08/23/13 17:07	1
Manganese	**0.53**	**J B**	1.5	0.073	mg/Kg		08/22/13 12:05	08/23/13 17:07	1
Nickel	**9.1**		3.9	0.26	mg/Kg		08/22/13 12:05	08/23/13 17:07	1
Selenium	0.49	U	0.49	0.44	mg/Kg		08/22/13 12:05	08/23/13 17:07	1
Silver	0.49	U	0.49	0.098	mg/Kg		08/22/13 12:05	08/23/13 17:07	1
Thallium	0.98	U	0.98	0.54	mg/Kg		08/22/13 12:05	08/23/13 17:07	1
Vanadium	**0.39**	**J**	4.9	0.12	mg/Kg		08/22/13 12:05	08/23/13 17:07	1
Zinc	**2.8**		2.0	0.98	mg/Kg		08/22/13 12:05	08/23/13 17:07	1

Method: 7471A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	0.10	U	0.10	0.015	mg/Kg		08/22/13 14:10	08/23/13 12:11	1

Client: ARCADIS U.S., Inc.
Project/Site: Racer PNC Pontiac MI - B0064607.2013

TestAmerica Job ID: 240-28188-1

Method: 8260B - Volatile Organic Compounds (GC/MS)

Matrix: Waste **Prep Type: Total/NA**

		Percent Surrogate Recovery (Acceptance Limits)			
		BFB	DBFM	12DCE	TOL
Lab Sample ID	Client Sample ID	(26-141)	(30-122)	(39-128)	(33-134)
240-28188-1	MWM2-29_LNAPL	105	97	109	92
LCS 240-99013/2-A	Lab Control Sample	133	101	124	121
MB 240-99013/1-A	Method Blank	115	110	118	113

Surrogate Legend

BFB = 4-Bromofluorobenzene (Surr)
DBFM = Dibromofluoromethane (Surr)
12DCE = 1,2-Dichloroethane-d4 (Surr)
TOL = Toluene-d8 (Surr)

Method: 8270C - Semivolatile Organic Compounds (GC/MS)

Matrix: Waste **Prep Type: Total/NA**

		Percent Surrogate Recovery (Acceptance Limits)					
		FBP	2FP	NBZ	PHL	TPH	TBP
Lab Sample ID	Client Sample ID	(51-112)	(18-164)	(59-122)	(24-153)	(44-136)	(23-134)
240-28188-1	MWM2-29_LNAPL	95	92	141 X	87	116	74
240-28188-1 MS	MWM2-29_LNAPL	92	93	137 X	95	110	97
240-28188-1 MSD	MWM2-29_LNAPL	92	98	141 X	107	119	79
LCS 240-98601/5-A	Lab Control Sample	96	96	96	100	109	101
MB 240-98601/4-A	Method Blank	85	87	81	90	101	82

Surrogate Legend

FBP = 2-Fluorobiphenyl (Surr)
2FP = 2-Fluorophenol (Surr)
NBZ = Nitrobenzene-d5 (Surr)
PHL = Phenol-d5 (Surr)
TPH = Terphenyl-d14 (Surr)
TBP = 2,4,6-Tribromophenol (Surr)

Method: 8082 - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Matrix: Waste **Prep Type: Total/NA**

		Percent Surrogate Recovery (Acceptance Limits)	
		DCB2	TCX2
Lab Sample ID	Client Sample ID	(13-185)	(29-173)
240-28188-1	MWM2-29_LNAPL	0 X	0 X
240-28188-1 MS	MWM2-29_LNAPL	0 X	0 X
240-28188-1 MSD	MWM2-29_LNAPL	0 X	0 X
LCS 240-98599/5-A	Lab Control Sample	137	126
MB 240-98599/4-A	Method Blank	114	110

Surrogate Legend

DCB = DCB Decachlorobiphenyl
TCX = Tetrachloro-m-xylene

Method: 8260B - Volatile Organic Compounds (GC/MS)

Lab Sample ID: MB 240-99013/1-A
Matrix: Waste
Analysis Batch: 99034

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 99013

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	4000	U	4000	170	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
Benzene	1000	U	1000	12	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
Bromodichloromethane	1000	U	1000	9.9	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
Bromoform	1000	U	1000	19	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
Bromomethane	2000	U	2000	29	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
2-Butanone (MEK)	4000	U	4000	43	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
Carbon disulfide	1000	U	1000	12	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
Carbon tetrachloride	1000	U	1000	6.4	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
Chlorobenzene	1000	U	1000	6.4	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
Chloroethane	2000	U	2000	61	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
Chloroform	1000	U	1000	8.8	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
Chloromethane	2000	U	2000	14	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
cis-1,2-Dichloroethene	1000	U	1000	6.9	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
cis-1,3-Dichloropropene	1000	U	1000	7.9	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
Cyclohexane	2000	U	2000	40	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
Dibromochloromethane	1000	U	1000	12	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
1,2-Dibromo-3-Chloropropane	1000	U	1000	50	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
1,2-Dibromoethane	1000	U	1000	10	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
1,2-Dichlorobenzene	1000	U	1000	8.6	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
1,3-Dichlorobenzene	1000	U	1000	4.8	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
1,4-Dichlorobenzene	1000	U	1000	8.0	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
Dichlorodifluoromethane	2000	U	2000	16	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
1,1-Dichloroethane	1000	U	1000	17	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
1,2-Dichloroethane	1000	U	1000	10	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
1,1-Dichloroethene	1000	U	1000	18	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
1,2-Dichloropropane	1000	U	1000	8.2	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
Ethylbenzene	1000	U	1000	5.4	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
2-Hexanone	4000	U	4000	20	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
Isopropylbenzene	1000	U	1000	6.5	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
Methyl acetate	2000	U	2000	25	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
Methylcyclohexane	1000	U	1000	12	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
Methylene Chloride	1000	U	1000	77	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
4-Methyl-2-pentanone (MIBK)	4000	U	4000	48	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
Methyl tert-butyl ether	4000	U	4000	7.1	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
Styrene	1000	U	1000	5.6	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
1,1,2,2-Tetrachloroethane	1000	U	1000	8.9	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
Tetrachloroethene	1000	U	1000	12	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
Toluene	704	J	1000	17	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
trans-1,2-Dichloroethene	1000	U	1000	9.2	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
trans-1,3-Dichloropropene	1000	U	1000	20	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
1,2,4-Trichlorobenzene	1000	U	1000	7.3	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
1,1,1-Trichloroethane	1000	U	1000	21	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
1,1,2-Trichloroethane	1000	U	1000	12	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
Trichloroethene	1000	U	1000	9.7	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
Trichlorofluoromethane	2000	U	2000	16	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
1,1,2-Trichloro-1,2,2-trifluoroethane	2000	U	2000	39	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
Vinyl chloride	2000	U	2000	18	ug/Kg		08/26/13 15:35	08/26/13 21:36	1
Xylenes, Total	2000	U	2000	6.2	ug/Kg		08/26/13 15:35	08/26/13 21:36	1

Method: 8260B - Volatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: MB 240-99013/1-A
Matrix: Waste
Analysis Batch: 99034

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 99013

Surrogate	MB %Recovery	MB Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	115		26 - 141	08/26/13 15:35	08/26/13 21:36	1
Dibromofluoromethane (Surr)	110		30 - 122	08/26/13 15:35	08/26/13 21:36	1
1,2-Dichloroethane-d4 (Surr)	118		39 - 128	08/26/13 15:35	08/26/13 21:36	1
Toluene-d8 (Surr)	113		33 - 134	08/26/13 15:35	08/26/13 21:36	1

Lab Sample ID: LCS 240-99013/2-A
Matrix: Waste
Analysis Batch: 99034

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 99013

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Acetone	10000	12000		ug/Kg		120	16 - 156
Benzene	5000	5430		ug/Kg		109	70 - 117
Bromodichloromethane	5000	4730		ug/Kg		95	28 - 123
Bromoform	5000	3840		ug/Kg		77	10 - 117
Bromomethane	5000	5430		ug/Kg		109	10 - 114
2-Butanone (MEK)	10000	12200		ug/Kg		122	10 - 199
Carbon disulfide	5000	5120		ug/Kg		102	10 - 132
Carbon tetrachloride	5000	5050		ug/Kg		101	29 - 118
Chlorobenzene	5000	5290		ug/Kg		106	71 - 116
Chloroethane	5000	5400		ug/Kg		108	10 - 120
Chloroform	5000	5240		ug/Kg		105	63 - 116
Chloromethane	5000	5400		ug/Kg		108	25 - 110
cis-1,2-Dichloroethene	5000	5970		ug/Kg		119	60 - 125
cis-1,3-Dichloropropene	5000	4950		ug/Kg		99	25 - 120
Cyclohexane	5000	4740		ug/Kg		95	40 - 120
Dibromochloromethane	5000	4090		ug/Kg		82	22 - 113
1,2-Dibromo-3-Chloropropane	5000	4090		ug/Kg		82	10 - 129
1,2-Dibromoethane	5000	4890		ug/Kg		98	47 - 123
1,2-Dichlorobenzene	5000	5510		ug/Kg		110	68 - 118
1,3-Dichlorobenzene	5000	5140		ug/Kg		103	66 - 121
1,4-Dichlorobenzene	5000	5570		ug/Kg		111	65 - 119
Dichlorodifluoromethane	5000	4210		ug/Kg		84	10 - 110
1,1-Dichloroethane	5000	5580		ug/Kg		112	63 - 117
1,2-Dichloroethane	5000	6040	*	ug/Kg		121	68 - 119
1,1-Dichloroethene	5000	5770		ug/Kg		115	44 - 143
1,2-Dichloropropane	5000	5280		ug/Kg		106	73 - 113
Ethylbenzene	5000	5170		ug/Kg		103	66 - 119
2-Hexanone	10000	11500		ug/Kg		115	43 - 130
Isopropylbenzene	5000	5530		ug/Kg		111	61 - 123
Methyl acetate	25000	29700		ug/Kg		119	44 - 173
Methylcyclohexane	5000	5460		ug/Kg		109	41 - 133
Methylene Chloride	5000	6090		ug/Kg		122	27 - 172
4-Methyl-2-pentanone (MIBK)	10000	11800		ug/Kg		118	49 - 121
Methyl tert-butyl ether	5000	5440		ug/Kg		109	34 - 157
m-Xylene & p-Xylene	5000	5270		ug/Kg		105	67 - 118
o-Xylene	5000	5370		ug/Kg		107	68 - 120
Styrene	5000	4720		ug/Kg		94	60 - 120
1,1,2,2-Tetrachloroethane	5000	5540		ug/Kg		111	54 - 121

Method: 8260B - Volatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: LCS 240-99013/2-A
Matrix: Waste
Analysis Batch: 99034

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 99013

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Tetrachloroethene	5000	5690		ug/Kg		114	58 - 131
Toluene	5000	5770		ug/Kg		115	66 - 123
trans-1,2-Dichloroethene	5000	6250	*	ug/Kg		125	58 - 121
trans-1,3-Dichloropropene	5000	5460		ug/Kg		109	22 - 122
1,2,4-Trichlorobenzene	5000	4800		ug/Kg		96	41 - 135
1,1,1-Trichloroethane	5000	5360		ug/Kg		107	38 - 122
1,1,2-Trichloroethane	5000	5350		ug/Kg		107	74 - 114
Trichloroethene	5000	5010		ug/Kg		100	59 - 124
Trichlorofluoromethane	5000	5850		ug/Kg		117	17 - 145
1,1,2-Trichloro-1,2,2-trifluoroethane	5000	4520		ug/Kg		90	48 - 151
Vinyl chloride	5000	4980		ug/Kg		100	33 - 110
Xylenes, Total	10000	10600		ug/Kg		106	68 - 119

Surrogate	*LCS %Recovery*	*LCS Qualifier*	*Limits*
4-Bromofluorobenzene (Surr)	*133*		*26 - 141*
Dibromofluoromethane (Surr)	*101*		*30 - 122*
1,2-Dichloroethane-d4 (Surr)	*124*		*39 - 128*
Toluene-d8 (Surr)	*121*		*33 - 134*

Method: 8270C - Semivolatile Organic Compounds (GC/MS)

Lab Sample ID: MB 240-98601/4-A
Matrix: Waste
Analysis Batch: 98896

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 98601

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acenaphthene	20000	U	20000	55	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Acenaphthylene	20000	U	20000	84	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Acetophenone	20000	U	20000	330	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Anthracene	20000	U	20000	140	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Atrazine	20000	U	20000	660	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Benzaldehyde	20000	U	20000	410	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Benzo[a]anthracene	20000	U	20000	84	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Benzo[a]pyrene	20000	U	20000	140	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Benzo[b]fluoranthene	20000	U	20000	140	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Benzo[g,h,i]perylene	20000	U	20000	110	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Benzo[k]fluoranthene	20000	U	20000	140	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
1,1'-Biphenyl	20000	U	20000	430	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Bis(2-chloroethoxy)methane	20000	U	20000	960	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Bis(2-chloroethyl)ether	20000	U	20000	250	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Bis(2-ethylhexyl) phthalate	20000	U	20000	960	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
4-Bromophenyl phenyl ether	20000	U	20000	280	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Butyl benzyl phthalate	20000	U	20000	220	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Caprolactam	20000	U	20000	470	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Carbazole	20000	U	20000	560	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
4-Chloroaniline	20000	U	20000	310	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
4-Chloro-3-methylphenol	20000	U	20000	3100	ug/Kg		08/22/13 15:34	08/26/13 20:17	1

Client: ARCADIS U.S., Inc.
Project/Site: Racer PNC Pontiac MI - B0064607.2013

TestAmerica Job ID: 240-28188-1

Method: 8270C - Semivolatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: MB 240-98601/4-A
Matrix: Waste
Analysis Batch: 98896

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 98601

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
2-Chloronaphthalene	20000	U	20000	380	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
2-Chlorophenol	20000	U	20000	220	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
4-Chlorophenyl phenyl ether	20000	U	20000	220	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Chrysene	20000	U	20000	59	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Dibenz(a,h)anthracene	20000	U	20000	90	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Dibenzofuran	20000	U	20000	50	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
3,3'-Dichlorobenzidine	96000	U	96000	290	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
2,4-Dichlorophenol	20000	U	20000	320	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Diethyl phthalate	20000	U	20000	370	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
2,4-Dimethylphenol	20000	U	20000	410	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Dimethyl phthalate	20000	U	20000	380	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Di-n-butyl phthalate	20000	U	20000	300	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
4,6-Dinitro-2-methylphenol	96000	U	96000	2800	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
2,4-Dinitrophenol	96000	U	96000	2500	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
2,4-Dinitrotoluene	20000	U	20000	340	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
2,6-Dinitrotoluene	20000	U	20000	350	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Di-n-octyl phthalate	20000	U	20000	660	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Fluoranthene	20000	U	20000	56	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Fluorene	20000	U	20000	78	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Hexachlorobenzene	20000	U	20000	84	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Hexachlorobutadiene	20000	U	20000	150	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Hexachlorocyclopentadiene	96000	U	96000	170	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Hexachloroethane	20000	U	20000	290	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Indeno[1,2,3-cd]pyrene	20000	U	20000	120	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Isophorone	20000	U	20000	210	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
2-Methylnaphthalene	20000	U	20000	59	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
2-Methylphenol	20000	U	20000	400	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
3 & 4 Methylphenol	40000	U	40000	1200	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Naphthalene	20000	U	20000	53	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
2-Nitroaniline	96000	U	96000	310	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
3-Nitroaniline	96000	U	96000	190	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
4-Nitroaniline	96000	U	96000	220	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Nitrobenzene	20000	U	20000	380	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
2-Nitrophenol	20000	U	20000	200	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
4-Nitrophenol	96000	U	96000	4900	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
N-Nitrosodi-n-propylamine	20000	U	20000	460	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
N-Nitrosodiphenylamine	20000	U	20000	250	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
2,2'-oxybis[1-chloropropane]	20000	U	20000	310	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Pentachlorophenol	20000	U	20000	2700	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Phenanthrene	20000	U	20000	66	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Phenol	20000	U	20000	340	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
Pyrene	20000	U	20000	60	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
2,4,5-Trichlorophenol	20000	U	20000	290	ug/Kg		08/22/13 15:34	08/26/13 20:17	1
2,4,6-Trichlorophenol	20000	U	20000	410	ug/Kg		08/22/13 15:34	08/26/13 20:17	1

Surrogate	*MB %Recovery*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
2-Fluorobiphenyl (Surr)	*85*		*51 - 112*	*08/22/13 15:34*	*08/26/13 20:17*	*1*
2-Fluorophenol (Surr)	*87*		*18 - 164*	*08/22/13 15:34*	*08/26/13 20:17*	*1*

Method: 8270C - Semivolatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: MB 240-98601/4-A
Matrix: Waste
Analysis Batch: 98896

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 98601

Surrogate	MB %Recovery	MB Qualifier	Limits	Prepared	Analyzed	Dil Fac
Nitrobenzene-d5 (Surr)	81		59 - 122	08/22/13 15:34	08/26/13 20:17	1
Phenol-d5 (Surr)	90		24 - 153	08/22/13 15:34	08/26/13 20:17	1
Terphenyl-d14 (Surr)	101		44 - 136	08/22/13 15:34	08/26/13 20:17	1
2,4,6-Tribromophenol (Surr)	82		23 - 134	08/22/13 15:34	08/26/13 20:17	1

Lab Sample ID: LCS 240-98601/5-A
Matrix: Waste
Analysis Batch: 99097

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 98601

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Acenaphthene	50000	45900		ug/Kg		92	64 - 110
Acenaphthylene	50000	43700		ug/Kg		87	67 - 110
Acetophenone	50000	48000		ug/Kg		96	62 - 124
Anthracene	50000	46700		ug/Kg		93	64 - 110
Atrazine	100000	109000		ug/Kg		109	63 - 134
Benzaldehyde	100000	81800		ug/Kg		82	45 - 150
Benzo[a]anthracene	50000	46000		ug/Kg		92	60 - 110
Benzo[a]pyrene	50000	47200		ug/Kg		94	56 - 110
Benzo[b]fluoranthene	50000	44400		ug/Kg		89	55 - 110
Benzo[g,h,i]perylene	50000	46500		ug/Kg		93	64 - 110
Benzo[k]fluoranthene	50000	48900		ug/Kg		98	62 - 112
1,1'-Biphenyl	50000	46700		ug/Kg		93	61 - 110
Bis(2-chloroethoxy)methane	50000	47400		ug/Kg		95	63 - 113
Bis(2-chloroethyl)ether	50000	48900		ug/Kg		98	57 - 131
Bis(2-ethylhexyl) phthalate	50000	47500		ug/Kg		95	56 - 110
4-Bromophenyl phenyl ether	50000	48300		ug/Kg		97	62 - 110
Butyl benzyl phthalate	50000	47400		ug/Kg		95	59 - 110
Caprolactam	100000	99000		ug/Kg		99	60 - 116
Carbazole	50000	49800		ug/Kg		100	63 - 110
4-Chloroaniline	50000	42900		ug/Kg		86	21 - 110
4-Chloro-3-methylphenol	50000	44700		ug/Kg		89	67 - 110
2-Chloronaphthalene	50000	47600		ug/Kg		95	66 - 110
2-Chlorophenol	50000	46300		ug/Kg		93	68 - 116
4-Chlorophenyl phenyl ether	50000	47300		ug/Kg		95	64 - 110
Chrysene	50000	45500		ug/Kg		91	63 - 110
Dibenz(a,h)anthracene	50000	45500		ug/Kg		91	62 - 110
Dibenzofuran	50000	45600		ug/Kg		91	67 - 110
3,3'-Dichlorobenzidine	100000	91300	J	ug/Kg		91	25 - 110
2,4-Dichlorophenol	50000	47400		ug/Kg		95	69 - 110
Diethyl phthalate	50000	47000		ug/Kg		94	65 - 110
2,4-Dimethylphenol	50000	59000	*	ug/Kg		118	56 - 110
Dimethyl phthalate	50000	46100		ug/Kg		92	69 - 110
Di-n-butyl phthalate	50000	49800		ug/Kg		100	65 - 110
4,6-Dinitro-2-methylphenol	100000	74800	J	ug/Kg		75	30 - 110
2,4-Dinitrophenol	100000	67300	J	ug/Kg		67	10 - 110
2,4-Dinitrotoluene	50000	47200		ug/Kg		94	67 - 110
2,6-Dinitrotoluene	50000	47900		ug/Kg		96	73 - 110
Di-n-octyl phthalate	50000	45900		ug/Kg		92	50 - 111

Method: 8270C - Semivolatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: LCS 240-98601/5-A
Matrix: Waste
Analysis Batch: 99097

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 98601

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Fluoranthene	50000	48800		ug/Kg		98	65 - 110
Fluorene	50000	45800		ug/Kg		92	66 - 110
Hexachlorobenzene	50000	48600		ug/Kg		97	65 - 110
Hexachlorobutadiene	50000	47300		ug/Kg		95	67 - 116
Hexachlorocyclopentadiene	50000	40700	J	ug/Kg		81	54 - 110
Hexachloroethane	50000	47100		ug/Kg		94	64 - 125
Indeno[1,2,3-cd]pyrene	50000	46300		ug/Kg		93	62 - 110
Isophorone	50000	46300		ug/Kg		93	68 - 112
2-Methylnaphthalene	50000	46700		ug/Kg		93	65 - 121
2-Methylphenol	50000	48000		ug/Kg		96	67 - 118
3 & 4 Methylphenol	50000	49000		ug/Kg		98	66 - 115
Naphthalene	50000	45900		ug/Kg		92	73 - 110
2-Nitroaniline	50000	49500	J	ug/Kg		99	57 - 117
3-Nitroaniline	50000	45000	J	ug/Kg		90	47 - 110
4-Nitroaniline	50000	46900	J	ug/Kg		94	58 - 110
Nitrobenzene	50000	48500		ug/Kg		97	62 - 121
2-Nitrophenol	50000	50400		ug/Kg		101	71 - 110
4-Nitrophenol	100000	106000		ug/Kg		106	26 - 128
N-Nitrosodi-n-propylamine	50000	47000		ug/Kg		94	61 - 127
N-Nitrosodiphenylamine	100000	92900		ug/Kg		93	62 - 110
2,2'-oxybis[1-chloropropane]	50000	47900		ug/Kg		96	49 - 141
Pentachlorophenol	100000	106000		ug/Kg		106	25 - 110
Phenanthrene	50000	46700		ug/Kg		93	64 - 110
Phenol	50000	49600		ug/Kg		99	68 - 117
Pyrene	50000	47300		ug/Kg		95	61 - 110
2,4,5-Trichlorophenol	50000	45900		ug/Kg		92	59 - 110
2,4,6-Trichlorophenol	50000	46900		ug/Kg		94	64 - 110

Surrogate	*LCS %Recovery*	*LCS Qualifier*	*Limits*
2-Fluorobiphenyl (Surr)	*96*		*51 - 112*
2-Fluorophenol (Surr)	*96*		*18 - 164*
Nitrobenzene-d5 (Surr)	*96*		*59 - 122*
Phenol-d5 (Surr)	*100*		*24 - 153*
Terphenyl-d14 (Surr)	*109*		*44 - 136*
2,4,6-Tribromophenol (Surr)	*101*		*23 - 134*

Lab Sample ID: 240-28188-1 MS
Matrix: Waste
Analysis Batch: 98896

Client Sample ID: MWM2-29_LNAPL
Prep Type: Total/NA
Prep Batch: 98601

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Acenaphthene	44000	J	50500	87700	J	ug/Kg		87	10 - 200
Acenaphthylene	400000	U	50500	50000	J	ug/Kg		99	10 - 200
Acetophenone	400000	U	50500	140000	J F	ug/Kg		277	50 - 130
Anthracene	140000	J	50500	191000	J	ug/Kg		104	10 - 200
Atrazine	400000	U	101000	107000	J	ug/Kg		106	50 - 130
Benzaldehyde	400000	U	101000	106000	J	ug/Kg		105	10 - 130
Benzo[a]anthracene	33000	J	50500	73400	J	ug/Kg		79	10 - 200

Method: 8270C - Semivolatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: 240-28188-1 MS
Matrix: Waste
Analysis Batch: 98896

Client Sample ID: MWM2-29_LNAPL
Prep Type: Total/NA
Prep Batch: 98601

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Benzo[a]pyrene	400000	U	50500	42900	J	ug/Kg		85	10 - 200
Benzo[b]fluoranthene	400000	U	50500	45400	J	ug/Kg		90	10 - 200
Benzo[g,h,i]perylene	400000	U	50500	39600	J	ug/Kg		78	10 - 200
Benzo[k]fluoranthene	400000	U	50500	44500	J	ug/Kg		88	10 - 200
1,1'-Biphenyl	20000	J	50500	65800	J	ug/Kg		90	50 - 130
Bis(2-chloroethoxy)methane	400000	U	50500	49600	J	ug/Kg		98	36 - 110
Bis(2-chloroethyl)ether	400000	U	50500	48700	J	ug/Kg		96	32 - 118
Bis(2-ethylhexyl) phthalate	400000	U	50500	85300	J	ug/Kg		169	10 - 200
4-Bromophenyl phenyl ether	400000	U	50500	47900	J	ug/Kg		95	44 - 120
Butyl benzyl phthalate	400000	U	50500	52600	J	ug/Kg		104	43 - 138
Caprolactam	400000	U	101000	400000	U F	ug/Kg		0	50 - 130
Carbazole	400000	U	50500	56600	J	ug/Kg		112	10 - 162
4-Chloroaniline	400000	U	50500	49500	J	ug/Kg		98	11 - 110
4-Chloro-3-methylphenol	400000	U	50500	400000	U	ug/Kg		NC	32 - 117
2-Chloronaphthalene	400000	U	50500	46300	J	ug/Kg		92	40 - 110
2-Chlorophenol	400000	U	50500	49700	J	ug/Kg		98	32 - 110
4-Chlorophenyl phenyl ether	400000	U	50500	51600	J	ug/Kg		102	47 - 116
Chrysene	22000	J	50500	63000	J	ug/Kg		81	10 - 200
Dibenz(a,h)anthracene	400000	U	50500	42200	J	ug/Kg		83	10 - 200
Dibenzofuran	400000	U	50500	53800	J	ug/Kg		107	10 - 200
3,3'-Dichlorobenzidine	1900000	U	101000	111000	J	ug/Kg		110	10 - 110
2,4-Dichlorophenol	400000	U	50500	48800	J	ug/Kg		97	33 - 110
Diethyl phthalate	400000	U	50500	54400	J	ug/Kg		108	48 - 118
2,4-Dimethylphenol	400000	U *	50500	68500	J F	ug/Kg		136	19 - 114
Dimethyl phthalate	400000	U	50500	48700	J	ug/Kg		96	47 - 116
Di-n-butyl phthalate	400000	U	50500	60500	J	ug/Kg		120	31 - 145
4,6-Dinitro-2-methylphenol	1900000	U	101000	1900000	U F	ug/Kg		0	10 - 110
2,4-Dinitrophenol	1900000	U	101000	219000	J F	ug/Kg		217	10 - 110
2,4-Dinitrotoluene	400000	U	50500	73600	J F	ug/Kg		146	42 - 118
2,6-Dinitrotoluene	400000	U	50500	31900	J	ug/Kg		63	28 - 137
Di-n-octyl phthalate	400000	U	50500	57300	J	ug/Kg		113	10 - 182
Fluoranthene	140000	J	50500	185000	J	ug/Kg		95	10 - 200
Fluorene	260000	J	50500	294000	J 4	ug/Kg		73	10 - 187
Hexachlorobenzene	400000	U	50500	35400	J	ug/Kg		70	37 - 122
Hexachlorobutadiene	400000	U	50500	44000	J	ug/Kg		87	30 - 110
Hexachlorocyclopentadiene	1900000	U	50500	1900000	U F	ug/Kg		0	10 - 110
Hexachloroethane	400000	U	50500	144000	J F	ug/Kg		284	13 - 110
Indeno[1,2,3-cd]pyrene	400000	U	50500	42500	J	ug/Kg		84	10 - 200
Isophorone	400000	U	50500	60300	J	ug/Kg		119	32 - 129
2-Methylnaphthalene	240000	J	50500	280000	J 4	ug/Kg		69	10 - 200
2-Methylphenol	400000	U	50500	48100	J	ug/Kg		95	19 - 124
3 & 4 Methylphenol	800000	U	50500	52800	J	ug/Kg		105	27 - 116
Naphthalene	91000	J	50500	133000	J	ug/Kg		84	10 - 200
2-Nitroaniline	1900000	U	50500	39400	J	ug/Kg		78	31 - 141
3-Nitroaniline	1900000	U	50500	37800	J	ug/Kg		75	27 - 110
4-Nitroaniline	1900000	U	50500	35000	J	ug/Kg		69	23 - 124
Nitrobenzene	400000	U	50500	50700	J	ug/Kg		100	33 - 111
2-Nitrophenol	400000	U	50500	48400	J	ug/Kg		96	17 - 110

Method: 8270C - Semivolatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: 240-28188-1 MS
Matrix: Waste
Analysis Batch: 98896

Client Sample ID: MWM2-29_LNAPL
Prep Type: Total/NA
Prep Batch: 98601

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
4-Nitrophenol	1900000	U	101000	1900000	U F	ug/Kg		0	10 - 125
N-Nitrosodi-n-propylamine	400000	U	50500	69400	J F	ug/Kg		137	30 - 121
N-Nitrosodiphenylamine	400000	U	101000	221000	J F	ug/Kg		219	10 - 169
2,2'-oxybis[1-chloropropane]	400000	U	50500	50900	J	ug/Kg		101	50 - 130
Pentachlorophenol	400000	U	101000	88100	J	ug/Kg		87	10 - 182
Phenanthrene	800000		50500	848000	4	ug/Kg		91	10 - 200
Phenol	400000	U	50500	49200	J	ug/Kg		97	10 - 144
Pyrene	210000	J	50500	240000	J 4	ug/Kg		57	10 - 200
2,4,5-Trichlorophenol	400000	U	50500	40200	J	ug/Kg		80	32 - 112
2,4,6-Trichlorophenol	400000	U	50500	38500	J	ug/Kg		76	22 - 110

Surrogate	*MS %Recovery*	*MS Qualifier*	*Limits*
2-Fluorobiphenyl (Surr)	*92*		*51 - 112*
2-Fluorophenol (Surr)	*93*		*18 - 164*
Nitrobenzene-d5 (Surr)	*137*	*X*	*59 - 122*
Phenol-d5 (Surr)	*95*		*24 - 153*
Terphenyl-d14 (Surr)	*110*		*44 - 136*
2,4,6-Tribromophenol (Surr)	*97*		*23 - 134*

Lab Sample ID: 240-28188-1 MSD
Matrix: Waste
Analysis Batch: 98896

Client Sample ID: MWM2-29_LNAPL
Prep Type: Total/NA
Prep Batch: 98601

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Acenaphthene	44000	J	51500	91700	J	ug/Kg		93	10 - 200	4	30
Acenaphthylene	400000	U	51500	49400	J	ug/Kg		96	10 - 200	1	30
Acetophenone	400000	U	51500	154000	J F	ug/Kg		299	50 - 130	10	30
Anthracene	140000	J	51500	217000	J	ug/Kg		153	10 - 200	13	30
Atrazine	400000	U	103000	129000	J	ug/Kg		125	50 - 130	19	30
Benzaldehyde	400000	U	103000	120000	J	ug/Kg		117	10 - 130	13	30
Benzo[a]anthracene	33000	J	51500	76800	J	ug/Kg		84	10 - 200	5	30
Benzo[a]pyrene	400000	U	51500	46900	J	ug/Kg		91	10 - 200	9	30
Benzo[b]fluoranthene	400000	U	51500	43800	J	ug/Kg		85	10 - 200	4	30
Benzo[g,h,i]perylene	400000	U	51500	42200	J	ug/Kg		82	10 - 200	6	30
Benzo[k]fluoranthene	400000	U	51500	42300	J	ug/Kg		82	10 - 200	5	30
1,1'-Biphenyl	20000	J	51500	67000	J	ug/Kg		91	50 - 130	2	30
Bis(2-chloroethoxy)methane	400000	U	51500	51900	J	ug/Kg		101	36 - 110	5	30
Bis(2-chloroethyl)ether	400000	U	51500	51900	J	ug/Kg		101	32 - 118	6	30
Bis(2-ethylhexyl) phthalate	400000	U	51500	96300	J	ug/Kg		187	10 - 200	12	30
4-Bromophenyl phenyl ether	400000	U	51500	49800	J	ug/Kg		97	44 - 120	4	30
Butyl benzyl phthalate	400000	U	51500	74900	J F	ug/Kg		145	43 - 138	35	30
Caprolactam	400000	U	103000	410000	U F	ug/Kg		0	50 - 130	NC	30
Carbazole	400000	U	51500	54400	J	ug/Kg		106	10 - 162	4	30
4-Chloroaniline	400000	U	51500	50000	J	ug/Kg		97	11 - 110	1	30
4-Chloro-3-methylphenol	400000	U	51500	410000	U	ug/Kg		NC	32 - 117	NC	30
2-Chloronaphthalene	400000	U	51500	48200	J	ug/Kg		93	40 - 110	4	30
2-Chlorophenol	400000	U	51500	54300	J	ug/Kg		105	32 - 110	9	30
4-Chlorophenyl phenyl ether	400000	U	51500	49400	J	ug/Kg		96	47 - 116	4	30

Method: 8270C - Semivolatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: 240-28188-1 MSD
Matrix: Waste
Analysis Batch: 98896

Client Sample ID: MWM2-29_LNAPL
Prep Type: Total/NA
Prep Batch: 98601

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Chrysene	22000	J	51500	71900	J	ug/Kg		97	10 - 200	13	30
Dibenz(a,h)anthracene	400000	U	51500	39100	J	ug/Kg		76	10 - 200	8	30
Dibenzofuran	400000	U	51500	54600	J	ug/Kg		106	10 - 200	1	30
3,3'-Dichlorobenzidine	1900000	U	103000	117000	J F	ug/Kg		114	10 - 110	5	30
2,4-Dichlorophenol	400000	U	51500	48500	J	ug/Kg		94	33 - 110	1	30
Diethyl phthalate	400000	U	51500	53800	J	ug/Kg		104	48 - 118	1	30
2,4-Dimethylphenol	400000	U *	51500	68000	J F	ug/Kg		132	19 - 114	1	30
Dimethyl phthalate	400000	U	51500	49600	J	ug/Kg		96	47 - 116	2	30
Di-n-butyl phthalate	400000	U	51500	52700	J	ug/Kg		102	31 - 145	14	30
4,6-Dinitro-2-methylphenol	1900000	U	103000	2000000	U F	ug/Kg		0	10 - 110	NC	30
2,4-Dinitrophenol	1900000	U	103000	233000	J F	ug/Kg		226	10 - 110	6	30
2,4-Dinitrotoluene	400000	U	51500	76200	J F	ug/Kg		148	42 - 118	3	30
2,6-Dinitrotoluene	400000	U	51500	32000	J	ug/Kg		62	28 - 137	0	30
Di-n-octyl phthalate	400000	U	51500	48100	J	ug/Kg		93	10 - 182	17	30
Fluoranthene	140000	J	51500	210000	J	ug/Kg		142	10 - 200	13	30
Fluorene	260000	J	51500	331000	J 4	ug/Kg		143	10 - 187	12	30
Hexachlorobenzene	400000	U	51500	35100	J	ug/Kg		68	37 - 122	1	30
Hexachlorobutadiene	400000	U	51500	48500	J	ug/Kg		94	30 - 110	10	30
Hexachlorocyclopentadiene	1900000	U	51500	2000000	U F	ug/Kg		0	10 - 110	NC	30
Hexachloroethane	400000	U	51500	172000	J F	ug/Kg		335	13 - 110	18	30
Indeno[1,2,3-cd]pyrene	400000	U	51500	42100	J	ug/Kg		82	10 - 200	1	30
Isophorone	400000	U	51500	67100	J F	ug/Kg		130	32 - 129	11	30
2-Methylnaphthalene	240000	J	51500	321000	J 4	ug/Kg		147	10 - 200	14	30
2-Methylphenol	400000	U	51500	54900	J	ug/Kg		106	19 - 124	13	30
3 & 4 Methylphenol	800000	U	51500	55700	J	ug/Kg		108	27 - 116	5	30
Naphthalene	91000	J	51500	156000	J	ug/Kg		127	10 - 200	16	30
2-Nitroaniline	1900000	U	51500	42300	J	ug/Kg		82	31 - 141	7	30
3-Nitroaniline	1900000	U	51500	43900	J	ug/Kg		85	27 - 110	15	30
4-Nitroaniline	1900000	U	51500	27700	J	ug/Kg		54	23 - 124	23	30
Nitrobenzene	400000	U	51500	53200	J	ug/Kg		103	33 - 111	5	30
2-Nitrophenol	400000	U	51500	58400	J F	ug/Kg		113	17 - 110	19	30
4-Nitrophenol	1900000	U	103000	2000000	U F	ug/Kg		0	10 - 125	NC	30
N-Nitrosodi-n-propylamine	400000	U	51500	21400	J F	ug/Kg		41	30 - 121	106	30
N-Nitrosodiphenylamine	400000	U	103000	227000	J F	ug/Kg		220	10 - 169	3	30
2,2'-oxybis[1-chloropropane]	400000	U	51500	54200	J	ug/Kg		105	50 - 130	6	30
Pentachlorophenol	400000	U	103000	88500	J	ug/Kg		86	10 - 182	0	30
Phenanthrene	800000		51500	983000	4	ug/Kg		353	10 - 200	15	30
Phenol	400000	U	51500	58700	J	ug/Kg		114	10 - 144	18	30
Pyrene	210000	J	51500	280000	J 4	ug/Kg		134	10 - 200	16	30
2,4,5-Trichlorophenol	400000	U	51500	36900	J	ug/Kg		72	32 - 112	9	30
2,4,6-Trichlorophenol	400000	U	51500	43600	J	ug/Kg		85	22 - 110	12	30

Surrogate	*MSD %Recovery*	*MSD Qualifier*	*Limits*
2-Fluorobiphenyl (Surr)	*92*		*51 - 112*
2-Fluorophenol (Surr)	*98*		*18 - 164*
Nitrobenzene-d5 (Surr)	*141*	*X*	*59 - 122*
Phenol-d5 (Surr)	*107*		*24 - 153*
Terphenyl-d14 (Surr)	*119*		*44 - 136*

Method: 8270C - Semivolatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: 240-28188-1 MSD
Matrix: Waste
Analysis Batch: 98896

Client Sample ID: MWM2-29_LNAPL
Prep Type: Total/NA
Prep Batch: 98601

Surrogate	MSD %Recovery	MSD Qualifier	Limits
2,4,6-Tribromophenol (Surr)	*79*		*23 - 134*

Method: 8082 - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Lab Sample ID: MB 240-98599/4-A
Matrix: Waste
Analysis Batch: 98726

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 98599

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aroclor-1016	1000	U	1000	190	ug/Kg		08/22/13 15:19	08/23/13 14:47	1
Aroclor-1221	1000	U	1000	220	ug/Kg		08/22/13 15:19	08/23/13 14:47	1
Aroclor-1232	1000	U	1000	170	ug/Kg		08/22/13 15:19	08/23/13 14:47	1
Aroclor-1242	1000	U	1000	290	ug/Kg		08/22/13 15:19	08/23/13 14:47	1
Aroclor-1248	1000	U	1000	200	ug/Kg		08/22/13 15:19	08/23/13 14:47	1
Aroclor-1254	1000	U	1000	120	ug/Kg		08/22/13 15:19	08/23/13 14:47	1
Aroclor-1260	1000	U	1000	130	ug/Kg		08/22/13 15:19	08/23/13 14:47	1

Surrogate	MB %Recovery	MB Qualifier	Limits	Prepared	Analyzed	Dil Fac
DCB Decachlorobiphenyl	*114*		*13 - 185*	*08/22/13 15:19*	*08/23/13 14:47*	*1*
Tetrachloro-m-xylene	*110*		*29 - 173*	*08/22/13 15:19*	*08/23/13 14:47*	*1*

Lab Sample ID: LCS 240-98599/5-A
Matrix: Waste
Analysis Batch: 98726

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 98599

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
Aroclor-1016			10000	11400		ug/Kg		114	66 - 149		
Aroclor-1260			10000	13000		ug/Kg		130	50 - 155		

Surrogate	LCS %Recovery	LCS Qualifier	Limits
DCB Decachlorobiphenyl	*137*		*13 - 185*
Tetrachloro-m-xylene	*126*		*29 - 173*

Lab Sample ID: 240-28188-1 MS
Matrix: Waste
Analysis Batch: 98726

Client Sample ID: MWM2-29_LNAPL
Prep Type: Total/NA
Prep Batch: 98599

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits		
Aroclor-1016	510000	U	9710	1740000		ug/Kg		NC	10 - 178		
Aroclor-1260	510000	U	9710	68000	J	ug/Kg		NC	26 - 143		

Surrogate	MS %Recovery	MS Qualifier	Limits
DCB Decachlorobiphenyl	*0*	*X*	*13 - 185*
Tetrachloro-m-xylene	*0*	*X*	*29 - 173*

Method: 8082 - Polychlorinated Biphenyls (PCBs) by Gas Chromatography (Continued)

Lab Sample ID: 240-28188-1 MSD
Matrix: Waste
Analysis Batch: 98726

Client Sample ID: MWM2-29_LNAPL
Prep Type: Total/NA
Prep Batch: 98599

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Aroclor-1016	510000	U	9710	1700000		ug/Kg		NC	10 - 178	2	30
Aroclor-1260	510000	U	9710	149000	J F	ug/Kg		NC	26 - 143	75	30

Surrogate	*MSD %Recovery*	*MSD Qualifier*	*Limits*
DCB Decachlorobiphenyl	*0*	*X*	*13 - 185*
Tetrachloro-m-xylene	*0*	*X*	*29 - 173*

Method: 6010B - Metals (ICP)

Lab Sample ID: MB 240-98541/1-A
Matrix: Waste
Analysis Batch: 98850

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 98541

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	1.0	U	1.0	0.39	mg/Kg		08/22/13 11:42	08/23/13 15:25	1
Arsenic	1.0	U	1.0	0.30	mg/Kg		08/22/13 11:42	08/23/13 15:25	1
Barium	0.0986	J	20	0.071	mg/Kg		08/22/13 11:42	08/23/13 15:25	1
Beryllium	0.50	U	0.50	0.043	mg/Kg		08/22/13 11:42	08/23/13 15:25	1
Cadmium	0.20	U	0.20	0.036	mg/Kg		08/22/13 11:42	08/23/13 15:25	1
Chromium	0.50	U	0.50	0.20	mg/Kg		08/22/13 11:42	08/23/13 15:25	1
Cobalt	5.0	U	5.0	0.16	mg/Kg		08/22/13 11:42	08/23/13 15:25	1
Copper	2.5	U	2.5	0.74	mg/Kg		08/22/13 11:42	08/23/13 15:25	1
Lead	0.30	U	0.30	0.19	mg/Kg		08/22/13 11:42	08/23/13 15:25	1
Manganese	0.0963	J	1.5	0.074	mg/Kg		08/22/13 11:42	08/23/13 15:25	1
Nickel	4.0	U	4.0	0.27	mg/Kg		08/22/13 11:42	08/23/13 15:25	1
Selenium	0.50	U	0.50	0.45	mg/Kg		08/22/13 11:42	08/23/13 15:25	1
Silver	0.50	U	0.50	0.10	mg/Kg		08/22/13 11:42	08/23/13 15:25	1
Thallium	1.0	U	1.0	0.55	mg/Kg		08/22/13 11:42	08/23/13 15:25	1
Vanadium	5.0	U	5.0	0.12	mg/Kg		08/22/13 11:42	08/23/13 15:25	1
Zinc	2.0	U	2.0	1.0	mg/Kg		08/22/13 11:42	08/23/13 15:25	1

Lab Sample ID: LCS 240-98541/2-A
Matrix: Waste
Analysis Batch: 98850

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 98541

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Antimony	50.0	43.2		mg/Kg		86	80 - 120
Arsenic	200	177		mg/Kg		89	80 - 120
Barium	200	170		mg/Kg		85	80 - 120
Beryllium	5.00	4.17		mg/Kg		83	80 - 120
Cadmium	5.00	4.39		mg/Kg		88	80 - 120
Chromium	20.0	17.4		mg/Kg		87	80 - 120
Cobalt	50.0	42.8		mg/Kg		86	80 - 120
Copper	25.0	21.6		mg/Kg		86	80 - 120
Lead	50.0	43.1		mg/Kg		86	80 - 120
Manganese	50.0	44.2		mg/Kg		88	80 - 120
Nickel	50.0	42.8		mg/Kg		86	80 - 120
Selenium	200	173		mg/Kg		86	80 - 120

Method: 6010B - Metals (ICP) (Continued)

Lab Sample ID: LCS 240-98541/2-A
Matrix: Waste
Analysis Batch: 98850

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 98541

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Silver	5.00	4.47		mg/Kg		89	80 - 120
Thallium	200	177		mg/Kg		88	80 - 120
Vanadium	50.0	43.5		mg/Kg		87	80 - 120
Zinc	50.0	44.7		mg/Kg		89	80 - 120

Method: 7471A - Mercury (CVAA)

Lab Sample ID: MB 240-98556/1-A
Matrix: Waste
Analysis Batch: 98742

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 98556

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	0.10	U	0.10	0.015	mg/Kg		08/22/13 14:10	08/23/13 11:31	1

Lab Sample ID: LCS 240-98556/2-A
Matrix: Waste
Analysis Batch: 98742

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 98556

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Mercury	0.833	0.842		mg/Kg		101	73 - 121

GC/MS VOA

Prep Batch: 99013

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
240-28188-1	MWM2-29_LNAPL	Total/NA	Waste	5030B	
LCS 240-99013/2-A	Lab Control Sample	Total/NA	Waste	5030B	
MB 240-99013/1-A	Method Blank	Total/NA	Waste	5030B	

Analysis Batch: 99034

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
240-28188-1	MWM2-29_LNAPL	Total/NA	Waste	8260B	99013
LCS 240-99013/2-A	Lab Control Sample	Total/NA	Waste	8260B	99013
MB 240-99013/1-A	Method Blank	Total/NA	Waste	8260B	99013

GC/MS Semi VOA

Prep Batch: 98601

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
240-28188-1	MWM2-29_LNAPL	Total/NA	Waste	3580A	
240-28188-1 MS	MWM2-29_LNAPL	Total/NA	Waste	3580A	
240-28188-1 MSD	MWM2-29_LNAPL	Total/NA	Waste	3580A	
LCS 240-98601/5-A	Lab Control Sample	Total/NA	Waste	3580A	
MB 240-98601/4-A	Method Blank	Total/NA	Waste	3580A	

Analysis Batch: 98896

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
240-28188-1	MWM2-29_LNAPL	Total/NA	Waste	8270C	98601
240-28188-1 MS	MWM2-29_LNAPL	Total/NA	Waste	8270C	98601
240-28188-1 MSD	MWM2-29_LNAPL	Total/NA	Waste	8270C	98601
MB 240-98601/4-A	Method Blank	Total/NA	Waste	8270C	98601

Analysis Batch: 99097

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
LCS 240-98601/5-A	Lab Control Sample	Total/NA	Waste	8270C	98601

GC Semi VOA

Prep Batch: 98599

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
240-28188-1	MWM2-29_LNAPL	Total/NA	Waste	3580A	
240-28188-1 MS	MWM2-29_LNAPL	Total/NA	Waste	3580A	
240-28188-1 MSD	MWM2-29_LNAPL	Total/NA	Waste	3580A	
LCS 240-98599/5-A	Lab Control Sample	Total/NA	Waste	3580A	
MB 240-98599/4-A	Method Blank	Total/NA	Waste	3580A	

Analysis Batch: 98726

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
240-28188-1	MWM2-29_LNAPL	Total/NA	Waste	8082	98599
240-28188-1 MS	MWM2-29_LNAPL	Total/NA	Waste	8082	98599
240-28188-1 MSD	MWM2-29_LNAPL	Total/NA	Waste	8082	98599
LCS 240-98599/5-A	Lab Control Sample	Total/NA	Waste	8082	98599
MB 240-98599/4-A	Method Blank	Total/NA	Waste	8082	98599

Metals

Prep Batch: 98541

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
240-28188-1	MWM2-29_LNAPL	Total/NA	Waste	3050B	
LCS 240-98541/2-A	Lab Control Sample	Total/NA	Waste	3050B	
MB 240-98541/1-A	Method Blank	Total/NA	Waste	3050B	

Prep Batch: 98556

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
240-28188-1	MWM2-29_LNAPL	Total/NA	Waste	7471A	
LCS 240-98556/2-A	Lab Control Sample	Total/NA	Waste	7471A	
MB 240-98556/1-A	Method Blank	Total/NA	Waste	7471A	

Analysis Batch: 98742

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
240-28188-1	MWM2-29_LNAPL	Total/NA	Waste	7471A	98556
LCS 240-98556/2-A	Lab Control Sample	Total/NA	Waste	7471A	98556
MB 240-98556/1-A	Method Blank	Total/NA	Waste	7471A	98556

Analysis Batch: 98850

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
240-28188-1	MWM2-29_LNAPL	Total/NA	Waste	6010B	98541
LCS 240-98541/2-A	Lab Control Sample	Total/NA	Waste	6010B	98541
MB 240-98541/1-A	Method Blank	Total/NA	Waste	6010B	98541

Lab Chronicle

Client: ARCADIS U.S., Inc.
Project/Site: Racer PNC Pontiac MI - B0064607.2013

TestAmerica Job ID: 240-28188-1

Client Sample ID: MWM2-29_LNAPL
Date Collected: 08/19/13 15:00
Date Received: 08/22/13 09:10

Lab Sample ID: 240-28188-1
Matrix: Waste

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	5030B			99013	08/26/13 15:35	LAM	TAL CAN
Total/NA	Analysis	8260B		1	99034	08/26/13 22:00	TJL1	TAL CAN
Total/NA	Prep	3580A			98601	08/22/13 15:34	KEC	TAL CAN
Total/NA	Analysis	8270C		20	98896	08/26/13 21:34	MRU	TAL CAN
Total/NA	Prep	3580A			98599	08/22/13 15:19	KEC	TAL CAN
Total/NA	Analysis	8082		500	98726	08/23/13 14:03	HMB	TAL CAN
Total/NA	Prep	7471A			98556	08/22/13 14:10	DEE	TAL CAN
Total/NA	Analysis	7471A		1	98742	08/23/13 12:11	ADS	TAL CAN
Total/NA	Prep	3050B			98541	08/22/13 12:05	DEE	TAL CAN
Total/NA	Analysis	6010B		1	98850	08/23/13 17:07	NJT	TAL CAN

Laboratory References:

TAL CAN = TestAmerica Canton, 4101 Shuffel Street NW, North Canton, OH 44720, TEL (330)497-9396

Certification Summary

Client: ARCADIS U.S., Inc.
Project/Site: Racer PNC Pontiac MI - B0064607.2013

TestAmerica Job ID: 240-28188-1

Laboratory: TestAmerica Canton

All certifications held by this laboratory are listed. Not all certifications are applicable to this report.

Authority	Program	EPA Region	Certification ID	Expiration Date
California	NELAP	9	01144CA	06-30-14
Connecticut	State Program	1	PH-0590	12-31-13
Florida	NELAP	4	E87225	06-30-14
Georgia	State Program	4	N/A	06-30-14
Illinois	NELAP	5	200004	07-31-13 *
Kansas	NELAP	7	E-10336	01-31-14
Kentucky	State Program	4	58	06-30-14
L-A-B	DoD ELAP		L2315	07-18-16
Minnesota	NELAP	5	039-999-348	12-31-13
Nevada	State Program	9	OH-000482008A	07-31-14
New Jersey	NELAP	2	OH001	06-30-14
New York	NELAP	2	10975	04-01-14
Ohio VAP	State Program	5	CL0024	01-19-14
Pennsylvania	NELAP	3	68-00340	08-31-13
Texas	NELAP	6		08-31-13
USDA	Federal		P330-11-00328	08-26-14
Virginia	NELAP	3	460175	09-14-13
Washington	State Program	10	C971	01-12-14
Wisconsin	State Program	5	999518190	08-31-13

* Expired certification is currently pending renewal and is considered valid.

5.8

SERIAL NUMBER: 03535

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

ARCADIS

TestAmerica Laboratories, Inc.
3355 McLemore Drive
Pensacola, FL 32514

Tel: 850.474.1001
Fax: 850.478.2671
www.testamericainc.com

QUOTE NO.	BOTTLE ORDER NO.	ORDER - LOG-IN NO.

