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Revitalizing Auto Communities Environmental Response Trust (RACER)

LNAPL Remediation Technology Bench-Scale Testing Report

Southend of Buick City (Formerly known as General Motors Corporation North American Operations Facility)

Flint, Michigan

March 9, 2012

ARCADIS

LNAPL Remediation Technology Bench-Scale Testing Report

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EXECUTIVE SUMMARY

ARCADIS, on behalf of the Revitalizing Automotive Communities Environmental Response (RACER) Trust, conducted bench-scale treatability studies to evaluate the potential to recover light non-aqueous phase liquid (LNAPL) characterized as hydraulic oil and fuel oil from four areas of interest (AOI) at the Site. The purpose of the testing was to assess LNAPL remediation technology performance on the LNAPL types present at the site using the following remedial technologies:

- Physical (Hydraulic) LNAPL Recovery
- Surfactant-Enhanced LNAPL Recovery
- Thermally-Enhanced LNAPL Recovery via
    - hot water flooding
    - high temperature application (thermal conductive heating)
- In-Situ Chemical Oxidation (ISCO)
- Surfactant-Enhanced ISCO

The results of the bench scale treatability study are outlined below.

- The physical (hydraulic) recovery results showed that all in-situ LNAPL saturations were at residual saturation indicating physical recovery methods may not recover significant LNAPL from the subsurface.
- The surfactant-enhanced LNAPL recovery demonstrated that at the five soil cores representative of subsurface conditions surfactant flooding did not increase the recoverable fraction of LNAPL
- Results of the thermally-enhanced LNAPL recovery by hot water flood at the five soil cores representative of subsurface conditions showed that hot water flooding did not increase the recoverable fraction of LNAPL
- The thermally-enhanced LNAPL recovery by high temperature application via thermal conductive heating was effective at reducing concentrations of TPH in soil from 60% to greater than 99%. This technology is effective; however, implementation of this technology at the scale of Buick City is cost prohibitive.
- Results of the ISCO testing demonstrated that there was no significant reduction in TPH concentration observed for any of the treatments: persulfate, Fenton's, or surfactant-enhanced, on either LNAPL type, which is consistent with the understanding that ISCO is designed to remediate dissolved-phase petroleum impacts.

In summary, the bench scale treatability study found that LNAPL recovery in the Southend appears limited or cost prohibitive even with enhanced remediation methods regardless of the LNAPL type.

1. Overview

Bench-scale testing of light non-aqueous phase liquid (LNAPL) remediation technologies was completed at the Revitalizing Automotive Communities Environmental Response (RACER) Trust Buick City Site (the Site) as required by the *U. S. EPA Final Decision and Response to Comments* (EPA, 2010) and in accordance with the *Corrective Measures Implementation (CMI) Work Plan* (ARCADIS, 2010a); the *LNAPL Remediation Technology Bench-Scale Testing* (ARCADIS, 2010b) (the Work Plan); the *Response to Comments - LNAPL Remediation Technology Bench-Scale Testing Memo* (Response to Comments) (ARCADIS, 2011a), and the *Parameter Selection for Phase I Surfactant-enhanced ISCO Testing Memo* (ISCO Testing Memo) (ARCADIS, 2011b).

The Site is centered at 902 E. Leith Street, Flint, Michigan and consists of 425 acres of former automotive manufacturing property formerly owned and operated by General Motors Corporation (GM). The Site is divided into two areas, the Southend (located South of Leith Street, and the Northend (located north of Leith Street). Manufacturing operations at the Site ceased in December 2010.

The purpose of this report is to provide a summary of the results of the bench-scale testing.

2. Bench-Scale Treatability Studies

ARCADIS conducted bench-scale treatability studies to evaluate the potential to recover two LNAPL types characterized as hydraulic oil and fuel oil from four areas of interest (AOI) at the Site. The purpose of the testing was to assess LNAPL remediation technology performance on the variable soil types and LNAPL types present at the site. As discussed in the Work Plan, the bench-scale tests were conducted to assess the following remedial technologies:

- Physical (Hydraulic) LNAPL Recovery: Recovery of LNAPL through conventional hydraulic methods (pumping, skimming, etc.).
- Surfactant-Enhanced LNAPL Recovery: Enhanced physical recovery of LNAPL by flooding the LNAPL affected area with surfactant and extracting LNAPL.
- Thermally-Enhanced LNAPL Recovery via
    - Hot water flooding: Enhanced physical recovery of LNAPL by flooding the LNAPL affected area with hot water and simultaneously extracting LNAPL.
    - High temperature application: The subsurface is heated above the boiling point of water to increase the volatilization of LNAPL and the resulting vapors are removed with vapor extraction wells. Two common methods are electrical resistive heating (ERH) or thermal conductive heating (TCH).
- In-Situ Chemical Oxidation (ISCO): An oxidant is injected into the subsurface to chemically oxidize the LNAPL.
- Surfactant-Enhanced ISCO: Surfactant is injected with oxidant to increase the solubility of the LNAPL, increasing the rate of chemical oxidation.

3. Methodology

Bench scale tests were conducted by PTS Laboratories (PTS) of Santa Fe Springs, California; Core Laboratories of Houston, Texas; and the ARCADIS Treatability Laboratory in Durham, North Carolina. PTS and Core are geotechnical laboratories that specialize in petrophysical analyses of unconsolidated soil cores. The ARCADIS Treatability Laboratory conducts treatability testing to determine if a proposed technology is suitable for solving a given contamination problem; to validate proposed new technologies; and to optimize parameters such as reagent dose, treatment time, and flow rates for the application of conventional technologies.

The testing was focused on AOIs located at the Southend of the Site and utilized LNAPL and soil cores collected from AOIs characterized predominantly by hydraulic oil (AOI 12-A, -B, -C and AOI 02-B) and fuel oil (AOI 40-A,-B and AOI 16-C). The testing was performed in accordance with the Work Plan submitted October 28th 2010, the Response to Comments submitted March 25th 2011, and the ISCO Testing Memo submitted October 26, 2011. Specific details of the methodologies used to conduct the bench-scale testing are presented in these documents as well as the laboratory reports in Appendices A, B, and C.

The testing was conducted in three parts, preliminary testing, bench-scale testing, and injectability testing. Preliminary fluid property tests were conducted on Site LNAPL and groundwater to provide a basis for selecting enhanced bench-scale test conditions. Methods and results of the preliminary testing are presented in Section 4. Section 5 discusses the methods and results from the bench-scale tests, which consisted of laboratory tests designed to evaluate the efficacy of the five remediation technologies outlined in Section 2. Finally, injectability testing, where water was introduced into monitoring wells to determine the feasibility of reagent injections, is discussed in Section 6.

Section 7 offers conclusions regarding the bench scale tests.

4. Sampling and Analysis: Preliminary Fluid Properties Testing

The purpose of the preliminary fluid properties testing was to evaluate the properties of Site groundwater and LNAPL in natural, heated, and surfactant amended conditions. The results of these tests were utilized to define the parameters of the bench-scale tests that used elevated temperatures or surfactant amendments. A brief description and purpose of each fluid property test is described below:

LNAPL Viscosity: LNAPL at each AOI was analyzed for viscosity at multiple temperatures to target an optimum water temperature for the bench scale thermally-enhanced recovery via hot water flooding test.

Groundwater - LNAPL Interfacial Tension (IFT): Groundwater and LNAPL pairs from each AOI were analyzed for IFT to target an optimum water temperature for the bench scale thermally-enhanced recovery via hot water flooding test.

Surfactant IFT Screening: This IFT test measured the capacity of a surfactant to reduce the water-LNAPL IFT to determine the optimal surfactant and amendment concentration to utilize in the bench scale surfactant-enhanced LNAPL recovery and surfactant–enhanced ISCO tests

Simulated Distillation: This test uses gas chromatography to separate LNAPL constituents by boiling points, ranging from approximately 20° to 600° Celsius and is commonly used for petroleum analyses in place of physical distillation testing. This test was used to determine the method and target temperature for the bench scale thermally-enhanced recovery utilizing high temperature application test.

LNAPL and groundwater samples collected in April 2011 from monitoring wells RFI-16-018, LIF-002-018, RFI-12-23, and LIF-40-072 were sent to PTS Laboratories for analysis of density, viscosity, and three interfacial tension (IFT) pairs (air-water, air-LNAPL and water-LNAPL). LNAPL samples collected from these monitoring wells were also sent to Core Laboratories for simulated distillation analysis. In addition, the LNAPL samples from RFI-12-23 and LIF-40-072 were analyzed by PTS Laboratories for specific gravity, density, viscosity, and IFT at elevated temperature and surfactant interfacial screening. The associated laboratory data reports are included in Appendix A.

4.1 LNAPL Viscosity

4.1.1 Testing

LNAPL samples were sent to PTS Laboratories for analysis of viscosity. LNAPL viscosity was tested utilizing ASTM D445, which assesses fluid viscosity at a controlled temperature. All LNAPL samples were analyzed to determine viscosity at three temperatures: 70°F, 100°F, and 130°F. Additional testing at elevated temperatures (150°F, 180°F) was conducted on the samples from RFI-12-23 and LIF-40-072.

4.1.2 Results and Discussion

The results of the viscosity testing are presented in Table 1 and Figure 1. LNAPL recovery rates are proportional to the viscosity of the LNAPL; therefore reducing the LNAPL viscosity increases the rate of LNAPL recovery. Because the cost to implement hot water flooding increases as the target temperature increases, viscosity versus temperature was evaluated to assess the incremental benefit of increased temperature on reduction of LNAPL viscosity at the site. As expected, viscosity decreased as the temperature increased, as shown in Table 1 and Figure 1. LNAPL viscosity continued to decrease through the highest temperature at which viscosity was evaluated; therefore ARCADIS conservatively recommended the highest temperature PTS could safely operate the bench-scale thermally-enhanced recovery via hot water test, which is 200°F. This temperature is consistent with the field application of hot water flooding which is conducted at temperatures below the boiling point of water, 212 °F

4.2 Interfacial Tension

4.2.1 Testing

Interfacial tension testing determines the IFT between air-water, air-LNAPL, and water-LNAPL fluid pairs were analyzed utilizing ASTM D971. IFT is influenced by temperature; for the fluids under consideration the IFT decreases as temperature increases. The standard interfacial testing protocols provide IFT pairs at room temperature, approximately 72°F. Additional testing of the water-LNAPL pairs were conducted at elevated temperatures, 130°F, 150°F, and 180°F.

4.2.2 Results and Discussion

Results of the testing are presented in Table 2 and Figure 2.

A reduction in interfacial tension between LNAPL and groundwater increases the recoverability of LNAPL in porous media. The results of the IFT analysis presented in Table 2 and Figure 2 shows that the IFT decreases with temperature, as expected. Similar to the viscosity curve in Figure 1, Figure 2 indicates that the IFT continues to decrease with temperature. As such, ARCADIS conservatively selected the highest temperature PTS could safely operate the bench scale thermally-enhanced recovery via hot water flooding test, which is at 200 °F. This temperature is consistent with the field application of hot water flooding which is conducted at temperatures below the boiling point of water, 212 °F.

4.3 Surfactant Interfacial Tension Screening

4.3.1 Testing

This IFT test measured the capacity of a surfactant to reduce the water-LNAPL IFT to determine the optimal surfactant and amendment concentration to utilize in the bench scale surfactant-enhanced LNAPL recovery and surfactant–enhanced ISCO tests. Three surfactants were tested at five amendment concentrations each as shown below:

1. Sodium dioctyl sulfosuccinate (CAS # 577-11-7), commercially known as Aerosol® OT (AOT)
   - Utilized a 75% solution of Aerosol® OT (AOT-75)
   - Concentrations of 0.67%, 1.33%, 2.67%, 4%, and 6.7% by weight were selected based on literature reviews (Shiau, et al, 2003)
2. Gold Crew Release
   - Concentrations of 1%, 2%, 3%, 4.5%, and 5% by volume were selected based on literature reviews (Tworkowski and Baer)
3. Ivey-sol from Ivey International (106 for Fuel Oil and 108 for Hydraulic Oil)
   - Concentrations of 0.005%, 0.125%, 0.5%, 0.75%, and 1.125% weight by volume were recommended by the manufacturer (personal comm., 2011a)

4.3.2 Results and Discussion

The results of the surfactant IFT screening are presented on Table 3 and Figure 3. AOT-75 consistently created the greatest reduction in IFT for both fuel oil and hydraulic oil, Figure 3. AOT is also commercially available through many vendors and is the least expensive of the three surfactants.

A 3% solution of AOT-75 was selected for the bench-scale testing of surfactants because it reduced the IFT below 1 dyne/cm, which is a common target to increase LNAPL recovery (Keuper et. al, 1999). The water-LNAPL IFT was reduced to below 1 dyne/cm at a concentration less than 3%, however the 3% solution provided additional surfactant in case of mass loss due to adsorption to the soil matrix. The 3% solution of AOT-75 was utilized in the surfactant-enhanced LNAPL recovery and surfactant-enhanced ISCO tests (discussed in Sections 4.3 and 4.5, respectively).

4.4 Simulated Distillation

4.4.1 Testing

LNAPL samples were sent to Core Laboratories for simulated distillation testing. This test uses gas chromatography to separate LNAPL constituents by boiling points, ranging from approximately 20° to 600° Celsius and is commonly used for petroleum analyses in place of physical distillation testing.

4.4.2 Results and Discussion

The results of the simulated distillation are presented in Table 4 and Figure 4.

The simulated distillation curves were evaluated to determine the appropriate methodology to conduct the thermally-enhanced LNAPL recovery by high temperature application. The distribution of hydrocarbons in both the fuel oil and hydraulic oil show a significant portion of the LNAPLs have boiling points above 400°C and would be considered semi-volatile organic compounds (SVOCs).

Steam or electric resistive heating (ERH), both conducted at the boiling point of water, are not recommended for SVOCs because a higher temperature is required to volatilize these compounds. The thermal method recommended for SVOCs is thermal conductive heating (TCH) which thermally destroys the LNAPL. TCH is performed by installing metal probes through the LNAPL zone with a spacing of 7 to 12 feet on

center. Soil vapor extraction wells are installed to extract the resulting vapors. The probes are heated to 1000 to 1200°C and target a minimum temperature at the center point of the probes, (DOD, 2005).

Literature reviews and conversations with TCH vendors recommend a target temperature of 335°C - 380°C to completely destroy SVOC type LNAPLs. ARCADIS conservatively operated the test at 380°C for three days (Stegemeier et. al, 2001 and Personal Comm., 2011b). Although the target temperature is below the maximum boiling point of the LNAPL, the increased temperature reduces the vapor pressure and increases the mole fraction in the vapor phase allowing for vaporization at this lower temperature.

5. Sampling and Analysis: Bench-Scale Testing

The results of the preliminary fluid properties testing were used to define the parameters of the bench-scale testing, which consisted of laboratory tests designed to assess the following remedial technologies:

- Physical (Hydraulic) LNAPL Recovery through residual saturation analysis
- Surfactant-Enhanced LNAPL Recovery through surfactant flooding of soil cores
- Thermally-Enhanced LNAPL Recovery via
    - hot water flooding of soil cores
    - thermal conductive heating
- In-Situ Chemical Oxidation
- Surfactant-Enhanced ISCO

The following section summarizes the sampling, methodology, and results of the bench-scale tests.

5.1 Soil Core Collection and Sample Interval Selection

A total of 49 feet of soil core were collected from ten borings located in the Southend AOIs where LNAPL is present in the subsurface. A hollow-stem auger rig with a two-foot long and three-inch in diameter Shelby tube sampler was used to collect cores with as little disturbance to the pore structure as possible. Soil cores were collected from across the LNAPL smear zone, which was partially located below the water table at some locations. The two-foot cores were packed vertically, frozen using dry ice, and shipped with fresh dry ice to PTS for petrophysical analyses.

The process for selecting the sample intervals for laboratory analysis of undisturbed soil cores is iterative. First, the petrophysical laboratory photographs the frozen cores using natural and ultraviolet light. The natural light photographs show the soil structure while the ultraviolet photographs were used to assess LNAPL distribution in the soil cores. The polyaromatic compounds in petroleum products fluoresce within the visible light spectrum when exposed to ultraviolet light; therefore, a brighter blue fluorescence generally indicates higher LNAPL saturation zones. ARCADIS reviewed the core photographs generated by the laboratory and selected core segments for testing based on the soil structure observations and visual degree of LNAPL impact. The most

LNAPL-impacted portions of the cores were selected for petrophysical tests by targeting the areas which showed the highest UV fluorescence.

The soil core photographs are shown along-side soil boring logs from the same or nearby locations in Appendix B. The sample intervals selected for each core are also shown on the figures in Appendix B.

5.2 Physical (Hydraulic), Surfactant-Enhanced, and Thermally-Enhanced by Hot Water Flood LNAPL Recovery

5.2.1 Testing

Soil cores representing the highest UV response from a range of soil types and AOIs were selected through the process described above for additional testing at PTS Laboratories. The following tests were conducted to evaluate the incremental increase in recovery by enhanced technologies by quantifying changes in LNAPL saturation of soil cores:

- **Physica**l: Residual Saturation by Water Drive (RSWD) - this method forces water though the sample to displace free LNAPL. This test provides porosity, field LNAPL saturation, and residual LNAPL saturation under water displacement conditions, which is expected to be greater than residual saturation under air displacement conditions. The test is conducted at hydraulic gradients that far exceed typical site conditions; hence, values for residual LNAPL saturation measured using this method will be conservative as compared to field residual saturation.
- **Surfactant-enhanced:** Residual Saturation by Water Drive plus Surfactant Drive (RSWD + Surf) - this test is similar to RSWD; however, after RSWD is completed surfactant is added to the water and the test is repeated. The selected surfactant (AOT) and the concentration of the surfactant (3%) were based on the results of the IFT screening described in Section 4.3.
- **Thermally-Enhanced by How Water Flood:** Residual Saturation by Water Drive plus Hot Water Flood (RSWD + HWF) - this test is similar to RSWD; however, after RSWD is completed, the test is repeated with heated water driven through the soil core. The temperature of the hot water flood was determined from the temperature-viscosity and temperature-IFT relationships described in Section 4.1 and 4.2-Revise sentence).

5.2.2 Results and Discussion

The results of these tests are broken down into the three methods, physical recovery, surfactant-enhanced recovery, and thermally-enhanced recovery by hot water flood. The physical recovery provides the LNAPL recovery baseline to compare any additional LNAPL recovery from surfactant or thermally-enhanced recovery tests. The physical recovery test method, RSWD, provides the field LNAPL saturation and the residual LNAPL saturation. The difference between the field LNAPL saturation and residual LNAPL saturation is the recoverable fraction of LNAPL through physical recovery methods, pumping, skimming, etc.

The additional recovery of LNAPL beyond the RSWD-derived residual LNAPL saturation due to the surfactant or hot water flood represents the additional fraction of LNAPL that can be recovered through these enhanced methods.

5.2.2.1 Physical (Hydraulic) Recovery

LNAPL saturation was assessed on soil cores collected from the Site through the petrophysical laboratory analysis Residual Saturation by Water Drive (RSWD). A total of twelve RSWD test were performed on samples collected from the Southend AOIs where LNAPL is located in the subsurface. The testing showed that all twelve samples were at residual saturation, indicating LNAPL is immobile as defined by the ITRC (2009) under saturated conditions.

The lab results indicate that the potential to recover LNAPL through hydraulic methods are limited. However, field observations of LNAPL accumulation in monitoring wells in the Southend demonstrate that LNAPL is recoverable to some degree. An LNAPL transmissivity testing program that is being performed at the site will help resolve the LNAPL recoverability on a field scale.

LNAPL saturation testing results are shown in Table 5. All petrophysical testing laboratory reports are presented in Appendix B. PTS noted that two of the tests, LIF-40-011 at 10.2 feet below ground (fbg) LIF-16-017 at 12.9 fbg, were terminated early due to low permeability of the soil cores.

5.2.2.2 Surfactant-Enhanced LNAPL Recovery

At six of the locations that RSWD testing was performed, a second water drive was conducted with a solution of AOT-75 to determine if additional LNAPL can be extracted from the soil cores if a surfactant was introduced during recovery efforts. LNAPL saturation results are shown in Table 5.

Only one of the six locations resulted in additional LNAPL recovery, LIF-40-004 at 27.1 fbg. LNAPL saturation was reduced from 20.1% to 7.6%, a reduction of 64%. LIF-40-004 was installed in the vicinity of a collapsed tunnel and the sands encountered in this boring are collapsed backfill that is not consistent with the general site geology, which is generally finer grained glacially deposited materials. This location was included to evaluate enhanced technologies in optimum conditions at the request of EPA.

Further, PTS labs identified a "gel" plugging the injection side of the soil core while injecting the surfactant amended water into the core at LIF-02-007 at 10.1 fbg and LIF-12-018 at 11.7 fbg. ARCADIS reviewed literature on AOT and determined that 3% is above the solubility limit for AOT-75 and might be creating the plugging of the core. The remaining tests were conducted with a 2% concentration, the solubility limit of AOT-75, which still reduces the IFT to under the target of 1 dyne/cm; however plugging was still observed. On average 60% less pore volumes were passed through the soil cores due to the reduction in permeability. Only the sandy soil core from LIF-40-004 did not exhibit a decrease in pore volumes due to plugging. It is important to note that in the five soil cores without additional LNAPL recovery, at least 1.4 pore volumes of surfactant amended water was flushed through the core with no observed LNAPL. The observed plugging was a secondary affect, reducing the permeability of the soil and inhibiting injections, but was not the reason LNAPL was not recovered.

5.2.2.3 Thermally-Enhanced LNAPL Recovery by Hot Water Flood

At six of the locations that RSWD testing was performed, a second water drive was conducted with water heated to 200°F to determine if additional LNAPL can be extracted from the soil cores if hot water flooding was conducted at the site. LNAPL saturation results are shown in Table 5.

Only one of the six locations resulted in additional LNAPL recovery, LIF-40-004 at 27.3 fbg, the same location and similar depth that had success with the surfactant flood. LNAPL saturation was reduced from 12.0% to 10.7%, a reduction of 11%. Again, LIF-40-004 was installed in the vicinity of a collapsed tunnel and the sands encountered in this boring are collapsed backfill that is not consistent with the general site geology, which is characterized by finer grained glacial depositions. This location was included to evaluate enhanced technologies in optimum conditions at the request of EPA.

PTS noted that gas and odors were observed during the hot water injections, which may be volatilization of LNAPL due to the heated water. It was determined that this

represents a limited percentage of the observed LNAPL and was not a major contributor to LNAPL removal.

5.3 Thermally-Enhanced Recovery by High Temperature Application

5.3.1 Testing

Based on the soil core photographs described in Section 5.1, soil collected from LIF-16-017 (fuel oil) and LIF-12-010 (hydraulic oil) were selected for thermally-enhanced recovery by high temperature application. ARCADIS evaluated two soil samples from the hydraulic oil area, AOI 12, and selected the core with the highest concentration for the testing.

The high temperature application test was designed to mimic conditions at the target temperatures achieved utilizing thermal conductive heating (TCH) based on the results of the simulated distillation, described in Section 4.1.4, Full-scale TCH is implemented by installing metal probes through the LNAPL zone with a spacing of 7 to 12 feet on center. Soil vapor extraction wells are installed to extract the resulting vapors. The probes are heated to 1000 to 1200°C and target a minimum temperature at the center point of the probes, the target temperature.

Literature reviews and conversations with TCH vendors recommend a target temperature of 335°C - 380°C to completely destroy LNAPLs similar to those found at Buick City. ARCADIS conservatively operated the test at 380°C for three days (Stegemeier et al, 2001 and Personal Comm., 2011b). Although the target temperature is below the maximum boiling point of the LNAPL, the increased temperature reduces the vapor pressure and increases the mole fraction in the vapor phase allowing for vaporization at this lower temperature.

For each selected sample interval, duplicate soil samples were sent to TestAmerica for Total petroleum hydrocarbon (TPH) analysis by modified Method 8015/MDEQ 507. Samples were submitted prior to treatment (baseline), and after treatment (post-treatment). Additional details on the methodology and laboratory reports are included in the ARCADIS Treatability Report presented in Appendix C.

5.3.2 Results and Discussion

The results of the TPH analyses for thermally-enhanced recovery by high temperature application are provided in Table 6. The fuel oil sample showed a decrease in TPH

from 16,400 milligrams per kilogram (mg/kg) in the baseline analysis to non-detect resulting in a greater than 99% reduction in TPH over the three day test (using the detection limit to calculate the reduction).

The results of the TPH analysis for sample hydraulic oil sample had an average C_{10}-C_{20} TPH concentration of 680 mg/kg, and an average C_{20}-C_{34} TPH concentration of 3,350 mg/kg. Post thermal testing C_{10}-C_{20} TPH concentration was not detected and the average C_{20}-C_{34} TPH concentration of 1,350 mg/kg is a 60% reduction for that carbon range.

5.4 In-Situ Chemical Oxidation (ISCO) and Surfactant-Enhanced ISCO

5.4.1 Testing

Bench-scale ISCO and surfactant-enhanced ISCO testing began in June 2011. Each reactor consists of a 250 milliliter (mL) jar with Site groundwater and LNAPL collected from AOI 12 (RFI-12-23, hydraulic oil) and AOI 40 (RFI-40-07R2, fuel oil) designed to create a constant surface area of LNAPL and groundwater interface during the fourteen day testing period. Prior to the addition of any reagents, each reactor received 147 mL of homogenized location-specific groundwater and 10 mL of the respective location-specific LNAPL. To provide sufficient volume for visual observations of LNAPL treatment or other changes in appearance, a volume of 10 mL of LNAPL was determined to form a measureable LNAPL band at approximately 0.25 inches thick inside the 250 mL reactor. The following treatments were prepared to study the efficacy of ISCO to destroy free phase LNAPL from the Site:

1. **Control 1**: Room temperature control (no oxidant added)

2. **Control 2**: Heated (50°C) control (no oxidant added)

3. **Sodium Persulfate with Iron Activation**: Klozür™ sodium persulfate ($Na_2S_2O_8$, CAS# 7775-27-1; 99.4% purity, obtained by FMC Corporation) chemically activated with ferrous iron chelated by citric acid (dosed to 400 grams per liter [g/L] sodium persulfate, 500 milligrams per liter [mg/L] ferrous iron and citric acid at 5:1 iron [Fe] to citric acid molar ratio)

4. **Sodium Persulfate with Alkaline Activation**: Klozür™ sodium persulfate chemically activated with strong alkaline condition treatment (dosed to 400 g/L sodium persulfate, and sodium hydroxide [pH >11.5])

5. **Sodium Persulfate with Heat Activation:** Klozür™ sodium persulfate thermally activated (dosed to 400 g/L sodium persulfate and temperature at 50°C)

6. **Fenton's Reagent with EDTA**: Hydrogen peroxide chemically activated with Dissolvine® E-FE-13 ferrous iron chelated by Ethylenediaminetetraacetic acid (EDTA) ($C_{10}H_{12}FeN_2O_8Na$. $3H_2O$, CAS# 15708-41-5; 89% purity, obtained by FMC Corporation) (dosed to 80 g/L hydrogen peroxide, 100 mg/L ferrous iron as Fe EDTA at 1:1 Fe to EDTA molar ratio)

7. **Surfactant-Enhanced:** AOT at 2% and Klozür™ sodium persulfate chemically activated with strong alkaline condition treatment (dosed to 400 g/L sodium persulfate, and sodium hydroxide [pH >11.5])

A total of fourteen reactors were prepared, seven reactors per LNAPL type. The reactors were placed on a roller table for a fourteen day period to receive gentle agitation and ensure adequate contact between the LNAPL and the oxidants.

After 14 days of agitation the LNAPL bands were re-measured with a ruler (no changes in LNAPL thickness observed); the reactors were analyzed for total oxidant demand (TOD); and the reactors were then sent to TestAmerica in North Canton, Ohio, to be extracted in their entirety and analyzed for total petroleum hydrocarbons (TPH) by modified Method MDEQ 507. Additional details on the methodology and laboratory reports are included in the ARCADIS Treatability Report presented in Appendix C.

5.4.2 Results and Discussion

The results of the ISCO and surfactant-enhanced ISCO testing are presented in Table 7 and Figures 5 and 6. The standard error bars shown in Figures 5 and 6 are equivalent to the standard error for groundwater analytical results, 30% of the hydrocarbon concentration.

5.4.2.1 Total Oxidant Demand Discussion

The results of the TOD analysis indicate that in Treatments #3, #4, #5, and #7 the sodium persulfate oxidant utilization ranged from 17% to 88%; while the hydrogen peroxide present in the Fenton's/EDTA oxidant in Treatment #6 was 100% utilized.

Some activator chemistries applied with the sodium persulfate oxidant performed better than others as not only illustrated by percent utilization, but also with decreases in pH (persulfate consumption yields sulfuric acid). Treatment #'s 3, 5 and 6 performed similarly on the AOI-40 fuel oil and the AOI-12 hydraulic oil, while Treatment #4 performed better with the AOI-40 fuel oil than the AOI-12 hydraulic oil as indicated by the larger decrease in pH and increase in percent utilization.

Treatment #5, which was heat activated, proved to be the best activator of sodium persulfate for both AOI-40 fuel oil and AOI-12 hydraulic oil.

Treatment #7, which used AOT, exhibited greater oxidant utilization for both the AOI-40 fuel oil and AOI-12 hydraulic oil than the identical reactors without surfactant (treatment #4). Oxidant utilization increased by 6% in the AOI-40 reactor and by 15% in the AOI-12 reactor with the addition of 2% AOT surfactant by weight.

One potential cause for the increase in TOD for both AOI-40 and AOI-12 in treatment #7 is that the AOT acted as an additional oxidant demand for the sodium persulfate, leaving less sodium persulfate to interact with LNAPL. This may have caused the percent utilization values in Table 7 to be skewed artificially high. While there was an increase in TOD when compared with the alkaline activated reactors from initial testing, there was no observable destruction of LNAPL with the addition of AOT surfactant in either reactor during surfactant-enhanced ISCO testing.

5.4.2.2 TPH Discussion

Analytical results of TPH from AOI 40 and AOI 12 samples are summarized in Table 7. Figures 5 and 6 show the results plotted with error bars representing the standard lab error for AOI 40 and AOI 12, respectively.

The results indicate there is no significant reduction in TPH concentration for any of the treatments from either AOI-40 or AOI-12, even though the oxidant concentration added to the reactors was much higher than would typically be used in the field. The mass of oxidant added was enough to completely oxidize the carbon present as TPH contaminants. The relative lack of oxidation is believed to be due to the fact that ISCO is primarily effective on dissolved-phase contaminants, rather than nonaqueous phase contaminants. For example, Treatments # 3, 4, 5, and 7 received a total concentration of 400 g/L sodium persulfate, which is roughly twenty times greater than typical concentrations used in the field, and demonstrated insignificant treatment of the free-phase LNAPL.

Even the addition of surfactant to enhance ISCO via increased solubility of the LNAPL had no significant reduction in the TPH concentration. The addition of AOT surfactant serves to reduce the IFT between the LNAPL and enhance the solubility of the LNAPL into groundwater. The testing performed at the ARCADIS Treatability Laboratory does not allow for the quantification of an increase in solubility of the LNAPL, however, it does demonstrate that regardless of any effect on LNAPL solubility, the addition of AOT does not improve LNAPL destruction with sodium persulfate under alkaline activation conditions.

Note that the concentrations of TPH C_{10}-C_{20} and C_{20}-C_{34} both increased in the two reactors dosed with surfactant. The increase in TPH concentration is attributed to the laboratory response of surfactant, a C_{20} compound.

The Work Plan called for a second phase of ISCO testing utilizing soil slurries to mimic optimized in-situ conditions. However, based on the results of the reactor tests, the second phase was not conducted.

6. Injectability Testing

On October 14, 2011 pass/fail injectability testing was performed at one well within each of the Southend AOIs (LIF-02-007, LIF-12-010, LIF-16-017, and LIF-40-022). This test was conducted to determine if injecting a reagent into the subsurface would be possible if the bench scale tests indicated surfactant flooding, hot water flooding, or ISCO would be an effective remedy.

Approximately 10 gallons of water was added to each well to quickly increase the water level. Water levels were measured with a transducer and were monitored for at least thirty minutes. Based on ARCADIS' standard operating practices, a well would be considered passing if the water table recovers to 90% within 30 minutes of the test.

A summary of the tests results is provided in Table 8 and transducer data is included as Appendix D. All locations except LIF-40-022 passed the test, indicating that injections to the subsurface may be feasible. Based on the limited success of the bench scale tests, additional testing to determine maximum injection rates was not conducted.

7. Conclusions

The bench-scale testing of five remedial options were evaluated in this program. LNAPL recovery in the Southend appears limited even utilizing enhanced remediation methods. In summary:

- Physical (Hydraulic) Recovery: In-situ LNAPL saturations at all soil cores samples were at residual saturation indicating physical recovery methods may not recover significant LNAPL from the subsurface.
- Surfactant-enhanced LNAPL Recovery: At five soil cores surfactant flooding did not increase the recoverable fraction of LNAPL under these soil conditions. Only one of the six samples demonstrated an increase in LNAPL recovery from physical recovery. The test indicates at that location LNAPL saturation could be reduced by 64%. However, 36% of the LNAPL would still be left in place and the soil conditions at that core are not representative of site conditions.
- Thermally-enhanced LNAPL Recovery by Hot Water Flood: At five soil cores hot water flooding did not increase the recoverable fraction of LNAPL under these soil conditions. Only one of the six samples demonstrated an increase in LNAPL recovery from physical recovery. The test indicates at that location LNAPL saturation could be reduced by 11%. However, 89% of the LNAPL would still be left in place and the soil conditions at that core are not representative of site conditions.
- Thermally-enhanced LNAPL Recovery by High Temperature Application: Applying a thermal conductive heating approach to the LNAPL affected soil reduced concentrations of TPH in soil from 60% to greater than 99%. This technology is the most promising in removing significant amounts of LNAPL from the subsurface. However, implementation of this technology is expensive. Costs range from $200 to $670 per cubic yard (DOD, 2006) and the largest TCH project conducted to date was 48,000 cubic yards (TerraTherm website, TerraTherm is the only vendor licensed in the United States to offer this technology for remediation). By comparison, preliminary estimates for Buick City's LNAPL affected volume is approximately 300,000 cubic yards.
- In-Situ Chemical Oxidation: As expected, there was no significant reduction in TPH concentration observed for any of the treatments: persulfate, Fenton's, or surfactant-enhanced, on either LNAPL type, even though the oxidant concentration added to the reactors was much higher than would typically be used in the field. The relative lack of oxidation is believed to be due to the fact

that ISCO is primarily effective on dissolved-phase contaminants, rather than nonaqueous phase contaminants.

- Injectability testing suggests that injecting reagent into the subsurface is possible. However, water drive tests performed by PTS suggest that most of the cores impacted with LNAPL had limited permeability. This is consistent with the heterogeneity of the soils and the distribution of LNAPL observed at Buick City. In heterogeneous environments LNAPL is often trapped in the low conductivity fine-grained soils and injections migrate through higher conductivity lenses. This results in injections of reagents that by-pass the LNAPL.

8. References

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Tables

Table 1 : Fluid Properties

Bench Scale Results Summary

Buick City, Flint, Michigan

AOI/NAPL TYPE	MATRIX	TEMPERATURE, °F	SPECIFIC GRAVITY	DENSITY, g/cc	VISCOSITY	
					centistokes	centipoise
AOI 40 Fuel Oil	Water	70	0.9980	0.9960	1.03	1.02
		100	0.9981	0.9912	0.694	0.688
		130	0.9973	0.9833	0.550	0.541
		150	0.9988	0.9793	0.476	0.466
		180	0.9694	0.9627	0.394	0.379
	NAPL	70	0.7890	0.7874	1.51	1.19
		100	0.7779	0.7725	1.23	0.949
		130	0.7721	0.7613	0.987	0.751
		150	0.7537	0.7522	0.901	0.677
		180	0.7414	0.7363	0.759	0.559
AOI 16 Fuel Oil	Water	70	1.001	0.9986	1.057	1.055
		100	1.001	0.9943	0.704	0.700
		130	1.002	0.9884	0.553	0.547
	NAPL	70	0.8722	0.8704	5.92	5.15
		100	0.8563	0.8504	3.93	3.34
		130	0.8604	0.8483	2.74	2.33
AOI 12 Hydraulic Oil	Water	70	0.9994	0.9974	1.025	1.022
		100	0.9997	0.9928	0.693	0.688
		130	1.001	0.9872	0.548	0.541
		150	0.9822	0.9802	0.476	0.466
		180	0.9709	0.9642	0.404	0.390
	NAPL	70	0.8827	0.8809	54.1	47.7
		100	0.8740	0.8679	22.4	19.4
		130	0.8715	0.8593	12.3	10.6
		150	0.8534	0.8516	9.06	7.71
		180	0.8476	0.8417	6.03	5.08
AOI 02 Hydraulic Oil	Water	70	1.000	0.9980	0.986	0.984
		100	1.000	0.9931	0.698	0.694
		130	1.001	0.9873	0.558	0.551
	NAPL	70	0.9081	0.9063	400	362
		100	0.8994	0.8932	130	116
		130	0.8993	0.8867	52.5	46.6

Table 2: Interfacial Tension

Bench Scale Results Summary

Buick City, Flint, Michigan

AOI / NAPL Type	PHASE PAIR		TEMPERATURE,	INTERFACIAL TENSION,
	PHASE	PHASE	°F	Dynes/centimeter
AOI 40 Fuel Oil	Groundwater	Air	72.5	68.8
	NAPL	Air	72.5	23.8
	Groundwater	NAPL	72.5	7.6
	Groundwater	NAPL	130	10.3
	Groundwater	NAPL	150	7.7
	Groundwater	NAPL	180	5.2*
AOI 16 Fuel Oil	Groundwater	Air	72.5	72.3
	NAPL	Air	72.5	28.4
	Groundwater	NAPL	72.5	12.8
AOI 12 Hydraulic Oil	Groundwater	Air	73.4	67.7
	NAPL	Air	73.4	29.9
	Groundwater	NAPL	73.4	14.7
	Groundwater	NAPL	130	14.6
	Groundwater	NAPL	150	12.7
	Groundwater	NAPL	180	12.3*
AOI 02 Hydraulic Oil	Groundwater	Air	73.4	58.5
	NAPL	Air	73.4	32.4
	Groundwater	NAPL	73.4	12.1

Notes:

*Laboratory was unable to obtain reproducible measurements due to the high temperature of the fluid system; the most representative values are reported. IFT measurements were also attempted by spinning drop method at 180° but were unable to measure due to oil drops adhering to the glass capillary.

Table 3: Surfactant Screening of Groundwater-LNAPL Interfacial Tensions
Bench Scale Results Summary
Buick City, Flint, Michigan

AOI/FUEL TYPE	SURFACTANT	CONCENTRATION	PRICE/GALLON	RELATIVE COST	SURFACTANT CONCENTRATION MEASURMENT METHOD	AVERAGE IFT
AOI 40 Fuel Oil	AOT 75%	0.67	$26	$17	wt	1.32
		1.33	$26	$35	wt	0.725
		2.67	$26	$70	wt	0.348
		4.00	$26	$105	wt	0.247
		6.67	$26	$175	wt	0.142
	Gold Crew Release	1	$38	$38	v/v	1.74
		2	$38	$76	v/v	1.06
		3	$38	$114	v/v	0.737
		4.5	$38	$171	v/v	0.764
		6	$38	$228	v/v	0.513
	Ivey-sol 106	0.005	$47	$0	w/v	NA
		0.125	$47	$6	w/v	9.71
		0.5	$47	$24	w/v	4.27
		0.75	$47	$35	w/v	4.41
		1.125	$47	$53	w/v	3.09
AOI 12 Hydraulic Oil	AOT 75%	0.67	$26	$18	wt	2.18
		1.33	$26	$35	wt	1.4
		2.67	$26	$70	wt	0.791
		4.00	$26	$105	wt	0.629
		6.67	$26	$175	wt	0.674
	Gold Crew Release	1	$38	$38	v/v	4.92
		2	$38	$76	v/v	1.36
		3	$38	$114	v/v	1.09
		4.5	$38	$171	v/v	0.786
		6	$38	$228	v/v	0.716
	Ivey-sol 108	0.005	$49	$0	w/v	NA
		0.125	$49	$6	w/v	NA
		0.5	$49	$25	w/v	5.68
		0.75	$49	$37	w/v	6.36
		1.125	$49	$56	w/v	6.6

Notes:
NA - Not analyzed, IFT was too high for test method
v/v - percent volume by volume
w/v - percent weight by volume
wt - percent weight

Table 4 : Simulated Distillation

Bench Scale Results Summary

Buick City, Flint, Michigan

FUEL OIL				HYDRAULIC OIL			
AOI 40		AOI 16		AOI 12		AOI 02	
TEMP (°C)	PERCENT YIELD	TEMP (°C)	PERCENT YIELD	TEMP (°C)	PERCENT YIELD	TEMP (°C)	PERCENT YIELD
28	0.5%	109	0.5%	171	0.5%	311	0.5%
78	5.0%	172	5.0%	223	5.0%	382	5.0%
92	10.0%	196	10.0%	246	10.0%	407	10.0%
110	15.0%	211	15.0%	267	15.0%	422	15.0%
120	20.0%	221	20.0%	291	20.0%	432	20.0%
133	25.0%	229	25.0%	318	25.0%	440	25.0%
146	30.0%	239	30.0%	355	30.0%	447	30.0%
159	35.0%	246	35.0%	391	35.0%	453	35.0%
173	40.0%	253	40.0%	416	40.0%	458	40.0%
191	45.0%	260	45.0%	433	45.0%	464	45.0%
219	50.0%	268	50.0%	447	50.0%	469	50.0%
334	55.0%	276	55.0%	460	55.0%	475	55.0%
463	60.0%	287	60.0%	474	60.0%	481	60.0%
547	65.0%	301	65.0%	489	65.0%	487	65.0%
		321	70.0%	507	70.0%	493	70.0%
		364	75.0%	534	75.0%	503	75.0%
		467	80.0%	573	80.0%	522	80.0%
		558	85.0%			570	85.0%

Table 5: Laboratory LNAPL Saturations
Bench Scale Results Summary
Buick City, Flint, Michigan

SAMPLE ID	DEPTH (ft)	CONCENTRATION OF SURFACTANT	NAPL SATURATION (% Pore Space)				REDUCTION IN LNAPL SATURATION FROM RSWD
			FIELD	RSWD (residual saturation)	AFTER SURFACTANT FLOOD	AFTER HOT WATER FLOOD at 200°F	
LIF-02-007 (8-10')	10.1	2.25%	14.4	14.4	14.4	---	0.00%
LIF-12-018 (10-12')	11.7	2.25%	8.7	8.7	8.7	---	0.00%
LIF-12-010 (20-22)	20.65	1.5%	10.3	10.3	10.3	---	0.0%
LIF-16-017 (12-14)	13.1	1.5%	20.5	20.5	20.5	---	0.0%
LIF-40-011 (9-11)	10.0	1.5%	10.0	10.0	10.0	---	0.0%
LIF-40-004 (26-28)	27.1	1.5%	20.1	20.1	**7.6**	---	62.4%
LIF-02-018 (9-11)	10.1	---	2.1	2.1	---	2.1	0.0%
LIF-12-010 (20-22)	21.1	---	12.4	12.4	---	12.4	0.0%
LIF-12-024 (8-10')	9.35	---	5.5	5.5	---	5.5	0.0%
LIF-16-017 (12-14)	12.9	---	21.4	21.4	---	21.4	0.0%
LIF-40-011 (9-11)	10.2	---	3.2	3.2	---	3.2	0.0%
LIF-40-004 (26-28)	27.3	---	12.0	12.0	---	**10.7**	10.7%

Table 6: Results of Thermally Enhanced Recovery by High Temperature Application
Bench Scale Results Summary
Buick City, Flint, Michigan

AOI/LNAPL TYPE	SAMPLE ID	BASELINE		POST TREATMENT (Heated for 3 Days)		PERCENT REDUCTION	
		C_{10}-C_{20}	C_{20}-C_{34}	C_{10}-C_{20}	C_{20}-C_{34}	C_{10}-C_{20}	C_{20}-C_{34}
		(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
AOI 16 Fuel Oil	LIF-16-017 (12-24)	3,500	14,000	<17	<17	99.5%	99.9%
	LIF-16-017 (12-24) Dup	3,300	12,000	<17	<17	99.5%	99.9%
	Average	3,400	13,000	<17	<17	99.5%	99.9%
AOI 12 Hydraulic Oil	LIF-12-010 (18-20)	660	3,200	<84	1,100	87.3%	65.6%
	LIF-12-010 (18-20) Dup	700	3,500	<84	1,600	88.0%	54.3%
	Average	680	3,350	<84	1,350	87.6%	60.0%
AOI 12 Hydraulic Oil	LIF-12-018 (10-12)	320	110	LIF-12-018 (10-12) Not Tested Because of Low TPH Concentrations			
	LIF-12-018 (10-12) Dup	280	100				
	Average	300	105				

Table 7: Results of ISCO Testing
Bench Scale Results Summary
Buick City, Flint, Michigan

SAMPLE NUMBER AND TREATMENT	AOI / NAPL TYPTE	pH	ORIGINAL OXIDANT ADDITION	OXIDANT UTILIZATION		C_{10}-C_{20}	C_{20}-C_{34}	
		s.u.	(g/L)	(g/L)	% Utilization	(µg/L)	(µg/L)	
#1 Room Temp Control	AOI-40 Fuel Oil	--	0	--	--	5,000,000	1,300,000	U
#2 50°C Control		--	0	--	--	5,100,000	1,200,000	U
#3 Iron Activated		1	400	66.8	17%	5,200,000	1,100,000	U
#4 Alkaline Activated		10	400	114.4	29%	4,900,000	1,000,000	U
#5 Heat Activated 50°C		1	400	328.6	82%	4,300,000	1,100,000	U
#6 Fentons EDTA		7	80	79.9	100%	5,500,000	1,300,000	U
#7 Surfactant Enhanced		---	400	138.2	35%	6,400,000	2,100,000	
#1 Room Temp Control	AOI-12 Hydraulic Oil	--	0	--	--	7,800,000	3,300,000	
#2 50°C Control		--	0	--	--	8,800,000	3,700,000	
#3 Iron Activated		1	400	66.8	17%	8,000,000	3,900,000	
#4 Alkaline Activated		14	400	66.8	17%	7,200,000	3,300,000	
#5 Heat Activated 50°C		1	400	352.4	88%	7,900,000	3,900,000	
#6 Fentons EDTA		7	80	79.9	100%	7,800,000	3,400,000	
#7 Surfactant Enhanced		---	400	126.3	32%	11,000,000	7,000,000	

Table 8: Results of Injectability Testing
Bench Scale Results Summary
Buick City, Flint, Michigan

MONITORING WELL ID	INITIAL WATER RISE (ft)	RECOVERY AFTER 30 MINUTES	PASS/FAIL
LIF-02-007	3.88	99%	Pass
LIF-12-010	3.56	98%	Pass
LIF-16-017	1.32	92%	Pass
LIF-40-022	6.99	23%	Fail

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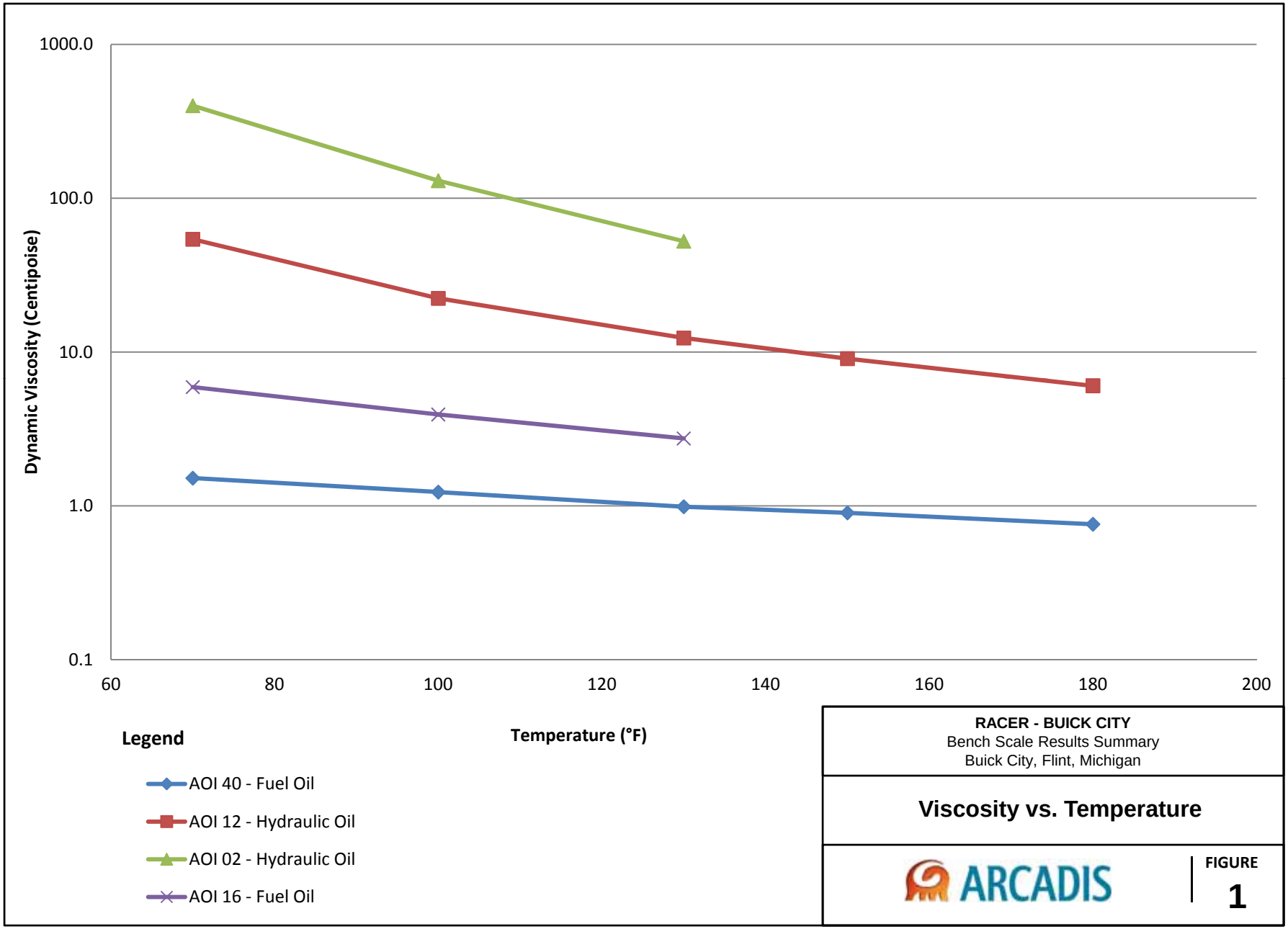
Figures



RACER - BUICK CITY
Bench Scale Results Summary
Buick City, Flint, Michigan

Viscosity vs. Temperature

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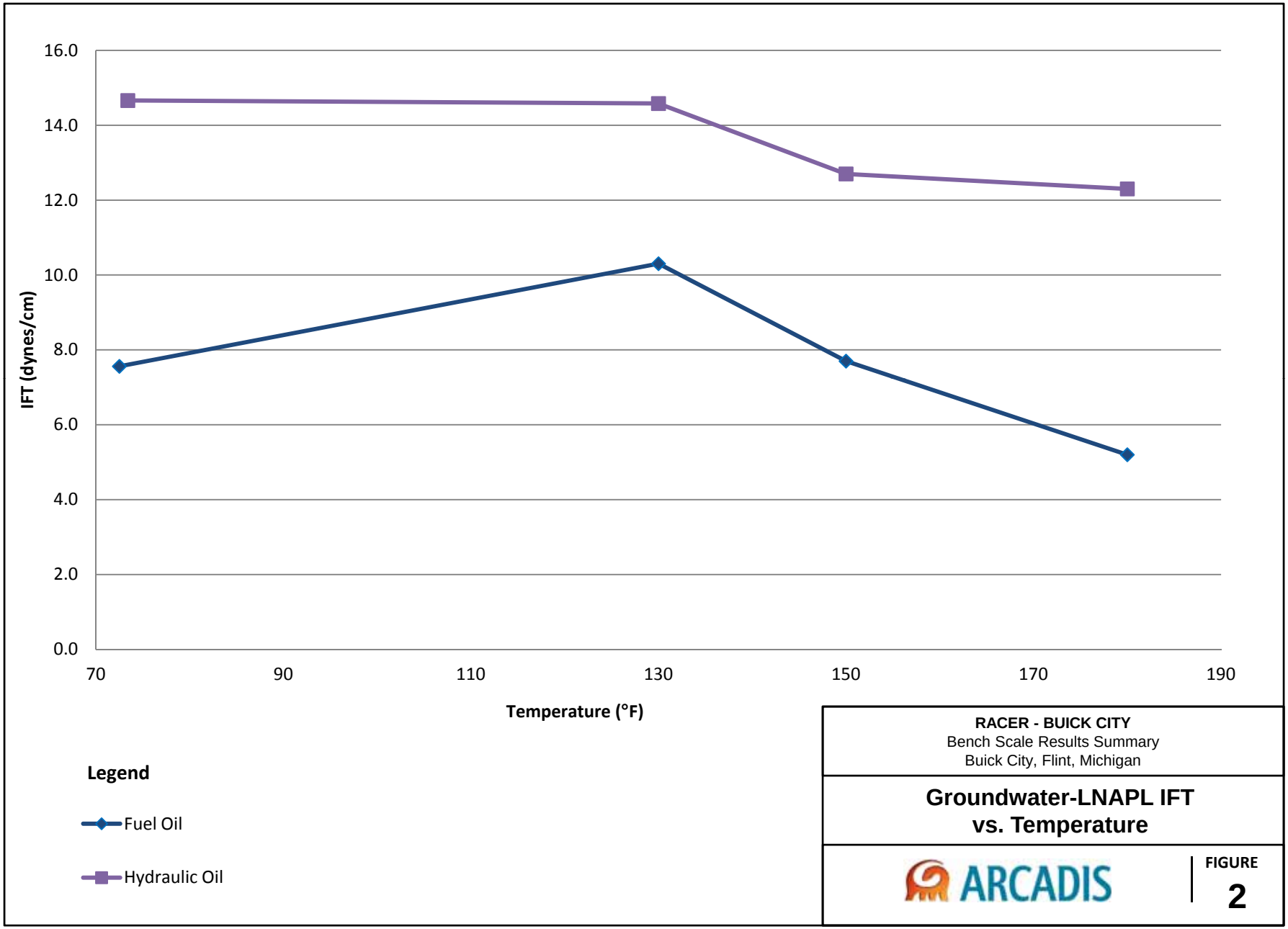
FIGURE
1



RACER - BUICK CITY
Bench Scale Results Summary
Buick City, Flint, Michigan

Groundwater-LNAPL IFT vs. Temperature

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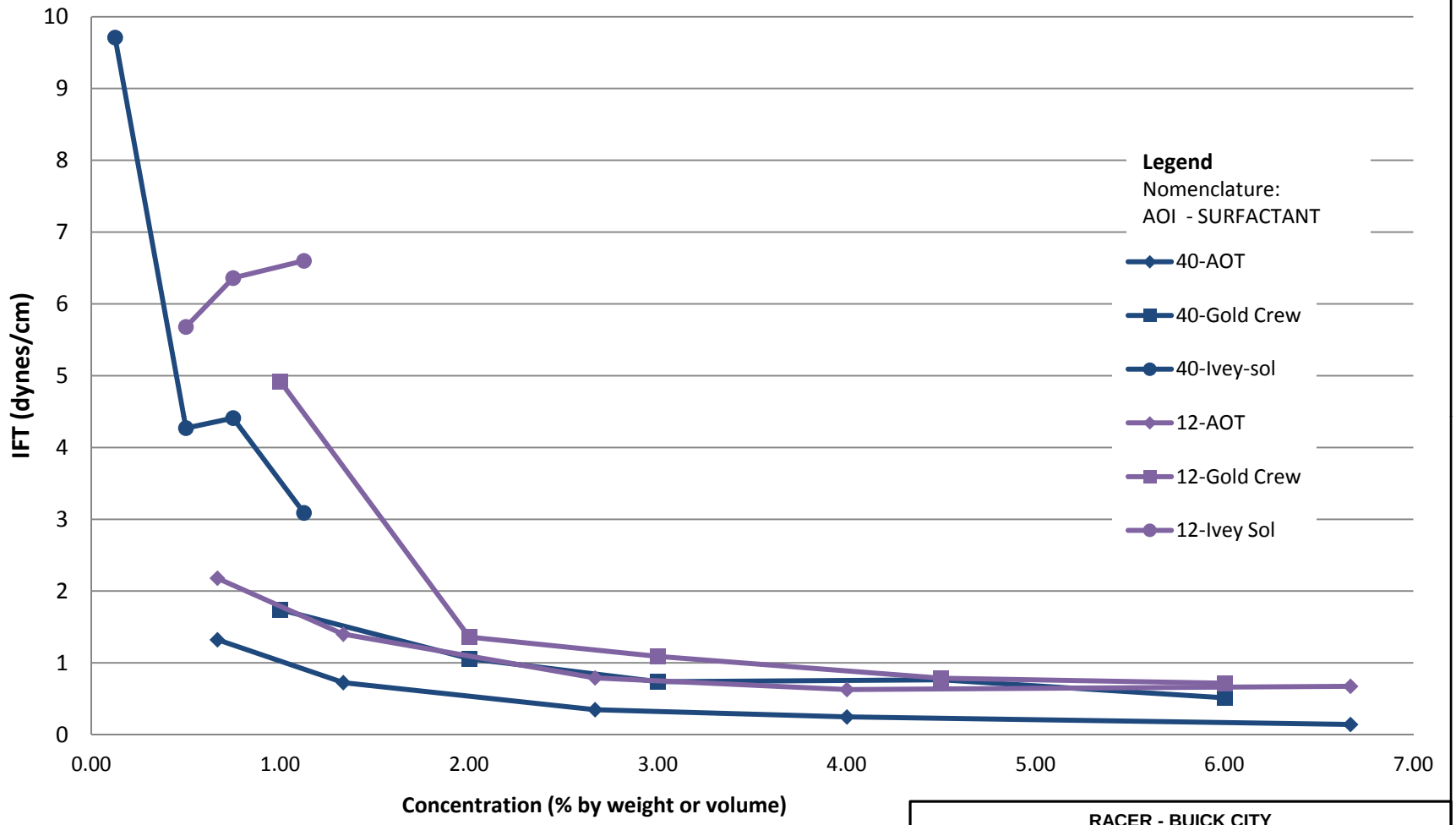
FIGURE
2



Notes:
All surfactant IFT tests conducted at 77 °F
IFT without Surfactant (at 72.5 °F):
AOI 12 (GW/Hydraulic Oil) = 14.7 dynes/cm
AOI 40 (GW/Fuel Oil) = 7.6 dynes/cm

RACER - BUICK CITY
Bench Scale Results Summary
Buick City, Flint, Michigan

Groundwater - LNAPL Interfacial Tension vs. Surfactant Concentration

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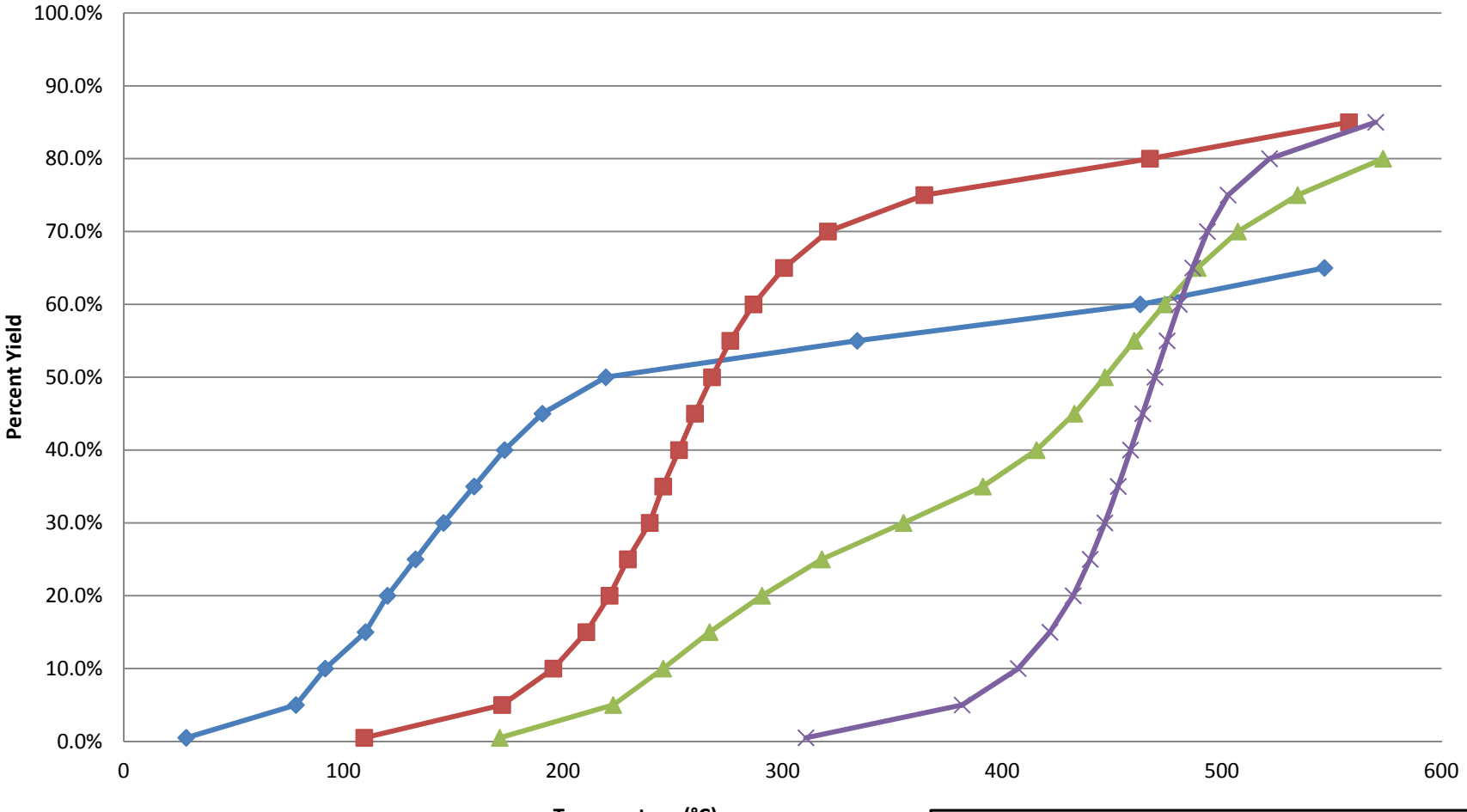
FIGURE
3



RACER - BUICK CITY
Bench Scale Results Summary
Buick City, Flint, Michigan

Simulated Distillation

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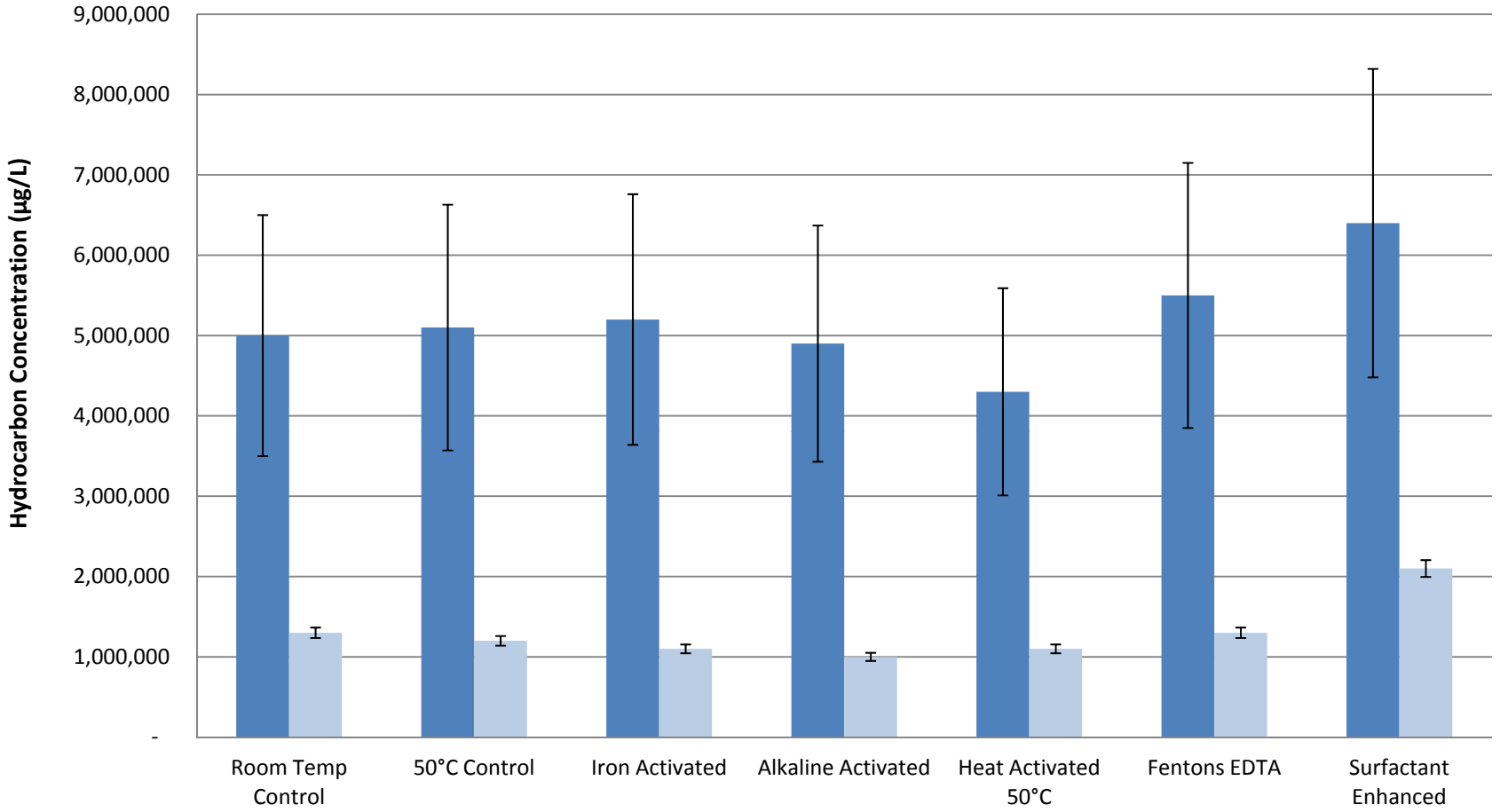
FIGURE
4



RACER - BUICK CITY
Bench Scale Results Summary
Buick City, Flint, Michigan

Results of ISCO Testing:
AOI 40 - Fuel Oil

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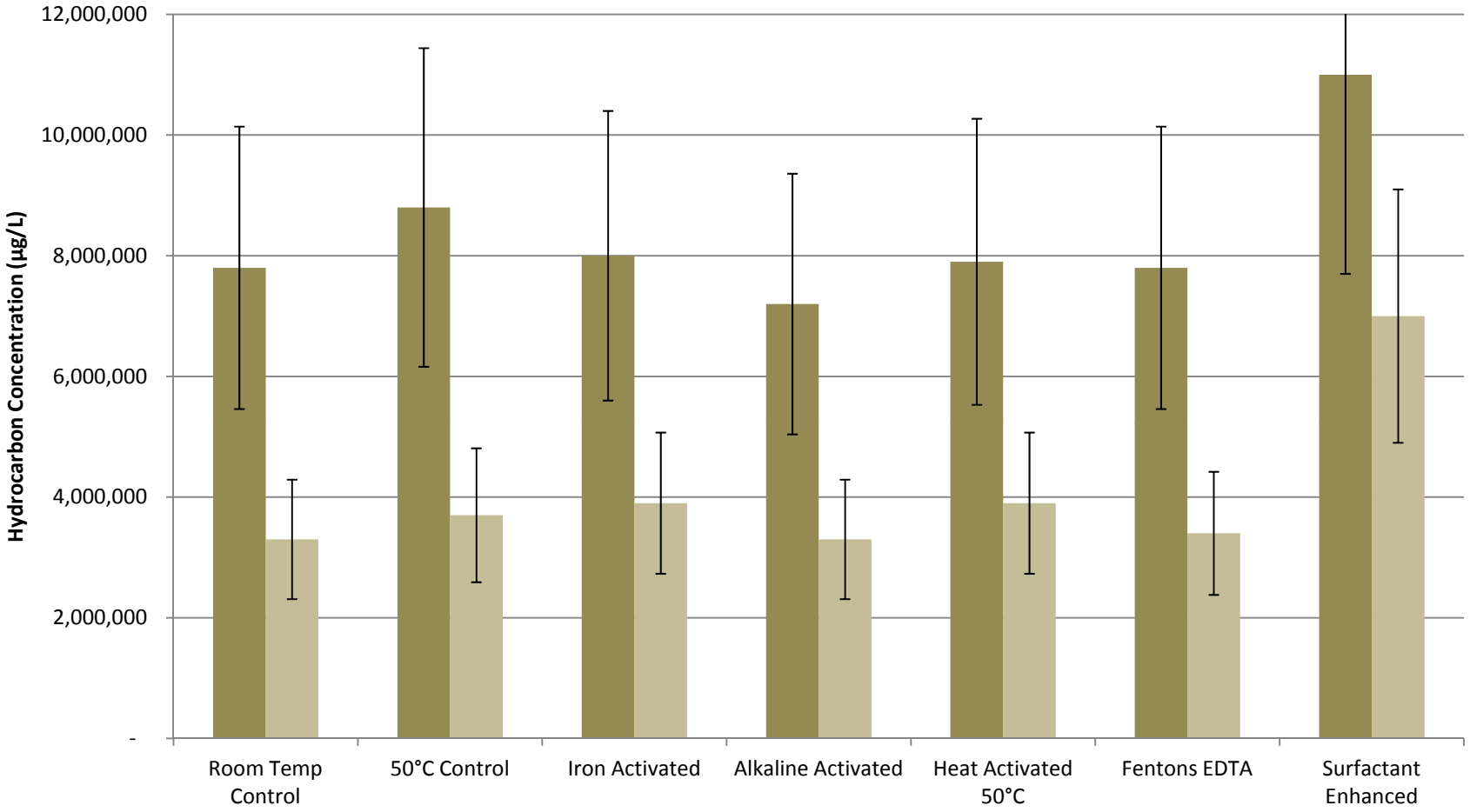
FIGURE
5



RACER - BUICK CITY
Bench Scale Results Summary
Buick City, Flint, Michigan

Results of ISCO Testing:
AOI 12 - Hydraulic Oil

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FIGURE
6

Appendix **A**

Laboratory Data Reports

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

Job Number: 240-2221-1

Job Description: Buick City NAPL Study - B0064410.2011.00

For:
ARCADIS U.S., Inc.
4915 Prospectus Drive
Suite F
Durham, NC 27713

Attention: Mr. David Liles

Approved for release.
Denise Pohl
Project Manager II
8/19/2011 2:15 PM

Denise Pohl
Project Manager II
denise.pohl@testamericainc.com
08/19/2011

cc: Final Data Tracking

The test results in this report meet all NELAP requirements for parameters for which accreditation is required or available. Any exceptions to the 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. This report is confidential and is intended for the sole use of TestAmerica and its client. All questions regarding this report should be directed to the TestAmerica Project Manager who has signed this report.

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CASE NARRATIVE

Client: ARCADIS U.S., Inc.

Project: Buick City NAPL Study - B0064410.2011.00

Report Number: 240-2221-1

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 07/01/2011; the samples arrived in good condition, properly preserved and on ice. The temperature of the coolers at receipt was 3.9 and 5.7 C.

DIESEL RANGE ORGANICS (DRO)

Samples AOI-12-HYD OIL (1) ROOM TEMP CONTROL (240-2221-1), AOI-40 FUEL OIL (1) ROOM TEMP CONTROL (240-2221-2), AOI-12-HYD OIL (2) 50C CONTROL (240-2221-3), AOI-40 FUEL OIL (2) 50C CONTROL (240-2221-4), AOI-12-HYD OIL (3) IRON ACTIVATED (240-2221-5), AOI-40 FUEL OIL (3) IRON ACTIVATED (240-2221-6), AOI-12-HYD OIL (4) ALKALINE ACTIVATED (240-2221-7), AOI-40 FUEL OIL (4) ALKALINE ACTIVATED (240-2221-8), AOI-12-HYD OIL (5) HEAT ACTIVATED 50C (240-2221-9), AOI-40 FUEL OIL (5) HEAT ACTIVATED 50C (240-2221-10), AOI-12-HYD OIL (6) FENTONS EDTA (240-2221-11) and AOI-40 FUEL OIL (6) FENTONS EDTA (240-2221-12) were analyzed for diesel range organics (DRO) in accordance with EPA SW-846 Method 8015B - DRO. The samples were analyzed on 08/02/2011.

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.

n-Nonane failed the surrogate recovery criteria low for AOI-12-HYD OIL (1) ROOM TEMP CONTROL (240-2221-1).

n-Nonane failed the surrogate recovery criteria high for AOI-40 FUEL OIL (5) HEAT ACTIVATED 50C (240-2221-10).

n-Nonane failed the surrogate recovery criteria low for AOI-12-HYD OIL (6) FENTONS EDTA (240-2221-11).

n-Nonane failed the surrogate recovery criteria high for AOI-40 FUEL OIL (6) FENTONS EDTA (240-2221-12).

n-Nonane failed the surrogate recovery criteria high for AOI-40 FUEL OIL (1) ROOM TEMP CONTROL (240-2221-2).

n-Nonane failed the surrogate recovery criteria low for AOI-12-HYD OIL (2) 50C CONTROL (240-2221-3).

n-Nonane failed the surrogate recovery criteria high for AOI-40 FUEL OIL (2) 50C CONTROL (240-2221-4).

n-Nonane failed the surrogate recovery criteria low for AOI-12-HYD OIL (3) IRON ACTIVATED (240-2221-5).

n-Nonane failed the surrogate recovery criteria high for AOI-40 FUEL OIL (3) IRON ACTIVATED (240-2221-6).

n-Nonane failed the surrogate recovery criteria low for AOI-12-HYD OIL (4) ALKALINE ACTIVATED (240-2221-7).

n-Nonane failed the surrogate recovery criteria high for AOI-40 FUEL OIL (4) ALKALINE ACTIVATED (240-2221-8).

n-Nonane failed the surrogate recovery criteria low for AOI-12-HYD OIL (5) HEAT ACTIVATED 50C (240-2221-9). Refer to the QC report for details.

Samples AOI-12-HYD OIL (1) ROOM TEMP CONTROL (240-2221-1)[250X], AOI-40 FUEL OIL (1) ROOM TEMP CONTROL (240-2221-2)[250X], AOI-12-HYD OIL (2) 50C CONTROL (240-2221-3)[250X], AOI-40 FUEL OIL (2) 50C CONTROL (240-2221-4)[250X], AOI-12-HYD OIL (3) IRON ACTIVATED (240-2221-5)[250X], AOI-40 FUEL OIL (3) IRON ACTIVATED (240-2221-6)[250X], AOI-12-HYD OIL (4) ALKALINE ACTIVATED (240-2221-7)[250X], AOI-40 FUEL OIL (4) ALKALINE ACTIVATED (240-2221-8)[250X], AOI-12-HYD OIL (5) HEAT ACTIVATED 50C (240-2221-9)[250X], AOI-40 FUEL OIL (5) HEAT ACTIVATED 50C (240-2221-10)[250X], AOI-12-HYD OIL (6) FENTONS EDTA (240-2221-11)[250X] and AOI-40 FUEL OIL (6) FENTONS EDTA (240-2221-12)[250X] required dilution prior to analysis. The reporting limits have been adjusted accordingly.

Method(s) 3510C: Insufficient sample volume was provided to perform matrix spike/matrix spike duplicate (MS/MSD) for batch 9903, 8015.

Method(s) 3510C: Due to the matrix, the following sample(s) could not be concentrated to the final method required volume: AOI-12-HYD OIL (1) ROOM TEMP CONTROL, AOI-12-HYD OIL (2) 50C CONTROL, AOI-12-HYD OIL (3) IRON ACTIVATED, AOI-12-HYD OIL (4) ALKALINE ACTIVATED, AOI-12-HYD OIL (5) HEAT ACTIVATED 50C, AOI-12-HYD OIL (6) FENTONS EDTA. The reporting limits (RLs) are elevated proportionately.

Method(s) 3510C: The following sample(s) was prepared outside of preparation holding time: Samples were requested to be analyzed by client after holding time had expired. AOI-12-HYD OIL (1) ROOM TEMP CONTROL, AOI-12-HYD OIL (2) 50C CONTROL, AOI-12-HYD OIL (3) IRON ACTIVATED, AOI-12-HYD OIL (4) ALKALINE ACTIVATED, AOI-12-HYD OIL (5) HEAT ACTIVATED 50C, AOI-12-HYD OIL (6) FENTONS EDTA, AOI-40 FUEL OIL (1) ROOM TEMP CONTROL, AOI-40 FUEL OIL (2) 50C CONTROL, AOI-40 FUEL OIL (3) IRON ACTIVATED, AOI-40 FUEL OIL (4) ALKALINE ACTIVATED, AOI-40 FUEL OIL (5) HEAT ACTIVATED 50C, AOI-40 FUEL OIL (6) FENTONS EDTA

Method(s) 8015B: The following sample(s) contained a petroleum product which most closely resembles the clients supplied fingerprint of hydraulic oil.: AOI-12-HYD OIL (1) ROOM TEMP CONTROL, AOI-12-HYD OIL (2) 50C CONTROL, AOI-12-HYD OIL (3) IRON ACTIVATED, AOI-12-HYD OIL (4) ALKALINE ACTIVATED, AOI-12-HYD OIL (5) HEAT ACTIVATED 50C, AOI-12-HYD OIL (6) FENTONS EDTA.

Method(s) 8015B: The following sample(s) contained a petroleum product which most closely resembles the clients supplied fingerprint of fuel oil.: AOI-40 FUEL OIL (1) ROOM TEMP CONTROL, AOI-40 FUEL OIL (2) 50C CONTROL, AOI-40 FUEL OIL (3) IRON ACTIVATED, AOI-40 FUEL OIL (4) ALKALINE ACTIVATED, AOI-40 FUEL OIL (5) HEAT ACTIVATED 50C, AOI-40 FUEL OIL (6) FENTONS EDTA

No other difficulties were encountered during the DRO analyses.

All other quality control parameters were within the acceptance limits.

EXECUTIVE SUMMARY - Detections

Client: ARCADIS U.S., Inc. Job Number: 240-2221-1

Lab Sample ID / Analyte	Client Sample ID	Result	Qualifier	Reporting Limit	Units	Method
240-2221-1	**AOI-12-HYD OIL (1) ROOM TEMP CONTROL**					
C10-C20		7800000	H	1400000	ug/L	8015B
C20-C34		3300000	H	1400000	ug/L	8015B
240-2221-2	**AOI-40 FUEL OIL (1) ROOM TEMP CONTROL**					
C10-C20		5000000	H	1300000	ug/L	8015B
240-2221-3	**AOI-12-HYD OIL (2) 50C CONTROL**					
C10-C20		8800000	H	1400000	ug/L	8015B
C20-C34		3700000	H	1400000	ug/L	8015B
240-2221-4	**AOI-40 FUEL OIL (2) 50C CONTROL**					
C10-C20		5100000	H	1200000	ug/L	8015B
240-2221-5	**AOI-12-HYD OIL (3) IRON ACTIVATED**					
C10-C20		8000000	H	1100000	ug/L	8015B
C20-C34		3900000	H	1100000	ug/L	8015B
240-2221-6	**AOI-40 FUEL OIL (3) IRON ACTIVATED**					
C10-C20		5200000	H	1100000	ug/L	8015B
240-2221-7	**AOI-12-HYD OIL (4) ALKALINE ACTIVATED**					
C10-C20		7200000	H	1100000	ug/L	8015B
C20-C34		3300000	H	1100000	ug/L	8015B
240-2221-8	**AOI-40 FUEL OIL (4) ALKALINE ACTIVATED**					
C10-C20		4900000	H	1000000	ug/L	8015B
240-2221-9	**AOI-12-HYD OIL (5) HEAT ACTIVATED 50C**					
C10-C20		7900000	H	1100000	ug/L	8015B
C20-C34		3900000	H	1100000	ug/L	8015B
240-2221-10	**AOI-40 FUEL OIL (5) HEAT ACTIVATED 50C**					
C10-C20		4300000	H	1100000	ug/L	8015B

EXECUTIVE SUMMARY - Detections

Client: ARCADIS U.S., Inc. Job Number: 240-2221-1

Lab Sample ID / Analyte	Client Sample ID	Result	Qualifier	Reporting Limit	Units	Method
240-2221-11	**AOI-12-HYD OIL (6) FENTONS EDTA**					
C10-C20		7800000	H	1400000	ug/L	8015B
C20-C34		3400000	H	1400000	ug/L	8015B
240-2221-12	**AOI-40 FUEL OIL (6) FENTONS EDTA**					
C10-C20		5500000	H	1300000	ug/L	8015B

METHOD SUMMARY

Client: ARCADIS U.S., Inc. Job Number: 240-2221-1

Description	Lab Location	Method	Preparation Method
Matrix Water			
Diesel Range Organics (DRO) (GC)	TAL NC	SW846 8015B	
Liquid-Liquid Extraction (Separatory Funnel)			SW846 3510C

Lab References:

TAL NC = TestAmerica North Canton

Method References:

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: 240-2221-1

Method	Analyst	Analyst ID
SW846 8015B	Geis, Sharon	SG

SAMPLE SUMMARY

Client: ARCADIS U.S., Inc. Job Number: 240-2221-1

Lab Sample ID	Client Sample ID	Client Matrix	Date/Time Sampled	Date/Time Received
240-2221-1	AOI-12-HYD OIL (1) ROOM TEMP CONTROL	Water	06/30/2011 1330	07/01/2011 1000
240-2221-2	AOI-40 FUEL OIL (1) ROOM TEMP CONTROL	Water	06/30/2011 1330	07/01/2011 1000
240-2221-3	AOI-12-HYD OIL (2) 50C CONTROL	Water	06/30/2011 1330	07/01/2011 1000
240-2221-4	AOI-40 FUEL OIL (2) 50C CONTROL	Water	06/30/2011 1330	07/01/2011 1000
240-2221-5	AOI-12-HYD OIL (3) IRON ACTIVATED	Water	06/30/2011 1330	07/01/2011 1000
240-2221-6	AOI-40 FUEL OIL (3) IRON ACTIVATED	Water	06/30/2011 1330	07/01/2011 1000
240-2221-7	AOI-12-HYD OIL (4) ALKALINE ACTIVATED	Water	06/30/2011 1330	07/01/2011 1000
240-2221-8	AOI-40 FUEL OIL (4) ALKALINE ACTIVATED	Water	06/30/2011 1330	07/01/2011 1000
240-2221-9	AOI-12-HYD OIL (5) HEAT ACTIVATED 50C	Water	06/30/2011 1330	07/01/2011 1000
240-2221-10	AOI-40 FUEL OIL (5) HEAT ACTIVATED 50C	Water	06/30/2011 1330	07/01/2011 1000
240-2221-11	AOI-12-HYD OIL (6) FENTONS EDTA	Water	06/30/2011 1330	07/01/2011 1000
240-2221-12	AOI-40 FUEL OIL (6) FENTONS EDTA	Water	06/30/2011 1330	07/01/2011 1000

SAMPLE RESULTS

Client: ARCADIS U.S., Inc. Job Number: 240-2221-1

Client Sample ID: **AOI-12-HYD OIL (1) ROOM TEMP CONTROL**

Lab Sample ID: 240-2221-1 Date Sampled: 06/30/2011 1330
Client Matrix: Water Date Received: 07/01/2011 1000

8015B Diesel Range Organics (DRO) (GC)

Analysis Method:	8015B	Analysis Batch:	240-10476	Instrument ID:	A2HP14F
Prep Method:	3510C	Prep Batch:	240-9903	Initial Weight/Volume:	200 mL
Dilution:	250			Final Weight/Volume:	11.5 mL
Analysis Date:	08/02/2011 0936			Injection Volume:	1 uL
Prep Date:	07/27/2011 1024			Result Type:	PRIMARY

Analyte	Result (ug/L)	Qualifier	MDL	RL
C10-C20	7800000	H	680000	1400000
C20-C34	3300000	H	680000	1400000

Surrogate	%Rec	Qualifier	Acceptance Limits
n-Nonane	0	X	10 - 110

Client: ARCADIS U.S., Inc. Job Number: 240-2221-1

Client Sample ID: **AOI-40 FUEL OIL (1) ROOM TEMP CONTROL**

Lab Sample ID: 240-2221-2 Date Sampled: 06/30/2011 1330
Client Matrix: Water Date Received: 07/01/2011 1000

8015B Diesel Range Organics (DRO) (GC)

Analysis Method:	8015B	Analysis Batch:	240-10476	Instrument ID:	A2HP14F
Prep Method:	3510C	Prep Batch:	240-9903	Initial Weight/Volume:	200 mL
Dilution:	250			Final Weight/Volume:	10 mL
Analysis Date:	08/02/2011 1025			Injection Volume:	1 uL
Prep Date:	07/27/2011 1024			Result Type:	PRIMARY

Analyte	Result (ug/L)	Qualifier	MDL	RL
C10-C20	5000000	H	600000	1300000
C20-C34	1300000	U H	600000	1300000

Surrogate	%Rec	Qualifier	Acceptance Limits
n-Nonane	13425	X	10 - 110

Client: ARCADIS U.S., Inc. Job Number: 240-2221-1

Client Sample ID: **AOI-12-HYD OIL (2) 50C CONTROL**

Lab Sample ID: 240-2221-3 Date Sampled: 06/30/2011 1330
Client Matrix: Water Date Received: 07/01/2011 1000

8015B Diesel Range Organics (DRO) (GC)

Analysis Method:	8015B	Analysis Batch:	240-10476	Instrument ID:	A2HP14F
Prep Method:	3510C	Prep Batch:	240-9903	Initial Weight/Volume:	200 mL
Dilution:	250			Final Weight/Volume:	11 mL
Analysis Date:	08/02/2011 1113			Injection Volume:	1 uL
Prep Date:	07/27/2011 1024			Result Type:	PRIMARY

Analyte	Result (ug/L)	Qualifier	MDL	RL
C10-C20	8800000	H	650000	1400000
C20-C34	3700000	H	650000	1400000

Surrogate	%Rec	Qualifier	Acceptance Limits
n-Nonane	0	X	10 - 110

Client: ARCADIS U.S., Inc. Job Number: 240-2221-1

Client Sample ID: **AOI-40 FUEL OIL (2) 50C CONTROL**

Lab Sample ID: 240-2221-4 Date Sampled: 06/30/2011 1330
Client Matrix: Water Date Received: 07/01/2011 1000

8015B Diesel Range Organics (DRO) (GC)

Analysis Method:	8015B	Analysis Batch:	240-10476	Instrument ID:	A2HP14F
Prep Method:	3510C	Prep Batch:	240-9903	Initial Weight/Volume:	210 mL
Dilution:	250			Final Weight/Volume:	10 mL
Analysis Date:	08/02/2011 1201			Injection Volume:	1 uL
Prep Date:	07/27/2011 1024			Result Type:	PRIMARY

Analyte	Result (ug/L)	Qualifier	MDL	RL
C10-C20	5100000	H	570000	1200000
C20-C34	1200000	U H	570000	1200000

Surrogate	%Rec	Qualifier	Acceptance Limits
n-Nonane	8475	X	10 - 110

Client: ARCADIS U.S., Inc. Job Number: 240-2221-1

Client Sample ID: **AOI-12-HYD OIL (3) IRON ACTIVATED**

Lab Sample ID: 240-2221-5 Date Sampled: 06/30/2011 1330
Client Matrix: Water Date Received: 07/01/2011 1000

8015B Diesel Range Organics (DRO) (GC)

Analysis Method:	8015B	Analysis Batch:	240-10476	Instrument ID:	A2HP14F
Prep Method:	3510C	Prep Batch:	240-9903	Initial Weight/Volume:	240 mL
Dilution:	250			Final Weight/Volume:	10.5 mL
Analysis Date:	08/02/2011 1250			Injection Volume:	1 uL
Prep Date:	07/27/2011 1024			Result Type:	PRIMARY

Analyte	Result (ug/L)	Qualifier	MDL	RL
C10-C20	8000000	H	520000	1100000
C20-C34	3900000	H	520000	1100000

Surrogate	%Rec	Qualifier	Acceptance Limits
n-Nonane	0	X	10 - 110

Client: ARCADIS U.S., Inc. Job Number: 240-2221-1

Client Sample ID: **AOI-40 FUEL OIL (3) IRON ACTIVATED**

Lab Sample ID: 240-2221-6 Date Sampled: 06/30/2011 1330
Client Matrix: Water Date Received: 07/01/2011 1000

8015B Diesel Range Organics (DRO) (GC)

Analysis Method:	8015B	Analysis Batch:	240-10476	Instrument ID:	A2HP14F
Prep Method:	3510C	Prep Batch:	240-9903	Initial Weight/Volume:	230 mL
Dilution:	250			Final Weight/Volume:	10 mL
Analysis Date:	08/02/2011 1338			Injection Volume:	1 uL
Prep Date:	07/27/2011 1024			Result Type:	PRIMARY

Analyte	Result (ug/L)	Qualifier	MDL	RL
C10-C20	5200000	H	520000	1100000
C20-C34	1100000	U H	520000	1100000

Surrogate	%Rec	Qualifier	Acceptance Limits
n-Nonane	15025	X	10 - 110

Client: ARCADIS U.S., Inc. Job Number: 240-2221-1

Client Sample ID: **AOI-12-HYD OIL (4) ALKALINE ACTIVATED**

Lab Sample ID: 240-2221-7 Date Sampled: 06/30/2011 1330
Client Matrix: Water Date Received: 07/01/2011 1000

8015B Diesel Range Organics (DRO) (GC)

Analysis Method:	8015B	Analysis Batch:	240-10476	Instrument ID:	A2HP14F
Prep Method:	3510C	Prep Batch:	240-9903	Initial Weight/Volume:	240 mL
Dilution:	250			Final Weight/Volume:	11 mL
Analysis Date:	08/02/2011 1515			Injection Volume:	1 uL
Prep Date:	07/27/2011 1024			Result Type:	PRIMARY

Analyte	Result (ug/L)	Qualifier	MDL	RL
C10-C20	7200000	H	550000	1100000
C20-C34	3300000	H	550000	1100000

Surrogate	%Rec	Qualifier	Acceptance Limits
n-Nonane	0	X	10 - 110

Client: ARCADIS U.S., Inc. Job Number: 240-2221-1

Client Sample ID: **AOI-40 FUEL OIL (4) ALKALINE ACTIVATED**

Lab Sample ID: 240-2221-8 Date Sampled: 06/30/2011 1330
Client Matrix: Water Date Received: 07/01/2011 1000

8015B Diesel Range Organics (DRO) (GC)

Analysis Method:	8015B	Analysis Batch:	240-10476	Instrument ID:	A2HP14F
Prep Method:	3510C	Prep Batch:	240-9903	Initial Weight/Volume:	240 mL
Dilution:	250			Final Weight/Volume:	10 mL
Analysis Date:	08/02/2011 1603			Injection Volume:	1 uL
Prep Date:	07/27/2011 1024			Result Type:	PRIMARY

Analyte	Result (ug/L)	Qualifier	MDL	RL
C10-C20	4900000	H	500000	1000000
C20-C34	1000000	U H	500000	1000000

Surrogate	%Rec	Qualifier	Acceptance Limits
n-Nonane	9925	X	10 - 110

Client: ARCADIS U.S., Inc. Job Number: 240-2221-1

Client Sample ID: **AOI-12-HYD OIL (5) HEAT ACTIVATED 50C**

Lab Sample ID: 240-2221-9 Date Sampled: 06/30/2011 1330
Client Matrix: Water Date Received: 07/01/2011 1000

8015B Diesel Range Organics (DRO) (GC)

Analysis Method:	8015B	Analysis Batch:	240-10476	Instrument ID:	A2HP14F
Prep Method:	3510C	Prep Batch:	240-9903	Initial Weight/Volume:	230 mL
Dilution:	250			Final Weight/Volume:	10.5 mL
Analysis Date:	08/02/2011 1652			Injection Volume:	1 uL
Prep Date:	07/27/2011 1024			Result Type:	PRIMARY

Analyte	Result (ug/L)	Qualifier	MDL	RL
C10-C20	7900000	H	540000	1100000
C20-C34	3900000	H	540000	1100000

Surrogate	%Rec	Qualifier	Acceptance Limits
n-Nonane	0	X	10 - 110

Client: ARCADIS U.S., Inc. Job Number: 240-2221-1

Client Sample ID: **AOI-40 FUEL OIL (5) HEAT ACTIVATED 50C**

Lab Sample ID: 240-2221-10 Date Sampled: 06/30/2011 1330
Client Matrix: Water Date Received: 07/01/2011 1000

8015B Diesel Range Organics (DRO) (GC)

Analysis Method:	8015B	Analysis Batch:	240-10476	Instrument ID:	A2HP14F
Prep Method:	3510C	Prep Batch:	240-9903	Initial Weight/Volume:	230 mL
Dilution:	250			Final Weight/Volume:	10 mL
Analysis Date:	08/02/2011 1740			Injection Volume:	1 uL
Prep Date:	07/27/2011 1024			Result Type:	PRIMARY

Analyte	Result (ug/L)	Qualifier	MDL	RL
C10-C20	4300000	H	520000	1100000
C20-C34	1100000	U H	520000	1100000

Surrogate	%Rec	Qualifier	Acceptance Limits
n-Nonane	8500	X	10 - 110

Client: ARCADIS U.S., Inc. Job Number: 240-2221-1

Client Sample ID: **AOI-12-HYD OIL (6) FENTONS EDTA**

Lab Sample ID: 240-2221-11 Date Sampled: 06/30/2011 1330
Client Matrix: Water Date Received: 07/01/2011 1000

8015B Diesel Range Organics (DRO) (GC)

Analysis Method:	8015B	Analysis Batch:	240-10476	Instrument ID:	A2HP14F
Prep Method:	3510C	Prep Batch:	240-9903	Initial Weight/Volume:	200 mL
Dilution:	250			Final Weight/Volume:	11 mL
Analysis Date:	08/02/2011 1828			Injection Volume:	1 uL
Prep Date:	07/27/2011 1024			Result Type:	PRIMARY

Analyte	Result (ug/L)	Qualifier	MDL	RL
C10-C20	7800000	H	650000	1400000
C20-C34	3400000	H	650000	1400000

Surrogate	%Rec	Qualifier	Acceptance Limits
n-Nonane	0	X	10 - 110

Client: ARCADIS U.S., Inc. Job Number: 240-2221-1

Client Sample ID: **AOI-40 FUEL OIL (6) FENTONS EDTA**

Lab Sample ID: 240-2221-12 Date Sampled: 06/30/2011 1330
Client Matrix: Water Date Received: 07/01/2011 1000

8015B Diesel Range Organics (DRO) (GC)

Analysis Method:	8015B	Analysis Batch:	240-10476	Instrument ID:	A2HP14F
Prep Method:	3510C	Prep Batch:	240-9903	Initial Weight/Volume:	200 mL
Dilution:	250			Final Weight/Volume:	10 mL
Analysis Date:	08/02/2011 1917			Injection Volume:	1 uL
Prep Date:	07/27/2011 1024			Result Type:	PRIMARY

Analyte	Result (ug/L)	Qualifier	MDL	RL
C10-C20	5500000	H	600000	1300000
C20-C34	1300000	U H	600000	1300000

Surrogate	%Rec	Qualifier	Acceptance Limits
n-Nonane	10400	X	10 - 110

DATA REPORTING QUALIFIERS

Client: ARCADIS U.S., Inc. Job Number: 240-2221-1

Lab Section	Qualifier	Description
GC Semi VOA		
	U	Indicates the analyte was analyzed for but not detected.
	H	Sample was prepped or analyzed beyond the specified holding time
	X	Surrogate is outside control limits

QUALITY CONTROL RESULTS

Client: ARCADIS U.S., Inc. Job Number: 240-2221-1

QC Association Summary

Lab Sample ID	Client Sample ID	Report Basis	Client Matrix	Method	Prep Batch
GC Semi VOA					
Prep Batch: 240-9903					
LCS 240-9903/14-A	Lab Control Sample	T	Water	3510C	
MB 240-9903/13-A	Method Blank	T	Water	3510C	
240-2221-1	AOI-12-HYD OIL (1) ROOM TEMP CONTROL	T	Water	3510C	
240-2221-2	AOI-40 FUEL OIL (1) ROOM TEMP CONTROL	T	Water	3510C	
240-2221-3	AOI-12-HYD OIL (2) 50C CONTROL	T	Water	3510C	
240-2221-4	AOI-40 FUEL OIL (2) 50C CONTROL	T	Water	3510C	
240-2221-5	AOI-12-HYD OIL (3) IRON ACTIVATED	T	Water	3510C	
240-2221-6	AOI-40 FUEL OIL (3) IRON ACTIVATED	T	Water	3510C	
240-2221-7	AOI-12-HYD OIL (4) ALKALINE ACTIVATED	T	Water	3510C	
240-2221-8	AOI-40 FUEL OIL (4) ALKALINE ACTIVATED	T	Water	3510C	
240-2221-9	AOI-12-HYD OIL (5) HEAT ACTIVATED 50C	T	Water	3510C	
240-2221-10	AOI-40 FUEL OIL (5) HEAT ACTIVATED 50C	T	Water	3510C	
240-2221-11	AOI-12-HYD OIL (6) FENTONS EDTA	T	Water	3510C	
240-2221-12	AOI-40 FUEL OIL (6) FENTONS EDTA	T	Water	3510C	
Analysis Batch:240-10213					
LCS 240-9903/14-A	Lab Control Sample	T	Water	8015B	240-9903
MB 240-9903/13-A	Method Blank	T	Water	8015B	240-9903

Client: ARCADIS U.S., Inc. Job Number: 240-2221-1

QC Association Summary

Lab Sample ID	Client Sample ID	Report Basis	Client Matrix	Method	Prep Batch
GC Semi VOA					
Analysis Batch:240-10476					
240-2221-1	AOI-12-HYD OIL (1) ROOM TEMP CONTROL	T	Water	8015B	240-9903
240-2221-2	AOI-40 FUEL OIL (1) ROOM TEMP CONTROL	T	Water	8015B	240-9903
240-2221-3	AOI-12-HYD OIL (2) 50C CONTROL	T	Water	8015B	240-9903
240-2221-4	AOI-40 FUEL OIL (2) 50C CONTROL	T	Water	8015B	240-9903
240-2221-5	AOI-12-HYD OIL (3) IRON ACTIVATED	T	Water	8015B	240-9903
240-2221-6	AOI-40 FUEL OIL (3) IRON ACTIVATED	T	Water	8015B	240-9903
240-2221-7	AOI-12-HYD OIL (4) ALKALINE ACTIVATED	T	Water	8015B	240-9903
240-2221-8	AOI-40 FUEL OIL (4) ALKALINE ACTIVATED	T	Water	8015B	240-9903
240-2221-9	AOI-12-HYD OIL (5) HEAT ACTIVATED 50C	T	Water	8015B	240-9903
240-2221-10	AOI-40 FUEL OIL (5) HEAT ACTIVATED 50C	T	Water	8015B	240-9903
240-2221-11	AOI-12-HYD OIL (6) FENTONS EDTA	T	Water	8015B	240-9903
240-2221-12	AOI-40 FUEL OIL (6) FENTONS EDTA	T	Water	8015B	240-9903

Report Basis
T = Total

Surrogate Recovery Report

8015B Diesel Range Organics (DRO) (GC)

Client Matrix: Water

Lab Sample ID	Client Sample ID	C91 %Rec
240-2221-1	AOI-12-HYD OIL (1) ROOM TEMP CONTROL	0X
240-2221-2	AOI-40 FUEL OIL (1) ROOM TEMP CONTROL	1342X 5
240-2221-3	AOI-12-HYD OIL (2) 50C CONTROL	0X
240-2221-4	AOI-40 FUEL OIL (2) 50C CONTROL	8475X
240-2221-5	AOI-12-HYD OIL (3) IRON ACTIVATED	0X
240-2221-6	AOI-40 FUEL OIL (3) IRON ACTIVATED	1502X 5
240-2221-7	AOI-12-HYD OIL (4) ALKALINE ACTIVATED	0X
240-2221-8	AOI-40 FUEL OIL (4) ALKALINE ACTIVATED	9925X
240-2221-9	AOI-12-HYD OIL (5) HEAT ACTIVATED 50C	0X
240-2221-10	AOI-40 FUEL OIL (5) HEAT ACTIVATED 50C	8500X
240-2221-11	AOI-12-HYD OIL (6) FENTONS EDTA	0X
240-2221-12	AOI-40 FUEL OIL (6) FENTONS EDTA	1040X 0
MB 240-9903/13-A		60
LCS 240-9903/14-A		74

Surrogate	Acceptance Limits
C9 = n-Nonane	10-110

Client: ARCADIS U.S., Inc. Job Number: 240-2221-1

Method Blank - Batch: 240-9903

Method: 8015B
Preparation: 3510C

Lab Sample ID:	MB 240-9903/13-A	Analysis Batch:	240-10213	Instrument ID:	A2HP14F
Client Matrix:	Water	Prep Batch:	240-9903	Lab File ID:	P14F0000018.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	1000 mL
Analysis Date:	07/29/2011 1634	Units:	ug/L	Final Weight/Volume:	10 mL
Prep Date:	07/27/2011 1024			Injection Volume:	1 uL
Leach Date:	N/A			Column ID:	PRIMARY

Analyte	Result	Qual	MDL	RL
Diesel	1000	U	480	1000
C10-C20	1000	U	480	1000
C20-C34	1000	U	480	1000

Surrogate	% Rec	Acceptance Limits
n-Nonane	60	10 - 110

Lab Control Sample - Batch: 240-9903

Method: 8015B
Preparation: 3510C

Lab Sample ID:	LCS 240-9903/14-A	Analysis Batch:	240-10213	Instrument ID:	A2HP14F
Client Matrix:	Water	Prep Batch:	240-9903	Lab File ID:	P14F0000033.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	1000 mL
Analysis Date:	07/29/2011 2236	Units:	ug/L	Final Weight/Volume:	10 mL
Prep Date:	07/27/2011 1024			Injection Volume:	1 uL
Leach Date:	N/A			Column ID:	PRIMARY

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Diesel	5000	4900	98	36 - 124	

Surrogate	% Rec	Acceptance Limits
n-Nonane	74	10 - 110

ARCADIS
Infrastructure, environment, buildings

ID#:

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

Page ___ of ___

Lab Work Order #

Send Results to:

Contact & Company Name: Dave Liles ARCADIS
Telephone: 919-544-4535
Address:
Fax:
City State Zip
E-mail Address:

Project Name/Location (City, State): Buick City
Project #:
Sampler's Printed Name: Andy Baumeister
Sampler's Signature:

Sample ID	Collection Date	Collection Time	Type (✓) Comp	Type (✓) Grab	Matrix	MDNRE 507 modified *	Preservative	Filtered (✓)	# of Containers	Container Information	REMARKS
#1 Room Temp Control-Hyd	6/30	13:30			W/NL	✓	E		1	25ml	
#1 Room Temp Control-Fuel						✓					
#2 50C Control-Hyd						✓					
#2 50C Control-Fuel						✓					
[redacted]						✓					
[redacted]						✓					
[redacted]						✓					
[redacted]						✓					
[redacted]						✓					
[redacted]						✓					
[redacted]						✓					

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

Special Instructions/Comments:

* method modifications discussed w/ Ray Risden

☐ Special QA/QC Instructions(✓):

Laboratory Information and Receipt		Relinquished By	Received By	Relinquished By	Laboratory Received By
Lab Name:	Cooler Custody Seal (✓)	Printed Name: Andy Baumeister	Printed Name:	Printed Name:	Printed Name: John McFaddan
☐ Cooler packed with ice (✓)	☐ Intact ☐ Not Intact	Signature:	Signature:	Signature:	Signature:
Specify Turnaround Requirements:	Sample Receipt:	Firm: ARCADIS	Firm/Courier:	Firm/Courier:	Firm: TA DC
Shipping Tracking #:	Condition/Cooler Temp: _____	Date/Time: 6/30/11 13:40	Date/Time:	Date/Time:	Date/Time: 7/1/11 1000

20730826 CofC AR Form 01.12.2007

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

ARCADIS
Infrastructure, environment, buildings

ID#:

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

Page ___ of ___

Lab Work Order #

Send Results to:

Contact & Company Name: Dave Liles ARCADIS	Telephone: 919-544-4535
Address:	Fax:
City / State / Zip	E-mail Address:
Project Name/Location (City, State): Buick City	Project #:
Sampler's Printed Name: Andy Baumeister	Sampler's Signature: [signature]

Preservative	E
Filtered (✓)	
# of Containers	1
Container Information	5mL

PARAMETER ANALYSIS & METHOD: See Rpt Risden

Sample ID	Collection Date	Collection Time	Type (✓) Comp	Type (✓) Grab	Matrix	See Rpt Risden							REMARKS
AOI-12 Hyd oil	6/30	15:35		✓	NL	X							
AOI-40 Fuel oil	"	"		✓	NL	X							

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, W - Water, T - Tissue, SE - Sediment, SL - Sludge, A - Air, NL - NAPL/Oil, SW - Sample Wipe, 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:	Andy Baumeister			John McFadden
Signature:	[signature]			[signature]
Firm:	ARCADIS			TA NC
Date/Time:	6/30/11 13:45			7/1/11 1000

20730826 CofC AR Form 01.12.2007

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

TestAmerica Cooler Receipt Form/Narrative **Lot Number:** 2221
North Canton Facility

Client Arcadis Project Buick City By: (Signature)
Cooler Received on 7/1/11 Opened on 7/1/11
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 2 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 3.7 °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:
Received 2nd cooler (remainder of sample containers) on 7/1/11
No analyses marked on COC. Will log analyses once PM gives them to receiving to enter.

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
Client Cooler	3.9	Received 7/1/11	IR	Ice
Client Cooler	5.7	Received 7/7/11	"	"

Discrepancies Cont'd:

Login Sample Receipt Checklist

Client: ARCADIS U.S., Inc.

Job Number: 240-2221-1

Login Number: 2221

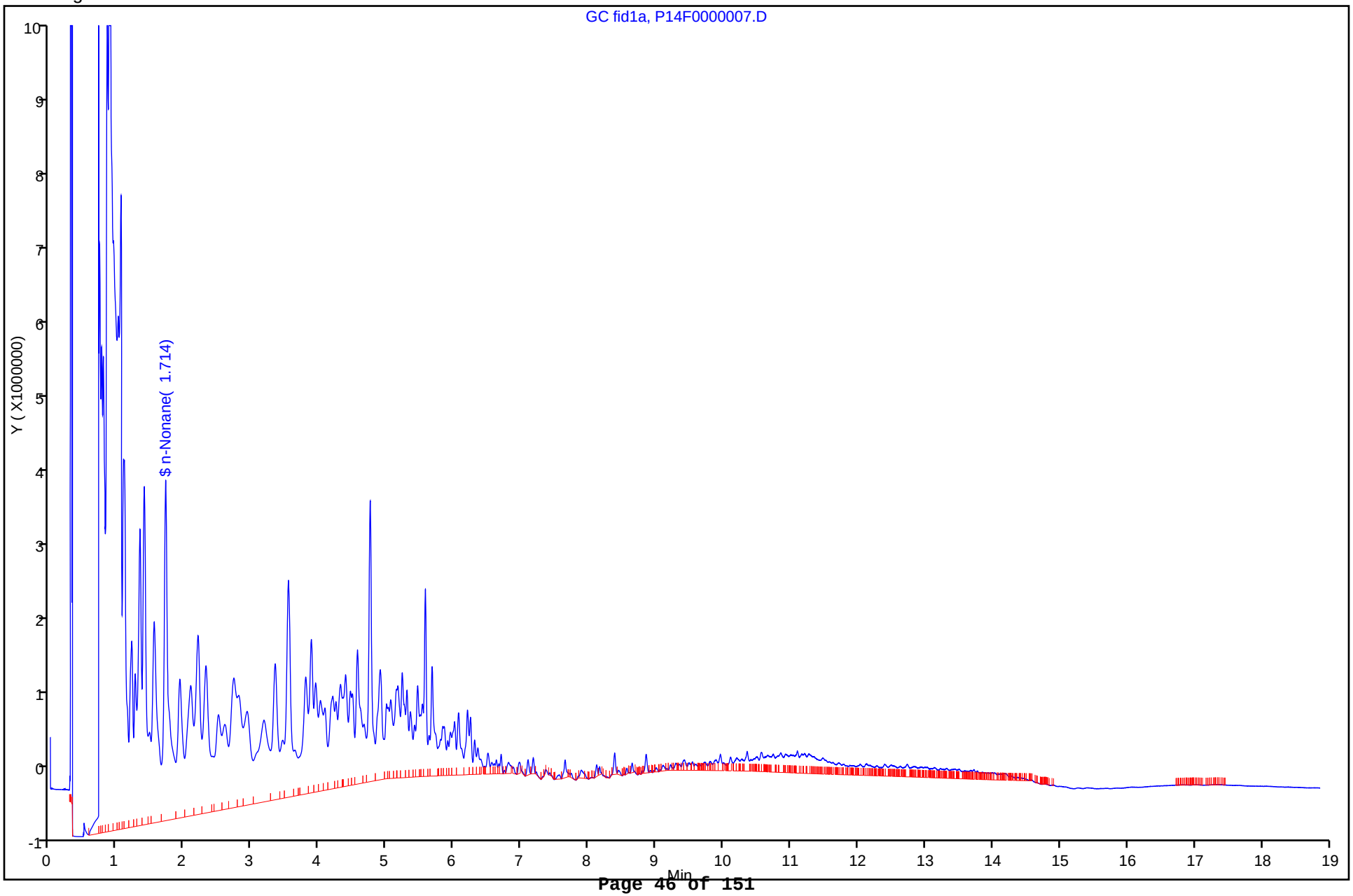
List Source: TestAmerica North Canton

List Number: 1

Creator: McFadden, John

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	3.9, 5.7
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	

Report Date: 12-Aug-2011 08:15:28 Chrom Revision: 2.0 11-Aug-2011 08:33:58
Data File: \\Ncchrom\ChromData\A2HP14F\20110802-2310.b\P14F0000007.D
Injection Date: 02-Aug-2011 10:25:10 Limit Group: GC TPH DIESEL ICAL
Client ID: AOI-40 FUEL OIL (1) ROOM TEMP CONTROL
Instrument ID: A2HP14F
Lims Batch ID: 10476 Lims Sample ID: 7
Operator ID: 2398 Injection Vol: 1.00 ul
Y Scaling: Method Defined: Set to Absolute Y Value



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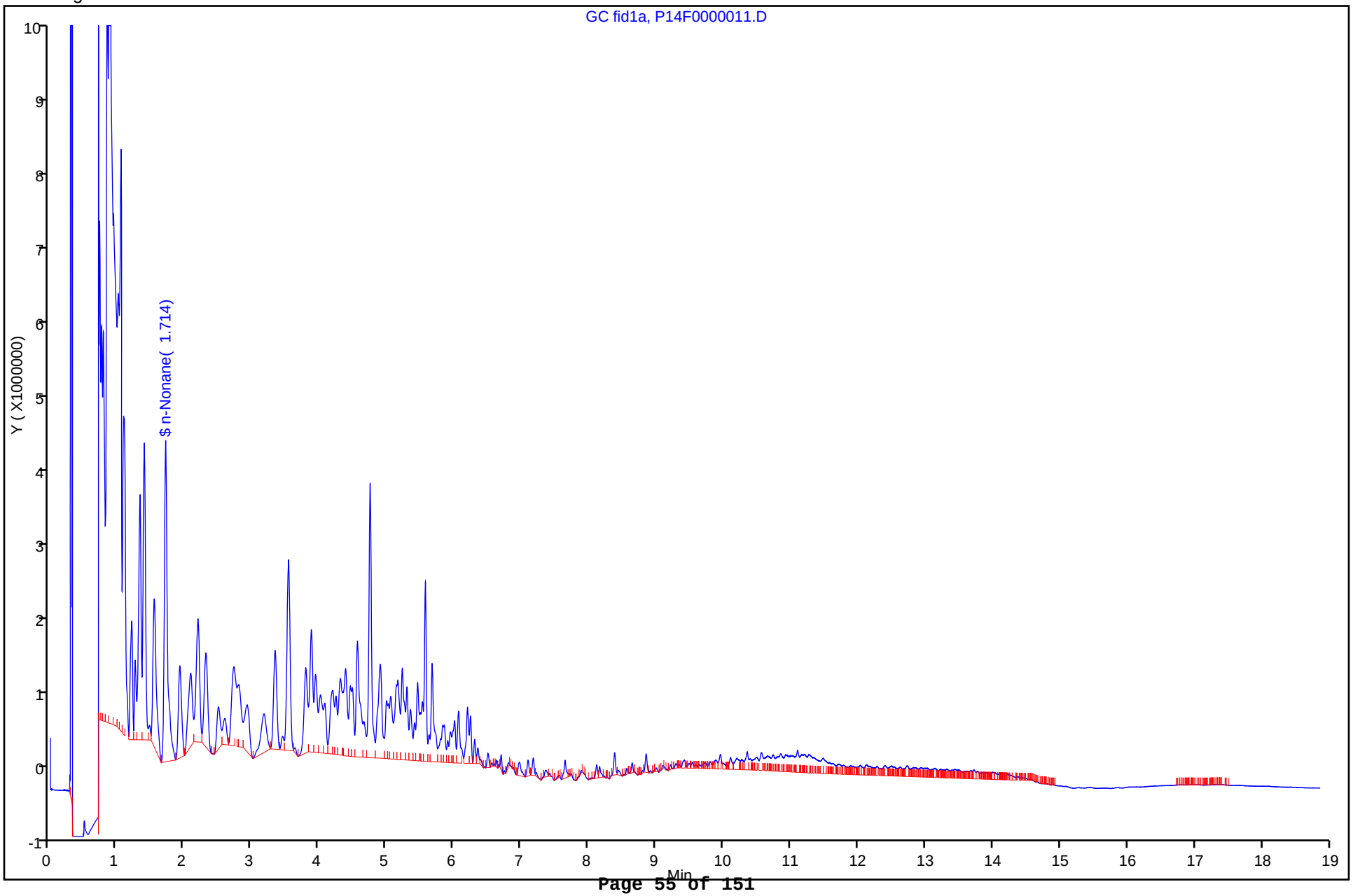
Data File: \\Ncchrom\ChromData\A2HP14F\20110802-2310.b\P14F0000011.D
Injection Date: 02-Aug-2011 12:01:53 Limit Group: GC TPH DIESEL ICAL
Client ID: AOI-40 FUEL OIL (2) 50C CONTROL
Instrument ID: A2HP14F
Lims Batch ID: 10476 Lims Sample ID: 11
Operator ID: 2398 Injection Vol: 1.00 ul
Y Scaling: Method Defined: Set to Absolute Y Value



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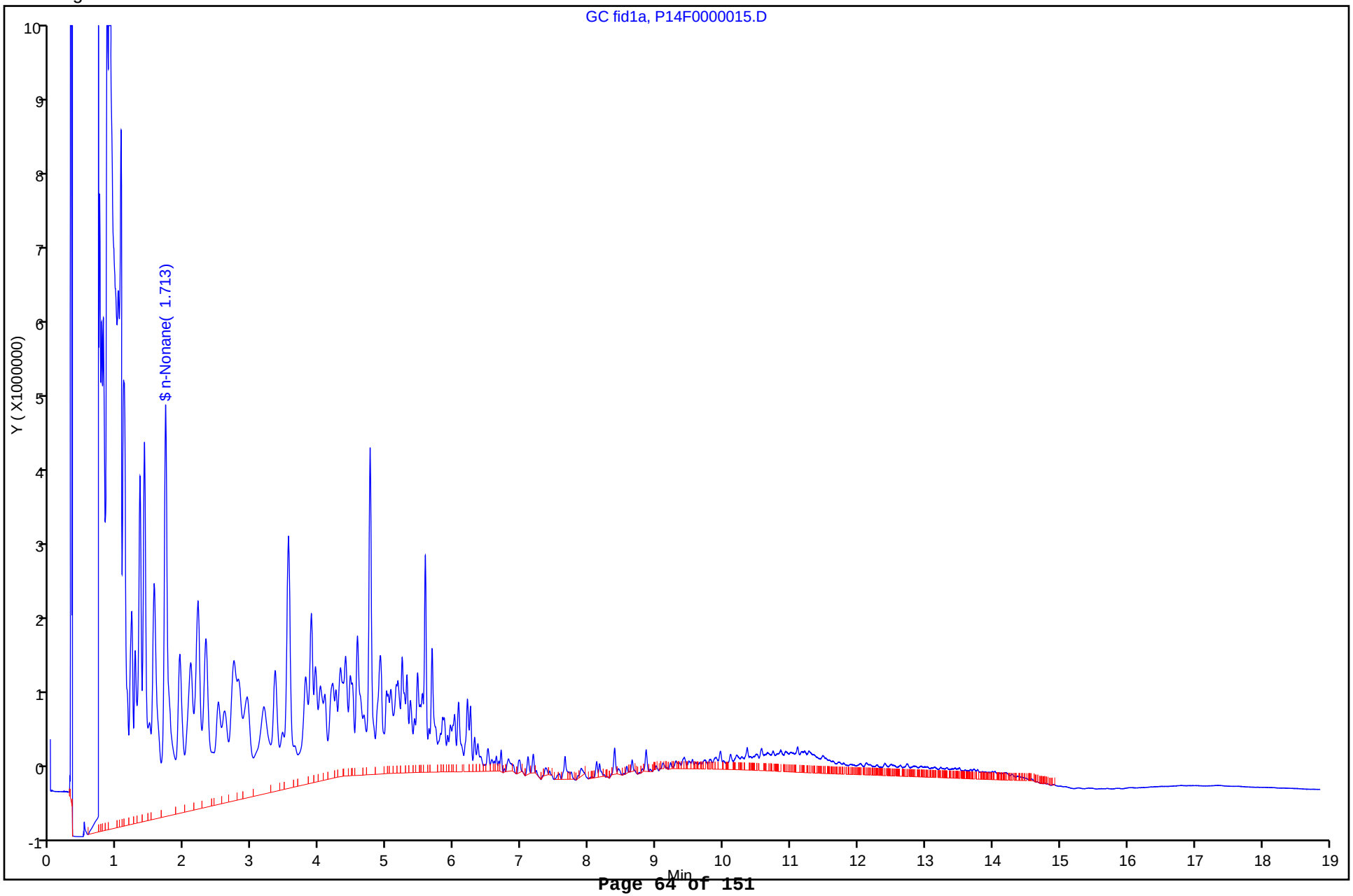
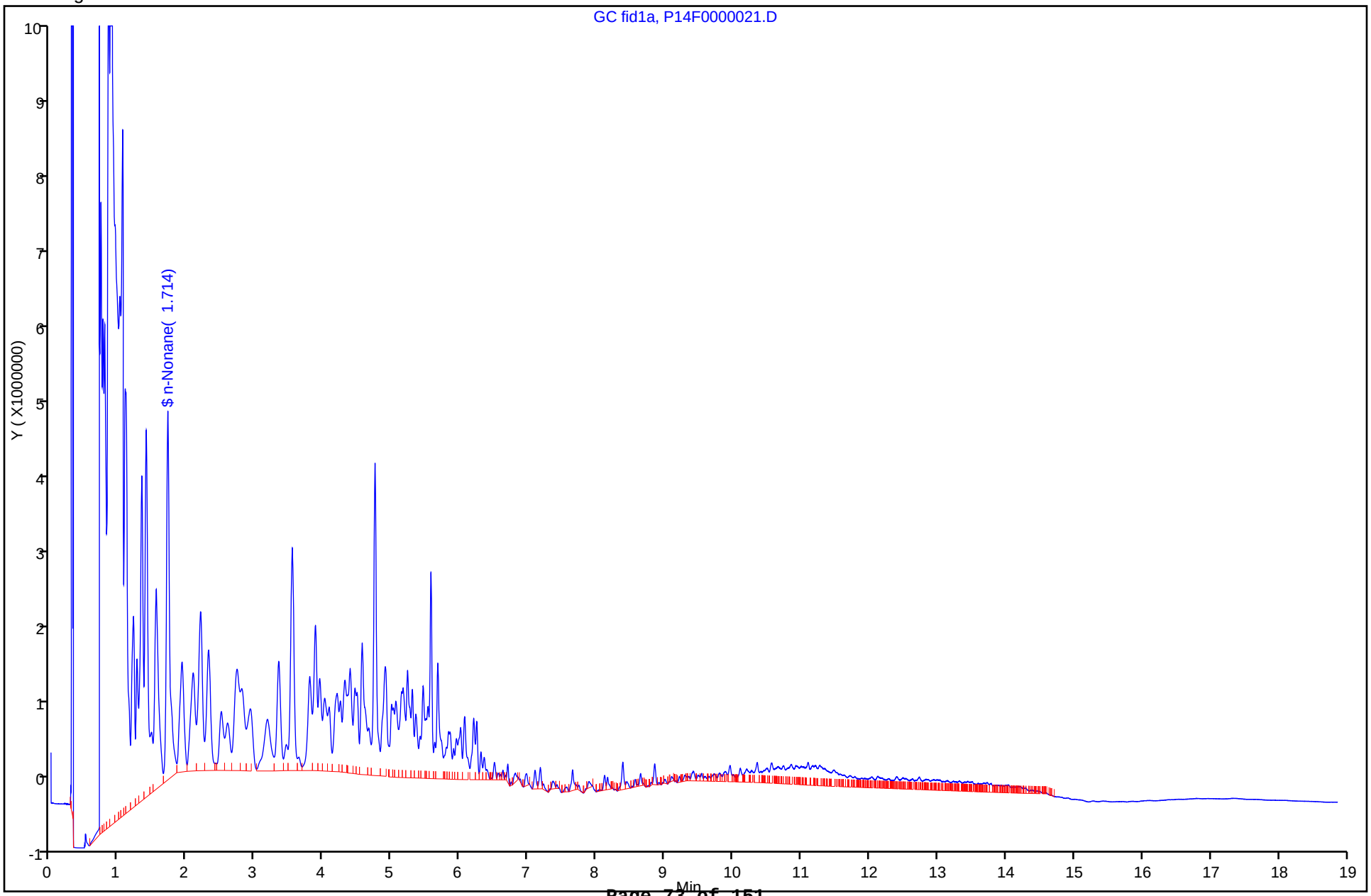
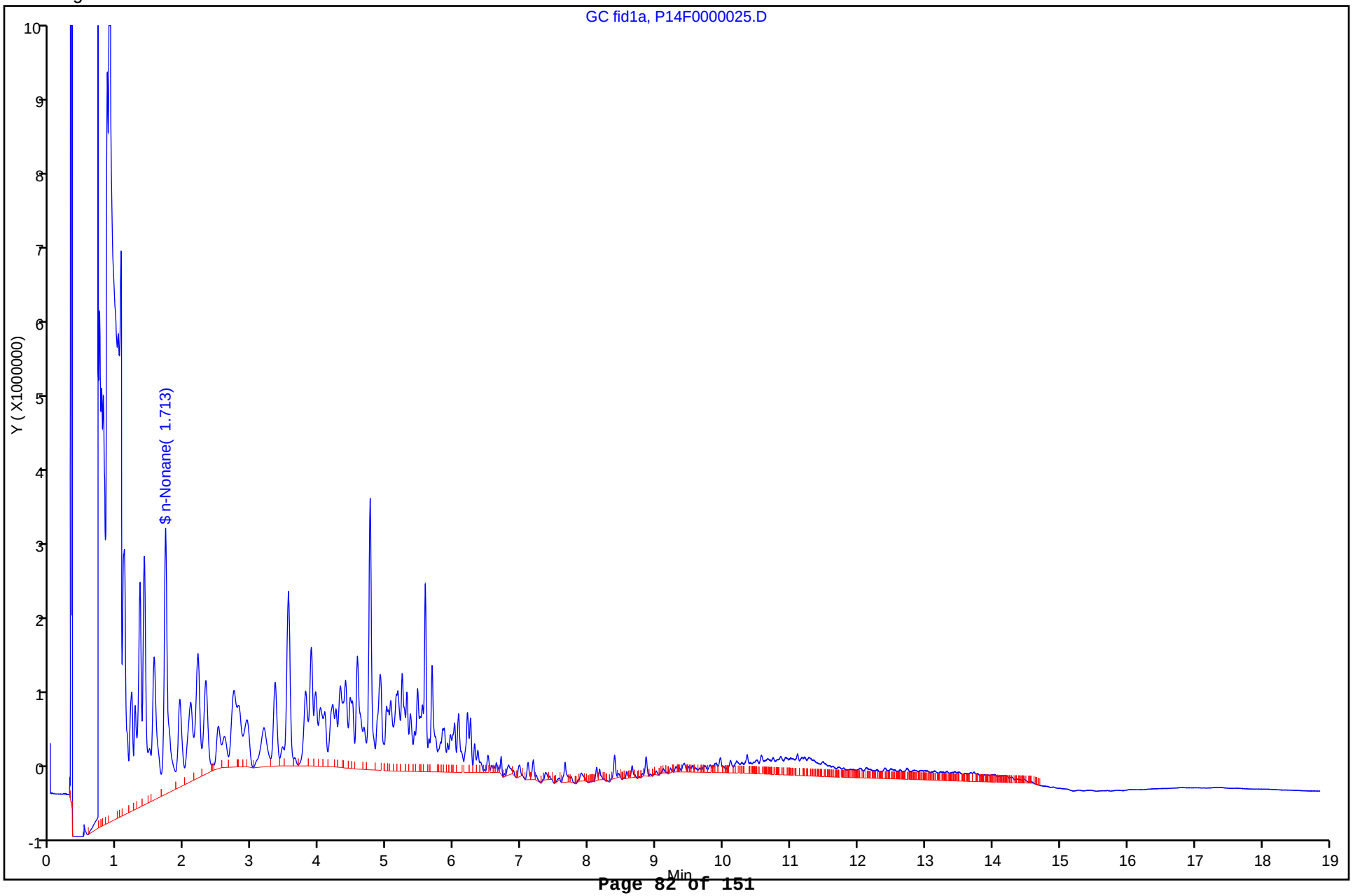
Data File: \\Ncchrom\ChromData\A2HP14F\20110802-2310.b\P14F0000015.D
Injection Date: 02-Aug-2011 13:38:38 Limit Group: GC TPH DIESEL ICAL
Client ID: AOI-40 FUEL OIL (3) IRON ACTIVATED
Instrument ID: A2HP14F
Lims Batch ID: 10476 Lims Sample ID: 15
Operator ID: 2398 Injection Vol: 1.00 ul
Y Scaling: Method Defined: Set to Absolute Y Value