CONSULTANT ARCADIS	ARCADIS OFFICE ADDRESS	ARCADIS PM	PAGE	OF
Novi, MI	28550 Cabot Dr. Ste, 500	Christi Kiker	1	1

FACILITY ID# & ADDRESS (CITY & STATE)	ARCADIS WORK AUTORIZATION #
RACER PNC Pontiac, MI	B006460 7.2013

SAMPLED BY:	
DCS	Drew Shaw

CLIENT PHONE:	CLIENT E-MAIL OR FAX:
248-994-2240	248-994-2241

TAT REQUESTED: RUSH NEEDS LAB PREAPPROVAL ☐ NORMAL - 14 CALENDAR DAYS
☐1 DAY ☐2 DAYS ☐5 DAYS ☐10 DAYS ☒OTHER: 3 DAY

SAMPLE DISPOSAL: ☐RETURN TO CLIENT ☒DISPOSAL BY LAB
PACKAGE (DELIVERABLE): ☐TX TRRP ☐NJ ☐OTHER:

REQUESTED ANALYSIS

POSSIBLE HAZARD IDENTIFICATION
☐ NON-HAZARD
☐ FLAMMABLE
☐ RADIOACTIVE
☐ POISON B
☒ UNKNOWN
☐ OTHER:

NO. OF COOLERS PER SHIPMENT:

SAMPLE DATE	SAMPLE TIME	SAMPLE IDENTIFICATION	PRESERVATIVE: No Preservative	HCL - Hydrochloric Acid	HNO3 - Nitric Acid	H2SO4 - Sulfuric Acid or H3PO4	NAOH - Sodium Hydroxide	CH3OH - Methanol	NAHSO4 - Sodium Bisulfate	NA2S2O3 - Sodium Thiosulfate	Other:	MATRIX: Drinking Water	Aqueous GW, SW, WW	Solid, Semisolid, Sediment	Air	NonAqueous (Oil, Solvent, etc.)	NUMBER OF CONTAINERS SUBMITTED: VOC 8260	SVOC 8270	PCB 8082	SPECIAL INSTRUCTION
8/19/13	1500	MWM2-29_LNAPL	X													X	1	1	1	

240-28188 Chain of Custody

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:
Drew Shaw	8/19/13	1800		8/22/13	15:00			
RECEIVED BY: (SIGNATURE)	DATE:	TIME:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:
	8/21/13	14:46						

LABORATORY USE ONLY

RECEIVED FOR LABORATORY BY:	DATE:	TIME:	CUSTODY INTACT? ☐ YES ☐ NO	CUSTODY SEAL NO.	COOLER TEMPERATURE(S) °C & OTHER REMARKS:
	8-22-13	910			

TAL - 0070 0513

TestAmerica Canton Sample Receipt Form/Narrative **Login # : 28188**
Canton Facility

Client Arcadis Site Name _____ Cooler unpacked by:

Cooler Received on 8-22-13 Opened on 8-22-13

FedEx: 1st Grd (Exp) UPS FAS Stetson Client Drop Off TestAmerica Courier Other _____

TestAmerica Cooler # _____ Foam Box (Client Cooler) Box Other _____

Packing material used: (Bubble Wrap) Foam Plastic Bag None Other _____

COOLANT: (Wet Ice) Blue Ice Dry Ice Water None

1. Cooler temperature upon receipt

IR GUN# A	(CF -1 °C) Observed Cooler Temp. _____ °C	Corrected Cooler Temp. _____ °C	☐ See Multiple Cooler Form
IR GUN# 4	(CF 0 °C) Observed Cooler Temp. _____ °C	Corrected Cooler Temp. _____ °C	
IR GUN# 5	(CF +1 °C) Observed Cooler Temp. _____ °C	Corrected Cooler Temp. _____ °C	
IR GUN# 8	(CF -0 °C) Observed Cooler Temp. 5.8 °C	Corrected Cooler Temp. 5.8 °C	

2. Were custody seals on the outside of the cooler(s)? If Yes Quantity 2 (Yes) No
   -Were custody seals on the outside of the cooler(s) signed & dated? (Yes) No NA
   -Were custody seals on the bottle(s)? Yes (No)
3. Shippers' packing slip attached to the cooler(s)? (Yes) No
4. Did custody papers accompany the sample(s)? (Yes) No
5. Were the custody papers relinquished & signed in the appropriate place? (Yes) No
6. Did all bottles arrive in good condition (Unbroken)? (Yes) No
7. Could all bottle labels be reconciled with the COC? (Yes) No
8. Were correct bottle(s) used for the test(s) indicated? (Yes) No
9. Sufficient quantity received to perform indicated analyses? (Yes) No
10. Were sample(s) at the correct pH upon receipt? Yes No (NA) pH Strip Lot# **HC376062**
11. Were VOAs on the COC? Yes (No)
12. Were air bubbles >6 mm in any VOA vials? Yes No (NA)
13. Was a trip blank present in the cooler(s)? Yes (No)

Contacted PM _____ Date _____ by _____ via Verbal Voice Mail Other
Concerning _____

14. CHAIN OF CUSTODY & SAMPLE DISCREPANCIES Samples processed by:

15. SAMPLE CONDITION

Sample(s) _____ were received after the recommended holding time had expired.
Sample(s) _____ were received in a broken container.
Sample(s) _____ were received with bubble >6 mm in diameter. (Notify PM)

16. SAMPLE PRESERVATION

Sample(s) _____ were further preserved in the laboratory.
Time preserved: _____ Preservative(s) added/Lot number(s): _____.

ANALYTICAL REPORT

Job Number: 240-3339-1

Job Description: Racer Pontiac NAPL

For:
ARCADIS U.S., Inc.
28550 Cabot Drive
Suite 500
Novi, MI 48377

Attention: Mr. Bruce Rust

Approved for release.
Mark J Loeb
Project Manager II
9/9/2011 4:48 PM

Designee for
Denise Pohl
Project Manager II
denise.pohl@testamericainc.com
09/09/2011

TestAmerica Laboratories, Inc.
TestAmerica North Canton 4101 Shuffel Street NW, North Canton, OH 44720
Tel (330) 497-9396 Fax (330) 497-0772 www.testamericainc.com

CASE NARRATIVE

Client: ARCADIS U.S., Inc.

Project: Racer Pontiac NAPL

Report Number: 240-3339-1

With the exceptions noted as flags or footnotes, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. In addition all laboratory quality control samples were within established control limits, with any exceptions noted below. Each sample was analyzed to achieve the lowest possible reporting limit within the constraints of the method. In some cases, due to interference or analytes present at high concentrations, samples were diluted. For diluted samples, the reporting limits are adjusted relative to the dilution required.

TestAmerica North Canton attests to the validity of the laboratory data generated by TestAmerica facilities reported herein. All analyses performed by TestAmerica facilities were done using established laboratory SOPs that incorporate QA/QC procedures described in the application methods. TestAmerica's operations groups have reviewed the data for compliance with the laboratory QA/QC plan, and data have been found to be compliant with laboratory protocols unless otherwise noted below.

The test results in this report meet all NELAP requirements for parameters for which accreditation is required or available. Any exceptions to NELAP requirements are noted in this report. Pursuant to NELAP, this report may not be reproduced, except in full, without the written approval of the laboratory.

Calculations are performed before rounding to avoid round-off errors in calculated results.

All holding times were met and proper preservation noted for the methods performed on these samples, unless otherwise detailed in the individual sections below.

All solid sample results are reported on an "as received" basis unless otherwise indicated by the presence of a % solids value in the method header.

This laboratory report is confidential and is intended for the sole use of TestAmerica and its client.

RECEIPT

The samples were received on 08/25/2011; the samples arrived in good condition, properly preserved and on ice. The temperature of the coolers at receipt was 0.5 C.

VOLATILE ORGANIC COMPOUNDS (GC-MS)

Sample MWW-8-65-081811 (240-3339-1) was analyzed for volatile organic compounds (GC-MS) in accordance with EPA SW-846 Method 8260B. The samples were analyzed on 09/02/2011.

Acetone and Methyl acetate were detected in method blank MB 240-13832/1-A at levels that were above the method detection limit but below the reporting limit. The values should be considered estimates, and have been flagged "J". If the associated sample reported a result above the MDL and/or RL, the result has been "B" flagged. Refer to the QC report for details.

Sample MWW-8-65-081811 (240-3339-1)[2X] required dilution prior to analysis. The reporting limits have been adjusted accordingly.

No other difficulties were encountered during the VOCs analysis. All other quality control parameters were within the acceptance limits.

SEMIVOLATILE ORGANIC COMPOUNDS (GC-MS)

Sample MWW-8-65-081811 (240-3339-1) was analyzed for semivolatile organic compounds (GC-MS) in accordance with EPA SW-846 Method 8270C. The samples were analyzed on 09/01/2011.

Surrogates are added during the extraction process prior to dilution. When the sample is diluted, surrogate recoveries are diluted out and no corrective action is required.

Sample MWW-8-65-081811 (240-3339-1)[100X] required dilution prior to analysis. The reporting limits have been adjusted accordingly. Due to the dilution required, the following surrogates were recovered below acceptance limits: 2,4,6-Tribromophenol (Surr), 2-Fluorobiphenyl (Surr), 2-Fluorophenol (Surr), Nitrobenzene-d5 (Surr), Phenol-d5 (Surr) and Terphenyl-d14 (Surr). Refer to the QC report for details.

Benzaldehyde failed the recovery criteria high for LCS 240-13941/3-A. Refer to the QC report for details.

Insufficient sample volume was available to perform a matrix spike/matrix spike duplicate (MS/MSD) associated with batch 13941.

No other difficulties were encountered during the SVOC analysis. All other quality control parameters were within the acceptance limits.

POLYCHLORINATED BIPHENYLS (PCBS)

Sample MWW-8-65-081811 (240-3339-1) was analyzed for polychlorinated biphenyls (PCBs) in accordance with EPA SW-846 Method 8082. The samples were analyzed on 09/01/2011.

Surrogates are added during the extraction process prior to dilution. When the sample dilution is 5X or greater, surrogate recoveries are diluted out and no corrective action is required.

The following sample appears to contain polychlorinated biphenyls (PCBs); however, due to weathering or other environmental processes, the PCBs in the sample do not closely match any of the laboratory's Aroclor standards used for instrument calibration: MWW-8-65-081811. The sample has been quantified and reported. Due to the poor match with the Aroclor standard(s), there is increased qualitative and quantitative uncertainty associated with this result.

The following sample(s) required a tetrabutylammonium sulfite (TBA) clean-up to reduce matrix interferences caused by sulfur: MWW-8-65-081811.

Insufficient sample volume was available to perform a matrix spike/matrix spike duplicate (MS/MSD) associated with batch 13940.

No difficulties were encountered during the PCBs analysis. All quality control parameters were within the acceptance limits.

SPECIFIC GRAVITY

Sample MWW-8-65-081811 (240-3339-1) was analyzed for specific gravity in accordance with SM 2710F. The samples were analyzed on 09/01/2011.

No difficulties were encountered during the specific gravity analysis. All quality control parameters were within the acceptance limits.

EXECUTIVE SUMMARY - Detections

Client: ARCADIS U.S., Inc. Job Number: 240-3339-1

Lab Sample ID / Analyte	Client Sample ID	Result	Qualifier	Reporting Limit	Units	Method
240-3339-1	**MWW-8-65-081811**					
Acetone		3000	J B	9300	ug/Kg	8260B
Ethylbenzene		890	J	2300	ug/Kg	8260B
Tetrachloroethene		870	J	2300	ug/Kg	8260B
Xylenes, Total		4600	J	4700	ug/Kg	8260B
Isopropylbenzene		1400	J	2300	ug/Kg	8260B
Methylcyclohexane		1100	J	2300	ug/Kg	8260B
1,1'-Biphenyl		110000	J	1900000	ug/Kg	8270C
2-Methylnaphthalene		270000	J	1900000	ug/Kg	8270C
Fluorene		360000	J	1900000	ug/Kg	8270C
Phenanthrene		840000	J	1900000	ug/Kg	8270C
Aroclor-1248		2100		960	ug/Kg	8082
Aroclor-1260		1200		960	ug/Kg	8082
Specific Gravity		0.83		0.10	NONE	SM 2710F

METHOD SUMMARY

Client: ARCADIS U.S., Inc. Job Number: 240-3339-1

Description	Lab Location	Method	Preparation Method
Matrix Waste			
Volatile Organic Compounds (GC/MS) - Solid Matrix	TAL NC	SW846 8260B	
Purge and Trap			SW846 5030B
Semivolatile Organic Compounds (GC/MS)	TAL NC	SW846 8270C	
Waste Dilution			SW846 3580A
Polychlorinated Biphenyls (PCBs) by Gas Chromatography	TAL NC	SW846 8082	
Waste Dilution			SW846 3580A
Specific Gravity	TAL NC	SM SM 2710F	

Lab References:

TAL NC = TestAmerica North Canton

Method References:

SM = "Standard Methods For The Examination Of Water And Wastewater",

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

METHOD / ANALYST SUMMARY

Client: ARCADIS U.S., Inc. Job Number: 240-3339-1

Method	Analyst	Analyst ID
SW846 8260B	Lavey, Tim	TL
SW846 8270C	Ulman, Mark	MU
SW846 8082	Roach, Carolynne	CR
SM SM 2710F	Menapace, Jason	JM

SAMPLE SUMMARY

Client: ARCADIS U.S., Inc. Job Number: 240-3339-1

Lab Sample ID	Client Sample ID	Client Matrix	Date/Time Sampled	Date/Time Received
240-3339-1	MWW-8-65-081811	Waste	08/18/2011 0000	08/25/2011 0920

SAMPLE RESULTS

Client: ARCADIS U.S., Inc. Job Number: 240-3339-1

Client Sample ID: **MWW-8-65-081811**

Lab Sample ID: 240-3339-1 Date Sampled: 08/18/2011 0000
Client Matrix: Waste Date Received: 08/25/2011 0920

8260B Volatile Organic Compounds (GC/MS) - Solid Matrix

Analysis Method:	8260B	Analysis Batch:	240-14125	Instrument ID:	A3UX9
Prep Method:	5030B	Prep Batch:	240-13832	Lab File ID:	UX99558.D
Dilution:	2.0			Initial Weight/Volume:	0.86 g
Analysis Date:	09/02/2011 0207			Final Weight/Volume:	5 mL
Prep Date:	08/30/2011 2253				

Analyte	DryWt Corrected: N	Result (ug/Kg)	Qualifier	MDL	RL
Acetone		3000	J B	400	9300
Benzene		2300	U	28	2300
Dichlorobromomethane		2300	U	23	2300
Bromoform		2300	U	44	2300
Bromomethane		4700	U	67	4700
2-Butanone (MEK)		9300	U	100	9300
Carbon disulfide		2300	U	28	2300
Carbon tetrachloride		2300	U	15	2300
Chlorobenzene		2300	U	15	2300
Chloroethane		4700	U	140	4700
Chloroform		2300	U	20	2300
Chloromethane		4700	U	33	4700
1,1-Dichloroethane		2300	U	40	2300
1,2-Dichloroethane		2300	U	23	2300
1,1-Dichloroethene		2300	U	42	2300
1,2-Dichloropropane		2300	U	19	2300
cis-1,3-Dichloropropene		2300	U	18	2300
trans-1,3-Dichloropropene		2300	U	47	2300
Ethylbenzene		890	J	13	2300
2-Hexanone		9300	U	47	9300
Methylene Chloride		2300	U	180	2300
4-Methyl-2-pentanone (MIBK)		9300	U	110	9300
Styrene		2300	U	13	2300
1,1,2,2-Tetrachloroethane		2300	U	21	2300
Tetrachloroethene		870	J	28	2300
Toluene		2300	U	40	2300
Trichloroethene		2300	U	23	2300
Vinyl chloride		4700	U	42	4700
Xylenes, Total		4600	J	19	4700
1,1,1-Trichloroethane		2300	U	49	2300
1,1,2-Trichloroethane		2300	U	28	2300
Cyclohexane		4700	U	93	4700
1,2-Dibromo-3-Chloropropane		2300	U	120	2300
Ethylene Dibromide		2300	U	23	2300
Dichlorodifluoromethane		4700	U	37	4700
cis-1,2-Dichloroethene		2300	U	16	2300
trans-1,2-Dichloroethene		2300	U	21	2300
Isopropylbenzene		1400	J	15	2300
Methyl acetate		4700	U	58	4700
Methyl tert-butyl ether		9300	U	17	9300
1,1,2-Trichloro-1,2,2-trifluoroethane		4700	U	91	4700
1,2,4-Trichlorobenzene		2300	U	17	2300
1,2-Dichlorobenzene		2300	U	20	2300
1,3-Dichlorobenzene		2300	U	11	2300
1,4-Dichlorobenzene		2300	U	19	2300
Trichlorofluoromethane		4700	U	37	4700

Client: ARCADIS U.S., Inc. Job Number: 240-3339-1

Client Sample ID: **MWW-8-65-081811**

Lab Sample ID: 240-3339-1 Date Sampled: 08/18/2011 0000
Client Matrix: Waste Date Received: 08/25/2011 0920

8260B Volatile Organic Compounds (GC/MS) - Solid Matrix

Analysis Method:	8260B	Analysis Batch:	240-14125	Instrument ID:	A3UX9
Prep Method:	5030B	Prep Batch:	240-13832	Lab File ID:	UX99558.D
Dilution:	2.0			Initial Weight/Volume:	0.86 g
Analysis Date:	09/02/2011 0207			Final Weight/Volume:	5 mL
Prep Date:	08/30/2011 2253				

Analyte	DryWt Corrected: N	Result (ug/Kg)	Qualifier	MDL	RL
Chlorodibromomethane		2300	U	28	2300
Methylcyclohexane		1100	J	28	2300

Surrogate	%Rec	Qualifier	Acceptance Limits
1,2-Dichloroethane-d4 (Surr)	92		39 - 128
4-Bromofluorobenzene (Surr)	97		26 - 141
Toluene-d8 (Surr)	79		33 - 134
Dibromofluoromethane (Surr)	74		30 - 122

Client: ARCADIS U.S., Inc. Job Number: 240-3339-1

Client Sample ID: **MWW-8-65-081811**

Lab Sample ID: 240-3339-1 Date Sampled: 08/18/2011 0000
Client Matrix: Waste Date Received: 08/25/2011 0920

8270C Semivolatile Organic Compounds (GC/MS)

Analysis Method:	8270C	Analysis Batch:	240-14121	Instrument ID:	A4HP9
Prep Method:	3580A	Prep Batch:	240-13941	Lab File ID:	3339A1C.D
Dilution:	100			Initial Weight/Volume:	1.03 g
Analysis Date:	09/01/2011 2353			Final Weight/Volume:	10.00 mL
Prep Date:	08/31/2011 1410			Injection Volume:	1 uL

Analyte	DryWt Corrected: N	Result (ug/Kg)	Qualifier	MDL	RL
1,1'-Biphenyl		110000	J	42000	1900000
2,2'-oxybis[1-chloropropane]		1900000	U	30000	1900000
2,4,5-Trichlorophenol		1900000	U	29000	1900000
2,4,6-Trichlorophenol		1900000	U	40000	1900000
2,4-Dichlorophenol		1900000	U	31000	1900000
2,4-Dimethylphenol		1900000	U	40000	1900000
2,4-Dinitrophenol		9300000	U	240000	9300000
2,4-Dinitrotoluene		1900000	U	33000	1900000
2,6-Dinitrotoluene		1900000	U	34000	1900000
2-Chloronaphthalene		1900000	U	37000	1900000
2-Chlorophenol		1900000	U	21000	1900000
2-Methylnaphthalene		270000	J	5800	1900000
2-Methylphenol		1900000	U	39000	1900000
2-Nitroaniline		9300000	U	30000	9300000
2-Nitrophenol		1900000	U	20000	1900000
3,3'-Dichlorobenzidine		9300000	U	29000	9300000
3-Nitroaniline		9300000	U	19000	9300000
4,6-Dinitro-2-methylphenol		9300000	U	270000	9300000
4-Bromophenyl phenyl ether		1900000	U	27000	1900000
4-Chloro-3-methylphenol		1900000	U	300000	1900000
4-Chloroaniline		1900000	U	30000	1900000
4-Chlorophenyl phenyl ether		1900000	U	21000	1900000
4-Nitroaniline		9300000	U	21000	9300000
4-Nitrophenol		9300000	U	470000	9300000
Acenaphthene		1900000	U	5400	1900000
Acenaphthylene		1900000	U	8200	1900000
Acetophenone		1900000	U	32000	1900000
Anthracene		1900000	U	13000	1900000
Atrazine		1900000	U	64000	1900000
Benzaldehyde		1900000	U *	40000	1900000
Benzo[a]anthracene		1900000	U	8200	1900000
Benzo[a]pyrene		1900000	U	13000	1900000
Benzo[b]fluoranthene		1900000	U	13000	1900000
Benzo[g,h,i]perylene		1900000	U	10000	1900000
Benzo[k]fluoranthene		1900000	U	13000	1900000
Bis(2-chloroethoxy)methane		1900000	U	93000	1900000
Bis(2-chloroethyl)ether		1900000	U	24000	1900000
Bis(2-ethylhexyl) phthalate		1900000	U	93000	1900000
Butyl benzyl phthalate		1900000	U	22000	1900000
Caprolactam		1900000	U	45000	1900000
Carbazole		1900000	U	54000	1900000
Chrysene		1900000	U	5800	1900000
Dibenz(a,h)anthracene		1900000	U	8700	1900000
Dibenzofuran		1900000	U	4800	1900000
Diethyl phthalate		1900000	U	36000	1900000
Dimethyl phthalate		1900000	U	37000	1900000

Client: ARCADIS U.S., Inc. Job Number: 240-3339-1

Client Sample ID: **MWW-8-65-081811**

Lab Sample ID: 240-3339-1 Date Sampled: 08/18/2011 0000
Client Matrix: Waste Date Received: 08/25/2011 0920

8270C Semivolatile Organic Compounds (GC/MS)

Analysis Method:	8270C	Analysis Batch:	240-14121	Instrument ID:	A4HP9
Prep Method:	3580A	Prep Batch:	240-13941	Lab File ID:	3339A1C.D
Dilution:	100			Initial Weight/Volume:	1.03 g
Analysis Date:	09/01/2011 2353			Final Weight/Volume:	10.00 mL
Prep Date:	08/31/2011 1410			Injection Volume:	1 uL

Analyte	DryWt Corrected: N	Result (ug/Kg)	Qualifier	MDL	RL
Di-n-butyl phthalate		1900000	U	29000	1900000
Di-n-octyl phthalate		1900000	U	64000	1900000
Fluoranthene		1900000	U	5400	1900000
Fluorene		360000	J	7600	1900000
Hexachlorobenzene		1900000	U	8200	1900000
Hexachlorobutadiene		1900000	U	15000	1900000
Hexachlorocyclopentadiene		9300000	U	17000	9300000
Hexachloroethane		1900000	U	29000	1900000
Indeno[1,2,3-cd]pyrene		1900000	U	12000	1900000
Isophorone		1900000	U	20000	1900000
Naphthalene		1900000	U	5200	1900000
Nitrobenzene		1900000	U	37000	1900000
N-Nitrosodi-n-propylamine		1900000	U	44000	1900000
N-Nitrosodiphenylamine		1900000	U	24000	1900000
Pentachlorophenol		1900000	U	260000	1900000
Phenol		1900000	U	33000	1900000
Phenanthrene		840000	J	6400	1900000
Pyrene		1900000	U	5800	1900000
3 & 4 Methylphenol		3900000	U	120000	3900000

Surrogate	%Rec	Qualifier	Acceptance Limits
2-Fluorobiphenyl (Surr)	0	X	44 - 110
2-Fluorophenol (Surr)	0	X	49 - 110
2,4,6-Tribromophenol (Surr)	0	X	16 - 124
Nitrobenzene-d5 (Surr)	0	X	53 - 110
Phenol-d5 (Surr)	0	X	47 - 110
Terphenyl-d14 (Surr)	0	X	36 - 128

Client: ARCADIS U.S., Inc. Job Number: 240-3339-1

Client Sample ID: **MWW-8-65-081811**

Lab Sample ID: 240-3339-1 Date Sampled: 08/18/2011 0000
Client Matrix: Waste Date Received: 08/25/2011 0920

8082 Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analysis Method:	8082	Analysis Batch:	240-14107	Instrument ID:	A2HP12
Prep Method:	3580A	Prep Batch:	240-13940	Initial Weight/Volume:	1.04 g
Dilution:	1.0			Final Weight/Volume:	10.00 mL
Analysis Date:	09/01/2011 1645			Injection Volume:	1 mL
Prep Date:	08/31/2011 1405			Result Type:	PRIMARY

Analyte	DryWt Corrected: N	Result (ug/Kg)	Qualifier	MDL	RL
Aroclor-1016		960	U	180	960
Aroclor-1221		960	U	210	960
Aroclor-1232		960	U	160	960
Aroclor-1242		960	U	280	960
Aroclor-1248		2100		190	960
Aroclor-1254		960	U	120	960
Aroclor-1260		1200		130	960

Surrogate	%Rec	Qualifier	Acceptance Limits
Tetrachloro-m-xylene	99		29 - 173
DCB Decachlorobiphenyl	77		13 - 185

General Chemistry

Client Sample ID: **MWW-8-65-081811**

Lab Sample ID: 240-3339-1 Date Sampled: 08/18/2011 0000

Client Matrix: Waste Date Received: 08/25/2011 0920

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
Specific Gravity	0.83		NONE	0.10	0.10	1.0	SM 2710F

Analysis Batch: 240-14035 Analysis Date: 09/01/2011 0921 DryWt Corrected: N

DATA REPORTING QUALIFIERS

Client: ARCADIS U.S., Inc. Job Number: 240-3339-1

Lab Section	Qualifier	Description
GC/MS VOA		
	B	Compound was found in the blank and sample.
	U	Indicates the analyte was analyzed for but not detected.
	J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
GC/MS Semi VOA		
	U	Indicates the analyte was analyzed for but not detected.
	*	LCS or LCSD exceeds the control limits
	J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
	X	Surrogate is outside control limits
GC Semi VOA		
	U	Indicates the analyte was analyzed for but not detected.

QUALITY CONTROL RESULTS

Client: ARCADIS U.S., Inc. Job Number: 240-3339-1

QC Association Summary

Lab Sample ID	Client Sample ID	Report Basis	Client Matrix	Method	Prep Batch
GC/MS VOA					
Prep Batch: 240-13832					
LCS 240-13832/2-A	Lab Control Sample	T	Waste	5030B	
MB 240-13832/1-A	Method Blank	T	Waste	5030B	
240-3339-1	MWW-8-65-081811	T	Waste	5030B	
Analysis Batch:240-14125					
LCS 240-13832/2-A	Lab Control Sample	T	Waste	8260B	240-13832
MB 240-13832/1-A	Method Blank	T	Waste	8260B	240-13832
240-3339-1	MWW-8-65-081811	T	Waste	8260B	240-13832
GC/MS Semi VOA					
Prep Batch: 240-13941					
LCS 240-13941/3-A	Lab Control Sample	T	Waste	3580A	
MB 240-13941/2-A	Method Blank	T	Waste	3580A	
240-3339-1	MWW-8-65-081811	T	Waste	3580A	
Analysis Batch:240-14121					
LCS 240-13941/3-A	Lab Control Sample	T	Waste	8270C	240-13941
MB 240-13941/2-A	Method Blank	T	Waste	8270C	240-13941
240-3339-1	MWW-8-65-081811	T	Waste	8270C	240-13941
GC Semi VOA					
Prep Batch: 240-13940					
LCS 240-13940/3-A	Lab Control Sample	T	Waste	3580A	
MB 240-13940/2-A	Method Blank	T	Waste	3580A	
240-3339-1	MWW-8-65-081811	T	Waste	3580A	
Analysis Batch:240-14107					
LCS 240-13940/3-A	Lab Control Sample	T	Waste	8082	240-13940
MB 240-13940/2-A	Method Blank	T	Waste	8082	240-13940
240-3339-1	MWW-8-65-081811	T	Waste	8082	240-13940

Report Basis
T = Total

Report Basis
T = Total

Report Basis
T = Total

Client: ARCADIS U.S., Inc. Job Number: 240-3339-1

QC Association Summary

Lab Sample ID	Client Sample ID	Report Basis	Client Matrix	Method	Prep Batch
General Chemistry					
Analysis Batch:240-14035					
240-3339-1	MWW-8-65-081811	T	Waste	SM 2710F	

Report Basis
T = Total

Client: ARCADIS U.S., Inc. Job Number: 240-3339-1

Surrogate Recovery Report

8260B Volatile Organic Compounds (GC/MS) - Solid Matrix

Client Matrix: Waste

Lab Sample ID	Client Sample ID	DCA %Rec	BFB %Rec	TOL %Rec	DBFM %Rec
240-3339-1	MWW-8-65-081811	92	97	79	74
MB 240-13832/1-A		92	105	98	78
LCS 240-13832/2-A		98	110	100	77

Surrogate	Acceptance Limits
DCA = 1,2-Dichloroethane-d4 (Surr)	39-128
BFB = 4-Bromofluorobenzene (Surr)	26-141
TOL = Toluene-d8 (Surr)	33-134
DBFM = Dibromofluoromethane (Surr)	30-122

Client: ARCADIS U.S., Inc. Job Number: 240-3339-1

Surrogate Recovery Report

8270C Semivolatile Organic Compounds (GC/MS)

Client Matrix: Waste

Lab Sample ID	Client Sample ID	FBP %Rec	2FP %Rec	TBP %Rec	NBZ %Rec	PHL %Rec	TPH %Rec
240-3339-1	MWW-8-65-081811	0X	0X	0X	0X	0X	0X
MB 240-13941/2-A		86	96	79	92	96	99
LCS 240-13941/3-A		83	99	89	94	100	92

Surrogate	Acceptance Limits
FBP = 2-Fluorobiphenyl (Surr)	44-110
2FP = 2-Fluorophenol (Surr)	49-110
TBP = 2,4,6-Tribromophenol (Surr)	16-124
NBZ = Nitrobenzene-d5 (Surr)	53-110
PHL = Phenol-d5 (Surr)	47-110
TPH = Terphenyl-d14 (Surr)	36-128

Client: ARCADIS U.S., Inc.

Job Number: 240-3339-1

Surrogate Recovery Report

8082 Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Client Matrix: Waste

Lab Sample ID	Client Sample ID	TCX1 %Rec	DCB1 %Rec
240-3339-1	MWW-8-65-081811	99	77
MB 240-13940/2-A		108	103
LCS 240-13940/3-A		115	97

Surrogate	Acceptance Limits
TCX = Tetrachloro-m-xylene	29-173
DCB = DCB Decachlorobiphenyl	13-185

Client: ARCADIS U.S., Inc. Job Number: 240-3339-1

Method Blank - Batch: 240-13832

Method: 8260B
Preparation: 5030B

Lab Sample ID:	MB 240-13832/1-A	Analysis Batch:	240-14125	Instrument ID:	A3UX9
Client Matrix:	Waste	Prep Batch:	240-13832	Lab File ID:	UX99549.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	1 g
Analysis Date:	09/01/2011 2231	Units:	ug/Kg	Final Weight/Volume:	5 mL
Prep Date:	08/30/2011 2253				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Acetone	258	J	170	4000
Benzene	1000	U	12	1000
Dichlorobromomethane	1000	U	9.9	1000
Bromoform	1000	U	19	1000
Bromomethane	2000	U	29	2000
2-Butanone (MEK)	4000	U	43	4000
Carbon disulfide	1000	U	12	1000
Carbon tetrachloride	1000	U	6.4	1000
Chlorobenzene	1000	U	6.4	1000
Chloroethane	2000	U	61	2000
Chloroform	1000	U	8.8	1000
Chloromethane	2000	U	14	2000
1,1-Dichloroethane	1000	U	17	1000
1,2-Dichloroethane	1000	U	10	1000
1,1-Dichloroethene	1000	U	18	1000
1,2-Dichloropropane	1000	U	8.2	1000
cis-1,3-Dichloropropene	1000	U	7.9	1000
trans-1,3-Dichloropropene	1000	U	20	1000
Ethylbenzene	1000	U	5.4	1000
2-Hexanone	4000	U	20	4000
Methylene Chloride	1000	U	77	1000
4-Methyl-2-pentanone (MIBK)	4000	U	48	4000
Styrene	1000	U	5.6	1000
1,1,2,2-Tetrachloroethane	1000	U	8.9	1000
Tetrachloroethene	1000	U	12	1000
Toluene	1000	U	17	1000
Trichloroethene	1000	U	9.7	1000
Vinyl chloride	2000	U	18	2000
Xylenes, Total	2000	U	8.1	2000
1,1,1-Trichloroethane	1000	U	21	1000
1,1,2-Trichloroethane	1000	U	12	1000
Cyclohexane	2000	U	40	2000
1,2-Dibromo-3-Chloropropane	1000	U	50	1000
Ethylene Dibromide	1000	U	10	1000
Dichlorodifluoromethane	2000	U	16	2000
cis-1,2-Dichloroethene	1000	U	6.9	1000
trans-1,2-Dichloroethene	1000	U	9.2	1000
Isopropylbenzene	1000	U	6.5	1000
Methyl acetate	133	J	25	2000
Methyl tert-butyl ether	4000	U	7.1	4000
1,1,2-Trichloro-1,2,2-trifluoroethane	2000	U	39	2000
1,2,4-Trichlorobenzene	1000	U	7.3	1000
1,2-Dichlorobenzene	1000	U	8.6	1000
1,3-Dichlorobenzene	1000	U	4.8	1000
1,4-Dichlorobenzene	1000	U	8.0	1000

Client: ARCADIS U.S., Inc. Job Number: 240-3339-1

Method Blank - Batch: 240-13832

Method: 8260B
Preparation: 5030B

Lab Sample ID:	MB 240-13832/1-A	Analysis Batch:	240-14125	Instrument ID:	A3UX9
Client Matrix:	Waste	Prep Batch:	240-13832	Lab File ID:	UX99549.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	1 g
Analysis Date:	09/01/2011 2231	Units:	ug/Kg	Final Weight/Volume:	5 mL
Prep Date:	08/30/2011 2253				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Trichlorofluoromethane	2000	U	16	2000
Chlorodibromomethane	1000	U	12	1000
Methylcyclohexane	1000	U	12	1000
m-Xylene & p-Xylene	2000	U	6.2	2000
o-Xylene	1000	U	8.5	1000

Surrogate	% Rec	Acceptance Limits
1,2-Dichloroethane-d4 (Surr)	92	39 - 128
4-Bromofluorobenzene (Surr)	105	26 - 141
Toluene-d8 (Surr)	98	33 - 134
Dibromofluoromethane (Surr)	78	30 - 122

Client: ARCADIS U.S., Inc. Job Number: 240-3339-1

Lab Control Sample - Batch: 240-13832

Method: 8260B
Preparation: 5030B

Lab Sample ID:	LCS 240-13832/2-A	Analysis Batch:	240-14125	Instrument ID:	A3UX9
Client Matrix:	Waste	Prep Batch:	240-13832	Lab File ID:	UX99550.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	1 g
Analysis Date:	09/01/2011 2255	Units:	ug/Kg	Final Weight/Volume:	5 mL
Prep Date:	08/30/2011 2253				
Leach Date:	N/A				

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Acetone	10000	8300	83	16 - 156	
Benzene	5000	5040	101	70 - 117	
Dichlorobromomethane	5000	5050	101	28 - 123	
Bromoform	5000	3270	65	10 - 117	
Bromomethane	5000	3950	79	10 - 114	
2-Butanone (MEK)	10000	9350	94	10 - 199	
Carbon disulfide	5000	4850	97	10 - 132	
Carbon tetrachloride	5000	4630	93	29 - 118	
Chlorobenzene	5000	4770	95	71 - 116	
Chloroethane	5000	3740	75	10 - 120	
Chloroform	5000	5770	115	63 - 116	
Chloromethane	5000	3980	80	25 - 110	
1,1-Dichloroethane	5000	5000	100	63 - 117	
1,2-Dichloroethane	5000	5270	105	68 - 119	
1,1-Dichloroethene	5000	4720	94	44 - 143	
1,2-Dichloropropane	5000	4710	94	73 - 113	
cis-1,3-Dichloropropene	5000	4330	87	25 - 120	
trans-1,3-Dichloropropene	5000	5260	105	22 - 122	
Ethylbenzene	5000	4810	96	66 - 119	
2-Hexanone	10000	10300	103	43 - 130	
Methylene Chloride	5000	5230	105	27 - 172	
4-Methyl-2-pentanone (MIBK)	10000	8740	87	49 - 121	
Styrene	5000	4750	95	60 - 120	
1,1,2,2-Tetrachloroethane	5000	5420	108	54 - 121	
Tetrachloroethene	5000	5350	107	58 - 131	
Toluene	5000	5670	113	66 - 123	
Trichloroethene	5000	4210	84	59 - 124	
Vinyl chloride	5000	4130	83	33 - 110	
1,1,1-Trichloroethane	5000	5470	109	38 - 122	
1,1,2-Trichloroethane	5000	5610	112	74 - 114	
Cyclohexane	5000	4830	97	40 - 120	
1,2-Dibromo-3-Chloropropane	5000	4600	92	10 - 129	
Ethylene Dibromide	5000	5550	111	47 - 123	
Dichlorodifluoromethane	5000	3620	72	10 - 110	
cis-1,2-Dichloroethene	5000	4950	99	60 - 125	
trans-1,2-Dichloroethene	5000	5220	104	58 - 121	
Isopropylbenzene	5000	5140	103	61 - 123	
Methyl acetate	5000	5340	107	44 - 173	
Methyl tert-butyl ether	5000	6070	121	34 - 157	
1,1,2-Trichloro-1,2,2-trifluoroethane	5000	5960	119	48 - 151	
1,2,4-Trichlorobenzene	5000	5550	111	41 - 135	

Client: ARCADIS U.S., Inc. Job Number: 240-3339-1

Lab Control Sample - Batch: 240-13832

Method: 8260B
Preparation: 5030B

Lab Sample ID:	LCS 240-13832/2-A	Analysis Batch:	240-14125	Instrument ID:	A3UX9
Client Matrix:	Waste	Prep Batch:	240-13832	Lab File ID:	UX99550.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	1 g
Analysis Date:	09/01/2011 2255	Units:	ug/Kg	Final Weight/Volume:	5 mL
Prep Date:	08/30/2011 2253				
Leach Date:	N/A				

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
1,2-Dichlorobenzene	5000	5310	106	68 - 118	
1,3-Dichlorobenzene	5000	5180	104	66 - 121	
1,4-Dichlorobenzene	5000	5030	101	65 - 119	
Trichlorofluoromethane	5000	4100	82	17 - 145	
Chlorodibromomethane	5000	3770	75	22 - 113	
Methylcyclohexane	5000	4840	97	41 - 133	
m-Xylene & p-Xylene	10000	9550	96	67 - 118	
o-Xylene	5000	4750	95	68 - 120	

Surrogate	% Rec	Acceptance Limits
1,2-Dichloroethane-d4 (Surr)	98	39 - 128
4-Bromofluorobenzene (Surr)	110	26 - 141
Toluene-d8 (Surr)	100	33 - 134
Dibromofluoromethane (Surr)	77	30 - 122

Client: ARCADIS U.S., Inc. Job Number: 240-3339-1

Method Blank - Batch: 240-13941

Method: 8270C
Preparation: 3580A

Lab Sample ID:	MB 240-13941/2-A	Analysis Batch:	240-14121	Instrument ID:	A4HP9
Client Matrix:	Waste	Prep Batch:	240-13941	Lab File ID:	MB13941.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	1.00 g
Analysis Date:	09/01/2011 1509	Units:	ug/Kg	Final Weight/Volume:	10.00 mL
Prep Date:	08/31/2011 1410			Injection Volume:	1 uL
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
1,1'-Biphenyl	20000	U	430	20000
2,2'-oxybis[1-chloropropane]	20000	U	310	20000
2,4,5-Trichlorophenol	20000	U	290	20000
2,4,6-Trichlorophenol	20000	U	410	20000
2,4-Dichlorophenol	20000	U	320	20000
2,4-Dimethylphenol	20000	U	410	20000
2,4-Dinitrophenol	96000	U	2500	96000
2,4-Dinitrotoluene	20000	U	340	20000
2,6-Dinitrotoluene	20000	U	350	20000
2-Chloronaphthalene	20000	U	380	20000
2-Chlorophenol	20000	U	220	20000
2-Methylnaphthalene	20000	U	59	20000
2-Methylphenol	20000	U	400	20000
2-Nitroaniline	96000	U	310	96000
2-Nitrophenol	20000	U	200	20000
3,3'-Dichlorobenzidine	96000	U	290	96000
3-Nitroaniline	96000	U	190	96000
4,6-Dinitro-2-methylphenol	96000	U	2800	96000
4-Bromophenyl phenyl ether	20000	U	280	20000
4-Chloro-3-methylphenol	20000	U	3100	20000
4-Chloroaniline	20000	U	310	20000
4-Chlorophenyl phenyl ether	20000	U	220	20000
4-Nitroaniline	96000	U	220	96000
4-Nitrophenol	96000	U	4900	96000
Acenaphthene	20000	U	55	20000
Acenaphthylene	20000	U	84	20000
Acetophenone	20000	U	330	20000
Anthracene	20000	U	140	20000
Atrazine	20000	U	660	20000
Benzaldehyde	20000	U	410	20000
Benzo[a]anthracene	20000	U	84	20000
Benzo[a]pyrene	20000	U	140	20000
Benzo[b]fluoranthene	20000	U	140	20000
Benzo[g,h,i]perylene	20000	U	110	20000
Benzo[k]fluoranthene	20000	U	140	20000
Bis(2-chloroethoxy)methane	20000	U	960	20000
Bis(2-chloroethyl)ether	20000	U	250	20000
Bis(2-ethylhexyl) phthalate	20000	U	960	20000
Butyl benzyl phthalate	20000	U	220	20000
Caprolactam	20000	U	470	20000
Carbazole	20000	U	560	20000
Chrysene	20000	U	59	20000
Dibenz(a,h)anthracene	20000	U	90	20000
Dibenzofuran	20000	U	50	20000
Diethyl phthalate	20000	U	370	20000

Client: ARCADIS U.S., Inc. Job Number: 240-3339-1

Method Blank - Batch: 240-13941

Method: 8270C
Preparation: 3580A

Lab Sample ID:	MB 240-13941/2-A	Analysis Batch:	240-14121	Instrument ID:	A4HP9
Client Matrix:	Waste	Prep Batch:	240-13941	Lab File ID:	MB13941.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	1.00 g
Analysis Date:	09/01/2011 1509	Units:	ug/Kg	Final Weight/Volume:	10.00 mL
Prep Date:	08/31/2011 1410			Injection Volume:	1 uL
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Dimethyl phthalate	20000	U	380	20000
Di-n-butyl phthalate	20000	U	300	20000
Di-n-octyl phthalate	20000	U	660	20000
Fluoranthene	20000	U	56	20000
Fluorene	20000	U	78	20000
Hexachlorobenzene	20000	U	84	20000
Hexachlorobutadiene	20000	U	150	20000
Hexachlorocyclopentadiene	96000	U	170	96000
Hexachloroethane	20000	U	290	20000
Indeno[1,2,3-cd]pyrene	20000	U	120	20000
Isophorone	20000	U	210	20000
Naphthalene	20000	U	53	20000
Nitrobenzene	20000	U	380	20000
N-Nitrosodi-n-propylamine	20000	U	460	20000
N-Nitrosodiphenylamine	20000	U	250	20000
Pentachlorophenol	20000	U	2700	20000
Phenol	20000	U	340	20000
Phenanthrene	20000	U	66	20000
Pyrene	20000	U	60	20000
3 & 4 Methylphenol	40000	U	1200	40000

Surrogate	% Rec	Acceptance Limits
2-Fluorobiphenyl (Surr)	86	44 - 110
2-Fluorophenol (Surr)	96	49 - 110
2,4,6-Tribromophenol (Surr)	79	16 - 124
Nitrobenzene-d5 (Surr)	92	53 - 110
Phenol-d5 (Surr)	96	47 - 110
Terphenyl-d14 (Surr)	99	36 - 128

Client: ARCADIS U.S., Inc. Job Number: 240-3339-1

Lab Control Sample - Batch: 240-13941

Method: 8270C
Preparation: 3580A

Lab Sample ID:	LCS 240-13941/3-A	Analysis Batch:	240-14121	Instrument ID:	A4HP9
Client Matrix:	Waste	Prep Batch:	240-13941	Lab File ID:	LCS13941.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	1.00 g
Analysis Date:	09/01/2011 1528	Units:	ug/Kg	Final Weight/Volume:	10.00 mL
Prep Date:	08/31/2011 1410			Injection Volume:	1 uL
Leach Date:	N/A				

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
1,1'-Biphenyl	50000	40700	81	50 - 130	
2,2'-oxybis[1-chloropropane]	50000	52400	105	50 - 130	
2,4,5-Trichlorophenol	50000	43500	87	49 - 110	
2,4,6-Trichlorophenol	50000	44400	89	51 - 110	
2,4-Dichlorophenol	50000	47000	94	52 - 110	
2,4-Dimethylphenol	50000	45600	91	44 - 110	
2,4-Dinitrophenol	50000	30900	62	10 - 148	J
2,4-Dinitrotoluene	50000	48000	96	61 - 110	
2,6-Dinitrotoluene	50000	48000	96	60 - 110	
2-Chloronaphthalene	50000	44600	89	56 - 110	
2-Chlorophenol	50000	48000	96	51 - 110	
2-Methylnaphthalene	50000	54100	108	61 - 110	
2-Methylphenol	50000	50000	100	50 - 110	
2-Nitroaniline	50000	50200	100	55 - 110	J
2-Nitrophenol	50000	44000	88	48 - 110	
3,3'-Dichlorobenzidine	50000	23100	46	36 - 110	J
3-Nitroaniline	50000	30700	61	47 - 110	J
4,6-Dinitro-2-methylphenol	50000	36800	74	35 - 110	J
4-Bromophenyl phenyl ether	50000	43600	87	59 - 110	
4-Chloro-3-methylphenol	50000	49700	99	51 - 110	
4-Chloroaniline	50000	21600	43	24 - 110	
4-Chlorophenyl phenyl ether	50000	46100	92	59 - 110	
4-Nitroaniline	50000	42200	84	53 - 110	J
4-Nitrophenol	50000	42500	85	43 - 110	J
Acenaphthene	50000	42200	84	52 - 110	
Acenaphthylene	50000	43200	86	56 - 110	
Acetophenone	50000	49800	100	50 - 130	
Anthracene	50000	42500	85	59 - 110	
Atrazine	50000	48400	97	50 - 130	
Benzaldehyde	50000	70900	142	10 - 130	*
Benzo[a]anthracene	50000	41200	82	54 - 110	
Benzo[a]pyrene	50000	39200	78	45 - 110	
Benzo[b]fluoranthene	50000	47400	95	50 - 110	
Benzo[g,h,i]perylene	50000	48200	96	49 - 110	
Benzo[k]fluoranthene	50000	43200	86	46 - 110	
Bis(2-chloroethoxy)methane	50000	49200	98	54 - 110	
Bis(2-chloroethyl)ether	50000	52300	105	41 - 124	
Bis(2-ethylhexyl) phthalate	50000	42600	85	52 - 113	
Butyl benzyl phthalate	50000	45500	91	58 - 110	
Caprolactam	50000	49500	99	50 - 130	
Carbazole	50000	42800	86	59 - 110	

Client: ARCADIS U.S., Inc. Job Number: 240-3339-1

Lab Control Sample - Batch: 240-13941

Method: 8270C
Preparation: 3580A

Lab Sample ID:	LCS 240-13941/3-A	Analysis Batch:	240-14121	Instrument ID:	A4HP9
Client Matrix:	Waste	Prep Batch:	240-13941	Lab File ID:	LCS13941.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	1.00 g
Analysis Date:	09/01/2011 1528	Units:	ug/Kg	Final Weight/Volume:	10.00 mL
Prep Date:	08/31/2011 1410			Injection Volume:	1 uL
Leach Date:	N/A				

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Chrysene	50000	41800	84	54 - 110	
Dibenz(a,h)anthracene	50000	47000	94	47 - 110	
Dibenzofuran	50000	44100	88	57 - 110	
Diethyl phthalate	50000	44600	89	57 - 110	
Dimethyl phthalate	50000	46300	93	59 - 110	
Di-n-butyl phthalate	50000	44600	89	60 - 110	
Di-n-octyl phthalate	50000	48700	97	55 - 110	
Fluoranthene	50000	43900	88	58 - 110	
Fluorene	50000	43800	88	54 - 110	
Hexachlorobenzene	50000	45100	90	58 - 110	
Hexachlorobutadiene	50000	48600	97	59 - 110	
Hexachlorocyclopentadiene	50000	35300	71	31 - 110	J
Hexachloroethane	50000	51400	103	60 - 110	
Indeno[1,2,3-cd]pyrene	50000	47100	94	44 - 110	
Isophorone	50000	48900	98	52 - 128	
Naphthalene	50000	47100	94	55 - 110	
Nitrobenzene	50000	51200	102	50 - 115	
N-Nitrosodi-n-propylamine	50000	52600	105	42 - 131	
N-Nitrosodiphenylamine	50000	43100	86	59 - 110	
Pentachlorophenol	50000	26600	53	42 - 110	
Phenol	50000	50700	101	47 - 110	
Phenanthrene	50000	41800	84	58 - 110	
Pyrene	50000	40700	81	56 - 110	
3 & 4 Methylphenol	100000	102000	102	53 - 110	

Surrogate	% Rec	Acceptance Limits
2-Fluorobiphenyl (Surr)	83	44 - 110
2-Fluorophenol (Surr)	99	49 - 110
2,4,6-Tribromophenol (Surr)	89	16 - 124
Nitrobenzene-d5 (Surr)	94	53 - 110
Phenol-d5 (Surr)	100	47 - 110
Terphenyl-d14 (Surr)	92	36 - 128

Client: ARCADIS U.S., Inc. Job Number: 240-3339-1

Method Blank - Batch: 240-13940

Method: 8082
Preparation: 3580A

Lab Sample ID:	MB 240-13940/2-A	Analysis Batch:	240-14107	Instrument ID:	A2HP12
Client Matrix:	Waste	Prep Batch:	240-13940	Lab File ID:	P1290110.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	1.00 g
Analysis Date:	09/01/2011 1715	Units:	ug/Kg	Final Weight/Volume:	10.00 mL
Prep Date:	08/31/2011 1405			Injection Volume:	1 mL
Leach Date:	N/A			Column ID:	PRIMARY

Analyte	Result	Qual	MDL	RL
Aroclor-1016	1000	U	190	1000
Aroclor-1221	1000	U	220	1000
Aroclor-1232	1000	U	170	1000
Aroclor-1242	1000	U	290	1000
Aroclor-1248	1000	U	200	1000
Aroclor-1254	1000	U	120	1000
Aroclor-1260	1000	U	130	1000

Surrogate	% Rec	Acceptance Limits
Tetrachloro-m-xylene	108	29 - 173
DCB Decachlorobiphenyl	103	13 - 185

Lab Control Sample - Batch: 240-13940

Method: 8082
Preparation: 3580A

Lab Sample ID:	LCS 240-13940/3-A	Analysis Batch:	240-14107	Instrument ID:	A2HP12
Client Matrix:	Waste	Prep Batch:	240-13940	Lab File ID:	P1290109.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	1.00 g
Analysis Date:	09/01/2011 1700	Units:	ug/Kg	Final Weight/Volume:	10.00 mL
Prep Date:	08/31/2011 1405			Injection Volume:	1 mL
Leach Date:	N/A			Column ID:	PRIMARY

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Aroclor-1016	10000	10400	104	66 - 149	
Aroclor-1260	10000	8870	89	50 - 155	

Surrogate	% Rec	Acceptance Limits
Tetrachloro-m-xylene	115	29 - 173
DCB Decachlorobiphenyl	97	13 - 185

ARCADIS
Infrastructure, environment, buildings

ID#:

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

Page 1 of 1

Lab Work Order #

Send Results to:

Contact & Company Name: ARCADIS
Telephone: 248-994-2273
Address: 28550 CABOT DR
Fax: 248-994-2241
City: NOVI State: MI Zip: 48377
E-mail Address: BRUCERUST@ARCADIS-US.com
Project Name/Location (City, State): MLC PONTIAC
Project #: B00164607
Sampler's Printed Name: SCOTT FILIPIAK
Sampler's Signature: Scott Filipiak

Sample ID	Collection Date	Collection Time	Type (✓) Comp	Type (✓) Grab	Matrix	Preservative	Filtered (✓)	# of Containers	Container Information	PCBs, VOCs	5 VOCs	Specific Gravity	Viscosity	TAL Metals	BTU / Flashpoint		REMARKS
						E	NO	1	4oz								
MWW-8-65-081811	8/18/11			X	NL	X	X	X	X	X	X						Include chromatograms from VOC analysis

PARAMETER ANALYSIS & METHOD

Keys

Preservation Key:
A. H_2SO_4
B. HCL
C. HNO_3
D. NaOH
E. None
F. Other: _____
G. Other: _____
H. Other: _____

Container Information Key:
1. 40 ml Vial
2. 1 L Amber
3. 250 ml Plastic
4. 500 ml Plastic
5. Encore
6. 2 oz. Glass
7. 4 oz. Glass
8. 8 oz. Glass
9. Other: _____
10. Other: _____

Matrix Key:
SO - Soil
SE - Sediment
NL - NAPL/Oil
W - Water
SL - Sludge
SW - Sample Wipe
T - Tissue
A - Air
Other: _____

Special Instructions/Comments:

☐ Special QA/QC Instructions(✓):

Laboratory Information and Receipt

Lab Name:
☐ Cooler packed with ice (✓)
Specify Turnaround Requirements:
Shipping Tracking #:
Cooler Custody Seal (✓) ☐ Intact ☐ Not Intact
Sample Receipt:
Condition/Cooler Temp: _____

Relinquished By	Received By	Relinquished By	Laboratory Received By
Printed Name: SCOTT FILIPIAK	Printed Name: ARCADIS FEDEX	Printed Name: Bruce Rust	Printed Name: Ryan Clase
Signature: Scott Filipiak	Signature:	Signature:	Signature:
Firm: ARCADIS	Firm/Courier:	Firm/Courier: ARCADIS	Firm: TAL
Date/Time: 8-22-11	Date/Time: 8-22-11	Date/Time: 8/24/11 5:10	Date/Time: 8/24/11 8:10

20730826 CofC AR Form 01.12.2007

Distribution: WHITE – Laboratory returns with results YELLOW – Lab copy PINK – Retained by ARCADIS

Chris Lange TAL 8/25/11 920

TestAmerica Cooler Receipt Form/Narrative **Lot Number:**_____
North Canton Facility

Client Arcadis Project _____ By: (Signature)
Cooler Received on 8-25-11 Opened on 8-25-11
FedEx ☑ UPS ☐ DHL ☐ FAS ☐ Stetson ☐ Client Drop Off ☐ TestAmerica Courier ☐ Other _____
TestAmerica Cooler # _____ Multiple Coolers ☐ Foam Box ☐ Client Cooler ☑ Other _____

1. Were custody seals on the outside of the cooler(s)? Yes ☐ No ☑ Intact? Yes ☐ No ☐ NA ☑
   If YES, Quantity_____ Quantity Unsalvageable_____
   Were custody seals on the outside of cooler(s) signed and dated? Yes ☐ No ☐ NA ☑
   Were custody seals on the bottle(s)? Yes ☐ No ☑
   If YES, are there any exceptions? _____
2. Shippers' packing slip attached to the cooler(s)? Yes ☑ No ☐
3. Did custody papers accompany the sample(s)? Yes ☑ No ☐ Relinquished by client? Yes ☑ No ☐
4. Were the custody papers signed in the appropriate place? Yes ☑ No ☐
5. Packing material used: Bubble Wrap ☑ Foam ☐ None ☐ Other _____
6. Cooler temperature upon receipt 0.5 °C See back of form for multiple coolers/temps ☐
   METHOD: IR ☑ Other ☐ _____
   COOLANT: Wet Ice ☑ Blue Ice ☐ Dry Ice ☐ Water ☐ None ☐
7. Did all bottles arrive in good condition (Unbroken)? Yes ☑ No ☐
8. Could all bottle labels be reconciled with the COC? Yes ☑ No ☐
9. Were sample(s) at the correct pH upon receipt? Yes ☐ No ☐ NA ☑
10. Were correct bottle(s) used for the test(s) indicated? Yes ☑ No ☐
11. Were air bubbles >6 mm in any VOA vials? Yes ☐ No ☐ NA ☑
12. Sufficient quantity received to perform indicated analyses? Yes ☑ No ☐
13. Was a trip blank present in the cooler(s)? Yes ☐ No ☑ Were VOAs on the COC? Yes ☐ No ☑

Contacted PM _____ Date _____ by _____ via Verbal ☐ Voice Mail ☐ Other ☐
Concerning _____

14. CHAIN OF CUSTODY

The following discrepancies occurred:

15. SAMPLE CONDITION

Sample(s) _____ were received after the recommended holding time had expired.
Sample(s) _____ were received in a broken container.
Sample(s) _____ were received with bubble >6 mm in diameter. (Notify PM)

16. SAMPLE PRESERVATION

Sample(s) _____ were further preserved in Sample Receiving to meet recommended pH level(s). *Nitric Acid Lot#* 100110-HNO_3; *Sulfuric Acid Lot#* 110410-H_2SO_4; *Sodium Hydroxide Lot#* 100108 -*NaOH; Hydrochloric Acid Lot#* 092006-*HCl; Sodium Hydroxide and Zinc Acetate Lot#* 100108-$(CH_3COO)_2ZN/NaOH$. What time was preservative added to sample(s)? _____

Client ID	pH	Date	Initials

TestAmerica Cooler Receipt Form/Narrative
North Canton Facility

Client ID	pH	Date	Initials
Cooler #	**Temp. °C**	**Method**	**Coolant**

Discrepancies Cont'd

Login Sample Receipt Checklist

Client: ARCADIS U.S., Inc.