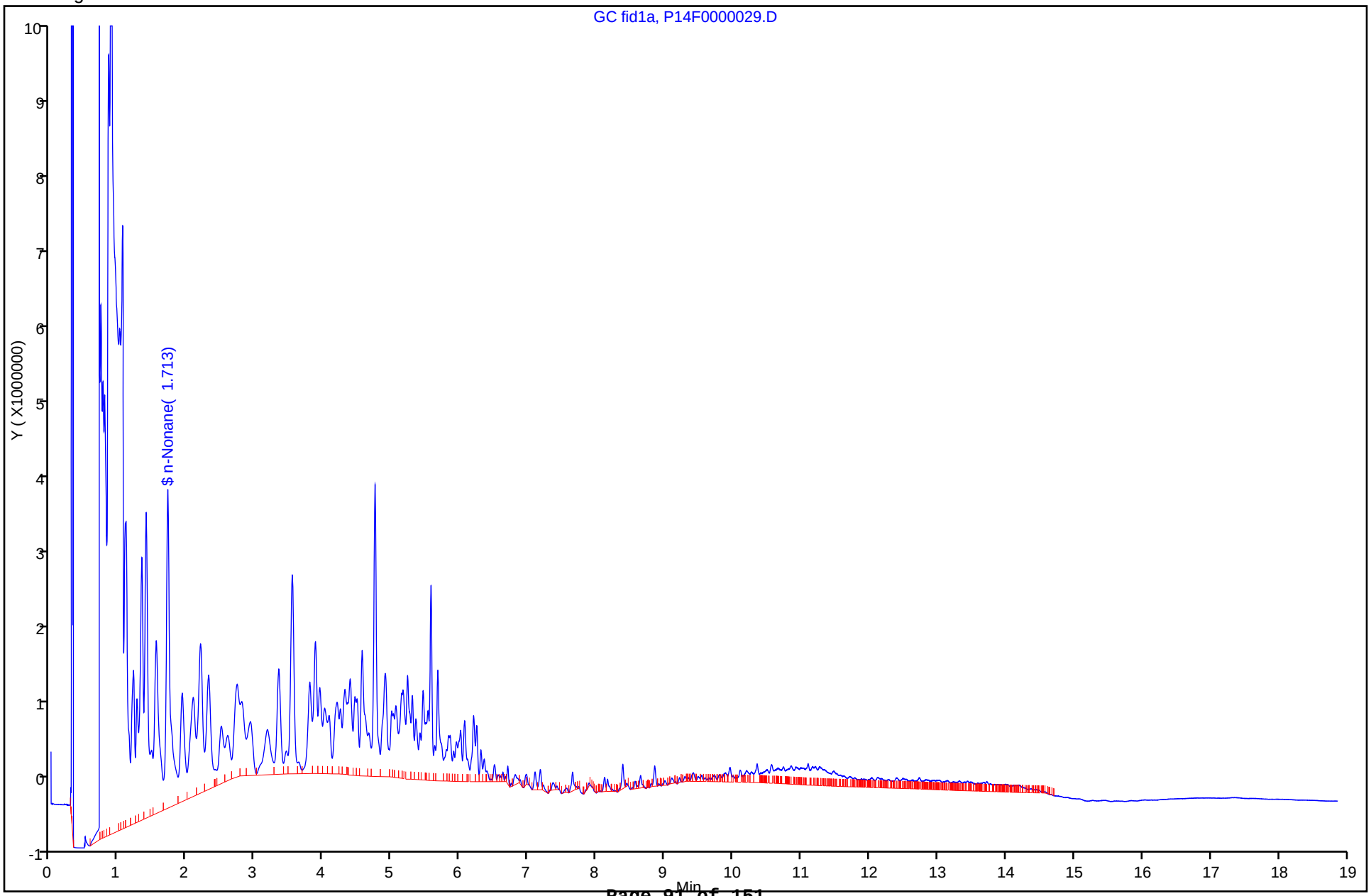
Report Date: 12-Aug-2011 08:15:37 Chrom Revision: 2.0 11-Aug-2011 08:33:58
Data File: \\Ncchrom\ChromData\A2HP14F\20110802-2310.b\P14F0000021.D
Injection Date: 02-Aug-2011 16:03:41 Limit Group: GC TPH DIESEL ICAL
Client ID: AOI-40 FUEL OIL (4) ALKALINE ACTIVATED
Instrument ID: A2HP14F
Lims Batch ID: 10476 Lims Sample ID: 21
Operator ID: 2398 Injection Vol: 1.00 ul
Y Scaling: Method Defined: Set to Absolute Y Value



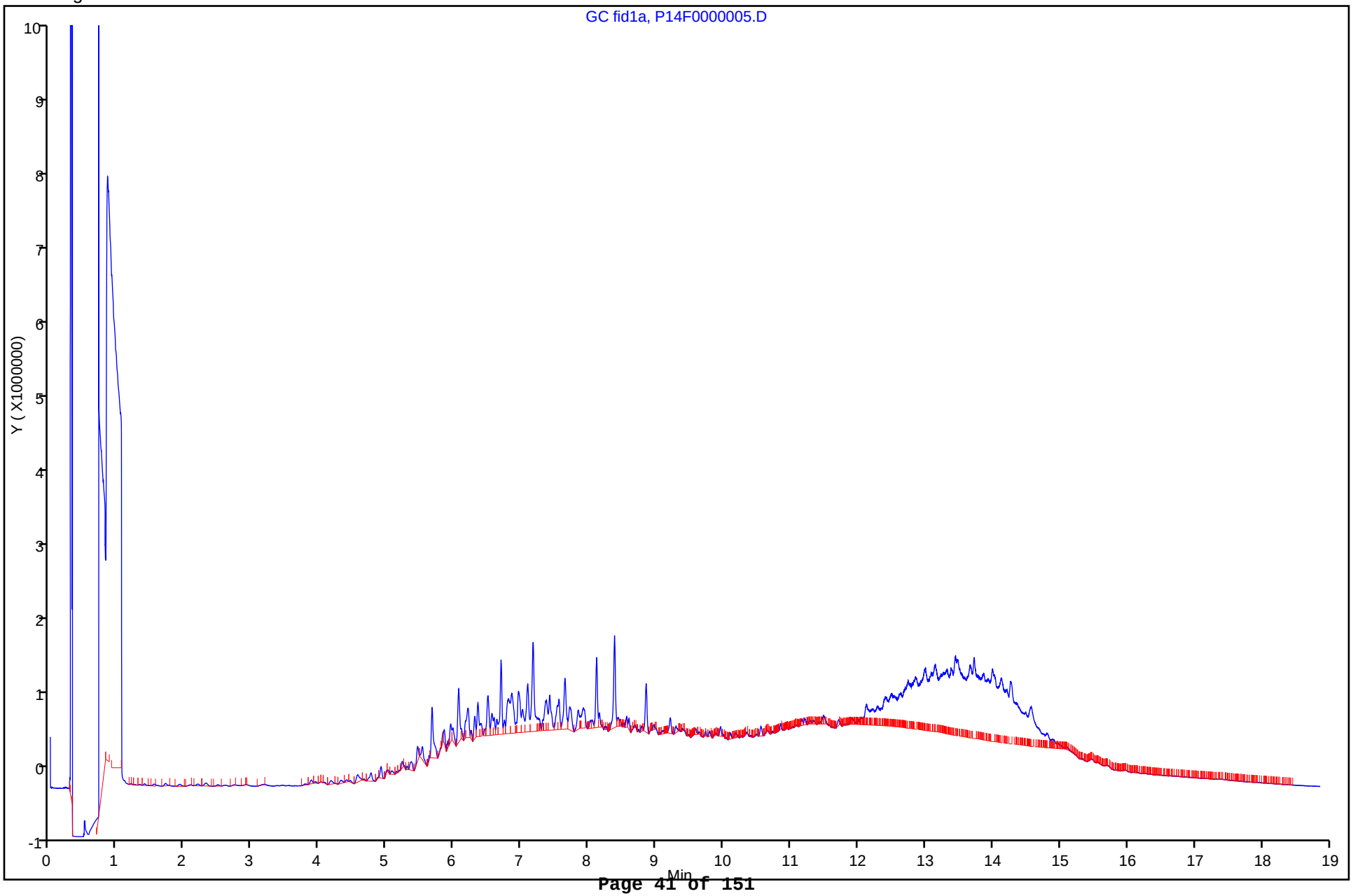
Report Date: 12-Aug-2011 08:15:39 Chrom Revision: 2.0 11-Aug-2011 08:33:58
Data File: \\Ncchrom\ChromData\A2HP14F\20110802-2310.b\P14F0000025.D
Injection Date: 02-Aug-2011 17:40:38 Limit Group: GC TPH DIESEL ICAL
Client ID: AOI-40 FUEL OIL (5) HEAT ACTIVATED 50C
Instrument ID: A2HP14F
Lims Batch ID: 10476 Lims Sample ID: 25
Operator ID: 2398 Injection Vol: 1.00 ul
Y Scaling: Method Defined: Set to Absolute Y Value



Report Date: 12-Aug-2011 08:15:41 Chrom Revision: 2.0 11-Aug-2011 08:33:58
Data File: \\Ncchrom\ChromData\A2HP14F\20110802-2310.b\P14F0000029.D
Injection Date: 02-Aug-2011 19:17:19 Limit Group: GC TPH DIESEL ICAL
Client ID: AOI-40 FUEL OIL (6) FENTONS EDTA
Instrument ID: A2HP14F
Lims Batch ID: 10476 Lims Sample ID: 29
Operator ID: 2398 Injection Vol: 1.00 ul
Y Scaling: Method Defined: Set to Absolute Y Value



Report Date: 12-Aug-2011 08:15:27 Chrom Revision: 2.0 11-Aug-2011 08:33:58
Data File: \\Ncchrom\ChromData\A2HP14F\20110802-2310.b\P14F0000005.D
Injection Date: 02-Aug-2011 09:36:44 Limit Group: GC TPH DIESEL ICAL
Client ID: AOI-12-HYD OIL (1) ROOM TEMP CONTROL
Instrument ID: A2HP14F
Lims Batch ID: 10476 Lims Sample ID: 5
Operator ID: 2398 Injection Vol: 1.00 ul
Y Scaling: Method Defined: Set to Absolute Y Value

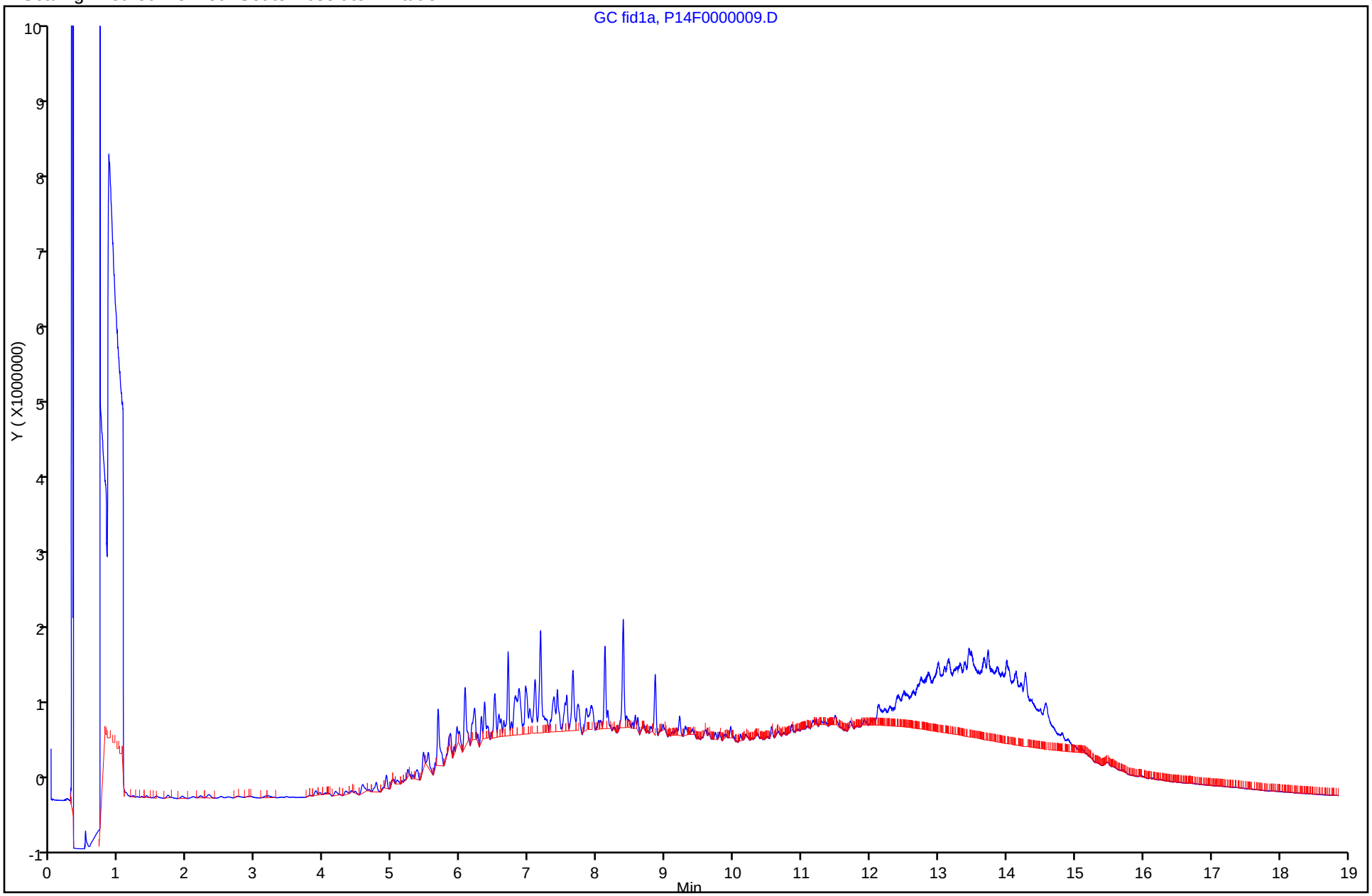


Report Date: 12-Aug-2011 08:15:29 Chrom Revision: 2.0 11-Aug-2011 08:33:58

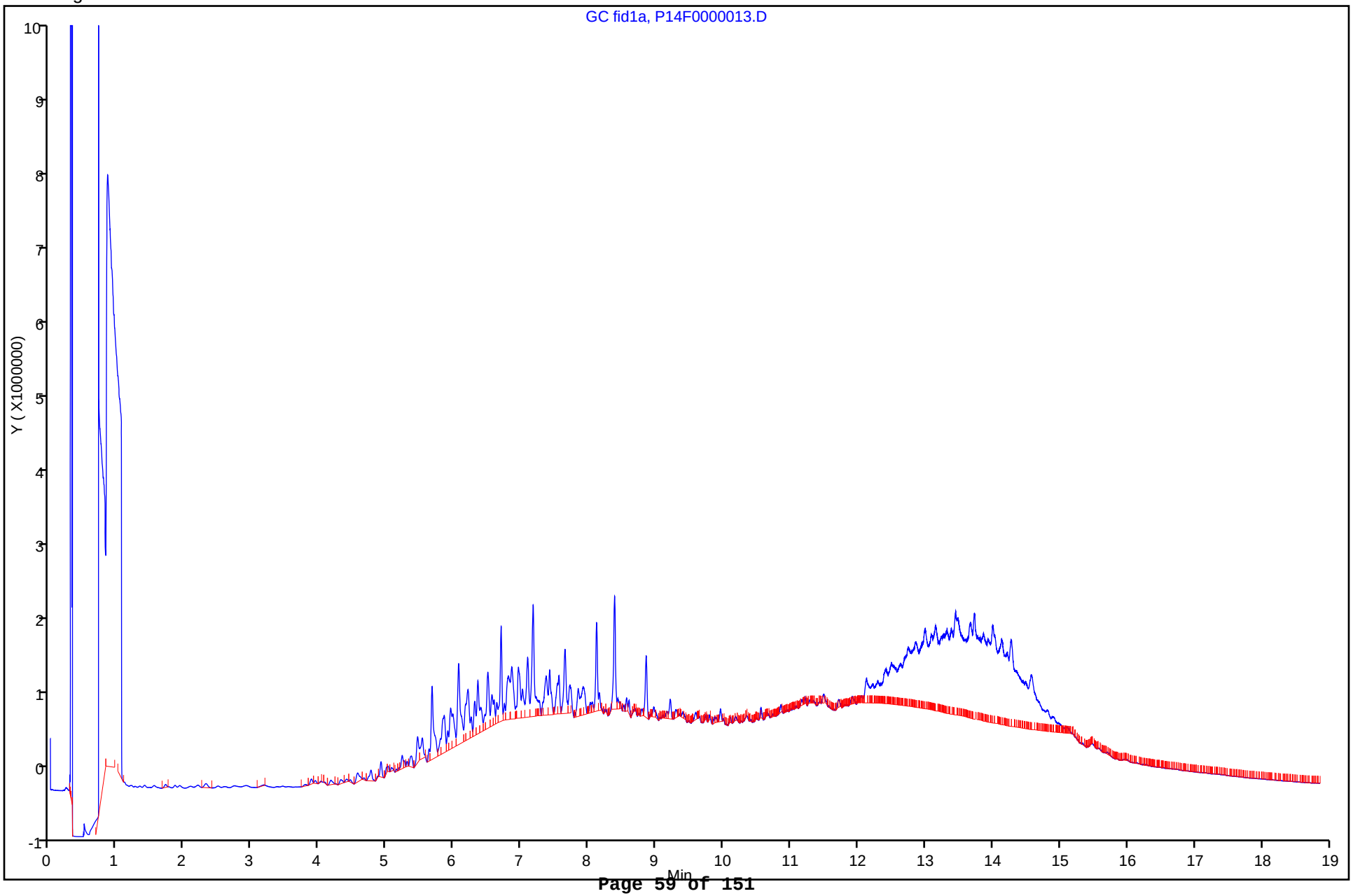
Data File: \\Ncchrom\ChromData\A2HP14F\20110802-2310.b\P14F0000009.D

Injection Date:	02-Aug-2011 11:13:23	Limit Group:	GC TPH DIESEL ICAL
Client ID:	AOI-12-HYD OIL (2) 50C CONTROL	Instrument ID:	A2HP14F
Lims Batch ID:	10476	Lims Sample ID:	9
Operator ID:	2398	Injection Vol:	1.00 ul

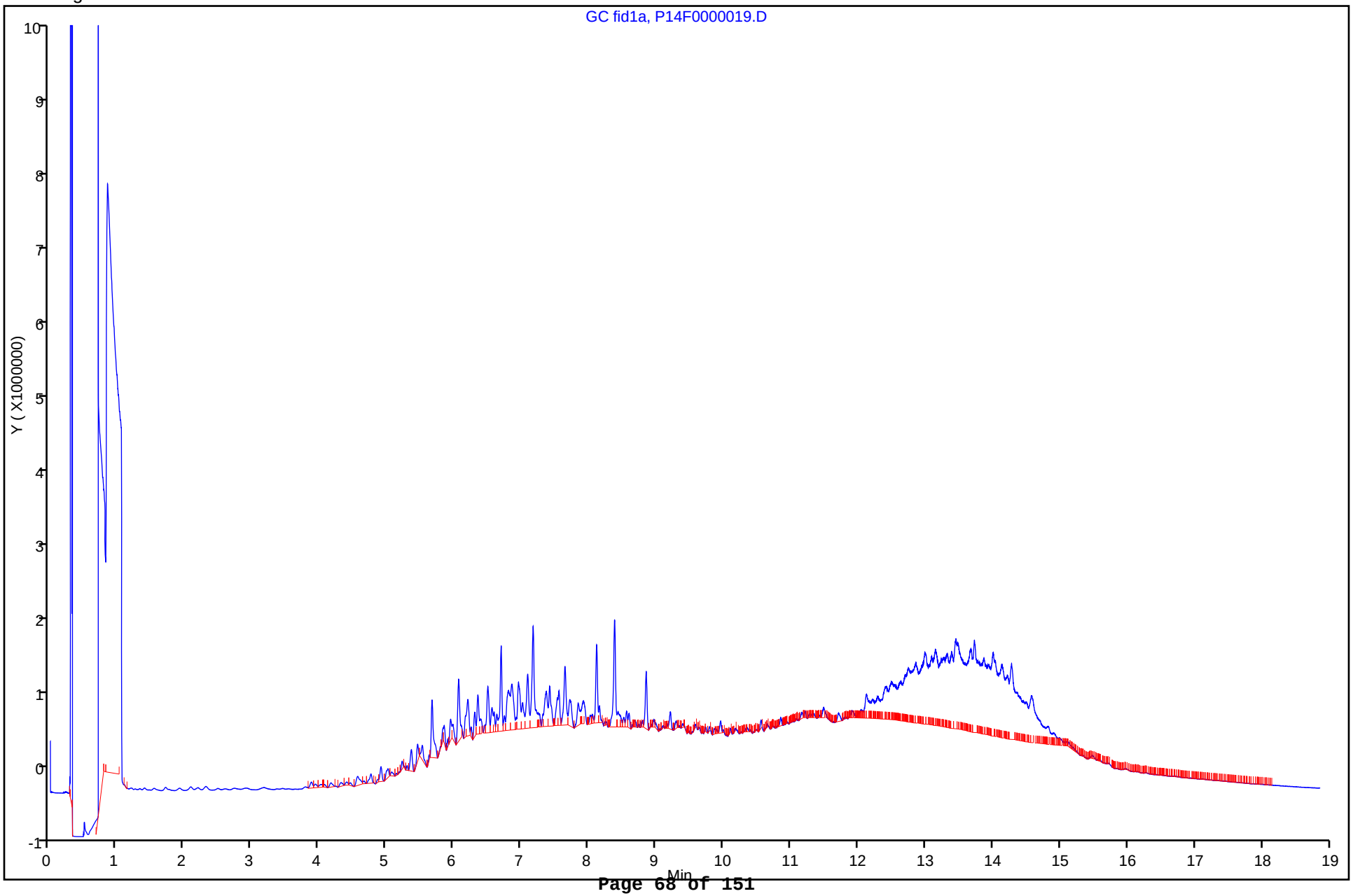
Y Scaling: Method Defined: Set to Absolute Y Value



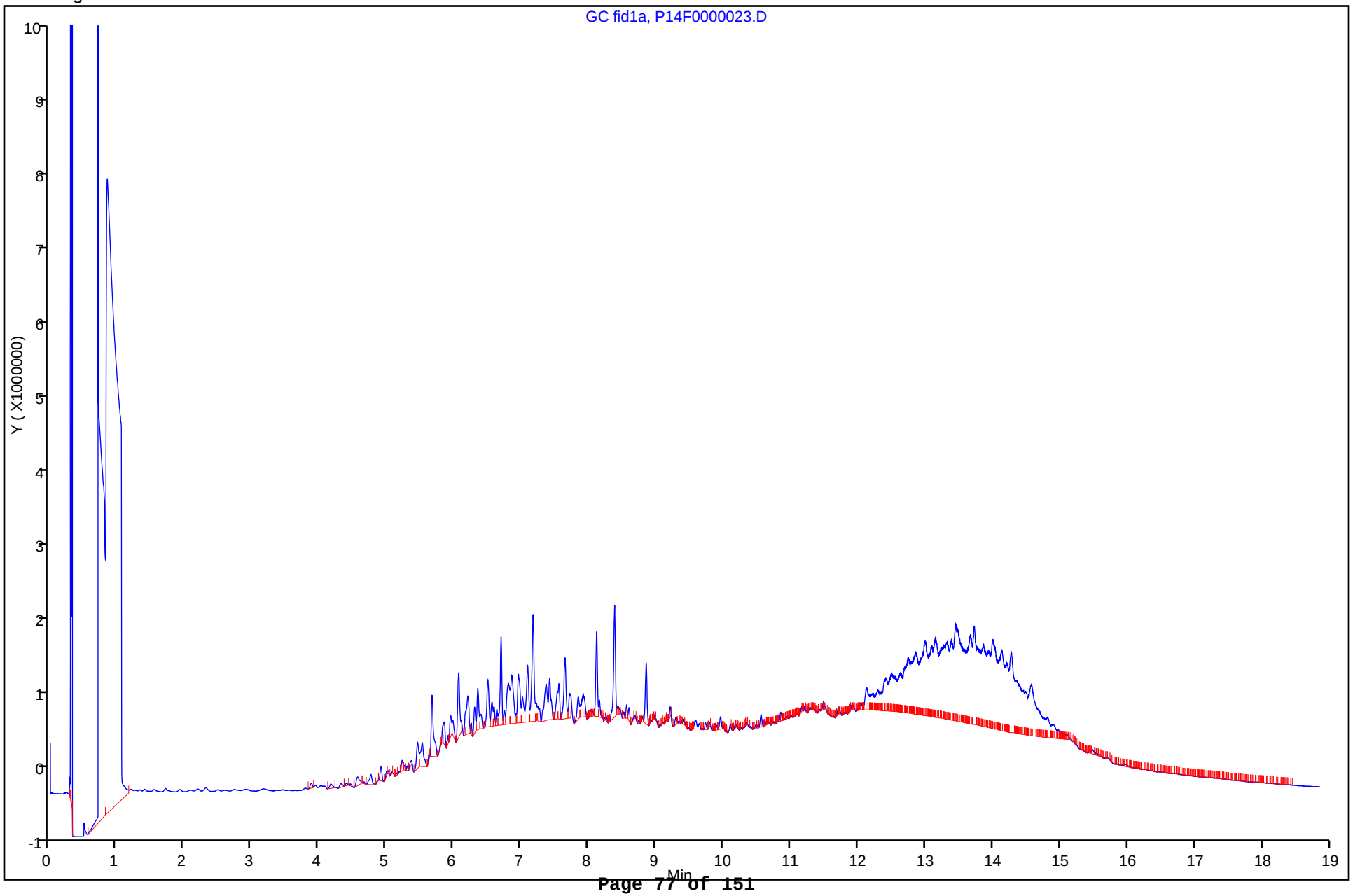
Report Date: 12-Aug-2011 08:15:32 Chrom Revision: 2.0 11-Aug-2011 08:33:58
Data File: \\Ncchrom\ChromData\A2HP14F\20110802-2310.b\P14F0000013.D
Injection Date: 02-Aug-2011 12:50:22 Limit Group: GC TPH DIESEL ICAL
Client ID: AOI-12-HYD OIL (3) IRON ACTIVATED
Instrument ID: A2HP14F
Lims Batch ID: 10476 Lims Sample ID: 13
Operator ID: 2398 Injection Vol: 1.00 ul
Y Scaling: Method Defined: Set to Absolute Y Value



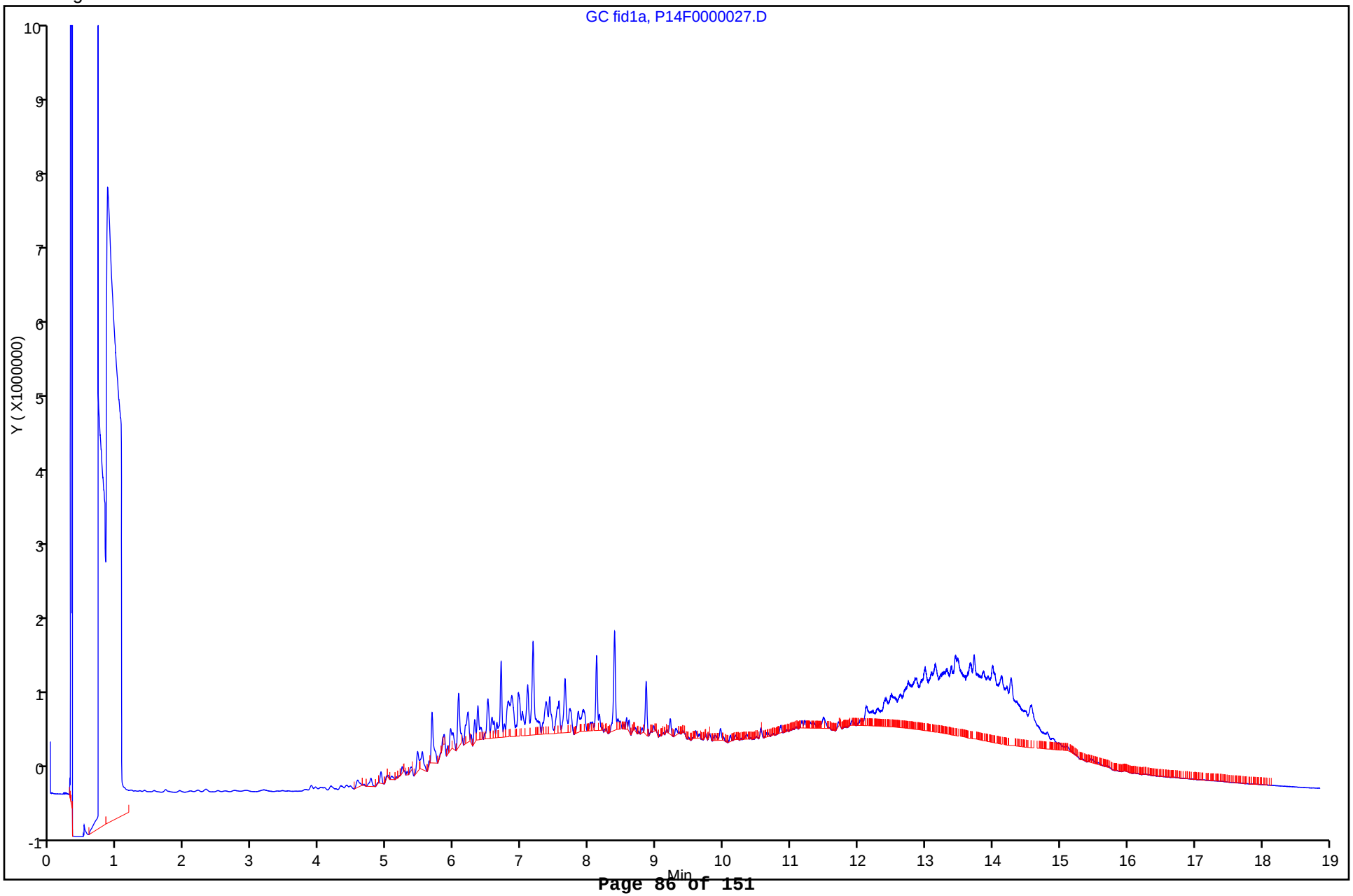
Report Date: 12-Aug-2011 08:15:36 Chrom Revision: 2.0 11-Aug-2011 08:33:58
Data File: \\Ncchrom\ChromData\A2HP14F\20110802-2310.b\P14F0000019.D
Injection Date: 02-Aug-2011 15:15:28 Limit Group: GC TPH DIESEL ICAL
Client ID: AOI-12-HYD OIL (4) ALKALINE ACTIVATED
Instrument ID: A2HP14F
Lims Batch ID: 10476 Lims Sample ID: 19
Operator ID: 2398 Injection Vol: 1.00 ul
Y Scaling: Method Defined: Set to Absolute Y Value



Report Date: 12-Aug-2011 08:15:38 Chrom Revision: 2.0 11-Aug-2011 08:33:58
Data File: \\Ncchrom\ChromData\A2HP14F\20110802-2310.b\P14F0000023.D
Injection Date: 02-Aug-2011 16:52:07 Limit Group: GC TPH DIESEL ICAL
Client ID: AOI-12-HYD OIL (5) HEAT ACTIVATED 50C
Instrument ID: A2HP14F
Lims Batch ID: 10476 Lims Sample ID: 23
Operator ID: 2398 Injection Vol: 1.00 ul
Y Scaling: Method Defined: Set to Absolute Y Value



Report Date: 12-Aug-2011 08:15:40 Chrom Revision: 2.0 11-Aug-2011 08:33:58
Data File: \\Ncchrom\ChromData\A2HP14F\20110802-2310.b\P14F0000027.D
Injection Date: 02-Aug-2011 18:28:49 Limit Group: GC TPH DIESEL ICAL
Client ID: AOI-12-HYD OIL (6) FENTONS EDTA
Instrument ID: A2HP14F
Lims Batch ID: 10476 Lims Sample ID: 27
Operator ID: 2398 Injection Vol: 1.00 ul
Y Scaling: Method Defined: Set to Absolute Y Value



TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

Job Number: 240-7408-1

Job Description: Buick City

For:
ARCADIS U.S., Inc.
4915 Prospectus Drive
Suite F
Durham, NC 27713

Attention: Mr. David Liles

Approved for release.
Denise Pohl
Project Manager II
1/20/2012 2:16 PM

Denise Pohl
Project Manager II
denise.pohl@testamericainc.com
01/20/2012

The test results in this report meet all NELAP requirements for parameters for which accreditation is required or available. Any exceptions to the 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. This report is confidential and is intended for the sole use of TestAmerica and its client. All questions regarding this report should be directed to the TestAmerica Project Manager who has signed this report.

US EPA ARCHIVE DOCUMENT

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: Buick City

Report Number: 240-7408-1

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 01/04/2012; the samples arrived in good condition and properly preserved. The temperature of the cooler at receipt was 13.6 C.

DIESEL RANGE ORGANICS (DRO)

Samples AOI-40 (240-7408-1) and AOI-12 (240-7408-2) were analyzed for diesel range organics (DRO) in accordance with EPA SW-846 Method 8015B - DRO. The samples were prepared on 01/05/2012 and analyzed on 01/13/2012.

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.

n-Nonane failed the surrogate recovery criteria high for AOI-40 (240-7408-1). n-Nonane failed the surrogate recovery criteria low for AOI-12 (240-7408-2). Refer to the QC report for details.

Samples AOI-40 (240-7408-1)[100X] and AOI-12 (240-7408-2)[200X] required dilution prior to analysis. The reporting limits have been adjusted accordingly.

Method(s) 3520C: Insufficient sample volume was available to perform a matrix spike/matrix spike duplicate (MS/MSD) associated with batch 29145, 8015.

No other difficulties were encountered during the DRO analyses.

All other quality control parameters were within the acceptance limits.

EXECUTIVE SUMMARY - Detections

Client: ARCADIS U.S., Inc. Job Number: 240-7408-1

Lab Sample ID / Analyte	Client Sample ID	Result	Qualifier	Reporting Limit	Units	Method
240-7408-1	**AOI-40**					
C10-C20		6400000		460000	ug/L	8015B
C20-C34		2100000		460000	ug/L	8015B
240-7408-2	**AOI-12**					
C10-C20		11000000		1100000	ug/L	8015B
C20-C34		7000000		1100000	ug/L	8015B

METHOD SUMMARY

Client: ARCADIS U.S., Inc. Job Number: 240-7408-1

Description	Lab Location	Method	Preparation Method
Matrix Water			
Diesel Range Organics (DRO) (GC)	TAL NC	SW846 8015B	
Liquid-Liquid Extraction (Continuous)			SW846 3520C

Lab References:

TAL NC = TestAmerica North Canton

Method References:

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: 240-7408-1

Method	Analyst	Analyst ID
SW846 8015B	Geis, Sharon	SG

SAMPLE SUMMARY

Client: ARCADIS U.S., Inc. Job Number: 240-7408-1

Lab Sample ID	Client Sample ID	Client Matrix	Date/Time Sampled	Date/Time Received
240-7408-1	AOI-40	Water	01/03/2012 1600	01/04/2012 0930
240-7408-2	AOI-12	Water	01/03/2012 1600	01/04/2012 0930

SAMPLE RESULTS

Client: ARCADIS U.S., Inc. Job Number: 240-7408-1

Client Sample ID: **AOI-40**

Lab Sample ID: 240-7408-1 Date Sampled: 01/03/2012 1600
Client Matrix: Water Date Received: 01/04/2012 0930

8015B Diesel Range Organics (DRO) (GC)

Analysis Method:	8015B	Analysis Batch:	240-30067	Instrument ID:	A2HP14R
Prep Method:	3520C	Prep Batch:	240-29145	Initial Weight/Volume:	240 mL
Dilution:	100			Final Weight/Volume:	11 mL
Analysis Date:	01/13/2012 0941			Injection Volume:	1 uL
Prep Date:	01/05/2012 1000			Result Type:	PRIMARY

Analyte	Result (ug/L)	Qualifier	MDL	RL
C10-C20	6400000		220000	460000
C20-C34	2100000		220000	460000

Surrogate	%Rec	Qualifier	Acceptance Limits
n-Nonane	8954	X	10 - 110

Client: ARCADIS U.S., Inc. Job Number: 240-7408-1

Client Sample ID: **AOI-12**

Lab Sample ID: 240-7408-2 Date Sampled: 01/03/2012 1600
Client Matrix: Water Date Received: 01/04/2012 0930

8015B Diesel Range Organics (DRO) (GC)

Analysis Method:	8015B	Analysis Batch:	240-30067	Instrument ID:	A2HP14R
Prep Method:	3520C	Prep Batch:	240-29145	Initial Weight/Volume:	245 mL
Dilution:	200			Final Weight/Volume:	14 mL
Analysis Date:	01/13/2012 1005			Injection Volume:	1 uL
Prep Date:	01/05/2012 1000			Result Type:	PRIMARY

Analyte	Result (ug/L)	Qualifier	MDL	RL
C10-C20	11000000		540000	1100000
C20-C34	7000000		540000	1100000

Surrogate	%Rec	Qualifier	Acceptance Limits
n-Nonane	0	X	10 - 110

DATA REPORTING QUALIFIERS

Client: ARCADIS U.S., Inc. Job Number: 240-7408-1

Lab Section	Qualifier	Description
GC Semi VOA		
	U	Indicates the analyte was analyzed for but not detected.
	X	Surrogate is outside control limits

QUALITY CONTROL RESULTS

Client: ARCADIS U.S., Inc. Job Number: 240-7408-1

QC Association Summary

Lab Sample ID	Client Sample ID	Report Basis	Client Matrix	Method	Prep Batch
GC Semi VOA					
Prep Batch: 240-29145					
LCS 240-29145/4-A	Lab Control Sample	T	Water	3520C	
MB 240-29145/3-A	Method Blank	T	Water	3520C	
240-7408-1	AOI-40	T	Water	3520C	
240-7408-2	AOI-12	T	Water	3520C	
Analysis Batch:240-30067					
LCS 240-29145/4-A	Lab Control Sample	T	Water	8015B	240-29145
MB 240-29145/3-A	Method Blank	T	Water	8015B	240-29145
240-7408-1	AOI-40	T	Water	8015B	240-29145
240-7408-2	AOI-12	T	Water	8015B	240-29145

Report Basis

T = Total

Client: ARCADIS U.S., Inc.

Job Number: 240-7408-1

Surrogate Recovery Report

8015B Diesel Range Organics (DRO) (GC)

Client Matrix: Water

Lab Sample ID	Client Sample ID	C91 %Rec
240-7408-1	AOI-40	8954X
240-7408-2	AOI-12	0X
MB 240-29145/3-A		68
LCS 240-29145/4-A		68

Surrogate	Acceptance Limits
C9 = n-Nonane	10-110

Client: ARCADIS U.S., Inc. Job Number: 240-7408-1

Method Blank - Batch: 240-29145

Method: 8015B
Preparation: 3520C

Lab Sample ID:	MB 240-29145/3-A	Analysis Batch:	240-30067	Instrument ID:	A2HP14R
Client Matrix:	Water	Prep Batch:	240-29145	Lab File ID:	P14R0000007.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	1000 mL
Analysis Date:	01/13/2012 1030	Units:	ug/L	Final Weight/Volume:	10 mL
Prep Date:	01/05/2012 1000			Injection Volume:	1 uL
Leach Date:	N/A			Column ID:	PRIMARY

Analyte	Result	Qual	MDL	RL
C10-C20	1000	U	480	1000
C20-C34	1000	U	480	1000
Diesel	1000	U	480	1000

Surrogate	% Rec	Acceptance Limits
n-Nonane	68	10 - 110

Lab Control Sample - Batch: 240-29145

Method: 8015B
Preparation: 3520C

Lab Sample ID:	LCS 240-29145/4-A	Analysis Batch:	240-30067	Instrument ID:	A2HP14R
Client Matrix:	Water	Prep Batch:	240-29145	Lab File ID:	P14R0000008.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	1000 mL
Analysis Date:	01/13/2012 1055	Units:	ug/L	Final Weight/Volume:	10 mL
Prep Date:	01/05/2012 1000			Injection Volume:	1 uL
Leach Date:	N/A			Column ID:	PRIMARY

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Diesel	5000	4030	81	36 - 124	

Surrogate	% Rec	Acceptance Limits
n-Nonane	68	10 - 110

ARCADIS
Infrastructure · Water · Environment · Buildings

ID#:

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

Page 1 of 1

Lab Work Order #

Send Results to:

Contact & Company Name: David Liles, ARCADIS	Telephone: 9195444535
Address:	Fax:
City / State / Zip	E-mail Address:
Project Name/Location (City, State): Buck City	Project #:
Sampler's Printed Name: Stephanie Branch	Sampler's Signature: Stephanie Branch

Preservative	E							
Filtered (✓)								
# of Containers	1							
Container Information	3							

PARAMETER ANALYSIS & METHOD

Sample ID	Collection Date	Collection Time	Type (✓) Comp	Type (✓) Grab	Matrix	HDNPE modified 507*							REMARKS
AOI-40	1/3/12	16:00		✓	W	X							
AOI-12	↓	↓		↓	↓	X							
													Turn around time
													10 business days

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~~ glass
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; W - Water; T - Tissue; SE - Sediment; SL - Sludge; A - Air; NL - NAPL/Oil; SW - Sample Wipe; Other: ______

Special Instructions/Comments:
* Method modified as discussed w/ Ray Risden

☐ Special QA/QC Instructions(✓):

Laboratory Information and Receipt		Relinquished By	Received By	Relinquished By	Laboratory Received By
Lab Name:	Cooler Custody Seal (✓)	Printed Name: Stephanie Branch	Printed Name: Lita Vance	Printed Name:	Printed Name:
☐ Cooler packed with ice (✓)	☐ Intact ☐ Not Intact	Signature: Stephanie Branch	Signature: Lita Vance	Signature:	Signature:
Specify Turnaround Requirements:	Sample Receipt:	Firm: ARCADIS	Firm/Courier:	Firm/Courier:	Firm:
Shipping Tracking #:	Condition/Cooler Temp: ______	Date/Time: 1/3/12 16:00	Date/Time: 1/4/12 9:30	Date/Time:	Date/Time:

20730826 CofC AR Form 01.12.2007

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

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

Client ARCADIS Project _____ By: T Vance
Cooler Received on 1.4.12 Opened on 1.4.12 (Signature)
~~FedEx~~ UPS DHL FAS Stetson Client Drop Off TestAmerica Courier Other_____
TestAmerica Cooler # _____ Multiple Coolers Foam Box Client Cooler Other Box

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 Bag
6. Cooler temperature upon receipt 13.6 °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# 110410-HNO_3; Sulfuric Acid Lot# 041911-H_2SO_4; Sodium Hydroxide Lot# 121809 -NaOH; Hydrochloric Acid Lot# 041911-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: 240-7408-1

Login Number: 7408

List Source: TestAmerica North Canton

List Number: 1

Creator: Sutek, Nick

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.	N/A	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	13.6
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	

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

Job Number: 240-5436-1

Job Description: Buick City - B0064410.2011.00301

For:
ARCADIS U.S., Inc.
4915 Prospectus Drive
Suite F
Durham, NC 27713

Attention: Mr. David Liles

Approved for release.
Denise Pohl
Project Manager II
11/16/2011 3:15 PM

Denise Pohl
Project Manager II
denise.pohl@testamericainc.com
11/16/2011

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CASE NARRATIVE

Client: ARCADIS U.S., Inc.

Project: Buick City - B0064410.2011.00301

Report Number: 240-5436-1

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 11/01/2011; the samples arrived in good condition, properly preserved and on ice. The temperature of the coolers at receipt was 4.8 C.

DIESEL RANGE ORGANICS (DRO)

Samples LIF-12-010 (240-5436-1) and LIF-12-010 DUP (240-5436-2) were analyzed for diesel range organics (DRO) in accordance with EPA SW-846 Method 8015B - DRO. The samples were prepared on 11/03/2011 and 11/04/2011 and analyzed on 11/07/2011 and 11/10/2011.

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.

Samples LIF-12-010 (240-5436-1)[5X] and LIF-12-010 DUP (240-5436-2)[5X] required dilution prior to analysis. The reporting limits have been adjusted accordingly.

No difficulties were encountered during the DRO analyses.

All quality control parameters were within the acceptance limits.

PERCENT SOLIDS

Samples LIF-12-010 (240-5436-1) and LIF-12-010 DUP (240-5436-2) were analyzed for percent solids in accordance with EPA Method 160.3 MOD. The samples were analyzed on 11/02/2011.

No difficulties were encountered during the % solids analyses.

All quality control parameters were within the acceptance limits.

EXECUTIVE SUMMARY - Detections

Client: ARCADIS U.S., Inc. Job Number: 240-5436-1

Lab Sample ID / Analyte	Client Sample ID	Result	Qualifier	Reporting Limit	Units	Method
240-5436-1	**LIF-12-010**					
C20-C34		1100		84	mg/Kg	8015B
Percent Solids		100		0.10	%	Moisture
Percent Moisture		0.051		0.10	%	Moisture
240-5436-2	**LIF-12-010 DUP**					
C20-C34		1600		84	mg/Kg	8015B
Percent Solids		100		0.10	%	Moisture
Percent Moisture		0.12		0.10	%	Moisture

METHOD SUMMARY

Client: ARCADIS U.S., Inc. Job Number: 240-5436-1

Description	Lab Location	Method	Preparation Method
Matrix Solid			
Diesel Range Organics (DRO) (GC)	TAL NC	SW846 8015B	
Soxhlet Extraction			SW846 3540C
Percent Moisture	TAL NC	EPA Moisture	

Lab References:

TAL NC = TestAmerica North Canton

Method References:

EPA = US Environmental Protection Agency

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: 240-5436-1

Method	Analyst	Analyst ID
SW846 8015B	Geis, Sharon	SG
SW846 8015B	Van Doren, Carolyn	CV
EPA Moisture	Nicholas, Courtney	CN

SAMPLE SUMMARY

Client: ARCADIS U.S., Inc. Job Number: 240-5436-1

Lab Sample ID	Client Sample ID	Client Matrix	Date/Time Sampled	Date/Time Received
240-5436-1	LIF-12-010	Solid	10/31/2011 0000	11/01/2011 0930
240-5436-2	LIF-12-010 DUP	Solid	10/31/2011 0000	11/01/2011 0930

SAMPLE RESULTS

Client: ARCADIS U.S., Inc. Job Number: 240-5436-1

Client Sample ID: **LIF-12-010**

Lab Sample ID: 240-5436-1 Date Sampled: 10/31/2011 0000
Client Matrix: Solid % Moisture: 0.1 Date Received: 11/01/2011 0930

8015B Diesel Range Organics (DRO) (GC)

Analysis Method:	8015B	Analysis Batch:	240-22181	Instrument ID:	A2HP5
Prep Method:	3540C	Prep Batch:	240-21751	Initial Weight/Volume:	30.01 g
Dilution:	5.0			Final Weight/Volume:	5 mL
Analysis Date:	11/07/2011 2050			Injection Volume:	1 uL
Prep Date:	11/03/2011 0836			Result Type:	PRIMARY

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	MDL	RL
C10-C20		84	U	46	84
C20-C34		1100		46	84

Surrogate	%Rec	Qualifier	Acceptance Limits
n-Nonane	33		10 - 110

Client: ARCADIS U.S., Inc. Job Number: 240-5436-1

Client Sample ID: **LIF-12-010 DUP**

Lab Sample ID: 240-5436-2 Date Sampled: 10/31/2011 0000
Client Matrix: Solid % Moisture: 0.1 Date Received: 11/01/2011 0930

8015B Diesel Range Organics (DRO) (GC)

Analysis Method:	8015B	Analysis Batch:	240-22713	Instrument ID:	A2HP5
Prep Method:	3540C	Prep Batch:	240-21930	Initial Weight/Volume:	30.02 g
Dilution:	5.0			Final Weight/Volume:	5 mL
Analysis Date:	11/10/2011 1451			Injection Volume:	1 uL
Prep Date:	11/04/2011 0846			Result Type:	PRIMARY

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	MDL	RL
C10-C20		84	U	46	84
C20-C34		1600		46	84

Surrogate	%Rec	Qualifier	Acceptance Limits
n-Nonane	37		10 - 110

General Chemistry

Client Sample ID: **LIF-12-010**

Lab Sample ID: 240-5436-1 Date Sampled: 10/31/2011 0000

Client Matrix: Solid Date Received: 11/01/2011 0930

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
Percent Solids	100		%	0.10	0.10	1.0	Moisture
Analysis Batch: 240-21603	Analysis Date: 11/02/2011 1017						DryWt Corrected: N
Percent Moisture	0.051		%	0.10	0.10	1.0	Moisture
Analysis Batch: 240-21603	Analysis Date: 11/02/2011 1017						DryWt Corrected: N

General Chemistry

Client Sample ID: **LIF-12-010 DUP**

Lab Sample ID: 240-5436-2 Date Sampled: 10/31/2011 0000

Client Matrix: Solid Date Received: 11/01/2011 0930

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
Percent Solids	100		%	0.10	0.10	1.0	Moisture
Analysis Batch: 240-21603	Analysis Date: 11/02/2011 1017						DryWt Corrected: N
Percent Moisture	0.12		%	0.10	0.10	1.0	Moisture
Analysis Batch: 240-21603	Analysis Date: 11/02/2011 1017						DryWt Corrected: N

DATA REPORTING QUALIFIERS

Client: ARCADIS U.S., Inc. Job Number: 240-5436-1

Lab Section	Qualifier	Description
GC Semi VOA		
	U	Indicates the analyte was analyzed for but not detected.

QUALITY CONTROL RESULTS

Client: ARCADIS U.S., Inc. Job Number: 240-5436-1

QC Association Summary

Lab Sample ID	Client Sample ID	Report Basis	Client Matrix	Method	Prep Batch
GC Semi VOA					
Prep Batch: 240-21751					
LCS 240-21751/22-A	Lab Control Sample	T	Solid	3540C	
MB 240-21751/21-A	Method Blank	T	Solid	3540C	
240-5436-1	LIF-12-010	T	Solid	3540C	
Prep Batch: 240-21930					
LCS 240-21930/24-A	Lab Control Sample	T	Solid	3540C	
MB 240-21930/23-A	Method Blank	T	Solid	3540C	
240-5436-2	LIF-12-010 DUP	T	Solid	3540C	
Analysis Batch:240-22181					
LCS 240-21751/22-A	Lab Control Sample	T	Solid	8015B	240-21751
MB 240-21751/21-A	Method Blank	T	Solid	8015B	240-21751
240-5436-1	LIF-12-010	T	Solid	8015B	240-21751
Analysis Batch:240-22713					
LCS 240-21930/24-A	Lab Control Sample	T	Solid	8015B	240-21930
MB 240-21930/23-A	Method Blank	T	Solid	8015B	240-21930
240-5436-2	LIF-12-010 DUP	T	Solid	8015B	240-21930

Report Basis
T = Total

General Chemistry					
Analysis Batch:240-21603					
240-5436-1	LIF-12-010	T	Solid	Moisture	
240-5436-2	LIF-12-010 DUP	T	Solid	Moisture	
240-5436-2DU	Duplicate	T	Solid	Moisture	

Report Basis
T = Total

Surrogate Recovery Report

8015B Diesel Range Organics (DRO) (GC)

Client Matrix: Solid

Lab Sample ID	Client Sample ID	C91 %Rec
240-5436-1	LIF-12-010	33
240-5436-2	LIF-12-010 DUP	37
MB 240-21751/21-A		38
MB 240-21930/23-A		36
LCS 240-21751/22-A		37
LCS 240-21930/24-A		38

Surrogate	Acceptance Limits
C9 = n-Nonane	10-110

Client: ARCADIS U.S., Inc. Job Number: 240-5436-1

Method Blank - Batch: 240-21751

Method: 8015B
Preparation: 3540C

Lab Sample ID:	MB 240-21751/21-A	Analysis Batch:	240-22181	Instrument ID:	A2HP5
Client Matrix:	Solid	Prep Batch:	240-21751	Lab File ID:	P5110705.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	30 g
Analysis Date:	11/07/2011 1228	Units:	mg/Kg	Final Weight/Volume:	5 mL
Prep Date:	11/03/2011 0836			Injection Volume:	1 uL
Leach Date:	N/A			Column ID:	PRIMARY

Analyte	Result	Qual	MDL	RL
Diesel	17	U	9.3	17
C10-C20	17	U	9.3	17
C20-C34	17	U	9.3	17

Surrogate	% Rec	Acceptance Limits
n-Nonane	38	10 - 110

Lab Control Sample - Batch: 240-21751

Method: 8015B
Preparation: 3540C

Lab Sample ID:	LCS 240-21751/22-A	Analysis Batch:	240-22181	Instrument ID:	A2HP5
Client Matrix:	Solid	Prep Batch:	240-21751	Lab File ID:	P5110708.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	30 g
Analysis Date:	11/07/2011 1356	Units:	mg/Kg	Final Weight/Volume:	5 mL
Prep Date:	11/03/2011 0836			Injection Volume:	1 uL
Leach Date:	N/A			Column ID:	PRIMARY

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Diesel	83.3	57.7	69	47 - 138	

Surrogate	% Rec	Acceptance Limits
n-Nonane	37	10 - 110

Client: ARCADIS U.S., Inc. Job Number: 240-5436-1

Method Blank - Batch: 240-21930

Method: 8015B
Preparation: 3540C

Lab Sample ID:	MB 240-21930/23-A	Analysis Batch:	240-22713	Instrument ID:	A2HP5
Client Matrix:	Solid	Prep Batch:	240-21930	Lab File ID:	P5111016.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	30 g
Analysis Date:	11/10/2011 1749	Units:	mg/Kg	Final Weight/Volume:	5 mL
Prep Date:	11/04/2011 0846			Injection Volume:	1 uL
Leach Date:	N/A			Column ID:	PRIMARY

Analyte	Result	Qual	MDL	RL
Diesel	17	U	9.3	17
C10-C20	17	U	9.3	17
C20-C34	17	U	9.3	17

Surrogate	% Rec	Acceptance Limits
n-Nonane	36	10 - 110

Lab Control Sample - Batch: 240-21930

Method: 8015B
Preparation: 3540C

Lab Sample ID:	LCS 240-21930/24-A	Analysis Batch:	240-22713	Instrument ID:	A2HP5
Client Matrix:	Solid	Prep Batch:	240-21930	Lab File ID:	P5111029.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	30 g
Analysis Date:	11/11/2011 0011	Units:	mg/Kg	Final Weight/Volume:	5 mL
Prep Date:	11/04/2011 0846			Injection Volume:	1 uL
Leach Date:	N/A			Column ID:	PRIMARY

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Diesel	83.3	54.8	66	47 - 138	

Surrogate	% Rec	Acceptance Limits
n-Nonane	38	10 - 110

Client: ARCADIS U.S., Inc. Job Number: 240-5436-1

Duplicate - Batch: 240-21603

Method: Moisture
Preparation: N/A

Lab Sample ID:	240-5436-2	Analysis Batch:	240-21603	Instrument ID:	No Equipment
Client Matrix:	Solid	Prep Batch:	N/A	Lab File ID:	N/A
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	11/02/2011 1017	Units:	%	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	Sample Result/Qual	Result	RPD	Limit	Qual
Percent Solids	100	100	0.008	20	
Percent Moisture	0.12	0.12	7	20	

ARCADIS

Laboratory Task Order No./P.O. No. _____

CHAIN-OF-CUSTODY RECORD

Page 1 of 1

Project Number/Name Buick City

Project Location _____

Laboratory _____

Project Manager Dave Liles 919-544-4535

Sampler(s)/Affiliation Andy Baumeister

Sample ID/Location	Matrix	Date/Time Sampled	Lab ID	ANALYSIS / METHOD / SIZE: Modified 8015 m DNRE 507 diesel range/oil range						Remarks	Total
LIF-12-D10	S	10/31/11		X						Standard TAT	
LIF-12-010 DUP	S	10/31/11		X							

Page 19 of 22

Sample Matrix: L = Liquid; S = Solid; A = Air

Total No. of Bottles/ Containers

					Seal Intact?
Relinquished by: Andy Baumeister	Organization: ARCADIS	Date 10/31/11	Time 15:37		
Received by:	Organization: TAL	Date 11/1/11	Time 9:30 AM		Yes No N/A
Relinquished by:	Organization:	Date / /	Time		Seal Intact?
Received by:	Organization:	Date / /	Time		Yes No N/A

Special Instructions/Remarks: _____

Delivery Method: ☐ In Person ☑ Common Carrier FedEx (SPECIFY) ☐ Lab Courier ☐ Other _____ (SPECIFY)

AG 05-12/01

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

Client: Buck Co. Project _____ By: _____
Cooler Received on 11.1.11 Opened on 11.1.11 (Signature)
FedEx ☒ UPS ☐ DHL ☐ FAS ☐ Stetson ☐ Client Drop Off ☐ TestAmerica Courier ☐ Other_____
TestAmerica Cooler # TA no # 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 1 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 4.8 °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# 110410-HNO_3; Sulfuric Acid Lot# 110410-H_2SO_4; Sodium Hydroxide Lot# 121809 -NaOH; Hydrochloric Acid Lot# 041911-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: 240-5436-1

Login Number: 5436

List Source: TestAmerica North Canton

List Number: 1

Creator: Sutek, Nick

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	4.8
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	

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

Job Number: 240-3820-1

Job Description: Buick City - B0064410.2011.00301

For:
ARCADIS U.S., Inc.
4915 Prospectus Drive
Suite F
Durham, NC 27713

Attention: Mr. David Liles

Approved for release.
Denise Pohl
Project Manager II
9/29/2011 6:22 PM

Denise Pohl
Project Manager II
denise.pohl@testamericainc.com
09/29/2011

cc: Final Data Tracking

The test results in this report meet all NELAP requirements for parameters for which accreditation is required or available. Any exceptions to the 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. This report is confidential and is intended for the sole use of TestAmerica and its client. All questions regarding this report should be directed to the TestAmerica Project Manager who has signed this report.

US EPA ARCHIVE DOCUMENT

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: Buick City - B0064410.2011.00301

Report Number: 240-3820-1

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 09/14/2011; the samples arrived in good condition, properly preserved and on ice. The temperature of the cooler at receipt was 3.9 C.

DIESEL RANGE ORGANICS (DRO)

Samples LIF-16-017 HEATED (240-3820-1) and LIF-16-017 HEATED (DUP) (240-3820-2) were analyzed for diesel range organics (DRO) in accordance with EPA SW-846 Method 8015B - DRO. The samples were analyzed on 09/26/2011.

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.

No difficulties were encountered during the DRO analyses.

All quality control parameters were within the acceptance limits.

PERCENT SOLIDS

Samples LIF-16-017 HEATED (240-3820-1) and LIF-16-017 HEATED (DUP) (240-3820-2) were analyzed for percent solids in accordance with EPA Method 160.3 MOD. The samples were analyzed on 09/15/2011.

No difficulties were encountered during the % solids analyses.

All quality control parameters were within the acceptance limits.

EXECUTIVE SUMMARY - Detections

Client: ARCADIS U.S., Inc. Job Number: 240-3820-1

Lab Sample ID / Analyte	Client Sample ID	Result	Qualifier	Reporting Limit	Units	Method
240-3820-1	**LIF-16-017 HEATED**					
Percent Solids		100		0.10	%	Moisture
Percent Moisture		0.13		0.10	%	Moisture
240-3820-2FD	**LIF-16-017 HEATED (DUP)**					
Percent Solids		100		0.10	%	Moisture
Percent Moisture		0.20		0.10	%	Moisture

METHOD SUMMARY

Client: ARCADIS U.S., Inc. Job Number: 240-3820-1

Description	Lab Location	Method	Preparation Method
Matrix Solid			
Diesel Range Organics (DRO) (GC)	TAL NC	SW846 8015B	
Soxhlet Extraction			SW846 3540C
Percent Moisture	TAL NC	EPA Moisture	

Lab References:

TAL NC = TestAmerica North Canton

Method References:

EPA = US Environmental Protection Agency

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: 240-3820-1

Method	Analyst	Analyst ID
SW846 8015B	Geis, Sharon	SG
EPA Moisture	Nicholas, Courtney	CN

SAMPLE SUMMARY

Client: ARCADIS U.S., Inc. Job Number: 240-3820-1

Lab Sample ID	Client Sample ID	Client Matrix	Date/Time Sampled	Date/Time Received
240-3820-1	LIF-16-017 HEATED	Solid	09/13/2011 1700	09/14/2011 0930
240-3820-2FD	LIF-16-017 HEATED (DUP)	Solid	09/13/2011 1700	09/14/2011 0930

SAMPLE RESULTS

Client: ARCADIS U.S., Inc. Job Number: 240-3820-1

Client Sample ID: **LIF-16-017 HEATED**

Lab Sample ID: 240-3820-1 Date Sampled: 09/13/2011 1700
Client Matrix: Solid % Moisture: 0.1 Date Received: 09/14/2011 0930

8015B Diesel Range Organics (DRO) (GC)

Analysis Method:	8015B	Analysis Batch:	240-16703	Instrument ID:	A2HP14F
Prep Method:	3540C	Prep Batch:	240-16283	Initial Weight/Volume:	30.06 g
Dilution:	1.0			Final Weight/Volume:	5 mL
Analysis Date:	09/26/2011 1836			Injection Volume:	1 uL
Prep Date:	09/22/2011 0831			Result Type:	PRIMARY

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	MDL	RL
C10-C20		17	U	9.3	17
C20-C34		17	U	9.3	17

Surrogate	%Rec	Qualifier	Acceptance Limits
n-Nonane	52		10 - 110

Client: ARCADIS U.S., Inc. Job Number: 240-3820-1

Client Sample ID: **LIF-16-017 HEATED (DUP)**

Lab Sample ID: 240-3820-2FD Date Sampled: 09/13/2011 1700
Client Matrix: Solid % Moisture: 0.2 Date Received: 09/14/2011 0930

8015B Diesel Range Organics (DRO) (GC)

Analysis Method:	8015B	Analysis Batch:	240-16703	Instrument ID:	A2HP14F
Prep Method:	3540C	Prep Batch:	240-16283	Initial Weight/Volume:	29.89 g
Dilution:	1.0			Final Weight/Volume:	5 mL
Analysis Date:	09/26/2011 1900			Injection Volume:	1 uL
Prep Date:	09/22/2011 0831			Result Type:	PRIMARY

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	MDL	RL
C10-C20		17	U	9.3	17
C20-C34		17	U	9.3	17

Surrogate	%Rec	Qualifier	Acceptance Limits
n-Nonane	56		10 - 110

General Chemistry

Client Sample ID: **LIF-16-017 HEATED**

Lab Sample ID: 240-3820-1 Date Sampled: 09/13/2011 1700

Client Matrix: Solid Date Received: 09/14/2011 0930

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
Percent Solids	100		%	0.10	0.10	1.0	Moisture
Analysis Batch: 240-15476	Analysis Date: 09/15/2011 0953						DryWt Corrected: N
Percent Moisture	0.13		%	0.10	0.10	1.0	Moisture
Analysis Batch: 240-15476	Analysis Date: 09/15/2011 0953						DryWt Corrected: N

General Chemistry

Client Sample ID: **LIF-16-017 HEATED (DUP)**

Lab Sample ID: 240-3820-2FD Date Sampled: 09/13/2011 1700

Client Matrix: Solid Date Received: 09/14/2011 0930

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
Percent Solids	100		%	0.10	0.10	1.0	Moisture
Analysis Batch: 240-15476	Analysis Date: 09/15/2011 0953						DryWt Corrected: N
Percent Moisture	0.20		%	0.10	0.10	1.0	Moisture
Analysis Batch: 240-15476	Analysis Date: 09/15/2011 0953						DryWt Corrected: N

DATA REPORTING QUALIFIERS

Client: ARCADIS U.S., Inc. Job Number: 240-3820-1

Lab Section	Qualifier	Description
GC Semi VOA		
	U	Indicates the analyte was analyzed for but not detected.

QUALITY CONTROL RESULTS

Client: ARCADIS U.S., Inc. Job Number: 240-3820-1

QC Association Summary

Lab Sample ID	Client Sample ID	Report Basis	Client Matrix	Method	Prep Batch
GC Semi VOA					
Prep Batch: 240-16283					
LCS 240-16283/20-A	Lab Control Sample	T	Solid	3540C	
MB 240-16283/21-A	Method Blank	T	Solid	3540C	
240-3820-1	LIF-16-017 HEATED	T	Solid	3540C	
240-3820-2FD	LIF-16-017 HEATED (DUP)	T	Solid	3540C	
Analysis Batch:240-16703					
LCS 240-16283/20-A	Lab Control Sample	T	Solid	8015B	240-16283
MB 240-16283/21-A	Method Blank	T	Solid	8015B	240-16283
240-3820-1	LIF-16-017 HEATED	T	Solid	8015B	240-16283
240-3820-2FD	LIF-16-017 HEATED (DUP)	T	Solid	8015B	240-16283

Report Basis
T = Total

General Chemistry					
Analysis Batch:240-15476					
240-3820-1	LIF-16-017 HEATED	T	Solid	Moisture	
240-3820-2FD	LIF-16-017 HEATED (DUP)	T	Solid	Moisture	
240-3820-2DU	Duplicate	T	Solid	Moisture	

Report Basis
T = Total

Client: ARCADIS U.S., Inc.

Job Number: 240-3820-1

Surrogate Recovery Report

8015B Diesel Range Organics (DRO) (GC)

Client Matrix: Solid

Lab Sample ID	Client Sample ID	C91 %Rec
240-3820-1	LIF-16-017 HEATED	52
240-3820-2	LIF-16-017 HEATED (DUP)	56
MB 240-16283/21-A		45
LCS 240-16283/20-A		45

Surrogate	Acceptance Limits
C9 = n-Nonane	10-110

Client: ARCADIS U.S., Inc. Job Number: 240-3820-1

Method Blank - Batch: 240-16283

Method: 8015B
Preparation: 3540C

Lab Sample ID:	MB 240-16283/21-A	Analysis Batch:	240-16703	Instrument ID:	A2HP14F
Client Matrix:	Solid	Prep Batch:	240-16283	Lab File ID:	P14F0000028.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	30 g
Analysis Date:	09/26/2011 2149	Units:	mg/Kg	Final Weight/Volume:	5 mL
Prep Date:	09/22/2011 0831			Injection Volume:	1 uL
Leach Date:	N/A			Column ID:	PRIMARY

Analyte	Result	Qual	MDL	RL
Diesel	17	U	9.3	17
C10-C20	17	U	9.3	17
C20-C34	17	U	9.3	17

Surrogate	% Rec	Acceptance Limits
n-Nonane	45	10 - 110

Lab Control Sample - Batch: 240-16283

Method: 8015B
Preparation: 3540C

Lab Sample ID:	LCS 240-16283/20-A	Analysis Batch:	240-16703	Instrument ID:	A2HP14F
Client Matrix:	Solid	Prep Batch:	240-16283	Lab File ID:	P14F0000029.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	30 g
Analysis Date:	09/26/2011 2213	Units:	mg/Kg	Final Weight/Volume:	5 mL
Prep Date:	09/22/2011 0831			Injection Volume:	1 uL
Leach Date:	N/A			Column ID:	PRIMARY

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Diesel	83.3	64.9	78	47 - 138	

Surrogate	% Rec	Acceptance Limits
n-Nonane	45	10 - 110

Client: ARCADIS U.S., Inc.

Job Number: 240-3820-1

Duplicate - Batch: 240-15476

Method: Moisture
Preparation: N/A

Lab Sample ID:	240-3820-2	Analysis Batch:	240-15476	Instrument ID:	No Equipment
Client Matrix:	Solid	Prep Batch:	N/A	Lab File ID:	N/A
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	09/15/2011 0953	Units:	%	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	Sample Result/Qual	Result	RPD	Limit	Qual
Percent Solids	100	100	0.05	20	
Percent Moisture	0.20	0.25	25	20	

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: 919 544-4535
Address:
Fax:
City State Zip
E-mail Address: david.likes@arcadis-us.com
Project Name/Location (City, State): Buick GL4
Project #: B0064410.2011.00301
Sampler's Printed Name: DAVE LIKES
Sampler's Signature: David S. Likes

Sample ID	Collection Date	Collection Time	Type (✓) Comp	Type (✓) Grab	Matrix	Preservative	Filtered (✓)	# of Containers	Container Information	Modified 8015 MDNRE 507 diesel range oil range
LIF-16-017 Heated	9/13	17:00		↓	SO	—		1	7	X
LIF-16-017 Heated (DUP)	↓	↓		↓	↓					X

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

REMARKS

standard TAT

Page 18 of 21

Special Instructions/Comments:

☐ Special QA/QC Instructions(✓):

Laboratory Information and Receipt

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

Relinquished By	Received By	Relinquished By	Laboratory Received By
Printed Name: DAVE LIKES	Printed Name: TERRELL SMITH	Printed Name:	Printed Name:
Signature: David S. Likes	Signature:	Signature:	Signature:
Firm: ARCADIS	Firm/Courier: TA	Firm/Courier:	Firm:
Date/Time: 9/13/11	Date/Time: 9-14-11 9:30	Date/Time:	Date/Time:

20730826 CofC AR Form 01.12.2007

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

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

Client ARCADIS Project BUICK CITY By: (Signature)
Cooler Received on 9-14-11 Opened on 9-14-11
FedEx [X] UPS [ ] DHL [ ] FAS [ ] Stetson [ ] Client Drop Off [ ] TestAmerica Courier [ ] Other_____
TestAmerica Cooler # _____ Multiple Coolers [ ] Foam Box [ ] Client Cooler [X] Other_____

1. Were custody seals on the outside of the cooler(s)? Yes [X] No [ ] Intact? Yes [X] No [ ] NA [ ]
   If YES, Quantity_____ Quantity Unsalvageable_____
   Were custody seals on the outside of cooler(s) signed and dated? Yes [ ] No [X] NA [ ]
   Were custody seals on the bottle(s)? Yes [ ] No [X]
   If YES, are there any exceptions? _____
2. Shippers' packing slip attached to the cooler(s)? Yes [X] No [ ]
3. Did custody papers accompany the sample(s)? Yes [X] No [ ] Relinquished by client? Yes [X] No [ ]
4. Were the custody papers signed in the appropriate place? Yes [X] No [ ]
5. Packing material used: Bubble Wrap [X] Foam [ ] None [ ] Other _____
6. Cooler temperature upon receipt 3.9 °C See back of form for multiple coolers/temps [ ]
   METHOD: IR [X] Other [ ] _____
   COOLANT: Wet Ice [X] Blue Ice [ ] Dry Ice [ ] Water [ ] None [ ]
7. Did all bottles arrive in good condition (Unbroken)? Yes [X] No [ ]
8. Could all bottle labels be reconciled with the COC? Yes [X] No [ ]
9. Were sample(s) at the correct pH upon receipt? Yes [ ] No [ ] NA [X]
10. Were correct bottle(s) used for the test(s) indicated? Yes [X] No [ ]
11. Were air bubbles >6 mm in any VOA vials? Yes [ ] No [ ] NA [X]
12. Sufficient quantity received to perform indicated analyses? Yes [X] No [ ]
13. Was a trip blank present in the cooler(s)? Yes [ ] No [X] Were VOAs on the COC? Yes [ ] No [X]

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: 240-3820-1

Login Number: 3820

List Source: TestAmerica North Canton

List Number: 1

Creator: Sutek, Nick

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	3.9
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	

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

Job Number: 240-3319-1

Job Description: BUICK CITY - B0064410.2011.00301

For:
ARCADIS U.S., Inc.
4915 Prospectus Drive
Suite F
Durham, NC 27713

Attention: Mr. David Liles

Approved for release.
Denise Pohl
Project Manager II
9/12/2011 1:39 PM

Denise Pohl
Project Manager II
denise.pohl@testamericainc.com
09/12/2011

cc: Final Data Tracking

The test results in this report meet all NELAP requirements for parameters for which accreditation is required or available. Any exceptions to the 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. This report is confidential and is intended for the sole use of TestAmerica and its client. All questions regarding this report should be directed to the TestAmerica Project Manager who has signed this report.

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: BUICK CITY - B0064410.2011.00301

Report Number: 240-3319-1

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 08/30/2011; the samples arrived in good condition, properly preserved and on ice. The temperature of the cooler at receipt was 3.7 C.

DIESEL RANGE ORGANICS (DRO)

Samples LIF-12-018 (240-3319-1) and LIF-12-018DUP (240-3319-2) were analyzed for diesel range organics (DRO) in accordance with EPA SW-846 Method 8015B - DRO. 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.

No difficulties were encountered during the DRO analyses.

All quality control parameters were within the acceptance limits.

POLYCHLORINATED BIPHENYLS (PCBS)

Samples LIF-12-018 (240-3319-1) and LIF-12-018DUP (240-3319-2) were 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.

Method(s) 8082: The following sample(s) required a tetrabutylammonium sulfite (TBA) clean-up to reduce matrix interferences caused by sulfur:

No other analytical or quality issues were noted.

No difficulties were encountered during the PCBs analyses.

All quality control parameters were within the acceptance limits.

PERCENT SOLIDS

Samples LIF-12-018 (240-3319-1) and LIF-12-018DUP (240-3319-2) were analyzed for percent solids in accordance with EPA Method 160.3 MOD. The samples were analyzed on 08/30/2011.

No difficulties were encountered during the % solids analyses.

All quality control parameters were within the acceptance limits.

EXECUTIVE SUMMARY - Detections

Client: ARCADIS U.S., Inc. Job Number: 240-3319-1

Lab Sample ID / Analyte	Client Sample ID	Result	Qualifier	Reporting Limit	Units	Method
240-3319-1	**LIF-12-018**					
C10-C20		320		21	mg/Kg	8015B
C20-C34		110		21	mg/Kg	8015B
Percent Solids		81		0.10	%	Moisture
Percent Moisture		19		0.10	%	Moisture
240-3319-2	**LIF-12-018DUP**					
C10-C20		280		21	mg/Kg	8015B
C20-C34		100		21	mg/Kg	8015B
Percent Solids		80		0.10	%	Moisture
Percent Moisture		20		0.10	%	Moisture

METHOD SUMMARY

Client: ARCADIS U.S., Inc. Job Number: 240-3319-1

Description	Lab Location	Method	Preparation Method
Matrix Solid			
Diesel Range Organics (DRO) (GC)	TAL NC	SW846 8015B	
Soxhlet Extraction			SW846 3540C
Polychlorinated Biphenyls (PCBs) by Gas Chromatography	TAL NC	SW846 8082	
Soxhlet Extraction			SW846 3540C
Percent Moisture	TAL NC	EPA Moisture	

Lab References:

TAL NC = TestAmerica North Canton

Method References:

EPA = US Environmental Protection Agency

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: 240-3319-1

Method	Analyst	Analyst ID
SW846 8015B	Geis, Sharon	SG
SW846 8082	Roach, Carolynne	CR
EPA Moisture	Nicholas, Courtney	CN

SAMPLE SUMMARY

Client: ARCADIS U.S., Inc. Job Number: 240-3319-1

Lab Sample ID	Client Sample ID	Client Matrix	Date/Time Sampled	Date/Time Received
240-3319-1	LIF-12-018	Solid	08/29/2011 0000	08/30/2011 0930
240-3319-2	LIF-12-018DUP	Solid	08/29/2011 0000	08/30/2011 0930

SAMPLE RESULTS

Client: ARCADIS U.S., Inc. Job Number: 240-3319-1

Client Sample ID: **LIF-12-018**

Lab Sample ID: 240-3319-1 Date Sampled: 08/29/2011 0000
Client Matrix: Solid % Moisture: 19.2 Date Received: 08/30/2011 0930

8015B Diesel Range Organics (DRO) (GC)

Analysis Method:	8015B	Analysis Batch:	240-14063	Instrument ID:	A2HP14F
Prep Method:	3540C	Prep Batch:	240-13728	Initial Weight/Volume:	29.83 g
Dilution:	1.0			Final Weight/Volume:	5 mL
Analysis Date:	09/01/2011 2119			Injection Volume:	1 uL
Prep Date:	08/30/2011 1355			Result Type:	PRIMARY

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	MDL	RL
C10-C20		320		12	21
C20-C34		110		12	21

Surrogate	%Rec	Qualifier	Acceptance Limits
n-Nonane	47		10 - 110

Client: ARCADIS U.S., Inc. Job Number: 240-3319-1

Client Sample ID: **LIF-12-018DUP**

Lab Sample ID: 240-3319-2 Date Sampled: 08/29/2011 0000
Client Matrix: Solid % Moisture: 19.8 Date Received: 08/30/2011 0930

8015B Diesel Range Organics (DRO) (GC)

Analysis Method:	8015B	Analysis Batch:	240-14063	Instrument ID:	A2HP14F
Prep Method:	3540C	Prep Batch:	240-13728	Initial Weight/Volume:	30.05 g
Dilution:	1.0			Final Weight/Volume:	5 mL
Analysis Date:	09/01/2011 2143			Injection Volume:	1 uL
Prep Date:	08/30/2011 1356			Result Type:	PRIMARY

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	MDL	RL
C10-C20		280		12	21
C20-C34		100		12	21

Surrogate	%Rec	Qualifier	Acceptance Limits
n-Nonane	42		10 - 110

Client: ARCADIS U.S., Inc. Job Number: 240-3319-1

Client Sample ID: **LIF-12-018**

Lab Sample ID: 240-3319-1 Date Sampled: 08/29/2011 0000
Client Matrix: Solid % Moisture: 19.2 Date Received: 08/30/2011 0930

8082 Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analysis Method:	8082	Analysis Batch:	240-14107	Instrument ID:	A2HP12
Prep Method:	3540C	Prep Batch:	240-13755	Initial Weight/Volume:	30.15 g
Dilution:	1.0			Final Weight/Volume:	10 mL
Analysis Date:	09/01/2011 2151			Injection Volume:	1 mL
Prep Date:	08/30/2011 1347			Result Type:	PRIMARY

Analyte	DryWt Corrected: Y	Result (ug/Kg)	Qualifier	MDL	RL
Aroclor-1016		41	U	26	41
Aroclor-1221		41	U	20	41
Aroclor-1232		41	U	17	41
Aroclor-1242		41	U	16	41
Aroclor-1248		41	U	21	41
Aroclor-1254		41	U	21	41
Aroclor-1260		41	U	21	41

Surrogate	%Rec	Qualifier	Acceptance Limits
Tetrachloro-m-xylene	60		29 - 151
DCB Decachlorobiphenyl	77		14 - 163

Client: ARCADIS U.S., Inc. Job Number: 240-3319-1

Client Sample ID: **LIF-12-018DUP**

Lab Sample ID: 240-3319-2 Date Sampled: 08/29/2011 0000
Client Matrix: Solid % Moisture: 19.8 Date Received: 08/30/2011 0930

8082 Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analysis Method:	8082	Analysis Batch:	240-14107	Instrument ID:	A2HP12
Prep Method:	3540C	Prep Batch:	240-13755	Initial Weight/Volume:	29.92 g
Dilution:	1.0			Final Weight/Volume:	10 mL
Analysis Date:	09/01/2011 2206			Injection Volume:	1 mL
Prep Date:	08/30/2011 1347			Result Type:	PRIMARY

Analyte	DryWt Corrected: Y	Result (ug/Kg)	Qualifier	MDL	RL
Aroclor-1016		41	U	26	41
Aroclor-1221		41	U	20	41
Aroclor-1232		41	U	18	41
Aroclor-1242		41	U	16	41
Aroclor-1248		41	U	21	41
Aroclor-1254		41	U	21	41
Aroclor-1260		41	U	21	41

Surrogate	%Rec	Qualifier	Acceptance Limits
Tetrachloro-m-xylene	60		29 - 151
DCB Decachlorobiphenyl	69		14 - 163

General Chemistry

Client Sample ID: **LIF-12-018**

Lab Sample ID: 240-3319-1 Date Sampled: 08/29/2011 0000

Client Matrix: Solid Date Received: 08/30/2011 0930

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
Percent Solids	81		%	0.10	0.10	1.0	Moisture
Analysis Batch: 240-13737	Analysis Date: 08/30/2011 0918						DryWt Corrected: N
Percent Moisture	19		%	0.10	0.10	1.0	Moisture
Analysis Batch: 240-13737	Analysis Date: 08/30/2011 0918						DryWt Corrected: N

General Chemistry

Client Sample ID: **LIF-12-018DUP**

Lab Sample ID: 240-3319-2 Date Sampled: 08/29/2011 0000

Client Matrix: Solid Date Received: 08/30/2011 0930

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
Percent Solids	80		%	0.10	0.10	1.0	Moisture
Analysis Batch: 240-13737	Analysis Date: 08/30/2011 0918						DryWt Corrected: N
Percent Moisture	20		%	0.10	0.10	1.0	Moisture
Analysis Batch: 240-13737	Analysis Date: 08/30/2011 0918						DryWt Corrected: N

DATA REPORTING QUALIFIERS

Client: ARCADIS U.S., Inc. Job Number: 240-3319-1

Lab Section	Qualifier	Description
GC Semi VOA		
	U	Indicates the analyte was analyzed for but not detected.

QUALITY CONTROL RESULTS

Client: ARCADIS U.S., Inc. Job Number: 240-3319-1

QC Association Summary

Lab Sample ID	Client Sample ID	Report Basis	Client Matrix	Method	Prep Batch
GC Semi VOA					
Prep Batch: 240-13728					
LCS 240-13728/20-A	Lab Control Sample	T	Solid	3540C	
MB 240-13728/19-A	Method Blank	T	Solid	3540C	
240-3319-1	LIF-12-018	T	Solid	3540C	
240-3319-2	LIF-12-018DUP	T	Solid	3540C	
Prep Batch: 240-13755					
LCS 240-13755/17-A	Lab Control Sample	T	Solid	3540C	
MB 240-13755/16-A	Method Blank	T	Solid	3540C	
240-3319-1	LIF-12-018	T	Solid	3540C	
240-3319-2	LIF-12-018DUP	T	Solid	3540C	
Analysis Batch:240-14063					
LCS 240-13728/20-A	Lab Control Sample	T	Solid	8015B	240-13728
MB 240-13728/19-A	Method Blank	T	Solid	8015B	240-13728
240-3319-1	LIF-12-018	T	Solid	8015B	240-13728
240-3319-2	LIF-12-018DUP	T	Solid	8015B	240-13728
Analysis Batch:240-14107					
LCS 240-13755/17-A	Lab Control Sample	T	Solid	8082	240-13755
MB 240-13755/16-A	Method Blank	T	Solid	8082	240-13755
240-3319-1	LIF-12-018	T	Solid	8082	240-13755
240-3319-2	LIF-12-018DUP	T	Solid	8082	240-13755

Report Basis
T = Total

General Chemistry

Analysis Batch:240-13737					
240-3319-1	LIF-12-018	T	Solid	Moisture	
240-3319-2	LIF-12-018DUP	T	Solid	Moisture	

Report Basis
T = Total

Client: ARCADIS U.S., Inc.

Job Number: 240-3319-1

Surrogate Recovery Report

8015B Diesel Range Organics (DRO) (GC)

Client Matrix: Solid

Lab Sample ID	Client Sample ID	C91 %Rec
240-3319-1	LIF-12-018	47
240-3319-2	LIF-12-018DUP	42
MB 240-13728/19-A		42
LCS 240-13728/20-A		35

Surrogate	Acceptance Limits
C9 = n-Nonane	10-110

Surrogate Recovery Report

8082 Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Client Matrix: Solid

Lab Sample ID	Client Sample ID	TCX1 %Rec	DCB1 %Rec
240-3319-1	LIF-12-018	60	77
240-3319-2	LIF-12-018DUP	60	69
MB 240-13755/16-A		72	93
LCS 240-13755/17-A		67	84

Surrogate	Acceptance Limits
TCX = Tetrachloro-m-xylene	29-151
DCB = DCB Decachlorobiphenyl	14-163

Client: ARCADIS U.S., Inc. Job Number: 240-3319-1

Method Blank - Batch: 240-13728

Method: 8015B
Preparation: 3540C

Lab Sample ID:	MB 240-13728/19-A	Analysis Batch:	240-14063	Instrument ID:	A2HP14F
Client Matrix:	Solid	Prep Batch:	240-13728	Lab File ID:	P14F0000015.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	30 g
Analysis Date:	09/01/2011 1718	Units:	mg/Kg	Final Weight/Volume:	5 mL
Prep Date:	08/30/2011 0903			Injection Volume:	1 uL
Leach Date:	N/A			Column ID:	PRIMARY

Analyte	Result	Qual	MDL	RL
Diesel	17	U	9.3	17
C10-C20	17	U	9.3	17
C20-C34	17	U	9.3	17

Surrogate	% Rec	Acceptance Limits
n-Nonane	42	10 - 110

Lab Control Sample - Batch: 240-13728

Method: 8015B
Preparation: 3540C

Lab Sample ID:	LCS 240-13728/20-A	Analysis Batch:	240-14063	Instrument ID:	A2HP14F
Client Matrix:	Solid	Prep Batch:	240-13728	Lab File ID:	P14F0000027.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	30 g
Analysis Date:	09/01/2011 2207	Units:	mg/Kg	Final Weight/Volume:	5 mL
Prep Date:	08/30/2011 0903			Injection Volume:	1 uL
Leach Date:	N/A			Column ID:	PRIMARY

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Diesel	83.3	60.2	72	47 - 138	

Surrogate	% Rec	Acceptance Limits
n-Nonane	35	10 - 110

Client: ARCADIS U.S., Inc. Job Number: 240-3319-1

Method Blank - Batch: 240-13755

Method: 8082
Preparation: 3540C

Lab Sample ID:	MB 240-13755/16-A	Analysis Batch:	240-14107	Instrument ID:	A2HP12
Client Matrix:	Solid	Prep Batch:	240-13755	Lab File ID:	P1290127.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	30 g
Analysis Date:	09/01/2011 2122	Units:	ug/Kg	Final Weight/Volume:	10 mL
Prep Date:	08/30/2011 1005			Injection Volume:	1 mL
Leach Date:	N/A			Column ID:	PRIMARY

Analyte	Result	Qual	MDL	RL
Aroclor-1016	33	U	21	33
Aroclor-1221	33	U	16	33
Aroclor-1232	33	U	14	33
Aroclor-1242	33	U	13	33
Aroclor-1248	33	U	17	33
Aroclor-1254	33	U	17	33
Aroclor-1260	33	U	17	33

Surrogate	% Rec	Acceptance Limits
Tetrachloro-m-xylene	72	29 - 151
DCB Decachlorobiphenyl	93	14 - 163

Lab Control Sample - Batch: 240-13755

Method: 8082
Preparation: 3540C

Lab Sample ID:	LCS 240-13755/17-A	Analysis Batch:	240-14107	Instrument ID:	A2HP12
Client Matrix:	Solid	Prep Batch:	240-13755	Lab File ID:	P1290128.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	30 g
Analysis Date:	09/01/2011 2137	Units:	ug/Kg	Final Weight/Volume:	10 mL
Prep Date:	08/30/2011 1005			Injection Volume:	1 mL
Leach Date:	N/A			Column ID:	PRIMARY

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Aroclor-1016	333	262	78	62 - 120	
Aroclor-1260	333	287	86	56 - 122	

Surrogate	% Rec	Acceptance Limits
Tetrachloro-m-xylene	67	29 - 151
DCB Decachlorobiphenyl	84	14 - 163

ARCADIS

Laboratory Task Order No./P.O. No. _____

CHAIN-OF-CUSTODY RECORD

Page 1 of 1

Project Number/Name: Brick City

Project Location: Durham, NC

Laboratory: Test America North Canton

Project Manager: Dave Liles

Sampler(s)/Affiliation: " "

Sample ID/Location	Matrix	Date/Time Sampled	Lab ID	ANALYSIS / METHOD / SIZE: SW846 8015B MDNR& 507	SW846 8082					Remarks	Total
LIF-12-018	S	8/29/11		✓	✓					5 day TAT	1
LIF-12-018 Dup	↓	"		✓	✓					" " "	1

Sample Matrix: L = Liquid; S = Solid; A = Air

Total No. of Bottles/ Containers: 2

Relinquished by: David S. Liles	Organization: ARCADIS	Date 8/29/11	Time 18:30	Seal Intact? Yes No N/A
Received by:	Organization: TALE	Date 8/30/11	Time 0930	
Relinquished by:	Organization:	Date / /	Time	Seal Intact? Yes No N/A
Received by:	Organization:	Date / /	Time	

Special Instructions/Remarks: _____

Delivery Method: ☐ In Person ☑ Common Carrier Fed Ex SPECIFY ☐ Lab Courier ☐ Other _____ SPECIFY

AG 05-12/01

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

Client ARCADIS Project Rock City By: _____
Cooler Received on 8-30-11 Opened on 8-30-11 (Signature)
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 2 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 3.7 °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 preserved 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: 240-3319-1

Login Number: 3319

List Source: TestAmerica North Canton

List Number: 1

Creator: Sutek, Nick

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	3.7
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	

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

Job Number: 240-2552-1

Job Description: Buick City - B0064410.2011.00

For:
ARCADIS U.S., Inc.
4915 Prospectus Drive
Suite F
Durham, NC 27713

Attention: Mr. David Liles

Approved for release.
Denise Pohl
Project Manager II
8/23/2011 3:43 PM

Denise Pohl
Project Manager II
denise.pohl@testamericainc.com
08/23/2011

cc: Final Data Tracking

The test results in this report meet all NELAP requirements for parameters for which accreditation is required or available. Any exceptions to the 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. This report is confidential and is intended for the sole use of TestAmerica and its client. All questions regarding this report should be directed to the TestAmerica Project Manager who has signed this report.

US EPA ARCHIVE DOCUMENT

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: Buick City - B0064410.2011.00

Report Number: 240-2552-1

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 07/29/2011 and 08/03/2011; the samples arrived in good condition, properly preserved and on ice. The temperature of the coolers at receipt was 0.8C.

DIESEL RANGE ORGANICS (DRO)

Samples LIF-16-017(12-14) (240-2552-1), LIF-12-010(18-20) (240-2552-2), LIF-16-017 DUP (240-2552-3) and LIF-12-010 DUP (240-2552-4) were analyzed for diesel range organics (DRO) in accordance with EPA SW-846 Method 8015B - DRO. The samples were analyzed on 08/09/2011.

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.

n-Nonane failed the surrogate recovery criteria low for LIF-16-017(12-14) (240-2552-1). n-Nonane failed the surrogate recovery criteria low for LIF-12-010(18-20) (240-2552-2). n-Nonane failed the surrogate recovery criteria low for LIF-16-017 DUP (240-2552-3). Refer to the QC report for details.

Samples LIF-16-017(12-14) (240-2552-1)[100X], LIF-12-010(18-20) (240-2552-2)[20X], LIF-16-017 DUP (240-2552-3)[50X] and LIF-12-010 DUP (240-2552-4)[20X] required dilution prior to analysis. The reporting limits have been adjusted accordingly.

No other difficulties were encountered during the DRO analyses.

All other quality control parameters were within the acceptance limits.

POLYCHLORINATED BIPHENYLS (PCBS)

Samples LIF-16-017(12-14) (240-2552-1), LIF-12-010(18-20) (240-2552-2), LIF-16-017 DUP (240-2552-3) and LIF-12-010 DUP (240-2552-4) were analyzed for polychlorinated biphenyls (PCBs) in accordance with EPA SW-846 Method 8082. The samples were analyzed on 08/08/2011 and 08/11/2011.

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.

Method(s) 8082: The following samples required a tetrabutylammonium sulfite (TBA) clean-up to reduce matrix interferences caused by sulfur: LIF-12-010 DUP, LIF-12-010(18-20), LIF-16-017 DUP, LIF-16-017(12-14).

Method(s) 8082: The following samples required a tetrabutylammonium sulfite (TBA) clean-up to reduce matrix interferences caused by sulfur: LIF-12-010 (18-20), LIF-16-017(12-14).

Method(s) 8082: The laboratory control sample (LCS) for these samples exceeded control limits for all analytes. LIF-12-010(18-20), LIF-16-017(12-14) The associated samples were re-prepared and/or re-analyzed outside holding time. Both sets of data have been reported.

No difficulties were encountered during the PCBs analyses.

All quality control parameters were within the acceptance limits.

PERCENT SOLIDS

Samples LIF-16-017(12-14) (240-2552-1), LIF-12-010(18-20) (240-2552-2), LIF-16-017 DUP (240-2552-3) and LIF-12-010 DUP (240-2552-4) were analyzed for percent solids in accordance with EPA SW846 Method 3550C. The samples were analyzed on 08/08/2011.

No difficulties were encountered during the % solids analyses.

All quality control parameters were within the acceptance limits.

EXECUTIVE SUMMARY - Detections

Client: ARCADIS U.S., Inc. Job Number: 240-2552-1

Lab Sample ID / Analyte	Client Sample ID	Result	Qualifier	Reporting Limit	Units	Method
240-2552-1	**LIF-16-017(12-14)**					
C10-C20		3500		1800	mg/Kg	8015B
C20-C34		14000		1800	mg/Kg	8015B
Percent Solids		90		0.10	%	Moisture
Percent Moisture		9.6		0.10	%	Moisture
240-2552-2	**LIF-12-010(18-20)**					
C10-C20		660		370	mg/Kg	8015B
C20-C34		3200		370	mg/Kg	8015B
Percent Solids		90		0.10	%	Moisture
Percent Moisture		10		0.10	%	Moisture
240-2552-3	**LIF-16-017 DUP**					
C10-C20		3300		920	mg/Kg	8015B
C20-C34		12000		920	mg/Kg	8015B
Percent Solids		90		0.10	%	Moisture
Percent Moisture		9.5		0.10	%	Moisture
240-2552-4	**LIF-12-010 DUP**					
C10-C20		700		360	mg/Kg	8015B
C20-C34		3500		360	mg/Kg	8015B
Percent Solids		92		0.10	%	Moisture
Percent Moisture		8.3		0.10	%	Moisture

METHOD SUMMARY

Client: ARCADIS U.S., Inc. Job Number: 240-2552-1

Description	Lab Location	Method	Preparation Method
Matrix Solid			
Diesel Range Organics (DRO) (GC)	TAL NC	SW846 8015B	
Soxhlet Extraction			SW846 3540C
Polychlorinated Biphenyls (PCBs) by Gas Chromatography	TAL NC	SW846 8082	
Soxhlet Extraction			SW846 3540C
Percent Moisture	TAL NC	EPA Moisture	

Lab References:

TAL NC = TestAmerica North Canton

Method References:

EPA = US Environmental Protection Agency

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: 240-2552-1

Method	Analyst	Analyst ID
SW846 8015B	Geis, Sharon	SG
SW846 8082	Hass, Lori	LH
SW846 8082	Roach, Carolynne	CR
EPA Moisture	Nicholas, Courtney	CN

SAMPLE SUMMARY

Client: ARCADIS U.S., Inc. Job Number: 240-2552-1

Lab Sample ID	Client Sample ID	Client Matrix	Date/Time Sampled	Date/Time Received
240-2552-1	LIF-16-017(12-14)	Solid	07/25/2011 1200	07/29/2011 0930
240-2552-2	LIF-12-010(18-20)	Solid	07/25/2011 1200	07/29/2011 0930
240-2552-3	LIF-16-017 DUP	Solid	08/02/2011 1300	08/03/2011 0930
240-2552-4	LIF-12-010 DUP	Solid	08/02/2011 1300	08/03/2011 0930

SAMPLE RESULTS

Client: ARCADIS U.S., Inc. Job Number: 240-2552-1

Client Sample ID: **LIF-16-017(12-14)**

Lab Sample ID: 240-2552-1 Date Sampled: 07/25/2011 1200
Client Matrix: Solid % Moisture: 9.6 Date Received: 07/29/2011 0930

8015B Diesel Range Organics (DRO) (GC)

Analysis Method:	8015B	Analysis Batch:	240-11328	Instrument ID:	A2HP14R
Prep Method:	3540C	Prep Batch:	240-10989	Initial Weight/Volume:	29.98 g
Dilution:	100			Final Weight/Volume:	5 mL
Analysis Date:	08/09/2011 1424			Injection Volume:	1 uL
Prep Date:	08/05/2011 1003			Result Type:	PRIMARY

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	MDL	RL
C10-C20		3500		1000	1800
C20-C34		14000		1000	1800

Surrogate	%Rec	Qualifier	Acceptance Limits
n-Nonane	0	X	10 - 110

Client: ARCADIS U.S., Inc. Job Number: 240-2552-1

Client Sample ID: **LIF-12-010(18-20)**

Lab Sample ID: 240-2552-2 Date Sampled: 07/25/2011 1200
Client Matrix: Solid % Moisture: 10.4 Date Received: 07/29/2011 0930

8015B Diesel Range Organics (DRO) (GC)

Analysis Method:	8015B	Analysis Batch:	240-11328	Instrument ID:	A2HP14R
Prep Method:	3540C	Prep Batch:	240-10989	Initial Weight/Volume:	30.02 g
Dilution:	20			Final Weight/Volume:	5 mL
Analysis Date:	08/09/2011 1449			Injection Volume:	1 uL
Prep Date:	08/05/2011 1003			Result Type:	PRIMARY

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	MDL	RL
C10-C20		660		210	370
C20-C34		3200		210	370

Surrogate	%Rec	Qualifier	Acceptance Limits
n-Nonane	0	X	10 - 110

Client: ARCADIS U.S., Inc. Job Number: 240-2552-1

Client Sample ID: **LIF-16-017 DUP**

Lab Sample ID: 240-2552-3 Date Sampled: 08/02/2011 1300
Client Matrix: Solid % Moisture: 9.5 Date Received: 08/03/2011 0930

8015B Diesel Range Organics (DRO) (GC)

Analysis Method:	8015B	Analysis Batch:	240-11328	Instrument ID:	A2HP14R
Prep Method:	3540C	Prep Batch:	240-10989	Initial Weight/Volume:	30.01 g
Dilution:	50			Final Weight/Volume:	5 mL
Analysis Date:	08/09/2011 1513			Injection Volume:	1 uL
Prep Date:	08/05/2011 1003			Result Type:	PRIMARY

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	MDL	RL
C10-C20		3300		510	920
C20-C34		12000		510	920

Surrogate	%Rec	Qualifier	Acceptance Limits
n-Nonane	0	X	10 - 110

Client: ARCADIS U.S., Inc. Job Number: 240-2552-1

Client Sample ID: **LIF-12-010 DUP**

Lab Sample ID: 240-2552-4 Date Sampled: 08/02/2011 1300
Client Matrix: Solid % Moisture: 8.3 Date Received: 08/03/2011 0930

8015B Diesel Range Organics (DRO) (GC)

Analysis Method:	8015B	Analysis Batch:	240-11328	Instrument ID:	A2HP14R
Prep Method:	3540C	Prep Batch:	240-10989	Initial Weight/Volume:	29.99 g
Dilution:	20			Final Weight/Volume:	5 mL
Analysis Date:	08/09/2011 1538			Injection Volume:	1 uL
Prep Date:	08/05/2011 1003			Result Type:	PRIMARY

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	MDL	RL
C10-C20		700		200	360
C20-C34		3500		200	360

Surrogate	%Rec	Qualifier	Acceptance Limits
n-Nonane	65		10 - 110

Client: ARCADIS U.S., Inc. Job Number: 240-2552-1

Client Sample ID: **LIF-16-017(12-14)**

Lab Sample ID: 240-2552-1 Date Sampled: 07/25/2011 1200
Client Matrix: Solid % Moisture: 9.6 Date Received: 07/29/2011 0930

8082 Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analysis Method:	8082	Analysis Batch:	240-11199	Instrument ID:	A2HP12
Prep Method:	3540C	Prep Batch:	240-10973	Initial Weight/Volume:	30.00 g
Dilution:	1.0			Final Weight/Volume:	10 mL
Analysis Date:	08/08/2011 1607			Injection Volume:	1 uL
Prep Date:	08/05/2011 0920			Result Type:	SECONDARY

Analyte	DryWt Corrected: Y	Result (ug/Kg)	Qualifier	MDL	RL
Aroclor-1016		36	U *	23	36
Aroclor-1221		36	U	18	36
Aroclor-1232		36	U	15	36
Aroclor-1242		36	U	14	36
Aroclor-1248		36	U	19	36
Aroclor-1254		36	U	19	36
Aroclor-1260		36	U *	19	36

Surrogate	%Rec	Qualifier	Acceptance Limits
Tetrachloro-m-xylene	11	X	29 - 151
DCB Decachlorobiphenyl	19		14 - 163

Client: ARCADIS U.S., Inc. Job Number: 240-2552-1

Client Sample ID: **LIF-16-017(12-14)**

Lab Sample ID: 240-2552-1 Date Sampled: 07/25/2011 1200
Client Matrix: Solid % Moisture: 9.6 Date Received: 07/29/2011 0930

8082 Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analysis Method:	8082	Analysis Batch:	240-11673	Instrument ID:	A2HP12
Prep Method:	3540C	Prep Batch:	240-11514	Initial Weight/Volume:	18.67 g
Dilution:	1.0			Final Weight/Volume:	10 mL
Analysis Date:	08/11/2011 1451	Run Type:	RE	Injection Volume:	1 uL
Prep Date:	08/10/2011 1248			Result Type:	PRIMARY

Analyte	DryWt Corrected: Y	Result (ug/Kg)	Qualifier	MDL	RL
Aroclor-1016		59	U H	37	59
Aroclor-1221		59	U H	28	59
Aroclor-1232		59	U H	25	59
Aroclor-1242		59	U H	23	59
Aroclor-1248		59	U H	30	59
Aroclor-1254		59	U H	30	59
Aroclor-1260		59	U H	30	59

Surrogate	%Rec	Qualifier	Acceptance Limits
Tetrachloro-m-xylene	88		29 - 151
DCB Decachlorobiphenyl	127		14 - 163

Client: ARCADIS U.S., Inc. Job Number: 240-2552-1

Client Sample ID: **LIF-12-010(18-20)**

Lab Sample ID: 240-2552-2 Date Sampled: 07/25/2011 1200
Client Matrix: Solid % Moisture: 10.4 Date Received: 07/29/2011 0930

8082 Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analysis Method:	8082	Analysis Batch:	240-11199	Instrument ID:	A2HP12
Prep Method:	3540C	Prep Batch:	240-10973	Initial Weight/Volume:	30.01 g
Dilution:	1.0			Final Weight/Volume:	10 mL
Analysis Date:	08/08/2011 1621			Injection Volume:	1 uL
Prep Date:	08/05/2011 0920			Result Type:	SECONDARY

Analyte	DryWt Corrected: Y	Result (ug/Kg)	Qualifier	MDL	RL
Aroclor-1016		37	U *	23	37
Aroclor-1221		37	U	18	37
Aroclor-1232		37	U	16	37
Aroclor-1242		37	U	15	37
Aroclor-1248		37	U	19	37
Aroclor-1254		37	U	19	37
Aroclor-1260		37	U *	19	37

Surrogate	%Rec	Qualifier	Acceptance Limits
Tetrachloro-m-xylene	24	X	29 - 151
DCB Decachlorobiphenyl	26		14 - 163

Client: ARCADIS U.S., Inc. Job Number: 240-2552-1

Client Sample ID: **LIF-12-010(18-20)**

Lab Sample ID: 240-2552-2 Date Sampled: 07/25/2011 1200
Client Matrix: Solid % Moisture: 10.4 Date Received: 07/29/2011 0930

8082 Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analysis Method:	8082	Analysis Batch:	240-11673	Instrument ID:	A2HP12
Prep Method:	3540C	Prep Batch:	240-11514	Initial Weight/Volume:	11.05 g
Dilution:	1.0			Final Weight/Volume:	10 mL
Analysis Date:	08/11/2011 1506	Run Type:	RE	Injection Volume:	1 uL
Prep Date:	08/10/2011 1248			Result Type:	PRIMARY

Analyte	DryWt Corrected: Y	Result (ug/Kg)	Qualifier	MDL	RL
Aroclor-1016		100	U H	64	100
Aroclor-1221		100	U H	48	100
Aroclor-1232		100	U H	42	100
Aroclor-1242		100	U H	39	100
Aroclor-1248		100	U H	52	100
Aroclor-1254		100	U H	52	100
Aroclor-1260		100	U H	52	100

Surrogate	%Rec	Qualifier	Acceptance Limits
Tetrachloro-m-xylene	47		29 - 151
DCB Decachlorobiphenyl	49		14 - 163

Client: ARCADIS U.S., Inc. Job Number: 240-2552-1

Client Sample ID: **LIF-16-017 DUP**

Lab Sample ID: 240-2552-3 Date Sampled: 08/02/2011 1300
Client Matrix: Solid % Moisture: 9.5 Date Received: 08/03/2011 0930

8082 Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analysis Method:	8082	Analysis Batch:	240-11673	Instrument ID:	A2HP12
Prep Method:	3540C	Prep Batch:	240-11514	Initial Weight/Volume:	20.48 g
Dilution:	1.0			Final Weight/Volume:	10 mL
Analysis Date:	08/11/2011 1520			Injection Volume:	1 uL
Prep Date:	08/10/2011 1248			Result Type:	PRIMARY

Analyte	DryWt Corrected: Y	Result (ug/Kg)	Qualifier	MDL	RL
Aroclor-1016		53	U	34	53
Aroclor-1221		53	U	26	53
Aroclor-1232		53	U	23	53
Aroclor-1242		53	U	21	53
Aroclor-1248		53	U	28	53
Aroclor-1254		53	U	28	53
Aroclor-1260		53	U	28	53

Surrogate	%Rec	Qualifier	Acceptance Limits
Tetrachloro-m-xylene	108		29 - 151
DCB Decachlorobiphenyl	102		14 - 163

Client: ARCADIS U.S., Inc. Job Number: 240-2552-1

Client Sample ID: **LIF-12-010 DUP**

Lab Sample ID: 240-2552-4 Date Sampled: 08/02/2011 1300
Client Matrix: Solid % Moisture: 8.3 Date Received: 08/03/2011 0930

8082 Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analysis Method:	8082	Analysis Batch:	240-11673	Instrument ID:	A2HP12
Prep Method:	3540C	Prep Batch:	240-11514	Initial Weight/Volume:	16.48 g
Dilution:	1.0			Final Weight/Volume:	10 mL
Analysis Date:	08/11/2011 1535			Injection Volume:	1 uL
Prep Date:	08/10/2011 1248			Result Type:	PRIMARY

Analyte	DryWt Corrected: Y	Result (ug/Kg)	Qualifier	MDL	RL
Aroclor-1016		65	U	42	65
Aroclor-1221		65	U	32	65
Aroclor-1232		65	U	28	65
Aroclor-1242		65	U	26	65
Aroclor-1248		65	U	34	65
Aroclor-1254		65	U	34	65
Aroclor-1260		65	U	34	65

Surrogate	%Rec	Qualifier	Acceptance Limits
Tetrachloro-m-xylene	48		29 - 151
DCB Decachlorobiphenyl	48		14 - 163

General Chemistry

Client Sample ID: **LIF-16-017(12-14)**

Lab Sample ID: 240-2552-1 Date Sampled: 07/25/2011 1200

Client Matrix: Solid Date Received: 07/29/2011 0930

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
Percent Solids	90		%	0.10	0.10	1.0	Moisture
Analysis Batch: 240-11202	Analysis Date: 08/08/2011 1304						DryWt Corrected: N
Percent Moisture	9.6		%	0.10	0.10	1.0	Moisture
Analysis Batch: 240-11202	Analysis Date: 08/08/2011 1304						DryWt Corrected: N

General Chemistry

Client Sample ID: **LIF-12-010(18-20)**

Lab Sample ID: 240-2552-2 Date Sampled: 07/25/2011 1200

Client Matrix: Solid Date Received: 07/29/2011 0930

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
Percent Solids	90		%	0.10	0.10	1.0	Moisture
Analysis Batch: 240-11202	Analysis Date: 08/08/2011 1304						DryWt Corrected: N
Percent Moisture	10		%	0.10	0.10	1.0	Moisture
Analysis Batch: 240-11202	Analysis Date: 08/08/2011 1304						DryWt Corrected: N

General Chemistry

Client Sample ID: **LIF-16-017 DUP**

Lab Sample ID: 240-2552-3 Date Sampled: 08/02/2011 1300

Client Matrix: Solid Date Received: 08/03/2011 0930

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
Percent Solids	90		%	0.10	0.10	1.0	Moisture
Analysis Batch: 240-11202	Analysis Date: 08/08/2011 1304						DryWt Corrected: N
Percent Moisture	9.5		%	0.10	0.10	1.0	Moisture
Analysis Batch: 240-11202	Analysis Date: 08/08/2011 1304						DryWt Corrected: N

General Chemistry

Client Sample ID: **LIF-12-010 DUP**

Lab Sample ID: 240-2552-4 Date Sampled: 08/02/2011 1300

Client Matrix: Solid Date Received: 08/03/2011 0930

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
Percent Solids	92		%	0.10	0.10	1.0	Moisture
Analysis Batch: 240-11202	Analysis Date: 08/08/2011 1304						DryWt Corrected: N
Percent Moisture	8.3		%	0.10	0.10	1.0	Moisture
Analysis Batch: 240-11202	Analysis Date: 08/08/2011 1304						DryWt Corrected: N

DATA REPORTING QUALIFIERS

Client: ARCADIS U.S., Inc. Job Number: 240-2552-1

Lab Section	Qualifier	Description
GC Semi VOA		
	U	Indicates the analyte was analyzed for but not detected.
	*	LCS or LCSD exceeds the control limits
	H	Sample was prepped or analyzed beyond the specified holding time
	X	Surrogate is outside control limits

QUALITY CONTROL RESULTS

Client: ARCADIS U.S., Inc. Job Number: 240-2552-1

QC Association Summary

Lab Sample ID	Client Sample ID	Report Basis	Client Matrix	Method	Prep Batch
GC Semi VOA					
Prep Batch: 240-10973					
LCS 240-10973/9-A	Lab Control Sample	T	Solid	3540C	
MB 240-10973/8-A	Method Blank	T	Solid	3540C	
240-2552-1	LIF-16-017(12-14)	T	Solid	3540C	
240-2552-2	LIF-12-010(18-20)	T	Solid	3540C	
Prep Batch: 240-10989					
LCS 240-10989/10-A	Lab Control Sample	T	Solid	3540C	
MB 240-10989/9-A	Method Blank	T	Solid	3540C	
240-2552-1	LIF-16-017(12-14)	T	Solid	3540C	
240-2552-2	LIF-12-010(18-20)	T	Solid	3540C	
240-2552-3	LIF-16-017 DUP	T	Solid	3540C	
240-2552-4	LIF-12-010 DUP	T	Solid	3540C	
Analysis Batch:240-11148					
LCS 240-10989/10-A	Lab Control Sample	T	Solid	8015B	240-10989
Analysis Batch:240-11199					
LCS 240-10973/9-A	Lab Control Sample	T	Solid	8082	240-10973
MB 240-10973/8-A	Method Blank	T	Solid	8082	240-10973
240-2552-1	LIF-16-017(12-14)	T	Solid	8082	240-10973
240-2552-2	LIF-12-010(18-20)	T	Solid	8082	240-10973
Analysis Batch:240-11328					
MB 240-10989/9-A	Method Blank	T	Solid	8015B	240-10989
240-2552-1	LIF-16-017(12-14)	T	Solid	8015B	240-10989
240-2552-2	LIF-12-010(18-20)	T	Solid	8015B	240-10989
240-2552-3	LIF-16-017 DUP	T	Solid	8015B	240-10989
240-2552-4	LIF-12-010 DUP	T	Solid	8015B	240-10989
Prep Batch: 240-11514					
LCS 240-11514/15-A	Lab Control Sample	T	Solid	3540C	
MB 240-11514/14-A	Method Blank	T	Solid	3540C	
240-2552-1RE	LIF-16-017(12-14)	T	Solid	3540C	
240-2552-2RE	LIF-12-010(18-20)	T	Solid	3540C	
240-2552-3	LIF-16-017 DUP	T	Solid	3540C	
240-2552-4	LIF-12-010 DUP	T	Solid	3540C	
Analysis Batch:240-11673					
240-2552-1RE	LIF-16-017(12-14)	T	Solid	8082	240-11514
240-2552-2RE	LIF-12-010(18-20)	T	Solid	8082	240-11514
240-2552-3	LIF-16-017 DUP	T	Solid	8082	240-11514
240-2552-4	LIF-12-010 DUP	T	Solid	8082	240-11514

Client: ARCADIS U.S., Inc. Job Number: 240-2552-1

QC Association Summary

Lab Sample ID	Client Sample ID	Report Basis	Client Matrix	Method	Prep Batch
GC Semi VOA					
Analysis Batch:240-11744					
LCS 240-11514/15-A	Lab Control Sample	T	Solid	8082	240-11514
MB 240-11514/14-A	Method Blank	T	Solid	8082	240-11514

Report Basis
T = Total

General Chemistry					
Analysis Batch:240-11202					
240-2552-1	LIF-16-017(12-14)	T	Solid	Moisture	
240-2552-2	LIF-12-010(18-20)	T	Solid	Moisture	
240-2552-3	LIF-16-017 DUP	T	Solid	Moisture	
240-2552-3DU	Duplicate	T	Solid	Moisture	
240-2552-4	LIF-12-010 DUP	T	Solid	Moisture	

Report Basis
T = Total

Client: ARCADIS U.S., Inc.

Job Number: 240-2552-1

Surrogate Recovery Report

8015B Diesel Range Organics (DRO) (GC)

Client Matrix: Solid

Lab Sample ID	Client Sample ID	C91 %Rec
240-2552-1	LIF-16-017(12-14)	0X
240-2552-2	LIF-12-010(18-20)	0X
240-2552-3	LIF-16-017 DUP	0X
240-2552-4	LIF-12-010 DUP	65
MB 240-10989/9-A		57
LCS 240-10989/10-A		67

Surrogate	Acceptance Limits
C9 = n-Nonane	10-110

Client: ARCADIS U.S., Inc.

Job Number: 240-2552-1

Surrogate Recovery Report

8082 Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Client Matrix: Solid

Lab Sample ID	Client Sample ID	TCX1 %Rec	TCX2 %Rec	DCB1 %Rec	DCB2 %Rec
240-2552-1	LIF-16-017(12-14)		11X		19
240-2552-1 RE	LIF-16-017(12-14) RE		88		127
240-2552-2	LIF-12-010(18-20)		24X		26
240-2552-2 RE	LIF-12-010(18-20) RE		47		49
240-2552-3	LIF-16-017 DUP		108		102
240-2552-4	LIF-12-010 DUP		48		48
MB 240-10973/8-A			55		69
MB 240-11514/14-A		75		78	
LCS 240-10973/9-A			0X		0X
LCS 240-11514/15-A		80		82	

Surrogate	Acceptance Limits
TCX = Tetrachloro-m-xylene	29-151
DCB = DCB Decachlorobiphenyl	14-163

Client: ARCADIS U.S., Inc. Job Number: 240-2552-1

Method Blank - Batch: 240-10989

Method: 8015B
Preparation: 3540C

Lab Sample ID:	MB 240-10989/9-A	Analysis Batch:	240-11328	Instrument ID:	A2HP14R
Client Matrix:	Solid	Prep Batch:	240-10989	Lab File ID:	P14R0000006.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	30 g
Analysis Date:	08/09/2011 1400	Units:	mg/Kg	Final Weight/Volume:	5 mL
Prep Date:	08/05/2011 1003			Injection Volume:	1 uL
Leach Date:	N/A			Column ID:	PRIMARY

Analyte	Result	Qual	MDL	RL
Diesel	17	U	9.3	17
C10-C20	17	U	9.3	17
C20-C34	17	U	9.3	17

Surrogate	% Rec	Acceptance Limits
n-Nonane	57	10 - 110

Lab Control Sample - Batch: 240-10989

Method: 8015B
Preparation: 3540C

Lab Sample ID:	LCS 240-10989/10-A	Analysis Batch:	240-11148	Instrument ID:	A2HP14R
Client Matrix:	Solid	Prep Batch:	240-10989	Lab File ID:	P14R0000014.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	30 g
Analysis Date:	08/08/2011 1441	Units:	mg/Kg	Final Weight/Volume:	5 mL
Prep Date:	08/05/2011 1003			Injection Volume:	1 uL
Leach Date:	N/A			Column ID:	PRIMARY

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Diesel	83.3	68.2	82	47 - 138	

Surrogate	% Rec	Acceptance Limits
n-Nonane	67	10 - 110

Client: ARCADIS U.S., Inc. Job Number: 240-2552-1

Method Blank - Batch: 240-10973

Method: 8082
Preparation: 3540C

Lab Sample ID:	MB 240-10973/8-A	Analysis Batch:	240-11199	Instrument ID:	A2HP12
Client Matrix:	Solid	Prep Batch:	240-10973	Lab File ID:	P1280811.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	30 g
Analysis Date:	08/08/2011 1523	Units:	ug/Kg	Final Weight/Volume:	10 mL
Prep Date:	08/05/2011 0920			Injection Volume:	1 uL
Leach Date:	N/A			Column ID:	SECONDARY

Analyte	Result	Qual	MDL	RL
Aroclor-1016	33	U	21	33
Aroclor-1221	33	U	16	33
Aroclor-1232	33	U	14	33
Aroclor-1242	33	U	13	33
Aroclor-1248	33	U	17	33
Aroclor-1254	33	U	17	33
Aroclor-1260	33	U	17	33

Surrogate	% Rec	Acceptance Limits
Tetrachloro-m-xylene	55	29 - 151
DCB Decachlorobiphenyl	69	14 - 163

Lab Control Sample - Batch: 240-10973

Method: 8082
Preparation: 3540C

Lab Sample ID:	LCS 240-10973/9-A	Analysis Batch:	240-11199	Instrument ID:	A2HP12
Client Matrix:	Solid	Prep Batch:	240-10973	Lab File ID:	P1280812.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	30 g
Analysis Date:	08/08/2011 1538	Units:	ug/Kg	Final Weight/Volume:	10 mL
Prep Date:	08/05/2011 0920			Injection Volume:	1 uL
Leach Date:	N/A			Column ID:	SECONDARY

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Aroclor-1016	333	33	0	62 - 120	U *
Aroclor-1260	333	33	0	56 - 122	U *

Surrogate	% Rec		Acceptance Limits
Tetrachloro-m-xylene	0	X	29 - 151
DCB Decachlorobiphenyl	0	X	14 - 163

Client: ARCADIS U.S., Inc. Job Number: 240-2552-1

Method Blank - Batch: 240-11514

Method: 8082
Preparation: 3540C

Lab Sample ID:	MB 240-11514/14-A	Analysis Batch:	240-11744	Instrument ID:	A2HP12
Client Matrix:	Solid	Prep Batch:	240-11514	Lab File ID:	P1281211.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	30 g
Analysis Date:	08/12/2011 0959	Units:	ug/Kg	Final Weight/Volume:	10 mL
Prep Date:	08/10/2011 1248			Injection Volume:	1 uL
Leach Date:	N/A			Column ID:	PRIMARY

Analyte	Result	Qual	MDL	RL
Aroclor-1016	33	U	21	33
Aroclor-1221	33	U	16	33
Aroclor-1232	33	U	14	33
Aroclor-1242	33	U	13	33
Aroclor-1248	33	U	17	33
Aroclor-1254	33	U	17	33
Aroclor-1260	33	U	17	33

Surrogate	% Rec	Acceptance Limits
Tetrachloro-m-xylene	75	29 - 151
DCB Decachlorobiphenyl	78	14 - 163

Lab Control Sample - Batch: 240-11514

Method: 8082
Preparation: 3540C

Lab Sample ID:	LCS 240-11514/15-A	Analysis Batch:	240-11744	Instrument ID:	A2HP12
Client Matrix:	Solid	Prep Batch:	240-11514	Lab File ID:	P1281219.D
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	30 g
Analysis Date:	08/12/2011 1155	Units:	ug/Kg	Final Weight/Volume:	10 mL
Prep Date:	08/10/2011 1248			Injection Volume:	1 uL
Leach Date:	N/A			Column ID:	PRIMARY

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Aroclor-1016	333	314	94	62 - 120	
Aroclor-1260	333	274	82	56 - 122	

Surrogate	% Rec	Acceptance Limits
Tetrachloro-m-xylene	80	29 - 151
DCB Decachlorobiphenyl	82	14 - 163

Client: ARCADIS U.S., Inc.