Job Number: 240-3339-1

Login Number: 3339

List Source: TestAmerica North Canton

List Number: 1

Creator: Livengood, Chris

Question	Answer	Comment
Radioactivity either was not measured or, if measured, is at or below background	N/A	
The cooler's custody seal, if present, is intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	0.5
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the sample IDs on the containers and the COC.	True	
Samples are received within Holding Time.	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
VOA sample vials do not have headspace or bubble is <6mm (1/4") in diameter.	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

Attachment 3

Laboratory analytical data – Zymax

ZymaX forensics

Ship all samples to: 600 South Andreasen Drive, Suite B
Escondido, CA. 92029-1917 Attention: Dr. Yi Wang

vox 760.781.3338 ext. 43; fax 760.781.3339
cell 609.721.2843

CHAIN of CUSTODY

Report to: Jon Smith E-mail: Jonathan.smith@arcadis-us.com

Company: ARCADIS

Address: 28550 Cabot Dr. Ste. 500
Novi, MI 48377

vox 248-994-2240 fax 248-994-2241

Project: ~~BOG~~ RACER PNC

Project # B0064607.2013

Sampler: Drew Shaw

ANALYSIS REQUESTED

Turnaround Time

☐ ASAP ☐ 2 Week
☐ 3 Week ☒ 4 Wk STD
☐ 2 Month ☐ 3 Month

Zymax use only	SAMPLE DISCRIPTION	Date Sampled	Time	Matrix	Preserve	EDB	C3-C44 w/ silica gel	# of containers	Remarks/Concentrations
43192-1	MWM2-29_LNAPL	8/19/13	1500	NAPL	None		X	3	
-2	MWW8-65_LNAPL	8/20/13	1460	NAPL	None		X	3	

By signing the relinquishment you agree to ZymaX's sample disposal policy

Comments:

Sample integrity upon reciept:

Samples received intact ☐
Samples received cold ☐
Custody seals ☐
Correct container types ☐

Bill 3rd party:

PO#: _____
Quote yes no

Relinquished by:
Signature
Print Drew Shaw
Company ARCADIS
Date 8/20/13 Time 1800

Recieved by:
Signature
Print
Company
Date Time

Relinquished by:
Signature
Print
Company
Date Time

Received by ZymaX Forensics:
Signature
Print ROBERT LE
Company ZymaX
Date 8/21/13 Time 10:20

For additional information, please send inquiries to: yi.wang@ZymaXusa.com or call Dr. Yi Wang at 609.721.2843 (cell)

C3-C44 Whole Oil Analysis

1. Gasoline Range PIANO Distribution
2. Whole Chromatogram
3. Expanded Chromatogram(in 3 pages)
4. Quantitation Report with Peak areas

ZymaX FORENSICS

8/21/2013

ZymaX ID	43192-1
Sample ID	MWW2-29-LNAPL
Evaporation	
n-Pentane / n-Heptane	0.00
2-Methylpentane / 2-Methylheptane	0.00
Waterwashing	
Benzene / Cyclohexane	0.00
Toluene / Methylcyclohexane	0.00
Aromatics / Total Paraffins (n+iso+cyc)	1.23
Aromatics / Naphthenes	0.00
Biodegradation	
(C4 - C8 Para + Isopara) / C4 - C8 Olefins	0.00
3-Methylhexane / n-Heptane	0.00
Methylcyclohexane / n-Heptane	0.00
Isoparaffins + Naphthenes / Paraffins	0.00
Octane rating	
2,2,4,-Trimethylpentane / Methylcyclohexane	0.00
Relative percentages - Bulk hydrocarbon composition as PIANO	
% Paraffinic	44.88
% Isoparaffinic	0.00
% Aromatic	55.12
% Naphthenic	0.00
% Olefinic	0.00

Submitted by,
Zymax Forensics, a DPRA Company

Shan-Tan Lu, Ph.D.
Director of Forensic Geochemistry

ZymaX FORENSICS

8/21/2013

ZymaX ID		43192-1
Sample ID		MWW2-29-LNAPL
		Relative Area %
1	Propane	0.00
2	Isobutane	0.00
3	Isobutene	0.00
4	Butane/Methanol	0.00
5	trans-2-Butene	0.00
6	cis-2-Butene	0.00
7	3-Methyl-1-butene	0.00
8	Isopentane	0.00
9	1-Pentene	0.00
10	2-Methyl-1-butene	0.00
11	Pentane	0.00
12	trans-2-Pentene	0.00
13	cis-2-Pentene/t-Butanol	0.00
14	2-Methyl-2-butene	0.00
15	2,2-Dimethylbutane	0.00
16	Cyclopentane	0.00
17	2,3-Dimethylbutane/MTBE	0.00
18	2-Methylpentane	0.00
19	3-Methylpentane	0.00
20	Hexane	0.00
21	trans-2-Hexene	0.00
22	3-Methylcyclopentene	0.00
23	3-Methyl-2-pentene	0.00
24	cis-2-Hexene	0.00
25	3-Methyl-trans-2-pentene	0.00
26	Methylcyclopentane	0.00
27	2,4-Dimethylpentane	0.00
28	Benzene	0.00
29	5-Methyl-1-hexene	0.00
30	Cyclohexane	0.00
31	2-Methylhexane/TAME	0.00
32	2,3-Dimethylpentane	0.00
33	3-Methylhexane	0.00
34A	1-trans-3-Dimethylcyclopentane	0.00
34B	1-cis-3-Dimethylcyclopentane	0.00
35	2,2,4-Trimethylpentane	0.00
I.S. #1	à,à,à-Trifluorotoluene	0.00

ZymaX FORENSICS

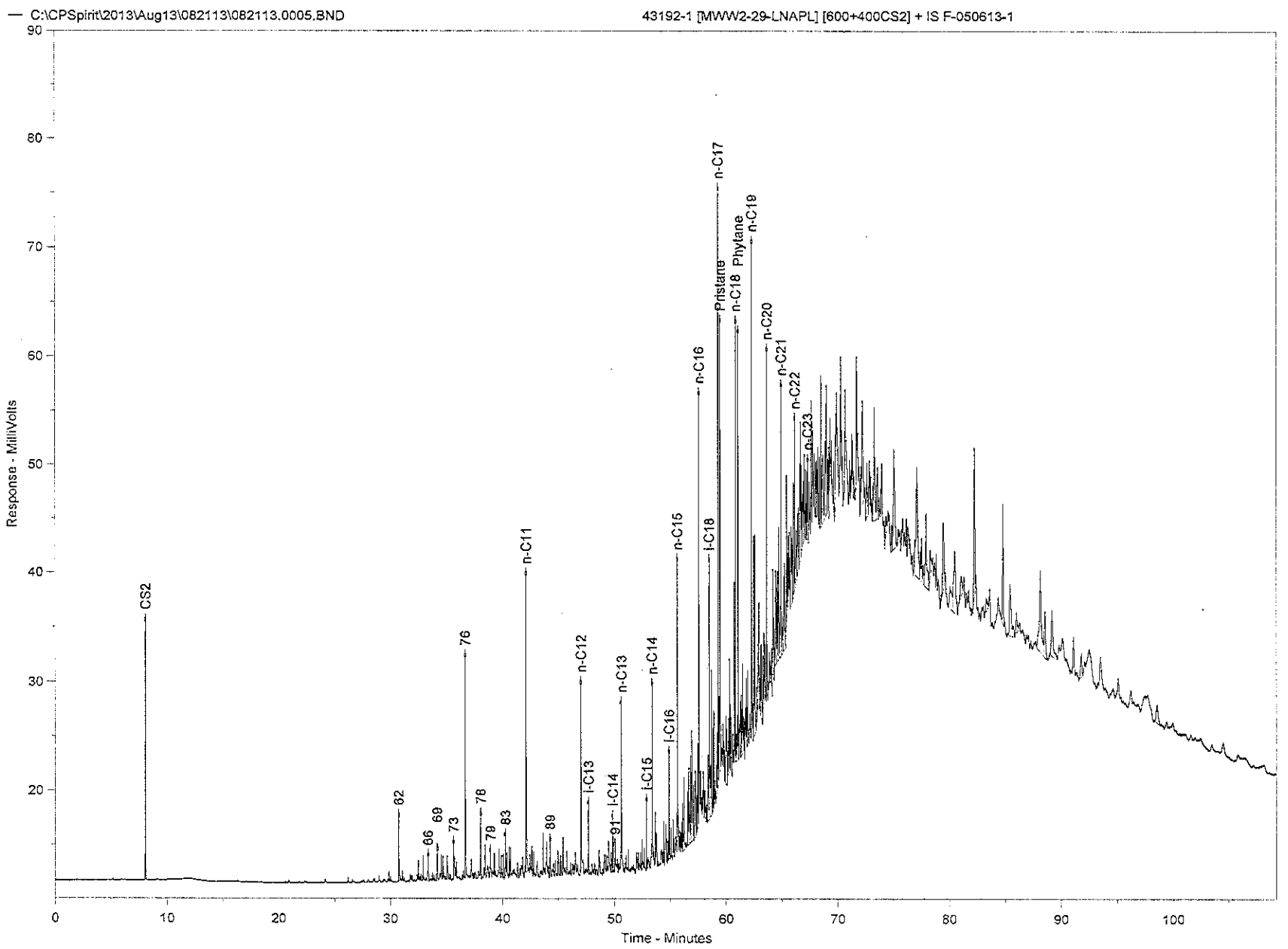
8/21/2013

ZymaX ID		43192-1
Sample ID		MWW2-29-LNAPL
		Relative Area %
36	n-Heptane	0.00
37	Methylcyclohexane	0.00
38	2,5-Dimethylhexane	0.00
39	2,4-Dimethylhexane	0.00
40	2,3,4-Trimethylpentane	0.00
41	Toluene/2,3,3-Trimethylpentane	0.00
42	2,3-Dimethylhexane	0.00
43	2-Methylheptane	0.00
44	4-Methylheptane	0.00
45	3,4-Dimethylhexane	0.00
46A	3-Ethyl-3-methylpentane	0.00
46B	1,4-Dimethylcyclohexane	0.00
47	3-Methylheptane	0.00
48	2,2,5-Trimethylhexane	0.00
49	n-Octane	0.00
50	2,2-Dimethylheptane	0.00
51	2,4-Dimethylheptane	0.00
52	Ethylcyclohexane	0.00
53	2,6-Dimethylheptane	0.00
54	Ethylbenzene	0.00
55	m+p Xylenes	0.00
56	4-Methyloctane	0.00
57	2-Methyloctane	0.00
58	3-Ethylheptane	0.00
59	3-Methyloctane	0.00
60	o-Xylene	0.00
61	1-Nonene	0.00
62	n-Nonane	10.74
I.S.#2	p-Bromofluorobenzene	0.00
63	Isopropylbenzene	0.00
64	3,3,5-Trimethylheptane	0.00
65	2,4,5-Trimethylheptane	0.00
66	n-Propylbenzene	5.16
67	1-Methyl-3-ethylbenzene	0.00
68	1-Methyl-4-ethylbenzene	0.00
69	1,3,5-Trimethylbenzene	6.73
70	3,3,4-Trimethylheptane	0.00

ZymaX FORENSICS

8/21/2013

ZymaX ID		43192-1
Sample ID		MWW2-29-LNAPL
		Relative Area %
71	1-Methyl-2-ethylbenzene	0.00
72	3-Methylnonane	0.00
73	1,2,4-Trimethylbenzene	8.02
74	Isobutylbenzene	0.00
75	sec-Butylbenzene	0.00
76	n-Decane	34.14
77	1,2,3-Trimethylbenzene	0.00
78	Indan	9.65
79	1,3-Diethylbenzene	6.55
80	1,4-Diethylbenzene	0.00
81	n-Butylbenzene	0.00
82	1,3-Dimethyl-5-ethylbenzene	0.00
83	1,4-Dimethyl-2-ethylbenzene	7.38
84	1,3-Dimethyl-4-ethylbenzene	0.00
85	1,2-Dimethyl-4-ethylbenzene	0.00
86	Undecene	0.00
87	1,2,4,5-Tetramethylbenzene	0.00
88	1,2,3,5-Tetramethylbenzene	0.00
89	1,2,3,4-Tetramethylbenzene	7.14
90	Naphthalene	0.00
91	2-Methyl-naphthalene	4.49
92	1-Methyl-naphthalene	0.00


C:\CPSpirit\2013\Aug13\082113\082113.0005.BND
43192-1 [MWW2-29-LNAPL] [600+400CS2] + IS F-050613-1
Response - MilliVolts
Time - Minutes
CS2
62
66
69
73
76
78
79
83
n-C11
89
n-C12
I-C13
I-C14
91
n-C13
I-C15
n-C14
I-C16
n-C15
I-C18
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Pristane
n-C17
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Phytane
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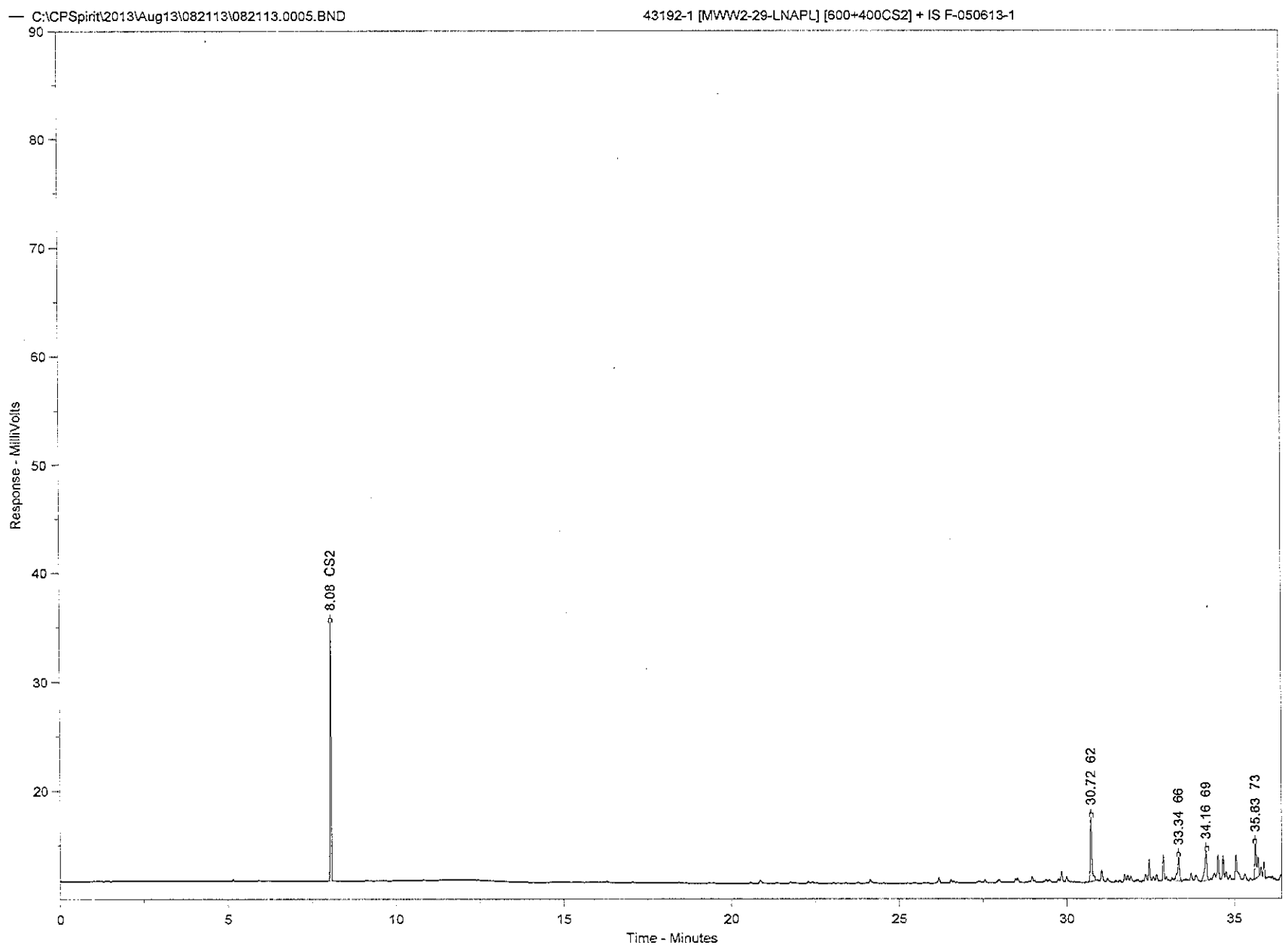
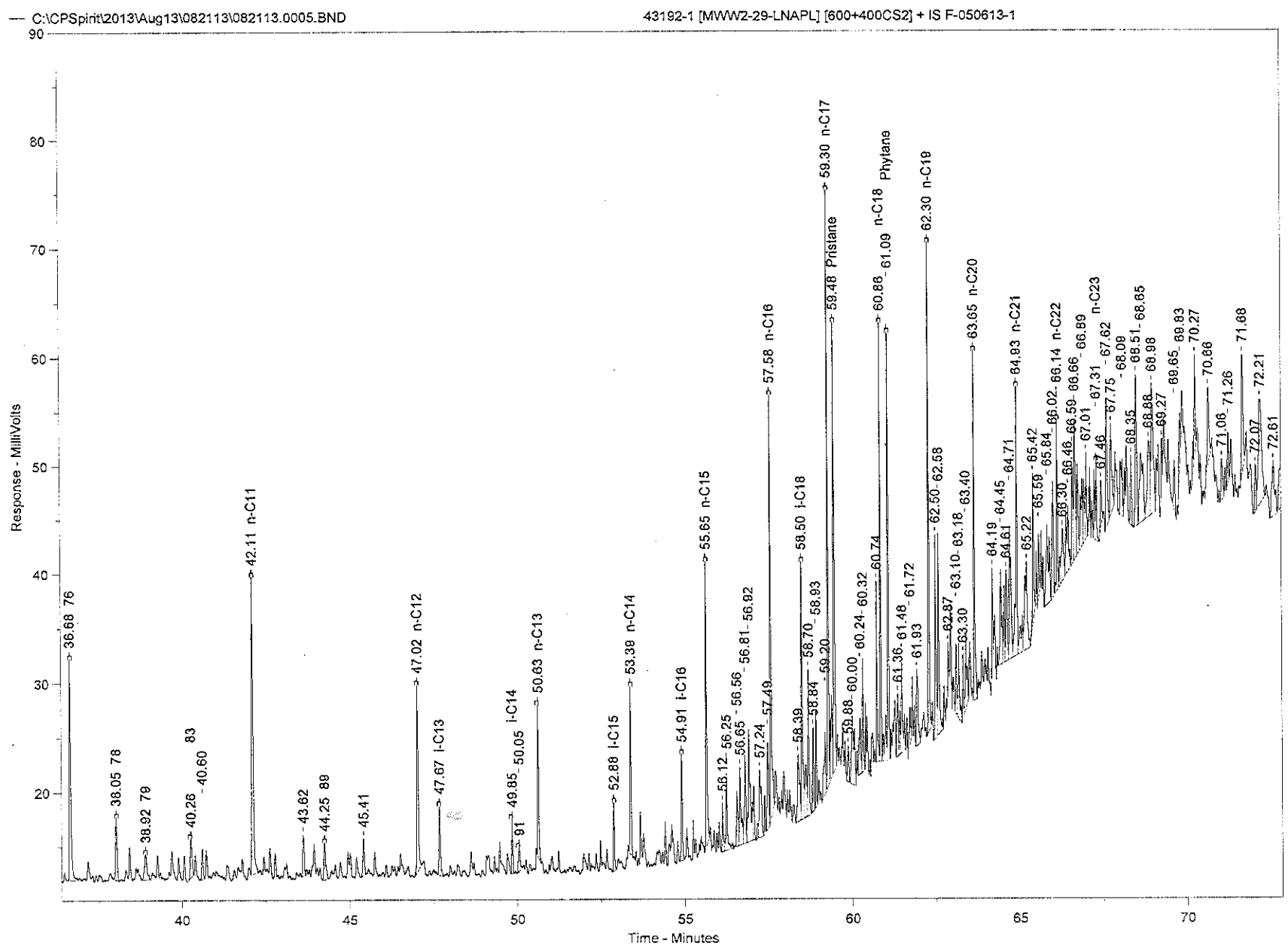
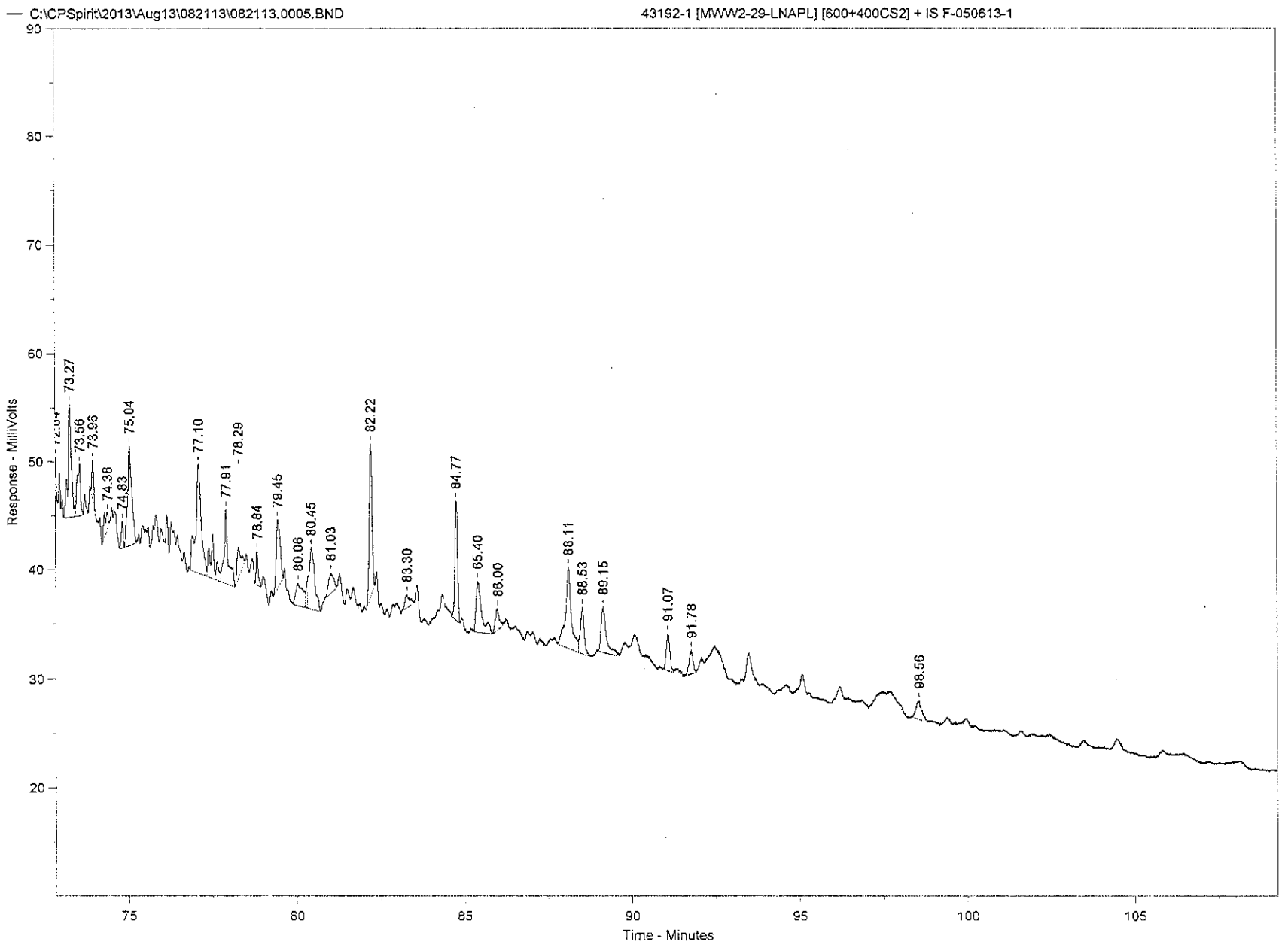
n-C20
n-C21
n-C22
n-C23


C:\CPSpirit\2013\Aug13\082113\082113.0005.BND
43192-1 [MWW2-29-LNAPL] [600+400CS2] + IS F-050613-1
Response - MilliVolts
Time - Minutes
8.08 CS2
30.72 62
33.34 66
34.16 69
35.83 73


C:\CPSpirit\2013\Aug13\082113\082113.0005.BND
43192-1 [MWWZ-29-LNAPL] [600+400CS2] + IS F-050613-1
Response - MilliVolts
Time - Minutes
36.68 76
38.05 78
38.92 79
40.26 83
40.60
42.11 n-C11
43.62
44.25 89
45.41
47.02 n-C12
47.67 i-C13
49.85 91
50.05 i-C14
50.63 n-C13
52.88 i-C15
53.39 n-C14
54.91 i-C16
55.65 n-C15
56.12
56.25
56.56
56.65
56.81
56.92
57.24
57.49
57.58 n-C16
58.39
58.50 i-C18
58.70
58.84
58.93
59.20
59.30 n-C17
59.48 Pristane
59.88
60.00
60.24
60.32
60.74
60.86
61.09 n-C18 Phytane
61.36
61.48
61.72
61.93
62.30 n-C19
62.50
62.58
62.87
63.10
63.18
63.30
63.40
63.65 n-C20
64.19
64.45
64.61
64.71
64.93 n-C21
65.22
65.42
65.59
65.84
66.02
66.14 n-C22
66.30
66.46
66.59
66.66
66.89
67.01
67.31
67.46
67.62
67.75
n-C23
68.09
68.35
68.51
68.65
68.88
68.98
69.27
69.65
69.83
70.27
70.66
71.06
71.26
71.68
72.07
72.21
72.61


C:\CPSpirit\2013\Aug13\082113\082113.0005.BND
43192-1 [MWW2-29-LNAPL] [600+400CS2] + IS F-050613-1
Response - MilliVolts
Time - Minutes
90
80
70
60
50
40
30
20
75
80
85
90
95
100
105
73.27
73.56
73.96
74.36
74.83
75.04
77.10
77.91
78.29
78.84
79.45
80.06
80.45
81.03
82.22
83.30
84.77
85.40
86.00
88.11
88.53
89.15
91.07
91.78
98.56

Sample Name = **43192-1 [MWW2-29-LNAPL] [600+400CS2] + IS F-050613-1**

Instrument = Instrument 1
Heading 1 =
Heading 2 =

Acquisition Port = DP#

Raw File Name = **C:\CPSpirit\2013\Aug13\082113\082113.0005.RAW**
Method File Name = C:\CPSpirit\C344.met
Calibration File Name = C:\CPSpirit\2013\Aug13\082113\082113.0005.BND

Date Taken (end) = 8/22/2013 4:32:28 PM
Method Version = 44
Calibration Version = 12

Peak Name	Ret. Time	Area %	Area
CS2	8.08	1.2561	52919.35
62	30.72	0.4746	19996.81
66	33.34	0.2281	9608.19
69	34.16	0.2973	12527.50
73	35.63	0.3541	14918.42
76	36.68	1.5079	63529.78
78	38.05	0.4262	17955.29
79	38.92	0.2893	12187.89
83	40.26	0.3259	13732.20
	40.60	0.1899	7998.61
n-C11	42.11	2.0166	84960.68
	43.62	0.2735	11521.76
89	44.25	0.3155	13292.21
	45.41	0.2575	10850.10
n-C12	47.02	1.1600	48871.91
i-C13	47.67	0.4455	18769.86
i-C14	49.85	0.2678	11283.67
91	50.05	0.1982	8352.33
n-C13	50.63	0.7653	32242.21
i-C15	52.88	0.3290	13861.75
n-C14	53.39	0.8116	34194.06
i-C16	54.91	0.5781	24357.21
n-C15	55.65	1.4091	59364.94
	56.12	0.2689	11327.91
	56.25	0.4427	18650.62
	56.56	0.4121	17362.35
	56.65	0.5686	23954.61
	56.81	0.5683	23944.57
	56.92	1.0684	45011.91
	57.24	0.6463	27229.97
	57.49	0.5736	24166.95
n-C16	57.58	2.0369	85817.74
	58.39	0.6350	26754.58
i-C18	58.50	1.4684	61862.88
	58.70	0.7073	29800.16
	58.84	0.4341	18289.93
	58.93	0.3760	15841.32
	59.20	0.4946	20839.27
n-C17	59.30	3.0470	128371.40
Pristane	59.48	2.3858	100515.10
	59.88	0.1972	8308.48
	60.00	0.8447	35587.04
	60.24	0.4218	17771.85
	60.32	0.5233	22046.46
	60.74	0.8069	33996.28
n-C18	60.86	1.6837	70936.22
Phytane	61.09	2.3040	97066.95
	61.36	0.3564	15014.79
	61.48	0.6792	28616.66
	61.72	0.2710	11417.75
	61.93	0.5857	24675.63
n-C19	62.30	2.1942	92441.70
	62.50	1.0856	45735.14
	62.58	1.0606	44685.02
	62.87	0.2029	8547.19

Peak Name	Ret. Time	Area %	Area
	63.10	0.3592	15131.24
	63.18	0.4338	18276.23
	63.30	0.2806	11822.79
	63.40	0.5059	21314.15
n-C20	63.65	1.5178	63944.93
	64.19	0.4606	19404.38
	64.45	0.7405	31195.93
	64.61	0.5793	24406.46
	64.71	1.1060	46597.83
n-C21	64.93	1.5241	64211.86
	65.22	1.0815	45564.36
	65.42	0.8712	36704.30
	65.59	0.3492	14710.73
	65.84	0.9560	40275.88
	66.02	0.8398	35382.19
n-C22	66.14	0.6880	28987.10
	66.30	0.5101	21492.78
	66.46	0.7428	31296.44
	66.59	0.6060	25532.36
	66.66	1.0211	43021.46
	66.89	0.5742	24193.05
	67.01	0.3967	16713.35
n-C23	67.31	0.6706	28254.03
	67.46	0.2816	11865.98
	67.62	0.8346	35162.95
	67.75	0.7149	30117.73
	68.09	0.5710	24055.40
	68.35	0.3686	15527.54
	68.51	0.9557	40262.88
	68.65	1.1020	46427.40
	68.88	0.9783	41215.93
	68.98	1.3568	57164.68
	69.27	0.2243	9448.85
	69.65	0.3109	13096.74
	69.83	0.4023	16950.60
	70.27	0.6730	28352.38
	70.66	0.6244	26307.21
	71.06	0.3304	13920.29
	71.26	0.2968	12504.56
	71.68	0.9206	38786.26
	72.07	0.3416	14391.44
	72.21	1.6420	69176.84
	72.61	0.7390	31135.56
	72.84	0.5966	25134.40
	73.27	1.7901	75419.89
	73.56	0.7944	33468.82
	73.96	0.3293	13873.88
	74.38	0.3732	15724.36
	74.83	0.2238	9427.91
	75.04	1.9220	80974.23
	77.10	2.8284	119163.60
	77.91	1.3639	57462.73
	78.29	0.5692	23981.40
	78.84	0.3099	13056.69
	79.45	1.2495	52641.86
	80.06	0.7471	31475.14
	80.45	1.5591	65687.69
	81.03	0.4640	19549.59
	82.22	1.9298	81304.05
	83.30	0.2819	11878.04
	84.77	1.4169	59696.51
	85.40	1.2739	53670.66
	86.00	0.3955	16661.39
	88.11	2.1642	91177.77
	88.53	0.7858	33107.66
	89.15	1.1028	46459.74
	91.07	0.6002	25286.66

Peak Name	Ret. Time	Area %	Area
	91.78	0.4234	17839.08
	98.56	0.4923	20741.07

Total Area = 4213055 Total Height = 1222800 Total Amount = 0

ZymaX FORENSICS

8/21/2013

ZymaX ID	43192-2
Sample ID	MWW8-65-LNAPL

Evaporation

n-Pentane / n-Heptane	0.00
2-Methylpentane / 2-Methylheptane	0.00

Waterwashing

Benzene / Cyclohexane	0.00
Toluene / Methylcyclohexane	0.00
Aromatics / Total Paraffins (n+iso+cyc)	0.00
Aromatics / Naphthenes	0.00

Biodegradation

(C4 - C8 Para + Isopara) / C4 - C8 Olefins	0.00
3-Methylhexane / n-Heptane	0.00
Methylcyclohexane / n-Heptane	0.00
Isoparaffins + Naphthenes / Paraffins	0.00

Octane rating

2,2,4,-Trimethylpentane / Methylcyclohexane	0.00

Relative percentages - Bulk hydrocarbon composition as PIANO

% Paraffinic	0.00
% Isoparaffinic	0.00
% Aromatic	100.00
% Naphthenic	0.00
% Olefinic	0.00

Submitted by,
Zymax Forensics, a DPRA Company

Shan-Tan Lu, Ph.D.
Director of Forensic Geochemistry

ZymaX FORENSICS

8/21/2013

ZymaX ID		43192-2
Sample ID		MWW8-65-LNAPL
		Relative Area %
1	Propane	0.00
2	Isobutane	0.00
3	Isobutene	0.00
4	Butane/Methanol	0.00
5	trans-2-Butene	0.00
6	cis-2-Butene	0.00
7	3-Methyl-1-butene	0.00
8	Isopentane	0.00
9	1-Pentene	0.00
10	2-Methyl-1-butene	0.00
11	Pentane	0.00
12	trans-2-Pentene	0.00
13	cis-2-Pentene/t-Butanol	0.00
14	2-Methyl-2-butene	0.00
15	2,2-Dimethylbutane	0.00
16	Cyclopentane	0.00
17	2,3-Dimethylbutane/MTBE	0.00
18	2-Methylpentane	0.00
19	3-Methylpentane	0.00
20	Hexane	0.00
21	trans-2-Hexene	0.00
22	3-Methylcyclopentene	0.00
23	3-Methyl-2-pentene	0.00
24	cis-2-Hexene	0.00
25	3-Methyl-trans-2-pentene	0.00
26	Methylcyclopentane	0.00
27	2,4-Dimethylpentane	0.00
28	Benzene	0.00
29	5-Methyl-1-hexene	0.00
30	Cyclohexane	0.00
31	2-Methylhexane/TAME	0.00
32	2,3-Dimethylpentane	0.00
33	3-Methylhexane	0.00
34A	1-trans-3-Dimethylcyclopentane	0.00
34B	1-cis-3-Dimethylcyclopentane	0.00
35	2,2,4-Trimethylpentane	0.00
I.S. #1	à,à,à-Trifluorotoluene	0.00

ZymaX FORENSICS

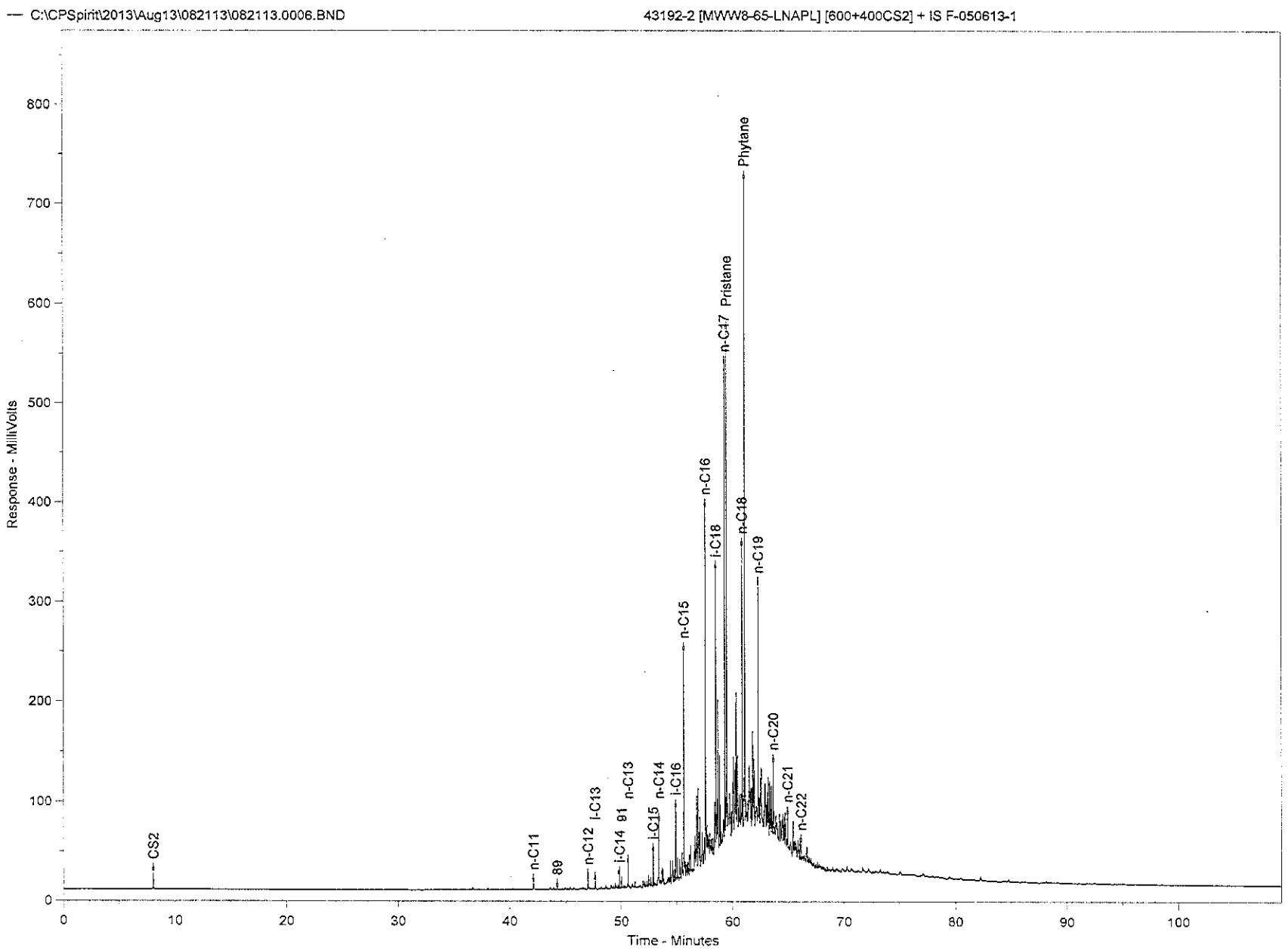
8/21/2013

ZymaX ID		43192-2
Sample ID		MWW8-65-LNAPL
		Relative Area %
36	n-Heptane	0.00
37	Methylcyclohexane	0.00
38	2,5-Dimethylhexane	0.00
39	2,4-Dimethylhexane	0.00
40	2,3,4-Trimethylpentane	0.00
41	Toluene/2,3,3-Trimethylpentane	0.00
42	2,3-Dimethylhexane	0.00
43	2-Methylheptane	0.00
44	4-Methylheptane	0.00
45	3,4-Dimethylhexane	0.00
46A	3-Ethyl-3-methylpentane	0.00
46B	1,4-Dimethylcyclohexane	0.00
47	3-Methylheptane	0.00
48	2,2,5-Trimethylhexane	0.00
49	n-Octane	0.00
50	2,2-Dimethylheptane	0.00
51	2,4-Dimethylheptane	0.00
52	Ethylcyclohexane	0.00
53	2,6-Dimethylheptane	0.00
54	Ethylbenzene	0.00
55	m+p Xylenes	0.00
56	4-Methyloctane	0.00
57	2-Methyloctane	0.00
58	3-Ethylheptane	0.00
59	3-Methyloctane	0.00
60	o-Xylene	0.00
61	1-Nonene	0.00
62	n-Nonane	0.00
I.S.#2	p-Bromofluorobenzene	0.00
63	Isopropylbenzene	0.00
64	3,3,5-Trimethylheptane	0.00
65	2,4,5-Trimethylheptane	0.00
66	n-Propylbenzene	0.00
67	1-Methyl-3-ethylbenzene	0.00
68	1-Methyl-4-ethylbenzene	0.00
69	1,3,5-Trimethylbenzene	0.00
70	3,3,4-Trimethylheptane	0.00

ZymaX FORENSICS

8/21/2013

ZymaX ID		43192-2
Sample ID		MWW8-65-LNAPL
		Relative Area %
71	1-Methyl-2-ethylbenzene	0.00
72	3-Methylnonane	0.00
73	1,2,4-Trimethylbenzene	0.00
74	Isobutylbenzene	0.00
75	sec-Butylbenzene	0.00
76	n-Decane	0.00
77	1,2,3-Trimethylbenzene	0.00
78	Indan	0.00
79	1,3-Diethylbenzene	0.00
80	1,4-Diethylbenzene	0.00
81	n-Butylbenzene	0.00
82	1,3-Dimethyl-5-ethylbenzene	0.00
83	1,4-Dimethyl-2-ethylbenzene	0.00
84	1,3-Dimethyl-4-ethylbenzene	0.00
85	1,2-Dimethyl-4-ethylbenzene	0.00
86	Undecene	0.00
87	1,2,4,5-Tetramethylbenzene	0.00
88	1,2,3,5-Tetramethylbenzene	0.00
89	1,2,3,4-Tetramethylbenzene	42.98
90	Naphthalene	0.00
91	2-Methyl-naphthalene	57.02
92	1-Methyl-naphthalene	0.00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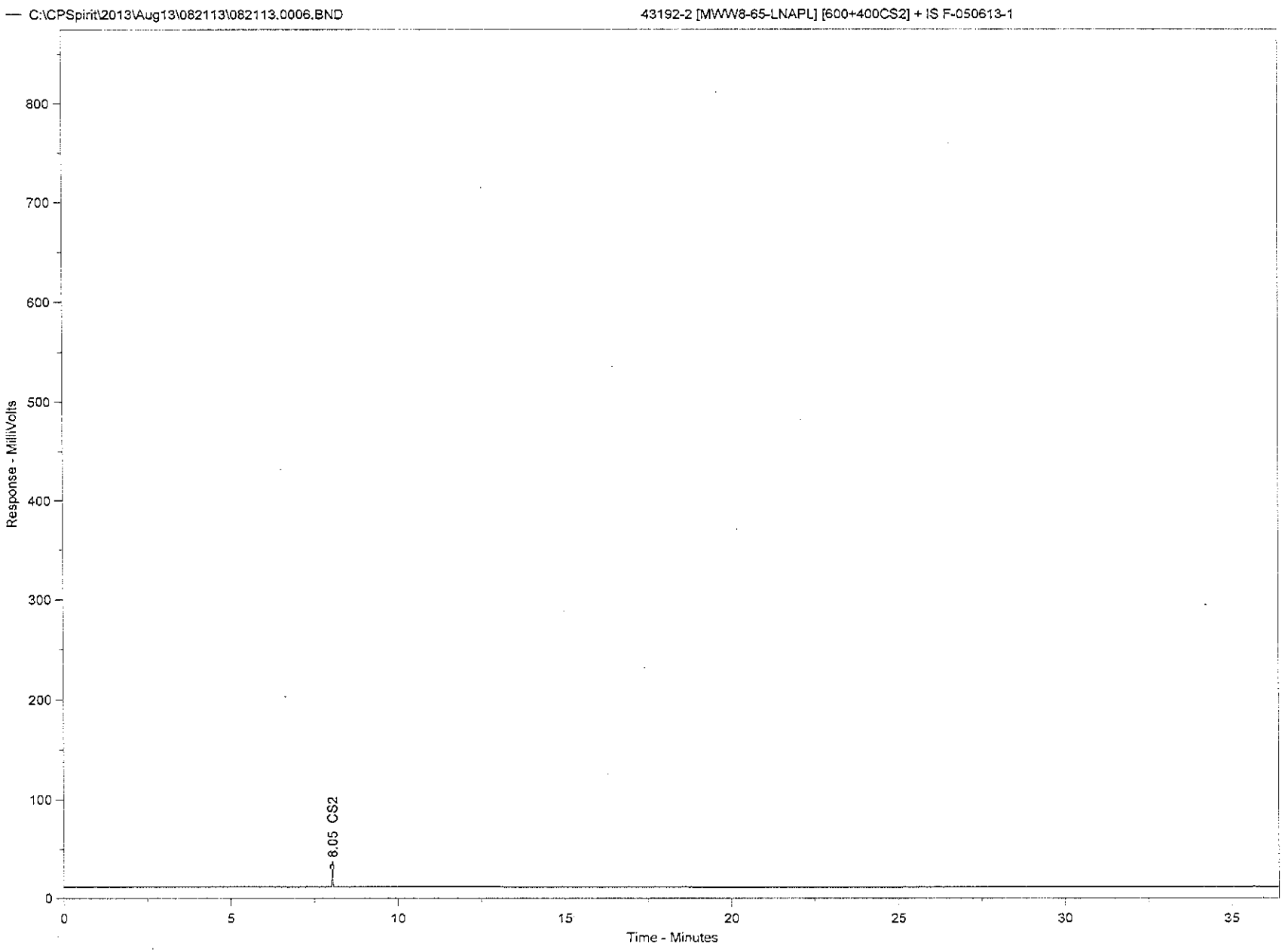
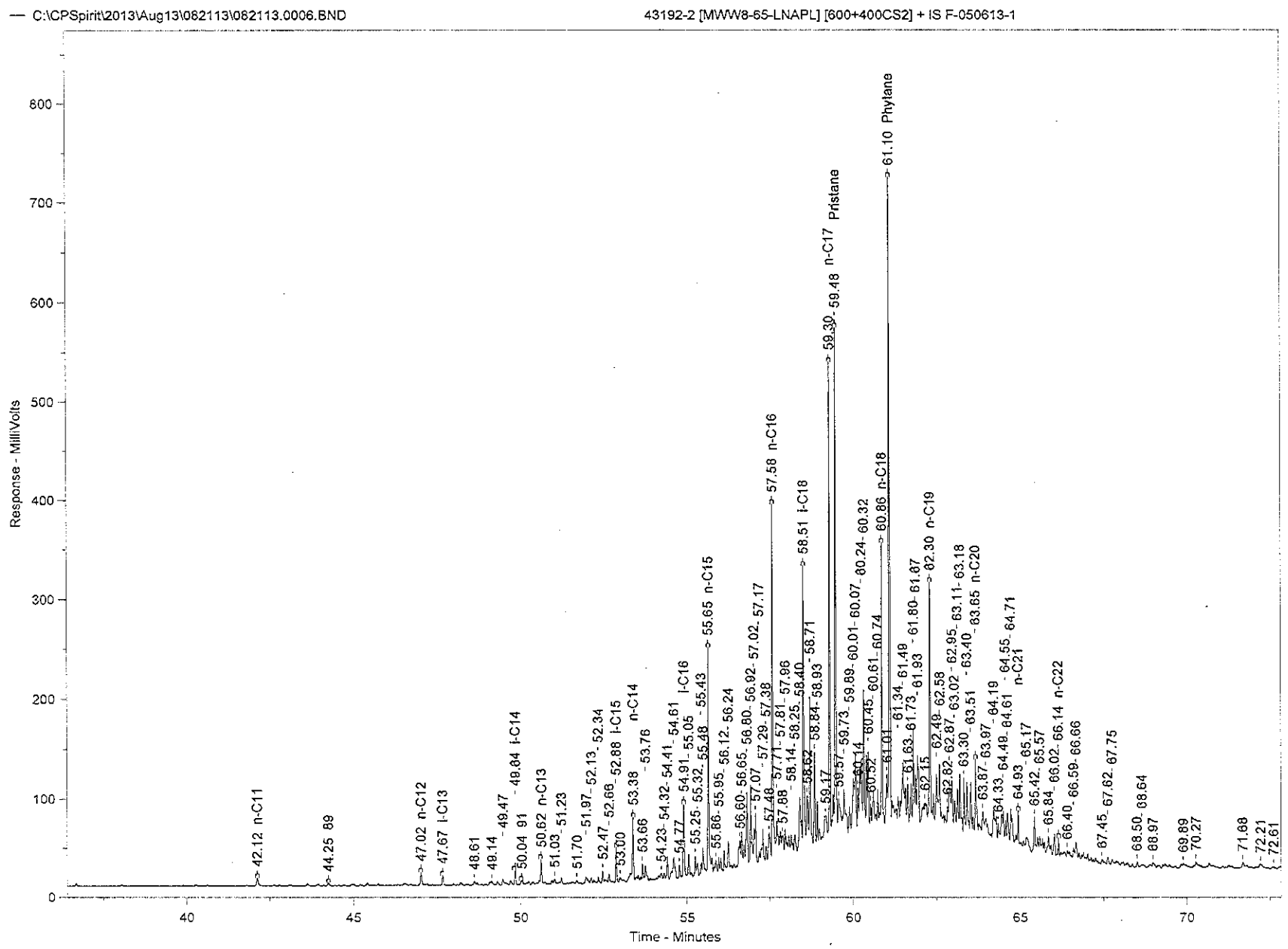
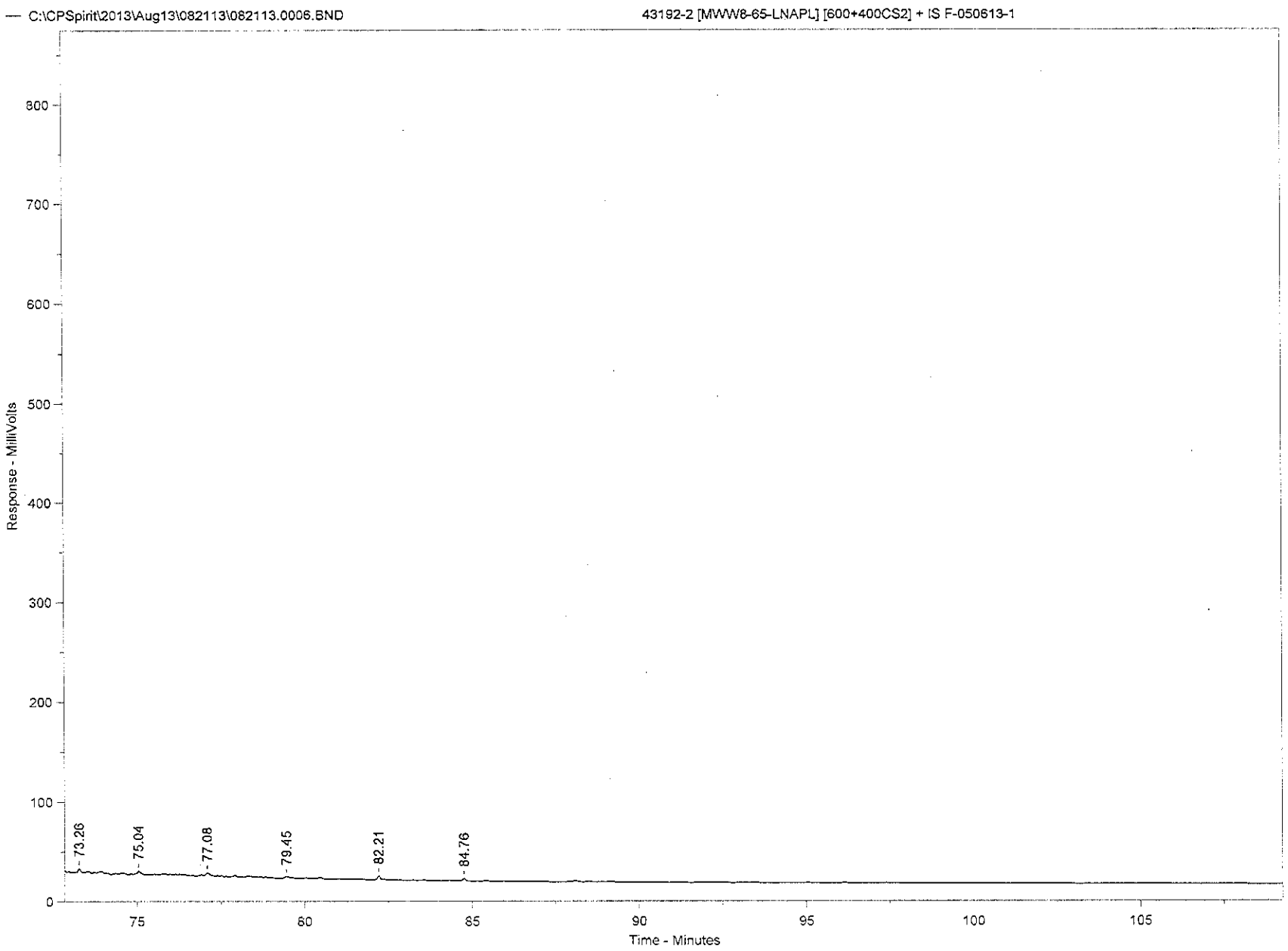
43192-2 [MWW8-65-LNAPL] [600+400CS2] + IS F-050613-1
Response - MilliVolts
Time - Minutes
CS2
n-C11
B9
n-C12
i-C13
i-C14
B1
n-C13
i-C15
n-C14
i-C16
n-C15
i-C18
n-C16
n-C17
Pristane
Phytane
n-C18
n-C19
n-C20
n-C21
n-C22


C:\CPSpirit\2013\Aug13\082113\082113.0006.BND
43192-2 [MWW8-65-LNAPL] [600+400CS2] + IS F-050613-1
Response - MilliVolts
800
700
600
500
400
300
200
100
0
8.05 CS2
0
5
10
15
20
25
30
35
Time - Minutes


C:\CPSpirit\2013\Aug13\082113\082113.0006.BND
43192-2 [MWW8-65-LNAPL] [600+400CS2] + IS F-050613-1
Response - MilliVolts
Time - Minutes
42.12 n-C11
44.25 89
47.02 n-C12
47.67 i-C13
48.61
49.14
49.47
50.04 91
49.84 i-C14
50.62 n-C13
51.03
51.23
51.70
51.97
52.13
52.34
52.47
52.66
52.88 i-C15
53.00
53.38
53.66
53.76 n-C14
54.23
54.32
54.41
54.61 i-C16
54.77
54.91
55.05
55.25
55.32
55.43
55.48
55.65 n-C15
55.86
55.95
56.12
56.24
56.60
56.65
56.80
56.92
57.02
57.17
57.07
57.29
57.38
57.48
57.58 n-C16
57.71
57.81
57.96
57.88
58.14
58.25
58.40
58.51 i-C18
58.62
58.71
58.84
58.93
59.17
59.30
59.48 n-C17 Pristane
59.57
59.73
59.89
60.01
60.07
60.24
60.32
60.14
60.52
60.45
60.61
60.74
60.86 n-C18 Phytane
61.01
61.34
61.49
61.63
61.73
61.93
61.80
61.87
62.15
62.30 n-C19
62.49
62.58
62.82
62.87
63.02
62.95
63.11
63.18
63.30
63.51
63.40
63.65 n-C20
63.87
63.97
64.19
64.33
64.49
64.61
64.55
64.71
64.93
65.17 n-C21
65.42
65.57
65.84
66.02
66.14 n-C22
66.40
66.59
66.66
67.45
67.62
67.75
68.50
68.64
68.97
69.89
70.27
71.68
72.21
72.61


C:\CPSpirit\2013\Aug13\082113\082113.0006.BND
43192-2 [MWW8-65-LNAPL] [600+400CS2] + IS F-050613-1
Response - MilliVolts
800
700
600
500
400
300
200
100
0
73.26
75.04
77.08
79.45
82.21
84.76
75
80
85
90
95
100
105
Time - Minutes

Sample Name = **43192-2 [MWW8-65-LNAPL] [600+400CS2] + IS F-050613-1**

Instrument = Instrument 1
Heading 1 =
Heading 2 =

Acquisition Port = DP#

Raw File Name = **C:\CPSpirit\2013\Aug13\082113\082113.0006.RAW**
Method File Name = C:\CPSpirit\C344.met
Calibration File Name = C:\CPSpirit\042413.cal

Date Taken (end) = 8/22/2013 6:56:14 PM
Method Version = 44
Calibration Version = 12

Peak Name	Ret. Time	Area %	Area
CS2	8.05	0.1166	36699.57
n-C11	42.12	0.0881	27743.61
89	44.25	0.0349	10985.47
n-C12	47.02	0.1222	38471.13
i-C13	47.67	0.0893	28104.80
	48.61	0.0253	7958.29
	49.14	0.0637	20063.66
	49.47	0.0883	27802.58
i-C14	49.84	0.1006	31675.84
91	50.04	0.0463	14582.56
n-C13	50.62	0.1599	50339.26
	51.03	0.0930	29262.72
	51.23	0.0530	16685.47
	51.70	0.0292	9192.03
	51.97	0.0872	27459.16
	52.13	0.0432	13614.16
	52.34	0.0468	14745.52
	52.47	0.0730	22991.15
	52.66	0.0591	18612.28
i-C15	52.88	0.2353	74078.67
	53.00	0.0367	11556.26
n-C14	53.38	0.6159	193878.00
	53.66	0.1340	42182.18
	53.76	0.1750	55080.36
	54.23	0.1041	32767.14
	54.32	0.0539	16978.97
	54.41	0.1772	55781.96
	54.61	0.3862	121570.20
	54.77	0.0987	31078.19
i-C16	54.91	0.6366	200388.00
	55.05	0.2315	72866.06
	55.25	0.1410	44382.55
	55.32	0.1102	34686.54
	55.43	0.0951	29938.10
	55.48	0.2694	84815.73
n-C15	55.65	1.6680	525058.90
	55.86	0.1037	32639.14
	55.95	0.0718	22598.98
	56.12	0.1646	51815.73
	56.24	0.3196	100590.10
	56.60	0.3968	124897.70
	56.65	0.3081	96994.77
	56.80	0.8113	255382.50
	56.92	0.8292	261030.30
	57.02	0.2982	93880.71
	57.07	0.4577	144066.50
	57.17	0.1769	55690.49
	57.29	0.5783	182055.10
	57.38	0.2062	64908.64
	57.48	0.5711	179774.20
n-C16	57.58	2.7002	849975.50
	57.71	0.6063	190851.00
	57.81	0.4225	132984.60
	57.88	0.4542	142977.50
	57.96	0.5935	186813.20

Peak Name	Ret. Time	Area %	Area
	58.14	0.4856	152856.70
	58.25	0.5091	160258.80
	58.40	1.2545	394899.10
i-C18	58.51	2.5360	798278.60
	58.62	0.9013	283730.10
	58.71	1.5434	485848.10
	58.84	1.1043	347601.30
	58.93	0.9926	312457.90
	59.17	1.1940	375859.30
n-C17	59.30	3.7143	1169205.00
Pristane	59.48	4.8195	1517100.00
	59.57	1.8012	566973.40
	59.73	1.4767	464846.80
	59.89	0.7899	248638.10
	60.01	1.3787	434006.00
	60.07	1.0291	323934.50
	60.14	0.7052	221977.70
	60.24	1.7484	550356.10
	60.32	1.5901	500533.80
	60.45	1.7392	547467.40
	60.52	0.6138	193219.60
	60.61	1.0874	342309.30
	60.74	1.0635	334769.20
n-C18	60.86	2.7613	869206.00
	61.01	1.2090	380572.10
Phytane	61.10	6.6387	2089743.00
	61.34	0.7980	251204.90
	61.49	2.6363	829874.80
	61.63	0.8317	261804.70
	61.73	1.0556	332291.50
	61.80	1.1996	377625.00
	61.87	0.7419	233550.80
	61.93	1.5953	502174.20
	62.15	2.2508	708527.20
n-C19	62.30	3.7452	1178926.00
	62.49	1.3193	415301.00
	62.58	2.4218	762343.70
	62.82	0.5031	158380.00
	62.87	1.1471	361102.80
	62.95	0.6760	212782.80
	63.02	0.7725	243165.70
	63.11	0.8650	272292.00
	63.18	1.1278	355008.40
	63.30	0.8351	262888.70
	63.40	1.0383	326827.80
	63.51	1.2813	403336.20
n-C20	63.65	1.2177	383304.10
	63.87	0.7531	237063.50
	63.97	1.3066	411285.30
	64.19	1.1530	362946.10
	64.33	0.4543	143005.50
	64.49	0.8881	279545.90
	64.55	0.3426	107859.30
	64.61	0.5670	178491.80
	64.71	0.9295	292594.80
n-C21	64.93	0.6546	206067.20
	65.17	0.4943	155601.50
	65.42	0.4953	155910.70
	65.57	0.3871	121851.90
	65.84	0.3513	110599.30
	66.02	0.2147	67585.19
n-C22	66.14	0.1063	33465.52
	66.40	0.1026	32302.60
	66.59	0.0813	25580.71
	66.66	0.1467	46166.28
	67.45	0.0457	14375.09
	67.62	0.0662	20849.28

Peak Name	Ret. Time	Area %	Area
	67.75	0.0510	16042.70
	68.50	0.0516	16232.93
	68.64	0.0633	19940.73
	68.97	0.1249	39308.91
	69.89	0.1108	34881.70
	70.27	0.0280	8804.46
	71.68	0.0537	16895.50
	72.21	0.1127	35476.88
	72.61	0.0397	12483.98
	73.26	0.0603	18997.09
	75.04	0.0942	29657.87
	77.08	0.0698	21961.58
	79.45	0.0805	25335.12
	82.21	0.0693	21822.38
	84.76	0.0447	14059.28

Total Area = 3.147841E+07 Total Height = 8650277 Total Amount = 0

Attachment 4

Laboratory analytical data – PTS Laboratories

PTS Laboratories

PTS File No: 43535
Client: ARCADIS
Report Date: 09/11/13

VISCOSITY, DENSITY, and SPECIFIC GRAVITY DATA

(METHODOLOGY: ASTM D445, ASTM D1481, API RP40)

Project Name: RACER - Pontiac North Campus
Project No: B0064607.2013

SAMPLE ID	MATRIX	TEMPERATURE, °F	SPECIFIC GRAVITY	DENSITY, g/cc	VISCOSITY	
					centistokes	centipoise
MWM2-29_WATER	Water	55	1.001	1.001	1.26	1.26
		70	1.001	0.9991		
MWM2-29_LNAPL	NAPL	55	0.8926	0.8921	134	120
		70	0.8883	0.8865		
MWW8-65_LNAPL	NAPL	55	0.8623	0.8618	17.9	15.5
		70	0.8577	0.8560		

QUALITY CONTROL DATA

Date:	09/04/13	09/04/13
FLUID TYPE:	Cannon® CVS S3	DI Water
TEMPERATURE, °F:	70	70
DENSITY, MEASURED:	0.8648	0.9982
DENSITY, PUBLISHED:	0.8642	0.9980
RPD:	0.07	0.02
VISCOSITY, MEASURED:	4.64	1.01

PTS Laboratories

PTS File No: 43535
Client: ARCADIS
Report Date: 09/11/13

VISCOSITY, DENSITY, and SPECIFIC GRAVITY DATA

(METHODOLOGY: ASTM D445, ASTM D1481, API RP40)

Project Name: RACER - Pontiac North Campus
Project No: B0064607.2013

VISCOSITY, PUBLISHED:	4.46	0.977
RPD:	3.76	2.79
CVS Lot #: 13101	CVS = Certified Viscosity Standard	

PTS File No: 43535
Client: ARCADIS
Report Date: 09/11/13

PTS Laboratories

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: DuNuoy Method - ASTM D971)

Project Name: RACER - Pontiac North Campus
Project No: B0064607.2013

PHASE PAIR		TEMPERATURE,	INTERFACIAL TENSION,
SAMPLE ID / PHASE	SAMPLE ID / PHASE	°F	Dynes/centimeter
MWM2-29_WATER	Air	75	71.8
MWM2-29_LNAPL	Air	75	30.8
MWM2-29_WATER	MWM2-29_LNAPL	75	7.8
MWM2-29_WATER	Air	75	71.8
MWW8-65_LNAPL	Air	75	29.4
MWM2-29_WATER	MWW8-65_LNAPL	75	13.5

QUALITY CONTROL DATA

Date: 09/05/13
PHASE PAIR: DIWATER / AIR
TEMPERATURE, °F: 76

PTS Laboratories

PTS File No: 43535
Client: ARCADIS
Report Date: 09/11/13

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: DuNuoy Method - ASTM D971)

Project Name: RACER - Pontiac North Campus
Project No: B0064607.2013

IFT, MEASURED: 72.1
IFT, PUBLISHED: 72.1
RPD: 0.07

PTS Laboratories, Inc.

8100 Secura Way • Santa Fe Springs, CA 90670
Telephone (562) 347-2500 • Fax (562) 907-3610

May 6, 2014

Christi Kiker
ARCADIS
28550 Cabot Drive, Ste. 500
Novi, MI 48377

Re: PTS File No: 43762
Physical Properties Data
RACER - Pontiac North Campus; B0064607.2013.0005

Dear Ms. Kiker:

Please find enclosed report for Physical Properties analyses conducted upon samples received from your RACER - Pontiac North Campus; B0064607.2013.0005 project. All analyses were performed by applicable ASTM, EPA, or API methodologies. An electronic version of the report has previously been sent to your attention via the internet. The cores remain in frozen storage and will be held indefinitely. Please note that core storage will be billed quarterly.

PTS Laboratories appreciates the opportunity to be of service. If you have any questions or require additional information, please give me a call at (562) 347-2502.

Sincerely,
PTS Laboratories, Inc.

Michael Mark Brady, P.G.
District Manager

Encl.

PTS Laboratories

Project Name: RACER - Pontiac North Campus
Project Number: B0064607.2013.0005

PTS File No: 43762
Client: ARCADIS

TEST PROGRAM - 20140331

CORE ID	Depth ft.	Core Recovery ft.	Slab and Core Photo	Grain Size Analyses	Free Product Mobility	A/W Drng. Capillarity Pkg.		Notes
		Plugs:	1/4:3/4	Grab	Hor. 1.5"	Hor. 1"		
Date Received: 20131118								
M2-16_6-9	**6-9**	**2.15**	**3**	**6.4-6.6, 7.6-7.8**	**6.4-6.6**	**7.6-7.8**		Core labeled M2-16_7-9
M2-21_17-19	**17-19**	**0.60**	**1**	**17.1-17.3, 17.3-17.5**	**17.3-17.5**	**17.1-17.3**		
TOTALS:	**2 - cores**	**2.75**	**4**	**4**	**2**	**2**		**4**

Laboratory Test Program Notes

Contaminant identification:

Standard TAT for basic analysis is 10 business days. Advanced tests require additional time.

*Sample locations to be selected by ARCADIS personnel from core photography.

ASTM D422: Dry Sieve only, Hydrometer analysis must be requested prior to initiating tests. Additional costs would apply.

Free Product Mobility Package: Applied centrifugal force demonstrates product mobility; includes residual saturations by Dean-Stark, total porosity, grain and dry bulk density.

Air/Water Drainage Capillarity Package: Air/Water Drainage Capillary Pressure Curve (air displacing water) with Air Permeability and Hydraulic Conductivity: includes fluid production vs. capillary pressure, total and air-filled porosity, grain density, dry bulk density, moisture content and total (water only) pore fluid saturations.

Grain Size Analyses coupled with FPM and A/W Drainage tests (on same interval). Grain size to be analyzed on sub-samples after running other specified analyses. Per client request

PTS File No: 43762
Client: ARCADIS
Report Date: 05/06/14

PTS Laboratories

FREE PRODUCT MOBILITY: INITIAL AND RESIDUAL SATURATIONS

(Centrifugal method: samples spun under air)

Project Name: RACER - Pontiac North Campus
Project No: B0064607.2013.0005

			METHODS:	API RP 40		API RP 40	ASTM D425M, DEAN-STARK			
							PORE FLUID SATURATIONS (3), % Pv			
				DENSITY			Initial Fluid Saturations		After Centrifuge at 1000xG	
SAMPLE ID.	DEPTH, ft.	SAMPLE ORIENTATION (1)	ANALYSIS DATE	DRY BULK, g/cc	GRAIN, g/cc	TOTAL POROSITY (2), %Vb	WATER (Swi) SATURATION	NAPL (Soi) SATURATION	WATER (Srw) SATURATION	NAPL (Sor) SATURATION
M2-16_6-9	6.5	H	20140410	1.68	2.68	37.3	72.9	12.5	51.1	12.4
NOTE: Trace NAPL produced. Produced water clear.										
M2-21_17-19	17.4	H	20140410	1.75	2.66	34.1	85.2	2.8	15.0	2.8
NOTE: No visible NAPL produced. Produced water clear with moderate hydrocarbon odor.										

(1) Sample Orientation: H = horizontal; V = vertical; R = remold

(2) Total Porosity = all interconnected pore channels.

(3) Fluid density used to calculate pore fluid saturations: Water = 0.9996 g/cc, NAPL = 0.8600 g/cc.

Swi = Initial Water Saturation as received prior to centrifuging at 1000xG, Soi = Initial NAPL Saturation as received prior to centrifuging at 1000xG.

Srw = Residual Water Saturation after centrifuging at 1000xG, Sor = Residual NAPL Saturation after centrifuging at 1000xG.

Vb = Bulk Volume, cc; Pv = Pore Volume, cc; ND = Not Detected

PTS Laboratories

PTS File No: 43762
Client: ARCADIS
Report Date: 05/06/14

SAMPLE PROPERTIES - AIR/WATER CAPILLARY PRESSURE

Project Name: RACER - Pontiac North Campus
Project No: B0064607.2013.0005

		METHODS:	API RP 40 / ASTM D2216	API RP 40		API RP 40		API RP 40
		SAMPLE	MOISTURE	DENSITY		POROSITY, %Vb (2)		TOTAL PORE FLUID
SAMPLE ID.	DEPTH, ft.	ORIENTATION (1)	CONTENT, % weight	DRY BULK, g/cc	GRAIN, g/cc	TOTAL	AIR FILLED	SATURATIONS (3), % Pv
M2-16_6-9	7.7	H	8.9	2.02	2.66	24.2	6.2	74.4
M2-21_17-19	17.2	H	16.2	1.74	2.68	34.9	6.6	81.0

(1) Sample Orientation: H = horizontal; V = vertical; R = remold

(2) Total Porosity = all interconnected pore channels; Air Filled = pore channels not occupied by pore fluids.

(3) Fluid density used to calculate pore fluid saturations: Water = 0.9996 g/cc.

Vb = Bulk Volume, cc; Pv = Pore Volume, cc; ND = Not Detected

PTS Laboratories

PTS File No: 43762
Client: ARCADIS
Report Date: 05/06/14

PERMEABILITY DATA - AIR/WATER CAPILLARY PRESSURE

Project Name: RACER - Pontiac North Campus
Project No: B0064607.2013.0005

		METHODS:	API RP 40; EPA 9100		
			25 PSI CONFINING STRESS		
SAMPLE ID.	DEPTH, ft.	SAMPLE ORIENTATION (1)	SPECIFIC PERMEABILITY TO AIR, millidarcy (2)	EFFECTIVE PERMEABILITY TO WATER, millidarcy (3,4)	HYDRAULIC CONDUCTIVITY, cm/s (4)
M2-16_6-9	7.7	H	95.1	7.84	7.82E-06
M2-21_17-19	17.2	H	3940	1320	1.32E-03

(1) Sample Orientation: H = horizontal; V = vertical; R = remold
(2) Specific = No pore fluids in place.
(3) Effective (Native) = With as-received pore fluids in place.
(4) Permeability to water and hydraulic conductivity measured at saturated conditions.
Air = Nitrogen gas, Water = filtered Laboratory Fresh (tap) or Site water.

PTS File No: 43762
Client: ARCADIS
Report Date: 05/06/14

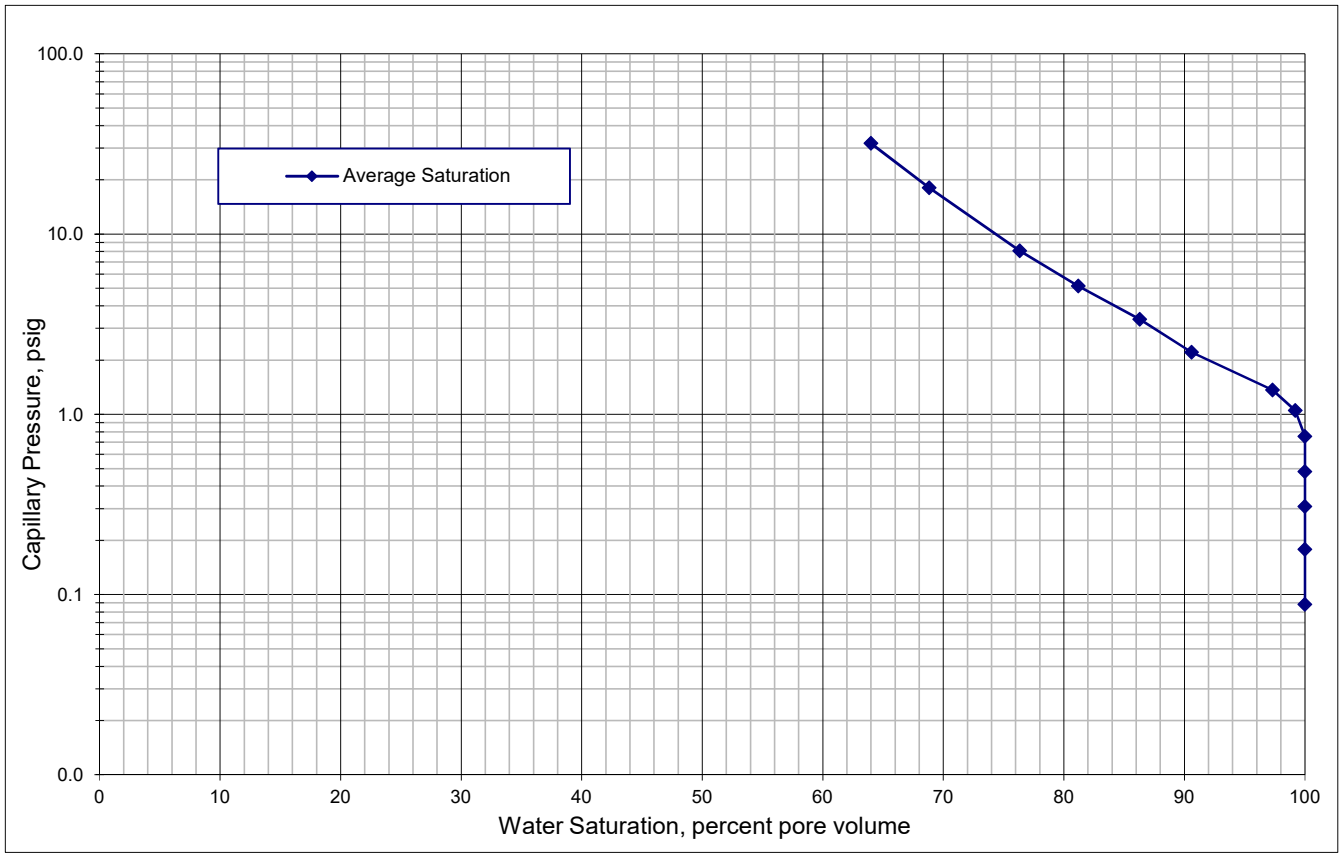
PTS Laboratories

AIR/WATER CAPILLARY PRESSURE TABULAR DATA

ASTM D6836; Method E (Centrifugal Method: air displacing water)

Project Name: RACER - Pontiac North Campus
Project No: B0064607.2013.0005

Capillary Pressure		Height Above Water Table,	Sample ID M2-16_6-9 at 7.7 ft.	
psi	cm water	ft	Average Saturation % pore volume	Moisture, % dry weight
0.000	0.00	0.000	100.0	10.6
0.088	6.21	0.205	100.0	10.6
0.178	12.5	0.412	100.0	10.6
0.308	21.7	0.713	100.0	10.6
0.481	33.8	1.11	100.0	10.6
0.755	53.1	1.75	100.0	10.6
1.053	74.0	2.44	99.2	10.6
1.37	96.1	3.16	97.3	10.4
2.21	155	5.11	90.6	9.6
3.37	237	7.79	86.3	9.2
5.14	362	11.9	81.2	8.6
8.06	567	18.7	76.3	8.1
18.1	1273	41.9	68.8	7.3
31.9	2245	73.9	64.0	6.8



PTS File No: 43762
Client: ARCADIS
Report Date: 05/06/14

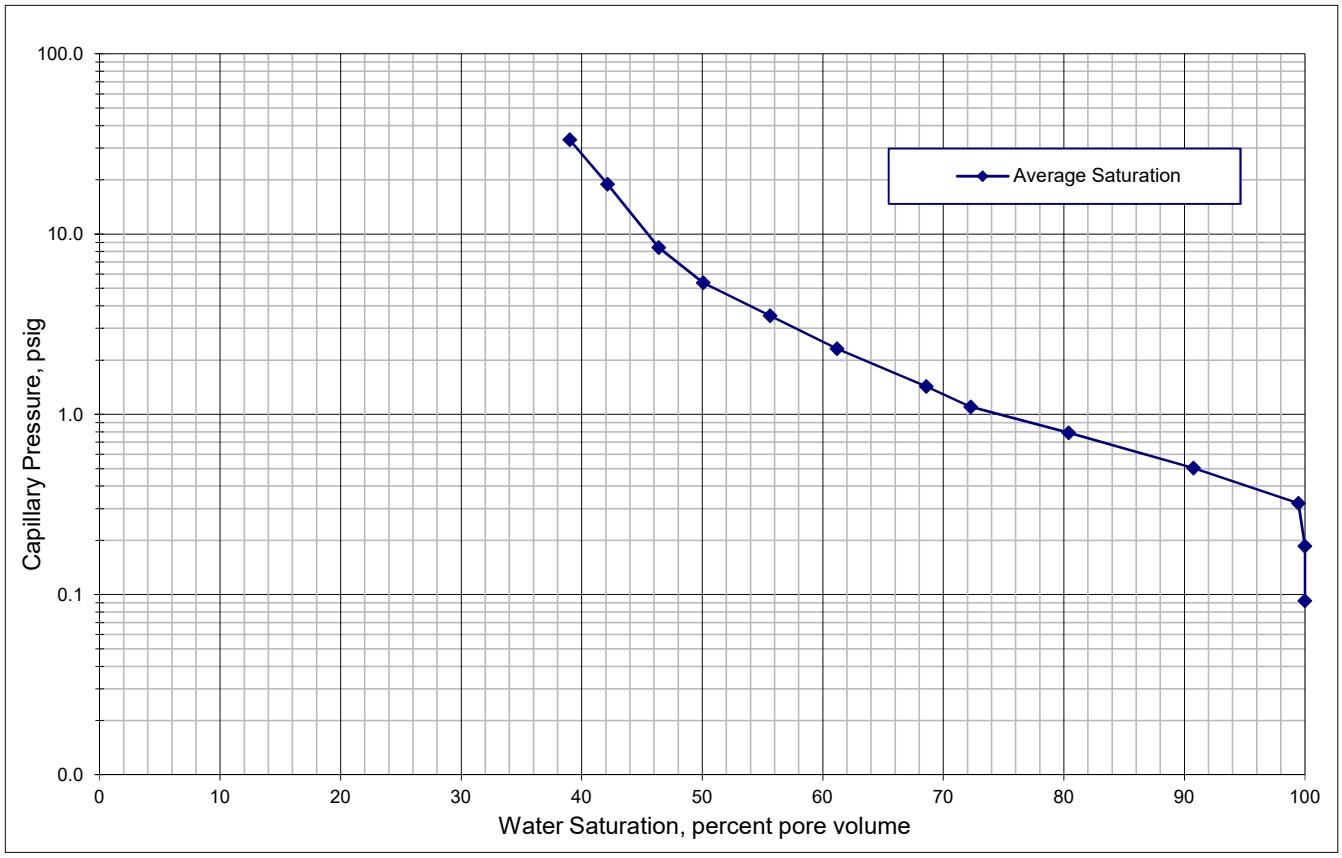
PTS Laboratories

AIR/WATER CAPILLARY PRESSURE TABULAR DATA

ASTM D6836; Method E (Centrifugal Method: air displacing water)

Project Name: RACER - Pontiac North Campus
Project No: B0064607.2013.0005

Capillary Pressure		Height Above Water Table,	Sample ID M2-21_17-19 at 17.2 ft.	
psi	cm water	ft	Average Saturation % pore volume	Moisture, % dry weight
0.000	0.00	0.000	100.0	17.6
0.092	6.49	0.214	100.0	17.6
0.186	13.1	0.430	100.0	17.6
0.322	22.6	0.745	99.4	17.5
0.503	35.3	1.16	90.8	16.0
0.789	55.5	1.83	80.4	14.2
1.100	77.3	2.55	72.3	12.8
1.43	100.4	3.31	68.6	12.1
2.31	162	5.34	61.2	10.8
3.52	247	8.14	55.6	9.8
5.37	378	12.4	50.1	8.8
8.43	592	19.5	46.4	8.2
18.9	1330	43.8	42.1	7.4
33.4	2346	77.2	39.0	6.9



PARTICLE SIZE SUMMARY

(METHODOLOGY: ASTM D422/D4464M)

PROJECT NAME: RACER - Pontiac North Campus
PROJECT NO: B0064607.2013.0005

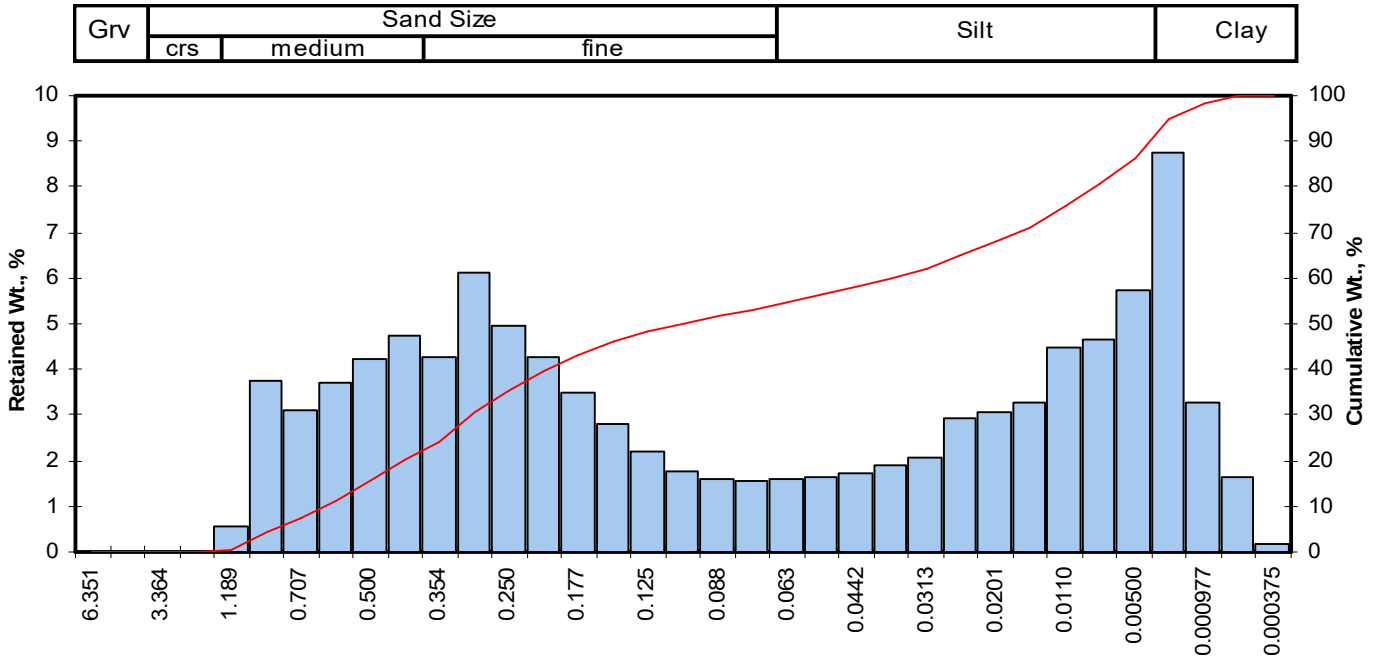
Sample ID	Depth, ft.	Mean Grain Size Description (1)	Median Grain Size mm	Particle Size Distribution, wt. percent						Silt & Clay
				Gravel	Sand Size			Silt	Clay	
					Coarse	Medium	Fine			
M2-16 6-9	7.7	Fine sand	0.105	0.00	0.00	20.06	33.08	33.06	13.81	46.86
M2-21 17-19	17.2	Fine sand	0.243	0.00	0.00	14.23	60.72	17.96	7.08	25.05
M2-21 17-19	17.4	Fine sand	0.274	0.00	0.00	20.89	60.32	13.41	5.38	18.79

(1) Based on Mean from Trask

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D4464M

Client:	ARCADIS	**PTS File No:**	43762
Project:	RACER - Pontiac North Campus	**Sample ID:**	M2-16 6-9
Project No:	B0064607.2013.0005	**Depth, ft:**	7.7



Opening		Phi of	U.S.	Sample Weight,	Increment Weight,	Cumulative Weight,
Inches	Millimeters	Screen	No.	grams	percent	percent
0.2500	6.351	-2.67	1/4	0.00	0.00	0.00
0.1873	4.757	-2.25	4	0.00	0.00	0.00
0.1324	3.364	-1.75	6	0.00	0.00	0.00
0.0787	2.000	-1.00	10	0.00	0.00	0.00
0.0468	1.189	-0.25	16	0.54	0.54	0.54
0.0331	0.841	0.25	20	3.75	3.75	4.29
0.0278	0.707	0.50	25	3.11	3.11	7.40
0.0234	0.595	0.75	30	3.70	3.70	11.11
0.0197	0.500	1.00	35	4.23	4.23	15.34
0.0166	0.420	1.25	40	4.72	4.72	20.06
0.0139	0.354	1.50	45	4.27	4.27	24.33
0.0117	0.297	1.75	50	6.11	6.11	30.45
0.0098	0.250	2.00	60	4.94	4.94	35.39
0.0083	0.210	2.25	70	4.28	4.28	39.67
0.0070	0.177	2.50	80	3.51	3.51	43.18
0.0059	0.149	2.75	100	2.81	2.81	45.99
0.0049	0.125	3.00	120	2.21	2.21	48.20
0.0041	0.105	3.25	140	1.78	1.78	49.98
0.0035	0.088	3.50	170	1.58	1.58	51.57
0.0029	0.074	3.75	200	1.57	1.57	53.14
0.0025	0.063	4.00	230	1.60	1.60	54.74
0.0021	0.053	4.25	270	1.64	1.64	56.38
0.00174	0.0442	4.50	325	1.73	1.73	58.11
0.00146	0.0372	4.75	400	1.88	1.88	59.99
0.00123	0.0313	5.00	450	2.08	2.08	62.07
0.000986	0.0250	5.32	500	2.92	2.92	64.99
0.000790	0.0201	5.64	635	3.04	3.04	68.03
0.000615	0.0156	6.00		3.26	3.26	71.30
0.000435	0.0110	6.50		4.50	4.50	75.80
0.000308	0.00781	7.00		4.65	4.65	80.45
0.000197	0.00500	7.65		5.74	5.74	86.19
0.000077	0.00195	9.00		8.73	8.73	94.93
0.000038	0.000977	10.00		3.27	3.27	98.20
0.000019	0.000488	11.00		1.63	1.63	99.83
0.000015	0.000375	11.38		0.17	0.17	100.00
TOTALS				**100.00**	**100.00**	**100.00**

Cumulative Weight Percent greater than			
Weight	Phi	Particle Size	
percent	Value	Inches	Millimeters
5	0.31	0.0318	0.808
10	0.68	0.0247	0.626
16	1.04	0.0192	0.488
25	1.53	0.0137	0.347
40	2.27	0.0081	0.207
50	3.25	0.0041	0.105
60	4.75	0.0015	0.037
75	6.41	0.0005	0.012
84	7.40	0.0002	0.006
90	8.24	0.0001	0.003
95	9.02	0.0001	0.002

Measure	Trask	Inman	Folk-Ward
Median, phi	3.25	3.25	3.25
Median, in.	0.0041	0.0041	0.0041
Median, mm	0.105	0.105	0.105
Mean, phi	2.48	4.22	3.90
Mean, in.	0.0071	0.0021	0.0026
Mean, mm	0.179	0.054	0.067
Sorting	5.434	3.182	2.911
Skewness	0.608	0.303	0.314
Kurtosis	0.269	0.370	0.731

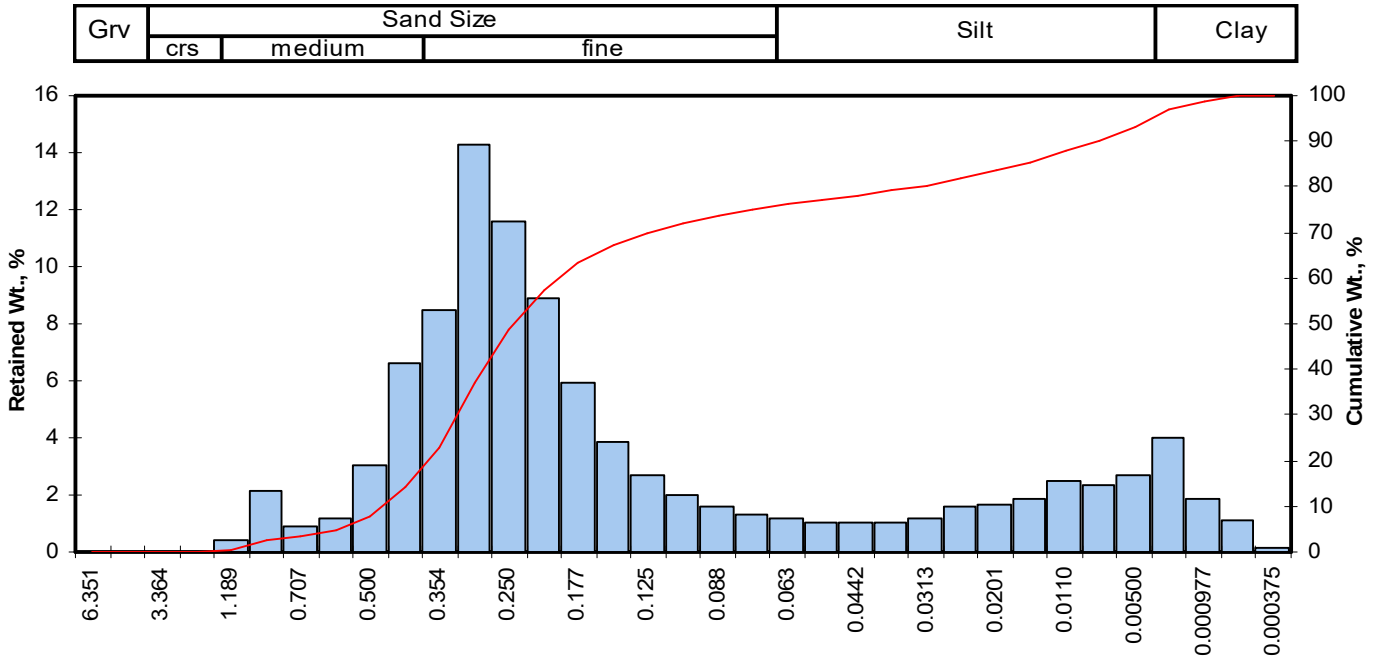
Grain Size Description (ASTM-USCS Scale)	Fine sand (based on Mean from Trask)

Description	Retained on Sieve #	Weight Percent
Gravel	4	0.00
Coarse Sand	10	0.00
Medium Sand	40	20.06
Fine Sand	200	33.08
Silt	>0.005 mm	33.06
Clay	<0.005 mm	13.81
	Total	**100**

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D4464M

Client:	ARCADIS	**PTS File No:**	43762
Project:	RACER - Pontiac North Campus	**Sample ID:**	M2-21 17-19
Project No:	B0064607.2013.0005	**Depth, ft:**	17.2



Opening		Phi of	U.S.	Sample Weight,	Increment Weight,	Cumulative Weight,
Inches	Millimeters	Screen	No.	grams	percent	percent
0.2500	6.351	-2.67	1/4	0.00	0.00	0.00
0.1873	4.757	-2.25	4	0.00	0.00	0.00
0.1324	3.364	-1.75	6	0.00	0.00	0.00
0.0787	2.000	-1.00	10	0.00	0.00	0.00
0.0468	1.189	-0.25	16	0.39	0.39	0.39
0.0331	0.841	0.25	20	2.17	2.17	2.56
0.0278	0.707	0.50	25	0.90	0.90	3.46
0.0234	0.595	0.75	30	1.15	1.15	4.61
0.0197	0.500	1.00	35	3.02	3.02	7.63
0.0166	0.420	1.25	40	6.60	6.60	14.23
0.0139	0.354	1.50	45	8.46	8.46	22.69
0.0117	0.297	1.75	50	14.30	14.30	37.00
0.0098	0.250	2.00	60	11.60	11.60	48.60
0.0083	0.210	2.25	70	8.91	8.91	57.51
0.0070	0.177	2.50	80	5.93	5.93	63.44
0.0059	0.149	2.75	100	3.84	3.84	67.28
0.0049	0.125	3.00	120	2.70	2.70	69.98
0.0041	0.105	3.25	140	2.02	2.02	72.00
0.0035	0.088	3.50	170	1.61	1.61	73.61
0.0029	0.074	3.75	200	1.34	1.34	74.95
0.0025	0.063	4.00	230	1.15	1.15	76.11
0.0021	0.053	4.25	270	1.02	1.02	77.13
0.00174	0.0442	4.50	325	1.00	1.00	78.13
0.00146	0.0372	4.75	400	1.05	1.05	79.18
0.00123	0.0313	5.00	450	1.14	1.14	80.32
0.000986	0.0250	5.32	500	1.59	1.59	81.91
0.000790	0.0201	5.64	635	1.68	1.68	83.59
0.000615	0.0156	6.00		1.84	1.84	85.43
0.000435	0.0110	6.50		2.47	2.47	87.90
0.000308	0.00781	7.00		2.34	2.34	90.24
0.000197	0.00500	7.65		2.68	2.68	92.92
0.000077	0.00195	9.00		4.01	4.01	96.93
0.000038	0.000977	10.00		1.86	1.86	98.79
0.000019	0.000488	11.00		1.09	1.09	99.88
0.000015	0.000375	11.38		0.12	0.12	100.00
TOTALS				**100.00**	**100.00**	**100.00**

Cumulative Weight Percent greater than

Weight percent	Phi Value	Particle Size Inches	Particle Size Millimeters
5	0.78	0.0229	0.581
10	1.09	0.0185	0.470
16	1.30	0.0160	0.406
25	1.54	0.0135	0.344
40	1.81	0.0112	0.284
50	2.04	0.0096	0.243
60	2.35	0.0077	0.195
75	3.76	0.0029	0.074
84	5.72	0.0007	0.019
90	6.95	0.0003	0.008
95	8.35	0.0001	0.003

Measure	Trask	Inman	Folk-Ward
Median, phi	2.04	2.04	2.04
Median, in.	0.0096	0.0096	0.0096
Median, mm	0.243	0.243	0.243
Mean, phi	2.26	3.51	3.02
Mean, in.	0.0082	0.0035	0.0049
Mean, mm	0.209	0.088	0.123
Sorting	2.158	2.209	2.251
Skewness	0.655	0.666	0.667
Kurtosis	0.292	0.712	1.397

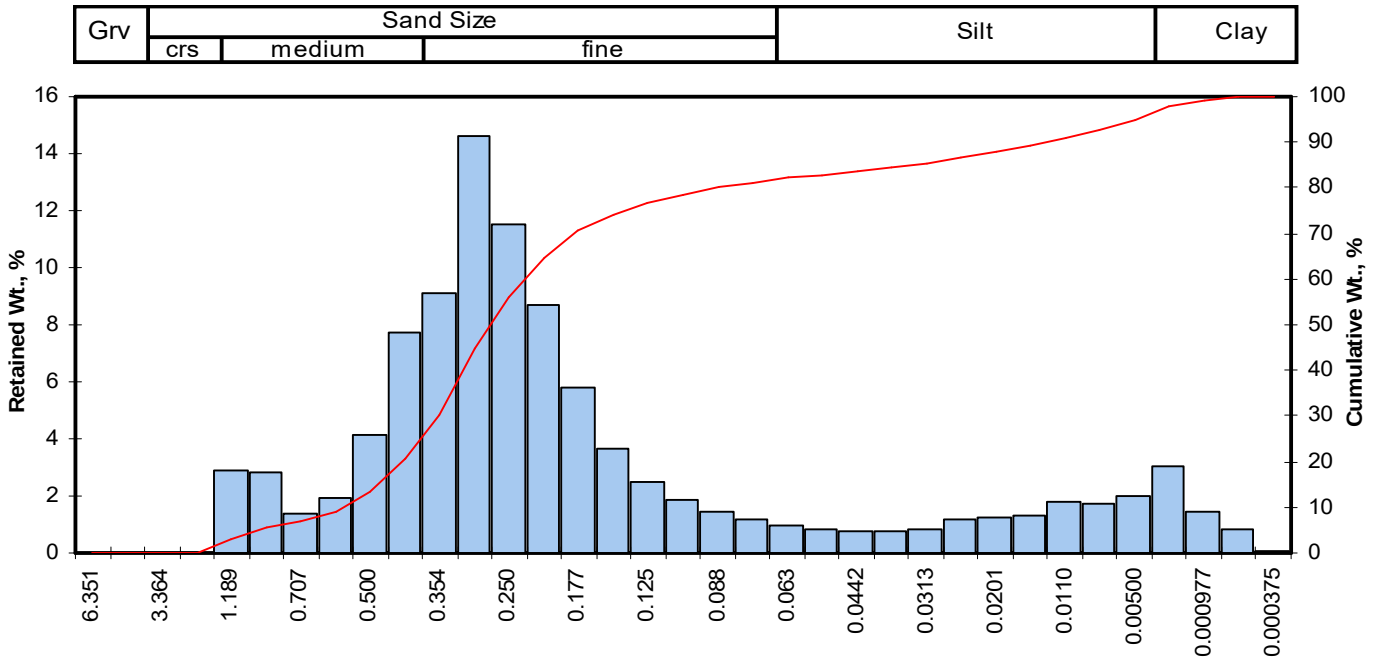
Grain Size Description (ASTM-USCS Scale)	Fine sand (based on Mean from Trask)

Description	Retained on Sieve #	Weight Percent
Gravel	4	0.00
Coarse Sand	10	0.00
Medium Sand	40	14.23
Fine Sand	200	60.72
Silt	>0.005 mm	17.96
Clay	<0.005 mm	7.08
	Total	**100**

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D4464M

Client:	ARCADIS	**PTS File No:**	43762
Project:	RACER - Pontiac North Campus	**Sample ID:**	M2-21 17-19
Project No:	B0064607.2013.0005	**Depth, ft:**	17.4



Opening		Phi of	U.S.	Sample Weight,	Increment Weight,	Cumulative Weight,
Inches	Millimeters	Screen	No.	grams	percent	percent
0.2500	6.351	-2.67	1/4	0.00	0.00	0.00
0.1873	4.757	-2.25	4	0.00	0.00	0.00
0.1324	3.364	-1.75	6	0.00	0.00	0.00
0.0787	2.000	-1.00	10	0.00	0.00	0.00
0.0468	1.189	-0.25	16	2.90	2.90	2.90
0.0331	0.841	0.25	20	2.81	2.81	5.71
0.0278	0.707	0.50	25	1.36	1.36	7.08
0.0234	0.595	0.75	30	1.95	1.95	9.03
0.0197	0.500	1.00	35	4.14	4.14	13.17
0.0166	0.420	1.25	40	7.71	7.72	20.89
0.0139	0.354	1.50	45	9.13	9.14	30.02
0.0117	0.297	1.75	50	14.60	14.61	44.63
0.0098	0.250	2.00	60	11.50	11.51	56.14
0.0083	0.210	2.25	70	8.71	8.72	64.86
0.0070	0.177	2.50	80	5.76	5.76	70.62
0.0059	0.149	2.75	100	3.68	3.68	74.30
0.0049	0.125	3.00	120	2.51	2.51	76.82
0.0041	0.105	3.25	140	1.83	1.83	78.65
0.0035	0.088	3.50	170	1.42	1.42	80.07
0.0029	0.074	3.75	200	1.14	1.14	81.21
0.0025	0.063	4.00	230	0.94	0.94	82.15
0.0021	0.053	4.25	270	0.80	0.80	82.95
0.00174	0.0442	4.50	325	0.75	0.75	83.70
0.00146	0.0372	4.75	400	0.78	0.78	84.48
0.00123	0.0313	5.00	450	0.85	0.85	85.33
0.000986	0.0250	5.32	500	1.18	1.18	86.51
0.000790	0.0201	5.64	635	1.23	1.23	87.74
0.000615	0.0156	6.00		1.34	1.34	89.09
0.000435	0.0110	6.50		1.82	1.82	90.91
0.000308	0.00781	7.00		1.73	1.73	92.64
0.000197	0.00500	7.65		1.98	1.98	94.62
0.000077	0.00195	9.00		3.02	3.02	97.64
0.000038	0.000977	10.00		1.45	1.45	99.09
0.000019	0.000488	11.00		0.82	0.82	99.91
0.000015	0.000375	11.38		0.09	0.09	100.00
TOTALS				**99.90**	**100.00**	**100.00**

Cumulative Weight Percent greater than

Weight percent	Phi Value	Particle Size Inches	Particle Size Millimeters
5	0.12	0.0362	0.918
10	0.81	0.0225	0.571
16	1.09	0.0185	0.469
25	1.36	0.0153	0.389
40	1.67	0.0124	0.314
50	1.87	0.0108	0.274
60	2.11	0.0091	0.232
75	2.82	0.0056	0.142
84	4.60	0.0016	0.041
90	6.25	0.0005	0.013
95	7.82	0.0002	0.004

Measure	Trask	Inman	Folk-Ward
Median, phi	1.87	1.87	1.87
Median, in.	0.0108	0.0108	0.0108
Median, mm	0.274	0.274	0.274
Mean, phi	1.91	2.84	2.52
Mean, in.	0.0104	0.0055	0.0069
Mean, mm	0.265	0.139	0.175
Sorting	1.657	1.752	2.041
Skewness	0.856	0.558	0.552
Kurtosis	0.222	1.195	2.164

Grain Size Description (ASTM-USCS Scale)	Fine sand (based on Mean from Trask)

Description	Retained on Sieve #	Weight Percent
Gravel	4	0.00
Coarse Sand	10	0.00
Medium Sand	40	20.89
Fine Sand	200	60.32
Silt	>0.005 mm	13.41
Clay	<0.005 mm	5.38
	Total	**100**

PARTICLE SIZE SUMMARY

(METHODOLOGY: ASTM D422M)

PROJECT NAME: RACER - Pontiac North Campus
PROJECT NO: B0064607.2013.0005

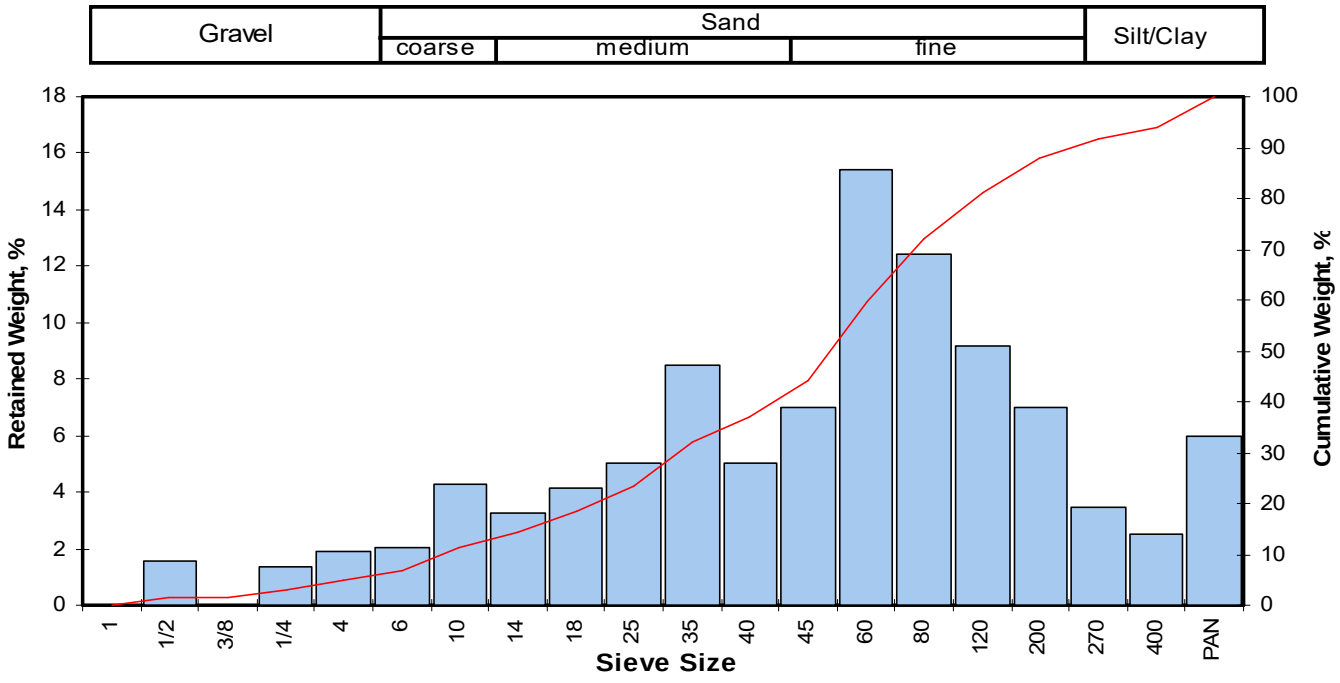
Sample ID	Depth, ft.	Mean Grain Size Description USCS/ASTM (1)	Median Grain Size, mm	Particle Size Distribution, wt. percent				
				Gravel	Sand Size			Silt/Clay
					Coarse	Medium	Fine	
M2-16_6-9	6.5	Fine sand	0.310	4.82	6.34	25.93	51.01	11.89

(1) Based on Mean fromTrask

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D422M

Client:	ARCADIS	**PTS File No:**	43762
Project:	RACER - Pontiac North Campus	**Sample ID:**	M2-16_6-9
Project No:	B0064607.2013.0005	**Depth, ft:**	6.5



Opening		Phi of	U.S. Sieve	Sample Weight	Incremental Weight,	Cumulative Weight,
Inches	Millimeters	Screen	No.	grams	percent	percent
0.9844	25.002	-4.64	1	0.00	0.00	0.00
0.4922	12.501	-3.64	1/2	1.65	1.55	1.55
0.3740	9.500	-3.25	3/8	0.00	0.00	1.55
0.2500	6.351	-2.67	1/4	1.47	1.38	2.93
0.1873	4.757	-2.25	4	2.02	1.89	4.82
0.1324	3.364	-1.75	6	2.19	2.05	6.87
0.0787	2.000	-1.00	10	4.57	4.29	11.16
0.0557	1.414	-0.50	14	3.45	3.24	14.40
0.0394	1.000	0.00	18	4.39	4.12	18.51
0.0278	0.707	0.50	25	5.39	5.06	23.57
0.0197	0.500	1.00	35	9.03	8.47	32.04
0.0166	0.420	1.25	40	5.39	5.06	37.09
0.0139	0.354	1.50	45	7.46	7.00	44.09
0.0098	0.250	2.00	60	16.46	15.44	59.53
0.0070	0.177	2.50	80	13.24	12.42	71.95
0.0049	0.125	3.00	120	9.78	9.17	81.12
0.0029	0.074	3.75	200	7.45	6.99	88.11
0.0021	0.053	4.25	270	3.66	3.43	91.54
0.0015	0.037	4.75	400	2.67	2.50	94.04
			PAN	6.35	5.96	100.00
TOTALS				106.62	100.00	100.00

Cumulative Weight Percent greater than			
Weight	Phi	Particle Size	
percent	Value	Inches	Millimeters
5	-2.21	0.1817	4.615
10	-1.20	0.0906	2.302
16	-0.31	0.0486	1.236
25	0.58	0.0263	0.667
40	1.35	0.0154	0.391
50	1.69	0.0122	0.310
60	2.02	0.0097	0.247
75	2.67	0.0062	0.158
84	3.31	0.0040	0.101
90	4.03	0.0024	0.061
95			

Measure	Trask	Inman	Folk-Ward
Median, phi	1.69	1.69	1.69
Median, in.	0.0122	0.0122	0.0122
Median, mm	0.310	0.310	0.310
Mean, phi	1.28	1.50	1.57
Mean, in.	0.0162	0.0139	0.0133
Mean, mm	0.412	0.353	0.338
Sorting	2.058	1.807	
Skewness	1.047	-0.105	
Kurtosis	0.114		

Grain Size Description (ASTM-USCS Scale)	Fine sand (based on Mean from Trask)

Description	Retained on Sieve #	Weight Percent
Gravel	4	4.82
Coarse Sand	10	6.34
Medium Sand	40	25.93
Fine Sand	200	51.01
Silt/Clay	<200	11.89
	Total	100

Phone: (562) 907-3607
Fax: (562) 907-3610

ARCADIS
Infrastructure · Water · Environment · Buildings

ID#:

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

43762

Page 1 of 1

Lab Work Order #

Send Results to:

Contact & Company Name: Christi Kiker / ARCADIS	Telephone: 248-994-2314 (was 2247) CS 11-15-13
Address: 28550 Cabot Dr Ste 500	Fax: 248-994-2241
City: Novi State: MI Zip: 48377	E-mail Address: Christi.Kiker@arcadis-us.com; jonathon.smith@arcadis-us.com
Project Name/Location (City, State): RACER PNC / Pontiac MI	Project #: B0D646007.2013.0005
Sampler's Printed Name: Christine Snyder	Sampler's Signature: Christine Snyder

Sample ID	Collection Date	Collection Time	Type (✓) Comp	Type (✓) Grab	Matrix	Preservative	Filtered (✓)	# of Containers	Container Information	Petrophysical Laboratory Analysis	REMARKS
MW-16_6-9	11-14-13	1515		X	SO	F		1	10		digital photography
MW-21_17-19	11-15-13	1400		X	SO	F		1	10		

Keys

Preservation Key:
A. H_2SO_4
B. HCL
C. HNO_3
D. NaOH
E. None
F. Other: Flash Freeze
G. Other: _____
H. Other: _____

Container Information Key:
1. 40 ml Vial
2. 1 L Amber
3. 250 ml Plastic
4. 500 ml Plastic
5. Encore
6. 2 oz. Glass
7. 4 oz. Glass
8. 8 oz. Glass
9. Other: _____
10. Other: Soil Core

Matrix Key:
SO - Soil; SE - Sediment; NL - NAPL/Oil; W - Water; SL - Sludge; SW - Sample Wipe; T - Tissue; A - Air; Other: _____

Special Instructions/Comments:

☐ Special QA/QC Instructions(✓):

Laboratory Information and Receipt		Relinquished By	Received By	Relinquished By	Laboratory Received By
Lab Name: PTS	Cooler Custody Seal (✓) ☐ Intact ☐ Not Intact	Printed Name: Christine Snyder	Printed Name: FedEX	Printed Name:	Printed Name: Robert Rojo
☒ Cooler packed with ice (✓) Dry Ice		Signature: Christine Snyder	Signature:	Signature:	Signature:
Specify Turnaround Requirements: Normal	Sample Receipt:	Firm: ARCADIS	Firm/Courier:	Firm/Courier:	Firm: PTS LABS
Shipping Tracking #:	Condition/Cooler Temp: -20°F	Date/Time: 11-15-13 / 1655	Date/Time:	Date/Time:	Date/Time: 11/18/13 14:15

PTS Laboratories, Inc.