Job Number: 240-2552-1

Duplicate - Batch: 240-11202

Method: Moisture
Preparation: N/A

Lab Sample ID:	240-2552-3	Analysis Batch:	240-11202	Instrument ID:	No Equipment
Client Matrix:	Solid	Prep Batch:	N/A	Lab File ID:	N/A
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	
Analysis Date:	08/08/2011 1304	Units:	%	Final Weight/Volume:	
Prep Date:	N/A				
Leach Date:	N/A				

Analyte	Sample Result/Qual	Result	RPD	Limit	Qual
Percent Solids	90	90	0.3	20	
Percent Moisture	9.5	9.8	3	20	

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: David Liles, ARCADIS
Telephone: 919 544 4535
Address:
Fax:
City / State / Zip
E-mail Address:

Project Name/Location (City, State): Buck City
Project #:

Sampler's Printed Name: Stephanie Branch
Sampler's Signature: Stephanie Branch

Sample ID	Collection Date	Collection Time	Type (✓) Comp	Type (✓) Grab	Matrix	Preservative	Filtered (✓)	# of Containers	Container Information	PCB 8082	MDNRE 507	TPH	REMARKS
LIF-16-007 (12-14)	7/25/11	12:00		↓	SO	E		1		X		X	MDNRE 507 PRO & ORO
LIF-12-010 (18-20)	↓	↓		↓	SO					X		X	" " " "

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

Special Instructions/Comments:

☐ Special QA/QC Instructions(✓):

Laboratory Information and Receipt		Relinquished By	Received By	Relinquished By	Laboratory Received By
Lab Name:	Cooler Custody Seal (✓): ☑ Intact ☑ Not Intact	Printed Name: Stephanie Branch	Printed Name:	Printed Name:	Printed Name: John McFalls
☐ Cooler packed with ice (✓)		Signature: Stephanie Branch	Signature:	Signature:	Signature:
Specify Turnaround Requirements:	Sample Receipt	Firm: ARCADIS	Firm/Courier:	Firm/Courier:	Firm: TT NC
Shipping Tracking #:	Condition/Cooler Temp:	Date/Time: 7/28/11 1500	Date/Time:	Date/Time:	Date/Time: 7/29/11 0950

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

ARCADIS
Infrastructure, environment, buildings

ID#:

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

Page ___ of ___

Lab Work Order #:

Send Results to:

Contact & Company Name: Dave Liles/ARCADIS
Telephone: 919-544-4535
Address:
Fax:
City State Zip
E-mail Address:

Project Name/Location (City, State): Buck City
Project #:
Sampler's Printed Name: Andy Baumeister
Sampler's Signature:

Sample ID	Collection Date	Collection Time	Type (✓) Comp	Type (✓) Grab	Matrix	Preservative	Filtered (✓)	# of Containers	Container Information	PCB/TPH 8082/MDNRE 507	REMARKS
LIF-16-017 DUP	8/2	13:00		↓	SO	E		1	1	X	MDNRE 507 PROFORO
LIF-12-010 DUP	↓	↓		↓	↓					X	" "

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		Relinquished By	Received By	Relinquished By	Laboratory Received By
Lab Name:	Cooler Custody Seal (✓)	Printed Name: Andy Baumeister	Printed Name: Chris Lilygood	Printed Name:	Printed Name:
☐ Cooler packed with ice (✓)	☐ Intact ☐ Not Intact	Signature:	Signature:	Signature:	Signature:
Specify Turnaround Requirements:	Sample Receipt:	Firm: ARCADIS	Firm/Courier: TAL	Firm/Courier:	Firm:
Shipping Tracking #:	Condition/Cooler Temp:	Date/Time: 8/2/11 13:20	Date/Time: 8/3/11 930	Date/Time:	Date/Time:

20730826 CoIC AR Form 01.12.2007

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

TestAmerica Cooler Receipt Form/Narrative **Lot Number:** 2552

North Canton Facility

Client Amedisys Project _____ By: _____ (Signature)

Cooler Received on 7/29/10 Opened on 7/29/10

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 2 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 3.4 °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 DJP Date 7/29/10 by _____ via Verbal ☒ Voice Mail ☐ Other ☐

Concerning #14

14. CHAIN OF CUSTODY

The following discrepancies occurred:

Did not receive enough volume to run PCB + TPH DRO. Client only sent 1x40mL vial full of dirt.

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:

TestAmerica Cooler Receipt Form/Narrative **Lot Number:** 2553
North Canton Facility

Client Arcadis Project _____ By: _____
Cooler Received on 5-3-11 Opened on 5-3-11 (Signature)
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 2 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 0.8 °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: 240-2552-1

Login Number: 2552

List Source: TestAmerica North Canton

List Number: 1

Creator: McFadden, John

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	3.4
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	

PTS File No: 41270
Client: ARCADIS

PTS Laboratories

VISCOSITY, DENSITY, and SPECIFIC GRAVITY DATA

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

PROJECT NAME: NAO Flint, MI
PROJECT NO: B0064410.2011.00301

SAMPLE ID	MATRIX	TEMPERATURE, °F	SPECIFIC GRAVITY	DENSITY, g/cc	VISCOSITY	
					centistokes	centipoise
AOI-40RFI-40-14RGW041411	Water	150	0.9988	0.9793	0.476	0.466
		180	0.9694	0.9627	0.394	0.379
AOI-40RFI-40-07R2HYDOIL-041411	NAPL	150	0.7537	0.7522	0.901	0.677
		180	0.7414	0.7363	0.759	0.559
AOI-12MW-RFI-12-33GW041411	Water	150	0.9822	0.9802	0.476	0.466
		180	0.9709	0.9642	0.404	0.390
AOI-12MW-RFI-12-23HYDOIL-041411	NAPL	150	0.8534	0.8516	9.06	7.71
		180	0.8476	0.8417	6.03	5.08

PTS File No: 41270
Client: ARCADIS

PTS Laboratories

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: DuNuoy Method - ASTM D971)

PROJECT NAME: NAO Flint, MI
PROJECT NO: B0064410.2011.00301

PHASE PAIR		TEMPERATURE,	INTERFACIAL TENSION,
SAMPLE ID / PHASE	SAMPLE ID / PHASE	°F	Dynes/centimeter
AOI-40RFI-40-14RGW041411	AOI-40RFI-40-07R2HYDOIL-041411	130	10.3
AOI-12MW-RFI-12-33GW041411	AOI-12MW-RFI-12-23HYDOIL-041411	130	14.6

QUALITY CONTROL DATA

PHASE PAIR:	DIWATER / AIR
TEMPERATURE, °F:	130
IFT, MEASURED:	67.6
IFT, PUBLISHED:	71.3
RPD:	-5.24

PTS File No: 41270
Client: ARCADIS

PTS Laboratories

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: DuNuoy Method - ASTM D971)

PROJECT NAME: NAO Flint, MI
PROJECT NO: B0064410.2011.00301

PHASE PAIR		TEMPERATURE,	INTERFACIAL TENSION,
SAMPLE ID / PHASE	SAMPLE ID / PHASE	°F	Dynes/centimeter
AOI-40RFI-40-14RGW041411	AOI-40RFI-40-07R2HYDOIL-041411	150	7.7
		180*	5.2
AOI-12MW-RFI-12-33GW041411	AOI-12MW-RFI-12-23HYDOIL-041411	150	12.7
		180*	12.3

*Laboratory was unable to obtain reproducible measurements due to the high temperature of the fluid system; the most representative values are reported. IFT measurements were also attempted by spinning drop method at 180° but were unable to measure due to oil drops adhering to the glass capillary.

QUALITY CONTROL DATA

PHASE PAIR:	DIWATER / AIR
TEMPERATURE, °F:	150
IFT, MEASURED:	64.6
IFT, PUBLISHED:	65.2
RPD:	-0.84

Oilfield Environmental and Compliance, INC.

Rachel Spitz
PTS Laboratories
8100 Secura Way
Santa Fe Springs, CA 90670

06 June 2011

RE: PTS Laboratories Work Order: 1102342

Dear Client:

Enclosed is an analytical report for the above referenced project. The samples included in this report were received on 17-May-11 15:00 and analyzed in accordance with the attached chain-of-custody.

Unless otherwise noted, all analytical testing was accomplished in accordance with the guidelines established in our Quality Assurance Manual, applicable standard operating procedures, and other related documentation. The results in this analytical report are limited to the samples tested and any reproduction thereof must be made in its entirety.

If you have any questions regarding this report, please do not hesitate to contact the undersigned.

Sincerely,

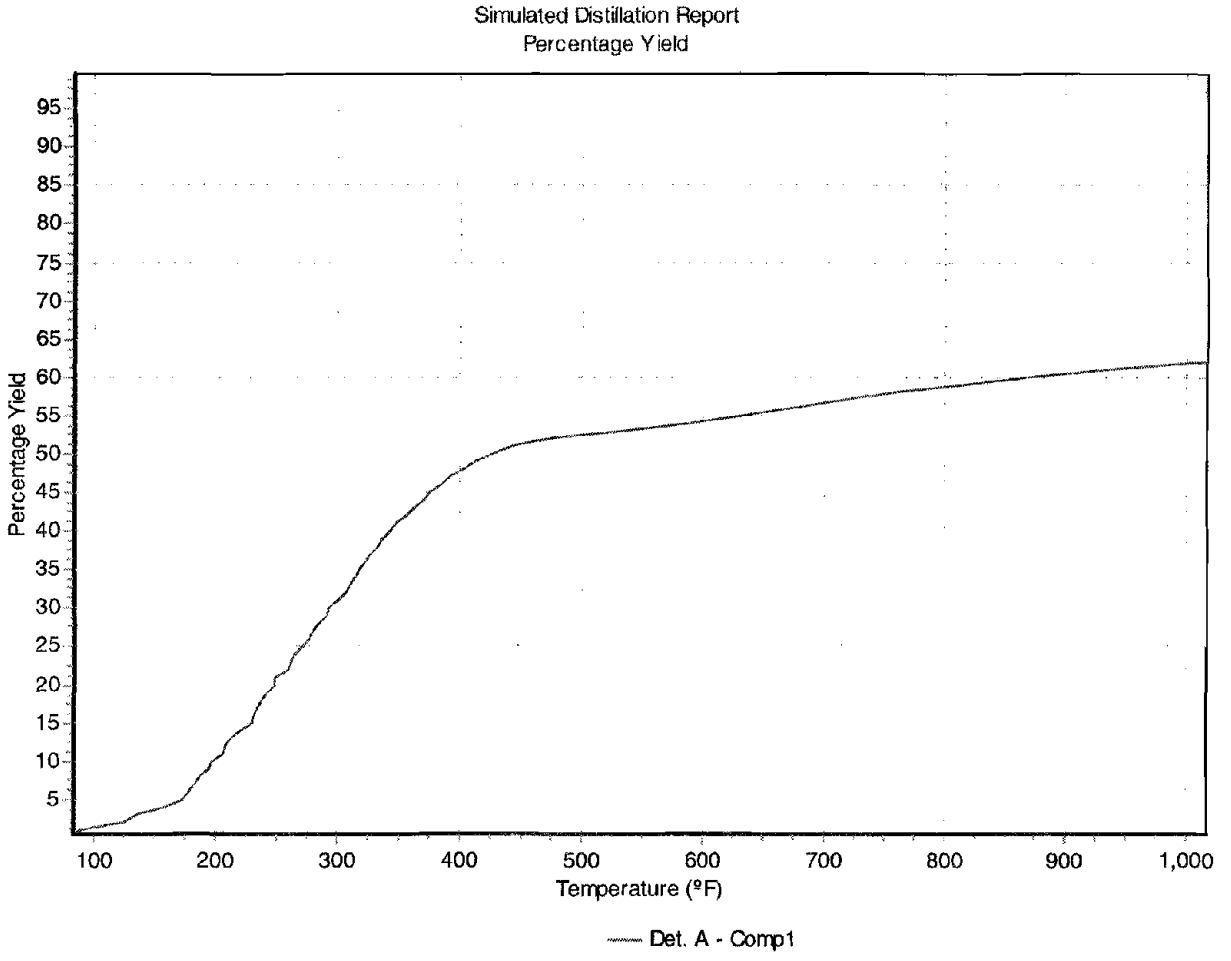
Lisa Race

Laboratory Manager

Simulated Distillation Engineering Report

AOI-40RFI-40-07RHYDOIL-041411 1102342-01

KHF -- 2 Jun 111 12:18 pm -- 2887.M
C:\HPChem\1\DATA\060211\F0CF0204.D (GC DATA FILE)



Percentage Yield Table

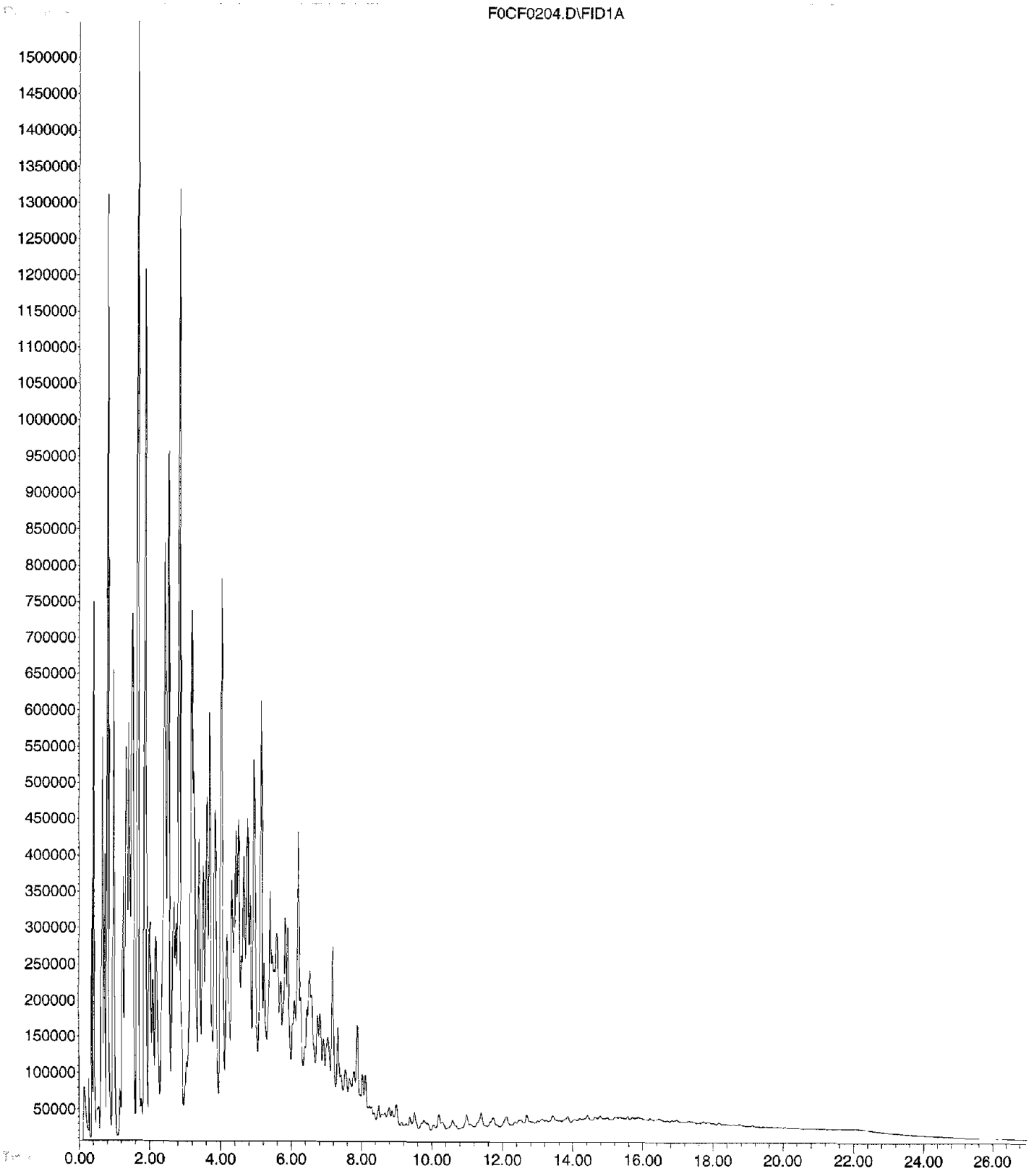
	Det. A - Comp1 Temp. (Deg. F)
IBP: 0.5%	83.00
5.00%	173.00
10.00%	197.00
15.00%	230.00
20.00%	248.00
25.00%	271.00
30.00%	294.00
35.00%	319.00
40.00%	344.00
45.00%	375.00
50.00%	427.00
55.00%	633.00
60.00%	865.00
65.00%	> 1016.00
70.00%	> 1016.00
75.00%	> 1016.00
80.00%	> 1016.00
85.00%	> 1016.00
90.00%	> 1016.00
95.00%	> 1016.00
FBP: 99.5%	> 1016.00

Total Det. A - Comp1: 61.933 %

WMI SimDis Report
6/3/2011 4:26:56 PM
WeMeasureIt, Inc.

Calibration: C:\HPChem\1\DATA\060211\F0CF0201.D\FID1A.CH
Blank: C:\HPChem\1\DATA\060211\F0CF0203.D
Qc Ref: C:\HPChem\1\DATA\060211\F0CF0202.D
SimDis Properties: custom properties

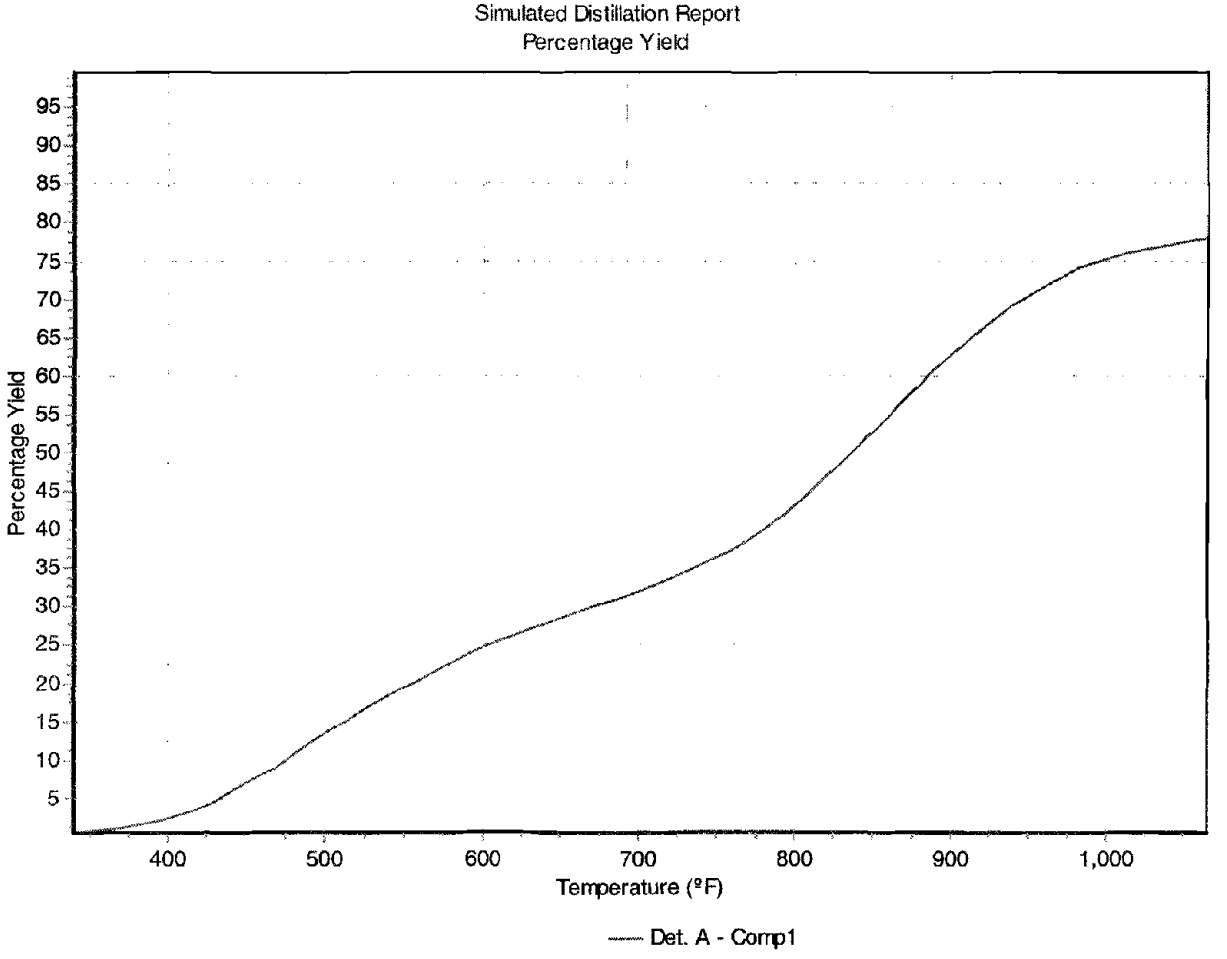
File : C:\HPCHEM\1\DATA\060211\F0CF0204.D
Operator : KHF
Acquired : 2 Jun 2011 12:18 using AcqMethod 2887.M
Instrument : CSS Instr
Sample Name: AOI-40RFI-40-07RHYDOIL-041411 1102342-01
Misc Info : 1@
Vial Number: 4



Simulated Distillation Engineering Report

AOI-12MW-RFI-12-23HYDOIL-041411 1102342-02

KHF -- 2 Jun 111 1:16 pm -- 2887.M
C:\HPChem\1\DATA\060211\F0CF0205.D (GC DATA FILE)



Percentage Yield Table

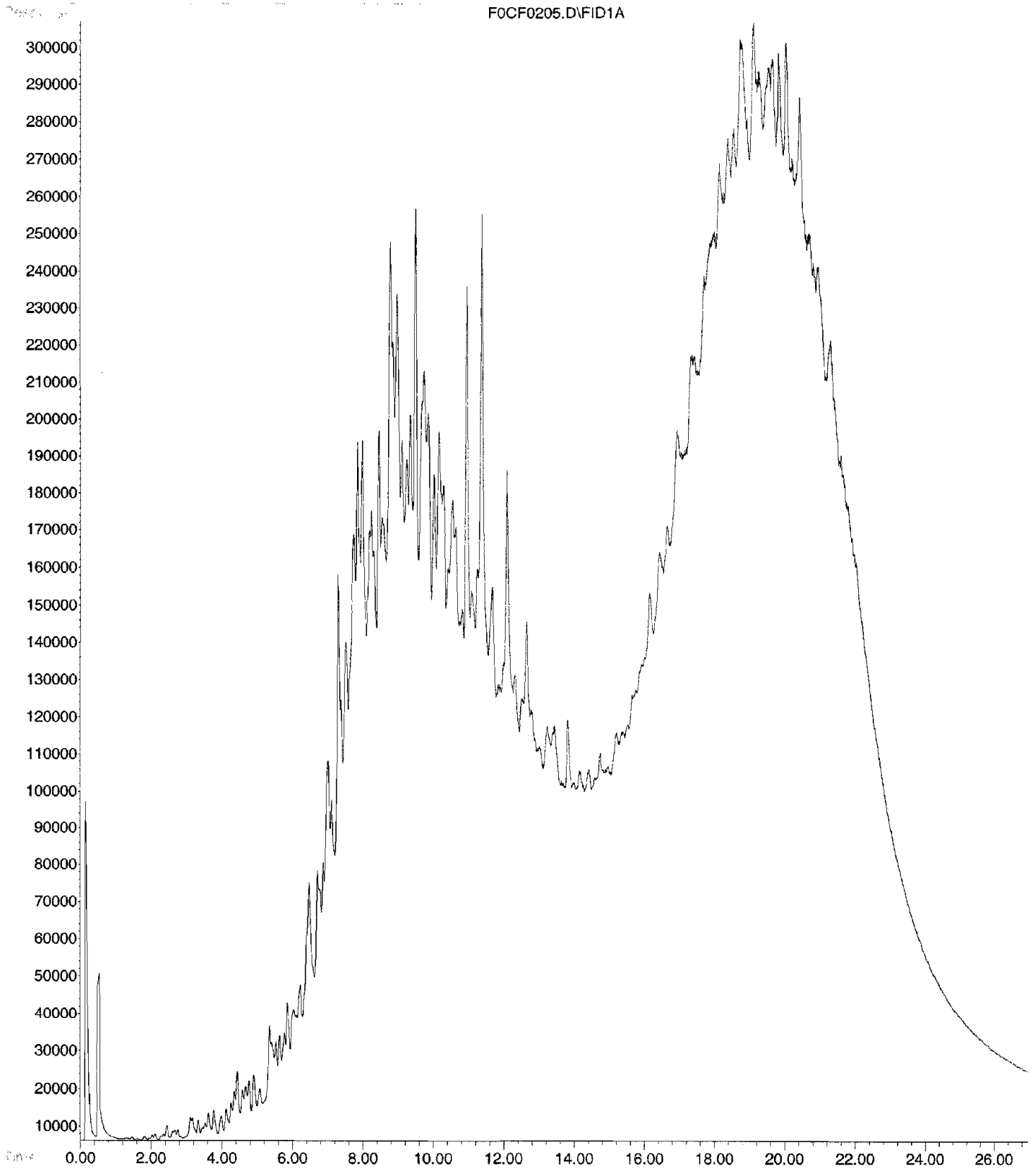
	Det. A - Comp1 Temp. (Deg. F)
IBP: 0.5%	340.00
5.00%	433.00
10.00%	474.00
15.00%	512.00
20.00%	555.00
25.00%	604.00
30.00%	671.00
35.00%	736.00
40.00%	780.00
45.00%	811.00
50.00%	836.00
55.00%	860.00
60.00%	885.00
65.00%	912.00
70.00%	945.00
75.00%	994.00
80.00%	> 1064.00
85.00%	> 1064.00
90.00%	> 1064.00
95.00%	> 1064.00
FBP: 99.5%	> 1064.00

Total Det. A - Comp1: 77.614 %

WMI SimDis Report
6/3/2011 4:24:07 PM
WeMeasureIt, Inc.

Calibration: C:\HPChem\1\DATA\060211\F0CF0201.D\FID1A.CH
Blank: C:\HPChem\1\DATA\060211\F0CF0203.D
Qc Ref: C:\HPChem\1\DATA\060211\F0CF0202.D
SimDis Properties: custom properties

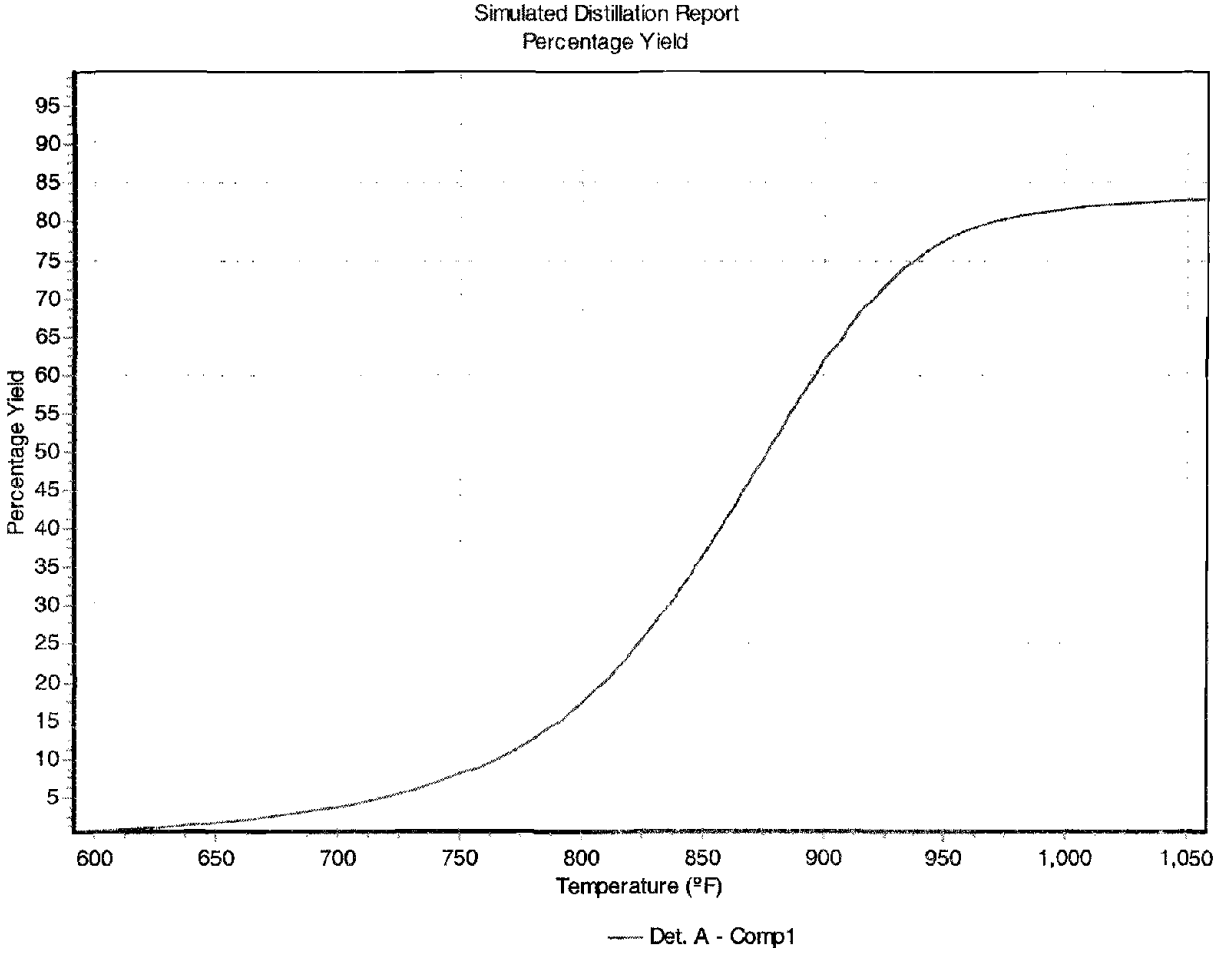
File : C:\HPCHEM\1\DATA\060211\F0CF0205.D
Operator : KHF
Acquired : 2 Jun 2011 13:16 using AcqMethod 2887.M
Instrument : CSS Instr
Sample Name: AOI-12MW-RFI-12-23HYDOIL-041411 1102342-02
Misc Info : 1@
Vial Number: 5



Simulated Distillation Engineering Report

AOI-02LIF-002-018HYDOIL-041411 1102342-03

KHF -- 2 Jun 111 3:54 pm -- 2887.M
C:\HPChem\1\DATA\060211\F0CF0207.D (GC DATA FILE)



Percentage Yield Table

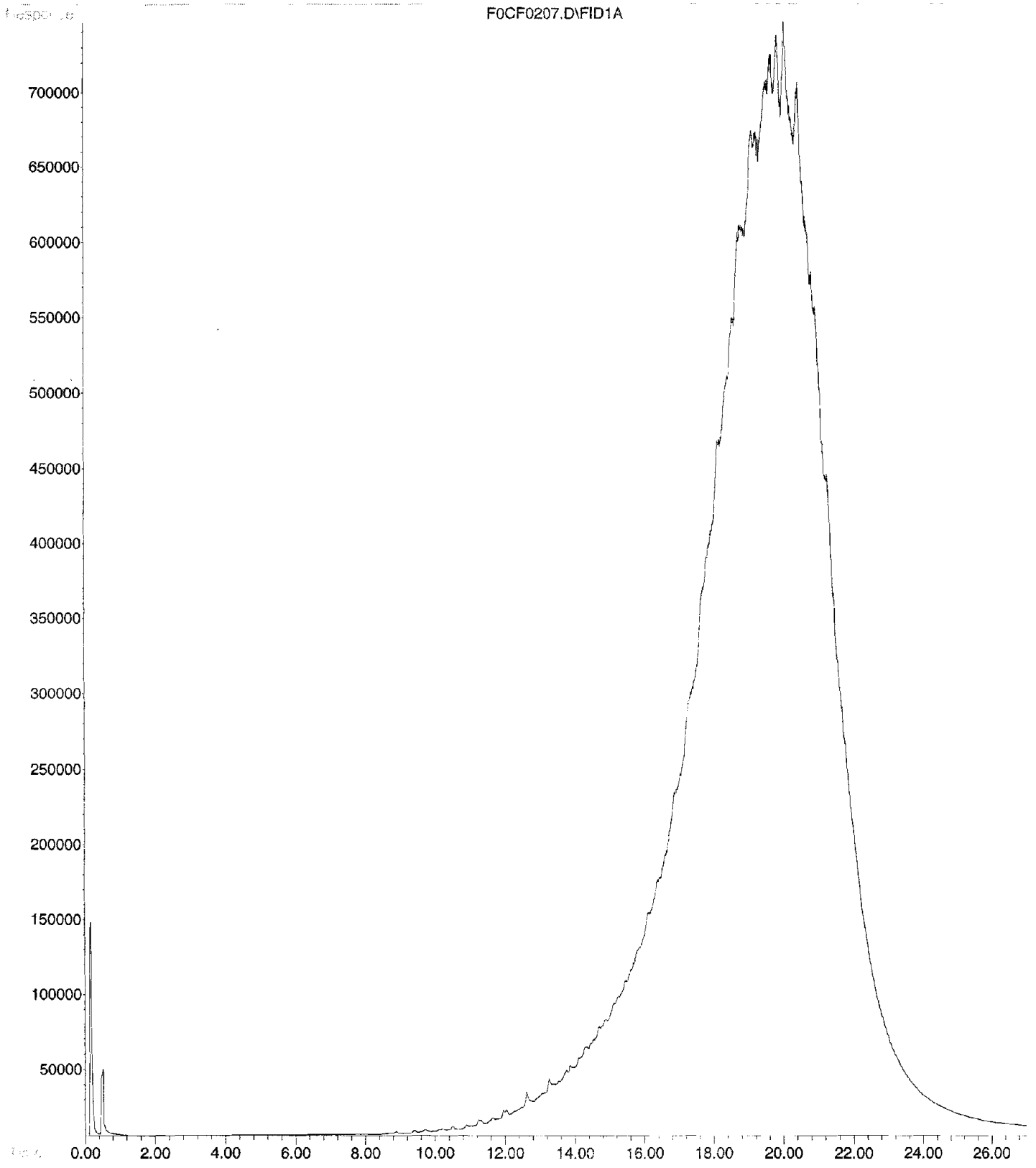
	Det. A - Comp1 Temp. (Deg. F)
IBP: 0.5%	591.00
5.00%	719.00
10.00%	765.00
15.00%	791.00
20.00%	810.00
25.00%	824.00
30.00%	836.00
35.00%	847.00
40.00%	857.00
45.00%	867.00
50.00%	877.00
55.00%	887.00
60.00%	897.00
65.00%	908.00
70.00%	920.00
75.00%	937.00
80.00%	971.00
85.00%	> 1058.00
90.00%	> 1058.00
95.00%	> 1058.00
FBP: 99.5%	> 1058.00

Total Det. A - Comp1: 82.612 %

WMI SimDis Report
6/6/2011 9:27:05 AM
WeMeasureIt, Inc.

Calibration: C:\HPChem\1\DATA\060211\F0CF0201.D\FID1A.CH
Blank: C:\HPChem\1\DATA\060211\F0CF0203.D
Qc Ref: C:\HPChem\1\DATA\060211\F0CF0202.D
SimDis Properties: custom properties

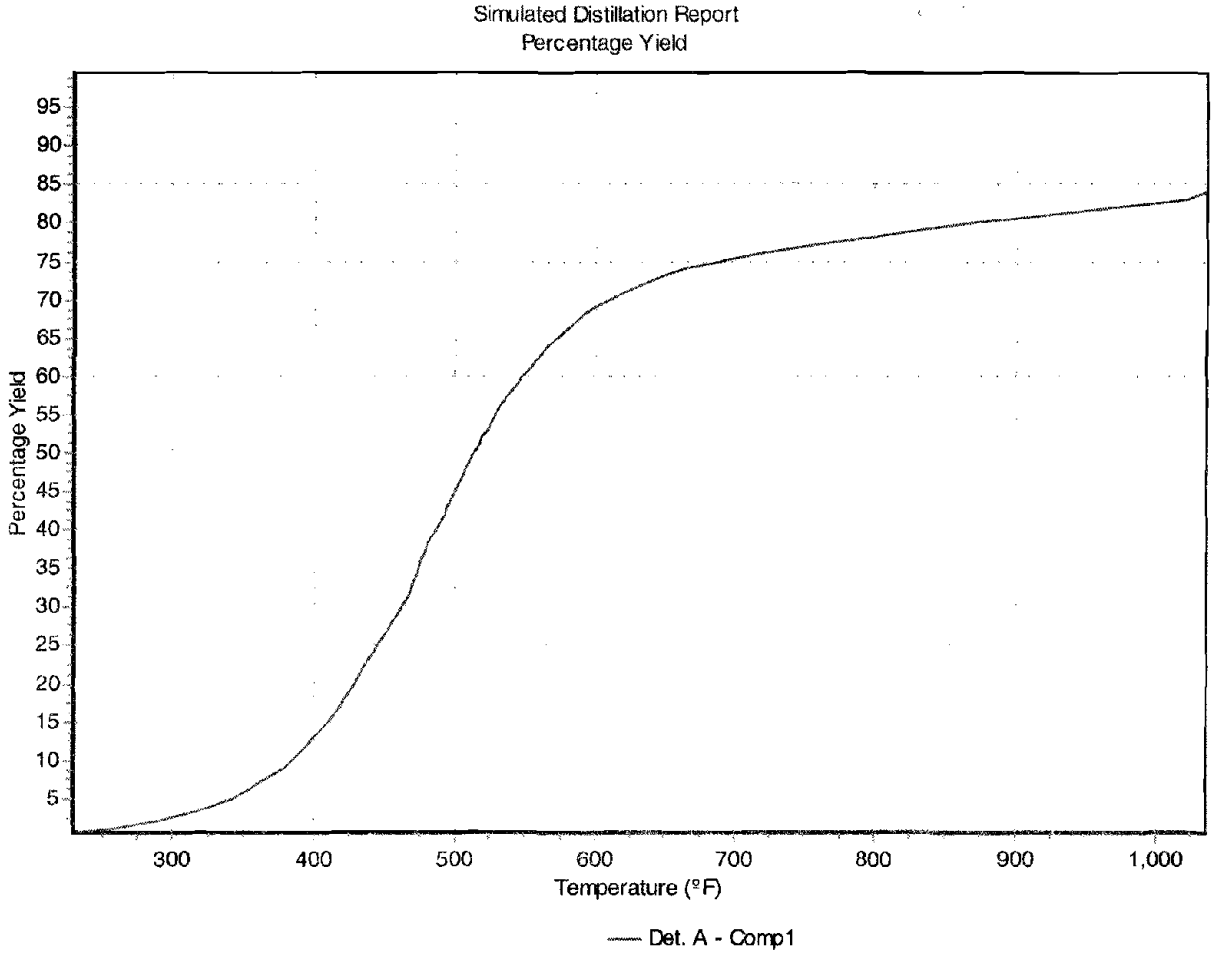
File : C:\HPCHEM\1\DATA\060211\F0CF0207.D
Operator : KHF
Acquired : 2 Jun 2011 15:54 using AcqMethod 2887.M
Instrument : CSS Instr
Sample Name: AOI-02LIF-002-018HYDOIL-041411 1102342-03
Misc Info : 1@
Vial Number: 7



Simulated Distillation Engineering Report

AOI-16RFI-16-08HYDOIL-041411 1102342-04

KHF -- 2 Jun 111 2:48 pm -- 2887.M
C:\HPChem\1\DATA\060211\F0CF0206.D (GC DATA FILE)



Percentage Yield Table

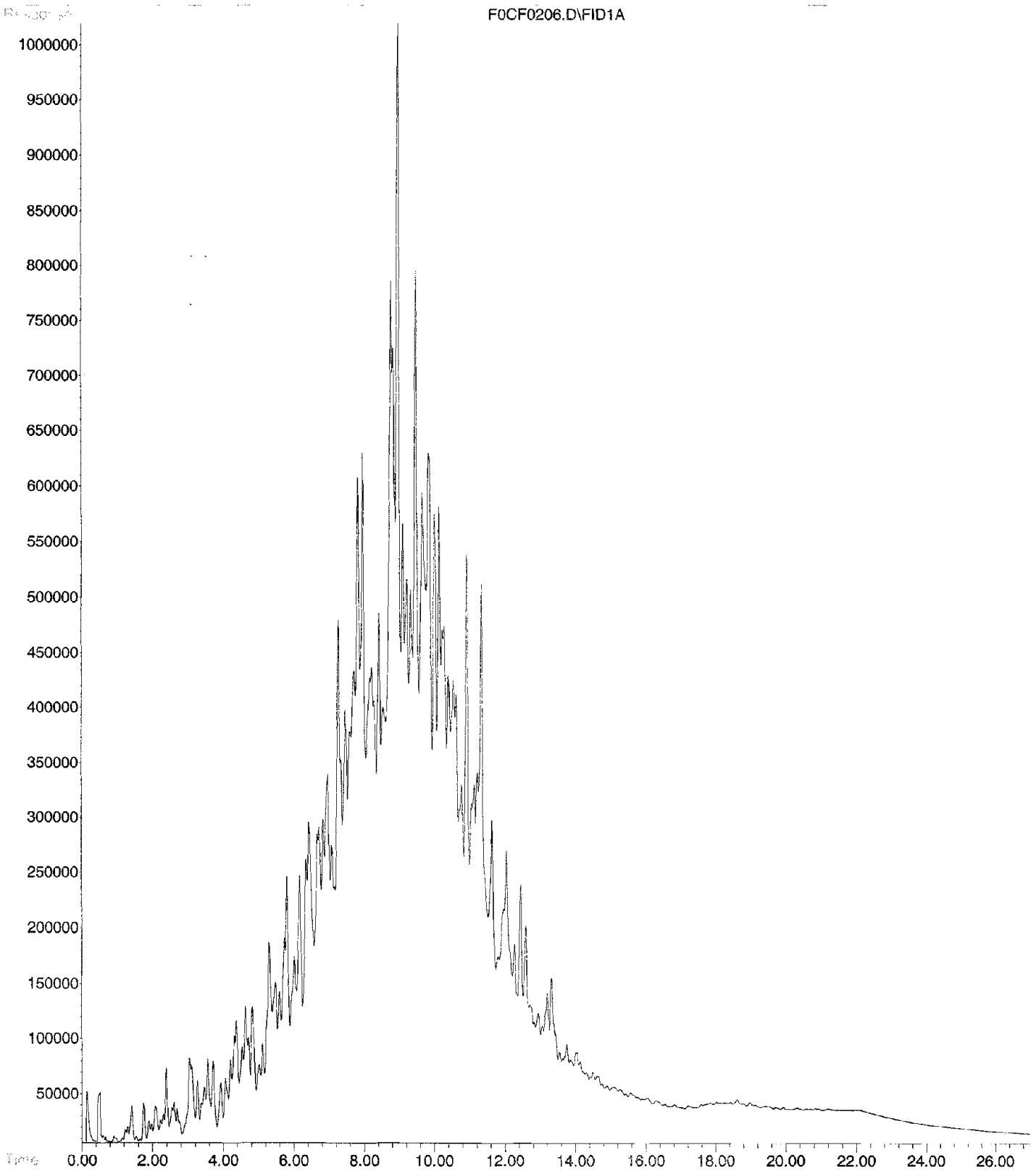
	Det. A - Comp1 Temp. (Deg. F)
IBP: 0.5%	229.00
5.00%	342.00
10.00%	384.00
15.00%	411.00
20.00%	430.00
25.00%	445.00
30.00%	463.00
35.00%	474.00
40.00%	487.00
45.00%	500.00
50.00%	514.00
55.00%	529.00
60.00%	548.00
65.00%	573.00
70.00%	609.00
75.00%	688.00
80.00%	873.00
85.00%	> 1036.00
90.00%	> 1036.00
95.00%	> 1036.00
FBP: 99.5%	> 1036.00

Total Det. A - Comp1: 83.164 %

WMI SimDis Report
6/6/2011 9:26:27 AM
WeMeasureIt, Inc.

Calibration: C:\HPChem\1\DATA\060211\F0CF0201.D\FID1A.CH
Blank: C:\HPChem\1\DATA\060211\F0CF0203.D
Qc Ref: C:\HPChem\1\DATA\060211\F0CF0202.D
SimDis Properties: custom properties

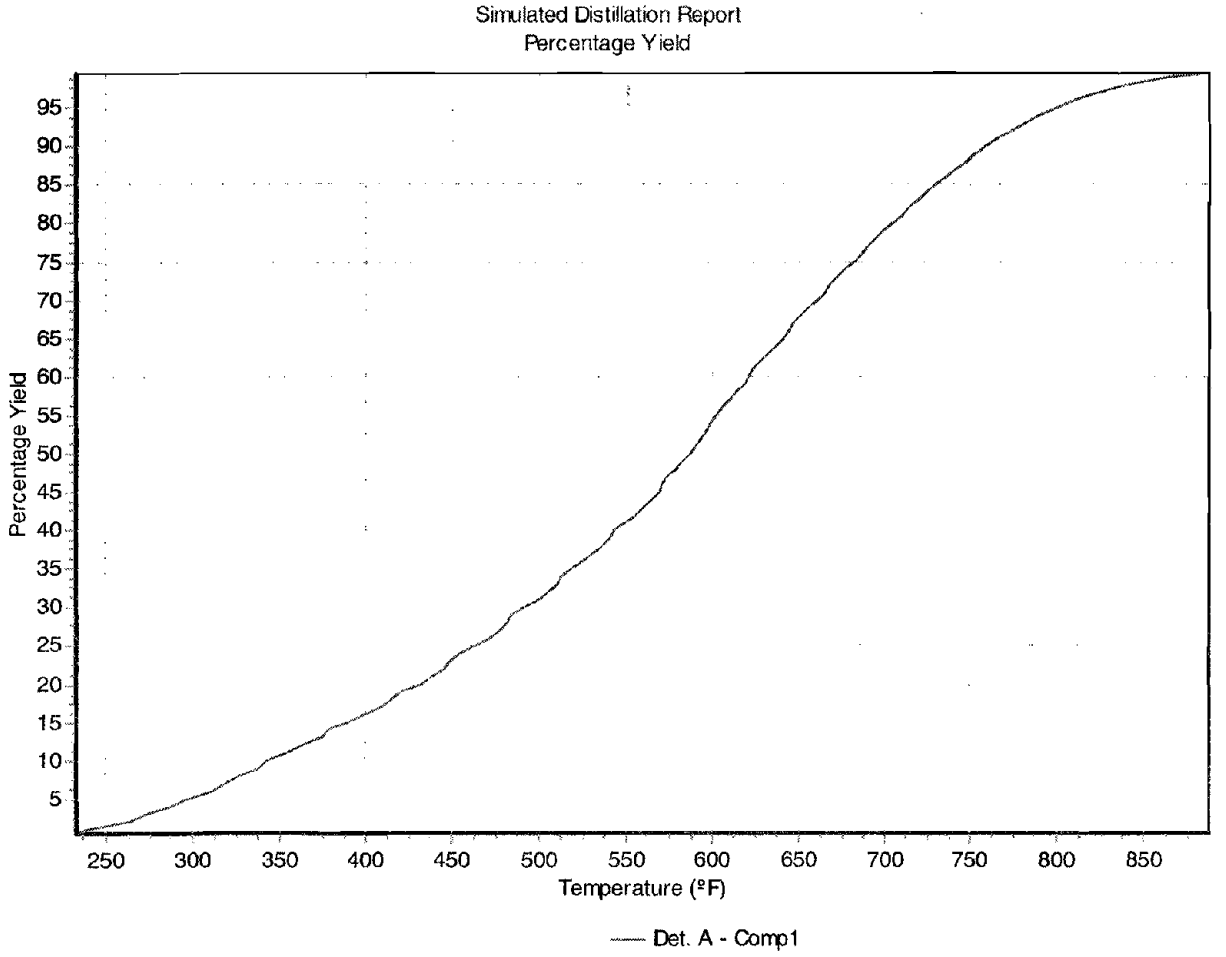
File : C:\HPCHEM\1\DATA\060211\F0CF0206.D
Operator : KHF
Acquired : 2 Jun 2011 14:48 using AcqMethod 2887.M
Instrument : CSS Instr
Sample Name: AOI-16RFI-16-08HYDOIL-041411 1102342-04
Misc Info : 1@
Vial Number: 6



Simulated Distillation Engineering Report

ASTM D2887 Oil 1030145

KHF -- 2 Jun 111 10:27 am -- 2887.M
C:\HPChem\1\DATA\060211\F0CF0202.D (GC DATA FILE)



Percentage Yield Table

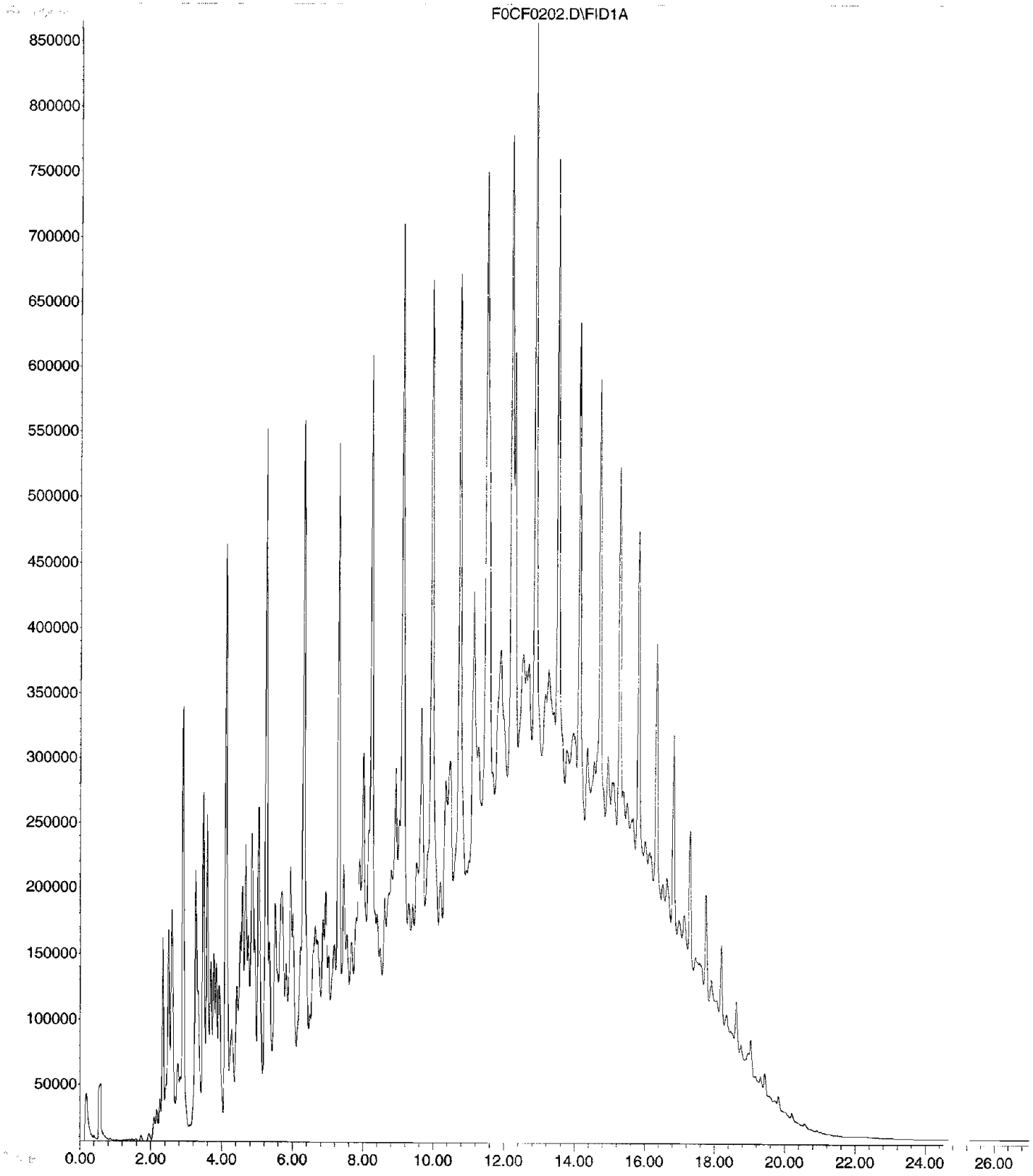
	Det. A - Comp1 Temp. (Deg. F)
IBP: 0.5%	233.00
5.00%	296.00
10.00%	342.00
15.00%	389.00
20.00%	431.00
25.00%	464.00
30.00%	492.00
35.00%	519.00
40.00%	544.00
45.00%	569.00
50.00%	586.00
55.00%	602.00
60.00%	620.00
65.00%	640.00
70.00%	660.00
75.00%	682.00
80.00%	705.00
85.00%	729.00
90.00%	759.00
95.00%	799.00
FBP: 99.5%	888.00

Total Det. A - Comp1: 100.000 %

WMI SimDis Report
6/3/2011 4:18:54 PM
WeMeasureIt, Inc.

Calibration: C:\HPChem\1\DATA\060211\F0CF0201.D\FID1A.CH
Blank: C:\HPChem\1\DATA\060211\F0CF0203.D
Qc Ref: C:\HPChem\1\DATA\060211\F0CF0202.D
SimDis Properties: custom properties

File : C:\HPCHEM\1\DATA\060211\F0CF0202.D
Operator : KHF
Acquired : 2 Jun 2011 10:27 using AcqMethod 2887.M
Instrument : CSS Instr
Sample Name: ASTM D2887 Oil 1030145
Misc Info : 1@
Vial Number: 2



PTS Laboratories, Inc.