8100 Secura Way • Santa Fe Springs, CA 90670
Telephone (562) 347-2500 • Fax (562) 907-3610

May 6, 2014

Christi Kiker
ARCADIS
28550 Cabot Drive, Ste. 500
Novi, MI 48377

Re: PTS File No: 43782
Physical Properties Data
RACER - Pontiac North Campus; B0064607.2013.0005

Dear Ms. Kiker:

Please find enclosed report for Physical Properties analyses conducted upon samples received from your RACER - Pontiac North Campus; B0064607.2013.0005 project. All analyses were performed by applicable ASTM, EPA, or API methodologies. An electronic version of the report has previously been sent to your attention via the internet. The cores remain in frozen storage and will be held indefinitely. Please note that core storage will be billed quarterly.

PTS Laboratories appreciates the opportunity to be of service. If you have any questions or require additional information, please give me a call at (562) 347-2502.

Sincerely,
PTS Laboratories, Inc.

Michael Mark Brady, P.G.
District Manager

Encl.

PTS Laboratories

Project Name: RACER - Pontiac North Campus
Project Number: B0064607.2013.0005

PTS File No: 43782
Client: ARCADIS

TEST PROGRAM - 20140331

CORE ID	Depth ft.	Core Recovery ft.	Slab and Core Photo	Grain Size Analyses	Free Product Mobility	A/W Drng. Capillarity Pkg.		Notes
		Plugs:	1/4:3/4	Grab	Hor. 1.5"	Hor. 1"		
Date Received: 20131121								
M2-42_13-15	13-15	1.20	2	13.4-13.6, 13.8-14.0, 14.0-14.2	13.4-13.6, 14.0-14.2	13.8-14.0		
M2-05_18-20	18-20	1.60	2	19.2-19.4, 19.4-19.6	19.4-19.6	19.2-19.4		
M2-01_39-40.5	39-40.5	1.10	2	39.0-39.2, 39.2-39.4	39.2-39.4	39.0-39.2		
W8-02_12-14	12-14	2.00	2	12.0-12.2	12.0-12.2			
W8-02_28-30	28-30	0.95	1	28.1-28.3	28.1-28.3			
W8-05_23.5-25.5	23.5-25.5	2.00	2	23.7-23.9, 23.9-24.1	23.9-24.1	23.7-23.9		
TOTALS:	6 - Cores	8.85	11	11	7	4		11

Laboratory Test Program Notes

Contaminant identification: _____

Standard TAT for basic analysis is 10 business days. Advanced tests require additional time.

*Sample locations to be selected by ARCADIS personnel from core photography.

ASTM D422: Dry Sieve only, Hydrometer analysis must be requested prior to initiating tests. Additional costs would apply.

Free Product Mobility Package: Applied centrifugal force demonstrates product mobility; includes residual saturations by Dean-Stark, total porosity, grain and dry bulk density.

Air/Water Drainage Capillarity Package: Air/Water Drainage Capillary Pressure Curve (air displacing water) with Air Permeability and Hydraulic Conductivity: includes fluid production vs. capillary pressure, total and air-filled porosity, grain density, dry bulk density, moisture content and total (water only) pore fluid saturations.

Grain Size Analyses coupled with FPM and A/W Drainage tests (on same interval). Grain size to be analyzed on sub-samples after running other specified analyses. Per client request

PTS File No: 43782
Client: ARCADIS
Report Date: 05/06/14

PTS Laboratories

FREE PRODUCT MOBILITY: INITIAL AND RESIDUAL SATURATIONS

(Centrifugal method: samples spun under air)

Project Name: RACER - Pontiac North Campus
Project No: B0064607.2013.0005

			METHODS:	API RP 40		API RP 40	ASTM D425M, DEAN-STARK			
							PORE FLUID SATURATIONS (3), % Pv			
				DENSITY			Initial Fluid Saturations		After Centrifuge at 1000xG	
SAMPLE ID.	DEPTH, ft.	SAMPLE ORIENTATION (1)	ANALYSIS DATE	DRY BULK, g/cc	GRAIN, g/cc	TOTAL POROSITY (2), %Vb	WATER (Swi) SATURATION	NAPL (Soi) SATURATION	WATER (Srw) SATURATION	NAPL (Sor) SATURATION
M2-42_13-15	13.5	H	20140409	1.48	2.70	45.3	50.3	20.2	6.0	10.4
NOTE: Light brown LNAPL produced. Produced water clear.										
M2-42_13-15	14.1	H	20140409	1.61	2.67	39.8	61.2	31.9	9.2	12.7
NOTE: Light brown LNAPL produced. Produced water clear.										
M2-05_18-20	19.5	H	20140409	1.89	2.71	30.4	42.5	24.6	40.6	10.9
NOTE: Dark brown LNAPL produced. Produced water clear.										
M2-01_39-40.5	39.3	H	20140409	2.19	2.73	19.6	69.4	8.5	45.2	8.5
NOTE: No visible NAPL produced. Produced water clear with faint hydrocarbon odor.										
W8-02_12-14	12.1	H	20140409	1.79	2.69	33.4	83.8	3.5	64.8	3.5
NOTE: No visible NAPL produced. Produced water clear with strong hydrocarbon odor.										
W8-02_28-30	28.2	H	20140409	1.77	2.70	34.5	86.0	1.7	55.1	1.7
NOTE: No visible NAPL produced. Produced water clear with strong hydrocarbon odor.										
W8-05_23.5-25.5	24.0	H	20140409	1.73	2.69	35.8	34.9	43.3	24.8	20.0
NOTE: Light brown LNAPL produced. Produced water clear.										

(1) Sample Orientation: H = horizontal; V = vertical; R = remold

(2) Total Porosity = all interconnected pore channels.

(3) Fluid density used to calculate pore fluid saturations: Water = 0.9996 g/cc, NAPL = 0.8600 g/cc.

Swi = Initial Water Saturation as received prior to centrifuging at 1000xG, Soi = Initial NAPL Saturation as received prior to centrifuging at 1000xG.

Srw = Residual Water Saturation after centrifuging at 1000xG, Sor = Residual NAPL Saturation after centrifuging at 1000xG.

Vb = Bulk Volume, cc; Pv = Pore Volume, cc; ND = Not Detected

PTS Laboratories

PTS File No: 43782
Client: ARCADIS
Report Date: 05/06/14

SAMPLE PROPERTIES - AIR/WATER CAPILLARY PRESSURE

Project Name: RACER - Pontiac North Campus
Project No: B0064607.2013.0005

		METHODS:	API RP 40 / ASTM D2216	API RP 40		API RP 40		API RP 40
		SAMPLE	MOISTURE	DENSITY		POROSITY, %Vb (2)		TOTAL PORE FLUID
SAMPLE ID.	DEPTH, ft.	ORIENTATION (1)	CONTENT, % weight	DRY BULK, g/cc	GRAIN, g/cc	TOTAL	AIR FILLED	SATURATIONS (3), % Pv
M2-42_13-15	13.9	H	22.0	1.53	2.65	42.4	8.9	78.9
M2-05_18-20	19.3	H	9.9	2.02	2.68	24.7	4.7	80.8
M2-01_39-40.5	39.1	H	10.4	2.00	2.71	26.2	5.5	79.1
W8-05_23.5-25.5	23.8	H	11.3	1.66	2.62	36.8	18.0	51.1

(1) Sample Orientation: H = horizontal; V = vertical; R = remold

(2) Total Porosity = all interconnected pore channels; Air Filled = pore channels not occupied by pore fluids.

(3) Fluid density used to calculate pore fluid saturations: Water = 0.9996 g/cc.

Vb = Bulk Volume, cc; Pv = Pore Volume, cc; ND = Not Detected

PTS File No: 43782
Client: ARCADIS
Report Date: 05/06/14

PTS Laboratories

PERMEABILITY DATA - AIR/WATER CAPILLARY PRESSURE

Project Name: RACER - Pontiac North Campus
Project No: B0064607.2013.0005

		METHODS:	**API RP 40; EPA 9100**		
			25 PSI CONFINING STRESS		
SAMPLE ID.	DEPTH, ft.	SAMPLE ORIENTATION (1)	SPECIFIC PERMEABILITY TO AIR, millidarcy (2)	EFFECTIVE PERMEABILITY TO WATER, millidarcy (3,4)	HYDRAULIC CONDUCTIVITY, cm/s (4)
M2-42_13-15	13.9	H	6030	4510	4.53E-03
M2-05_18-20	19.3	H	5.84	0.68	6.82E-07
M2-01_39-40.5	39.1	H	6.76	2.26	2.27E-06
W8-05_23.5-25.5	23.8	H	3860	487	4.86E-04

(1) Sample Orientation: H = horizontal; V = vertical; R = remold
(2) Specific = No pore fluids in place.
(3) Effective (Native) = With as-received pore fluids in place.
(4) Permeability to water and hydraulic conductivity measured at saturated conditions.
Air = Nitrogen gas, Water = filtered Laboratory Fresh (tap) or Site water.

PTS File No: 43782
Client: ARCADIS
Report Date: 05/06/14

PTS Laboratories

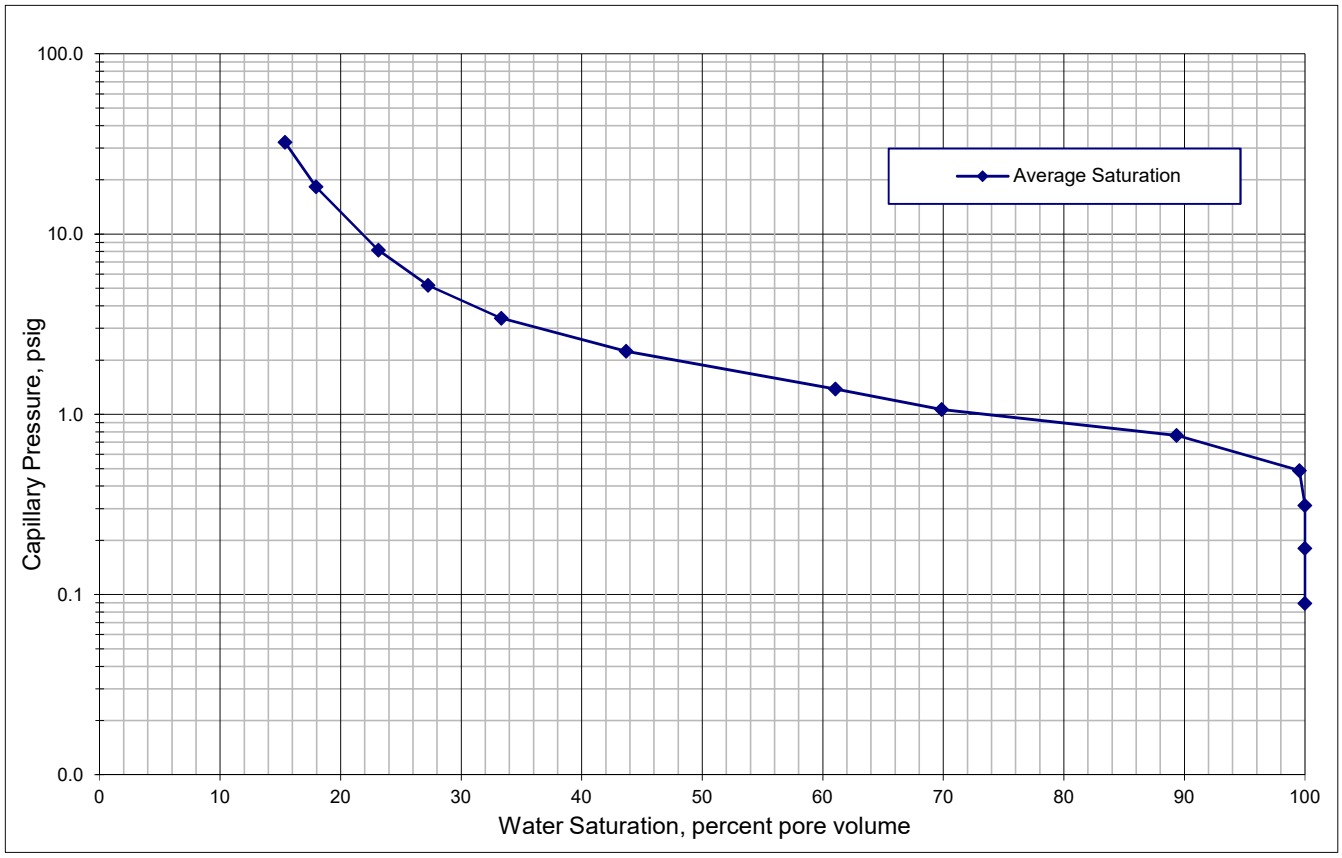
AIR/WATER CAPILLARY PRESSURE TABULAR DATA

ASTM D6836; Method E (Centrifugal Method: air displacing water)

Project Name: RACER - Pontiac North Campus
Project No: B0064607.2013.0005

Capillary Pressure		Height Above Water Table,	Sample ID M2-42_13-15 at 13.9 ft.	
			Average Saturation	Moisture,
psi	cm water	ft	% pore volume	% dry weight
0.000	0.00	0.000	100.0	25.4
0.089	6.29	0.207	100.0	25.4
0.180	12.7	0.417	100.0	25.4
0.312	21.9	0.721	100.0	25.4
0.487	34.2	1.13	99.5	25.3
0.764	53.8	1.77	89.3	22.7
1.063	74.7	2.46	69.9	17.8
1.38	97.3	3.20	61.0	15.5
2.24	157	5.17	43.7	11.1
3.41	239	7.88	33.3	8.5
5.20	366	12.0	27.2	7.0
8.16	574	18.9	23.1	5.9
18.3	1288	42.4	18.0	4.6
32.3	2272	74.8	15.4	4.0

* NAPL produced during centrifuge testing. Volume of NAPL produced added to volume of water produced.



PTS File No: 43782
Client: ARCADIS
Report Date: 05/06/14

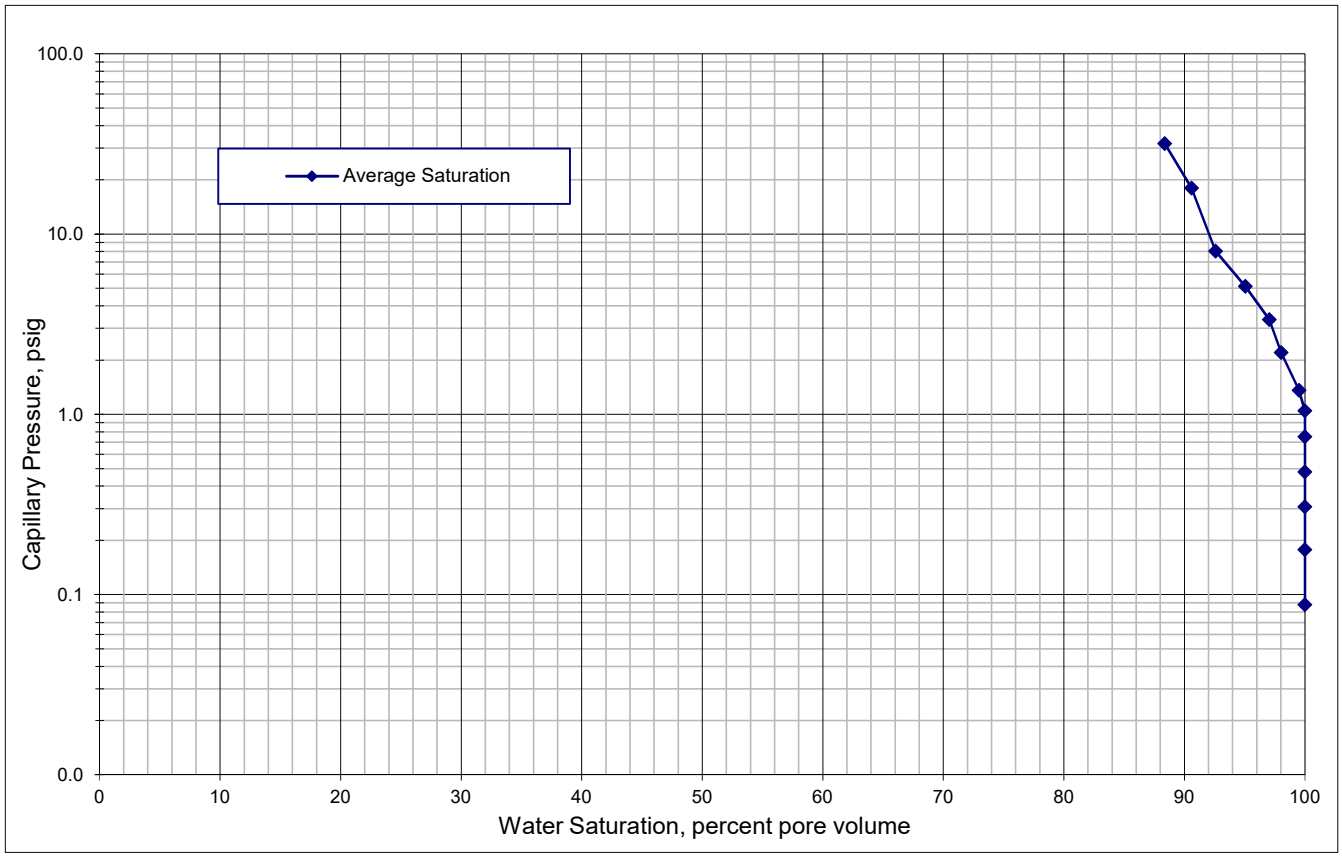
PTS Laboratories

AIR/WATER CAPILLARY PRESSURE TABULAR DATA

ASTM D6836; Method E (Centrifugal Method: air displacing water)

Project Name: RACER - Pontiac North Campus
Project No: B0064607.2013.0005

Capillary Pressure		Height Above Water Table,	Sample ID M2-05_18-20 at 19.3 ft.	
			Average Saturation	Moisture,
psi	cm water	ft	% pore volume	% dry weight
0.000	0.00	0.000	100.0	11.6
0.088	6.19	0.204	100.0	11.6
0.177	12.5	0.410	100.0	11.6
0.307	21.6	0.710	100.0	11.6
0.479	33.7	1.11	100.0	11.6
0.752	52.9	1.74	100.0	11.6
1.046	73.6	2.42	100.0	11.6
1.36	95.7	3.15	99.5	11.5
2.20	155	5.09	98.0	11.4
3.35	236	7.76	97.0	11.3
5.12	360	11.9	95.0	11.0
8.03	565	18.6	92.6	10.7
18.0	1268	41.7	90.6	10.5
31.8	2236	73.6	88.4	10.3



PTS File No: 43782
Client: ARCADIS
Report Date: 05/06/14

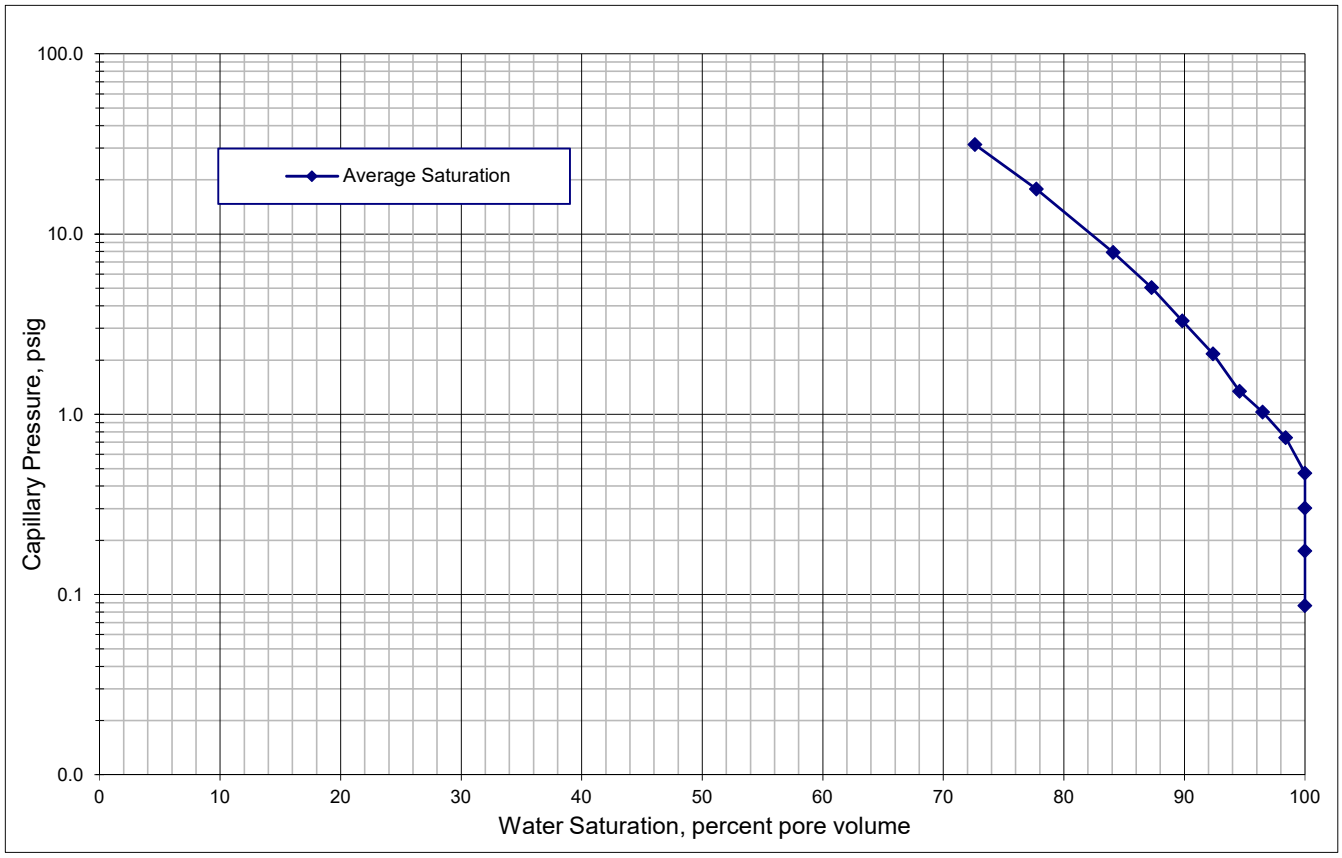
PTS Laboratories

AIR/WATER CAPILLARY PRESSURE TABULAR DATA

ASTM D6836; Method E (Centrifugal Method: air displacing water)

Project Name: RACER - Pontiac North Campus
Project No: B0064607.2013.0005

Capillary Pressure		Height Above Water Table,	Sample ID	
			M2-01_39-40.5 at 39.1 ft.	
psi	cm water	ft	Average Saturation % pore volume	Moisture, % dry weight
0.000	0.00	0.000	100.0	9.5
0.087	6.10	0.201	100.0	9.5
0.175	12.3	0.404	100.0	9.5
0.302	21.2	0.699	100.0	9.5
0.472	33.2	1.09	100.0	9.5
0.741	52.1	1.72	98.4	9.4
1.031	72.5	2.39	96.5	9.2
1.34	94.3	3.11	94.6	9.0
2.17	152	5.02	92.4	8.8
3.30	232	7.64	89.8	8.5
5.05	355	11.7	87.3	8.3
7.91	556	18.3	84.1	8.0
17.8	1249	41.1	77.7	7.4
31.3	2203	72.5	72.6	6.9



PTS File No: 43782
Client: ARCADIS
Report Date: 05/06/14

PTS Laboratories

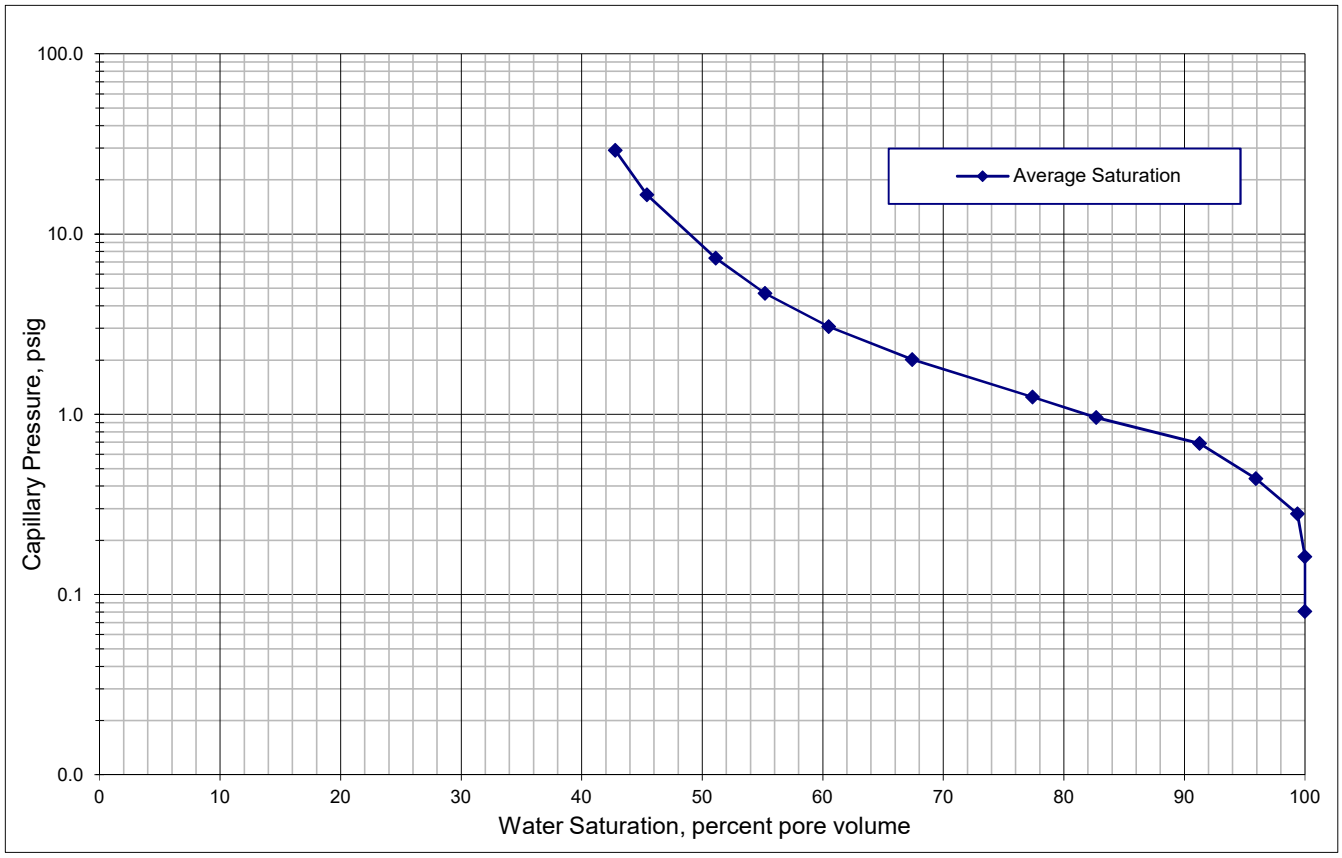
AIR/WATER CAPILLARY PRESSURE TABULAR DATA

ASTM D6836; Method E (Centrifugal Method: air displacing water)

Project Name: RACER - Pontiac North Campus
Project No: B0064607.2013.0005

Capillary Pressure		Height Above Water Table,	Sample ID	
			W8-05_23.5-25.5 at 23.8 ft.	
psi	cm water	ft	Average Saturation % pore volume	Moisture, % dry weight
0.000	0.00	0.000	100.0	20.0
0.081	5.67	0.187	100.0	20.0
0.162	11.4	0.376	100.0	20.0
0.281	19.8	0.650	99.4	19.9
0.439	30.9	1.02	95.9	19.2
0.690	48.5	1.60	91.2	18.2
0.959	67.4	2.22	82.7	16.5
1.25	87.7	2.89	77.4	15.5
2.02	142	4.67	67.4	13.5
3.07	216	7.11	60.5	12.1
4.69	330	10.9	55.2	11.0
7.36	517	17.0	51.1	10.2
16.5	1162	38.2	45.4	9.1
29.1	2049	67.5	42.8	8.6

* NAPL produced during centrifuge testing. Volume of NAPL produced added to volume of water produced.



PARTICLE SIZE SUMMARY

(METHODOLOGY: ASTM D422/D4464M)

PROJECT NAME: RACER - Pontiac North Campus
PROJECT NO: B0064607.2013.0005

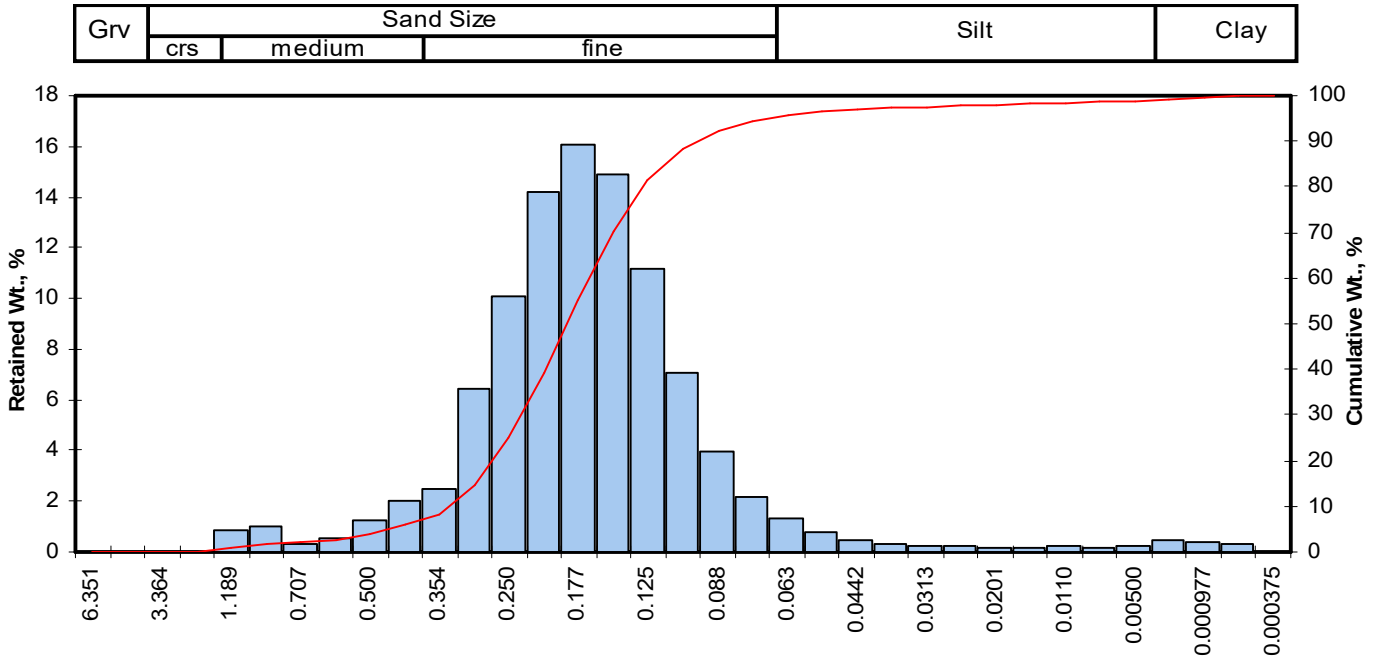
Sample ID	Depth, ft.	Mean Grain Size Description (1)	Median Grain Size mm	Particle Size Distribution, wt. percent						Silt & Clay
				Gravel	Sand Size			Silt	Clay	
					Coarse	Medium	Fine			
M2-42 13-15	13.5	Fine sand	0.187	0.00	0.00	5.92	88.53	4.34	1.21	5.55
M2-42 13-15	13.9	Fine sand	0.183	0.00	0.00	7.15	87.78	4.04	1.04	5.08
M2-42 13-15	14.1	Fine sand	0.191	0.00	0.00	7.12	86.75	4.87	1.26	6.13
M2-05_18-20	19.3	Fine sand	0.021	0.00	0.00	12.60	22.08	41.38	23.94	65.32
W8-02_12-14	12.1	Silt	0.019	0.00	0.00	9.46	20.25	46.29	24.01	70.30
W8-05_23.5-25.5	23.8	Medium sand	0.494	0.00	0.00	53.32	23.84	14.96	7.89	22.85

(1) Based on Mean from Trask

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D4464M

Client:	ARCADIS	**PTS File No:**	43782
Project:	RACER - Pontiac North Campus	**Sample ID:**	M2-42 13-15
Project No:	B0064607.2013.0005	**Depth, ft:**	13.5



Opening		Phi of	U.S.	Sample Weight,	Increment Weight,	Cumulative Weight,
Inches	Millimeters	Screen	No.	grams	percent	percent
0.2500	6.351	-2.67	1/4	0.00	0.00	0.00
0.1873	4.757	-2.25	4	0.00	0.00	0.00
0.1324	3.364	-1.75	6	0.00	0.00	0.00
0.0787	2.000	-1.00	10	0.00	0.00	0.00
0.0468	1.189	-0.25	16	0.84	0.84	0.84
0.0331	0.841	0.25	20	0.99	0.99	1.83
0.0278	0.707	0.50	25	0.32	0.32	2.15
0.0234	0.595	0.75	30	0.51	0.51	2.66
0.0197	0.500	1.00	35	1.28	1.28	3.94
0.0166	0.420	1.25	40	1.98	1.98	5.92
0.0139	0.354	1.50	45	2.45	2.45	8.37
0.0117	0.297	1.75	50	6.44	6.44	14.80
0.0098	0.250	2.00	60	10.10	10.09	24.90
0.0083	0.210	2.25	70	14.20	14.19	39.09
0.0070	0.177	2.50	80	16.10	16.09	55.18
0.0059	0.149	2.75	100	14.90	14.89	70.07
0.0049	0.125	3.00	120	11.20	11.19	81.27
0.0041	0.105	3.25	140	7.03	7.03	88.29
0.0035	0.088	3.50	170	3.95	3.95	92.24
0.0029	0.074	3.75	200	2.21	2.21	94.45
0.0025	0.063	4.00	230	1.29	1.29	95.74
0.0021	0.053	4.25	270	0.77	0.77	96.51
0.00174	0.0442	4.50	325	0.48	0.48	96.99
0.00146	0.0372	4.75	400	0.33	0.33	97.32
0.00123	0.0313	5.00	450	0.25	0.25	97.57
0.000986	0.0250	5.32	500	0.25	0.25	97.82
0.000790	0.0201	5.64	635	0.19	0.19	98.01
0.000615	0.0156	6.00		0.17	0.17	98.18
0.000435	0.0110	6.50		0.20	0.20	98.38
0.000308	0.00781	7.00		0.18	0.18	98.56
0.000197	0.00500	7.65		0.23	0.23	98.79
0.000077	0.00195	9.00		0.45	0.45	99.24
0.000038	0.000977	10.00		0.40	0.40	99.64
0.000019	0.000488	11.00		0.33	0.33	99.97
0.000015	0.000375	11.38		0.04	0.03	100.00
TOTALS				**100.10**	**100.00**	**100.00**

Cumulative Weight Percent greater than			
Weight	Phi	Particle Size	
percent	Value	Inches	Millimeters
5	1.13	0.0179	0.456
10	1.56	0.0133	0.338
16	1.78	0.0115	0.291
25	2.00	0.0098	0.250
40	2.26	0.0082	0.208
50	2.42	0.0074	0.187
60	2.58	0.0066	0.167
75	2.86	0.0054	0.138
84	3.10	0.0046	0.117
90	3.36	0.0038	0.098
95	3.86	0.0027	0.069

Measure	Trask	Inman	Folk-Ward
Median, phi	2.42	2.42	2.42
Median, in.	0.0074	0.0074	0.0074
Median, mm	0.187	0.187	0.187
Mean, phi	2.37	2.44	2.43
Mean, in.	0.0076	0.0073	0.0073
Mean, mm	0.194	0.184	0.185
Sorting	1.346	0.659	0.742
Skewness	0.992	0.029	0.042
Kurtosis	0.232	1.066	1.300
Grain Size Description (ASTM-USCS Scale)		Fine sand (based on Mean from Trask)	

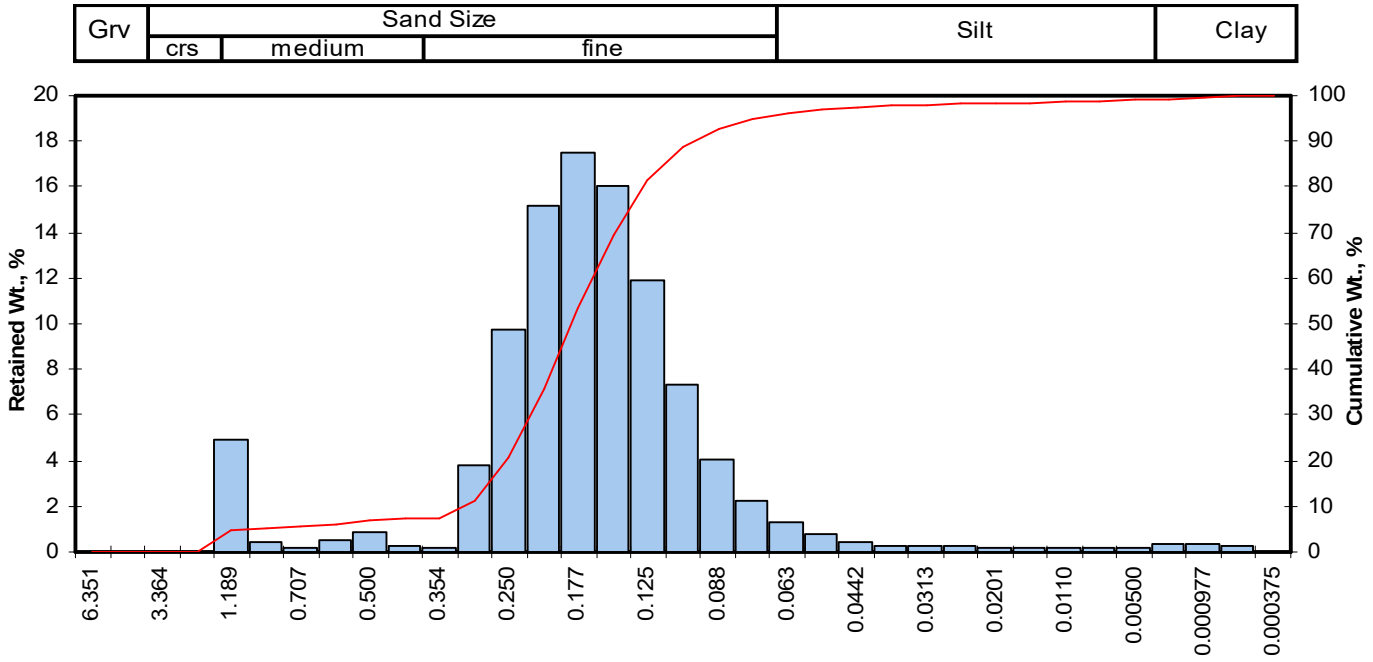
Description	Retained on Sieve #	Weight Percent
Gravel	4	0.00
Coarse Sand	10	0.00
Medium Sand	40	5.92
Fine Sand	200	88.53
Silt	>0.005 mm	4.34
Clay	<0.005 mm	1.21
	Total	**100**

Phone: (562) 907-3607
Fax: (562) 907-3610

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D4464M

Client:	ARCADIS	**PTS File No:**	43782
Project:	RACER - Pontiac North Campus	**Sample ID:**	M2-42 13-15
Project No:	B0064607.2013.0005	**Depth, ft:**	13.9



Opening		Phi of	U.S.	Sample Weight,	Increment Weight,	Cumulative Weight,
Inches	Millimeters	Screen	No.	grams	percent	percent
0.2500	6.351	-2.67	1/4	0.00	0.00	0.00
0.1873	4.757	-2.25	4	0.00	0.00	0.00
0.1324	3.364	-1.75	6	0.00	0.00	0.00
0.0787	2.000	-1.00	10	0.00	0.00	0.00
0.0468	1.189	-0.25	16	4.91	4.91	4.91
0.0331	0.841	0.25	20	0.43	0.43	5.34
0.0278	0.707	0.50	25	0.18	0.18	5.52
0.0234	0.595	0.75	30	0.56	0.56	6.08
0.0197	0.500	1.00	35	0.82	0.82	6.90
0.0166	0.420	1.25	40	0.25	0.25	7.15
0.0139	0.354	1.50	45	0.18	0.18	7.33
0.0117	0.297	1.75	50	3.76	3.76	11.08
0.0098	0.250	2.00	60	9.71	9.71	20.79
0.0083	0.210	2.25	70	15.20	15.19	35.98
0.0070	0.177	2.50	80	17.50	17.49	53.47
0.0059	0.149	2.75	100	16.00	15.99	69.46
0.0049	0.125	3.00	120	11.90	11.89	81.36
0.0041	0.105	3.25	140	7.32	7.32	88.67
0.0035	0.088	3.50	170	4.04	4.04	92.71
0.0029	0.074	3.75	200	2.21	2.21	94.92
0.0025	0.063	4.00	230	1.28	1.28	96.20
0.0021	0.053	4.25	270	0.77	0.77	96.97
0.00174	0.0442	4.50	325	0.47	0.47	97.44
0.00146	0.0372	4.75	400	0.30	0.30	97.74
0.00123	0.0313	5.00	450	0.22	0.22	97.96
0.000986	0.0250	5.32	500	0.22	0.22	98.18
0.000790	0.0201	5.64	635	0.17	0.17	98.35
0.000615	0.0156	6.00		0.14	0.14	98.49
0.000435	0.0110	6.50		0.16	0.16	98.65
0.000308	0.00781	7.00		0.14	0.14	98.79
0.000197	0.00500	7.65		0.17	0.17	98.96
0.000077	0.00195	9.00		0.35	0.35	99.31
0.000038	0.000977	10.00		0.36	0.36	99.67
0.000019	0.000488	11.00		0.30	0.30	99.97
0.000015	0.000375	11.38		0.03	0.03	100.00
TOTALS				**100.10**	**100.00**	**100.00**

Cumulative Weight Percent greater than

Weight percent	Phi Value	Particle Size Inches	Particle Size Millimeters
5	-0.14	0.0435	1.104
10	1.68	0.0123	0.313
16	1.88	0.0107	0.272
25	2.07	0.0094	0.238
40	2.31	0.0080	0.202
50	2.45	0.0072	0.183
60	2.60	0.0065	0.165
75	2.87	0.0054	0.137
84	3.09	0.0046	0.117
90	3.33	0.0039	0.099
95	3.77	0.0029	0.074

Measure	Trask	Inman	Folk-Ward
Median, phi	2.45	2.45	2.45
Median, in.	0.0072	0.0072	0.0072
Median, mm	0.183	0.183	0.183
Mean, phi	2.41	2.48	2.47
Mean, in.	0.0074	0.0070	0.0071
Mean, mm	0.188	0.179	0.180
Sorting	1.318	0.607	0.895
Skewness	0.988	0.055	-0.136
Kurtosis	0.237	2.220	2.009

Grain Size Description (ASTM-USCS Scale)	Fine sand (based on Mean from Trask)

Description	Retained on Sieve #	Weight Percent
Gravel	4	0.00
Coarse Sand	10	0.00
Medium Sand	40	7.15
Fine Sand	200	87.78
Silt	>0.005 mm	4.04
Clay	<0.005 mm	1.04
	Total	**100**

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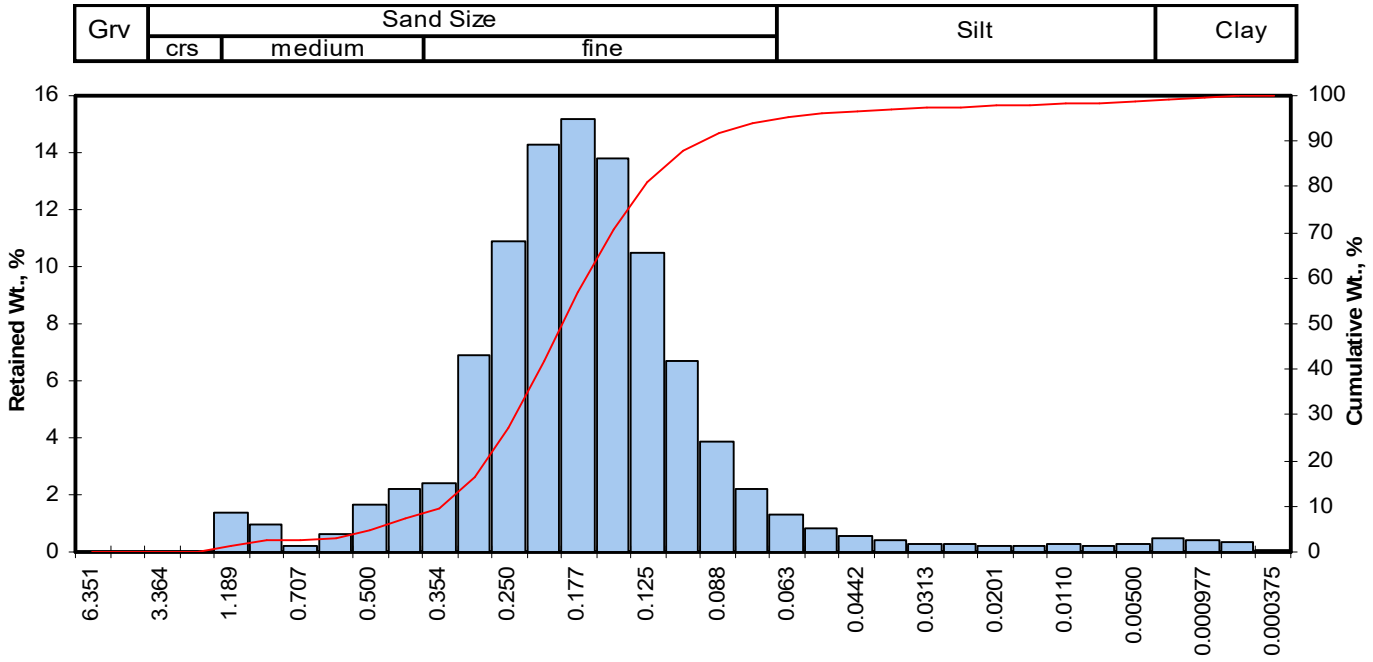
Fax: (562) 907-3610

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D4464M

Client:	ARCADIS	**PTS File No:**	43782
Project:	RACER - Pontiac North Campus	**Sample ID:**	M2-42 13-15
Project No:	B0064607.2013.0005	**Depth, ft:**	14.1



Opening		Phi of	U.S.	Sample Weight,	Increment Weight,	Cumulative Weight,
Inches	Millimeters	Screen	No.	grams	percent	percent
0.2500	6.351	-2.67	1/4	0.00	0.00	0.00
0.1873	4.757	-2.25	4	0.00	0.00	0.00
0.1324	3.364	-1.75	6	0.00	0.00	0.00
0.0787	2.000	-1.00	10	0.00	0.00	0.00
0.0468	1.189	-0.25	16	1.40	1.40	1.40
0.0331	0.841	0.25	20	0.98	0.98	2.38
0.0278	0.707	0.50	25	0.24	0.24	2.62
0.0234	0.595	0.75	30	0.60	0.60	3.22
0.0197	0.500	1.00	35	1.68	1.68	4.90
0.0166	0.420	1.25	40	2.22	2.22	7.12
0.0139	0.354	1.50	45	2.40	2.40	9.52
0.0117	0.297	1.75	50	6.89	6.89	16.42
0.0098	0.250	2.00	60	10.90	10.90	27.32
0.0083	0.210	2.25	70	14.30	14.31	41.63
0.0070	0.177	2.50	80	15.20	15.21	56.84
0.0059	0.149	2.75	100	13.80	13.81	70.64
0.0049	0.125	3.00	120	10.50	10.50	81.15
0.0041	0.105	3.25	140	6.70	6.70	87.85
0.0035	0.088	3.50	170	3.84	3.84	91.69
0.0029	0.074	3.75	200	2.18	2.18	93.87
0.0025	0.063	4.00	230	1.31	1.31	95.18
0.0021	0.053	4.25	270	0.82	0.82	96.00
0.00174	0.0442	4.50	325	0.53	0.53	96.53
0.00146	0.0372	4.75	400	0.38	0.38	96.91
0.00123	0.0313	5.00	450	0.30	0.30	97.21
0.000986	0.0250	5.32	500	0.31	0.31	97.52
0.000790	0.0201	5.64	635	0.24	0.24	97.76
0.000615	0.0156	6.00		0.22	0.22	97.98
0.000435	0.0110	6.50		0.26	0.26	98.24
0.000308	0.00781	7.00		0.23	0.23	98.47
0.000197	0.00500	7.65		0.27	0.27	98.74
0.000077	0.00195	9.00		0.49	0.49	99.23
0.000038	0.000977	10.00		0.41	0.41	99.64
0.000019	0.000488	11.00		0.32	0.32	99.96
0.000015	0.000375	11.38		0.04	0.04	100.00
TOTALS				**100.00**	**100.00**	**100.00**