CHAIN OF CUSTODY RECORD

PAGE OF

COMPANY: PTS Laboratories

ADDRESS: 8100 Secura Way, CITY: Santa Fe Springs, ZIP CODE: 90670

PROJECT MANAGER: Rachael Spitz (362) 347-2500

PROJECT NAME: NAO Flint, MI PHONE NUMBER: (562) 907-3610

PROJECT NUMBER: B0064410.2011.00301 FAX NUMBER:

SITE LOCATION:

SAMPLER SIGNATURE: Dudley Tan

PO#:

TURNAROUND TIME
24 HOURS ☐ 5 DAYS ☐
48 HOURS ☐ NORMAL ☒
72 HOURS ☐
OTHER:

SAMPLE INTEGRITY (CHECK):
INTACT ____ ON ICE ____

PTS QUOTE NO.:

PTS FILE: 41270

ANALYSIS REQUEST

SAMPLE ID NUMBER	DATE	TIME	DEPTH, FT	NUMBER OF SAMPLES	SOIL PROPERTIES PACKAGE	HYDRAULIC CONDUCTIVITY PACKAGE	PORE FLUID SATURATIONS PACKAGE	TCEQ/TNRCC PROPERTIES PACKAGE	CAPILLARITY PACKAGE	FLUID PROPERTIES PACKAGE	PHOTOLOG: CORE PHOTOGRAPHY	MOISTURE CONTENT, ASTM D2216	POROSITY: TOTAL, API RP40	POROSITY: EFFECTIVE, ASTM D425M	SPECIFIC GRAVITY, ASTM D854	BULK DENSITY (DRY), API RP40 or ASTM D2937	AIR PERMEABILITY, API RP40	HYDRAULIC CONDUCTIVITY, EPA9100, API RP40, D5084	GRAIN SIZE DISTRIBUTION, ASTM D422/4464M	TOC: WALKLEY-BLACK	ATTERBERG LIMITS, ASTM D4318	Simulated Distillation AST m D2887				COMMENTS
AOI-#0RFI-40-07RHYDOIL-041411	5/13	1400		2																		X				1102342-1A-B
AOI-12mw-RFI-12-23HYDOIL-041411	5/13	1400		2																		X				2A-B
AOI-02IF-002-018HYDOIL-041411	5/13	1400		2																		X				3A-B
AOI-16RFI-16-08HYDOIL-041411	5/13	1400		2																		X				4A-B

1. RELINQUISHED BY	2. RECEIVED BY	3. RELINQUISHED BY	4. RECEIVED BY
Dudley Tan		FedEx	Lynnette Yeo
COMPANY: PTS Laboratories	COMPANY:	COMPANY:	COMPANY: OEC
DATE: 5/13/11 TIME: 15:05	DATE: TIME:	DATE: TIME:	DATE: 5-17-11 TIME: 1500

SAMPLE RECEIPT

Rev 01/15/10

CLIENT: PTS OEC ID #: 1102342 Temp: 19 °C

Acceptable Range: 0°C to 6°C

COC RECEIVED DATE/TIME: 5-17-11 1500

RECEIPT LOGIN DATE/TIME: 5-17-11 1550

REFRIGERATOR(s): 7

SAMPLE TRANSPORT, RECEIPT, CONDITION & PRESERVATION:		Yes	No	N/A	(*) PROBLEM CHAIN FORM NEEDED
☐ OEC Courier/Sampler	COC document(s) received with samples	☒	☐*	☐	Custody Seals (circle): Present / Absent
☒ Delivery(Other than OEC Courier)	Correct containers for analysis requested	☒	☐*	☐	Samples / Coolers
☐ Samples Received on Ice	Container(s) intact and in good condition	☒	☐*	☐	Intact / Broken*
☐ Samples Received Outside Temp. Range*	Container label(s) consistent with COC	☒	☐*	☐	Method of Shipment & Tracking #(if applicable)
☐ Samples Direct from field (Outside Temp)	OEC preservative added (**note std ID)	☐**	☐	☒	FedEx (9612019) 1400307
☐ After-Hours Outside Drop-off [Brought Inside]	Proper preservation on sample label(s)	☐	☐	☒	(**) OEC Preservative ID: 15001747
(Initials/Date/Time):	VOA containers free of headspace	☐	☐*	☒	Dissolved Metals Filtration (Date/Init/Preserve ID)
	Tedlar Bags free of condensation	☐	☐*	☒	

CONTAINERS, COC CHANGES AND/OR CORRECTIONS — **CHANGES AUTHORIZED BY:**

OEC ID	Client ID ***If blank, refer to CoC	Container Description	Preservative	ResCl /pH	Matrix	Date/Time Sampled ***	Comments / Remarks / Condition Notes, Etc.
1-4 A-B		2-VOAs EA	—	—	PRODUCT		

RECEIPT LOGIN BY: ELH RECEIPT REVIEWED BY: [signature]

PTS File No: 41270
Client: ARCADIS

PTS Laboratories

VISCOSITY, DENSITY, and SPECIFIC GRAVITY DATA

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

PROJECT NAME: NAO Flint, MI
PROJECT NO: B0064410.2011.00301

SAMPLE ID	MATRIX	TEMPERATURE, °F	SPECIFIC GRAVITY	DENSITY, g/cc	VISCOSITY	
					centistokes	centipoise
AOI-40RFI-40-14RGW041411	Water	70	0.9980	0.9960	1.03	1.02
		100	0.9981	0.9912	0.694	0.688
		130	0.9973	0.9833	0.550	0.541
AOI-40RFI-40-07R2HYDOIL-041411	NAPL	70	0.7890	0.7874	1.51	1.19
		100	0.7779	0.7725	1.23	0.949
		130	0.7721	0.7613	0.987	0.751
AOI-12MW-RFI-12-33GW041411	Water	70	0.9994	0.9974	1.025	1.022
		100	0.9997	0.9928	0.693	0.688
		130	1.001	0.9872	0.548	0.541
AOI-12MW-RFI-12-23HYDOIL-041411	NAPL	70	0.8827	0.8809	54.1	47.7
		100	0.8740	0.8679	22.4	19.4
		130	0.8715	0.8593	12.3	10.6
AOI-02RFI-02-09GW-041411	Water	70	1.000	0.9980	0.986	0.984
		100	1.000	0.9931	0.698	0.694
		130	1.001	0.9873	0.558	0.551
AOI-02LIF-002-018HYDOIL-041411	NAPL	70	0.9081	0.9063	400	362
		100	0.8994	0.8932	130	116
		130	0.8993	0.8867	52.5	46.6
AOI-16RFI-16-09GW041411	Water	70	1.001	0.9986	1.057	1.055
		100	1.001	0.9943	0.704	0.700
		130	1.002	0.9884	0.553	0.547
AOI-16RFI-16-08HYDOIL041411	NAPL	70	0.8746	0.8728	5.92	5.17
		100	0.8653	0.8593	3.93	3.38
		130	0.8600	0.8479	2.74	2.33

PTS File No: 41270
Client: ARCADIS

PTS Laboratories

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: DuNuoy Method - ASTM D971)

PROJECT NAME: NAO Flint, MI
PROJECT NO: B0064410.2011.00301

PHASE PAIR		TEMPERATURE,	INTERFACIAL TENSION,
SAMPLE ID / PHASE	SAMPLE ID / PHASE	°F	Dynes/centimeter
AOI-40RFI-40-14RGW041411	Air	72.5	68.8
AOI-40RFI-40-07R2HYDOIL-041411	Air	72.5	23.8
AOI-40RFI-40-14RGW041411	AOI-40RFI-40-07R2HYDOIL-041411	72.5	7.6
AOI-12MW-RFI-12-33GW041411	Air	73.4	67.7
AOI-12MW-RFI-12-23HYDOIL-041411	Air	73.4	29.9
AOI-12MW-RFI-12-33GW041411	AOI-12MW-RFI-12-23HYDOIL-041411	73.4	14.7
AOI-02RFI-02-09GW-041411	Air	73.4	58.5
AOI-02LIF-002-018HYDOIL-041411	Air	73.4	32.4
AOI-02RFI-02-09GW-041411	AOI-02LIF-002-018HYDOIL-041411	73.4	12.1
AOI-16RFI-16-09GW041411	Air	72.5	72.3
AOI-16RFI-16-08HYDOIL041411	Air	72.5	28.4
AOI-16RFI-16-09GW041411	AOI-16RFI-16-08HYDOIL041411	72.5	12.8

QUALITY CONTROL DATA

PHASE PAIR:	DIWATER / AIR
TEMPERATURE, °F:	72.5
IFT, MEASURED:	72.1
IFT, PUBLISHED:	72.3
RPD:	-0.36

PTS File No: 41270
Client: ARCADIS

PTS Laboratories

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: Spinning Drop Method - UT Model 500)

PROJECT NAME: NAO Flint, MI
PROJECT NO: B0064410.2011.00301

FLUID SYSTEM		
FLUID TYPE	FLUID ID	DENSITY, g/cc
LNAPL	40RFI-40-07R2HYDOIL-041411	0.7834
Surfactant	0.665% by wt. AEROSOL OT 75%	1.0004

SPINNING DROP METHOD INTERFACIAL TENSION (IFT) DATA					
READING NO.	DATE / TIME	TECH.	DROP WIDTH, cm	PERIOD, ms/revolution	IFT, dyne/cm
1	20110618 / 845	LL	0.087	7.50	1.33
2	20110618 / 847	LL	0.091	8.00	1.32
3	20110618 / 849	LL	0.095	8.50	1.32
4	20110618 / 852	LL	0.098	9.00	1.30
5	20110618 / 855	LL	0.102	9.50	1.32
6	20110618 / 858	LL	0.106	10.00	1.34
				Average:	1.32
				Std Dev:	0.01
				RSD:	1.1

Drop Volume, ul: 15
Temperature, °C: 25.0

PTS File No: 41270
Client: ARCADIS

PTS Laboratories

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: Spinning Drop Method - UT Model 500)

PROJECT NAME: NAO Flint, MI
PROJECT NO: B0064410.2011.00301

FLUID SYSTEM		
FLUID TYPE	FLUID ID	DENSITY, g/cc
LNAPL	40RFI-40-07R2HYDOIL-041411	0.7824
Surfactant	1.33% by weight AEROSOL OT 75%	0.9999

SPINNING DROP METHOD INTERFACIAL TENSION (IFT) DATA					
READING NO.	DATE / TIME	TECH.	DROP WIDTH, cm	PERIOD, ms/revolution	IFT, dyne/cm
1	20110618 / 923	LL	0.070	7.49	0.702
2	20110618 / 925	LL	0.074	7.99	0.722
3	20110618 / 927	LL	0.077	8.50	0.724
4	20110618 / 930	LL	0.080	9.00	0.722
5	20110618 / 932	LL	0.084	9.50	0.736
6	20110618 / 935	LL	0.087	10.00	0.741
				Average:	0.725
				Std Dev:	0.01
				RSD:	1.9

Drop Volume, ul: 15
Temperature, °C: 26.1

PTS File No: 41270
Client: ARCADIS

PTS Laboratories

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: Spinning Drop Method - UT Model 500)

PROJECT NAME: NAO Flint, MI
PROJECT NO: B0064410.2011.00301

FLUID SYSTEM		
FLUID TYPE	FLUID ID	DENSITY, g/cc
LNAPL	40RFI-40-07R2HYDOIL-041411	0.7834
Surfactant	2.66% by weight AEROSOL OT 75%	1.0004

SPINNING DROP METHOD INTERFACIAL TENSION (IFT) DATA					
READING NO.	DATE / TIME	TECH.	DROP WIDTH, cm	PERIOD, ms/revolution	IFT, dyne/cm
1	20110618 / 1105	LL	0.056	7.50	0.357
2	20110618 / 1107	LL	0.057	8.00	0.327
3	20110618 / 1112	LL	0.061	8.50	0.347
4	20110618 / 1115	LL	0.063	9.00	0.351
5	20110618 / 1117	LL	0.065	9.50	0.350
6	20110618 / 1120	LL	0.068	10.00	0.355
				Average:	0.348
				Std Dev:	0.01
				RSD:	3.1

Drop Volume, ul: 15
Temperature, °C: 25.0

PTS File No: 41270
Client: ARCADIS

PTS Laboratories

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: Spinning Drop Method - UT Model 500)

PROJECT NAME: NAO Flint, MI
PROJECT NO: B0064410.2011.00301

FLUID SYSTEM		
FLUID TYPE	FLUID ID	DENSITY, g/cc
LNAPL	40RFI-40-07R2HYDOIL-041411	0.7813
Surfactant	4% by weight AEROSOL OT 75%	0.9995

SPINNING DROP METHOD INTERFACIAL TENSION (IFT) DATA					
READING NO.	DATE / TIME	TECH.	DROP WIDTH, cm	PERIOD, ms/revolution	IFT, dyne/cm
1	20110618 / 1145	LL	0.052	7.50	0.279
2	20110618 / 1147	LL	0.053	8.00	0.263
3	20110618 / 1150	LL	0.054	8.50	0.248
4	20110618 / 1152	LL	0.056	9.00	0.240
5	20110618 / 1155	LL	0.056	9.50	0.225
6	20110618 / 1158	LL	0.058	10.00	0.226
				Average:	0.247
				Std Dev:	0.02
				RSD:	8.6

Drop Volume, ul: 15
Temperature, °C: 27.1

PTS File No: 41270
Client: ARCADIS

PTS Laboratories

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: Spinning Drop Method - UT Model 500)

PROJECT NAME: NAO Flint, MI
PROJECT NO: B0064410.2011.00301

FLUID SYSTEM		
FLUID TYPE	FLUID ID	DENSITY, g/cc
LNAPL	40RFI-40-07R2HYDOIL-041411	0.7819
Surfactant	6.65% by weight AEROSOL OT 75%	0.9997

SPINNING DROP METHOD INTERFACIAL TENSION (IFT) DATA					
READING NO.	DATE / TIME	TECH.	DROP WIDTH, cm	PERIOD, ms/revolution	IFT, dyne/cm
1	20110618 / 1210	LL	0.045	7.49	0.183
2	20110618 / 1212	LL	0.042	7.99	0.132
3	20110618 / 1215	LL	0.044	8.50	0.136
4	20110618 / 1217	LL	0.045	9.00	0.131
5	20110618 / 1219	LL	0.048	9.50	0.135
6	20110618 / 1221	LL	0.049	10.00	0.134
				Average:	0.142
				Std Dev:	0.02
				RSD:	14.3

Drop Volume, ul: 15
Temperature, °C: 26.5

PTS File No: 41270
Client: ARCADIS

PTS Laboratories

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: Spinning Drop Method - UT Model 500)

PROJECT NAME: NAO Flint, MI
PROJECT NO: B0064410.2011.00301

FLUID SYSTEM		
FLUID TYPE	FLUID ID	DENSITY, g/cc
LNAPL	40RFI-40-07R2HYDOIL-041411	0.7851
Surfactant	1% by (v/v) Gold Crew Release	0.9987

SPINNING DROP METHOD INTERFACIAL TENSION (IFT) DATA					
READING NO.	DATE / TIME	TECH.	DROP WIDTH, cm	PERIOD, ms/revolution	IFT, dyne/cm
1	20110618 / 753	LL	0.097	7.50	1.81
2	20110618 / 755	LL	0.100	8.00	1.72
3	20110618 / 758	LL	0.104	8.50	1.75
4	20110618 / 800	LL	0.108	9.00	1.72
5	20110618 / 802	LL	0.112	9.49	1.75
6	20110618 / 803	LL	0.115	10.00	1.70
				Average:	1.74
				Std Dev:	0.04
				RSD:	2.2

Drop Volume, ul: 15
Temperature, °C: 23.5

PTS File No: 41270
Client: ARCADIS

PTS Laboratories

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: Spinning Drop Method - UT Model 500)

PROJECT NAME: NAO Flint, MI
PROJECT NO: B0064410.2011.00301

FLUID SYSTEM		
FLUID TYPE	FLUID ID	DENSITY, g/cc
LNAPL	40RFI-40-07R2HYDOIL-041411	0.7840
Surfactant	2% by (v/v) Gold Crew Release	0.9983

SPINNING DROP METHOD INTERFACIAL TENSION (IFT) DATA					
READING NO.	DATE / TIME	TECH.	DROP WIDTH, cm	PERIOD, ms/revolution	IFT, dyne/cm
1	20110617 / 1755	LL	0.082	7.50	1.10
2	20110617 / 1757	LL	0.085	8.00	1.07
3	20110617 / 1800	LL	0.088	8.50	1.05
4	20110617 / 1802	LL	0.091	9.00	1.04
5	20110617 / 1805	LL	0.094	9.50	1.03
6	20110617 / 1807	LL	0.098	10.00	1.05
				Average:	1.06
				Std Dev:	0.03
				RSD:	2.5

Drop Volume, ul: 15
Temperature, °C: 24.4

PTS File No: 41270
Client: ARCADIS

PTS Laboratories

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: Spinning Drop Method - UT Model 500)

PROJECT NAME: NAO Flint, MI
PROJECT NO: B0064410.2011.00301

FLUID SYSTEM		
FLUID TYPE	FLUID ID	DENSITY, g/cc
LNAPL	40RFI-40-07R2HYDOIL-041411	0.7846
Surfactant	3% by (v/v) Gold Crew Release	0.9985

SPINNING DROP METHOD INTERFACIAL TENSION (IFT) DATA					
READING NO.	DATE / TIME	TECH.	DROP WIDTH, cm	PERIOD, ms/revolution	IFT, dyne/cm
1	20110617 / 1715	LL	0.073	7.50	0.755
2	20110617 / 1717	LL	0.075	8.00	0.740
3	20110617 / 1720	LL	0.078	8.50	0.738
4	20110617 / 1722	LL	0.081	9.00	0.726
5	20110617 / 1725	LL	0.084	9.50	0.737
6	20110617 / 1727	LL	0.087	10.00	0.729
				Average:	0.737
				Std Dev:	0.01
				RSD:	1.4

Drop Volume, ul: 15
Temperature, °C: 23.7

PTS File No: 41270
Client: ARCADIS

PTS Laboratories

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: Spinning Drop Method - UT Model 500)

PROJECT NAME: NAO Flint, MI
PROJECT NO: B0064410.2011.00301

FLUID SYSTEM		
FLUID TYPE	FLUID ID	DENSITY, g/cc
LNAPL	40RFI-40-07R2HYDOIL-041411	0.7846
Surfactant	4.5% by (v/v) Gold Crew Release	0.9985

SPINNING DROP METHOD INTERFACIAL TENSION (IFT) DATA					
READING NO.	DATE / TIME	TECH.	DROP WIDTH, cm	PERIOD, ms/revolution	IFT, dyne/cm
1	20110617 / 940	LL	0.071	7.50	0.721
2	20110617 / 942	LL	0.075	8.00	0.743
3	20110617 / 945	LL	0.079	8.50	0.755
4	20110617 / 947	LL	0.082	9.00	0.756
5	20110617 / 950	LL	0.086	9.50	0.796
6	20110617 / 953	LL	0.090	10.00	0.810
				Average:	0.764
				Std Dev:	0.03
				RSD:	4.4

Drop Volume, ul: 15
Temperature, °C: 23.9

PTS File No: 41270
Client: ARCADIS

PTS Laboratories

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: Spinning Drop Method - UT Model 500)

PROJECT NAME: NAO Flint, MI
PROJECT NO: B0064410.2011.00301

FLUID SYSTEM		
FLUID TYPE	FLUID ID	DENSITY, g/cc
LNAPL	40RFI-40-07R2HYDOIL-041411	0.7834
Surfactant	6% by (v/v) Gold Crew Release	0.9981

SPINNING DROP METHOD INTERFACIAL TENSION (IFT) DATA					
READING NO.	DATE / TIME	TECH.	DROP WIDTH, cm	PERIOD, ms/revolution	IFT, dyne/cm
1	20110616 / 1725	LL	0.063	7.50	0.495
2	20110616 / 1727	LL	0.065	8.00	0.480
3	20110616 / 1730	LL	0.070	8.50	0.529
4	20110616 / 1732	LL	0.072	9.00	0.505
5	20110616 / 1735	LL	0.075	9.50	0.531
6	20110616 / 1740	LL	0.078	10.00	0.539
				Average:	0.513
				Std Dev:	0.02
				RSD:	4.6

Drop Volume, ul: 15
Temperature, °C: 25.0

PTS File No: 41270
Client: ARCADIS

PTS Laboratories

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: Spinning Drop Method - UT Model 500)

PROJECT NAME: NAO Flint, MI
PROJECT NO: B0064410.2011.00301

FLUID SYSTEM		
FLUID TYPE	FLUID ID	DENSITY, g/cc
LNAPL	40RFI-40-07R2HYDOIL-041411	
Surfactant	0.005% by (w/v) Ivey-sol 106	

SPINNING DROP METHOD INTERFACIAL TENSION (IFT) DATA					
READING NO.	DATE / TIME	TECH.	DROP WIDTH, cm	PERIOD, ms/revolution	IFT, dyne/cm

UNABLE TO MEASURE IFT BY SPINNING DROP TENSIOMETER, IFT OUTSIDE RANGE OF INSTRUMENT

IFT MEASURED BY DU NUOY TENSIOMETER METHOD, ASTM D971:	16.7
Average:	NA
Std Dev:	NA
RSD:	NA

Drop Volume, ul: NA
Temperature, °C: 23.4

QUALITY CONTROL DATA

PHASE PAIR:	DIWATER / AIR
TEMPERATURE, °F:	74.6
IFT, MEASURED:	72.3
IFT, PUBLISHED:	72.1
RPD:	0.16

PTS File No: 41270
Client: ARCADIS

PTS Laboratories

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: Spinning Drop Method - UT Model 500)

PROJECT NAME: NAO Flint, MI
PROJECT NO: B0064410.2011.00301

FLUID SYSTEM		
FLUID TYPE	FLUID ID	DENSITY, g/cc
LNAPL	40RFI-40-07R2HYDOIL-041411	0.7834
Surfactant	0.125% by (w/v) Ivey-sol 106	0.9963

SPINNING DROP METHOD INTERFACIAL TENSION (IFT) DATA					
READING NO.	DATE / TIME	TECH.	DROP WIDTH, cm	PERIOD, ms/revolution	IFT, dyne/cm
1	20110615 / 932	LL	0.171	7.50	9.91
2	20110615 / 935	LL	0.178	8.00	9.84
3	20110615 / 937	LL	0.185	8.50	9.77
4	20110615 / 940	LL	0.192	9.00	9.69
5	20110615 / 942	LL	0.198	9.50	9.58
6	20110615 / 945	LL	0.204	10.01	9.45
				Average:	9.71
				Std Dev:	0.17
				RSD:	1.7

Drop Volume, ul: 15
Temperature, °C: 24.9

PTS File No: 41270
Client: ARCADIS

PTS Laboratories

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: Spinning Drop Method - UT Model 500)

PROJECT NAME: NAO Flint, MI
PROJECT NO: B0064410.2011.00301

FLUID SYSTEM		
FLUID TYPE	FLUID ID	DENSITY, g/cc
LNAPL	40RFI-40-07R2HYDOIL-041411	0.7851
Surfactant	0.500% by (w/v) Ivey-sol 106	0.9968

SPINNING DROP METHOD INTERFACIAL TENSION (IFT) DATA					
READING NO.	DATE / TIME	TECH.	DROP WIDTH, cm	PERIOD, ms/revolution	IFT, dyne/cm
1	20110615 / 855	LL	0.130	7.50	4.27
2	20110615 / 858	LL	0.136	8.00	4.29
3	20110615 / 901	LL	0.141	8.50	4.28
4	20110615 / 903	LL	0.146	9.00	4.27
5	20110615 / 905	LL	0.152	9.50	4.26
6	20110615 / 908	LL	0.157	10.00	4.25
				Average:	4.27
				Std Dev:	0.01
				RSD:	0.3

Drop Volume, ul: 15
Temperature, °C: 23.5

PTS File No: 41270
Client: ARCADIS

PTS Laboratories

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: Spinning Drop Method - UT Model 500)

PROJECT NAME: NAO Flint, MI
PROJECT NO: B0064410.2011.00301

FLUID SYSTEM		
FLUID TYPE	FLUID ID	DENSITY, g/cc
LNAPL	40RFI-40-07R2HYDOIL-041411	0.7840
Surfactant	0.750% by (w/v) Ivey-sol 106	0.9965

SPINNING DROP METHOD INTERFACIAL TENSION (IFT) DATA					
READING NO.	DATE / TIME	TECH.	DROP WIDTH, cm	PERIOD, ms/revolution	IFT, dyne/cm
1	20110614 / 1800	LL	0.131	7.51	4.40
2	20110614 / 1802	LL	0.137	8.00	4.41
3	20110614 / 1805	LL	0.142	8.50	4.42
4	20110614 / 1807	LL	0.148	9.00	4.42
5	20110614 / 1810	LL	0.153	9.50	4.42
6	20110614 / 1812	LL	0.158	10.00	4.39
				Average:	4.41
				Std Dev:	0.01
				RSD:	0.3

Drop Volume, ul: 15
Temperature, °C: 24.5

PTS File No: 41270
Client: ARCADIS

PTS Laboratories

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: Spinning Drop Method - UT Model 500)

PROJECT NAME: NAO Flint, MI
PROJECT NO: B0064410.2011.00301

FLUID SYSTEM		
FLUID TYPE	FLUID ID	DENSITY, g/cc
LNAPL	40RFI-40-07R2HYDOIL-041411	0.7857
Surfactant	1.125% by (w/v) Ivey-sol 106	0.9968

SPINNING DROP METHOD INTERFACIAL TENSION (IFT) DATA					
READING NO.	DATE / TIME	TECH.	DROP WIDTH, cm	PERIOD, ms/revolution	IFT, dyne/cm
1	20110614 / 1553	LL	0.116	7.50	3.08
2	20110614 / 1556	LL	0.122	8.00	3.09
3	20110614 / 1558	LL	0.127	8.50	3.09
4	20110614 / 1600	LL	0.131	9.00	3.07
5	20110614 / 1602	LL	0.136	9.50	3.08
6	20110614 / 1605	LL	0.141	10.00	3.10
				Average:	3.09
				Std Dev:	0.01
				RSD:	0.3

Drop Volume, ul: 15
Temperature, °C: 23.2

PTS File No: 41270
Client: ARCADIS

PTS Laboratories

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: Spinning Drop Method - UT Model 500)

PROJECT NAME: NAO Flint, MI
PROJECT NO: B0064410.2011.00301

FLUID SYSTEM		
FLUID TYPE	FLUID ID	DENSITY, g/cc
LNAPL	12 MW-12-RFI-12-23HYDOIL-041411	0.8772
Surfactant	0.665% by weight AEROSOL OT 75%	1.000

SPINNING DROP METHOD INTERFACIAL TENSION (IFT) DATA					
READING NO.	DATE / TIME	TECH.	DROP WIDTH, cm	PERIOD, ms/revolution	IFT, dyne/cm
1	20110616 / 830	LL	0.125	7.50	2.21
2	20110616 / 832	LL	0.129	8.00	2.16
3	20110616 / 835	LL	0.135	8.50	2.21
4	20110616 / 837	LL	0.140	9.00	2.16
5	20110616 / 839	LL	0.145	9.50	2.17
6	20110616 / 841	LL	0.151	10.01	2.18
				Average:	2.18
				Std Dev:	0.02
				RSD:	1.0

Drop Volume, ul: 15
Temperature, °C: 24.9

PTS File No: 41270
Client: ARCADIS

PTS Laboratories

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: Spinning Drop Method - UT Model 500)

PROJECT NAME: NAO Flint, MI
PROJECT NO: B0064410.2011.00301

FLUID SYSTEM		
FLUID TYPE	FLUID ID	DENSITY, g/cc
LNAPL	12 MW-12-RFI-12-23HYDOIL-041411	0.8768
Surfactant	1.33% by weight AEROSOL OT 75%	1.000

SPINNING DROP METHOD INTERFACIAL TENSION (IFT) DATA					
READING NO.	DATE / TIME	TECH.	DROP WIDTH, cm	PERIOD, ms/revolution	IFT, dyne/cm
1	20110615 / 1740	LL	0.109	7.51	1.48
2	20110615 / 1746	LL	0.112	8.01	1.39
3	20110615 / 1748	LL	0.117	8.50	1.41
4	20110615 / 1750	LL	0.121	9.00	1.39
5	20110615 / 1752	LL	0.125	9.50	1.38
6	20110615 / 1755	LL	0.129	9.99	1.38
				Average:	1.40
				Std Dev:	0.04
				RSD:	2.7

Drop Volume, ul: 15
Temperature, °C: 25.5

PTS File No: 41270
Client: ARCADIS

PTS Laboratories

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: Spinning Drop Method - UT Model 500)

PROJECT NAME: NAO Flint, MI
PROJECT NO: B0064410.2011.00301

FLUID SYSTEM		
FLUID TYPE	FLUID ID	DENSITY, g/cc
LNAPL	12 MW-12-RFI-12-23HYDOIL-041411	0.8768
Surfactant	2.66% by weight AEROSOL OT 75%	1.000

SPINNING DROP METHOD INTERFACIAL TENSION (IFT) DATA					
READING NO.	DATE / TIME	TECH.	DROP WIDTH, cm	PERIOD, ms/revolution	IFT, dyne/cm
1	20110615 / 1650	LL	0.089	7.51	0.812
2	20110615 / 1652	LL	0.092	8.00	0.792
3	20110615 / 1655	LL	0.096	8.50	0.775
4	20110615 / 1658	LL	0.100	9.00	0.791
5	20110615 / 1700	LL	0.103	9.50	0.785
6	20110615 / 1702	LL	0.107	10.00	0.788
				Average:	0.791
				Std Dev:	0.01
				RSD:	1.5

Drop Volume, ul: 15
Temperature, °C: 25.5

PTS File No: 41270
Client: ARCADIS

PTS Laboratories

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: Spinning Drop Method - UT Model 500)

PROJECT NAME: NAO Flint, MI
PROJECT NO: B0064410.2011.00301

FLUID SYSTEM		
FLUID TYPE	FLUID ID	DENSITY, g/cc
LNAPL	12 MW-12-RFI-12-23HYDOIL-041411	0.8754
Surfactant	4% by weight AEROSOL OT 75%	0.9995

SPINNING DROP METHOD INTERFACIAL TENSION (IFT) DATA					
READING NO.	DATE / TIME	TECH.	DROP WIDTH, cm	PERIOD, ms/revolution	IFT, dyne/cm
1	20110618 / 1300	LL	0.082	7.50	0.634
2	20110618 / 1302	LL	0.085	8.00	0.627
3	20110618 / 1305	LL	0.089	8.50	0.625
4	20110618 / 1307	LL	0.092	9.00	0.622
5	20110618 / 1310	LL	0.096	9.50	0.640
6	20110618 / 1312	LL	0.099	10.01	0.626
				Average:	0.629
				Std Dev:	0.01
				RSD:	1.1

Drop Volume, ul: 15
Temperature, °C: 27.2

PTS File No: 41270
Client: ARCADIS

PTS Laboratories

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: Spinning Drop Method - UT Model 500)

PROJECT NAME: NAO Flint, MI
PROJECT NO: B0064410.2011.00301

FLUID SYSTEM		
FLUID TYPE	FLUID ID	DENSITY, g/cc
LNAPL	12 MW-12-RFI-12-23HYDOIL-041411	0.8754
Surfactant	6.65% by weight AEROSOL OT 75%	0.9995

SPINNING DROP METHOD INTERFACIAL TENSION (IFT) DATA					
READING NO.	DATE / TIME	TECH.	DROP WIDTH, cm	PERIOD, ms/revolution	IFT, dyne/cm
1	20110618 / 1320	LL	0.084	7.49	0.681
2	20110618 / 1321	LL	0.088	8.00	0.677
3	20110618 / 1322	LL	0.091	8.50	0.672
4	20110618 / 1324	LL	0.094	9.00	0.670
5	20110618 / 1326	LL	0.097	9.50	0.662
6	20110618 / 1328	LL	0.102	10.00	0.684
				Average:	0.674
				Std Dev:	0.01
				RSD:	1.2

Drop Volume, ul: 15
Temperature, °C: 27.0

PTS File No: 41270
Client: ARCADIS

PTS Laboratories

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: Spinning Drop Method - UT Model 500)

PROJECT NAME: NAO Flint, MI
PROJECT NO: B0064410.2011.00301

FLUID SYSTEM		
FLUID TYPE	FLUID ID	DENSITY, g/cc
LNAPL	12 MW-12-RFI-12-23HYDOIL-041411	0.8768
Surfactant	1% by (v/v) Gold Crew Release	0.9979

SPINNING DROP METHOD INTERFACIAL TENSION (IFT) DATA					
READING NO.	DATE / TIME	TECH.	DROP WIDTH, cm	PERIOD, ms/revolution	IFT, dyne/cm
1	20110616 / 1512	LL	0.165	7.49	5.05
2	20110616 / 1515	LL	0.171	8.00	4.91
3	20110616 / 1518	LL	0.179	8.50	4.98
4	20110616 / 1520	LL	0.184	9.00	4.84
5	20110616 / 1522	LL	0.191	9.50	4.89
6	20110616 / 1524	LL	0.197	10.00	4.83
				Average:	4.92
				Std Dev:	0.09
				RSD:	1.8

Drop Volume, ul: 15
Temperature, °C: 25.3

PTS File No: 41270
Client: ARCADIS

PTS Laboratories

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: Spinning Drop Method - UT Model 500)

PROJECT NAME: NAO Flint, MI
PROJECT NO: B0064410.2011.00301

FLUID SYSTEM		
FLUID TYPE	FLUID ID	DENSITY, g/cc
LNAPL	12 MW-12-RFI-12-23HYDOIL-041411	0.8783
Surfactant	2% by (v/v) Gold Crew Release	0.9985

SPINNING DROP METHOD INTERFACIAL TENSION (IFT) DATA					
READING NO.	DATE / TIME	TECH.	DROP WIDTH, cm	PERIOD, ms/revolution	IFT, dyne/cm
1	20110616 / 1432	LL	0.107	7.50	1.37
2	20110616 / 1435	LL	0.112	8.00	1.37
3	20110616 / 1437	LL	0.117	8.50	1.40
4	20110616 / 1440	LL	0.122	9.00	1.39
5	20110616 / 1442	LL	0.124	9.50	1.33
6	20110616 / 1446	LL	0.129	10.01	1.33
				Average:	1.36
				Std Dev:	0.03
				RSD:	2.1

Drop Volume, ul: 15
Temperature, °C: 24.0

PTS File No: 41270
Client: ARCADIS

PTS Laboratories

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: Spinning Drop Method - UT Model 500)

PROJECT NAME: NAO Flint, MI
PROJECT NO: B0064410.2011.00301

FLUID SYSTEM		
FLUID TYPE	FLUID ID	DENSITY, g/cc
LNAPL	12 MW-12-RFI-12-23HYDOIL-041411	0.8772
Surfactant	3% by (v/v) Gold Crew Release	0.9981

SPINNING DROP METHOD INTERFACIAL TENSION (IFT) DATA					
READING NO.	DATE / TIME	TECH.	DROP WIDTH, cm	PERIOD, ms/revolution	IFT, dyne/cm
1	20110616 / 1225	LL	0.100	7.50	1.13
2	20110616 / 1227	LL	0.104	8.00	1.10
3	20110616 / 1230	LL	0.108	8.50	1.10
4	20110616 / 1232	LL	0.112	9.00	1.08
5	20110616 / 1235	LL	0.115	9.50	1.07
6	20110616 / 1237	LL	0.119	10.00	1.06
				Average:	1.09
				Std Dev:	0.03
				RSD:	2.4

Drop Volume, ul: 15
Temperature, °C: 24.8

PTS File No: 41270
Client: ARCADIS

PTS Laboratories

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: Spinning Drop Method - UT Model 500)

PROJECT NAME: NAO Flint, MI
PROJECT NO: B0064410.2011.00301

FLUID SYSTEM		
FLUID TYPE	FLUID ID	DENSITY, g/cc
LNAPL	12 MW-12-RFI-12-23HYDOIL-041411	0.8772
Surfactant	4.5% by (v/v) Gold Crew Release	0.9981

SPINNING DROP METHOD INTERFACIAL TENSION (IFT) DATA					
READING NO.	DATE / TIME	TECH.	DROP WIDTH, cm	PERIOD, ms/revolution	IFT, dyne/cm
1	20110616 / 1055	LL	0.090	7.50	0.825
2	20110616 / 1058	LL	0.093	8.00	0.797
3	20110616 / 1100	LL	0.096	8.50	0.779
4	20110616 / 1102	LL	0.100	9.00	0.773
5	20110616 / 1105	LL	0.104	9.50	0.774
6	20110616 / 1107	LL	0.107	10.00	0.772
				Average:	0.786
				Std Dev:	0.02
				RSD:	2.7

Drop Volume, ul: 15
Temperature, °C: 25.1

PTS File No: 41270
Client: ARCADIS

PTS Laboratories

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: Spinning Drop Method - UT Model 500)

PROJECT NAME: NAO Flint, MI
PROJECT NO: B0064410.2011.00301

FLUID SYSTEM		
FLUID TYPE	FLUID ID	DENSITY, g/cc
LNAPL	12 MW-12-RFI-12-23HYDOIL-041411	0.8763
Surfactant	6% by (v/v) Gold Crew Release	0.9977

SPINNING DROP METHOD INTERFACIAL TENSION (IFT) DATA					
READING NO.	DATE / TIME	TECH.	DROP WIDTH, cm	PERIOD, ms/revolution	IFT, dyne/cm
1	20110616 / 920	LL	0.087	7.50	0.728
2	20110616 / 922	LL	0.090	8.00	0.728
3	20110616 / 927	LL	0.094	8.50	0.729
4	20110616 / 930	LL	0.097	9.00	0.715
5	20110616 / 932	LL	0.100	9.50	0.695
6	20110616 / 937	LL	0.103	10.00	0.699
				Average:	0.716
				Std Dev:	0.02
				RSD:	2.2

Drop Volume, ul: 15
Temperature, °C: 26.0

PTS File No: 41270
Client: ARCADIS

PTS Laboratories

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: Spinning Drop Method - UT Model 500)

PROJECT NAME: NAO Flint, MI
PROJECT NO: B0064410.2011.00301

FLUID SYSTEM		
FLUID TYPE	FLUID ID	DENSITY, g/cc
LNAPL	12 MW-12-RFI-12-23HYDOIL-041411	
Surfactant	0.005% by (w/v) Ivey-sol 108	

SPINNING DROP METHOD INTERFACIAL TENSION (IFT) DATA					
READING NO.	DATE / TIME	TECH.	DROP WIDTH, cm	PERIOD, ms/revolution	IFT, dyne/cm

UNABLE TO MEASURE IFT BY SPINNING DROP TENSIOMETER, IFT OUTSIDE RANGE OF INSTRUMENT

IFT MEASURED BY DU NUOY TENSIOMETER METHOD, ASTM D971:	18.9
Average:	NA
Std Dev:	NA
RSD:	NA

Drop Volume, ul: NA
Temperature, °C: 23.6

QUALITY CONTROL DATA

PHASE PAIR:	DIWATER / AIR
TEMPERATURE, °F:	74.6
IFT, MEASURED:	72.3
IFT, PUBLISHED:	72.1
RPD:	0.16

PTS File No: 41270
Client: ARCADIS

PTS Laboratories

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: Spinning Drop Method - UT Model 500)

PROJECT NAME: NAO Flint, MI
PROJECT NO: B0064410.2011.00301

FLUID SYSTEM		
FLUID TYPE	FLUID ID	DENSITY, g/cc
LNAPL	12 MW-12-RFI-12-23HYDOIL-041411	
Surfactant	0.125% by (w/v) Ivey-sol 108	

SPINNING DROP METHOD INTERFACIAL TENSION (IFT) DATA					
READING NO.	DATE / TIME	TECH.	DROP WIDTH, cm	PERIOD, ms/revolution	IFT, dyne/cm

UNABLE TO MEASURE IFT BY SPINNING DROP TENSIOMETER, IFT OUTSIDE RANGE OF INSTRUMENT

IFT MEASURED BY DU NUOY TENSIOMETER METHOD, ASTM D971:	11.3
Average:	NA
Std Dev:	NA
RSD:	NA

Drop Volume, ul: NA
Temperature, °C: 23.7

QUALITY CONTROL DATA

PHASE PAIR:	DIWATER / AIR
TEMPERATURE, °F:	74.6
IFT, MEASURED:	72.3
IFT, PUBLISHED:	72.1
RPD:	0.16

PTS File No: 41270
Client: ARCADIS

PTS Laboratories

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: Spinning Drop Method - UT Model 500)

PROJECT NAME: NAO Flint, MI
PROJECT NO: B0064410.2011.00301

FLUID SYSTEM		
FLUID TYPE	FLUID ID	DENSITY, g/cc
LNAPL	12 MW-12-RFI-12-23HYDOIL-041411	0.8778
Surfactant	0.500% by (w/v) Ivey-sol 108	0.9974

SPINNING DROP METHOD INTERFACIAL TENSION (IFT) DATA					
READING NO.	DATE / TIME	TECH.	DROP WIDTH, cm	PERIOD, ms/revolution	IFT, dyne/cm
1	20110615 / 1300	LL	0.173	7.50	5.72
2	20110615 / 1302	LL	0.181	8.00	5.76
3	20110615 / 1305	LL	0.189	8.50	5.78
4	20110615 / 1307	LL	0.195	9.00	5.69
5	20110615 / 1310	LL	0.201	9.50	5.59
6	20110615 / 1313	LL	0.207	10.00	5.54
				Average:	5.68
				Std Dev:	0.09
				RSD:	1.7

Drop Volume, ul: 15
Temperature, °C: 24.2

PTS File No: 41270
Client: ARCADIS

PTS Laboratories

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: Spinning Drop Method - UT Model 500)

PROJECT NAME: NAO Flint, MI
PROJECT NO: B0064410.2011.00301

FLUID SYSTEM		
FLUID TYPE	FLUID ID	DENSITY, g/cc
LNAPL	12 MW-12-RFI-12-23HYDOIL-041411	0.8772
Surfactant	0.750% by (w/v) Ivey-sol 108	0.9972

SPINNING DROP METHOD INTERFACIAL TENSION (IFT) DATA					
READING NO.	DATE / TIME	TECH.	DROP WIDTH, cm	PERIOD, ms/revolution	IFT, dyne/cm
1	20110615 / 1120	LL	0.180	7.50	6.53
2	20110615 / 1122	LL	0.188	7.99	6.48
3	20110615 / 1125	LL	0.195	8.50	6.38
4	20110615 / 1127	LL	0.202	9.00	6.32
5	20110615 / 1130	LL	0.209	9.50	6.30
6	20110615 / 1133	LL	0.214	10.00	6.16
				Average:	6.36
				Std Dev:	0.13
				RSD:	2.1

Drop Volume, ul: 15
Temperature, °C: 25.2

PTS File No: 41270
Client: ARCADIS

PTS Laboratories

INTERFACIAL / SURFACE TENSION DATA

(METHODOLOGY: Spinning Drop Method - UT Model 500)

PROJECT NAME: NAO Flint, MI
PROJECT NO: B0064410.2011.00301

FLUID SYSTEM		
FLUID TYPE	FLUID ID	DENSITY, g/cc
LNAPL	12 MW-12-RFI-12-23HYDOIL-041411	0.8778
Surfactant	1.125% by (w/v) Ivey-sol 108	0.9974

SPINNING DROP METHOD INTERFACIAL TENSION (IFT) DATA					
READING NO.	DATE / TIME	TECH.	DROP WIDTH, cm	PERIOD, ms/revolution	IFT, dyne/cm
1	20110615 / 1042	LL	0.183	7.50	6.74
2	20110615 / 1045	LL	0.190	8.00	6.65
3	20110615 / 1047	LL	0.197	8.50	6.60
4	20110615 / 1050	LL	0.205	9.00	6.59
5	20110615 / 1052	LL	0.212	9.49	6.58
6	20110615 / 1055	LL	0.218	10.00	6.43
				Average:	6.60
				Std Dev:	0.10
				RSD:	1.6

Drop Volume, ul: 15
Temperature, °C: 24.7

PTS File No: 40960
Client: ARCADIS

PTS Laboratories

ENDPOINT SATURATION WATER DRIVE TEST + HOT WATER DRIVE AT 200°F: INITIAL AND RESIDUAL SATURATIONS

PROJECT NAME: Bench Scale Test
PROJECT NO: B0064410.2010.00300

		METHODS:	API RP 40		API RP 40	API RP 40, DEAN-STARK			
						PORE FLUID SATURATIONS, % Pv			
		SAMPLE	DENSITY		TOTAL	Initial Fluid Saturations		After Waterflood Test	
SAMPLE ID.	DEPTH, ft.	ORIENTATION (1)	BULK, g/cc	GRAIN, g/cc	POROSITY, %Vb	WATER (Swi) SATURATION	NAPL (Soi) SATURATION	WATER (Srw) SATURATION	NAPL (Sor) SATURATION
Water Drive Test									
LIF-12-024 (8-10')	9.35	H	1.69	2.73	38.2	85.2	5.5	85.2	5.5
	NOTE:	**No visible LNAPL produced; 13.4 pore volumes of water injected. Produced water clear with no hydrocarbon odor.**							
Water Drive at 200°F									
LIF-12-024 (8-10')	9.35	H	1.69	2.73	38.2	85.2	5.5	85.2	5.5
	NOTE:	**No visible LNAPL produced; 4.2 pore volumes of water injected. Produced water clear with no hydrocarbon odor. Test discontinued due to low permeability. Sample producing gas (volatilizing LNAPL?) during hot water drive. Sample compressed slightly from confining pressure.**							

Water drives conducted at 25 psi confining pressure and 70°F. Laboratory fresh water (tap) used as injection fluid.
N/A = Not Analyzed. Vb = Bulk Volume, Pv = Pore Volume. (1) H = horizontal, V = vertical
Soi = Initial NAPL Saturation as received prior to water flooding, Swi = Initial Water Saturation as received prior to waterflooding
Sor = Residual NAPL Saturation after waterflooding, Srw = Residual Water Saturation after waterflooding
Water =0.9996 g/cc, NAPL = 0.8600 g/cc.

PTS File No: 40960
Client: ARCADIS

PTS Laboratories

ENDPOINT SATURATION WATER DRIVE TEST + HOT WATER DRIVE AT 200°F: INITIAL AND RESIDUAL SATURATIONS

PROJECT NAME: Bench Scale Test
PROJECT NO: B0064410.2010.00300

		METHODS:	API RP 40		API RP 40	API RP 40, DEAN-STARK			
						PORE FLUID SATURATIONS, % Pv			
		SAMPLE	DENSITY		TOTAL	Initial Fluid Saturations		After Waterflood Test	
SAMPLE ID.	DEPTH, ft.	ORIENTATION (1)	BULK, g/cc	GRAIN, g/cc	POROSITY, %Vb	WATER (Swi) SATURATION	NAPL (Soi) SATURATION	WATER (Srw) SATURATION	NAPL (Sor) SATURATION
Water Drive Test									
LIF-02-018 (9-11)	10.1	H	1.73	2.68	35.6	83.8	2.1	83.8	2.1
	NOTE:	**No visible LNAPL produced; 1.7 pore volumes of water injected. Produced water clear with no hydrocarbon odor. Test discontinued due to low permeability.**							
Water Drive at 200°F									
LIF-02-018 (9-11)	10.1	H	1.73	2.68	35.6	83.8	2.1	83.8	2.1
	NOTE:	**No visible LNAPL produced; 1.7 pore volumes of water injected. Produced water clear with faint hydrocarbon odor. Sample producing gas (volatilizing LNAPL?) during hot water drive. Test discontinued due to low permeability.**							

Water drives conducted at 25 psi confining pressure and 70°F. Laboratory fresh water (tap) used as injection fluid.
N/A = Not Analyzed. Vb = Bulk Volume, Pv = Pore Volume. (1) H = horizontal, V = vertical
Soi = Initial NAPL Saturation as received prior to water flooding, Swi = Initial Water Saturation as received prior to waterflooding
Sor = Residual NAPL Saturation after waterflooding, Srw = Residual Water Saturation after waterflooding
Water =0.9996 g/cc, NAPL = 0.8600 g/cc.

PTS File No: 40960
Client: ARCADIS

PTS Laboratories

ENDPOINT SATURATION WATER DRIVE TEST + HOT WATER DRIVE AT 200°F: INITIAL AND RESIDUAL SATURATIONS

PROJECT NAME: Bench Scale Test
PROJECT NO: B0064410.2010.00300

		METHODS:	API RP 40		API RP 40	API RP 40, DEAN-STARK			
						PORE FLUID SATURATIONS, % Pv			
		SAMPLE	DENSITY		TOTAL	Initial Fluid Saturations		After Waterflood Test	
SAMPLE ID.	DEPTH, ft.	ORIENTATION (1)	BULK, g/cc	GRAIN, g/cc	POROSITY, %Vb	WATER (Swi) SATURATION	NAPL (Soi) SATURATION	WATER (Srw) SATURATION	NAPL (Sor) SATURATION
Water Drive Test									
LIF-12-010 (20-22)	21.1	H	2.07	2.72	24.1	55.5	12.4	73.6	12.4
	NOTE:	**No visible LNAPL produced; 17.6 pore volumes of water injected. Produced water clear with no hydrocarbon odor.**							
Water Drive at 200°F									
LIF-12-010 (20-22)	21.1	H	2.07	2.72	24.1	73.6	12.4	73.6	12.4
	NOTE:	**No visible LNAPL produced; 17.6 pore volumes of water injected. Produced water clear with faint hydrocarbon odor. Sample producing gas (volatilizing LNAPL?) during hot water drive.**							

Water drives conducted at 25 psi confining pressure and 70°F. Laboratory fresh water (tap) used as injection fluid.
N/A = Not Analyzed. Vb = Bulk Volume, Pv = Pore Volume. (1) H = horizontal, V = vertical
Soi = Initial NAPL Saturation as received prior to water flooding, Swi = Initial Water Saturation as received prior to waterflooding
Sor = Residual NAPL Saturation after waterflooding, Srw = Residual Water Saturation after waterflooding
Water =0.9996 g/cc, NAPL = 0.8600 g/cc.

PTS File No: 40960
Client: ARCADIS

PTS Laboratories

ENDPOINT SATURATION WATER DRIVE TEST + HOT WATER DRIVE AT 200°F: INITIAL AND RESIDUAL SATURATIONS

PROJECT NAME: Bench Scale Test
PROJECT NO: B0064410.2010.00300

		METHODS:	API RP 40		API RP 40	API RP 40, DEAN-STARK			
						PORE FLUID SATURATIONS, % Pv			
		SAMPLE	DENSITY		TOTAL	Initial Fluid Saturations		After Waterflood Test	
SAMPLE ID.	DEPTH, ft.	ORIENTATION (1)	BULK, g/cc	GRAIN, g/cc	POROSITY, %Vb	WATER (Swi) SATURATION	NAPL (Soi) SATURATION	WATER (Srw) SATURATION	NAPL (Sor) SATURATION
Water Drive Test									
LIF-16-017 (12-14)	12.9	H	1.91	2.70	29.4	60.5	21.4	68.3	21.4
	NOTE:	**No visible LNAPL produced; 2.2 pore volumes of water injected. Produced water clear with no hydrocarbon odor. Test discontinued due to low permeability.**							
Water Drive at 200°F									
LIF-16-017 (12-14)	12.9	H	1.91	2.70	29.4	68.3	21.4	68.3	21.4
	NOTE:	**No visible LNAPL produced; 3.3 pore volumes of water injected. Produced water clear with no hydrocarbon odor changing to pale yellow with no hydrocarbon odor. Sample producing gas (volatilizing LNAPL?) during hot water drive. Test discontinued due to low permeability.**							

Water drives conducted at 25 psi confining pressure and 70°F. Laboratory fresh water (tap) used as injection fluid.
N/A = Not Analyzed. Vb = Bulk Volume, Pv = Pore Volume. (1) H = horizontal, V = vertical
Soi = Initial NAPL Saturation as received prior to water flooding, Swi = Initial Water Saturation as received prior to waterflooding
Sor = Residual NAPL Saturation after waterflooding, Srw = Residual Water Saturation after waterflooding
Water =0.9996 g/cc, NAPL = 0.8600 g/cc.

PTS File No: 40960
Client: ARCADIS

PTS Laboratories

ENDPOINT SATURATION WATER DRIVE TEST + HOT WATER DRIVE AT 200°F: INITIAL AND RESIDUAL SATURATIONS

PROJECT NAME: Bench Scale Test
PROJECT NO: B0064410.2010.00300

		METHODS:	API RP 40		API RP 40	API RP 40, DEAN-STARK			
						PORE FLUID SATURATIONS, % Pv			
		SAMPLE	DENSITY		TOTAL	Initial Fluid Saturations		After Waterflood Test	
SAMPLE ID.	DEPTH, ft.	ORIENTATION (1)	BULK, g/cc	GRAIN, g/cc	POROSITY, %Vb	WATER (Swi) SATURATION	NAPL (Soi) SATURATION	WATER (Srw) SATURATION	NAPL (Sor) SATURATION
Water Drive Test									
LIF-40-011 (9-11)	10.2	H	1.69	2.73	38.2	88.5	3.2	89.8	3.2
	NOTE:	**No visible LNAPL produced; 3.6 pore volumes of water injected. Produced water clear with no hydrocarbon odor. Test discontinued due to low permeability.**							
Water Drive at 200°F									
LIF-40-011 (9-11)	10.2	H	1.69	2.73	38.2	89.8	3.2	89.8	3.2
	NOTE:	**No visible LNAPL produced; 2.6 pore volumes of water injected. Produced water clear with no hydrocarbon odor. Sample producing gas (volatilizing LNAPL?) during hot water drive. Test discontinued due to low permeability.**							

Water drives conducted at 25 psi confining pressure and 70°F. Laboratory fresh water (tap) used as injection fluid.
N/A = Not Analyzed. Vb = Bulk Volume, Pv = Pore Volume. (1) H = horizontal, V = vertical
Soi = Initial NAPL Saturation as received prior to water flooding, Swi = Initial Water Saturation as received prior to waterflooding
Sor = Residual NAPL Saturation after waterflooding, Srw = Residual Water Saturation after waterflooding
Water =0.9996 g/cc, NAPL = 0.8600 g/cc.

PTS File No: 40960
Client: ARCADIS

PTS Laboratories

ENDPOINT SATURATION WATER DRIVE TEST + HOT WATER DRIVE AT 200°F: INITIAL AND RESIDUAL SATURATIONS

PROJECT NAME: Bench Scale Test
PROJECT NO: B0064410.2010.00300

		METHODS:	API RP 40		API RP 40	API RP 40, DEAN-STARK			
						PORE FLUID SATURATIONS, % Pv			
		SAMPLE	DENSITY		TOTAL	Initial Fluid Saturations		After Waterflood Test	
SAMPLE ID.	DEPTH, ft.	ORIENTATION (1)	BULK, g/cc	GRAIN, g/cc	POROSITY, %Vb	WATER (Swi) SATURATION	NAPL (Soi) SATURATION	WATER (Srw) SATURATION	NAPL (Sor) SATURATION
Water Drive Test									
LIF-40-004 (26-28)	27.3	H	1.60	2.68	40.4	54.8	12.0	54.8	12.0
	NOTE:	**No visible LNAPL produced; 10.4 pore volumes of water injected. Produced water clear with moderate hydrocarbon odor.**							
Water Drive at 200°F									
LIF-40-004 (26-28)	27.3	H	1.60	2.68	40.4	54.8	12.0	54.8	10.7
	NOTE:	**Clear with very light brown tint LNAPL produced; 10.4 pore volumes of water injected. Produced water clear with moderate hydrocarbon odor. Sample producing gas (volatilizing LNAPL?) during hot water drive. Sample compressed slightly from confining pressure.**							

Water drives conducted at 25 psi confining pressure and 70°F. Laboratory fresh water (tap) used as injection fluid.
N/A = Not Analyzed. Vb = Bulk Volume, Pv = Pore Volume. (1) H = horizontal, V = vertical
Soi = Initial NAPL Saturation as received prior to water flooding, Swi = Initial Water Saturation as received prior to waterflooding
Sor = Residual NAPL Saturation after waterflooding, Srw = Residual Water Saturation after waterflooding
Water =0.9996 g/cc, NAPL = 0.8600 g/cc.

PTS File No: 40960
Client: ARCADIS

PTS Laboratories

ENDPOINT SATURATION WATER DRIVE TEST + SURFACTANT DRIVE: INITIAL AND RESIDUAL SATURATIONS

PROJECT NAME: Bench Scale Test
PROJECT NO: B0064410.2010.00300

		METHODS:	API RP 40		API RP 40	API RP 40, DEAN-STARK			
						PORE FLUID SATURATIONS, % Pv			
		SAMPLE	DENSITY		TOTAL	Initial Fluid Saturations		After Waterflood Test	
SAMPLE ID.	DEPTH, ft.	ORIENTATION (1)	BULK, g/cc	GRAIN, g/cc	POROSITY, %Vb	WATER (Swi) SATURATION	NAPL (Soi) SATURATION	WATER (Srw) SATURATION	NAPL (Sor) SATURATION
Water Drive Test									
LIF-02-007 (8-10')	10.1	H	1.73	2.65	34.6	70.2	14.4	83.0	14.4
	NOTE:	**No visible LNAPL produced; 13.0 pore volumes of water injected. Produced water clear with no hydrocarbon odor.**							
Surfactant Drive									
LIF-02-007 (8-10')	10.1	H	1.73	2.65	34.6	83.0	14.4	83.0	14.4
	NOTE:	**No visible LNAPL produced; 2.0 pore volumes of water injected. Produced water clear with no hydrocarbon odor.**							
		No visible surfactant breakthrough. Test discontinued due to low permeability.							

Surfactant injection used 50:50 blend of AOI-12MW-RFI-12-33GW041411 and AOI-40RFI-40-14RGW041411 with Aerosol OT at 3% by weight.
Water drives conducted at 25 psi confining pressure and 70°F. Laboratory fresh water (tap) used as injection fluid.
N/A = Not Analyzed. Vb = Bulk Volume, Pv = Pore Volume. (1) H = horizontal, V = vertical
Soi = Initial NAPL Saturation as received prior to water flooding, Swi = Initial Water Saturation as received prior to waterflooding
Sor = Residual NAPL Saturation after waterflooding, Srw = Residual Water Saturation after waterflooding
Water =0.9996 g/cc, NAPL = 0.8600 g/cc.

PTS File No: 40960
Client: ARCADIS

PTS Laboratories

ENDPOINT SATURATION WATER DRIVE TEST + SURFACTANT DRIVE: INITIAL AND RESIDUAL SATURATIONS

PROJECT NAME: Bench Scale Test
PROJECT NO: B0064410.2010.00300

		METHODS:	API RP 40		API RP 40	API RP 40, DEAN-STARK			
						PORE FLUID SATURATIONS, % Pv			
		SAMPLE	DENSITY		TOTAL	Initial Fluid Saturations		After Waterflood Test	
SAMPLE ID.	DEPTH, ft.	ORIENTATION (1)	BULK, g/cc	GRAIN, g/cc	POROSITY, %Vb	WATER (Swi) SATURATION	NAPL (Soi) SATURATION	WATER (Srw) SATURATION	NAPL (Sor) SATURATION
Water Drive Test									
LIF-12-018 (10-12')	11.7	H	1.88	2.72	30.9	78.1	8.7	88.4	8.7
	NOTE:	**No visible LNAPL produced; 11.1 pore volumes of water injected. Produced water slightly cloudy with no hydrocarbon odor.**							
Surfactant Drive									
LIF-12-018 (10-12')	11.7	H	1.88	2.72	30.9	88.4	8.7	88.4	8.7
	NOTE:	**No visible LNAPL produced; 1.6 pore volumes of water injected. Produced water slightly cloudy with no hydrocarbon odor.**							
		No visible surfactant breakthrough. Test discontinued due to low permeability.							

Surfactant injection used 50:50 blend of AOI-12MW-RFI-12-33GW041411 and AOI-40RFI-40-14RGW041411 with Aerosol OT at 3% by weight.
Water drives conducted at 25 psi confining pressure and 70°F. Laboratory fresh water (tap) used as injection fluid.
N/A = Not Analyzed. Vb = Bulk Volume, Pv = Pore Volume. (1) H = horizontal, V = vertical
Soi = Initial NAPL Saturation as received prior to water flooding, Swi = Initial Water Saturation as received prior to waterflooding
Sor = Residual NAPL Saturation after waterflooding, Srw = Residual Water Saturation after waterflooding
Water =0.9996 g/cc, NAPL = 0.8600 g/cc.

PTS File No: 40960
Client: ARCADIS

PTS Laboratories

ENDPOINT SATURATION WATER DRIVE TEST + SURFACTANT DRIVE: INITIAL AND RESIDUAL SATURATIONS

PROJECT NAME: Bench Scale Test
PROJECT NO: B0064410.2010.00300

		METHODS:	API RP 40		API RP 40	API RP 40, DEAN-STARK			
						PORE FLUID SATURATIONS, % Pv			
		SAMPLE	DENSITY		TOTAL	Initial Fluid Saturations		After Waterflood Test	
SAMPLE ID.	DEPTH, ft.	ORIENTATION (1)	BULK, g/cc	GRAIN, g/cc	POROSITY, %Vb	WATER (Swi) SATURATION	NAPL (Soi) SATURATION	WATER (Srw) SATURATION	NAPL (Sor) SATURATION
Water Drive Test									
LIF-12-010 (20-22)	20.65	H	2.06	2.70	23.6	68.0	10.3	82.1	10.3
	NOTE:	**No visible LNAPL produced; 18.0 pore volumes of water injected. Produced water clear with no hydrocarbon odor.**							
Surfactant Drive									
LIF-12-010 (20-22)	20.65	H	2.06	2.70	23.6	82.1	10.3	82.1	10.3
	NOTE:	**No visible LNAPL produced; 7.3 pore volumes of water injected. Produced water cloudy with surfactant odor.**							
		Flow shut off due to surfactant plugging at approximately seven pore volumes of throughput, test discontinued.							

Surfactant injection used laboratory fresh water (filtered tap water) with Aerosol OT at 2% by weight.
Water drives conducted at 25 psi confining pressure and 70°F. Laboratory fresh water (tap) used as injection fluid.
N/A = Not Analyzed. Vb = Bulk Volume, Pv = Pore Volume. (1) H = horizontal, V = vertical
Soi = Initial NAPL Saturation as received prior to water flooding, Swi = Initial Water Saturation as received prior to waterflooding
Sor = Residual NAPL Saturation after waterflooding, Srw = Residual Water Saturation after waterflooding
Water =0.9996 g/cc, NAPL = 0.8600 g/cc.

PTS File No: 40960
Client: ARCADIS

PTS Laboratories

ENDPOINT SATURATION WATER DRIVE TEST + SURFACTANT DRIVE: INITIAL AND RESIDUAL SATURATIONS

PROJECT NAME: Bench Scale Test
PROJECT NO: B0064410.2010.00300

		METHODS:	API RP 40		API RP 40	API RP 40, DEAN-STARK			
						PORE FLUID SATURATIONS, % Pv			
		SAMPLE	DENSITY		TOTAL	Initial Fluid Saturations		After Waterflood Test	
SAMPLE ID.	DEPTH, ft.	ORIENTATION (1)	BULK, g/cc	GRAIN, g/cc	POROSITY, %Vb	WATER (Swi) SATURATION	NAPL (Soi) SATURATION	WATER (Srw) SATURATION	NAPL (Sor) SATURATION
Water Drive Test									
LIF-16-017 (12-14)	13.1	H	1.97	2.74	28.2	66.2	20.5	66.2	20.5
	NOTE:	**No visible LNAPL produced; 4.3 pore volumes of water injected. Produced water clear with no hydrocarbon odor.**							
Surfactant Drive									
LIF-16-017 (12-14)	13.1	H	1.97	2.74	28.2	66.2	20.5	66.2	20.5
	NOTE:	**No visible LNAPL produced; 1.4 pore volumes of water injected. Produced water clear with no hydrocarbon odor.**							
		No visible surfactant breakthrough. Test discontinued due to low permeability.							
		Sample compressed slightly from confining pressure.							

Surfactant injection used laboratory fresh water (filtered tap water) with Aerosol OT at 2% by weight.
Water drives conducted at 25 psi confining pressure and 70°F. Laboratory fresh water (tap) used as injection fluid.
N/A = Not Analyzed. Vb = Bulk Volume, Pv = Pore Volume. (1) H = horizontal, V = vertical
Soi = Initial NAPL Saturation as received prior to water flooding, Swi = Initial Water Saturation as received prior to waterflooding
Sor = Residual NAPL Saturation after waterflooding, Srw = Residual Water Saturation after waterflooding
Water =0.9996 g/cc, NAPL = 0.8600 g/cc.

PTS File No: 40960
Client: ARCADIS

PTS Laboratories

ENDPOINT SATURATION WATER DRIVE TEST + SURFACTANT DRIVE: INITIAL AND RESIDUAL SATURATIONS

PROJECT NAME: Bench Scale Test
PROJECT NO: B0064410.2010.00300

		METHODS:	API RP 40		API RP 40	API RP 40, DEAN-STARK			
						PORE FLUID SATURATIONS, % Pv			
		SAMPLE	DENSITY		TOTAL	Initial Fluid Saturations		After Waterflood Test	
SAMPLE ID.	DEPTH, ft.	ORIENTATION (1)	BULK, g/cc	GRAIN, g/cc	POROSITY, %Vb	WATER (Swi) SATURATION	NAPL (Soi) SATURATION	WATER (Srw) SATURATION	NAPL (Sor) SATURATION
Water Drive Test									
LIF-40-011 (9-11)	10.0	H	1.74	2.72	35.9	76.7	10.0	87.0	10.0
	NOTE:	**No visible LNAPL produced; 7.3 pore volumes of water injected. Produced water clear with no hydrocarbon odor.**							
Surfactant Drive									
LIF-40-011 (9-11)	10.0	H	1.74	2.72	35.9	87.0	10.0	87.0	10.0
	NOTE:	**No visible LNAPL produced; 2.2 pore volumes of water injected. Produced water cloudy with visible surfactant and odor. Surfactant breakthrough at approximately one pore volume of throughput. Test discontinued due to low permeability.**							

Surfactant injection used laboratory fresh water (filtered tap water) with Aerosol OT at 2% by weight.
Water drives conducted at 25 psi confining pressure and 70°F. Laboratory fresh water (tap) used as injection fluid.
N/A = Not Analyzed. Vb = Bulk Volume, Pv = Pore Volume. (1) H = horizontal, V = vertical
Soi = Initial NAPL Saturation as received prior to water flooding, Swi = Initial Water Saturation as received prior to waterflooding
Sor = Residual NAPL Saturation after waterflooding, Srw = Residual Water Saturation after waterflooding
Water =0.9996 g/cc, NAPL = 0.8600 g/cc.

PTS File No: 40960
Client: ARCADIS

PTS Laboratories

ENDPOINT SATURATION WATER DRIVE TEST + SURFACTANT DRIVE: INITIAL AND RESIDUAL SATURATIONS

PROJECT NAME: Bench Scale Test
PROJECT NO: B0064410.2010.00300

		METHODS:	API RP 40		API RP 40	API RP 40, DEAN-STARK			
						PORE FLUID SATURATIONS, % Pv			
		SAMPLE	DENSITY		TOTAL	Initial Fluid Saturations		After Waterflood Test	
SAMPLE ID.	DEPTH, ft.	ORIENTATION (1)	BULK, g/cc	GRAIN, g/cc	POROSITY, %Vb	WATER (Swi) SATURATION	NAPL (Soi) SATURATION	WATER (Srw) SATURATION	NAPL (Sor) SATURATION
Water Drive Test									
LIF-40-004 (26-28)	27.1	H	1.70	2.72	37.6	63.7	20.1	73.3	20.1
	NOTE:	**No visible LNAPL produced; 12.0 pore volumes of water injected. Produced water clear with moderate hydrocarbon odor.**							
Surfactant Drive									
LIF-40-004 (26-28)	27.1	H	1.70	2.72	37.6	73.3	20.1	85.8	7.6
	NOTE:	**Light brown LNAPL plus brown emulsion produced (see images); 12.0 pore volumes of water injected. Sample compressed slightly from confining pressure.**							

Surfactant injection used 50:50 blend of AOI-12MW-RFI-12-33GW041411 and AOI-40RFI-40-14RGW041411 with Aerosol OT at 2% by weight.
Water drives conducted at 25 psi confining pressure and 70°F. Laboratory fresh water (tap) used as injection fluid.
N/A = Not Analyzed. Vb = Bulk Volume, Pv = Pore Volume. (1) H = horizontal, V = vertical
Soi = Initial NAPL Saturation as received prior to water flooding, Swi = Initial Water Saturation as received prior to waterflooding
Sor = Residual NAPL Saturation after waterflooding, Srw = Residual Water Saturation after waterflooding
Water =0.9996 g/cc, NAPL = 0.8600 g/cc.


05/30/2007


05/30/2007


409
27.1 D H
05/30/2007


PTS Laboratories, Inc.
Job Number: 41270
Client: ARCADIS
Sample ID: Ground water with 3% Aerosol
Prepared By:
Preparation Date: 8/9/11
Expiration Date: 9/9/11
09/09/2011

08/19/2011

ARCADIS

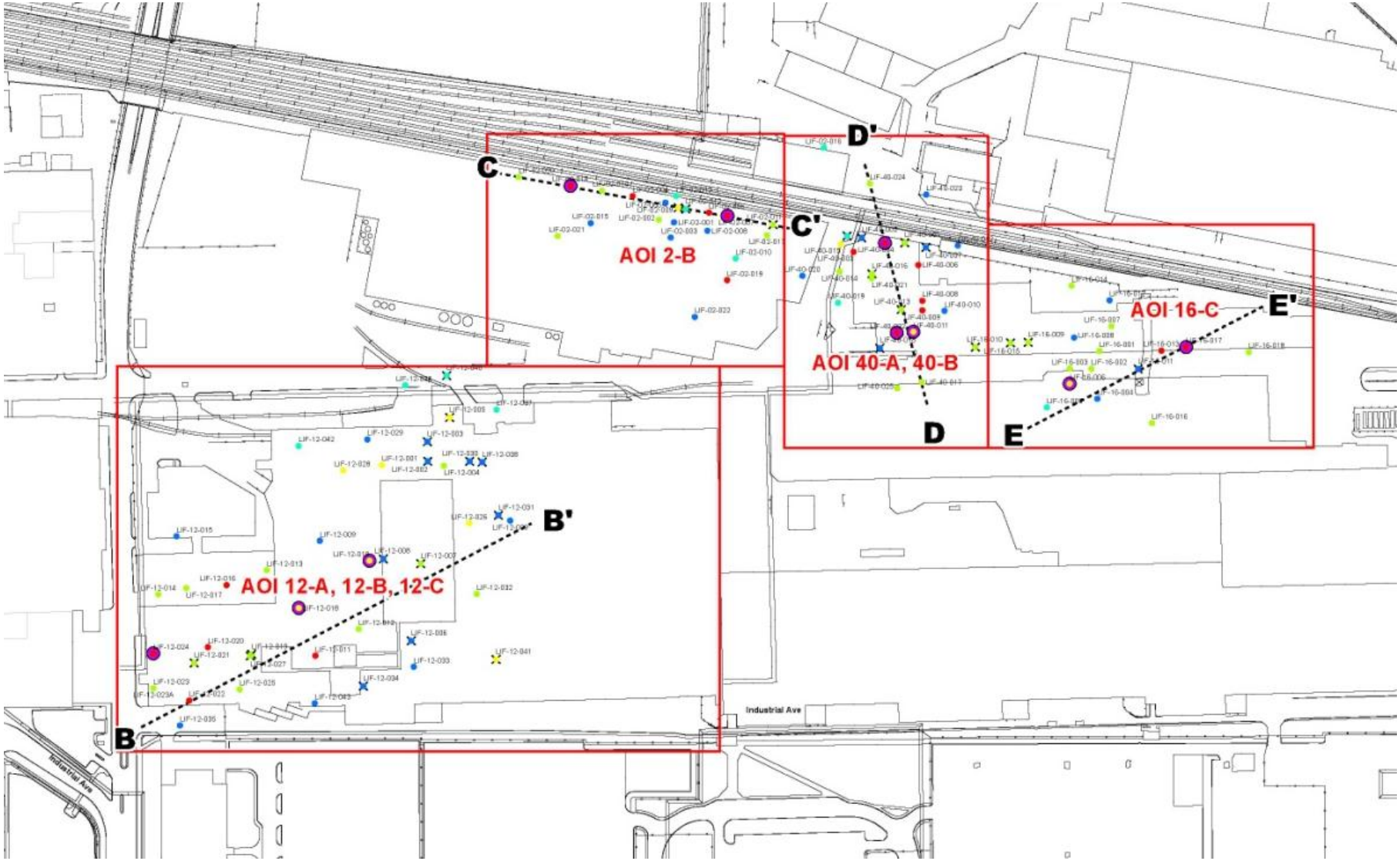
Appendix **B**

Petrophysical Testing Program and Laboratory Reports.

Southend Bench-Scale Testing

MLC –Buick City

Southend Site Plan

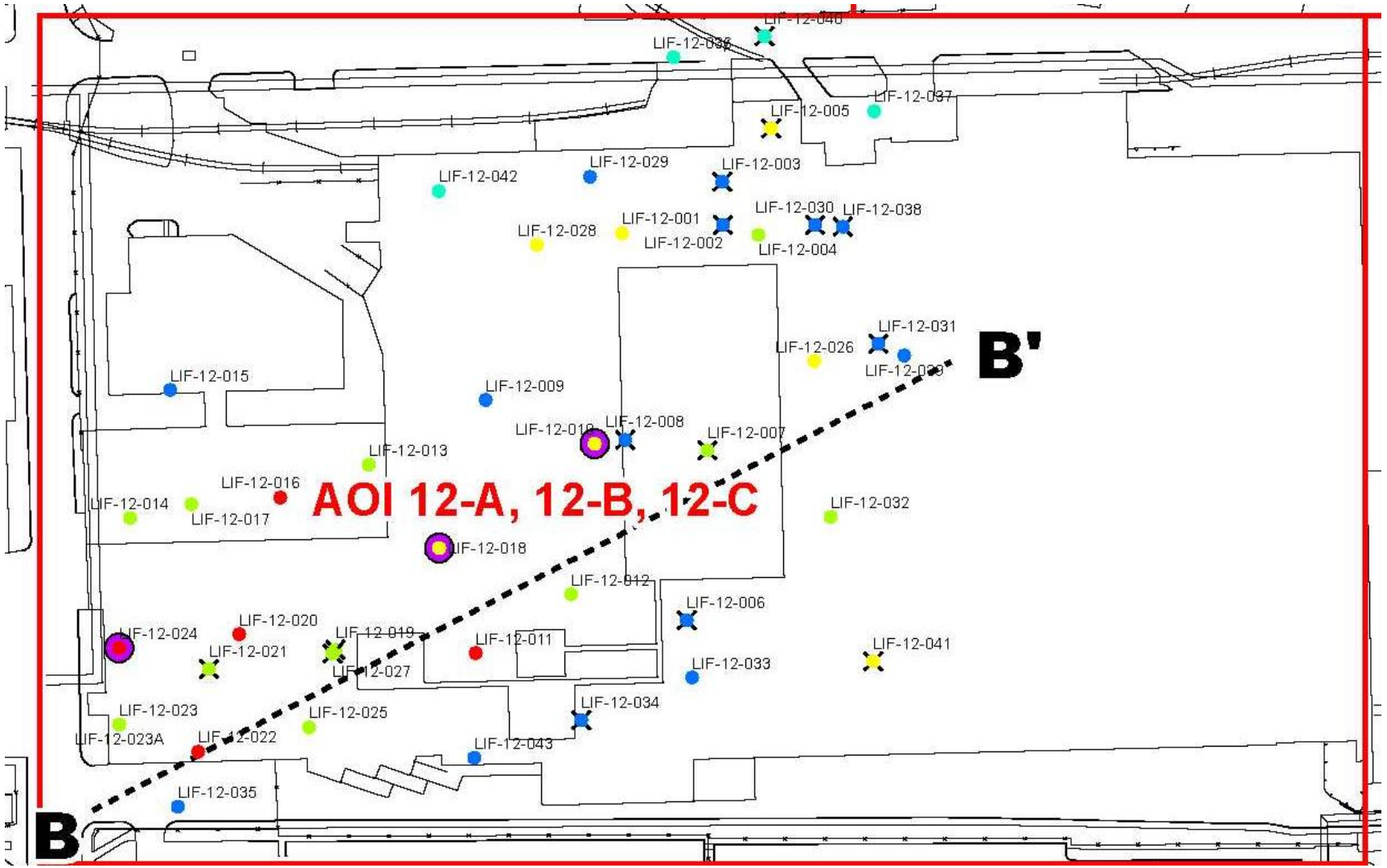


Summary Table

LIF [1] ID	Maximum TFI [2]	Core Start	Core End	Core Retreived	Fuel Type	Test Locations			
						ARCADIS Treatability Lab	RSWD	Surfactant Flush	Hot Water Flood
LIF-12-024	514	8	11	8-10.25	Hydraulic Oil		9.25-9.45		x
		15.5	17.5	--					
		22	24	22.5-23.7					
LIF-12-018	157	8	10	8-9.5					
		10	12	10-12		11.1- 11.6	11.6-11.8	x	
LIF-12-010	177	18	20	18-19.425		18.5-19			
		20	22	20-21.6			20.55-20.75	x	
							21.0-21.2		x
LIF-02-007	312	8	10.3	8-10.3			10-10.2	x	
		10	12	10-10.5		NOT TO BE USED			
LIF-02-018	336	7	9	7-8.25					
		9	11	9-10.6			10-10.2		x
LIF-40-004	247	6.5	8.5	--	Fuel Oil				
		9	11	9-10.2					
		26	28	26-27.8		26.5-27	27-27.2	x	
							27.2-27.4		x
LIF-40-011	410	9	11	9-10.85			9.9-10.1	x	
							10.1-10.3		x
		14	16	14.5-15.2					
		15	17	15.5-16.9					
LIF-40-022	410	18	20	18-19.05					
		20	22	20-21.5					
LIF-16-017	220	12	14	12-14		13.2-13.7	12.8-13		x
							13-13.2	x	
		21	23	21.5-22.65					
		23	25	23-24.4					
LIF-16-006	196	11	13.1	11.5-13.1					
		13.3	16	13.5-15.3					

AOI 12
Cross Section
and
Core Photos/Phase 1 Testing

LIF-12-010 (AOI 12-A/12-B)
LIF-12-018 (AOI 12-A)
LIF-12-024 (AOI 12-C)


LEGEND
LASER INDUCED FLUORESCENCE RESPONSE (%RE)
COMPLETED BORINGS
<5
5 -10
10 - 100
100 - 200
>200
REFUSAL BORINGS
<5
5 -10
10 - 100
100 - 200
>200
CORE LOCATION
SECTION PATH
AOI INVESTIGATION AREA
LIF-12-040
LIF-12-036
LIF-12-037
LIF-12-005
LIF-12-042
LIF-12-029
LIF-12-003
LIF-12-030
LIF-12-038
LIF-12-028
LIF-12-001
LIF-12-002
LIF-12-004
LIF-12-031
LIF-12-026
LIF-12-039
B'
LIF-12-015
LIF-12-009
LIF-12-010
LIF-12-008
LIF-12-007
LIF-12-013
LIF-12-016
AOI 12-A, 12-B, 12-C
LIF-12-014
LIF-12-017
LIF-12-032
LIF-12-018
LIF-12-012
LIF-12-006
LIF-12-024
LIF-12-020
LIF-12-019
LIF-12-021
LIF-12-011
LIF-12-041
LIF-12-027
LIF-12-033
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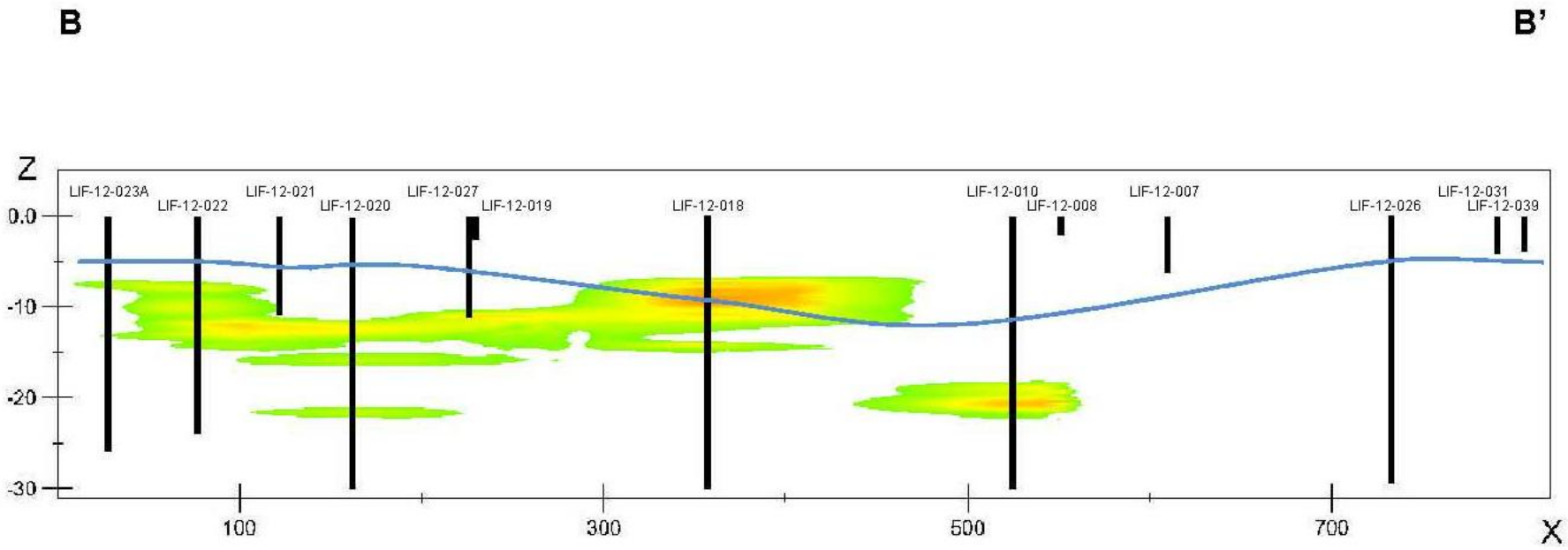
LIF-12-035
B



LEGEND

LIF RESPONSE

1000%

5%

Approximate Groundwater Elevation

NOTE:
Cross section exported from three-dimensional model and represents a two-dimensional projection of the displayed data.

Revitalizing Auto Communities Environmental Response Trust
NAP Flint Operations Site – Flint, MI
CMI Annual Report

LIF SOIL PROBE CROSS SECTION
AOI 12-A, 12-B, and 12-C

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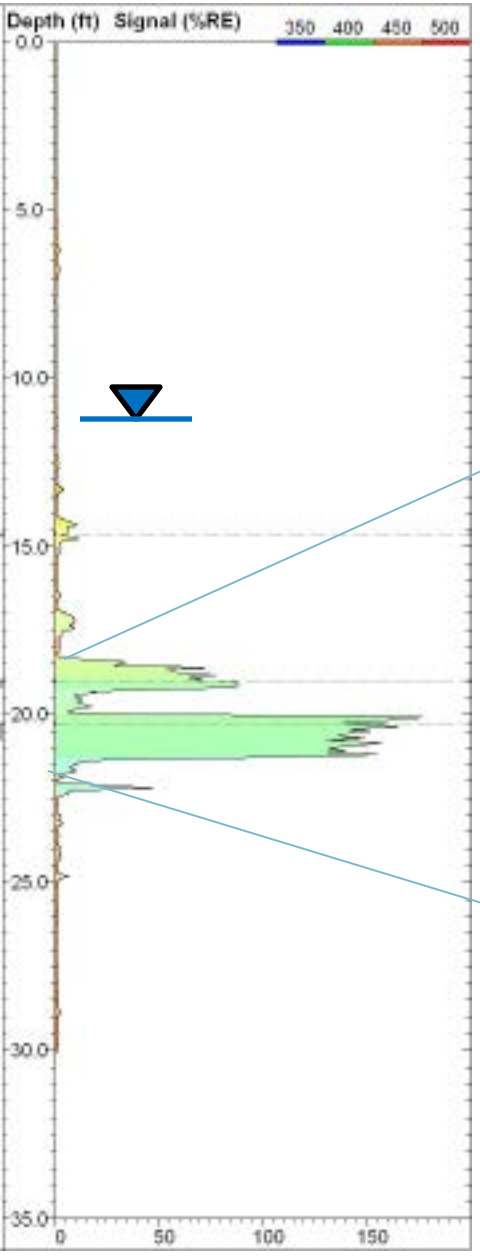
FIGURE
4

LIF-12-010
8/12/2010



LIF-12-010
12/16/2010

Date Start/Finish: 12/16/10
Drilling Company: Mateco Drilling
Driller's Name: Gary Swift
Drilling Method: HSA
Sampling Method: Split Spoon
Rig Type: NA

Northing: NA
Easting: NA
Casing Elevation: NA

Borehole Depth: 22'
Surface Elevation: NA

Descriptions By: M. Reightler

Well/Boring ID: LIF-12-010
Client: Motors Liquidation Company
Location: MLC Buick City
Flint, Michigan

DEPTH / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	Blow Count	Geologic Column	Stratigraphic Description	Well/Boring Construction
						CONCRETE	Well casing, 4" PVC
						HAND AUGER	
	1	0-5	5.0				
-5	2	5-7	1.16	4 4 4 4		SAND; medium to coarse, subrounded, trace silt, poorly sorted; moist, black.	Bentonite Pellets (3.5-6' bgs.)
						SAND; medium to coarse, subangular, little silt, poorly sorted; moist, light brown.	
						SAND; medium to coarse, some large pebble, poorly sorted; moist, light grey.	
	3	7-9	1.5	3 6 9 10		SAND; fine to medium, trace coarse, subangular, some silt, poorly sorted; moist, dark brownish black.	
						NOTE: light brown, less moist at 8.1' bgs.	
-10	4	9-11	1.46	3 9 4 6		CLAY; low plasticity, no dilatancy, some silt, trace large pebble; dry, dark gray.	
						SAND; fine to medium, trace coarse, subangular, some silt, poorly sorted; moist, dark brownish black.	
	5	11-13	1.5	3 3 5 5		CLAY; low plasticity, no dilatancy, trace silt, medium stiff to stiff; dry, grayish brown.	Sand Pack
	6	13-15	1.33	3 3 3 3		NOTE: low to medium plasticity, slow dilatancy; wet, soft to medium stiff at 12' bgs.	4" S.S. Well Screen Sch 304 30 Slot (8-18' bgs)
-15						NOTE: trace fine sand at 13' bgs.	
						NOTE: trace granule at 14.5' bgs.	
	7	15-17	1.5	3 3 2 3		NOTE: some silt, medium plasticlyt; wet, soft, gray at 17' bgs.	
	8	17-18	0.833	9 9		SAND; fine to coarse, subangular, some silt, trace clay, poorly sorted; wet, dark grey.	
				9 11 11 50		Shelby core collection. NOTE: unable to collect from 18-20' bgs.	
-20	9	18-22	1.16			SAND; fine to coarse, little silt, trace granule, subangular, poorly sorted; moist, gray.	
						End of boring at 22' bgs.	

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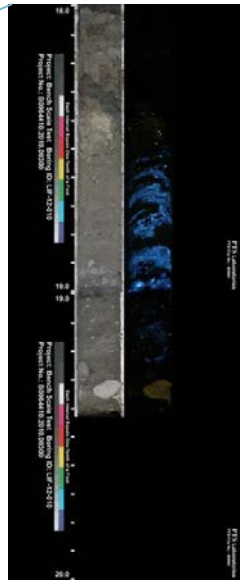
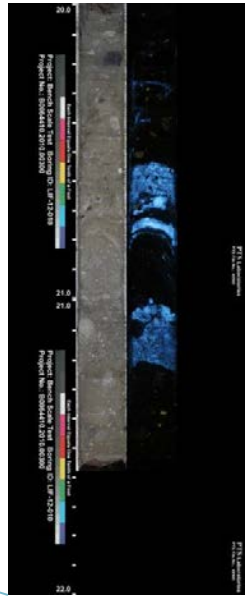
Remarks: bgs = below ground surface

Soil sample collected at 20-22' bgs for laboratory analysis. Unable to collect shelby tube sample from 18-20'
Groundwater encountered at 12' bgs
No odor observed

LIF-12-010
1/24/2011



18'

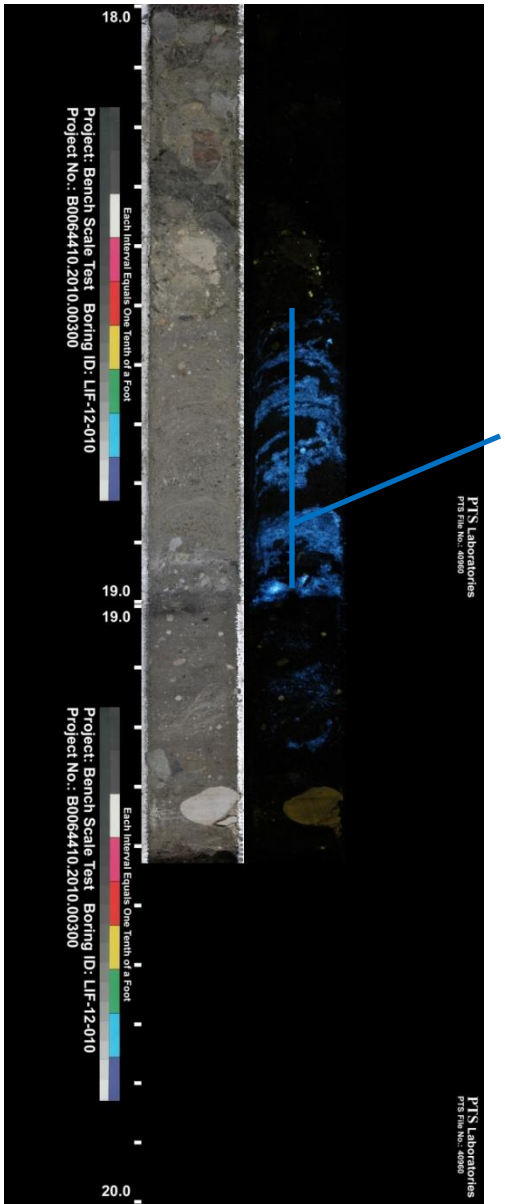


20'

22'

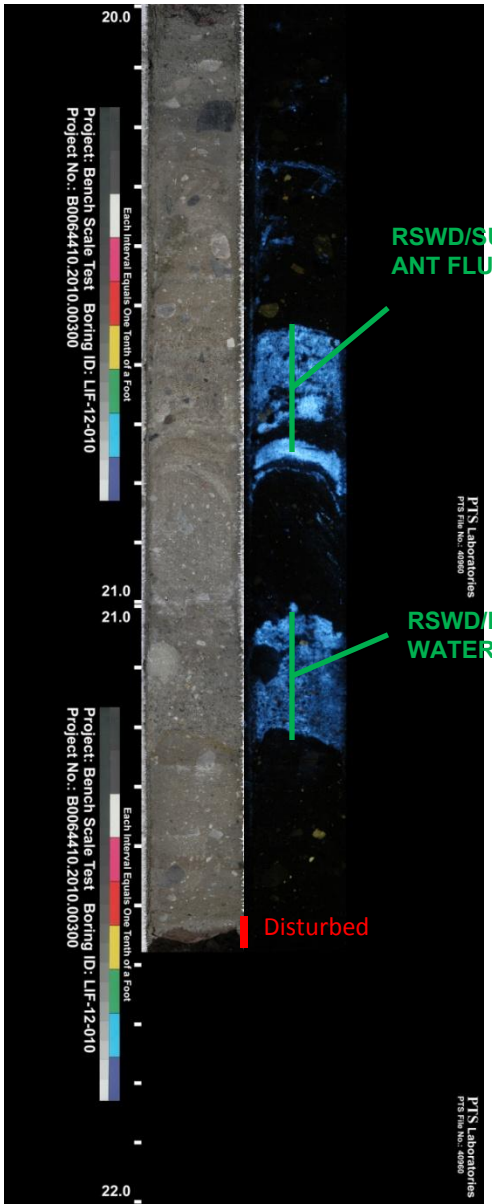
LIF-12-010
1/24/2011

18-20’



Thermally Enhanced Recovery by Heating Element (ARCADIS)

20-22’

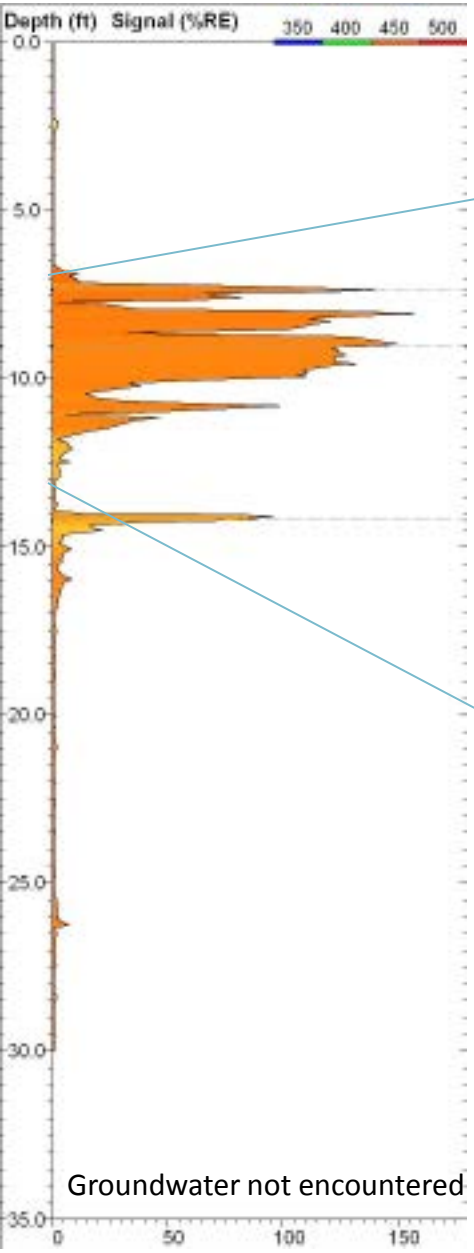


RSWD/SURFACTANT FLUSH

RSWD/HOT WATER FLOOD

Disturbed

LIF-12-018
8/12/2010



Groundwater not encountered

LIF-12-018
12/14/2010

Date Start/Finish: 12/15/10
Drilling Company: Mateco Drilling
Driller's Name: Gary Swift
Drilling Method: HSA
Sampling Method: Split Spoon, Shelby tube
Rig Type: NA

Northing: NA
Easting: NA
Casing Elevation: NA

Borehole Depth: 20"
Surface Elevation: NA

Descriptions By: M. Reightler

Well/Boring ID: LIF-12-018
Client: Motors Liquidation Company
Location: MLC Buick City
Flint, Michigan

DEPTH / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	Blow Count	Geologic Column	Stratigraphic Description	Well/Boring Construction
0						CONCRETE	Well casing, 4" PVC
	1	0-5	5.0			HAND AUGER	Bentonite Pellets (3.5-6' bgs.)
-5	2	5-7	2	4 4 5 5		SILT; low to medium plasticity, no dilatancy, some clay, trace very fine to fine sand; dry, soft, dark yellowish brown. NOTE: trace medium to coarse sand at 6.5' bgs.	
	3	7-8	1.25	3 5		SAND; fine to coarse, subangular, well sorted; dry, dark brownish gray.	
						SAND; coarse, subangular, trace gravel, well sorted; dry, dark grayish black.	
						CLAY; no to low plasticity, no diatancy, trace silt; dry, gray to brown.	
-10	4	8-12				Shelby tube collection.	
						CLAY; low plasticity, no dilatancy, some silt, trace fine sand; dry, stiff, dark grayish brown.	Sand Pack
	5	12-14	2	4 6 6 7		CLAY; low to medium plasticity, no dilatancy, little silt, ; moist, stiff to medium stiff, dary gray. NOTE: petroleum sheen at 14.5' bgs. NOTE: slow dilatancy; moist, soft from 13.2-14' bgs.	4" S.S. Well Screen Sch 304 30 Slot (8-18' bgs)
-15	6	14-16	1.58	6 6 6 6			
	7	16-18	1.75	7 13 15 13		SILT; low plasticity, no dilatancy, little clay, trace very fine sand; dry, light gray. NOTE: 1" wet seam at 16' bgs.	
	8	18-20	2	13 20 20 20			
-20						End of boring at 20' bgs.	

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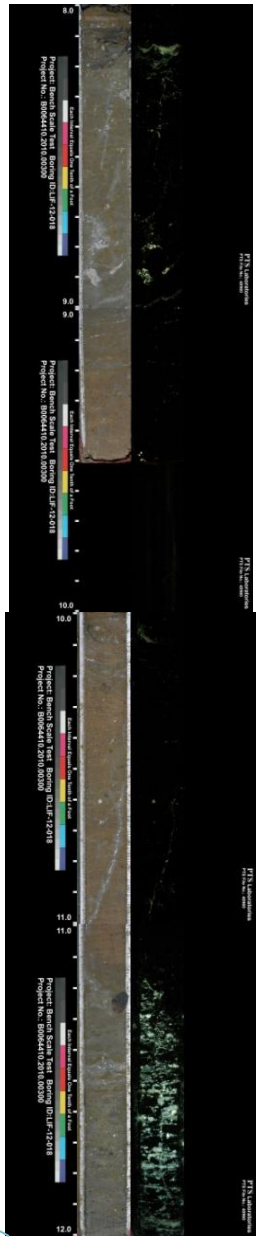
Remarks: bgs = below ground surface

Soil samples collected at 8-10' and 10-12' bgs for laboratory analysis.
Groundwater not encountered
No odor or staining observed

LIF-12-018
1/24/2011



8'

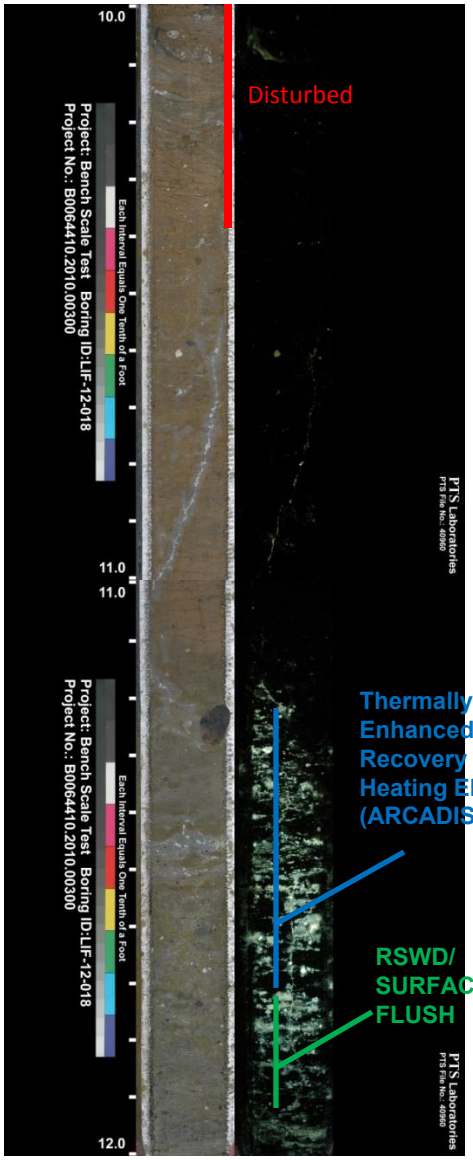
10'

12'

LIF-12-018
1/24/2011

8-10’

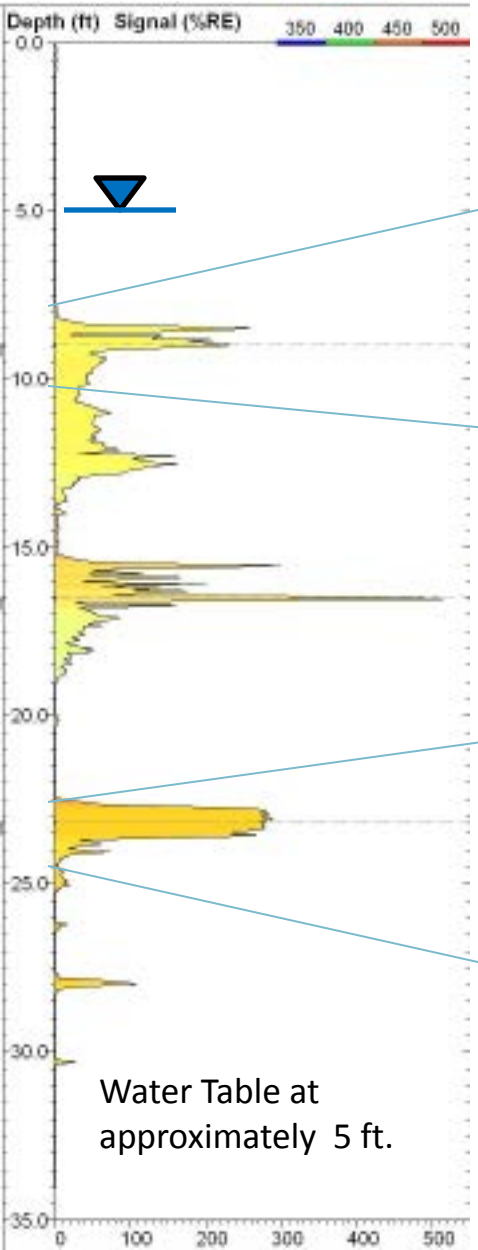
10-12’



LIF-12-024
8/12/2010

LIF-12-024
12/14/2010

LIF-12-024 Photo
1/24/2011



Water Table at approximately 5 ft.

Date Start/Finish: 12/14/10
Drilling Company: Mateco Drilling
Driller's Name: Gary Swift
Drilling Method: HSA
Sampling Method: Split Spoon, Shelby tube
Rig Type: NA

Northing: NA
Easting: NA
Casing Elevation: NA

Borehole Depth: 21'
Surface Elevation: NA

Descriptions By: M. Reightler

Well/Boring ID: LIF-12-24
Client: Motors Liquidation Company
Location: MLC Buick City
Flint, Michigan

DEPTH ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	Blow Count	Geologic Column	Stratigraphic Description	Well/Boring Construction
						HAND AUGER	
	1	0-5	5.0				
-5						SAND; fine to medium, subrounded, some silt, well-sorted; wet, black, odor.	Well casing, 4" PVC
	2	5-8	2.0			SILT; low plasticity, rapid dilatancy, some sand; wet, very soft, black to dark brown, odor - NAPL.	Bentonite Pellets (3.5-6' bgs.)
						CLAY; medium plasticity, slow dilatancy, trace silt; moist, medium to stiff, dark gray, odor - NAPL.	
						SAND; medium to coarse, trace granule, subangular; well sorted; moist, dark yellowish brown.	
						Shelby tube collection.	
-10						No recovery.	
	3	10-12	0.66	2 2 4 4		CLAY; high plasticity, low dilatancy, some silt, trace fine sand; dry, medium stiff, dark brown. NOTE: layer of fine to medium sand.	
	4	12-14	2.0	8 6 6 6		CLAY; medium plasticity, no dilatancy, trace silt; dry, medium stiff, gray to dark gray.	Sand Pack
						NOTE: soft from 14-14.2' bgs.	4" S.S. Well Screen Sch 304 30 Slot (6-18' bgs)
-15	5	14-15.5	1.33	8 6 6		SAND; fine to coarse, some clay, trace silt, poorly sorted; dry, gray, light odor.	
						CLAY; low to medium plasticity, no dilatancy, some silt, trace fine sand; dry, medium stiff to stiff, dark gray, odor.	
						Shelby tube collection attempted, no recovery.	
						CLAY; low plasticity, no dilatancy, trace silt; dry, very stiff to hard, dark gray.	
	6	17-19	NA			SILT; no to low plasticity, no dilatancy, trace clay; dry, very soft, gray.	
						NOTE: some clay, trace fine sand from 19-18.8' bgs.	
-20	7	19-21	1.92	14 21		SILT; no to low plasticity, no to slow dilatancy, trace clay, trace fine sand, trace granule to large pebble, subangular; dry, very stiff to hard, dark gray.	
						NOTE: low dilatancy, slightly moist at 19.8' bgs.	
						End of boring at 21' bgs.	

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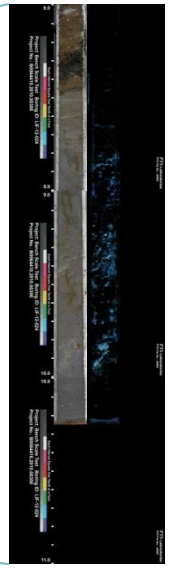
Remarks: bgs = below ground surface

Soil sample collected at 8-10' bgs for laboratory analysis.
Groundwater encountered at 5' bgs
No staining observed



8'

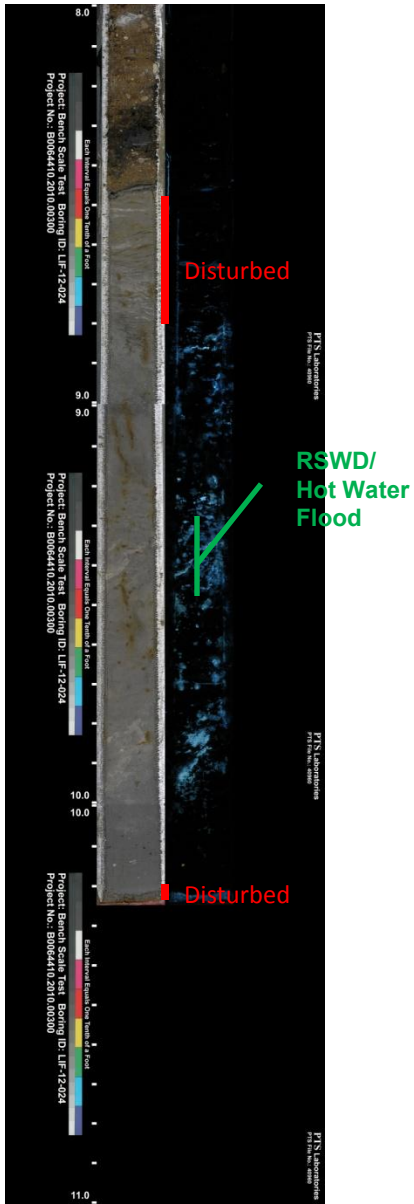
11'

22'

24'

LIF-12-024
1/24/2011

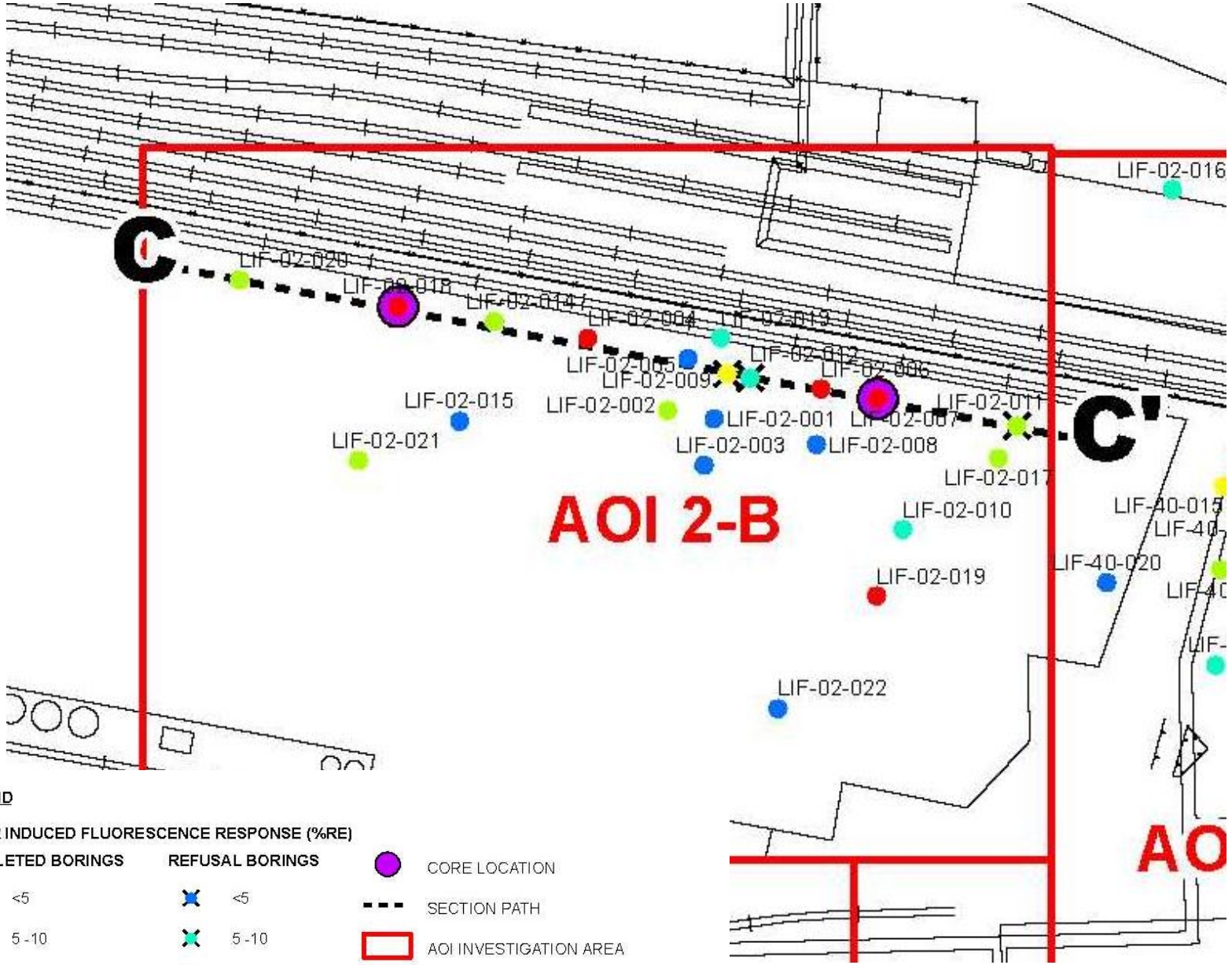
8-11’



22.5-23.7’

AOI 02
Cross Section
and
Core Photos/Phase 1 Testing

LIF-02-007
LIF-02-018

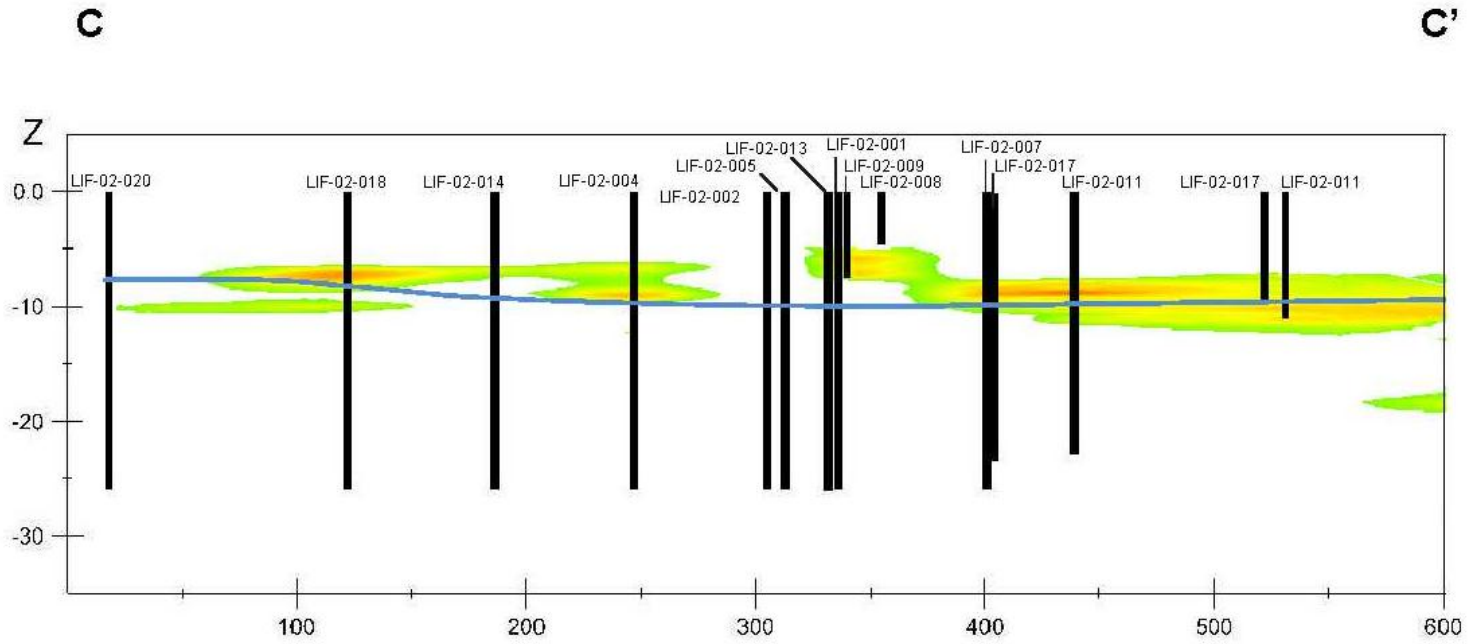


LEGEND

LASER INDUCED FLUORESCENCE RESPONSE (%RE)

COMPLETED BORINGS	REFUSAL BORINGS
<5	<5
5 -10	5 -10
10 - 100	10 - 100
100 - 200	100 - 200
>200	>200

- CORE LOCATION
- SECTION PATH
- AOI INVESTIGATION AREA



LEGEND

LIF RESPONSE

1000%

5%

Approximate Groundwater Elevation

NOTE:
Cross section exported from three-dimensional model and represents a two-dimensional projection of the displayed data.

Revitalizing Auto Communities Environmental Response Trust
NAP Flint Operations Site – Flint, MI
CMI Annual Report

LIF SOIL PROBE CROSS SECTION
AOI 02-B

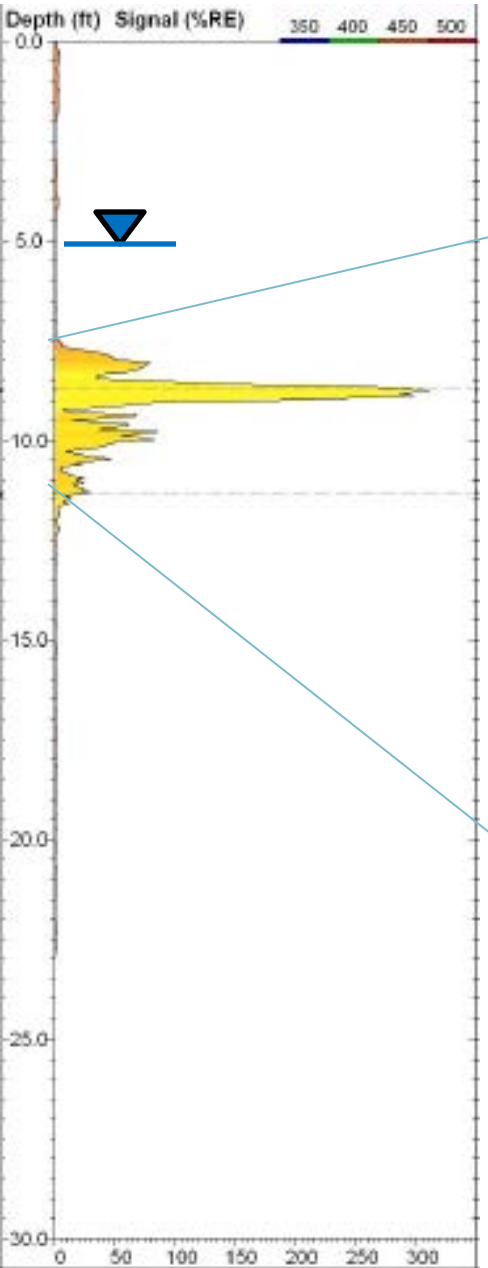
ARCADIS

FIGURE
5

LIF-02-007
8/6/2010

LIF-02-007 Soil Boring
12/14/2010

LIF-02-007 Photo
1/24/2011



Date Start/Finish: 12/17/10
Drilling Company: Mateco Drilling
Driller's Name: Gary Swift
Drilling Method: HSA
Sampling Method: Split Spoon
Rig Type: NA

Northing: NA
Easting: NA
Casing Elevation: NA

Borehole Depth: 18' bgs
Surface Elevation: NA

Descriptions By: Megan Reightler

Well/Boring ID: LIF-02-007
Client: Motors Liquidation Company
Location: MLC Buick City
Flint, Michigan

DEPTH / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	Blow Count	Geologic Column	Stratigraphic Description	Well/Boring Construction
						CONCRETE	Well casing, 4" PVC
	1	0-5	5.0			Hand auger	
-5	2	5-7	0.83	4 4 4 4		SAND; very fine to medium, trace coarse, some silt, trace large pebble, subangular, poorly sorted; wet, black. NOTE: LNAPL sheen present.	Bentonite Pellets (3.5-6' bgs.)
	3	7-8	0.42	3 4			
-10	4	8-12		8 6		Shelby tube collection.	Sand Pack
	5	12-14	0.8	5 8 13 11		SILT; low plasticity, no dilatancy, some very fine to medium sand, trace clay, trace medium to large pebble; dry, medium stiff, yellowish brown.	4" S.S. Well Screen Sch 304 30 Slot (8-18' bgs)
-15	6	14-16	0.6	5 9 11 11		CLAY; low plasticity, no dilatancy, some silt, trace large pebble, trace very fine to fine sand; dry to moist, medium stiff to very stiff, yellow brown.	
	7	16-18	0.8	17 29 38 50		SILT; no to low plasticity, no dilatancy, trace very fine sand, some clay, trace medium to large pebble; dry, light gray.	
						End of boring at 18' bgs.	

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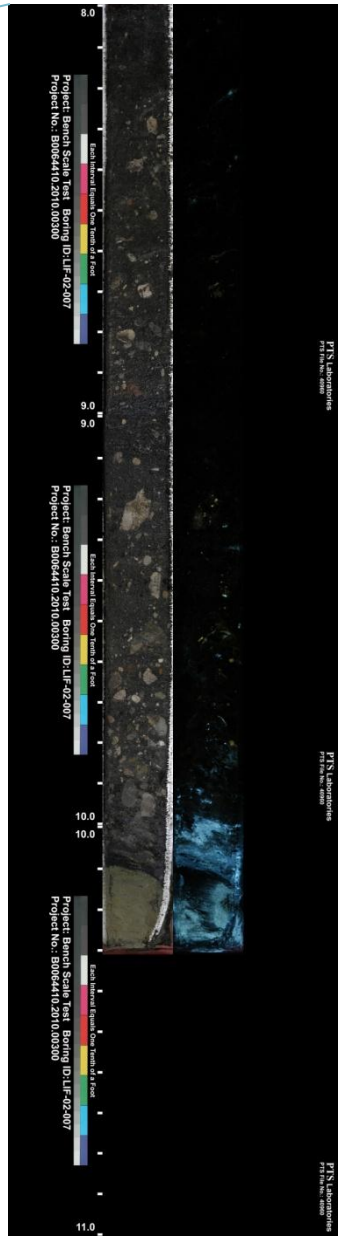
Remarks: bgs = below ground surface

Soil samples collected at 8-10' and 10-12' bgs for laboratory analysis
Groundwater encountered at 5' bgs
No odor or staining observed

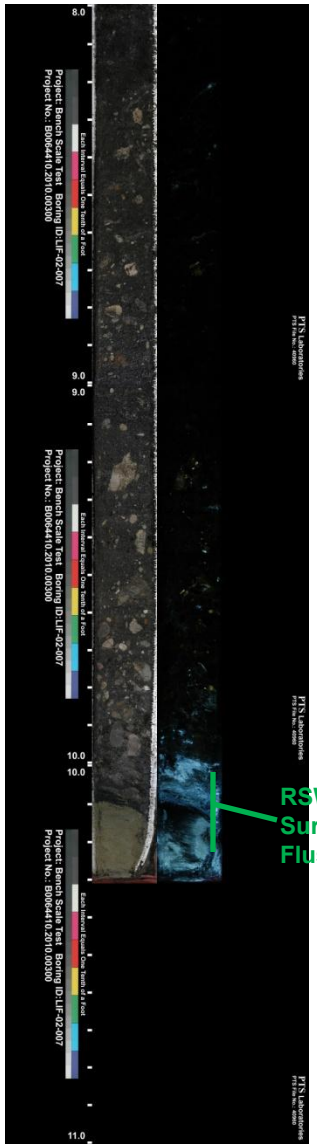


8'

11'

LIF-02-007
1/24/2011

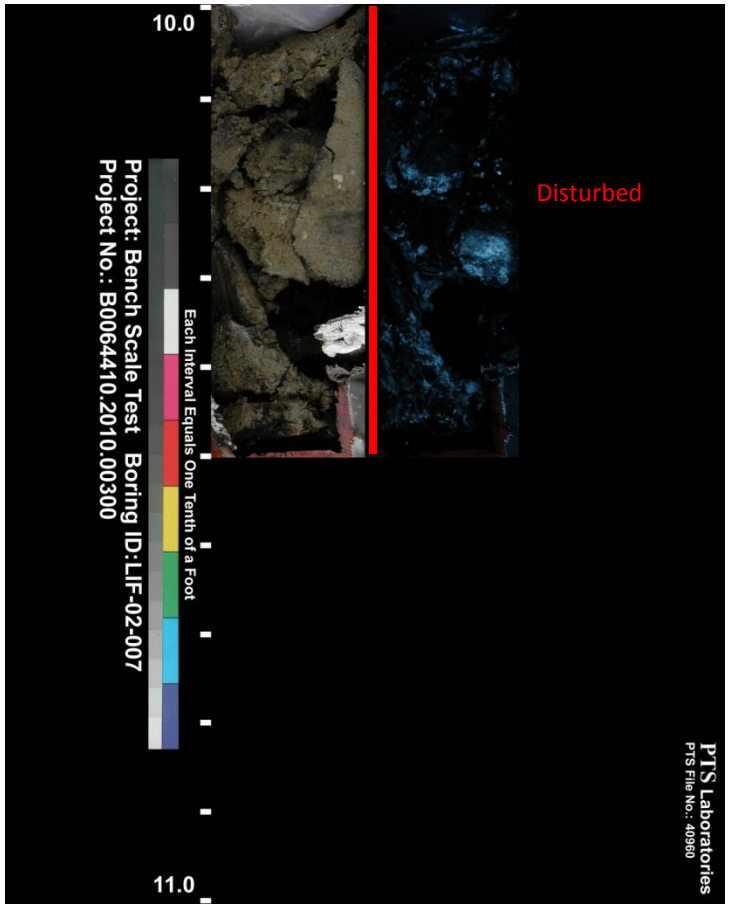
8-11’



RSWD/
Surfactant
Flush

Make sure sample collected from last portion of this core and not the 10 to 11 core.

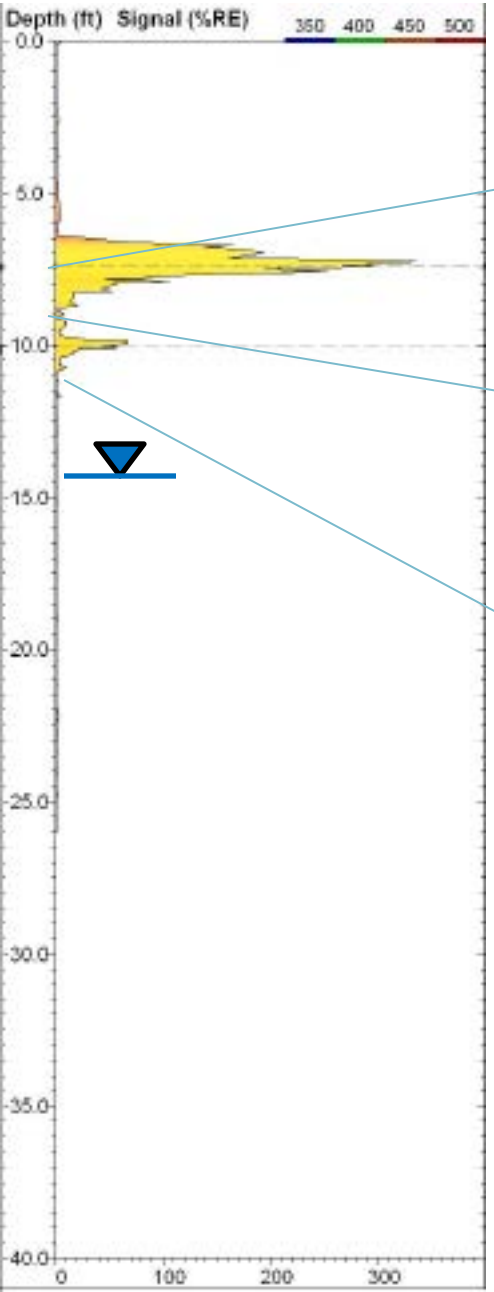
10-11’



LIF-02-018
8/18/2010

LIF-02-018Soil Boring
12/14/2010

LIF-02-018 Photo
1/24/2011



Date Start/Finish: 12/20/10
Drilling Company: Mateco Drilling
Driller's Name: Gary Swift
Drilling Method: HSA
Sampling Method: Split Spoon
Rig Type: NA

Northing: NA
Easting: NA
Casing Elevation: NA

Borehole Depth: 19'
Surface Elevation: NA

Descriptions By: Megan Reightler

Well/Boring ID: LIF-02-018
Client: Motors Liquidation Company

Location: MLC Buick City
Flint, Michigan

DEPTH / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	Blow Count	Geologic Column	Stratigraphic Description	Well/Boring Construction
						CONCRETE	Well casing, 4" PVC
						HAND AUGER	
	1	0-5	5.0				
-5				39		WOOD	Bentonite Pellets (3.5-6' bgs.)
	2	5-7	1.75	13		PEBBLE; large, some fine sand, subangular, poorly sorted; dry.	
				13		SILT; medium plasticity, no dilatancy, some very fine to fine sand, little clay; dry, medium stiff, dark brown. NOTE: odor.	
				13		Shelby tube collection.	
	3	7-11					
-10				4		SILT; high plasticity, rapid dilatancy, some clay, trace very fine sand, trace small pebble; moist, soft, dark brown.	Sand Pack
	4	11-13	1.75	5			
				5		SILT; low to medium plasticity, no dilatancy, some clay, trace very fine to fine sand; moist, medium stiff to stiff, dark brown.	4" S.S. Well Screen Sch 304 30 Slot (8-18' bgs)
				6			
	5	13-15	1.91	4			
				7			
				8		SAND; fine to coarse, trace silt, trace medium pebble, subangular, poorly sorted; wet, brown.	
				10			
-15				8		SILT; high plasticity, rapid dilatancy, some fine to coarse grain sand, trace medium pebble, trace clay; wet, dark brown.	
	6	15-17	2.0	14			
				17			
				23			
	7	17-19	2.0	13		SILT; low to medium plasticity, no dilatancy, some clay, trace very fine sand, trace medium to large pebble; moist, stiff to very stiff, dark brown.	
				18			
				20			
				20			
						End of boring at 19' bgs.	