Cumulative Weight Percent greater than			
Weight	Phi	Particle Size	
percent	Value	Inches	Millimeters
5	1.01	0.0195	0.496
10	1.52	0.0138	0.349
16	1.73	0.0118	0.300
25	1.95	0.0102	0.259
40	2.22	0.0084	0.214
50	2.39	0.0075	0.191
60	2.56	0.0067	0.170
75	2.85	0.0054	0.138
84	3.11	0.0046	0.116
90	3.39	0.0038	0.095
95	3.97	0.0025	0.064

Measure	Trask	Inman	Folk-Ward
Median, phi	2.39	2.39	2.39
Median, in.	0.0075	0.0075	0.0075
Median, mm	0.191	0.191	0.191
Mean, phi	2.33	2.42	2.41
Mean, in.	0.0078	0.0074	0.0074
Mean, mm	0.199	0.187	0.188
Sorting	1.369	0.686	0.790
Skewness	0.991	0.048	0.058
Kurtosis	0.238	1.154	1.335

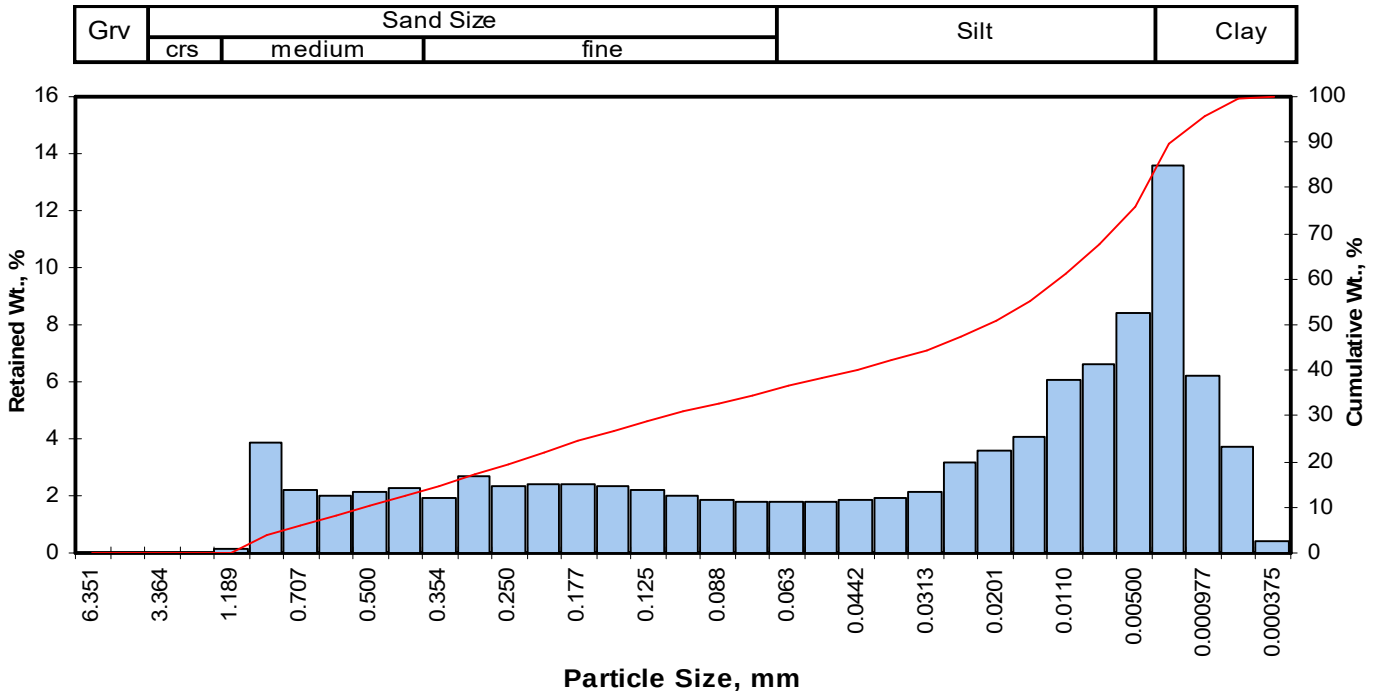
Grain Size Description (ASTM-USCS Scale)	Fine sand (based on Mean from Trask)

Description	Retained on Sieve #	Weight Percent
Gravel	4	0.00
Coarse Sand	10	0.00
Medium Sand	40	7.12
Fine Sand	200	86.75
Silt	>0.005 mm	4.87
Clay	<0.005 mm	1.26
	Total	**100**

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D4464M

Client:	ARCADIS	**PTS File No:**	43782
Project:	RACER - Pontiac North Campus	**Sample ID:**	M2-05_18-20
Project No:	B0064607.2013.0005	**Depth, ft:**	19.3



Opening		Phi of	U.S.	Sample Weight,	Increment Weight,	Cumulative Weight,
Inches	Millimeters	Screen	No.	grams	percent	percent
0.2500	6.351	-2.67	1/4	0.00	0.00	0.00
0.1873	4.757	-2.25	4	0.00	0.00	0.00
0.1324	3.364	-1.75	6	0.00	0.00	0.00
0.0787	2.000	-1.00	10	0.00	0.00	0.00
0.0468	1.189	-0.25	16	0.13	0.13	0.13
0.0331	0.841	0.25	20	3.87	3.87	4.00
0.0278	0.707	0.50	25	2.22	2.22	6.22
0.0234	0.595	0.75	30	1.99	1.99	8.21
0.0197	0.500	1.00	35	2.12	2.12	10.33
0.0166	0.420	1.25	40	2.27	2.27	12.60
0.0139	0.354	1.50	45	1.92	1.92	14.52
0.0117	0.297	1.75	50	2.68	2.68	17.20
0.0098	0.250	2.00	60	2.36	2.36	19.56
0.0083	0.210	2.25	70	2.43	2.43	21.99
0.0070	0.177	2.50	80	2.44	2.44	24.43
0.0059	0.149	2.75	100	2.36	2.36	26.79
0.0049	0.125	3.00	120	2.19	2.19	28.98
0.0041	0.105	3.25	140	2.02	2.02	31.00
0.0035	0.088	3.50	170	1.88	1.88	32.88
0.0029	0.074	3.75	200	1.80	1.80	34.68
0.0025	0.063	4.00	230	1.79	1.79	36.47
0.0021	0.053	4.25	270	1.81	1.81	38.28
0.00174	0.0442	4.50	325	1.84	1.84	40.12
0.00146	0.0372	4.75	400	1.93	1.93	42.05
0.00123	0.0313	5.00	450	2.15	2.15	44.20
0.000986	0.0250	5.32	500	3.20	3.20	47.40
0.000790	0.0201	5.64	635	3.58	3.58	50.98
0.000615	0.0156	6.00		4.06	4.06	55.04
0.000435	0.0110	6.50		6.04	6.04	61.08
0.000308	0.00781	7.00		6.60	6.60	67.68
0.000197	0.00500	7.65		8.38	8.38	76.06
0.000077	0.00195	9.00		13.60	13.60	89.66
0.000038	0.000977	10.00		6.19	6.19	95.85
0.000019	0.000488	11.00		3.74	3.74	99.59
0.000015	0.000375	11.38		0.41	0.41	100.00
TOTALS				**100.00**	**100.00**	**100.00**

Cumulative Weight Percent greater than

Weight percent	Phi Value	Particle Size Inches	Particle Size Millimeters
5	0.36	0.0306	0.778
10	0.96	0.0202	0.514
16	1.64	0.0126	0.321
25	2.56	0.0067	0.170
40	4.48	0.0018	0.045
50	5.55	0.0008	0.021
60	6.41	0.0005	0.012
75	7.56	0.0002	0.005
84	8.44	0.0001	0.003
90	9.05	0.0001	0.002
95	9.86	0.0000	0.001

Measure	Trask	Inman	Folk-Ward
Median, phi	5.55	5.55	5.55
Median, in.	0.0008	0.0008	0.0008
Median, mm	0.021	0.021	0.021
Mean, phi	3.52	5.04	5.21
Mean, in.	0.0034	0.0012	0.0011
Mean, mm	0.087	0.030	0.027
Sorting	5.663	3.399	3.139
Skewness	1.405	-0.152	-0.122
Kurtosis	0.160	0.397	0.778

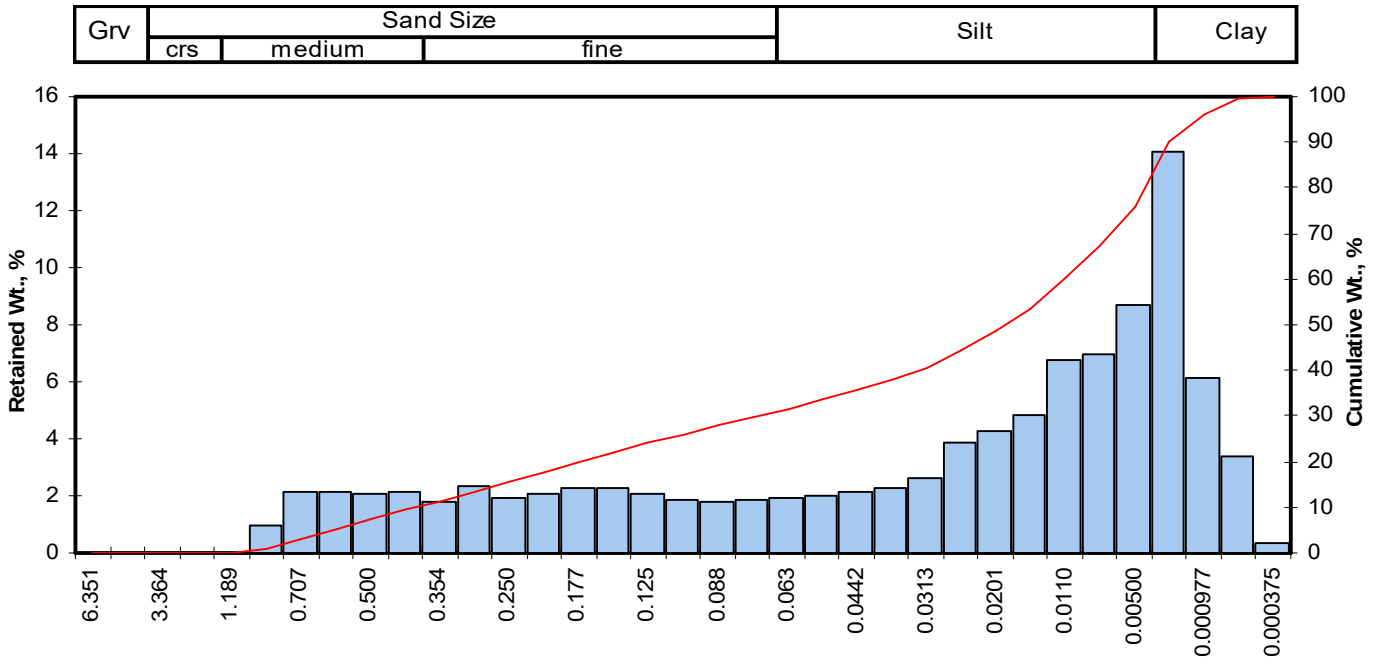
Grain Size Description (ASTM-USCS Scale)	Fine sand (based on Mean from Trask)

Description	Retained on Sieve #	Weight Percent
Gravel	4	0.00
Coarse Sand	10	0.00
Medium Sand	40	12.60
Fine Sand	200	22.08
Silt	>0.005 mm	41.38
Clay	<0.005 mm	23.94
	Total	**100**

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D4464M

Client:	ARCADIS	**PTS File No:**	43782
Project:	RACER - Pontiac North Campus	**Sample ID:**	W8-02_12-14
Project No:	B0064607.2013.0005	**Depth, ft:**	12.1



Opening		Phi of	U.S.	Sample Weight,	Increment Weight,	Cumulative Weight,
Inches	Millimeters	Screen	No.	grams	percent	percent
0.2500	6.351	-2.67	1/4	0.00	0.00	0.00
0.1873	4.757	-2.25	4	0.00	0.00	0.00
0.1324	3.364	-1.75	6	0.00	0.00	0.00
0.0787	2.000	-1.00	10	0.00	0.00	0.00
0.0468	1.189	-0.25	16	0.00	0.00	0.00
0.0331	0.841	0.25	20	0.99	0.99	0.99
0.0278	0.707	0.50	25	2.12	2.12	3.11
0.0234	0.595	0.75	30	2.16	2.16	5.27
0.0197	0.500	1.00	35	2.04	2.04	7.31
0.0166	0.420	1.25	40	2.15	2.15	9.46
0.0139	0.354	1.50	45	1.80	1.80	11.26
0.0117	0.297	1.75	50	2.32	2.32	13.58
0.0098	0.250	2.00	60	1.93	1.93	15.51
0.0083	0.210	2.25	70	2.08	2.08	17.59
0.0070	0.177	2.50	80	2.26	2.26	19.85
0.0059	0.149	2.75	100	2.26	2.26	22.11
0.0049	0.125	3.00	120	2.07	2.07	24.18
0.0041	0.105	3.25	140	1.88	1.88	26.05
0.0035	0.088	3.50	170	1.81	1.81	27.86
0.0029	0.074	3.75	200	1.84	1.84	29.70
0.0025	0.063	4.00	230	1.91	1.91	31.61
0.0021	0.053	4.25	270	1.99	1.99	33.60
0.00174	0.0442	4.50	325	2.11	2.11	35.71
0.00146	0.0372	4.75	400	2.30	2.30	38.01
0.00123	0.0313	5.00	450	2.61	2.61	40.62
0.000986	0.0250	5.32	500	3.84	3.84	44.46
0.000790	0.0201	5.64	635	4.27	4.27	48.73
0.000615	0.0156	6.00		4.80	4.80	53.53
0.000435	0.0110	6.50		6.76	6.76	60.29
0.000308	0.00781	7.00		6.99	6.99	67.28
0.000197	0.00500	7.65		8.72	8.72	75.99
0.000077	0.00195	9.00		14.10	14.10	90.09
0.000038	0.000977	10.00		6.14	6.14	96.23
0.000019	0.000488	11.00		3.41	3.41	99.64
0.000015	0.000375	11.38		0.36	0.36	100.00
TOTALS				**100.00**	**100.00**	**100.00**

Cumulative Weight Percent greater than			
Weight	Phi	Particle Size	
percent	Value	Inches	Millimeters
5	0.72	0.0239	0.608
10	1.33	0.0157	0.399
16	2.06	0.0094	0.240
25	3.11	0.0046	0.116
40	4.94	0.0013	0.033
50	5.74	0.0007	0.019
60	6.48	0.0004	0.011
75	7.57	0.0002	0.005
84	8.41	0.0001	0.003
90	8.99	0.0001	0.002
95	9.80	0.0000	0.001

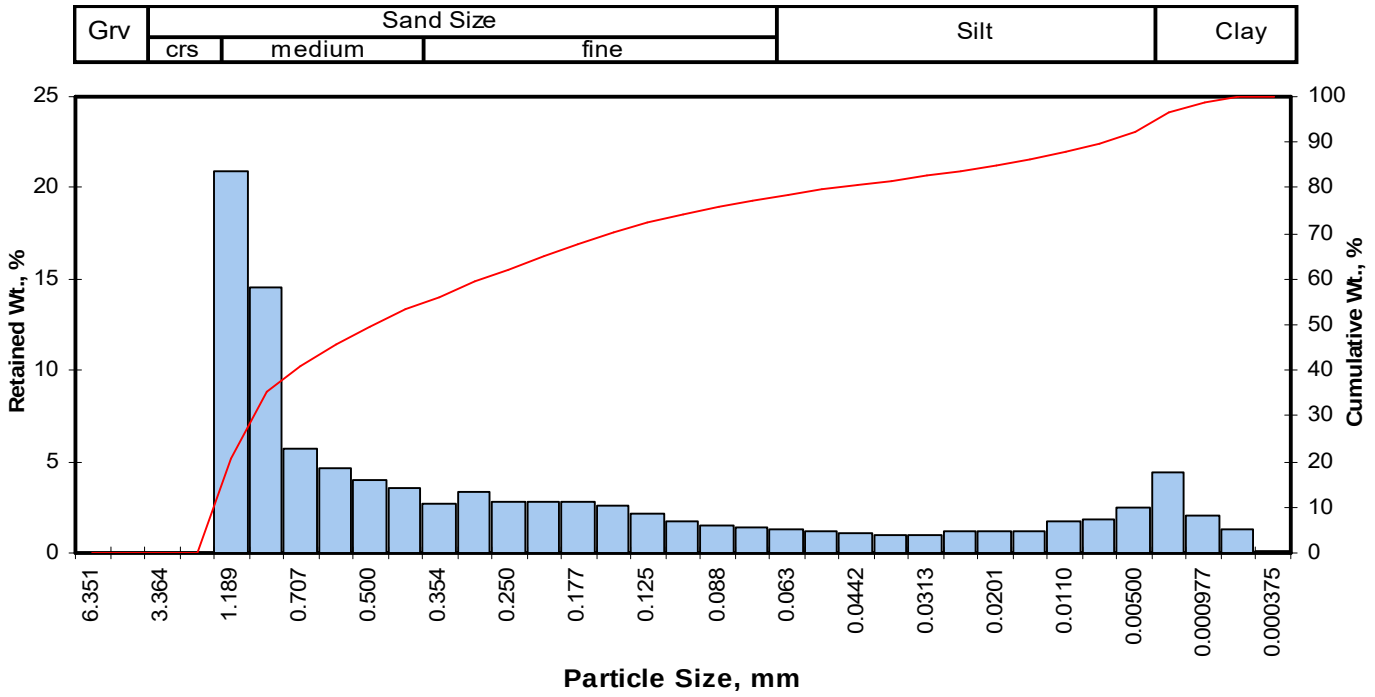
Measure	Trask	Inman	Folk-Ward
Median, phi	5.74	5.74	5.74
Median, in.	0.0007	0.0007	0.0007
Median, mm	0.019	0.019	0.019
Mean, phi	4.05	5.24	5.40
Mean, in.	0.0024	0.0010	0.0009
Mean, mm	0.061	0.027	0.024
Sorting	4.694	3.178	2.965
Skewness	1.315	-0.157	-0.131
Kurtosis	0.139	0.429	0.834
Grain Size Description (ASTM-USCS Scale)		Silt (based on Mean from Trask)	

Description	Retained on Sieve #	Weight Percent
Gravel	4	0.00
Coarse Sand	10	0.00
Medium Sand	40	9.46
Fine Sand	200	20.25
Silt	>0.005 mm	46.29
Clay	<0.005 mm	24.01
	Total	**100**

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D4464M

Client:	ARCADIS	**PTS File No:**	43782
Project:	RACER - Pontiac North Campus	**Sample ID:**	W8-05_23.5-25.5
Project No:	B0064607.2013.0005	**Depth, ft:**	23.8



Opening		Phi of	U.S.	Sample Weight,	Increment Weight,	Cumulative Weight,
Inches	Millimeters	Screen	No.	grams	percent	percent
0.2500	6.351	-2.67	1/4	0.00	0.00	0.00
0.1873	4.757	-2.25	4	0.00	0.00	0.00
0.1324	3.364	-1.75	6	0.00	0.00	0.00
0.0787	2.000	-1.00	10	0.00	0.00	0.00
0.0468	1.189	-0.25	16	20.90	20.90	20.90
0.0331	0.841	0.25	20	14.60	14.60	35.49
0.0278	0.707	0.50	25	5.66	5.66	41.15
0.0234	0.595	0.75	30	4.63	4.63	45.78
0.0197	0.500	1.00	35	3.99	3.99	49.77
0.0166	0.420	1.25	40	3.55	3.55	53.32
0.0139	0.354	1.50	45	2.65	2.65	55.97
0.0117	0.297	1.75	50	3.34	3.34	59.31
0.0098	0.250	2.00	60	2.79	2.79	62.10
0.0083	0.210	2.25	70	2.84	2.84	64.94
0.0070	0.177	2.50	80	2.81	2.81	67.75
0.0059	0.149	2.75	100	2.57	2.57	70.32
0.0049	0.125	3.00	120	2.15	2.15	72.47
0.0041	0.105	3.25	140	1.76	1.76	74.23
0.0035	0.088	3.50	170	1.52	1.52	75.74
0.0029	0.074	3.75	200	1.41	1.41	77.15
0.0025	0.063	4.00	230	1.32	1.32	78.47
0.0021	0.053	4.25	270	1.18	1.18	79.65
0.00174	0.0442	4.50	325	1.04	1.04	80.69
0.00146	0.0372	4.75	400	0.96	0.96	81.65
0.00123	0.0313	5.00	450	0.94	0.94	82.59
0.000986	0.0250	5.32	500	1.20	1.20	83.79
0.000790	0.0201	5.64	635	1.15	1.15	84.94
0.000615	0.0156	6.00		1.21	1.21	86.15
0.000435	0.0110	6.50		1.69	1.69	87.84
0.000308	0.00781	7.00		1.83	1.83	89.67
0.000197	0.00500	7.65		2.44	2.44	92.11
0.000077	0.00195	9.00		4.38	4.38	96.49
0.000038	0.000977	10.00		2.10	2.10	98.59
0.000019	0.000488	11.00		1.27	1.27	99.86
0.000015	0.000375	11.38		0.14	0.14	100.00
TOTALS				**100.00**	**100.00**	**100.00**

Cumulative Weight Percent greater than			
Weight	Phi	Particle Size	
percent	Value	Inches	Millimeters
5	-0.82	0.0695	1.766
10	-0.64	0.0614	1.559
16	-0.43	0.0529	1.343
25	-0.11	0.0425	1.079
40	0.45	0.0288	0.732
50	1.02	0.0195	0.494
60	1.81	0.0112	0.285
75	3.38	0.0038	0.096
84	5.38	0.0009	0.024
90	7.09	0.0003	0.007
95	8.54	0.0001	0.003

Measure	Trask	Inman	Folk-Ward
Median, phi	1.02	1.02	1.02
Median, in.	0.0195	0.0195	0.0195
Median, mm	0.494	0.494	0.494
Mean, phi	0.77	2.48	1.99
Mean, in.	0.0231	0.0071	0.0099
Mean, mm	0.588	0.180	0.252
Sorting	3.348	2.902	2.869
Skewness	0.652	0.503	0.555
Kurtosis	0.317	0.613	1.100
Grain Size Description (ASTM-USCS Scale)		Medium sand (based on Mean from Trask)	

Description	Retained on Sieve #	Weight Percent
Gravel	4	0.00
Coarse Sand	10	0.00
Medium Sand	40	53.32
Fine Sand	200	23.84
Silt	>0.005 mm	14.96
Clay	<0.005 mm	7.89
	Total	**100**

Phone: (562) 907-3607
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PARTICLE SIZE SUMMARY

(METHODOLOGY: ASTM D422M)

PROJECT NAME: RACER - Pontiac North Campus
PROJECT NO: B0064607.2013.0005

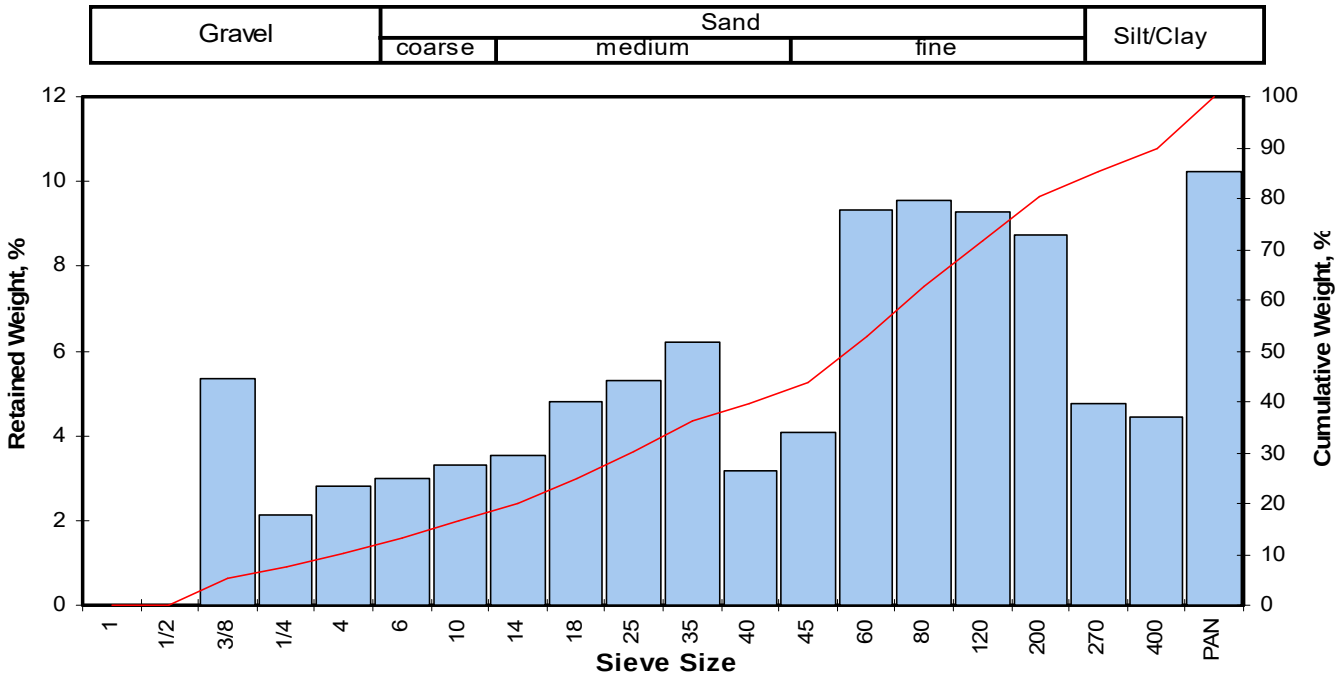
Sample ID	Depth, ft.	Mean Grain Size Description USCS/ASTM (1)	Median Grain Size, mm	Particle Size Distribution, wt. percent				
				Gravel	Sand Size			Silt/Clay
					Coarse	Medium	Fine	
M2-05_18-20	19.5	Medium sand	0.279	10.26	6.29	23.01	40.98	19.46
M2-01_39-40.5	39.1	Medium sand	0.465	17.89	10.42	23.72	32.48	15.49
M2-01_39-40.5	39.3	Coarse sand	1.564	39.72	8.13	17.65	24.50	10.02
W8-02_28-30	28.2	Fine sand	0.263	10.41	3.31	22.60	42.76	20.92
W8-05_23.5-25.5	24.0	Fine sand	0.136	5.15	8.55	15.79	30.76	39.76

(1) Based on Mean fromTrask

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D422M

Client:	ARCADIS	**PTS File No:**	43782
Project:	RACER - Pontiac North Campus	**Sample ID:**	M2-05_18-20
Project No:	B0064607.2013.0005	**Depth, ft:**	19.5



Opening		Phi of	U.S. Sieve	Sample Weight	Incremental Weight,	Cumulative Weight,
Inches	Millimeters	Screen	No.	grams	percent	percent
0.9844	25.002	-4.64	1	0.00	0.00	0.00
0.4922	12.501	-3.64	1/2	0.00	0.00	0.00
0.3740	9.500	-3.25	3/8	5.99	5.33	5.33
0.2500	6.351	-2.67	1/4	2.39	2.13	7.45
0.1873	4.757	-2.25	4	3.16	2.81	10.26
0.1324	3.364	-1.75	6	3.34	2.97	13.23
0.0787	2.000	-1.00	10	3.73	3.32	16.55
0.0557	1.414	-0.50	14	3.97	3.53	20.08
0.0394	1.000	0.00	18	5.41	4.81	24.90
0.0278	0.707	0.50	25	5.97	5.31	30.21
0.0197	0.500	1.00	35	6.97	6.20	36.40
0.0166	0.420	1.25	40	3.55	3.16	39.56
0.0139	0.354	1.50	45	4.57	4.06	43.63
0.0098	0.250	2.00	60	10.49	9.33	52.96
0.0070	0.177	2.50	80	10.72	9.53	62.49
0.0049	0.125	3.00	120	10.45	9.29	71.79
0.0029	0.074	3.75	200	9.84	8.75	80.54
0.0021	0.053	4.25	270	5.36	4.77	85.31
0.0015	0.037	4.75	400	5.01	4.46	89.76
			PAN	11.51	10.24	100.00
TOTALS				112.43	100.00	100.00

Cumulative Weight Percent greater than

Weight percent	Phi Value	Particle Size Inches	Particle Size Millimeters
5	-3.27	0.3804	9.662
10	-2.29	0.1924	4.888
16	-1.12	0.0859	2.181
25	0.01	0.0391	0.993
40	1.28	0.0162	0.413
50	1.84	0.0110	0.279
60	2.37	0.0076	0.194
75	3.28	0.0041	0.103
84	4.11	0.0023	0.058
90			
95			

Measure	Trask	Inman	Folk-Ward
Median, phi	1.84	1.84	1.84
Median, in.	0.0110	0.0110	0.0110
Median, mm	0.279	0.279	0.279
Mean, phi	0.87	1.49	1.61
Mean, in.	0.0216	0.0140	0.0129
Mean, mm	0.548	0.355	0.328
Sorting	3.101	2.619	
Skewness	1.148	-0.133	
Kurtosis			

Grain Size Description (ASTM-USCS Scale)	Medium sand (based on Mean from Trask)

Description	Retained on Sieve #	Weight Percent
Gravel	4	10.26
Coarse Sand	10	6.29
Medium Sand	40	23.01
Fine Sand	200	40.98
Silt/Clay	<200	19.46
	Total	100

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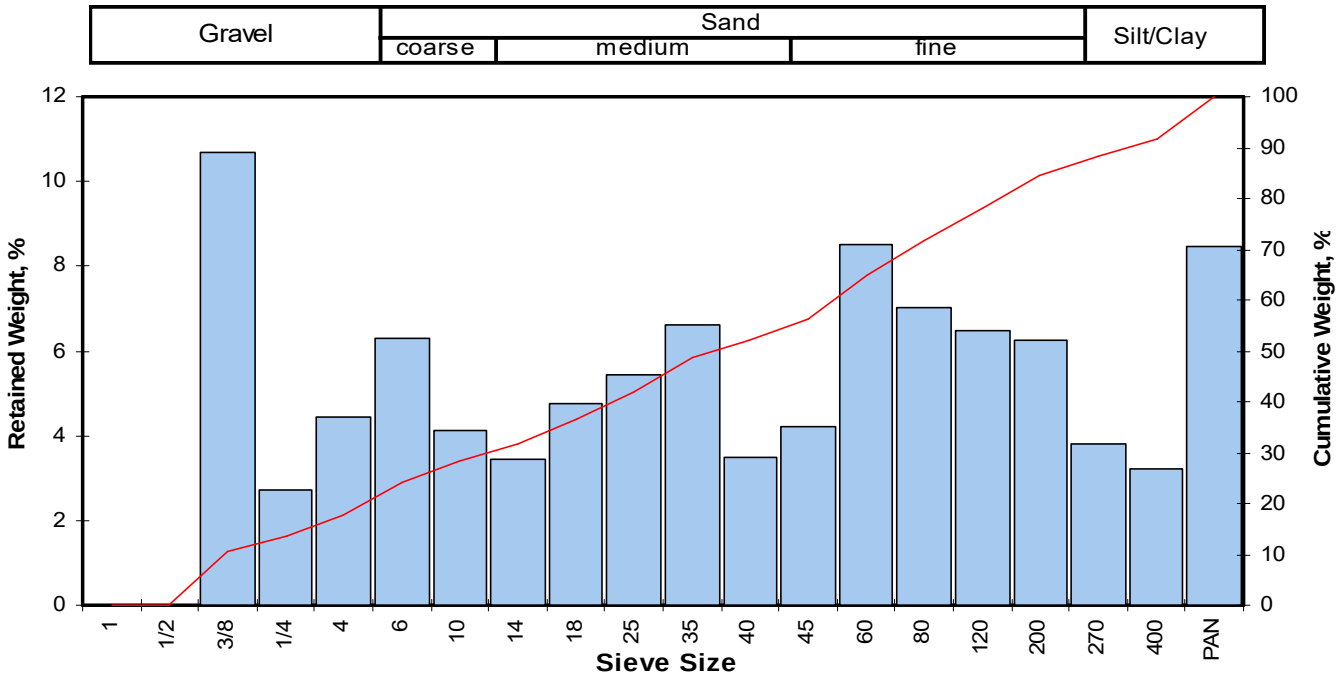
PTS Laboratories, Inc.

Particle Size Analysis - ASTM D422M

Client: ARCADIS
Project: RACER - Pontiac North Campus
Project No: B0064607.2013.0005

PTS File No: 43782
Sample ID: M2-01_39-40.5
Depth, ft: 39.1



Opening		Phi of	U.S. Sieve	Sample Weight	Incremental Weight,	Cumulative Weight,
Inches	Millimeters	Screen	No.	grams	percent	percent
0.9844	25.002	-4.64	1	0.00	0.00	0.00
0.4922	12.501	-3.64	1/2	0.00	0.00	0.00
0.3740	9.500	-3.25	3/8	3.48	10.69	10.69
0.2500	6.351	-2.67	1/4	0.89	2.74	13.43
0.1873	4.757	-2.25	4	1.45	4.46	17.89
0.1324	3.364	-1.75	6	2.05	6.30	24.19
0.0787	2.000	-1.00	10	1.34	4.12	28.30
0.0557	1.414	-0.50	14	1.12	3.44	31.75
0.0394	1.000	0.00	18	1.54	4.73	36.48
0.0278	0.707	0.50	25	1.77	5.44	41.92
0.0197	0.500	1.00	35	2.15	6.61	48.52
0.0166	0.420	1.25	40	1.14	3.50	52.03
0.0139	0.354	1.50	45	1.37	4.21	56.24
0.0098	0.250	2.00	60	2.77	8.51	64.75
0.0070	0.177	2.50	80	2.29	7.04	71.79
0.0049	0.125	3.00	120	2.11	6.48	78.27
0.0029	0.074	3.75	200	2.03	6.24	84.51
0.0021	0.053	4.25	270	1.24	3.81	88.32
0.0015	0.037	4.75	400	1.04	3.20	91.52
			PAN	2.76	8.48	100.00
TOTALS				32.54	100.00	100.00

Cumulative Weight Percent greater than			
Weight	Phi	Particle Size	
percent	Value	Inches	Millimeters
5	-3.46	0.4329	10.996
10	-3.27	0.3808	9.671
16	-2.43	0.2116	5.376
25	-1.60	0.1195	3.035
40	0.32	0.0315	0.799
50	1.11	0.0183	0.465
60	1.72	0.0119	0.303
75	2.75	0.0059	0.149
84	3.69	0.0031	0.078
90	4.51	0.0017	0.044
95			

Measure	Trask	Inman	Folk-Ward
Median, phi	1.11	1.11	1.11
Median, in.	0.0183	0.0183	0.0183
Median, mm	0.465	0.465	0.465
Mean, phi	-0.67	0.63	0.79
Mean, in.	0.0627	0.0254	0.0228
Mean, mm	1.592	0.646	0.579
Sorting	4.515	3.057	
Skewness	1.446	-0.155	
Kurtosis	0.150		

Grain Size Description (ASTM-USCS Scale)	Medium sand (based on Mean from Trask)

Description	Retained on Sieve #	Weight Percent
Gravel	4	17.89
Coarse Sand	10	10.42
Medium Sand	40	23.72
Fine Sand	200	32.48
Silt/Clay	<200	15.49
	Total	100

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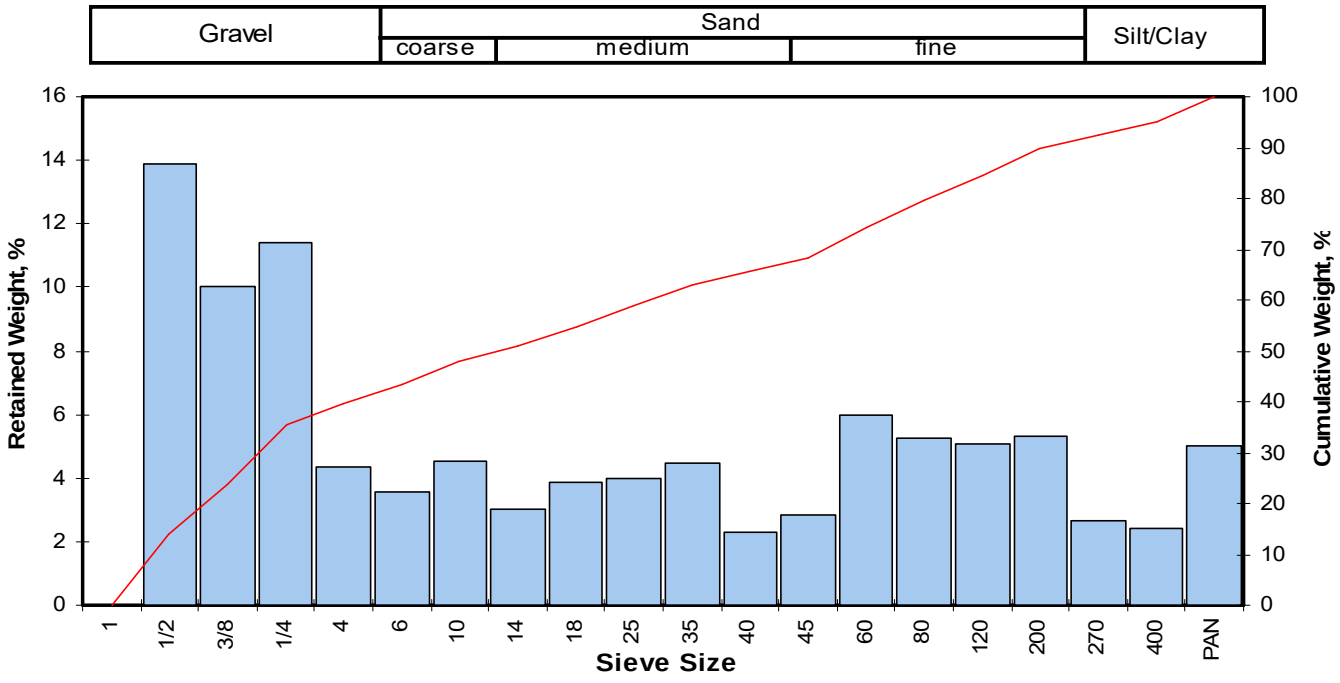
PTS Laboratories, Inc.

Particle Size Analysis - ASTM D422M

Client: ARCADIS
Project: RACER - Pontiac North Campus
Project No: B0064607.2013.0005

PTS File No: 43782
Sample ID: M2-01_39-40.5
Depth, ft: 39.3



Opening		Phi of	U.S. Sieve	Sample Weight	Incremental Weight,	Cumulative Weight,
Inches	Millimeters	Screen	No.	grams	percent	percent
0.9844	25.002	-4.64	1	0.00	0.00	0.00
0.4922	12.501	-3.64	1/2	15.74	13.90	13.90
0.3740	9.500	-3.25	3/8	11.38	10.05	23.95
0.2500	6.351	-2.67	1/4	12.90	11.39	35.34
0.1873	4.757	-2.25	4	4.95	4.37	39.72
0.1324	3.364	-1.75	6	4.04	3.57	43.28
0.0787	2.000	-1.00	10	5.16	4.56	47.84
0.0557	1.414	-0.50	14	3.45	3.05	50.89
0.0394	1.000	0.00	18	4.35	3.84	54.73
0.0278	0.707	0.50	25	4.54	4.01	58.74
0.0197	0.500	1.00	35	5.04	4.45	63.19
0.0166	0.420	1.25	40	2.60	2.30	65.49
0.0139	0.354	1.50	45	3.20	2.83	68.31
0.0098	0.250	2.00	60	6.80	6.01	74.32
0.0070	0.177	2.50	80	5.97	5.27	79.59
0.0049	0.125	3.00	120	5.74	5.07	84.66
0.0029	0.074	3.75	200	6.03	5.33	89.98
0.0021	0.053	4.25	270	2.98	2.63	92.62
0.0015	0.037	4.75	400	2.71	2.39	95.01
			PAN	5.65	4.99	100.00
TOTALS				113.23	100.00	100.00

Cumulative Weight Percent greater than			
Weight	Phi	Particle Size	
percent	Value	Inches	Millimeters
5	-4.28	0.7671	19.485
10	-3.92	0.5979	15.186
16	-3.56	0.4648	11.805
25	-3.19	0.3604	9.155
40	-2.21	0.1822	4.627
50	-0.65	0.0616	1.564
60	0.64	0.0252	0.641
75	2.06	0.0094	0.239
84	2.93	0.0051	0.131
90	3.75	0.0029	0.074
95	4.75	0.0015	0.037

Measure	Trask	Inman	Folk-Ward
Median, phi	-0.65	-0.65	-0.65
Median, in.	0.0616	0.0616	0.0616
Median, mm	1.564	1.564	1.564
Mean, phi	-2.23	-0.31	-0.42
Mean, in.	0.1849	0.0489	0.0528
Mean, mm	4.697	1.242	1.342
Sorting	6.189	3.248	2.993
Skewness	0.946	0.102	0.148
Kurtosis	0.295	0.390	0.704

Grain Size Description (ASTM-USCS Scale)	Coarse sand (based on Mean from Trask)

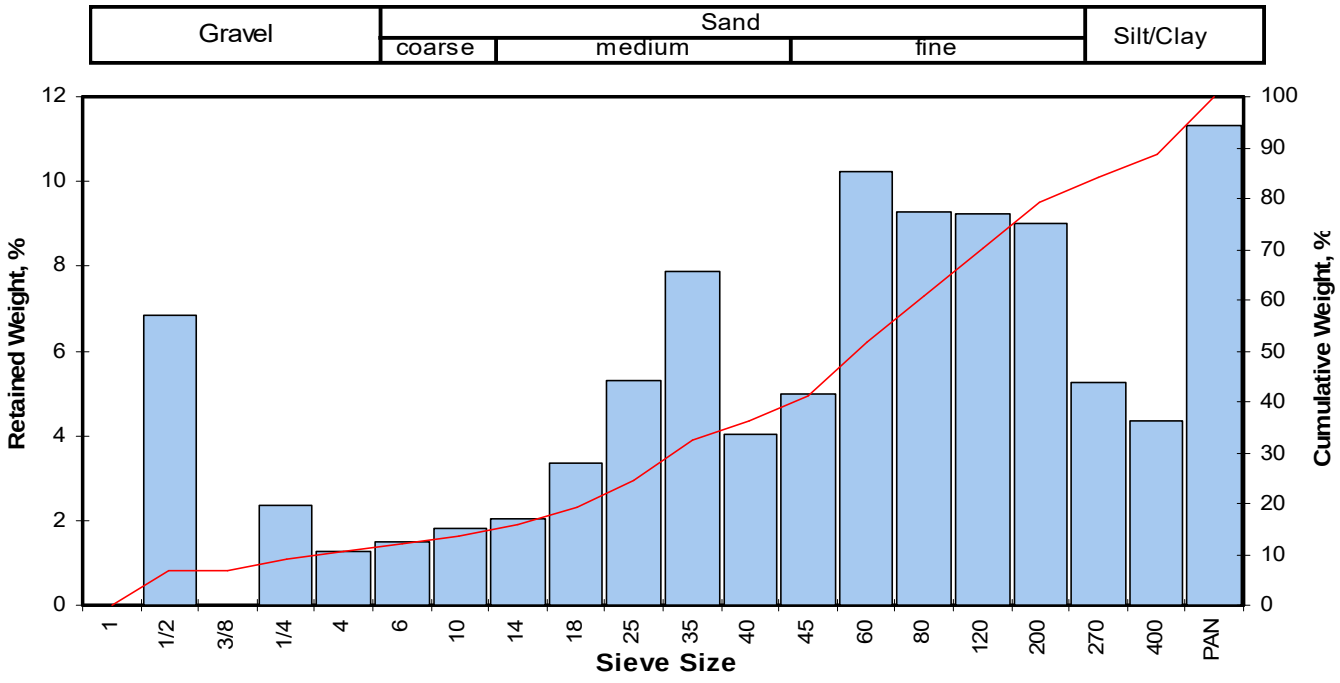
Description	Retained on Sieve #	Weight Percent
Gravel	4	39.72
Coarse Sand	10	8.13
Medium Sand	40	17.65
Fine Sand	200	24.50
Silt/Clay	<200	10.02
	Total	100

Phone: (562) 907-3607
Fax: (562) 907-3610

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D422M

Client:	ARCADIS	**PTS File No:**	43782
Project:	RACER - Pontiac North Campus	**Sample ID:**	W8-02_28-30
Project No:	B0064607.2013.0005	**Depth, ft:**	28.2



Opening		Phi of	U.S. Sieve	Sample Weight	Incremental Weight,	Cumulative Weight,
Inches	Millimeters	Screen	No.	grams	percent	percent
0.9844	25.002	-4.64	1	0.00	0.00	0.00
0.4922	12.501	-3.64	1/2	7.19	6.82	6.82
0.3740	9.500	-3.25	3/8	0.00	0.00	6.82
0.2500	6.351	-2.67	1/4	2.47	2.34	9.16
0.1873	4.757	-2.25	4	1.32	1.25	10.41
0.1324	3.364	-1.75	6	1.59	1.51	11.92
0.0787	2.000	-1.00	10	1.90	1.80	13.72
0.0557	1.414	-0.50	14	2.14	2.03	15.75
0.0394	1.000	0.00	18	3.51	3.33	19.08
0.0278	0.707	0.50	25	5.60	5.31	24.39
0.0197	0.500	1.00	35	8.31	7.88	32.27
0.0166	0.420	1.25	40	4.27	4.05	36.32
0.0139	0.354	1.50	45	5.26	4.99	41.31
0.0098	0.250	2.00	60	10.79	10.23	51.54
0.0070	0.177	2.50	80	9.80	9.29	60.83
0.0049	0.125	3.00	120	9.74	9.24	70.07
0.0029	0.074	3.75	200	9.50	9.01	79.08
0.0021	0.053	4.25	270	5.52	5.23	84.31
0.0015	0.037	4.75	400	4.59	4.35	88.67
			PAN	11.95	11.33	100.00
TOTALS				105.45	100.00	100.00

Cumulative Weight Percent greater than			
Weight	Phi	Particle Size	
percent	Value	Inches	Millimeters
5	-3.62	0.4842	12.298
10	-2.39	0.2060	5.232
16	-0.46	0.0543	1.378
25	0.54	0.0271	0.688
40	1.43	0.0146	0.370
50	1.92	0.0104	0.263
60	2.46	0.0072	0.182
75	3.41	0.0037	0.094
84	4.22	0.0021	0.054
90			
95			

Measure	Trask	Inman	Folk-Ward
Median, phi	1.92	1.92	1.92
Median, in.	0.0104	0.0104	0.0104
Median, mm	0.263	0.263	0.263
Mean, phi	1.35	1.88	1.89
Mean, in.	0.0154	0.0107	0.0106
Mean, mm	0.391	0.272	0.269
Sorting	2.705	2.341	
Skewness	0.966	-0.020	
Kurtosis			

Grain Size Description (ASTM-USCS Scale)	Fine sand (based on Mean from Trask)

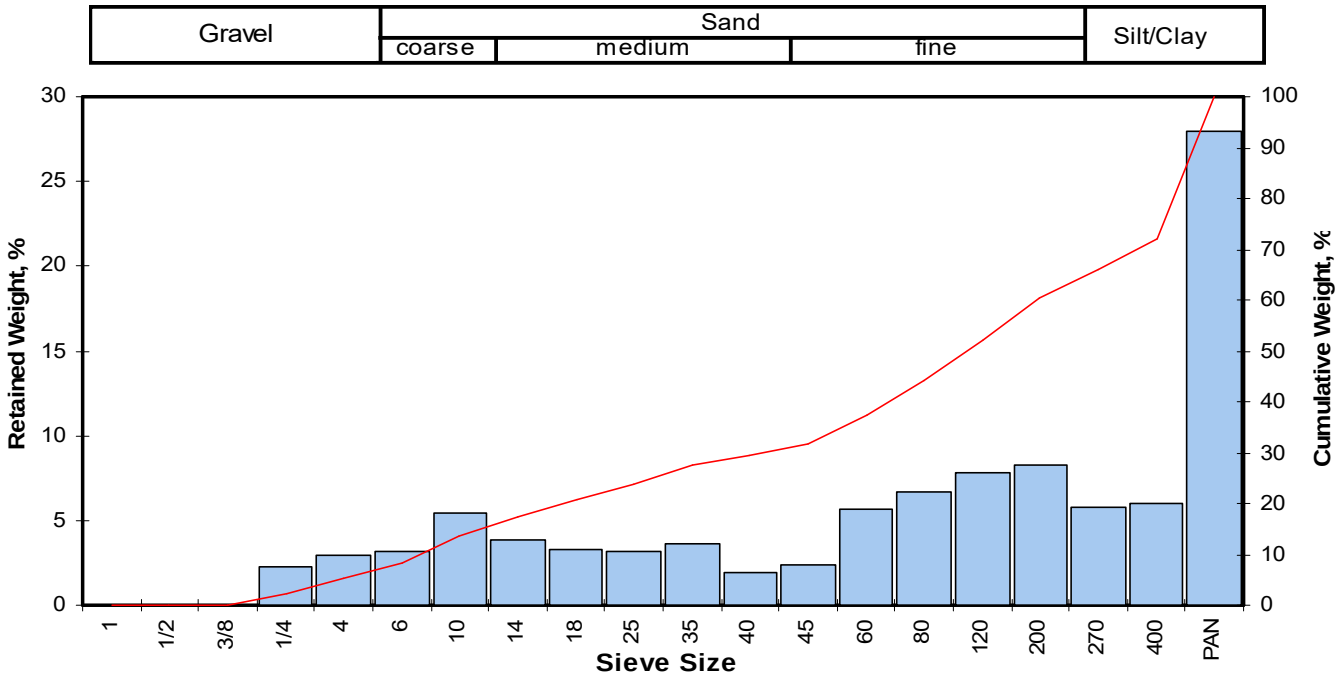
Description	Retained on Sieve #	Weight Percent
Gravel	4	10.41
Coarse Sand	10	3.31
Medium Sand	40	22.60
Fine Sand	200	42.76
Silt/Clay	<200	20.92
	Total	100

Phone: (562) 907-3607
Fax: (562) 907-3610

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D422M

Client:	ARCADIS	**PTS File No:**	43782
Project:	RACER - Pontiac North Campus	**Sample ID:**	W8-05_23.5-25.5
Project No:	B0064607.2013.0005	**Depth, ft:**	24.0



Opening		Phi of	U.S. Sieve	Sample Weight	Incremental Weight,	Cumulative Weight,
Inches	Millimeters	Screen	No.	grams	percent	percent
0.9844	25.002	-4.64	1	0.00	0.00	0.00
0.4922	12.501	-3.64	1/2	0.00	0.00	0.00
0.3740	9.500	-3.25	3/8	0.00	0.00	0.00
0.2500	6.351	-2.67	1/4	1.97	2.26	2.26
0.1873	4.757	-2.25	4	2.53	2.90	5.15
0.1324	3.364	-1.75	6	2.72	3.11	8.26
0.0787	2.000	-1.00	10	4.75	5.44	13.70
0.0557	1.414	-0.50	14	3.32	3.80	17.50
0.0394	1.000	0.00	18	2.89	3.31	20.81
0.0278	0.707	0.50	25	2.72	3.11	23.92
0.0197	0.500	1.00	35	3.19	3.65	27.58
0.0166	0.420	1.25	40	1.67	1.91	29.49
0.0139	0.354	1.50	45	2.07	2.37	31.86
0.0098	0.250	2.00	60	4.96	5.68	37.53
0.0070	0.177	2.50	80	5.82	6.66	44.20
0.0049	0.125	3.00	120	6.78	7.76	51.96
0.0029	0.074	3.75	200	7.24	8.29	60.24
0.0021	0.053	4.25	270	5.02	5.75	65.99
0.0015	0.037	4.75	400	5.26	6.02	72.01
			PAN	24.45	27.99	100.00
TOTALS				87.36	100.00	100.00

Cumulative Weight Percent greater than			
Weight	Phi	Particle Size	
percent	Value	Inches	Millimeters
5	-2.27	0.1901	4.829
10	-1.51	0.1122	2.849
16	-0.70	0.0639	1.622
25	0.65	0.0251	0.638
40	2.19	0.0087	0.220
50	2.87	0.0054	0.136
60	3.73	0.0030	0.075
75			
84			
90			
95			

Measure	Trask	Inman	Folk-Ward
Median, phi	2.87	2.87	2.87
Median, in.	0.0054	0.0054	0.0054
Median, mm	0.136	0.136	0.136
Mean, phi			
Mean, in.			
Mean, mm			
Sorting			
Skewness			
Kurtosis			

Grain Size Description (ASTM-USCS Scale)	Fine sand (based on Mean from Trask)

Description	Retained on Sieve #	Weight Percent
Gravel	4	5.15
Coarse Sand	10	8.55
Medium Sand	40	15.79
Fine Sand	200	30.76
Silt/Clay	<200	39.76
	Total	100

Phone: (562) 907-3607
Fax: (562) 907-3610

ARCADIS
Infrastructure · Water · Environment · Buildings

ID#:

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

43782

Page 1 of ___

Lab Work Order #

Send Results to:

Contact & Company Name: Jonathon Smith, Christi Kiker ARCADIS	Telephone: 248.994.2314
Address: 28550 Cabot Drive Ste 500	Fax: 248.994.2241
City: Novi State: MI Zip: 48377	E-mail Address: Jonathon.smith@arcadis-us.com christi.kiker@arcadis-us.com
Project Name/Location (City, State): RALER PNC/Pontiac MI	Project #: B0064607.2013.0005
Sampler's Printed Name: Christine Snyder	Sampler's Signature: Christine Snyder

Preservative	F							
Filtered (✓)								
# of Containers	1							
Container Information	9 or 10							

PARAMETER ANALYSIS & METHOD

Keys

Preservation Key:
A. H_2SO_4
B. HCL
C. HNO_3
D. NaOH
E. None
F. Other: Flash freeze
G. Other: _____
H. Other: _____

Container Information Key:
1. 40 ml Vial
2. 1 L Amber
3. 250 ml Plastic
4. 500 ml Plastic
5. Encore
6. 2 oz. Glass
7. 4 oz. Glass
8. 8 oz. Glass
9. Other: Shelby tube
10. Other: Acetate liner

Matrix Key:
SO - Soil
SE - Sediment
NL - NAPL/Oil
W - Water
SL - Sludge
SW - Sample Wipe
T - Tissue
A - Air
Other: _____

Sample ID	Collection Date	Collection Time	Type (✓) Comp	Type (✓) Grab	Matrix	Petrophysical / lab analysis	REMARKS
✓ M2-42_13-15	11-18-13	1030		X	SO	X	
✓ M2-05_18-20	11-18-13	1135		X	SO	X	
✓ M2-01_39-40.5	11-19-13	1130		X	SO	X	

Special Instructions/Comments:
* Cores submitted for digital photography (white & UV light). Hold cores for future analysis to be specified by ARCADIS

☐ Special QA/QC Instructions(✓):

Laboratory Information and Receipt		Relinquished By	Received By	Relinquished By	Laboratory Received By
Lab Name: PTS	Cooler Custody Seal (✓) ☐ Intact ☐ Not Intact	Printed Name: Christine Snyder	Printed Name: Robert Rojo	Printed Name:	Printed Name:
☐ Cooler packed with ice (✓)		Signature: Christine Snyder	Signature:	Signature:	Signature:
Specify Turnaround Requirements: Normal	Sample Receipt:	Firm: ARCADIS	Firm/Courier: PTS LABS	Firm/Courier:	Firm:
Shipping Tracking #:	Condition/Cooler Temp: -15 °F	Date/Time: 11-20-13/1800	Date/Time: 11/21/13 1120	Date/Time:	Date/Time:

ARCADIS
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ID#:

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

43782

Page 1 of 1

Lab Work Order #

Send Results to:

Contact & Company Name: Jonathon Smith, Christi Kiker ARCADIS	Telephone: 248.994.2314
Address: 28550 Cabot Dr Ste 500	Fax: 248.994.2241
City: Novi State: MI Zip: 48377	E-mail Address: jonathon.smith@arcadis-us.com christi.kiker@arcadis-us.com
Project Name/Location (City, State): RALEX BNC/Pontiac MI	Project #: B001646O7.2013.0005
Sampler's Printed Name: Christine Snyder	Sampler's Signature: Christine Snyder

Sample ID	Collection Date	Collection Time	Type (✓) Comp	Type (✓) Grab	Matrix	Preservative	Filtered (✓)	# of Containers	Container Information	Petrophysical/Laboratory Analysis	REMARKS
WB-02_12-14	11-19-13	1615		X	SO	F		1	9	X	
WB-02_28-30	11-19-13	1645		X	SO					X	
WB-05_23.5-25.5	11-20-13	1315		X	SO					X	

PARAMETER ANALYSIS & METHOD

Keys

Preservation Key:
A. H_2SO_4
B. HCL
C. HNO_3
D. NaOH
E. None
F. Other: Flash Freeze
G. Other:
H. Other:

Container Information Key:
1. 40 ml Vial
2. 1 L Amber
3. 250 ml Plastic
4. 500 ml Plastic
5. Encore
6. 2 oz. Glass
7. 4 oz. Glass
8. 8 oz. Glass
9. Other: Shelby tube
10. Other:

Matrix Key:
SO - Soil
W - Water
T - Tissue
SE - Sediment
SL - Sludge
A - Air
NL - NAPL/Oil
SW - Sample Wipe
Other:

Special Instructions/Comments:
*cores submitted for digital photography (white & UV light). Hold cores for future analysis to be specified by ARCADIS

☐ Special QA/QC Instructions(✓):

Laboratory Information and Receipt		Relinquished By	Received By	Relinquished By	Laboratory Received By
Lab Name: PTS	Cooler Custody Seal (✓) ☐ Intact ☐ Not Intact	Printed Name: Christine Snyder	Printed Name:	Printed Name:	Printed Name:
☒ Cooler packed with ice (✓) DRY ICE		Signature: Christine Snyder	Signature: Robert Rojo	Signature:	Signature:
Specify Turnaround Requirements: Normal	Sample Receipt:	Firm: ARCADIS	Firm/Courier: PTS LABS	Firm/Courier:	Firm:
Shipping Tracking #:	Condition/Cooler Temp: -15 °C	Date/Time: 11-2013 1800	Date/Time: 11/21/13 11:20	Date/Time:	Date/Time:

Attachment 5

Soil Core Photographs

39.0 40.0

Each Interval Equals One Tenth of a Foot

Project: RACER - Pontiac North Campus
Project No.: B0064607.2013.0005 Boring ID: M2-01

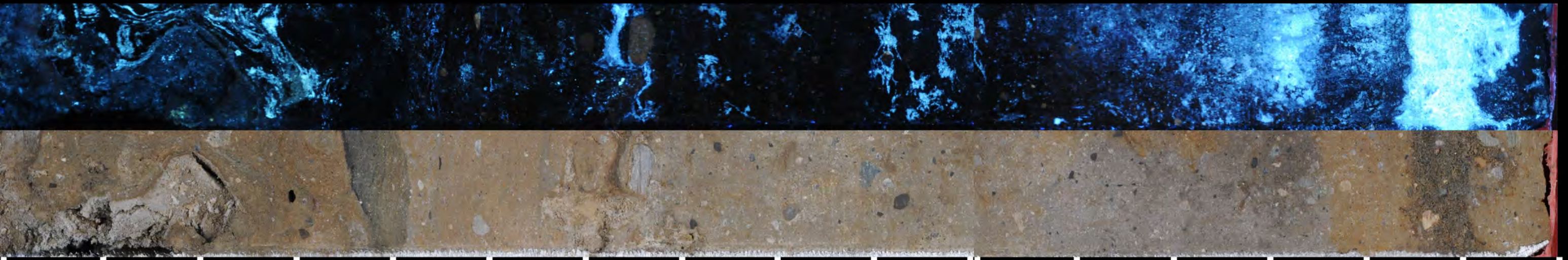
PTS Laboratories
PTS File No.: 43782

40.0 41.0

Each Interval Equals One Tenth of a Foot

Project: RACER - Pontiac North Campus
Project No.: B0064607.2013.0005 Boring ID: M2-01

PTS Laboratories
PTS File No.: 43782



18.0 19.0

Each Interval Equals One Tenth of a Foot

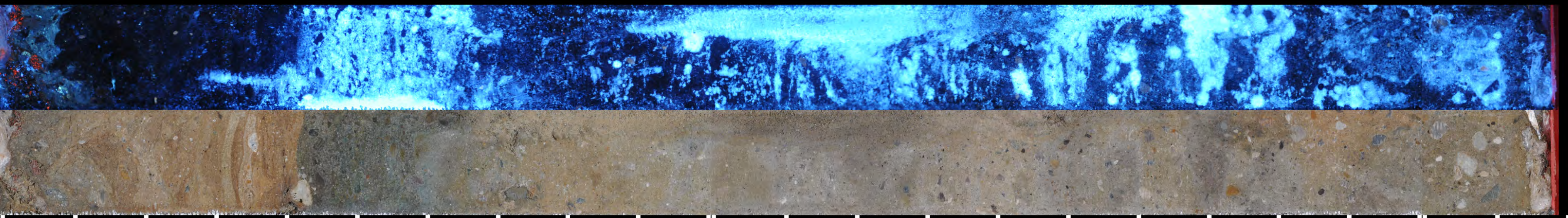
Project: RACER - Pontiac North Campus
Project No.: B0064607.2013.0005 Boring ID: M2-05

19.0 20.0

Each Interval Equals One Tenth of a Foot

Project: RACER - Pontiac North Campus
Project No.: B0064607.2013.0005 Boring ID: M2-05

PTS Laboratories
PTS File No.: 43762



6.0 7.0

Each Interval Equals One Tenth of a Foot

Project: RACER - Pontiac North Campus
Project No.: B0064607.2013.0005 Boring ID: M2-16_6-9

PTS Laboratories
PTS File No.: 43762

7.0 8.0

Each Interval Equals One Tenth of a Foot

Project: RACER - Pontiac North Campus
Project No.: B0064607.2013.0005 Boring ID: M2-16_6-9

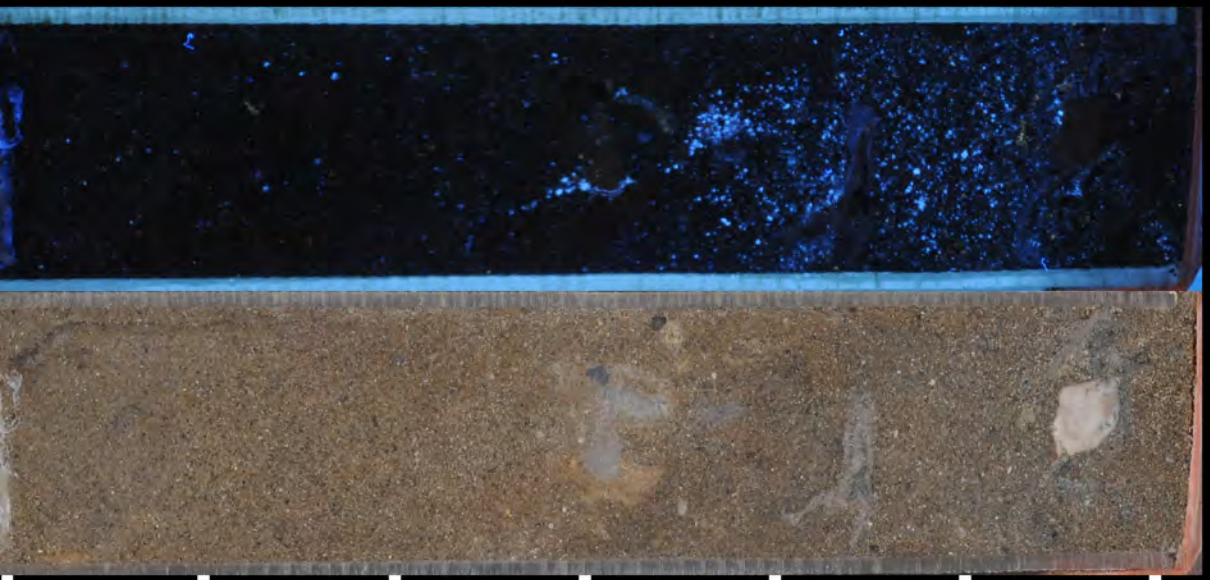
PTS Laboratories
PTS File No.: 43762

8.0 9.0

Each Interval Equals One Tenth of a Foot

Project: RACER - Pontiac North Campus
Project No.: B0064607.2013.0005 Boring ID: M2-16_6-9

PTS Laboratories
PTS File No.: 43762

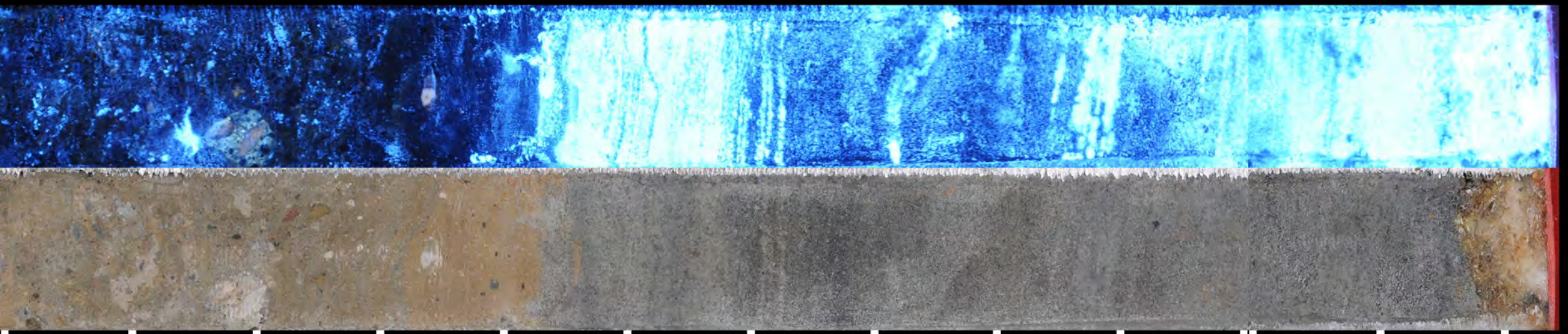


17.0

Each Interval Equals One Tenth of a Foot

18.0

Project: RACER - Pontiac North Campus
Project No.: B0064607.2013.0005 Boring ID: M2-21_17-19



13.0 14.0

Each Interval Equals One Tenth of a Foot

Project: RACER - Pontiac North Campus
Project No.: B0064607.2013.0005 Boring ID: M2-42

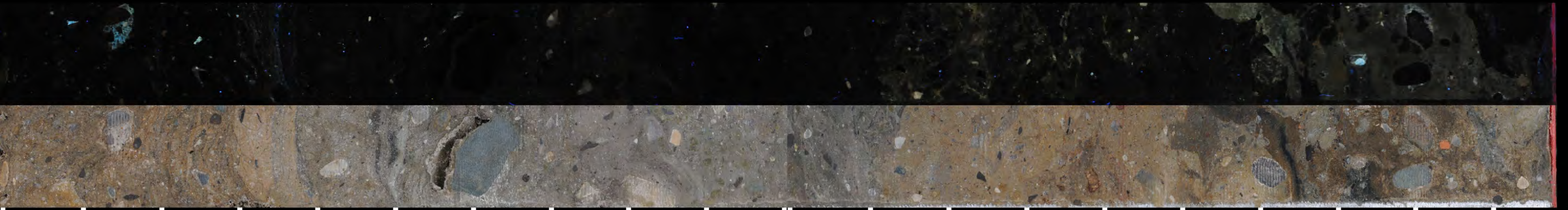
PTS Laboratories
PTS File No.: 43782

14.0 15.0

Each Interval Equals One Tenth of a Foot

Project: RACER - Pontiac North Campus
Project No.: B0064607.2013.0005 Boring ID: M2-42

PTS Laboratories
PTS File No.: 43782



Each Interval Equals One Tenth of a Foot

Project: RACER - Pontiac North Campus
Project No.: B0064607.2013.0005 Boring ID: W8-02

Each Interval Equals One Tenth of a Foot

Project: RACER - Pontiac North Campus
Project No.: B0064607.2013.0005 Boring ID: W8-02

PTS Laboratories
PTS File No.: 43782

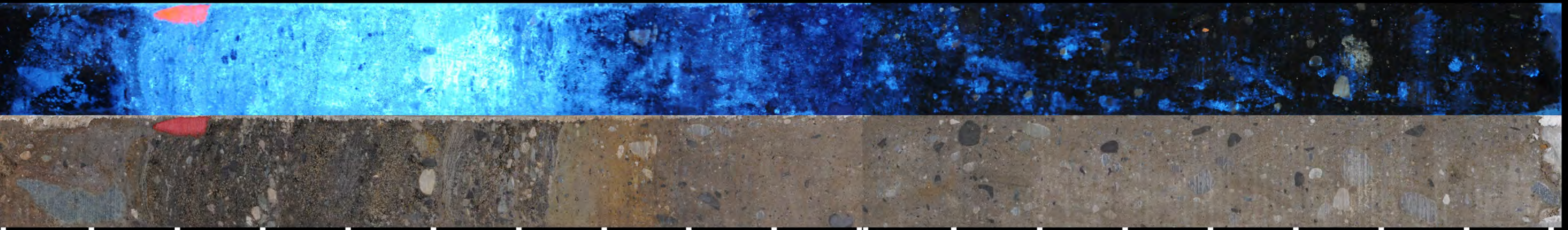
28.0

Each Interval Equals One Tenth of a Foot

29.0

Project: RACER - Pontiac North Campus
Project No.: B0064607.2013.0005 Boring ID: W8-02

PTS Laboratories
PTS File No.: 43782



Project: RACER - Pontiac North Campus
Project No.: B0064607.2013.0005 Boring ID: W8-05

24.5
25.5
Each Interval Equals One Tenth of a Foot
Project: RACER - Pontiac North Campus
Project No.: B0064607.2013.0005 Boring ID: W8-05

Attachment 6

Soil Boring Logs

Date Start: 8/27/13
Date Finish: 8/27/13
Drilling Company: Stern's Drilling
Driller's Name: B.Marshall
Drilling Method: HA to 5.0' bgs/Continuous
Sampling Method: 2" Split Spoon
Rig Type: Geoprobe
Water Level Start (ft. bgs.):
Water Level Finish (ft. btoc.):

Northing: 425169.48
Easting: 13412841.54
Casing Elevation: 967.23

Borehole Depth (ft. bgs.): 27.0' bgs.
Surface Elevation: 968.08

Descriptions By: D.Shaw

Well/Boring ID: **TWM2-01**

Client: RACER

Location: RACER PNC

Weather Conditions: Rain, 75 F

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
0 / 0									
	1	0.0-5.0	5.0	1.0 1.0 1.7 1.3			(0.0'-1.2') CONCRETE. (1.2'-7.7') SAND, very fine to fine; some silt; some clay; little granules to small pebbles, round; poorly sorted; dry; dark gray (2.5Y 4/1). NOTE: Wet at 3.0' bgs.		J-Plug Portland cement grout (0.0'-1.0' bgs) Bentonite chip (1.0'-2.0' bgs) 2" sch 40 pvc (0.5'-2.5' bgs)
5 / -5	2	5.0-7.0	0.75	0.8			NOTE: At 5.0' bgs, color change to black (10YR 2/1).		
	3	7.0-9.0	2.0	4.2 1.0			(7.7'-10.0') CLAY, some silt, medium to high plasticity; no dilatancy; medium stiff; dark gray (2.5Y 4/1).		2' stainless steel 10 slot (2.5'-12.5' bgs) Filter pack (2.0'-15.0' bgs)
10 / -10	4	9.0-11.0	1.6	3.2 0.8			(10.0'-19.9') CLAY, little to some silt; medium to high plasticity, no dilatancy; trace granules, round; dry; very stiff; brown (10YR 5/3).		
	5	11.0-13.0	2.0	0.0 0.0					
	6	13.0-15.0	1.8	0.0 0.0					Filter pack (12.5'-15.0' bgs)
15 / -15				0.0					

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Remarks: bgs = below ground surface
Groundwater encountered at 3.0' bgs.
No odor or staining observed.

Date Start: 8/27/13 **Date Finish:** 8/27/13 **Drilling Company:** Stern's Drilling **Driller's Name:** B.Marshall **Drilling Method:** HA to 5.0' bgs/Continuous **Sampling Method:** 2" Split Spoon **Rig Type:** Geoprobe **Water Level Start (ft. bgs.):** **Water Level Finish (ft. btoc.):**	**Northing:** 425169.48 **Easting:** 13412841.54 **Casing Elevation:** 967.23 **Borehole Depth (ft. bgs.):** 27.0' bgs. **Surface Elevation:** 968.08 **Descriptions By:** D.Shaw	**Well/Boring ID: TWM2-01** **Client:** RACER **Location:** RACER PNC **Weather Conditions:** Rain, 75 F

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
	7	15.0-17.0	2.0	0.0					
	8	17.0-19.0	2.0	0.0 0.0					
20 -20	9	19.0-21.0	2.0	0.0 0.0			(19.9'-27.0') CLAY, medium to low plasticity, no dilatancy, trace silt; trace small pebbles, round; trace fine sand; dry; stiff; dark gray (2.5Y 4/1).		
	10	21.0-23.0	2.0	0.0 0.0					
	11	23.0-25.0	2.0	0.0 0.0					
25 -25	12	25.0-27.0	1.6	0.0 0.0					
							End of boring at 27.0' bgs.		

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Remarks: bgs = below ground surface
Groundwater encountered at 3.0' bgs.
No odor or staining observed.

Date Start: 8/28/13
Date Finish: 8/28/13
Drilling Company: Stern's Drilling
Driller's Name: B.Marshall
Drilling Method: HA to 5.0' bgs/Continuous
Sampling Method: 2" Split Spoon
Rig Type: Geoprobe
Water Level Start (ft. bgs.):
Water Level Finish (ft. btoc.):

Northing: 425177.17
Easting: 13412846.33
Casing Elevation: 967.52

Borehole Depth (ft. bgs.): 27.0' bgs.
Surface Elevation: 968.06

Descriptions By: D.Shaw

Well/Boring ID: **TWM2-02**

Client: RACER

Location: RACER PNC

Weather Conditions: Cloudy/Rain, 75 F

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
0 / 0									J-Plug
				1.0					
5 / -5	1	5.0-7.0	1.3	1.0			(6.0'-10.5') CLAY, some silt, medium plasticity; no dilatancy; little fine sand; medium stiff; dark gray (2.5Y 4/1).		Portland cement grout (0.0'-12.0' bgs)
	2	7.0-9.0	1.8	1.5 3.3					2" sch 40 pvc (0.5'-15.0' bgs)
10 / -10	3	9.0-11.0	1.8	2.5 1.1			(10.5'-14.3') CLAY, little to some silt; medium plasticity; no dilatancy; trace granules to medium pebbles, round; dry; very stiff; brown (10YR 5/3).		
	4	11.0-13.0	2.0	0.5 0.5					Bentonite chip (12.0'-13.0' bgs)

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Remarks: bgs = below ground surface
Groundwater encountered on outside of core from 21.0'-24.0' bgs.
Odor detected from 14.3'-15.0, 17.0'-19.0' and 21.0'-24.0' bgs.
Slight sheen on outside of core from 21.0'-24.0' bgs.
No staining observed.
Shake test at 17-18': slightly positive.
Shake test at 18-19': negative.

Date Start: 8/28/13 **Date Finish:** 8/28/13 **Drilling Company:** Stern's Drilling **Driller's Name:** B.Marshall **Drilling Method:** HA to 5.0' bgs/Continuous **Sampling Method:** 2" Split Spoon **Rig Type:** Geoprobe **Water Level Start (ft. bgs.):** **Water Level Finish (ft. btoc.):**	**Northing:** 425177.17 **Easting:** 13412846.33 **Casing Elevation:** 967.52 **Borehole Depth (ft. bgs.):** 27.0' bgs. **Surface Elevation:** 968.06 **Descriptions By:** D.Shaw	**Well/Boring ID: TWM2-02** **Client:** RACER **Location:** RACER PNC **Weather Conditions:** Cloudy/Rain, 75 F

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
15 -15	5	13.0-15.0	2.0	0.5 1.1			(14.3'-15.0') SAND, very fine; trace granules to small pebbles, round; trace silt; trace fine sand; well sorted; moist; dark gray (2.5 4/1). NOTE: Slight odor.		
	6	15.0-17.0	2.0	0.8 0.8			(15.0'-18.0') CLAY, little to some silt; medium plasticity; no dilatancy; trace granules to medium pebbles, round; dry; very stiff; brown (10YR 5/3).		
	7	17.0-19.0	2.0	1.8 0.8			NOTE: From 17.0'-18.0' bgs, color change to dark gray (2.5Y 4/1); slight odor; little fine sand. (18.0'-27.0') CLAY, medium to high plasticity, no dilatancy; trace silt, trace small pebbles, round; trace fine sand, moist, stiff; dark gray (10YR 2.5Y 4/1).		
20 -20	8	19.0-21.0	2.0	0.0 0.0					2' stainless steel 10 slot (15.0'-25.0' bgs) Filter pack (13.0'-27.0' bgs)
	9	21.0-23.0	2.0	0.5 0.5			NOTE: From 21.0'-24.0' bgs, there is water on the outside of the core with a slight sheen, slight odor.		
	10	23.0-25.0	2.0	0.5 0.5					
25 -25	11	25.0-27.0	2.0	0.0 0.0					Filter pack (25.0'-27.0' bgs)
							End of boring at 27.0' bgs.		

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Remarks: bgs = below ground surface
Groundwater encountered on outside of core from 21.0'-24.0' bgs.
Odor detected from 14.3'-15.0, 17.0'-19.0' and 21.0'-24.0' bgs.
Slight sheen on outside of core from 21.0'-24.0' bgs.
No staining observed.
Shake test at 17-18': slightly positive.
Shake test at 18-19': negative.

Date Start: 11/12/13
Date Finish: 11/12/13
Drilling Company: Sterns
Driller's Name: B.Marshall
Drilling Method: Direct Push
Sampling Method: HA to 4.5'/Sonic
Rig Type: Geoprobe
Water Level Start (ft. bgs.):
Water Level Finish (ft. btoc.):

Northing: 425268.66
Easting: 13412836.68
Casing Elevation: 967.76

Borehole Depth (ft. bgs.): 44.0' bgs.
Surface Elevation: 968.08

Descriptions By: C.Snyder

Well/Boring ID: **TWM2-03**

Client: RACER

Location: RACER PNC

Weather Conditions: Partly Cloudy, 32 F

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
0 / 0									
	1	0.0-4.5	4.5	NA			(0.0'-1.0') CONCRETE.		J-Plug
				NA			(1.0'-5.5') SAND, fine to medium; well sorted; moist; yellowish brown (10YR 5/4); FILL. NOTE: Concrete fragments from 1.0'-2.0' bgs.		
				1.5					
				3.5					
5 / -5	2	4.5-8.0	3.6	0.3			NOTE: Collapsing sands at 4.5' bgs.		
				0.2			(5.5'-6.0') PEBBLES, medium to very large, subround; wet; black (10YR 2/1). NOTE: Slight odor.		
				1.5			(6.0'-6.5') CONCRETE.		
				0.3			(6.5'-18.0') CLAY, little silt, low plasticity, no dilatancy; trace granules to small pebbles, subround to subangular; moist; stiff; dark grayish brown (10YR 4/2). NOTE: Till.		
10 / -10	3	8.0-18.0	10.0	1.2					
				0.5					
				1.5					
				0.5					
				0.3					

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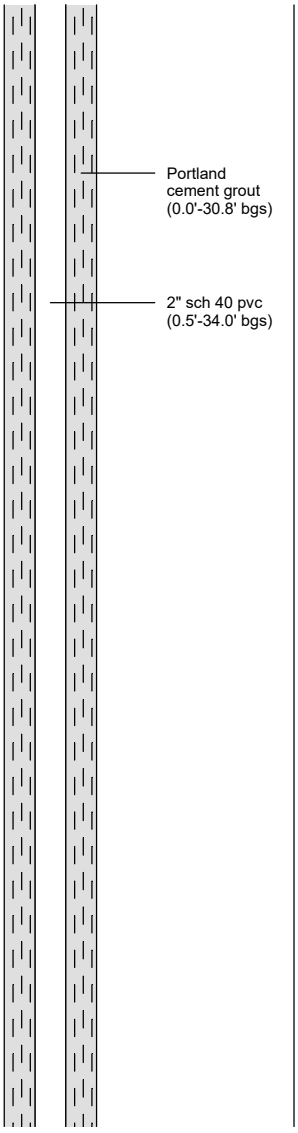
Remarks: bgs = below ground surface
Groundwater encountered from 5.5'-6.0' and at 41.5' bgs.
Slight odor detected from 5.5'-6.0' bgs.
No staining observed.
Shake test at 41.5': negative.

Date Start: 11/12/13 **Date Finish:** 11/12/13 **Drilling Company:** Sterns **Driller's Name:** B.Marshall **Drilling Method:** Direct Push **Sampling Method:** HA to 4.5'/Sonic **Rig Type:** Geoprobe **Water Level Start (ft. bgs.):** **Water Level Finish (ft. btoc.):**	**Northing:** 425268.66 **Easting:** 13412836.68 **Casing Elevation:** 967.76 **Borehole Depth (ft. bgs.):** 44.0' bgs. **Surface Elevation:** 968.08 **Descriptions By:** C.Snyder	**Well/Boring ID:** **TWM2-03** **Client:** RACER **Location:** RACER PNC **Weather Conditions:** Partly Cloudy, 32 F

DEPTH (feet bgs.)	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
					0.2					
					0.0					
15	-15				0.0			NOTE: Color change to gray (10YR 5/1) at 15.0' bgs.		
					0.0					
					0.0					
		4	18.0-28.0	10.0	0.3			(18.0'-28.0') CLAY, high plasticity; little silt; trace small to medium pebbles, subround to subangular; moist; soft; gray (10YR 5/1).		
					0.2					
20	-20				0.0					
					0.0					
					0.0					
					0.0					
					0.0					
25	-25				0.0					
					0.0					
					0.0					
					0.0					
					0.0			(28.0'-38.0') CLAY, medium plasticity; trace very fine to fine sand; trace small to medium pebbles, subround to subangular; moist; medium stiff; gray (10YR 5/1).		



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Remarks: bgs = below ground surface
Groundwater encountered from 5.5'-6.0' and at 41.5' bgs.
Slight odor detected from 5.5'-6.0' bgs.
No staining observed.
Shake test at 41.5': negative.

Date Start: 11/12/13 **Date Finish:** 11/12/13 **Drilling Company:** Sterns **Driller's Name:** B.Marshall **Drilling Method:** Direct Push **Sampling Method:** HA to 4.5'/Sonic **Rig Type:** Geoprobe **Water Level Start (ft. bgs.):** **Water Level Finish (ft. btoc.):**	**Northing:** 425268.66 **Easting:** 13412836.68 **Casing Elevation:** 967.76 **Borehole Depth (ft. bgs.):** 44.0' bgs. **Surface Elevation:** 968.08 **Descriptions By:** C.Snyder	**Well/Boring ID: TWM2-03** **Client:** RACER **Location:** RACER PNC **Weather Conditions:** Partly Cloudy, 32 F

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
30 -30	5	28.0-38.0	10.0	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0					Bentonite chip (30.8'-33.0' bgs)
35 -35									
40 -40	6	38.0-44.0	6.0	0.0 0.0 0.0 0.0 0.0 0.0			(38.0'-44.0') CLAY, little silt, low plasticity, no dilatancy; trace very fine sand; little small to large pebbles, subround; moist; stiff; gray (10YR 5/1). NOTE: 0.3' sand layer at 41.5' bgs; fine to medium sand; wet; gray (10YR 5/1).		Filter pack (33.0'-44.0' bgs) 2' stainless steel 10 slot (34.0'-44.0' bgs)
45 -45							End of boring at 44.0' bgs.		

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Remarks: bgs = below ground surface
Groundwater encountered from 5.5'-6.0' and at 41.5' bgs.
Slight odor detected from 5.5'-6.0' bgs.
No staining observed.
Shake test at 41.5': negative.

Date Start: 11/13/13 **Date Finish:** 11/13/13 **Drilling Company:** Sterns **Driller's Name:** B.Marshall **Drilling Method:** Direct Push **Sampling Method:** HA to 5.0'/Sonic **Rig Type:** Geoprobe **Water Level Start (ft. bgs.):** **Water Level Finish (ft. btoc.):**	**Northing:** 425067.16 **Easting:** 13412990.00 **Casing Elevation:** 967.64 **Borehole Depth (ft. bgs.):** 13.0' bgs. **Surface Elevation:** 968.13 **Descriptions By:** C.Snyder	**Well/Boring ID: TWM2-04** **Client:** RACER **Location:** RACER PNC **Weather Conditions:** Sunny, 35 F

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
0 / 0				NA			(0.0'-1.0') CONCRETE.		J-Plug; Portland cement grout (0.0'-1.0' bgs)
	1	0.0-5.0	5.0	0.7 1.4			(1.0'-4.0') SAND, very fine to fine; trace silt; trace granules to small pebbles, subround to subangular; poorly sorted; moist; yellowish brown (10YR 5/9). NOTE: Red brick; color change to olive brown (2.5Y 4/3) at 2.0' bgs.		Bentonite chip (1.0'-2.0' bgs); 2" sch 40 pvc (0.5'-3.0' bgs)
				0.7			(4.0'-6.0') CLAY, low plasticity; trace silt; trace fine sand; trace granules to medium pebbles, subround to subangular; moist; medium stiff; dark grayish brown (2.5Y 4/2). NOTE: Slight odor.		
5 / -5	2	5.0-8.0	3.0	0.0 0.5 0.6			(6.0'-8.5') CLAY, low plasticity; some very fine to fine sand; trace small to large pebbles, subround to subangular; wet; soft; dark gray (2.5Y 4/1). NOTE: Moderate odor.		Filter pack (2.0'-13.0' bgs); 2' stainless steel 10 slot (3.0'-13.0' bgs)
				0.0			(8.5'-13.0') CLAY, medium plasticity; little silt; trace fine sand; trace granules to small pebbles, subround to subangular; moist; medium stiff; gray (10YR 5/1).		
10 / -10	3	8.0-13.0	5.0	0.0 0.0 0.0 0.0					
							End of boring at 13.0' bgs.		

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Remarks: bgs = below ground surface
Groundwater encountered from 6.0'-8.5' bgs.
Slight odor detected from 4.0'-6.0' bgs.
Moderate odor detected from 6.0'-8.5' bgs.
No staining observed.
Shake test at 7': positive.

Date Start: 11/13/13 **Date Finish:** 11/13/13 **Drilling Company:** Sterns **Driller's Name:** B.Marshall **Drilling Method:** Direct Push **Sampling Method:** HA to 5.0'/Sonic **Rig Type:** Geoprobe **Water Level Start (ft. bgs.):** **Water Level Finish (ft. btoc.):**	**Northing:** 424980.21 **Easting:** 13412862.58 **Casing Elevation:** 967.69 **Borehole Depth (ft. bgs.):** 20.0' bgs. **Surface Elevation:** 968.03 **Descriptions By:** C.Snyder	**Well/Boring ID: TWM2-05** **Client:** RACER **Location:** RACER PNC **Weather Conditions:** Sunny, 33 F

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
0 / 0				NA			(0.0'-1.0') CONCRETE.		J-Plug
				4.5			(1.0'-2.0') SAND, fine; little silt; well sorted; dry; grayish brown (10YR 5/6). NOTE: Strong odor.		
	1	0.0-5.0	5.0	0.4			(2.0'-4.0') CLAY, little silt, non-plastic; trace fine to medium sand; dry; very stiff; olive brown (2.5Y 4/3). NOTE: Slight odor.		Portland cement grout (0.0'-7.0' bgs)
				0.5					
				0.8			(4.0'-11.0') CLAY, medium plasticity; some very fine to fine sand; trace small to medium pebbles, subround to subangular; moist; soft; dark grayish brown (2.5Y 4/2).		
5 / -5				0.3					2" sch 40 pvc (0.5'-10.0' bgs)
	2	5.0-10.0	3.1	0.2					
				0.1					
				0.0					Bentonite chip (7.0'-9.0' bgs)
				0.0					
10 / -10				0.0					
				0.0			(11.0'-16.0') CLAY, low plasticity; little silt; moist; stiff; light olive brown (2.5Y 5/4).		
	3	10.0-20.0	8.0	0.1					

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Remarks: bgs = below ground surface
Groundwater encountered from 16.0'-18.0' bgs.
Slight odor detected from 2.0'-4.0' bgs.
Strong odor detected from 1.0'-2.0' and 16.0'-18.0' bgs.
No staining observed.
Shake test at 16-17': slightly positive.

Date Start: 11/13/13 **Date Finish:** 11/13/13 **Drilling Company:** Sterns **Driller's Name:** B.Marshall **Drilling Method:** Direct Push **Sampling Method:** HA to 5.0'/Sonic **Rig Type:** Geoprobe **Water Level Start (ft. bgs.):** **Water Level Finish (ft. btoc.):**	**Northing:** 424980.21 **Easting:** 13412862.58 **Casing Elevation:** 967.69 **Borehole Depth (ft. bgs.):** 20.0' bgs. **Surface Elevation:** 968.03 **Descriptions By:** C.Snyder	**Well/Boring ID: TWM2-05** **Client:** RACER **Location:** RACER PNC **Weather Conditions:** Sunny, 33 F

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
15 -15				0.2 0.2 0.5 0.8 0.5 0.3 0.0			(16.0'-18.0') SAND, very fine to fine; trace small to medium pebbles, subround; trace silt; poorly sorted; wet; gray (10YR 5/1). NOTE: Strong odor. (18.0'-20.0') CLAY, medium plasticity; little silt; moist; stiff; gray (10YR 5/1).		Filter pack (9.0'-20.0' bgs) 2' stainless steel 10 slot (10.0'-20.0' bgs)
20 -20							End of boring at 20.0' bgs.		
25 -25									

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Remarks: bgs = below ground surface
Groundwater encountered from 16.0'-18.0' bgs.
Slight odor detected from 2.0'-4.0' bgs.
Strong odor detected from 1.0'-2.0' and 16.0'-18.0' bgs.
No staining observed.
Shake test at 16-17': slightly positive.

Date Start: 11/12/13 **Date Finish:** 11/12/13 **Drilling Company:** Sterns **Driller's Name:** B.Marshall **Drilling Method:** Direct Push **Sampling Method:** HA to 5.0'/Sonic **Rig Type:** Geoprobe **Water Level Start (ft. bgs.):** **Water Level Finish (ft. btoc.):**	**Northing:** 425059.54 **Easting:** 13412675.40 **Casing Elevation:** 967.53 **Borehole Depth (ft. bgs.):** 13.0' bgs. **Surface Elevation:** 968.02 **Descriptions By:** C.Snyder	**Well/Boring ID: TWM2-06** **Client:** RACER **Location:** RACER PNC **Weather Conditions:** Sunny, 25 F

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
							NOTE: Same lithology as TWM2-07 - adjacent to each other.		
0 / 0							(0.0'-1.0') CONCRETE.		J-Plug; Portland cement grout (0.0'-1.0' bgs)
	1	0.0-5.0	5.0	0.0			(1.0'-4.0') SAND, fine; well sorted; dry; grayish brown (10YR 5/2).		Bentonite chip (1.0'-2.0' bgs); 2" sch 40 pvc (0.5'-3.0' bgs)
				0.0			(4.0'-5.0') CLAY, low plasticity; little silt; dry; medium stiff; grayish brown (10YR 5/2).		
5 / -5	2	5.0-10.0	1.9	0.0 0.0 0.0			(5.0'-10.0') CLAY, medium plasticity, no dilatancy; little silt; trace granules to medium pebbles, subround to subangular; moist; medium stiff; grayish brown (10YR 5/2).		Filter pack (2.0'-13.0' bgs); 2' stainless steel 10 slot (3.0'-13.0' bgs)
10 / -10	3	10.0-13.0	3.0	0.0			(10.0'-13.0') CLAY, some silt; medium plasticity, slow dilatancy; trace small to medium pebbles, subround to subangular; moist; soft; gray (10YR 5/1).		
							End of boring at 13.0' bgs.		

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Remarks: bgs = below ground surface
No groundwater encountered.
No odor or staining observed.

Date Start: 11/11/13 **Date Finish:** 11/12/13 **Drilling Company:** Sterns **Driller's Name:** B.Marshall **Drilling Method:** Direct Push **Sampling Method:** HA to 5.0'/Sonic **Rig Type:** Geoprobe **Water Level Start (ft. bgs.):** **Water Level Finish (ft. btoc.):**	**Northing:** 425062.12 **Easting:** 13412675.20 **Casing Elevation:** 967.59 **Borehole Depth (ft. bgs.):** 25.0' bgs. **Surface Elevation:** 968.05 **Descriptions By:** C.Snyder	**Well/Boring ID: TWM2-07** **Client:** RACER **Location:** RACER PNC **Weather Conditions:** Snow, 32 F

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
0 / 0							(0.0'-1.0') CONCRETE.		J-Plug
	1	0.0-5.0	5.0	0.0			(1.0'-4.0') SAND, fine; well sorted; dry; grayish brown (10YR 5/2).		
				0.0			(4.0'-5.0') CLAY, low plasticity; little silt; dry; medium stiff; grayish brown (10YR 5/2).		
5 / -5	2	5.0-10.0	1.9	0.0			(5.0'-10.0') CLAY, medium plasticity; no dilatancy; little silt; trace granules to medium pebbles, subround to subangular; moist; medium stiff; grayish brown (10YR 5/2).		Portland cement grout (0.0'-12.3' bgs)
				0.0					2" sch 40 pvc (0.5'-15.0' bgs)
				0.0					
10 / -10				0.0			(10.0'-17.0') CLAY, some silt; medium plasticity, slow dilatancy; trace small to medium pebbles, subround to subangular; moist; soft; gray (10YR 5/1).		
	3	10.0-18.0	6.0						

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Remarks: bgs = below ground surface
Groundwater encountered from 20.5'-23.5' bgs.
Slight odor detected from 17.0'-20.0' bgs.
No staining observed.

Date Start: 11/11/13 **Date Finish:** 11/12/13 **Drilling Company:** Sterns **Driller's Name:** B.Marshall **Drilling Method:** Direct Push **Sampling Method:** HA to 5.0'/Sonic **Rig Type:** Geoprobe **Water Level Start (ft. bgs.):** **Water Level Finish (ft. btoc.):**	**Northing:** 425062.12 **Easting:** 13412675.20 **Casing Elevation:** 967.59 **Borehole Depth (ft. bgs.):** 25.0' bgs. **Surface Elevation:** 968.05 **Descriptions By:** C.Snyder	**Well/Boring ID:** **TWM2-07** **Client:** RACER **Location:** RACER PNC **Weather Conditions:** Snow, 32 F

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
15 -15				0.0 0.0 0.0 0.0 0.0			(17.0'-20.0') SAND, fine to medium; well sorted; moist; gray (10YR 5/1). NOTE: Slight odor.		Bentonite chip (12.3'-14.0' bgs)
20 -20	4	18.0-25.0	5.0	0.0 0.0 0.0 0.0 0.0 0.0			(20.0'-20.5') SILT and CLAY, medium plasticity; slow dilatancy; moist; medium stiff to soft; gray (10YR 5/1). (20.5'-23.5') SAND, very fine to fine; well sorted; wet; grayish brown (10YR 5/2).		Filter pack (14.0'-25.0' bgs) 2' stainless steel 10 slot (15.0'-25.0' bgs)
25 -25							(23.5'-25.0') CLAY, medium plasticity; some silt; trace granules to medium pebbles, subround to subangular; moist; soft; gray (10YR 5/1). End of boring at 25.0' bgs.		

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Remarks: bgs = below ground surface
Groundwater encountered from 20.5'-23.5' bgs.
Slight odor detected from 17.0'-20.0' bgs.
No staining observed.

Date Start: 8/27/13 **Date Finish:** 8/27/13 **Drilling Company:** Stern's Drilling **Driller's Name:** B.Marshall **Drilling Method:** HA to 5.0' bgs/Continuous **Sampling Method:** 2" Split Spoon **Rig Type:** Geoprobe **Water Level Start (ft. bgs.):** **Water Level Finish (ft. btoc.):**	**Northing:** 424668.06 **Easting:** 13413334.70 **Casing Elevation:** 969.37 **Borehole Depth (ft. bgs.):** 45.0' bgs. **Surface Elevation:** 966.90 **Descriptions By:** D.Shaw	**Well/Boring ID: TWW8-01** **Client:** RACER **Location:** RACER PNC **Weather Conditions:** Rain, 75 F

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
0 / 0	1	0.0-5.0	3.0	0.0 0.0 0.0 0.0			(0.0'-2.0') SAND, very fine to fine; some silt; some small to very large pebbles, subround; poorly sorted; dry; brown (10YR 5/3). (2.0'-4.0') SAND, very fine to medium, subround; little silt; little small to large pebbles, subround; poorly sorted; dry; very dark grayish brown (10YR 3/2). (4.0'-5.0') CLAY, low plasticity, slow dilatancy, and SAND, very fine; little silt; little small to large pebbles, subround; dry; soft; dark grayish brown (10YR 3/2).		J-Plug
5 / -5	2	5.0-7.0	1.5	0.0 0.0			(5.0'-14.0') CLAY, trace silt, medium to high plasticity; no dilatancy; little very fine sand; trace granules to small pebbles, round; dry; soft; dark grayish brown (10YR 3/2).		
	3	7.0-9.0	1.0	0.0 0.0					Portland cement grout (0.0'-161.0' bgs)
10 / -10	4	9.0-11.0	1.4	0.0 0.0			NOTE: At 10.0' bgs, little very fine to medium sand, subround.		2" sch 40 pvc (0.9'-20.0' bgs)
	5	11.0-13.0	1.5	0.8 1.5			NOTE: At 11.5' bgs, color change to very dark gray (5Y 3/1).		
				2.6			NOTE: At 13.0' bgs, moist; color change to gray (5Y 5/1).		

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Remarks: bgs = below ground surface
No groundwater encountered.
Odor detected from 23.3'-24.5' bgs.
Staining observed from 23.3'-24.5' and at 30.0' bgs.
Shake test at 14.5': slightly positive.

Date Start: 8/27/13
Date Finish: 8/27/13
Drilling Company: Stern's Drilling
Driller's Name: B.Marshall
Drilling Method: HA to 5.0' bgs/Continuous
Sampling Method: 2" Split Spoon
Rig Type: Geoprobe
Water Level Start (ft. bgs.):
Water Level Finish (ft. btoc.):

Northing: 424668.06
Easting: 13413334.70
Casing Elevation: 969.37

Borehole Depth (ft. bgs.): 45.0' bgs.
Surface Elevation: 966.90

Descriptions By: D.Shaw

Well/Boring ID: **TWW8-01**

Client: RACER

Location: RACER PNC

Weather Conditions: Rain, 75 F

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
15 -15	6	13.0-15.0	1.6	2.8			(14.0'-23.3') CLAY, trace silt; medium to high plasticity; no dilatancy; trace small pebbles, round; dry; very stiff; dark gray (2.5Y 4/1). NOTE: At.14.5' bgs, sand seam, fine to medium, trace granules. NOTE: At 15.0' bgs, stiff.		
	7	15.0-17.0	1.7	4.4 5.8					
	8	17.0-19.0	2.1	2.5 3.4					
20 -20	9	19.0-21.0	1.3	1.7 1.7					
	10	21.0-23.0	2.0	0.4 0.4					
	11	23.0-25.0	2.0	9.9 29.2			(23.3'-24.5') SAND, very fine to medium, subround; trace granules to small pebbles, subround; poorly sorted; dry; dark gray (2.5Y 4/1). NOTE: Moderate odor; staining black (2.5Y 2.5/1)		
25 -25	12	25.0-27.0	2.0	1.0 1.1			(24.5'-44.5') CLAY, trace silt, medium plasticity; no dilatancy; trace small pebbles, round; trace fine sand; moist; stiff; dark gray (2.5Y 4/1).		
	13	27.0-29.0	0.4	161.0					
30 -30				1.2					

Bentonite chip (16.0'-183.0' bgs)

2' stainless steel 10 slot (20.0'-30.0' bgs)

Filter pack (18.0'-40.0' bgs)

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Remarks: bgs = below ground surface
No groundwater encountered.
Odor detected from 23.3'-24.5' bgs.
Staining observed from 23.3'-24.5' and at 30.0' bgs.
Shake test at 14.5': slightly positive.

Date Start: 8/27/13 **Date Finish:** 8/27/13 **Drilling Company:** Stern's Drilling **Driller's Name:** B.Marshall **Drilling Method:** HA to 5.0' bgs/Continuous **Sampling Method:** 2" Split Spoon **Rig Type:** Geoprobe **Water Level Start (ft. bgs.):** **Water Level Finish (ft. btoc.):**	**Northing:** 424668.06 **Easting:** 13413334.70 **Casing Elevation:** 969.37 **Borehole Depth (ft. bgs.):** 45.0' bgs. **Surface Elevation:** 966.90 **Descriptions By:** D.Shaw	**Well/Boring ID: TWW8-01** **Client:** RACER **Location:** RACER PNC **Weather Conditions:** Rain, 75 F

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
30 -30	14	29.0-31.0	1.5	0.8			NOTE: At 30.0' bgs, brown staining; trace fine to medium sand.		
	15	31.0-33.0	0.0						
	16	33.0-35.0	1.4	0.5 0.5					
35 -35	17	35.0-37.0	1.8	0.5 0.5			NOTE: At 35.0' bgs, little fine to medium sand, subround.		Filter pack (30.0'-40.0' bgs)
	18	37.0-39.0	1.6	0.5 0.5			NOTE: At 37.0' bgs, moist.		
40 -40	19	39.0-41.0	0.7	0.0					
	20	41.0-43.0	0.2	0.0					
	21	43.0-45.0	1.6	0.0 0.0			(44.5'-45.0') SAND, very fine to fine, subround; some silt; trace clay; trace granules to medium pebbles, round; poorly sorted; dry; very tight; dark gray (2.5Y 4/1).		
45 -45							End of boring at 45.0' bgs.		

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Remarks: bgs = below ground surface
No groundwater encountered.
Odor detected from 23.3'-24.5' bgs.
Staining observed from 23.3'-24.5' and at 30.0' bgs.
Shake test at 14.5': slightly positive.

Date Start: 11/14/13 **Date Finish:** 11/14/13 **Drilling Company:** Sterns **Driller's Name:** B.Marshall **Drilling Method:** Direct Push **Sampling Method:** HA to 4.5'/Sonic **Rig Type:** Geoprobe **Water Level Start (ft. bgs.):** **Water Level Finish (ft. btoc.):**	**Northing:** 424621.36 **Easting:** 13413205.36 **Casing Elevation:** 968.57 **Borehole Depth (ft. bgs.):** 35.0' bgs. **Surface Elevation:** 968.80 **Descriptions By:** M.Castles-Humphrey	**Well/Boring ID: TWW8-02** **Client:** RACER **Location:** RACER PNC **Weather Conditions:** Sunny/Windy, 35-40 F

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
0 / 0	1	0.0-3.5	3.5	0.0 0.0			(0.0'-3.5') TOPSOIL; some large to very large pebbles; dry; loose; tree roots; no odor; very dark grayish brown (10YR 3/2).		J-Plug
	2	3.5-5.0		0.0			(3.5'-5.0') TOPSOIL and SAND, subround; some large pebbles; poorly sorted; medium dense; dry; very dark grayish brown (10YR 3/2).		
5 / -5	3	5.0-8.0	3.0	0.0 0.0 0.0			(5.0'-15.0') SILT, high plasticity; slow dilatancy, and SAND, some medium to large pebbles, rounded; poorly sorted; dry; hard; very dark grayish brown (10YR 3/2). NOTE: some black discoloration; plant fragments; no odor.		
10 / -10	4	8.0-18.0	5.9						Portland cement grout (0.0'-21.0' bgs) 2" sch 40 pvc (0.9'-24.0' bgs)

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Remarks: bgs = below ground surface
No groundwater encountered.
No odor detected.
Black discoloration observed from 5.0'-15.0' bgs.

Date Start: 11/14/13
Date Finish: 11/14/13
Drilling Company: Sterns
Driller's Name: B.Marshall
Drilling Method: Direct Push
Sampling Method: HA to 4.5'/Sonic
Rig Type: Geoprobe
Water Level Start (ft. bgs.):
Water Level Finish (ft. btoc.):

Northing: 424621.36
Easting: 13413205.36
Casing Elevation: 968.57

Borehole Depth (ft. bgs.): 35.0' bgs.
Surface Elevation: 968.80

Descriptions By: M.Castles-Humphrey

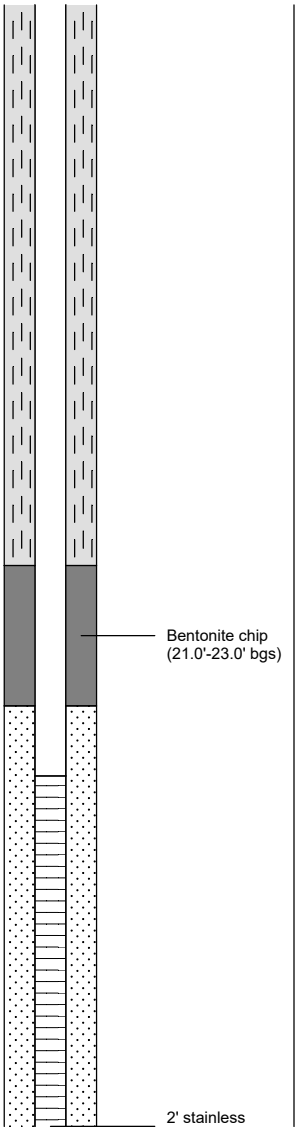
Well/Boring ID: **TWW8-02**

Client: RACER

Location: RACER PNC

Weather Conditions: Sunny/Windy, 35-40 F

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
15 -15							(15.0'-17.5') CLAY, high plasticity, no dilatancy; some silt; some sand; little small to medium pebbles; dry; soft; dark yellowish brown (10YR 3/6). NOTE: lighter gray mottling; metal fragments.		
							(17.5'-18.0') CLAY, medium plasticity; no dilatancy, and SAND; some silt; little small to medium pebbles; dry; soft; very dark grayish brown (10YR 3/2). No odor.		
							(18.0'-35.0') CLAY and SILT, high plasticity, no dilatancy; some fine to medium sand, subround; little small to large pebbles, subangular; poorly sorted; dry; stiff; yellowish brown (10YR 5/6). NOTE Glacial Till.		
20 -20	5	18.0-28.0	8.0	0.0					
				0.0					
				0.0					
				0.0					
				0.0					
25 -25				0.0					
				0.0					
				0.0					
				0.0					
				0.0			NOTE: At 28.0' bgs, moist; some small cobble.		



ARCADIS
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Remarks: bgs = below ground surface
No groundwater encountered.
No odor detected.
Black discoloration observed from 5.0'-15.0' bgs.

Date Start: 11/14/13
Date Finish: 11/14/13
Drilling Company: Sterns
Driller's Name: B.Marshall
Drilling Method: Direct Push
Sampling Method: HA to 4.5'/Sonic
Rig Type: Geoprobe
Water Level Start (ft. bgs.):
Water Level Finish (ft. btoc.):

Northing: 424621.36
Easting: 13413205.36
Casing Elevation: 968.57

Borehole Depth (ft. bgs.): 35.0' bgs.
Surface Elevation: 968.80

Descriptions By: M.Castles-Humphrey

Well/Boring ID: **TWW8-02**

Client: RACER

Location: RACER PNC

Weather Conditions: Sunny/Windy, 35-40 F

DEPTH (feet bgs.) / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level (ft. bgs.)	Well/Boring Construction
30 -30	6	28.0-35.0	7.0	0.0 0.2 0.6 0.8 0.4 0.4					steel 10 slot (24.0'-34.0' bgs) Filter pack (23.0'-35.0' bgs) Filter pack (34.0'-35.0' bgs)
35 -35							End of boring at 35.0' bgs.		
40 -40									
45 -45									

ARCADIS
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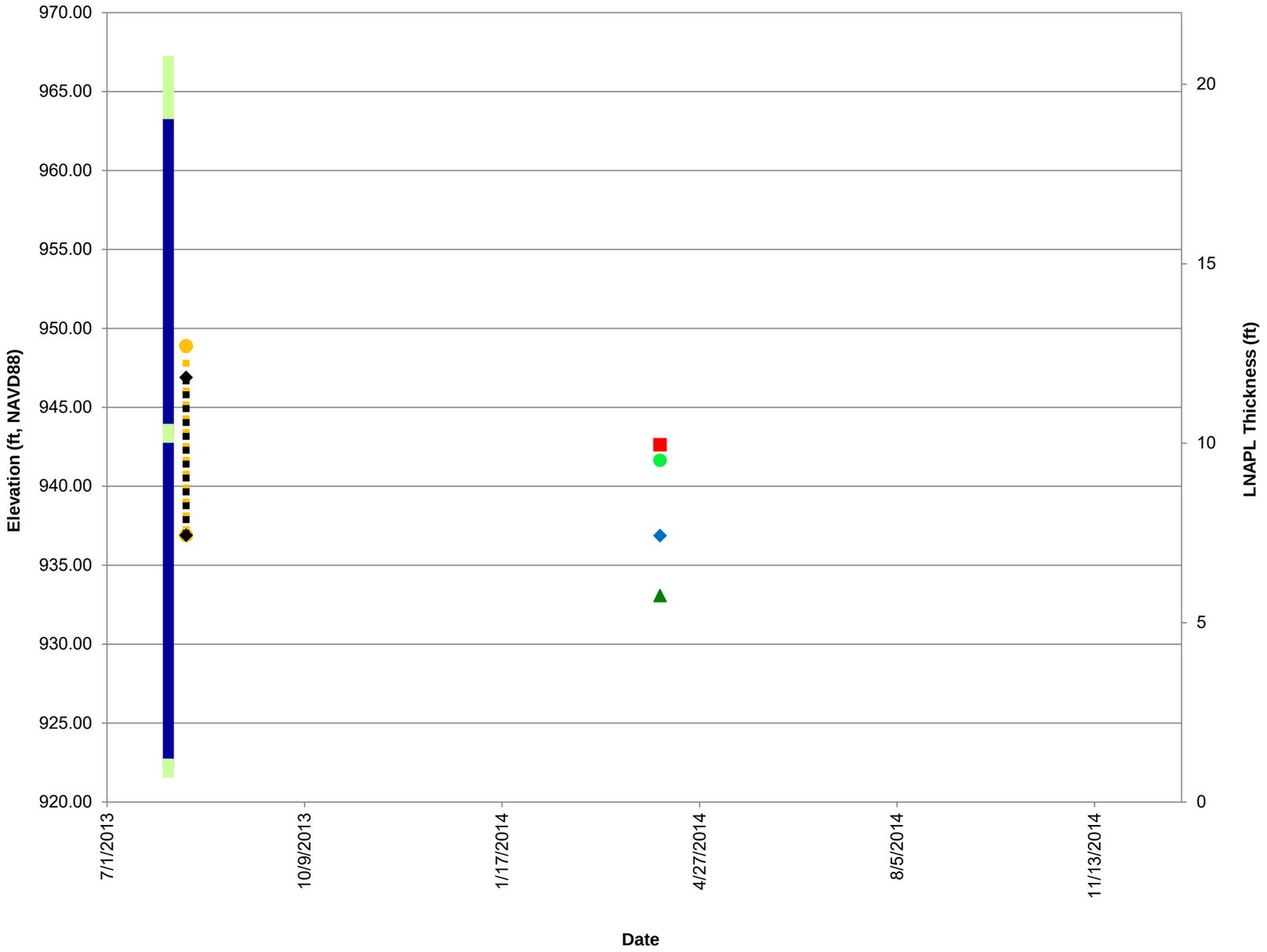
Remarks: bgs = below ground surface
No groundwater encountered.
No odor detected.
Black discoloration observed from 5.0'-15.0' bgs.

Attachment 7

TWW8-01 hydrograph



Air-NAPL Interface

NAPL-Water or Air-Water Interface

Potentiometric Surface

Fine sand

Clay

Filter Pack

Screened Interval

NAPL Thickness

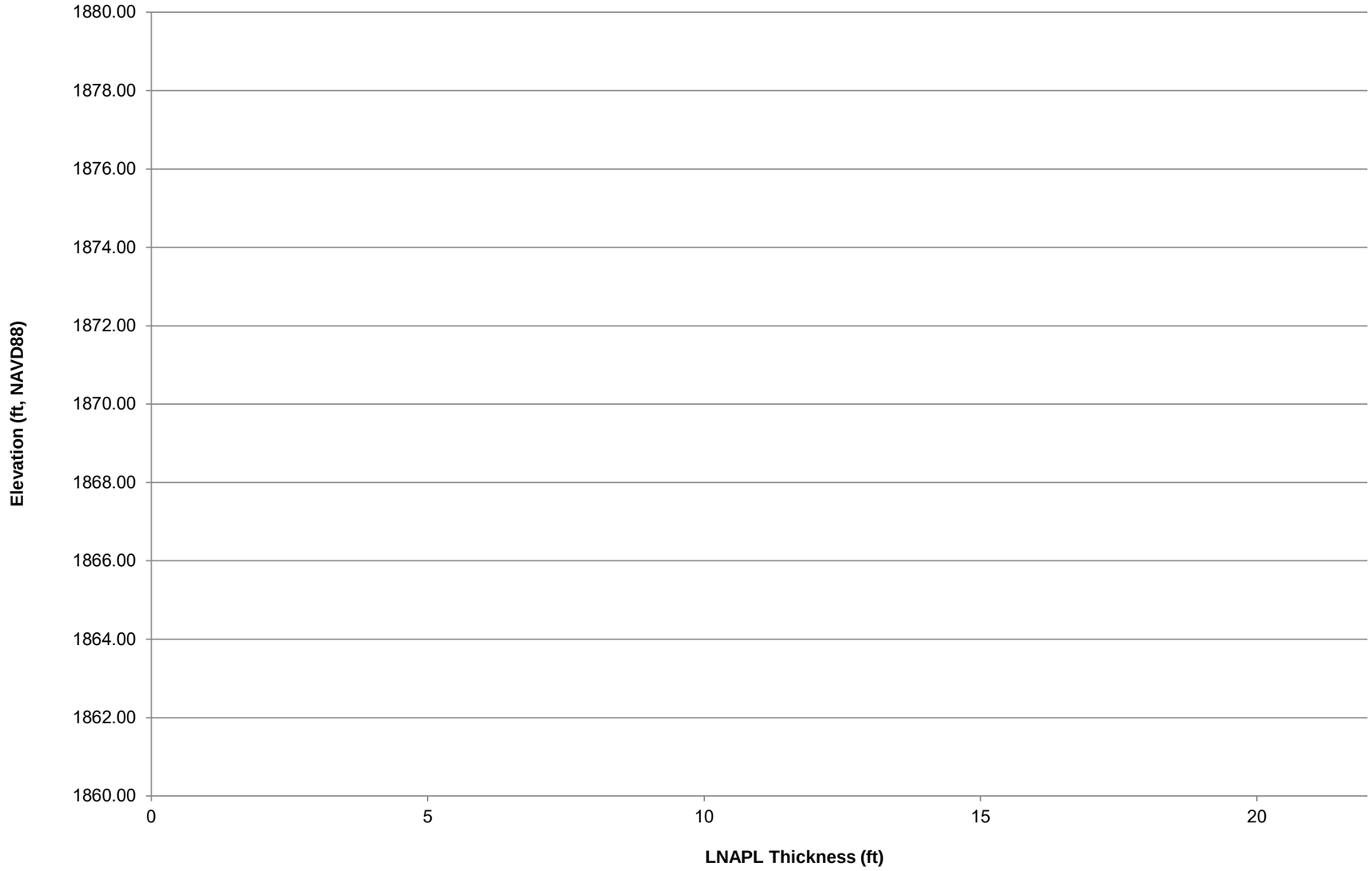
RACER Pontiac North Campus

TWW8-01 LNAPL HYDROGRAPH

ARCADIS

Attachment

7



Air-NAPL Interface

NAPL-Water or Air-Water Interface

Potentiometric Surface

Fine sand

Clay

Fine sand

Clay

Fine sand

Filter Pack

Screened Interval

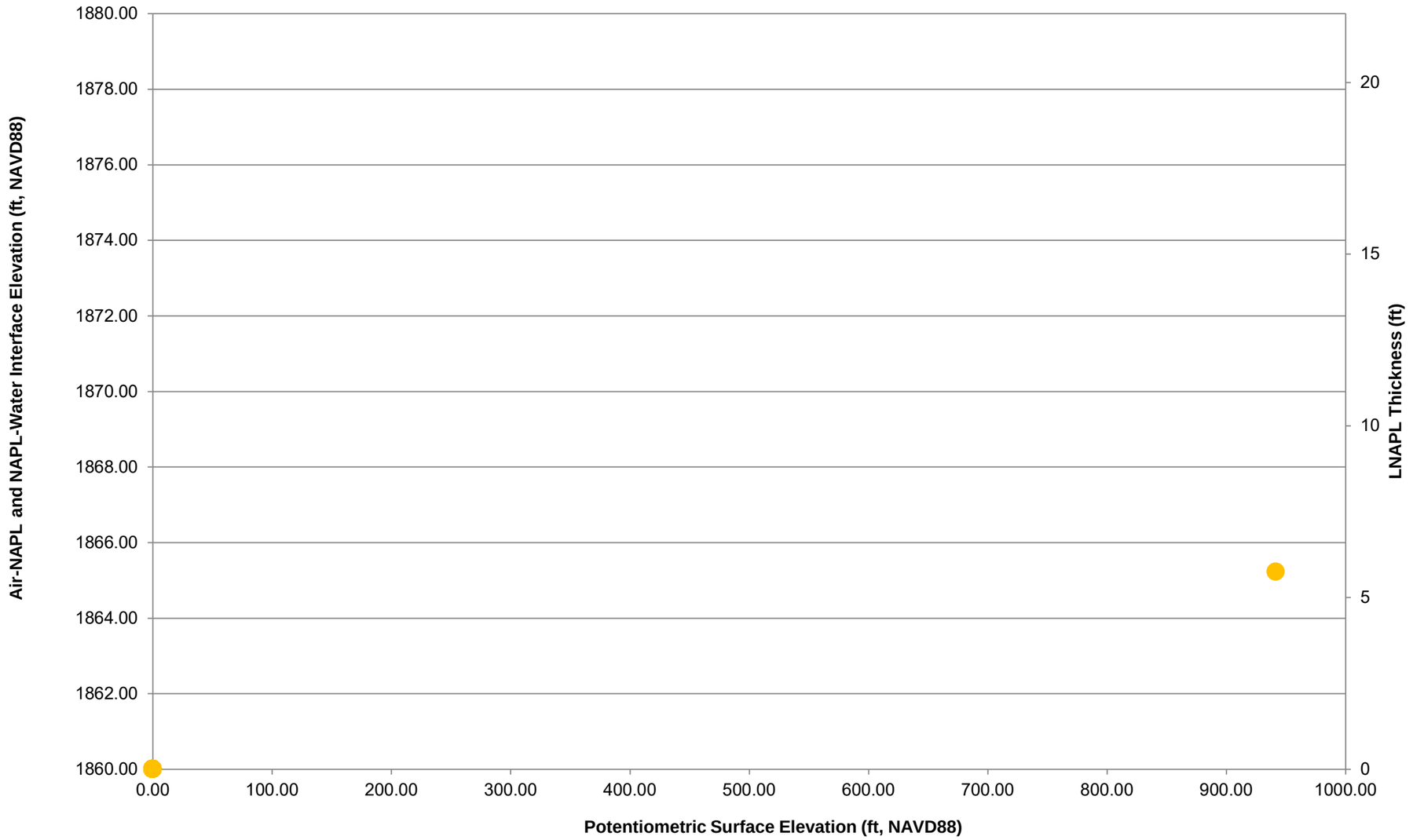
BNSF Childress Railyard
Childress, TX

TWW8-01 DIAGNOSTIC GAUGE PLOT

ARCADIS

FIGURE

7B



BNSF Childress Railyard
Childress, TX

TWW8-01 DIAGNOSTIC GAUGE PLOT

ARCADIS

FIGURE
7C

ARCADIS

Attachment 8

LNAPL Mobility Calculation Worksheets

1			**SITE/PROJECT INFORMATION**						**CASE STUDY ASSUMPTIONS**							
2	ARCADIS infrastructure, environment, buildings		Date:	5/23/2014					Case Name:	M2-01_39-40.5 at 39.3 ft bgs; capillary data from M2-01_39-40.5 at 39.1 ft bgs						
3			Site Name:	RACER- Pontiac North Campus					LNAPL Type:	Laboratory Results for AOI M2 LNAPL from well MWM2-29						
4			Site Location (City, ST):		Pontiac, Michigan				Geology Type:	Coarse sand						
5						Associated well: TWM2-03										
6	**CALCULATION INPUTS**								**INTERIM CALCULATIONS**							
7	***Parameter***		***Symbol***	***Value***	***Units***	***Source***			***Parameter***			***Symbol***	***Value***	***Units***	***API 4760 Equation***	***Report Equation***
8	**Site Data**								Air-Water Interface in Subsurface			z_{aw}	0	ft	datum	
9	Monitoring Well LNAPL Thickness		b_n	0	ft	field data April 7, 2014			Density Ratio			ρ_r	0.891	dimensionless		
10	Water-saturated Hydraulic Conductivity		K_w	2.27E-06	cm/s	AWCD data: M2-01_39-40.5 (39.1)			Air-LNAPL Interface in Well			z_{an}	0.000	ft	2.19	
11	Water Hydraulic Gradient		J_w	0.148	dimensionless	Fluid Level Data; 12/2 and 4/7			LNAPL-Water Interface in Well			z_{nw}	0.000	ft	2.20	
12									Maximum Free LNAPL in Subsurface			z_{max}	0.000	ft	2.38	
13	**Fluids Properties Data**								LNAPL vertical extent in subsurface				0.000	ft		
14	LNAPL Density		ρ_n	0.8921	g/cm3	PTS lab data - for MWM2-29			vG Alpha scaled to oil-water interactions			α_{nw}	0.244	1/ft	2.25	
15	LNAPL Viscosity		μ_n	1.2	g/cm-s	PTS lab data - for MWM2-29			vG Alpha scaled to oil-air interactions			α_{an}	0.507	1/ft	2.31	
16	Water Density		ρ_w	1.001	g/cm3	PTS lab data - for MWM2-29			M (Mualem)			M	0.099	dimensionless	2.6	
17	Water Viscosity		μ_w	0.0126	g/cm-s	PTS lab data - for MWM2-29			Viscosity Ratio			μ_r	95.238	dimensionless		
18	Surface Tension		σ_{aw}	71.8	dyne/cm	PTS lab data - for MWM2-29			LNAPL-saturated Hydraulic Conductivity			K_n	2.12E-08	cm/s	3.2	
19	Air-LNAPL Interfacial Tension		σ_{an}	30.8	dyne/cm	PTS lab data - for MWM2-29			LNAPL Hydraulic Gradient			J_n	0.166	dimensionless		
20	LNAPL-Water Interfacial Tension		σ_{nw}	7.8	dyne/cm	PTS lab data - for MWM2-29			Intrinsic Permeability			k	2.91E-11	cm2		
21																
22	**Aquifer Properties Data**								***RESULTS***							
23	van Genuchten (vG) Alpha		α	8.00E-03	1/cm	RETC results; M2-01_39-40.5 (39.1			***Parameter***			***Symbol***	***Value***	***Units***	***API 4760 Equation***	***Report Equation***
24	van Genuchten (vG) Beta		N	1.110	dimensionless	RETC results; M2-01_39-40.5 (39.1			Effective water saturation			$S_{e[w]}$	1.000	dimensionless	2.26	1
25	Displacement Pressure Head (Air-Water)		h_d	52.10	cm H_2O	AWCD data: M2-01_39-40.5 (39.1)			Effective total liquid saturation			$S_{e[t]}$	1.000	dimensionless	2.32	2
26	Porosity		n	0.196	dimensionless	FPM-C data: M2-01_39-40.5 (39.3)			Relative Permeability to LNAPL (Mualem)			$k_{rn}(S_w, S_{ni})$	0.000	dimensionless	3.14	4
27	Irreducible Water Saturation		S_{wr}	0.452	dimensionless	FPM-C data: M2-01_39-40.5 (39.3)			Effective Permeability to NAPL			$k_{n\text{-}eff}(S_w, S_{ni})$	0.00E+00	cm^2		
28	Field LNAPL Saturation		S_{ni}	0.085	dimensionless	FPM-C data: M2-01_39-40.5 (39.3)			LNAPL Velocity Potential			$v_n(S_{ni})$	0.00E+00	cm/s		7
29	Residual LNAPL Saturation		S_{nr}	0.085	dimensionless	FPM-C data: M2-01_39-40.5 (39.3)			Critical LNAPL Thickness			$b_{n[crit]}$	0.88	ft	3.25	8
30		= values are not used as inputs to calculations														

1			**SITE/PROJECT INFORMATION**						**CASE STUDY ASSUMPTIONS**								
2	ARCADIS Infrastructure, environment, buildings		Date:	5/23/2014					Case Name:	M2-05_18-20 at 19.5 ft bgs; capillary data from M2-01_39-40.5 at 39.1 ft bgs							
3			Site Name:	RACER- Pontiac North Campus					LNAPL Type:	Laboratory Results for AOI M2 LNAPL from well MWM2-29							
4			Site Location (City, ST):		Pontiac, Michigan				Geology Type:	Medium sand							
5						Associated well: TWM2-01											
6	**CALCULATION INPUTS**								**INTERIM CALCULATIONS**								
7	***Parameter***			***Symbol***	***Value***	***Units***	***Source***		***Parameter***			***Symbol***	***Value***	***Units***	***API 4760 Equation***	***Report Equation***	
8	**Site Data**								Air-Water Interface in Subsurface			z_{aw}	0	ft	datum		
9	Monitoring Well LNAPL Thickness			b_n	0	ft	field data April 7, 2014		Density Ratio			ρ_r	0.891	dimensionless			
10	Water-saturated Hydraulic Conductivity			K_w	2.27E-06	cm/s	AWCD data: M2-01_39-40.5 (39.1)		Air-LNAPL Interface in Well			z_{an}	0.000	ft	2.19		
11	Water Hydraulic Gradient			J_w	0.148	dimensionless	Fluid Level Data; 12/2 and 4/7		LNAPL-Water Interface in Well			z_{nw}	0.000	ft	2.20		
12									Maximum Free LNAPL in Subsurface			z_{max}	0.000	ft	2.38		
13	**Fluids Properties Data**								LNAPL vertical extent in subsurface				0.000	ft			
14	LNAPL Density			ρ_n	0.8921	g/cm3	PTS lab data - for MWM2-29		vG Alpha scaled to oil-water interactions			α_{nw}	0.244	1/ft	2.25		
15	LNAPL Viscosity			μ_n	1.2	g/cm-s	PTS lab data - for MWM2-29		vG Alpha scaled to oil-air interactions			α_{an}	0.507	1/ft	2.31		
16	Water Density			ρ_w	1.001	g/cm3	PTS lab data - for MWM2-29		M (Mualem)			M	0.099	dimensionless	2.6		
17	Water Viscosity			μ_w	0.0126	g/cm-s	PTS lab data - for MWM2-29		Viscosity Ratio			μ_r	95.238	dimensionless			
18	Surface Tension			σ_{aw}	71.8	dyne/cm	PTS lab data - for MWM2-29		LNAPL-saturated Hydraulic Conductivity			K_n	2.12E-08	cm/s	3.2		
19	Air-LNAPL Interfacial Tension			σ_{an}	30.8	dyne/cm	PTS lab data - for MWM2-29		LNAPL Hydraulic Gradient			J_n	0.166	dimensionless			
20	LNAPL-Water Interfacial Tension			σ_{nw}	7.8	dyne/cm	PTS lab data - for MWM2-29		Intrinsic Permeability			k	2.91E-11	cm2			
21																	
22	**Aquifer Properties Data**								***RESULTS***								
23	van Genuchten (vG) Alpha			α	8.00E-03	1/cm	RETC results; M2-01_39-40.5 (39.1		***Parameter***			***Symbol***	***Value***	***Units***	***API 4760 Equation***	***Report Equation***	
24	van Genuchten (vG) Beta			N	1.110	dimensionless	RETC results; M2-01_39-40.5 (39.1		Effective water saturation			$S_{e[w]}$	0.718	dimensionless	2.26	1	
25	Displacement Pressure Head (Air-Water)			h_d	52.10	cm H_2O	AWCD data: M2-01_39-40.5 (39.1)		Effective total liquid saturation			$S_{e[t]}$	1.000	dimensionless	2.32	2	
26	Porosity			n	0.304	dimensionless	FPM-C data: M2-05_18-20 (19.5)		Relative Permeability to LNAPL (Mualem)			$k_{rn}(S_w, S_{ni})$	0.492	dimensionless	3.14	4	
27	Irreducible Water Saturation			S_{wr}	0.406	dimensionless	FPM-C data: M2-05_18-20 (19.5)		Effective Permeability to NAPL			$k_{n\text{-}eff}(S_w, S_{ni})$	1.43E-11	cm^2			
28	Field LNAPL Saturation			S_{ni}	0.246	dimensionless	FPM-C data: M2-05_18-20 (19.5)		LNAPL Velocity Potential			$v_n(S_{ni})$	2.32E-08	cm/s		7	
29	Residual LNAPL Saturation			S_{nr}	0.109	dimensionless	FPM-C data: M2-05_18-20 (19.5)		Critical LNAPL Thickness			$b_{n[crit]}$	0.88	ft	3.25	8	
30	= values are not used as inputs to calculations																

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SITE/PROJECT INFORMATION

Date:	5/22/2014
Site Name:	RACER- Pontiac North Campus
Site Location (City, ST):	Pontiac, Michigan
	Associated well: TWM2-04

CASE STUDY ASSUMPTIONS

Case Name:	M2-16_6-9 at 6.5 ft bgs; capillary data from M2-01_39-40.5 at 39.1 ft bgs
LNAPL Type:	Laboratory Results for AOI M2 LNAPL from well MWM2-29
Geology Type:	Fine Sand

CALCULATION INPUTS

Parameter	*Symbol*	*Value*	*Units*	*Source*
Site Data				
Monitoring Well LNAPL Thickness	b_n	0	ft	field data Dec 2013
Water-saturated Hydraulic Conductivity	K_w	2.27E-06	cm/s	AWCD data: M2-01_39-40.5 (39.1)
Water Hydraulic Gradient	J_w	0.148	dimensionless	Fluid Level Data; 12/2 and 4/7
Fluids Properties Data				
LNAPL Density	ρ_n	0.8921	g/cm3	PTS lab data - for MWM2-29
LNAPL Viscosity	μ_n	1.2	g/cm-s	PTS lab data - for MWM2-29
Water Density	ρ_w	1.001	g/cm3	PTS lab data - for MWM2-29
Water Viscosity	μ_w	0.0126	g/cm-s	PTS lab data - for MWM2-29
Surface Tension	σ_{aw}	71.8	dyne/cm	PTS lab data - for MWM2-29
Air-LNAPL Interfacial Tension	σ_{an}	30.8	dyne/cm	PTS lab data - for MWM2-29
LNAPL-Water Interfacial Tension	σ_{nw}	7.8	dyne/cm	PTS lab data - for MWM2-29
Aquifer Properties Data				
van Genuchten (vG) Alpha	α	8.00E-03	1/cm	RETC results; M2-01_39-40.5 (39.1
van Genuchten (vG) Beta	N	1.110	dimensionless	RETC results; M2-01_39-40.5 (39.1
Displacement Pressure Head (Air-Water)	h_d	52.10	cm H_2O	AWCD data: M2-01_39-40.5 (39.1)
Porosity	n	0.373	dimensionless	FPM-C data: M2-16_6-9 (6.5)
Irreducible Water Saturation	S_{wr}	0.511	dimensionless	FPM-C data: M2-16_6-9 (6.5)
Field LNAPL Saturation	S_{ni}	0.125	dimensionless	FPM-C data: M2-16_6-9 (6.5)
Residual LNAPL Saturation	S_{nr}	0.124	dimensionless	FPM-C data: M2-16_6-9 (6.5)

= values are not used as inputs to calculations

INTERIM CALCULATIONS

Parameter	*Symbol*	*Value*	*Units*	*API 4760 Equation*	*Report Equation*
Air-Water Interface in Subsurface	z_{aw}	0	ft	datum	
Density Ratio	ρ_r	0.891	dimensionless		
Air-LNAPL Interface in Well	z_{an}	0.000	ft	2.19	
LNAPL-Water Interface in Well	z_{nw}	0.000	ft	2.20	
Maximum Free LNAPL in Subsurface	z_{max}	0.000	ft	2.38	
LNAPL vertical extent in subsurface		0.000	ft		
vG Alpha scaled to oil-water interactions	α_{nw}	0.244	1/ft	2.25	
vG Alpha scaled to oil-air interactions	α_{an}	0.507	1/ft	2.31	
M (Mualem)	M	0.099	dimensionless	2.6	
Viscosity Ratio	μ_r	95.238	dimensionless		
LNAPL-saturated Hydraulic Conductivity	K_n	2.12E-08	cm/s	3.2	
LNAPL Hydraulic Gradient	J_n	0.166	dimensionless		
Intrinsic Permeability	k	2.91E-11	cm2		

RESULTS

Parameter	*Symbol*	*Value*	*Units*	*API 4760 Equation*	*Report Equation*
Effective water saturation	$S_{e[w]}$	0.997	dimensionless	2.26	1
Effective total liquid saturation	$S_{e[t]}$	1.000	dimensionless	2.32	2
Relative Permeability to LNAPL (Mualem)	$k_{rn}(S_w, S_{ni})$	0.173	dimensionless	3.14	4
Effective Permeability to NAPL	$k_{n\text{-}eff}(S_w, S_{ni})$	5.04E-12	cm^2		
LNAPL Velocity Potential	$v_n(S_{ni})$	1.31E-08	cm/s		7
Critical LNAPL Thickness	$b_{n[crit]}$	0.88	ft	3.25	8

1			**SITE/PROJECT INFORMATION**						**CASE STUDY ASSUMPTIONS**							
2	ARCADIS Infrastructure, environment, buildings		Date:	5/23/2014					Case Name:	M2-21_17-19 at 17.4 ft bgs; capillary data from M2-21_17-19 at 17.2 ft bgs						
3			Site Name:	RACER- Pontiac North Campus					LNAPL Type:	Laboratory Results for AOI M2 LNAPL from well MWM2-29						
4			Site Location (City, ST):		Pontiac, Michigan				Geology Type:	Fine sand						
5						Associated well: TWM2-07										
6	**CALCULATION INPUTS**								**INTERIM CALCULATIONS**							
7	***Parameter***			***Symbol***	***Value***	***Units***	***Source***		***Parameter***			***Symbol***	***Value***	***Units***	***API 4760 Equation***	***Report Equation***
8	**Site Data**								Air-Water Interface in Subsurface			z_{aw}	0	ft	datum	
9	Monitoring Well LNAPL Thickness			b_n	1.85	ft	field data April 7, 2014		Density Ratio			ρ_r	0.891	dimensionless		
10	Water-saturated Hydraulic Conductivity			K_w	1.32E-03	cm/s	AWCD data: M2-21_17-19 (17.2)		Air-LNAPL Interface in Well			z_{an}	0.201	ft	2.19	
11	Water Hydraulic Gradient			J_w	0.148	dimensionless	Fluid Level Data; 12/2 and 4/7		LNAPL-Water Interface in Well			z_{nw}	-1.649	ft	2.20	
12									Maximum Free LNAPL in Subsurface			z_{max}	1.923	ft	2.38	
13	**Fluids Properties Data**								LNAPL vertical extent in subsurface				3.572	ft		
14	LNAPL Density			ρ_n	0.8921	g/cm3	PTS lab data - for MWM2-29		vG Alpha scaled to oil-water interactions			α_{nw}	0.641	1/ft	2.25	
15	LNAPL Viscosity			μ_n	1.2	g/cm-s	PTS lab data - for MWM2-29		vG Alpha scaled to oil-air interactions			α_{an}	1.330	1/ft	2.31	
16	Water Density			ρ_w	1.001	g/cm3	PTS lab data - for MWM2-29		M (Mualem)			M	0.451	dimensionless	2.6	
17	Water Viscosity			μ_w	0.0126	g/cm-s	PTS lab data - for MWM2-29		Viscosity Ratio			μ_r	95.238	dimensionless		
18	Surface Tension			σ_{aw}	71.8	dyne/cm	PTS lab data - for MWM2-29		LNAPL-saturated Hydraulic Conductivity			K_n	1.24E-05	cm/s	3.2	
19	Air-LNAPL Interfacial Tension			σ_{an}	30.8	dyne/cm	PTS lab data - for MWM2-29		LNAPL Hydraulic Gradient			J_n	0.166	dimensionless		
20	LNAPL-Water Interfacial Tension			σ_{nw}	7.8	dyne/cm	PTS lab data - for MWM2-29		Intrinsic Permeability			k	1.69E-08	cm2		
21																
22	**Aquifer Properties Data**								***RESULTS***							
23	van Genuchten (vG) Alpha			α	2.10E-02	1/cm	RETC results; M2-21_17-19 (17.2)		***Parameter***			***Symbol***	***Value***	***Units***	***API 4760 Equation***	***Report Equation***
24	van Genuchten (vG) Beta			N	1.820	dimensionless	RETC results; M2-21_17-19 (17.2)		Effective water saturation			$S_{e[w]}$	1.000	dimensionless	2.26	1
25	Displacement Pressure Head (Air-Water)			h_d	22.60	cm H_2O	AWCD data: M2-21_17-19 (17.2)		Effective total liquid saturation			$S_{e[t]}$	1.000	dimensionless	2.32	2
26	Porosity			n	0.341	dimensionless	FPM-C data: M2-21_17-19 (17.4)		Relative Permeability to LNAPL (Mualem)			$k_{rn}(S_w, S_{ni})$	0.000	dimensionless	3.14	4
27	Irreducible Water Saturation			S_{wr}	0.150	dimensionless	FPM-C data: M2-21_17-19 (17.4)		Effective Permeability to NAPL			$k_{n\text{-}eff}(S_w, S_{ni})$	0.00E+00	cm^2		
28	Field LNAPL Saturation			S_{ni}	0.028	dimensionless	FPM-C data: M2-21_17-19 (17.4)		LNAPL Velocity Potential			$v_n(S_{ni})$	0.00E+00	cm/s		7
29	Residual LNAPL Saturation			S_{nr}	0.028	dimensionless	FPM-C data: M2-21_17-19 (17.4)		Critical LNAPL Thickness			$b_{n[crit]}$	0.38	ft	3.25	8
30	= values are not used as inputs to calculations															

1			**SITE/PROJECT INFORMATION**						**CASE STUDY ASSUMPTIONS**							
2	ARCADIS Infrastructure, environment, buildings		Date:	5/23/2014					Case Name:	M2-42_13-15 at 13.5 ft bgs; capillary data from M2-42_13-15 at 13.9 ft bgs						
3			Site Name:	RACER- Pontiac North Campus					LNAPL Type:	Laboratory Results for AOI M2 LNAPL from well MWM2-29						
4			Site Location (City, ST):		Pontiac, Michigan				Geology Type:	Fine sand						
5						Associated well: TWM2-05										
6	**CALCULATION INPUTS**								**INTERIM CALCULATIONS**							
7	***Parameter***			***Symbol***	***Value***	***Units***	***Source***		***Parameter***			***Symbol***	***Value***	***Units***	***API 4760 Equation***	***Report Equation***
8	**Site Data**								Air-Water Interface in Subsurface			z_{aw}	0	ft	datum	
9	Monitoring Well LNAPL Thickness			b_n	0.01	ft	field data April 7, 2014		Density Ratio			ρ_r	0.891	dimensionless		
10	Water-saturated Hydraulic Conductivity			K_w	4.53E-03	cm/s	AWCD data: MW-42_13-15 (13.9)		Air-LNAPL Interface in Well			z_{an}	0.001	ft	2.19	
11	Water Hydraulic Gradient			J_w	0.148	dimensionless	Fluid Level Data; 12/2 and 4/7		LNAPL-Water Interface in Well			z_{nw}	-0.009	ft	2.20	
12									Maximum Free LNAPL in Subsurface			z_{max}	0.010	ft	2.38	
13	**Fluids Properties Data**								LNAPL vertical extent in subsurface				0.019	ft		
14	LNAPL Density			ρ_n	0.8921	g/cm3	PTS lab data - for MWM2-29		vG Alpha scaled to oil-water interactions			α_{nw}	0.397	1/ft	2.25	
15	LNAPL Viscosity			μ_n	1.2	g/cm-s	PTS lab data - for MWM2-29		vG Alpha scaled to oil-air interactions			α_{an}	0.823	1/ft	2.31	
16	Water Density			ρ_w	1.001	g/cm3	PTS lab data - for MWM2-29		M (Mualem)			M	0.600	dimensionless	2.6	
17	Water Viscosity			μ_w	0.0126	g/cm-s	PTS lab data - for MWM2-29		Viscosity Ratio			μ_r	95.238	dimensionless		
18	Surface Tension			σ_{aw}	71.8	dyne/cm	PTS lab data - for MWM2-29		LNAPL-saturated Hydraulic Conductivity			K_n	4.24E-05	cm/s	3.2	
19	Air-LNAPL Interfacial Tension			σ_{an}	30.8	dyne/cm	PTS lab data - for MWM2-29		LNAPL Hydraulic Gradient			J_n	0.166	dimensionless		
20	LNAPL-Water Interfacial Tension			σ_{nw}	7.8	dyne/cm	PTS lab data - for MWM2-29		Intrinsic Permeability			k	5.81E-08	cm2		
21																
22	**Aquifer Properties Data**								***RESULTS***							
23	van Genuchten (vG) Alpha			α	1.30E-02	1/cm	RETC results; MW-42_13-15 (13.9)		***Parameter***			***Symbol***	***Value***	***Units***	***API 4760 Equation***	***Report Equation***
24	van Genuchten (vG) Beta			N	2.500	dimensionless	RETC results; MW-42_13-15 (13.9)		Effective water saturation			$S_{e[w]}$	0.883	dimensionless	2.26	1
25	Displacement Pressure Head (Air-Water)			h_d	34.20	cm H_2O	AWCD data: MW-42_13-15 (13.9)		Effective total liquid saturation			$S_{e[t]}$	1.000	dimensionless	2.32	2
26	Porosity			n	0.453	dimensionless	FPM-C data: M2-42_13-15 (13.5)		Relative Permeability to LNAPL (Mualem)			$k_{rn}(S_w, S_{ni})$	0.060	dimensionless	3.14	4
27	Irreducible Water Saturation			S_{wr}	0.060	dimensionless	FPM-C data: M2-42_13-15 (13.5)		Effective Permeability to NAPL			$k_{n\text{-}eff}(S_w, S_{ni})$	3.51E-09	cm^2		
28	Field LNAPL Saturation			S_{ni}	0.202	dimensionless	FPM-C data: M2-42_13-15 (13.5)		LNAPL Velocity Potential			$v_n(S_{ni})$	4.63E-06	cm/s		7
29	Residual LNAPL Saturation			S_{nr}	0.104	dimensionless	FPM-C data: M2-42_13-15 (13.5)		Critical LNAPL Thickness			$b_{n[crit]}$	0.58	ft	3.25	8
30	= values are not used as inputs to calculations															

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SITE/PROJECT INFORMATION

Date: 5/23/2014
Site Name: RACER- Pontiac North Campus
Site Location (City, ST): Pontiac, Michigan
Associated well: TWM2-05

CASE STUDY ASSUMPTIONS

Case Name: M2-42_13-15 at 14.1 ft bgs; capillary data from M2-42_13-15 at 13.9 ft bgs
LNAPL Type: Laboratory Results for AOI M2 LNAPL from well MWM2-29
Geology Type: Fine sand

CALCULATION INPUTS

Parameter	*Symbol*	*Value*	*Units*	*Source*
Site Data				
Monitoring Well LNAPL Thickness	b_n	0.01	ft	field data April 7, 2014
Water-saturated Hydraulic Conductivity	K_w	4.53E-03	cm/s	AWCD data: MW-42_13-15 (13.9)
Water Hydraulic Gradient	J_w	0.148	dimensionless	Fluid Level Data; 12/2and 4/7
Fluids Properties Data				
LNAPL Density	ρ_n	0.8921	g/cm3	PTS lab data - for MWM2-29
LNAPL Viscosity	μ_n	1.2	g/cm-s	PTS lab data - for MWM2-29
Water Density	ρ_w	1.001	g/cm3	PTS lab data - for MWM2-29
Water Viscosity	μ_w	0.0126	g/cm-s	PTS lab data - for MWM2-29
Surface Tension	σ_{aw}	71.8	dyne/cm	PTS lab data - for MWM2-29
Air-LNAPL Interfacial Tension	σ_{an}	30.8	dyne/cm	PTS lab data - for MWM2-29
LNAPL-Water Interfacial Tension	σ_{nw}	7.8	dyne/cm	PTS lab data - for MWM2-29
Aquifer Properties Data				
van Genuchten (vG) Alpha	α	1.30E-02	1/cm	RETC results; MW-42_13-15 (13.9)
van Genuchten (vG) Beta	N	2.500	dimensionless	RETC results; MW-42_13-15 (13.9)
Displacement Pressure Head (Air-Water)	h_d	34.20	cm H_2O	AWCD data: MW-42_13-15 (13.9)
Porosity	n	0.398	dimensionless	FPM-C data: M2-42_13-15 (14.1)
Irreducible Water Saturation	S_{wr}	0.092	dimensionless	FPM-C data: M2-42_13-15 (14.1)
Field LNAPL Saturation	S_{ni}	0.319	dimensionless	FPM-C data: M2-42_13-15 (14.1)
Residual LNAPL Saturation	S_{nr}	0.127	dimensionless	FPM-C data: M2-42_13-15 (14.1)

= values are not used as inputs to calculations

INTERIM CALCULATIONS

Parameter	*Symbol*	*Value*	*Units*	*API 4760 Equation*	*Report Equation*
Air-Water Interface in Subsurface	z_{aw}	0	ft	datum	
Density Ratio	ρ_r	0.891	dimensionless		
Air-LNAPL Interface in Well	z_{an}	0.001	ft	2.19	
LNAPL-Water Interface in Well	z_{nw}	-0.009	ft	2.20	
Maximum Free LNAPL in Subsurface	z_{max}	0.010	ft	2.38	
LNAPL vertical extent in subsurface		0.019	ft		
vG Alpha scaled to oil-water interactions	α_{nw}	0.397	1/ft	2.25	
vG Alpha scaled to oil-air interactions	α_{an}	0.823	1/ft	2.31	
M (Mualem)	M	0.600	dimensionless	2.6	
Viscosity Ratio	μ_r	95.238	dimensionless		
LNAPL-saturated Hydraulic Conductivity	K_n	4.24E-05	cm/s	3.2	
LNAPL Hydraulic Gradient	J_n	0.166	dimensionless		
Intrinsic Permeability	k	5.81E-08	cm2		

RESULTS

Parameter	*Symbol*	*Value*	*Units*	*API 4760 Equation*	*Report Equation*
Effective water saturation	$S_{e[w]}$	0.754	dimensionless	2.26	1
Effective total liquid saturation	$S_{e[t]}$	1.000	dimensionless	2.32	2
Relative Permeability to LNAPL (Mualem)	$k_{rn}(S_w, S_{ni})$	0.174	dimensionless	3.14	4
Effective Permeability to NAPL	$k_{n\text{-}eff}(S_w, S_{ni})$	1.01E-08	cm^2		
LNAPL Velocity Potential	$v_n(S_{ni})$	9.65E-06	cm/s		7
Critical LNAPL Thickness	$b_{n[crit]}$	0.58	ft	3.25	8

1			**SITE/PROJECT INFORMATION**						**CASE STUDY ASSUMPTIONS**								
2	ARCADIS Infrastructure, environment, buildings		Date:	5/23/2014					Case Name:	W8-02_12-14 at 12.1 ft bgs; capillary data from M2-05_18-20 at 19.3 ft bgs							
3			Site Name:	RACER- Pontiac North Campus					LNAPL Type:	Laboratory Results for W8 LNAPL from well MWW8-65							
4			Site Location (City, ST):	Pontiac, Michigan					Geology Type:	Silt							
5																	
6	**CALCULATION INPUTS**			Associated well: TWW8-02					**INTERIM CALCULATIONS**								
7	***Parameter***		***Symbol***	***Value***	***Units***	***Source***			***Parameter***			***Symbol***	***Value***	***Units***	***API 4760 Equation***	***Report Equation***	
8	**Site Data**								Air-Water Interface in Subsurface			z_{aw}	0	ft	datum		
9	Monitoring Well LNAPL Thickness		b_n	2.88	ft	field data April 7, 2014			Density Ratio			ρ_r	0.861	dimensionless			
10	Water-saturated Hydraulic Conductivity		K_w	6.82E-07	cm/s	AWCD data: M2-05_18-20 (19.3)			Air-LNAPL Interface in Well			z_{an}	0.400	ft	2.19		
11	Water Hydraulic Gradient		J_w	0.411	dimensionless	Fluid Level Data; 4/7			LNAPL-Water Interface in Well			z_{nw}	-2.480	ft	2.20		
12									Maximum Free LNAPL in Subsurface			z_{max}	1.963	ft	2.38		
13	**Fluids Properties Data**								LNAPL vertical extent in subsurface				4.443	ft			
14	LNAPL Density		ρ_n	0.8618	g/cm3	PTS lab data - for MWW8-65			vG Alpha scaled to oil-water interactions			α_{nw}	0.090	1/ft	2.25		
15	LNAPL Viscosity		μ_n	0.155	g/cm-s	PTS lab data - for MWW8-65			vG Alpha scaled to oil-air interactions			α_{an}	0.256	1/ft	2.31		
16	Water Density		ρ_w	1.001	g/cm3	PTS lab data - for MWM2-29			M (Mualem)			M	0.476	dimensionless	2.6		
17	Water Viscosity		μ_w	0.0126	g/cm-s	PTS lab data - for MWM2-29			Viscosity Ratio			μ_r	12.302	dimensionless			
18	Surface Tension		σ_{aw}	71.8	dyne/cm	PTS lab data - for MWM2-29			LNAPL-saturated Hydraulic Conductivity			K_n	4.78E-08	cm/s	3.2		
19	Air-LNAPL Interfacial Tension		σ_{an}	29.4	dyne/cm	PTS lab data - for MWW8-65			LNAPL Hydraulic Gradient			J_n	0.477	dimensionless			
20	LNAPL-Water Interfacial Tension		σ_{nw}	13.5	dyne/cm	PTS lab data - for MWW8-65			Intrinsic Permeability			k	8.76E-12	cm2			
21																	
22	**Aquifer Properties Data**								***RESULTS***								
23	van Genuchten (vG) Alpha		α	4.00E-03	1/cm	RETC results; M2-05_18-20 (19.3)			***Parameter***			***Symbol***	***Value***	***Units***	***API 4760 Equation***	***Report Equation***	
24	van Genuchten (vG) Beta		N	1.910	dimensionless	RETC results; M2-05_18-20 (19.3)			Effective water saturation			$S_{e[w]}$	1.000	dimensionless	2.26	1	
25	Displacement Pressure Head (Air-Water)		h_d	95.70	cm H_2O	AWCD data: M2-05_18-20 (19.3)			Effective total liquid saturation			$S_{e[t]}$	1.000	dimensionless	2.32	2	
26	Porosity		n	0.334	dimensionless	FPM-C data: W8-02_12-14 (12.1)			Relative Permeability to LNAPL (Mualem)			$k_{rn}(S_w, S_{ni})$	0.000	dimensionless	3.14	4	
27	Irreducible Water Saturation		S_{wr}	0.648	dimensionless	FPM-C data: W8-02_12-14 (12.1)			Effective Permeability to NAPL			$k_{n\text{-}eff}(S_w, S_{ni})$	0.00E+00	cm^2			
28	Field LNAPL Saturation		S_{ni}	0.035	dimensionless	FPM-C data: W8-02_12-14 (12.1)			LNAPL Velocity Potential			$v_n(S_{ni})$	0.00E+00	cm/s		7	
29	Residual LNAPL Saturation		S_{nr}	0.035	dimensionless	FPM-C data: W8-02_12-14 (12.1)			Critical LNAPL Thickness			$b_{n[crit]}$	2.75	ft	3.25	8	
30	= values are not used as inputs to calculations																

1			**SITE/PROJECT INFORMATION**						**CASE STUDY ASSUMPTIONS**							
2	ARCADIS infrastructure, environment, buildings		Date:	5/23/2014					Case Name:	W8-02_28-30 at 28.2 ft bgs; capillary data from M2-01_39-40.5 at 39.1 ft bgs						
3			Site Name:	RACER- Pontiac North Campus					LNAPL Type:	Laboratory Results for W8 LNAPL from well MWW8-65						
4			Site Location (City, ST):	Pontiac, Michigan					Geology Type:	Fine sand						
5					Associated well: TWW8-02											
6	**CALCULATION INPUTS**								**INTERIM CALCULATIONS**							
7	***Parameter***		***Symbol***	***Value***	***Units***	***Source***			***Parameter***			***Symbol***	***Value***	***Units***	***API 4760 Equation***	***Report Equation***
8	**Site Data**								Air-Water Interface in Subsurface			z_{aw}	0	ft	datum	
9	Monitoring Well LNAPL Thickness		b_n	2.88	ft	field data April 7, 2014			Density Ratio			ρ_r	0.861	dimensionless		
10	Water-saturated Hydraulic Conductivity		K_w	2.27E-06	cm/s	AWCD data: M2-01_39-40.5 (39.1)			Air-LNAPL Interface in Well			z_{an}	0.400	ft	2.19	
11	Water Hydraulic Gradient		J_w	0.411	dimensionless	Fluid Level Data; 4/7			LNAPL-Water Interface in Well			z_{nw}	-2.480	ft	2.20	
12									Maximum Free LNAPL in Subsurface			z_{max}	1.963	ft	2.38	
13	**Fluids Properties Data**								LNAPL vertical extent in subsurface				4.443	ft		
14	LNAPL Density		ρ_n	0.8618	g/cm3	PTS lab data - for MWW8-65			vG Alpha scaled to oil-water interactions			α_{nw}	0.180	1/ft	2.25	
15	LNAPL Viscosity		μ_n	0.155	g/cm-s	PTS lab data - for MWW8-65			vG Alpha scaled to oil-air interactions			α_{an}	0.513	1/ft	2.31	
16	Water Density		ρ_w	1.001	g/cm3	PTS lab data - for MWM2-29			M (Mualem)			M	0.099	dimensionless	2.6	
17	Water Viscosity		μ_w	0.0126	g/cm-s	PTS lab data - for MWM2-29			Viscosity Ratio			μ_r	12.302	dimensionless		
18	Surface Tension		σ_{aw}	71.8	dyne/cm	PTS lab data - for MWM2-29			LNAPL-saturated Hydraulic Conductivity			K_n	1.59E-07	cm/s	3.2	
19	Air-LNAPL Interfacial Tension		σ_{an}	29.4	dyne/cm	PTS lab data - for MWW8-65			LNAPL Hydraulic Gradient			J_n	0.477	dimensionless		
20	LNAPL-Water Interfacial Tension		σ_{nw}	13.5	dyne/cm	PTS lab data - for MWW8-65			Intrinsic Permeability			k	2.91E-11	cm2		
21																
22	**Aquifer Properties Data**								***RESULTS***							
23	van Genuchten (vG) Alpha		α	8.00E-03	1/cm	RETC results; M2-01_39-40.5 (39.1			***Parameter***			***Symbol***	***Value***	***Units***	***API 4760 Equation***	***Report Equation***
24	van Genuchten (vG) Beta		N	1.110	dimensionless	RETC results; M2-01_39-40.5 (39.1			Effective water saturation			$S_{e[w]}$	1.000	dimensionless	2.26	1
25	Displacement Pressure Head (Air-Water)		h_d	52.10	cm H_2O	AWCD data: M2-01_39-40.5 (39.1)			Effective total liquid saturation			$S_{e[t]}$	1.000	dimensionless	2.32	2
26	Porosity		n	0.345	dimensionless	FPM-C data: W8-02_28-30 (28.2)			Relative Permeability to LNAPL (Mualem)			$k_{rn}(S_w, S_{ni})$	0.000	dimensionless	3.14	4
27	Irreducible Water Saturation		S_{wr}	0.551	dimensionless	FPM-C data: W8-02_28-30 (28.2)			Effective Permeability to NAPL			$k_{n\text{-}eff}(S_w, S_{ni})$	0.00E+00	cm^2		
28	Field LNAPL Saturation		S_{ni}	0.017	dimensionless	FPM-C data: W8-02_28-30 (28.2)			LNAPL Velocity Potential			$v_n(S_{ni})$	0.00E+00	cm/s		7
29	Residual LNAPL Saturation		S_{nr}	0.017	dimensionless	FPM-C data: W8-02_28-30 (28.2)			Critical LNAPL Thickness			$b_{n[crit]}$	1.50	ft	3.25	8
30		= values are not used as inputs to calculations														

1			**SITE/PROJECT INFORMATION**						**CASE STUDY ASSUMPTIONS**							
2	ARCADIS infrastructure, environment, buildings		Date:	5/23/2014					Case Name:	W8-05_23.5-25.5 at 24.0 ft bgs; capillary data from M2-01_39-40.5 at 39.1 ft bgs						
3			Site Name:	RACER- Pontiac North Campus					LNAPL Type:	Laboratory Results for W8 LNAPL from well MWW8-65						
4			Site Location (City, ST):	Pontiac, Michigan					Geology Type:	Fine sand						
5					Associated well: TWW8-01											
6	**CALCULATION INPUTS**								**INTERIM CALCULATIONS**							
7	***Parameter***		***Symbol***	***Value***	***Units***	***Source***			***Parameter***			***Symbol***	***Value***	***Units***	***API 4760 Equation***	***Report Equation***
8	**Site Data**								Air-Water Interface in Subsurface			z_{aw}	0	ft	datum	
9	Monitoring Well LNAPL Thickness		b_n	5.75	ft	field data April 7, 2014			Density Ratio			ρ_r	0.861	dimensionless		
10	Water-saturated Hydraulic Conductivity		K_w	2.27E-06	cm/s	AWCD data: M2-01_39-40.5 (39.1)			Air-LNAPL Interface in Well			z_{an}	0.800	ft	2.19	
11	Water Hydraulic Gradient		J_w	0.411	dimensionless	Fluid Level Data; 4/7			LNAPL-Water Interface in Well			z_{nw}	-4.950	ft	2.20	
12									Maximum Free LNAPL in Subsurface			z_{max}	3.920	ft	2.38	
13	**Fluids Properties Data**								LNAPL vertical extent in subsurface				8.870	ft		
14	LNAPL Density		ρ_n	0.8618	g/cm3	PTS lab data - for MWW8-65			vG Alpha scaled to oil-water interactions			α_{nw}	0.180	1/ft	2.25	
15	LNAPL Viscosity		μ_n	0.155	g/cm-s	PTS lab data - for MWW8-65			vG Alpha scaled to oil-air interactions			α_{an}	0.513	1/ft	2.31	
16	Water Density		ρ_w	1.001	g/cm3	PTS lab data - for MWM2-29			M (Mualem)			M	0.099	dimensionless	2.6	
17	Water Viscosity		μ_w	0.0126	g/cm-s	PTS lab data - for MWM2-29			Viscosity Ratio			μ_r	12.302	dimensionless		
18	Surface Tension		σ_{aw}	71.8	dyne/cm	PTS lab data - for MWM2-29			LNAPL-saturated Hydraulic Conductivity			K_n	1.59E-07	cm/s	3.2	
19	Air-LNAPL Interfacial Tension		σ_{an}	29.4	dyne/cm	PTS lab data - for MWW8-65			LNAPL Hydraulic Gradient			J_n	0.477	dimensionless		
20	LNAPL-Water Interfacial Tension		σ_{nw}	13.5	dyne/cm	PTS lab data - for MWW8-65			Intrinsic Permeability			k	2.91E-11	cm2		
21																
22	**Aquifer Properties Data**								***RESULTS***							
23	van Genuchten (vG) Alpha		α	8.00E-03	1/cm	RETC results; M2-01_39-40.5 (39.1			***Parameter***			***Symbol***	***Value***	***Units***	***API 4760 Equation***	***Report Equation***
24	van Genuchten (vG) Beta		N	1.110	dimensionless	RETC results; M2-01_39-40.5 (39.1			Effective water saturation			$S_{e[w]}$	0.578	dimensionless	2.26	1
25	Displacement Pressure Head (Air-Water)		h_d	52.10	cm H_2O	AWCD data: M2-01_39-40.5 (39.1)			Effective total liquid saturation			$S_{e[t]}$	1.000	dimensionless	2.32	2
26	Porosity		n	0.358	dimensionless	FPM-C data: W8-05_23.5-25.5 (24.			Relative Permeability to LNAPL (Mualem)			$k_{rn}(S_w, S_{ni})$	0.658	dimensionless	3.14	4
27	Irreducible Water Saturation		S_{wr}	0.248	dimensionless	FPM-C data: W8-05_23.5-25.5 (24.			Effective Permeability to NAPL			$k_{n\text{-}eff}(S_w, S_{ni})$	1.91E-11	cm^2		
28	Field LNAPL Saturation		S_{ni}	0.433	dimensionless	FPM-C data: W8-05_23.5-25.5 (24.			LNAPL Velocity Potential			$v_n(S_{ni})$	3.21E-07	cm/s		7
29	Residual LNAPL Saturation		S_{nr}	0.200	dimensionless	FPM-C data: W8-05_23.5-25.5 (24.			Critical LNAPL Thickness			$b_{n[crit]}$	1.50	ft	3.25	8
30	= values are not used as inputs to calculations															