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Remarks: bgs = below ground surface

Soil sample collected at 7-11' bgs for laboratory analysis
Groundwater encountered at 14.5' bgs
No staining observed

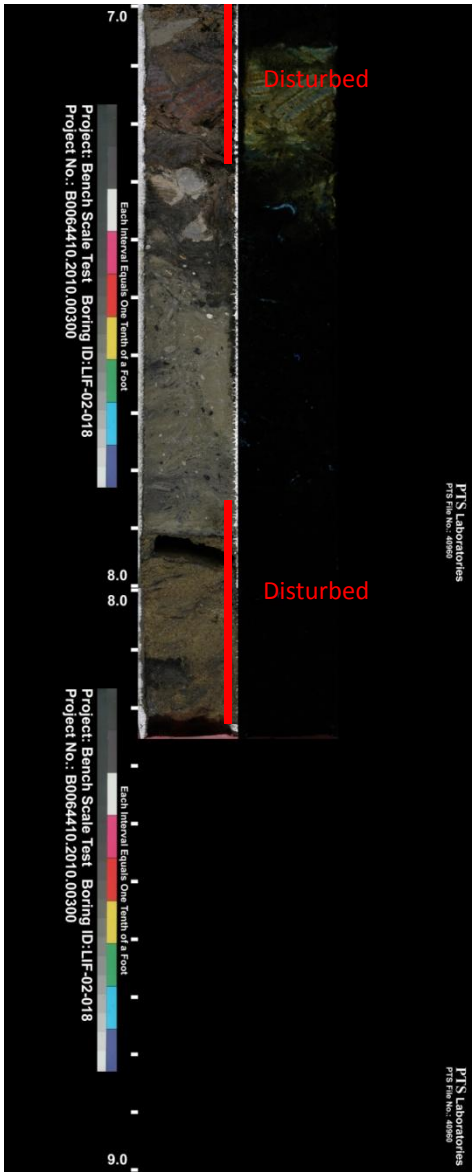
7'

9'

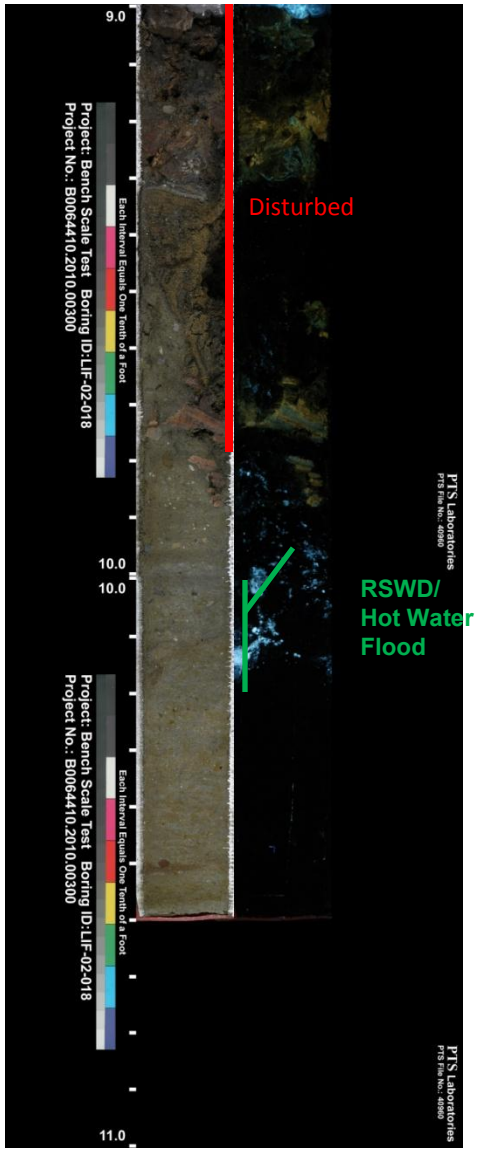
11'

LIF-02-018
1/24/2011

7-9’



9-11’



AOI 40
Cross Section
and
Core Photos/Phase 1 Testing

LIF-40-004
LIF-40-011
LIF-40-022

LEGEND

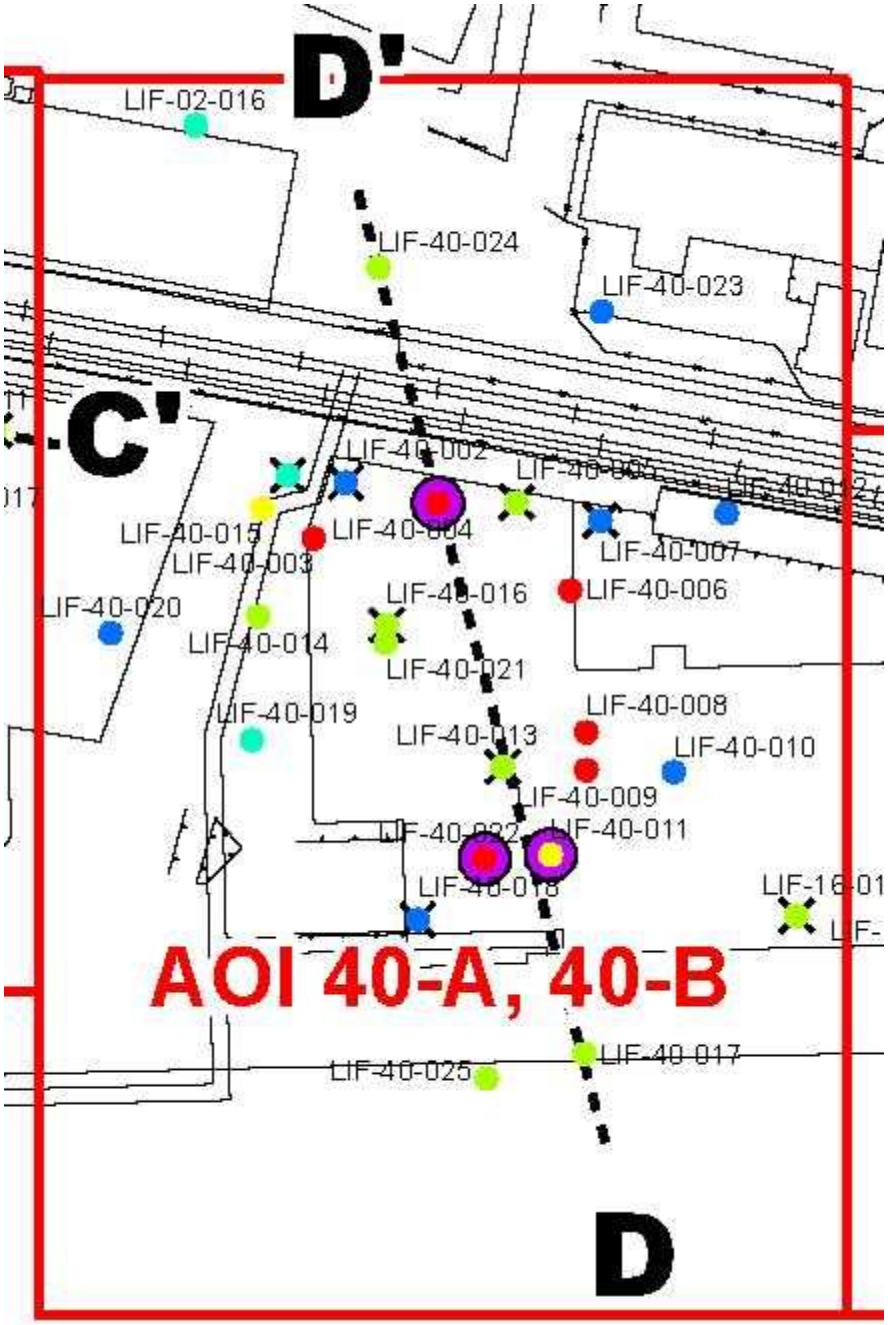
LASER INDUCED FLUORESCENCE RESPONSE (%RE)

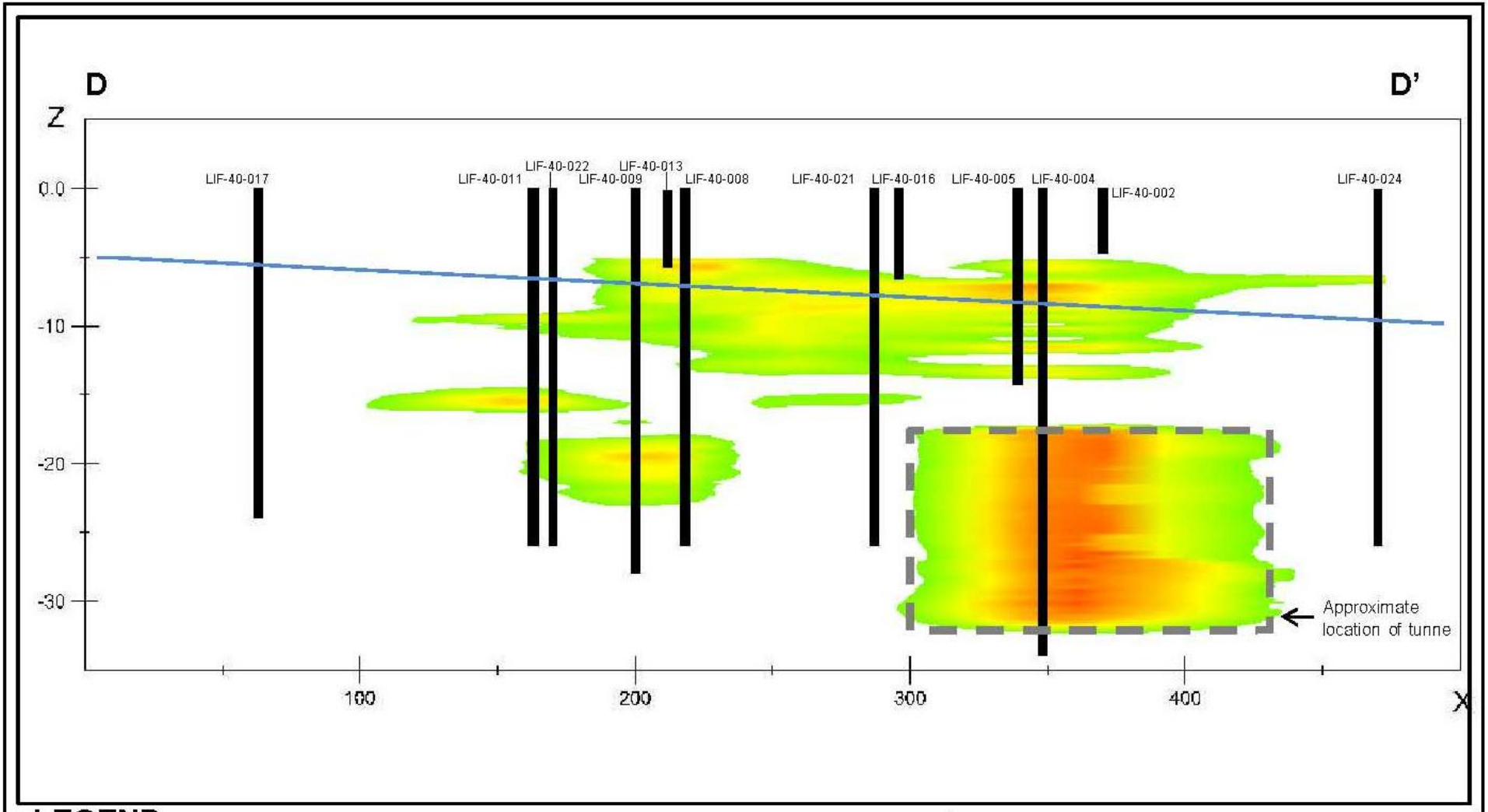
COMPLETED BORINGS	REFUSAL BORINGS
<5	<5
5 -10	5 -10
10 - 100	10 - 100
100 - 200	100 - 200
>200	>200

CORE LOCATION

SECTION PATH

AOI INVESTIGATION AREA





LEGEND

LIF RESPONSE

1000%

5%

Approximate Groundwater Elevation

NOTE:
Cross section exported from three-dimensional model and represents a two-dimensional projection of the displayed data.

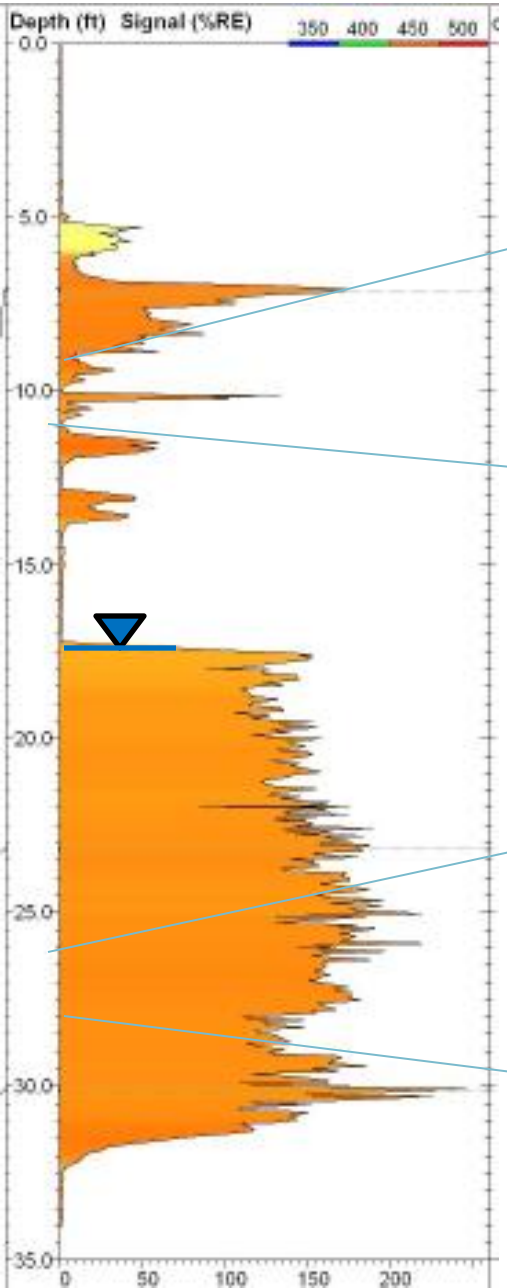
Revitalizing Auto Communities Environmental Response Trust
NAP Flint Operations Site – Flint, MI
CMI Annual Report

LIF SOIL PROBE CROSS SECTION
AOI 40-A and 40-C

ARCADIS

FIGURE
6

LIF-40-004
8/7/2010



LIF-40-004 Soil Boring
12/14/2010

Date Start/Finish: 12/21/10, 12/22/10
Drilling Company: Mateco Drilling
Driller's Name: Gary Swift
Drilling Method: HSA
Sampling Method: Split Spoon, Shelby tube
Rig Type: NA

Northing: NA
Easting: NA
Casing Elevation: NA
Borehole Depth: 28'
Surface Elevation: NA
Descriptions By: M. Reightler

Well/Boring ID: LIF-40-004
Client: Motors Liquidation Company
Location: MLC Buick City
Flint, Michigan

DEPTH / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	Blow Count	Geologic Column	Stratigraphic Description	Well/Boring Construction
	1	0-5	5.0			HAND AUGER	Bentonite Pellets (2-4' bgs.)
-5	2	5-7	0.66	8 1 1 1		SILT; high plasticity, rapid dilatancy, some clay, little sand, trace large pebble; wet, soft, brown. NOTE: 2 inches of white gooey substance at bottom of split spoon sample	Well casing, 4" PVC
	3	7-9				Shelby tube sample.	
	4	9-11				Shelby tube sample.	
-10						CLAY; medium plasticity, slow dilatancy, some silt, trace granule, subangular; wet, medium stiff, grayish brown.	Sand Pack
	5	11-13	1.75	5 7 11 12		SILT; low plasticity, no dilatancy, little clay, trace very fine sand; moist, medium stiff to stiff, grayish brown.	4" S.S. Well Screen Sch 304 30 Slot (8-18' bgs)
	6	13-15	0.0			No recovery	
-15	7	15-17	1.75	7 10 10 10		SILT; medium plasticity, no dilatancy, little clay, trace very fine sand, ; moist, medium stiff, grayish brown	
	8	17-19	1.83	6 8 8 11		SAND; fine to coarse, subrounded to subangular, trace silt, well sorted; wet, grayish brown. NOTE: strong odor.	
-20	9	19-21	1.83	4 6 9 11			
	10	21-23	2.0	9 9 12 15		SAND; fine to coarse, subrounded to subangular, trace silt, well sorted; moist, grayish brown. NOTE: strong odor.	
	11	23-25	2.0	2 3 3 6		SAND; medium to coarse, subrounded to subangular, well sorted; moist, grayish brown. NOTE: strong odor.	
-25	12	25-26	2.0	2 2			
	13	26-28				Shelby tube sample.	
						End of boring at 28' bgs.	

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Remarks: bgs = below ground surface

Soil sample collected at 7-9', 9-11' and 26-28' bgs for laboratory analysis.
Groundwater encountered at 17.3' bgs

LIF-40-004 Photo
1/24/2011

9'

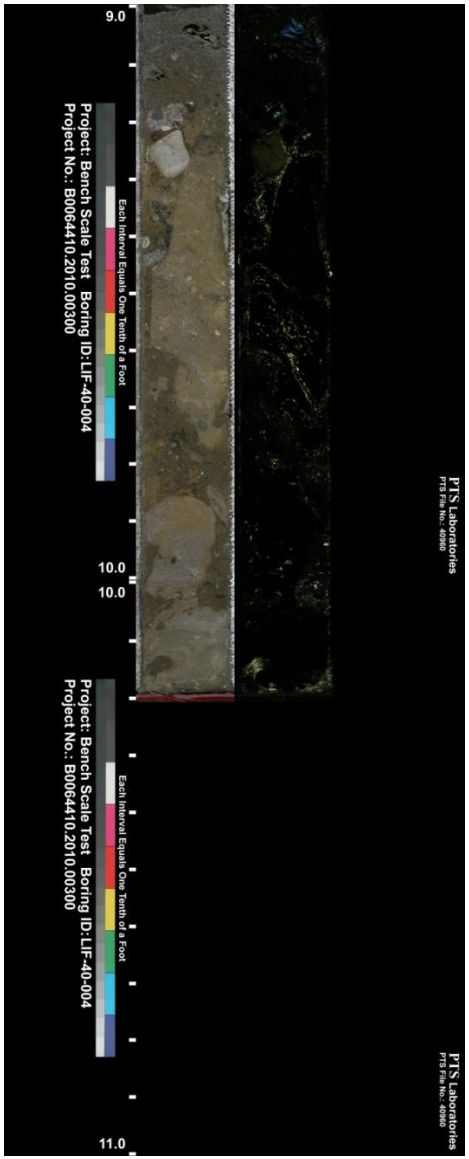
11'

26'

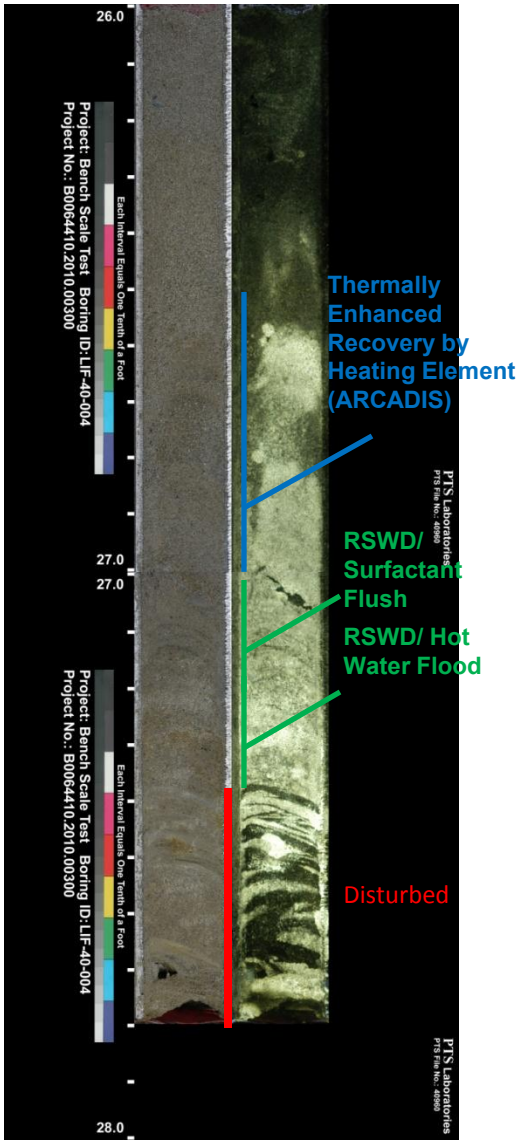
28'

LIF-40-004
1/24/2011

9-11’



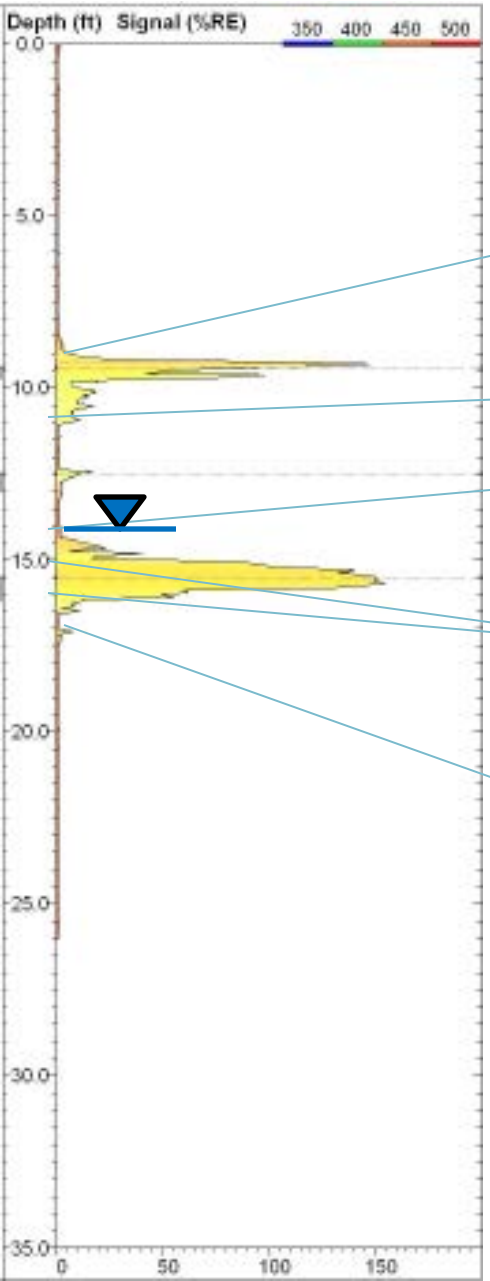
26-28’



LIF-40-011
8/9/2010

LIF-40-011 Soil Boring
12/14/2010

LIF-40-011 Photo
1/24/2011



Date Start/Finish: 12/21/10
Drilling Company: Mateco Drilling
Driller's Name: Gary Swift
Drilling Method: HSA
Sampling Method: Split Spoon, Shelby tube
Rig Type: NA

Northing: NA
Easting: NA
Casing Elevation: NA

Borehole Depth: 17.5'
Surface Elevation: NA

Descriptions By: M. Reightler

Well/Boring ID: LIF-40-011
Client: Motors Liquidation Company
Location: MLC Buick City
Flint, Michigan

DEPTH ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	Blow Count	Geologic Column	Stratigraphic Description	Well/Boring Construction
						HAND AUGER	
	1	0-5	5.0				
-5	2	5-7	1.58	3 3 3 3		SAND; very fine to medium, subrounded to subangular, some silt, well sorted; moist, yellowish brown. SILT; medium plasticity, no dilatancy, little clay, little very fine to fine sand; dry, soft to medium stiff, yellowish brown.	Well casing, 4" PVC Bentonite Pellets (3-5.5' bgs.)
	3	7-9	1.33	4 4 5 6		SILT; no to low plasticity, no dilatancy, little clay, trace fine to coarse sand, trace medium to large pebble; dry, stiff, yellowish brown.	
-10	4	9-11				Shelby tube sample.	
	5	11-13	1.91	7 7 13 15		SILT; no to low plasticity, no dilatancy, trace clay, trace very fine sand; dry, soft, gray.	Sand Pack 4" S.S. Well Screen Sch.304 30 Slot (7.5-17.5' bgs)
	6	13-14.5	1.58	7 13 17		NOTE: medium plasticity, no dilatancy; moist at 13.5' bgs. SAND; medium to coarse, trace large pebble, subrounded, trace silt, trace clay, poorly sorted; wet, gray.	
-15	7	14.5-17.5		12		Shelby tube sample.	
						End of boring at 17.5' bgs.	

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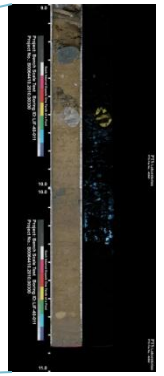
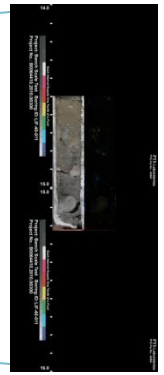
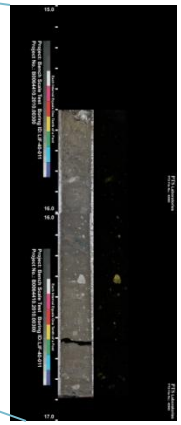
Remarks: bgs = below ground surface

Soil sample collected at 9-11' bgs and 14.5-17.5' bgs for laboratory analysis.
Groundwater encountered at 14' bgs
No odor observed

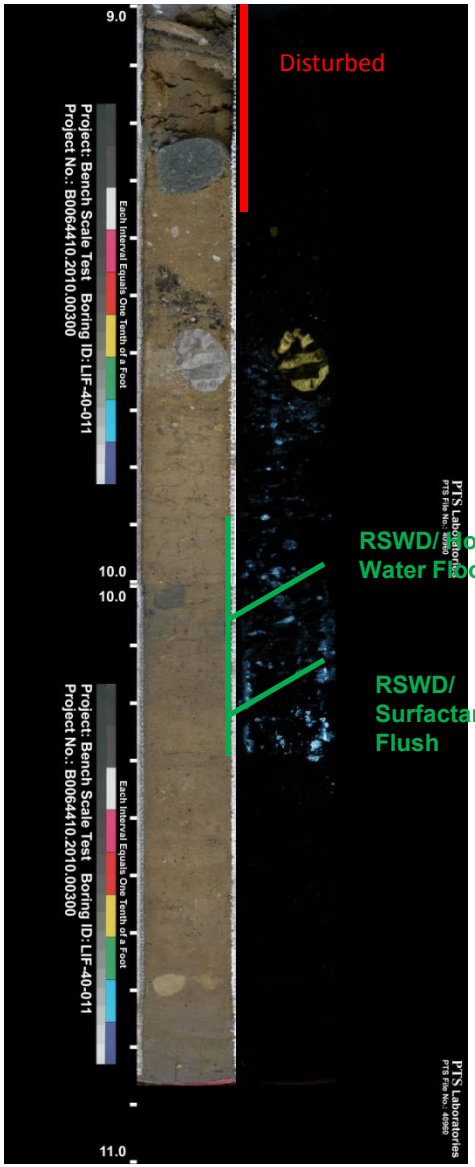

9'
11'


14'
16'

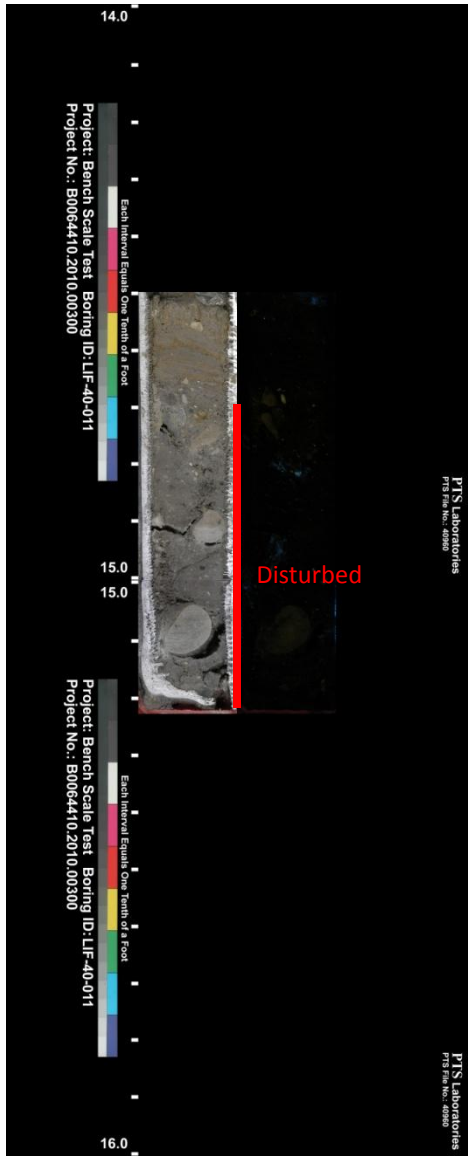

15'
17'

LIF-40-011
1/24/2011

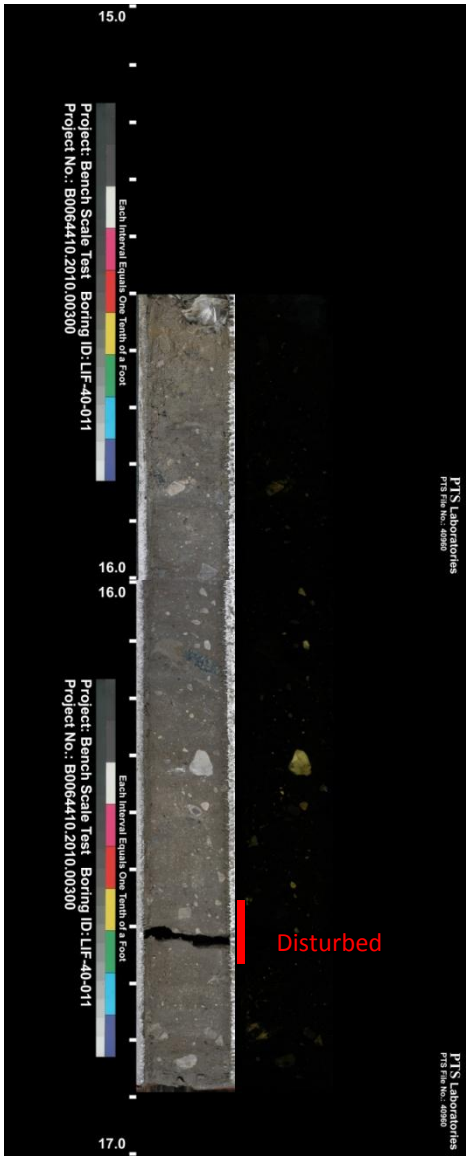
9-11’



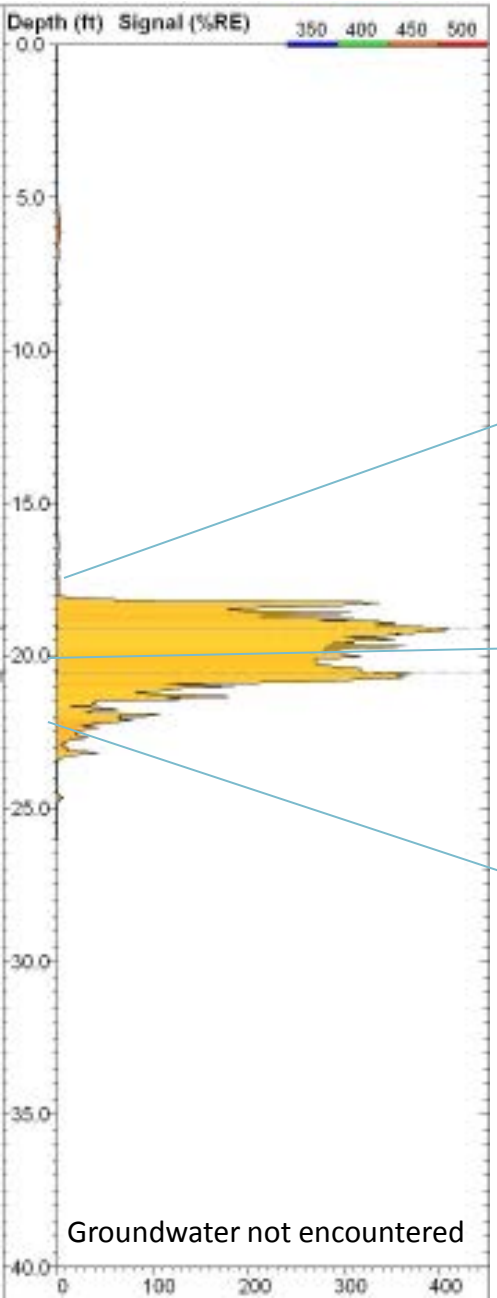
14-16’



15-17’



LIF-40-022 8/7/2010



Groundwater not encountered

LIF-40-022 Soil Boring 12/14/2010

Date Start/Finish: 12/21/10
Drilling Company: Mateco Drilling
Driller's Name: Gary Swift
Drilling Method: HSA
Sampling Method: Split Spoon, Shelby tube
Rig Type: NA

Northing: NA
Easting: NA
Casing Elevation: NA

Borehole Depth: 22'
Surface Elevation: NA

Descriptions By: M. Reightler

Well/Boring ID: LIF-40-022
Client: Motors Liquidation Company
Location: MLC Buick City
Flint, Michigan

DEPTH / ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	Blow Count	Geologic Column	Stratigraphic Description	Well/Boring Construction
						CONCRETE	
						HAND AUGER	
-5	1	0-7	5.0				Bentonite Pellets (3.5-6' bgs.)
	3	7-9	1.83	3 3 3 5		CLAY; medium plasticity, no dilatancy, some silt, trace very fine sand, trace medium to large pebble; dry to moist, dark yellowish brown.	
-10	4	9-11	1.91	5 7 12 15		SILT; no to low plasticity, no dilatancy, some clay; dry, very stiff, dark yellowish brown.	Well casing, 4" PVC
	5	11-13	1.83	5 5 5 5		SILT; medium plasticity, no dilatancy, some clay; moist, medium stiff, yellowish brown.	Sand Pack
						SILT; no to low plasticity, no dilatancy, little clay; dry, very stiff, gray.	4" S.S. Well Screen Sch 304 30 Slot (8-18' bgs)
	6	13-15	1.91	7 8 8 12		CLAY; low plasticity, no dilatancy, some silt; dry, very stiff, grayish brown.	
-15	7	15-17	1.25	5 5 7 10		SILT; no to low plasticity, no dilatancy, little clay, trace very fine sand; dry, medium stiff to stiff, gray.	
						NOTE: moist at 16.2' bgs.	
	8	17-18	1.0	7 7		SAND; very fine to coarse, trace large pebble, subrounded to subangular, little silt, trace clay, poorly sorted, wet, gray.	
						Shelby tube sample.	
-20	9	18-22					
						End of boring at 22' bgs.	

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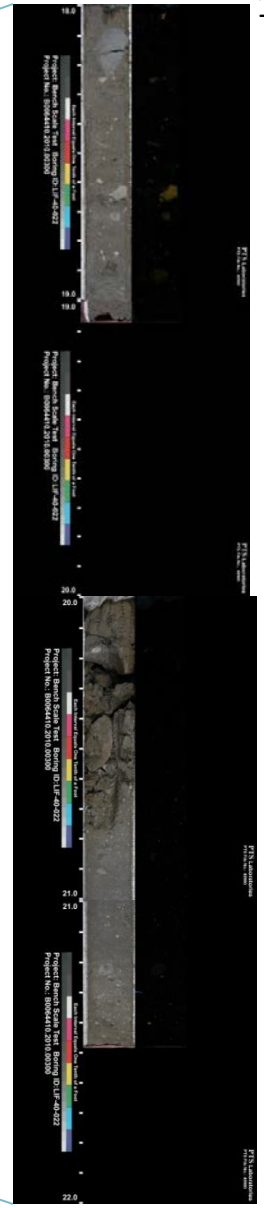
Remarks: bgs = below ground surface

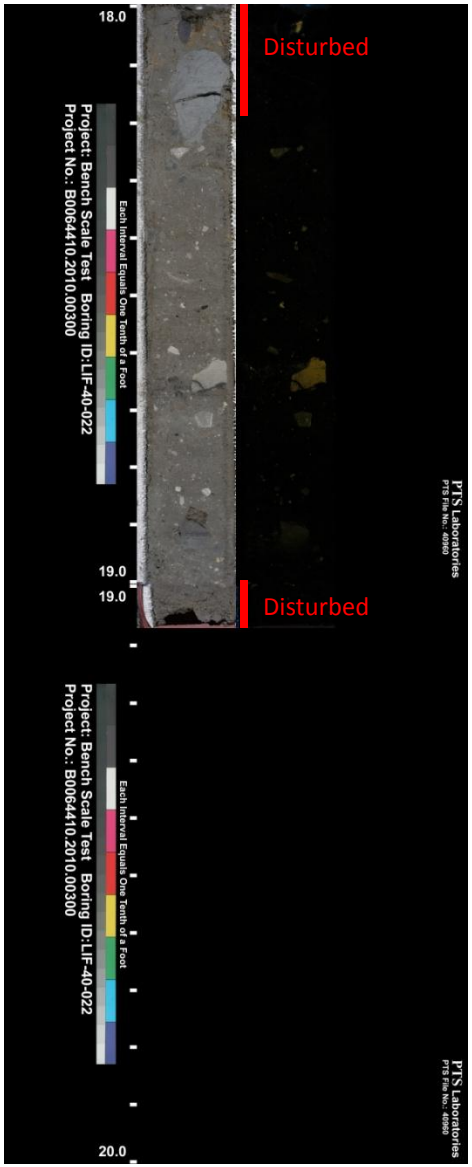
Soil samples collected at 18-20' and 20-22' bgs for laboratory analysis.
Groundwater not encountered
No odor observed

LIF-40-022 Photo 1/24/2011

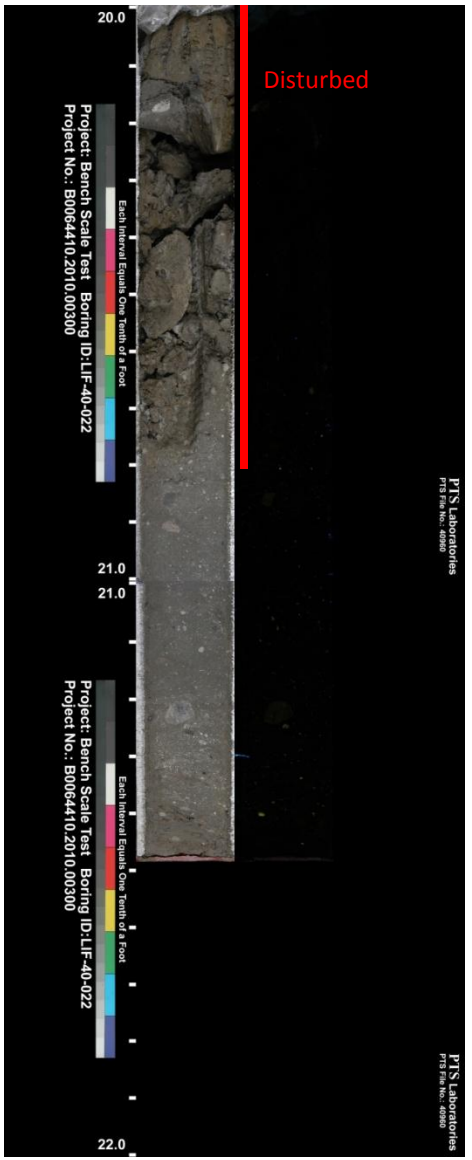


LIF-40-022
1/24/2011

18-20’



20-22’



AOI 16C
Cross Section
and
Core Photos/Phase 1 Testing

LIF-16-006
LIF-16-017

LEGEND

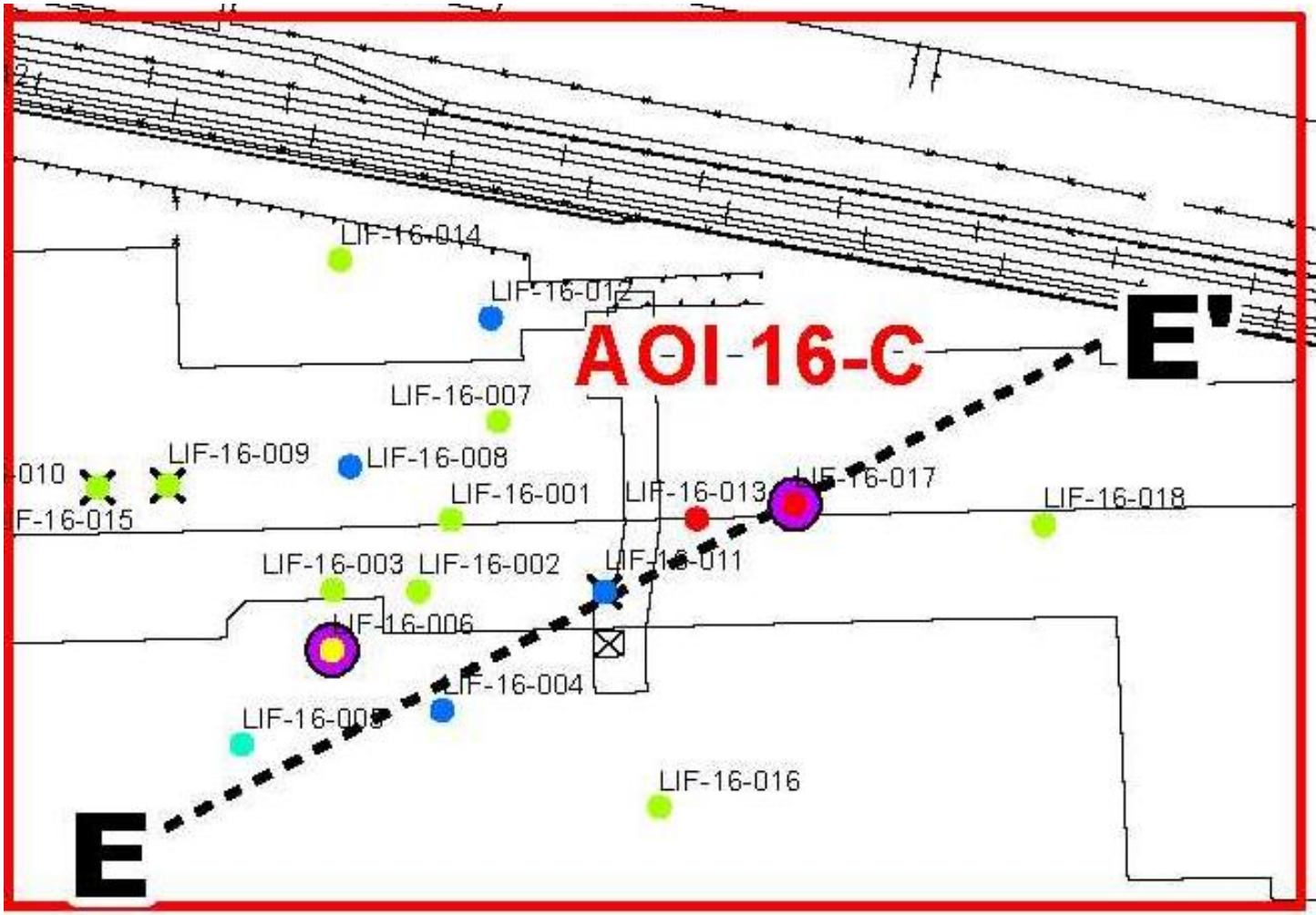
LASER INDUCED FLUORESCENCE RESPONSE (%RE)

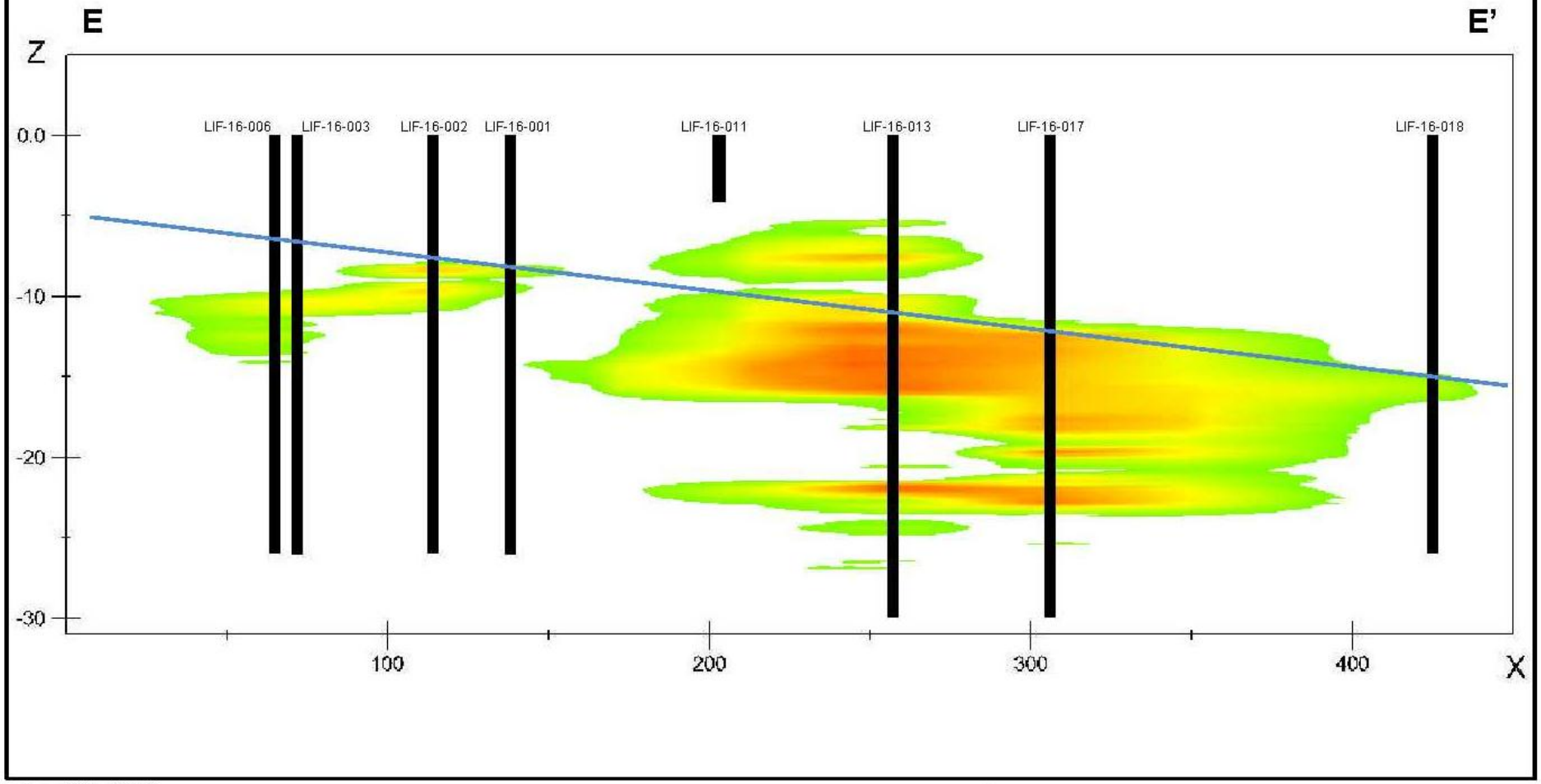
COMPLETED BORINGS	REFUSAL BORINGS
<5	<5
5 -10	5 -10
10 - 100	10 - 100
100 - 200	100 - 200
>200	>200

CORE LOCATION

SECTION PATH

AOI INVESTIGATION AREA





LEGEND

LIF RESPONSE

1000%

5%

Approximate Groundwater Elevation

NOTE:
Cross section exported from three-dimensional model and represents a two-dimensional projection of the displayed data.

Revitalizing Auto Communities Environmental Response Trust
NAP Flint Operations Site – Flint, MI
CMI Annual Report

LIF SOIL PROBE CROSS SECTION
AOI 16-C

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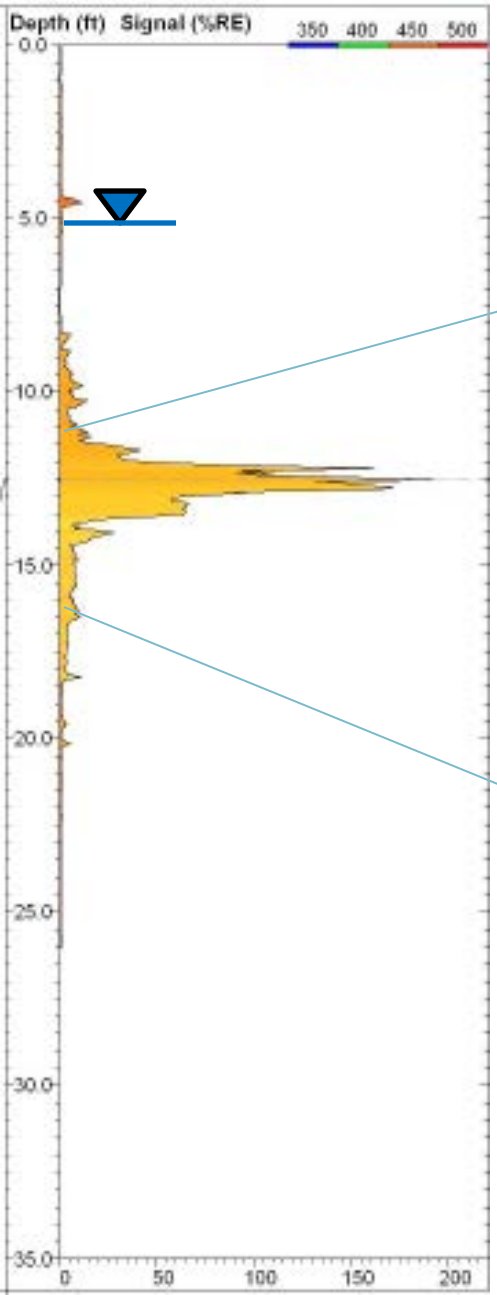
FIGURE
7

LIF-16-006
8/10/2010

LIF-16-006 Soil Boring
12/14/2010

LIF-16-006 Photo
1/24/2011



Date Start/Finish: 12/22/10
Drilling Company: Mateco Drilling
Driller's Name: Gary Swift
Drilling Method: HSA
Sampling Method: Split Spoon
Rig Type: NA

Northing: NA
Easting: NA
Casing Elevation: NA

Borehole Depth: 17.5'
Surface Elevation: NA

Descriptions By: Megan Reightler

Well/Boring ID: LIF-16-006
Client: Motors Liquidation Company
Location: MLC Buick City
Flint, Michigan

DEPTH / ELEVATION	Sample Run Number	Sample Int/Type	Recovery (feet)	Blow Count	Geologic Column	Stratigraphic Description	Well/Boring Construction
						CONCRETE	Bentonite Pellets (2-4' bgs.); Well casing, 4" PVC
	1	0-5	5.0			HAND AUGER	
-5	2	5-7	0.83	5 5 5 5		SAND; medium, trace very coarse, little medium to large pebble, subangular to subrounded, poorly sorted; wet, dark redish brown.	
	3	7-9	0.91	2 2 2 3		CLAY; medium plasticity, no dilatancy, some silt; moist, medium stiff to stiff, dark brown.	
-10	4	9-11	1.33	3 3 3 3		SILT; low to medium plasticity, rapid dilatancy, little clay, trace very fine to fine sand; wet, soft to stiff, dark brown.	Sand Pack; 4" S.S. Well Screen Sch 304 30 Slot (6-16' bgs)
	5	11-13				Shelby tube collection.	
	6	13-15				Shelby tube collection.	
-15	7	15-17.5	2.0	10 10 12 16		CLAY; no plasticity, no dilatancy, some silt, trace medium to large pebble, subrounded to subangular; dry, very stiff; dark gray.	
						End of boring at 17.5' bgs.	

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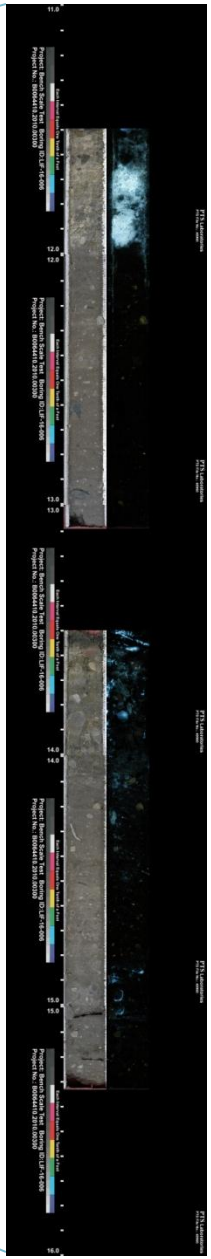
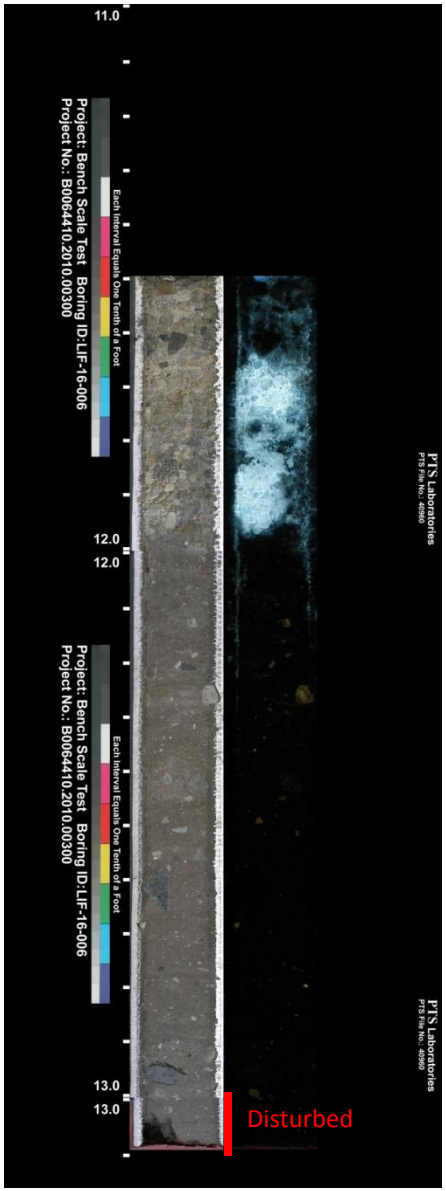
Remarks: bgs = below ground surface

Soil samples collected at 11.5-13.5' and 13.5-15.5' bgs for laboratory analysis
Groundwater encountered at 5' bgs
No odor or staining observed

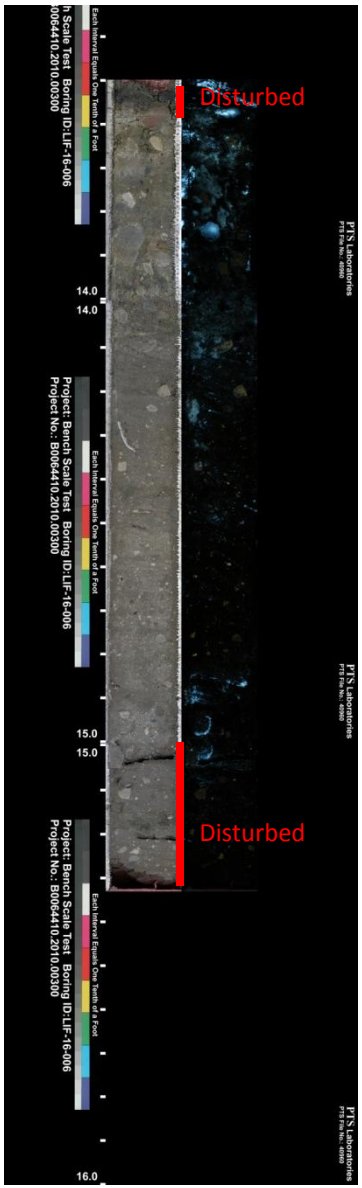


LIF-16-006
1/24/2011

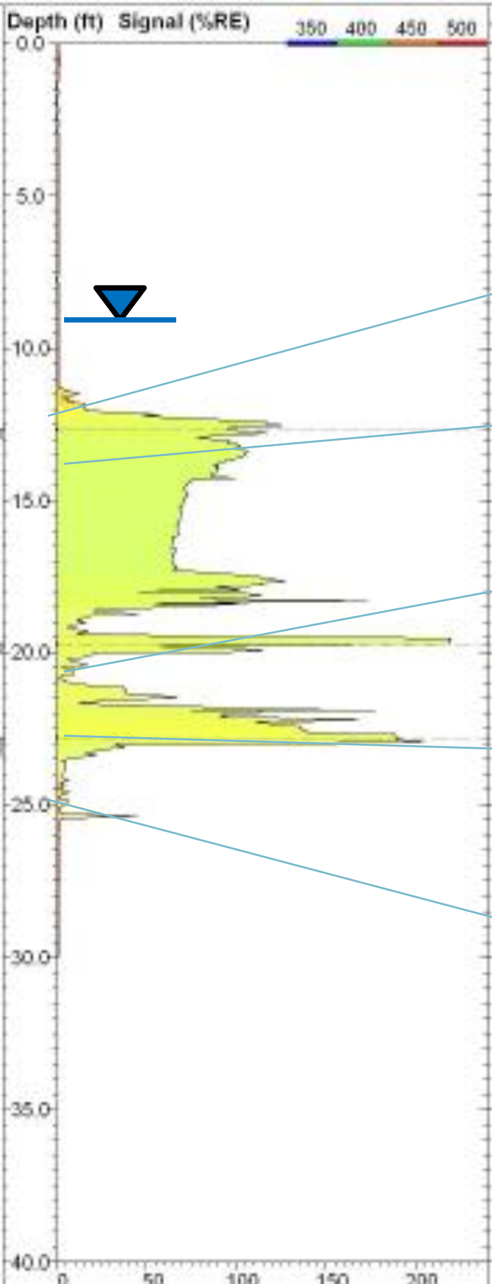
11.5-13.1’



13.3-16’



LIF-16-017
8/19/2010



LIF-16-017 Soil Boring
12/14/2010

Date Start/Finish: 12/22/10 **Drilling Company:** Mateco Drilling **Driller's Name:** Gary Swift **Drilling Method:** HSA **Sampling Method:** Split Spoon **Rig Type:** NA	**Northing:** NA **Easting:** NA **Casing Elevation:** NA **Borehole Depth:** 25' bgs **Surface Elevation:** NA **Descriptions By:** Megan Reightler	**Well/Boring ID: LIF-16-017** **Client:** Motors Liquidation Company **Location:** MLC Buick City Flint, Michigan

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	Blow Count	Geologic Column	Stratigraphic Description	Well/Boring Construction
	0						CONCRETE	
		1	0-5	5.0			HAND AUGER	Bentonite Pellets (2-4' bgs.); Well casing, 4" PVC
	-5	2	5-7	1.33	3 3 3 3		SAND; very fine to medium, trace medium to large pebble, subrounded, trace silt, poorly sorted; dry, dark yellowish brown. NOTE: slight odor, black first 1.5 inches.	
		3	7-9	1.75	1 1 2 2		SAND; fine to medium, subrounded to subangular, trace silt, well sorted; moist, light brown.	
	-10	4	9-11	0.92	3 5 5 6		SAND; fine to medium, trace large pebble, subangular, trace silt, well sorted; wet, light brown.	Sand Pack
							CLAY; high plasticity, rapid dilatancy, some silt, trace fine sand, trace coarse sand; wet, soft, yellowish brown.	4" S.S. Well Screen Sch 304 30 Slot (6-16' bgs)
		5	11-12	NA	7 9		SAND; very fine to medium, some silt, trace granule, subangular, poorly sorted; wet, dark gray. NOTE: strong odor.	
		6	12-14				Shelby tube collection.	
	-15	7	14-16	2.0	9 9 9 9		CLAY; low to medium plasticity, slow dilatancy, some silt, trace fine sand, trace very coarse sand; wet, stiff to very stiff, dark gray.	
		8	16-18	1.7	6 10 12 14		SILT; no to low plasticity, slow dilatancy, some clay, trace very coarse sand, subangular; wet, very stiff, dark gray.	
		9	18-20	0.5	10 14 14 15		NOTE: no dilatancy; dry at 19' bgs.	
	-20				3		CLAY; no to low plasticity, little silt, trace medium to large pebble, subrounded.	
							Shelby tube collection.	
	-25						End of boring at 25' bgs.	

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Remarks: bgs = below ground surface
NA = Not available

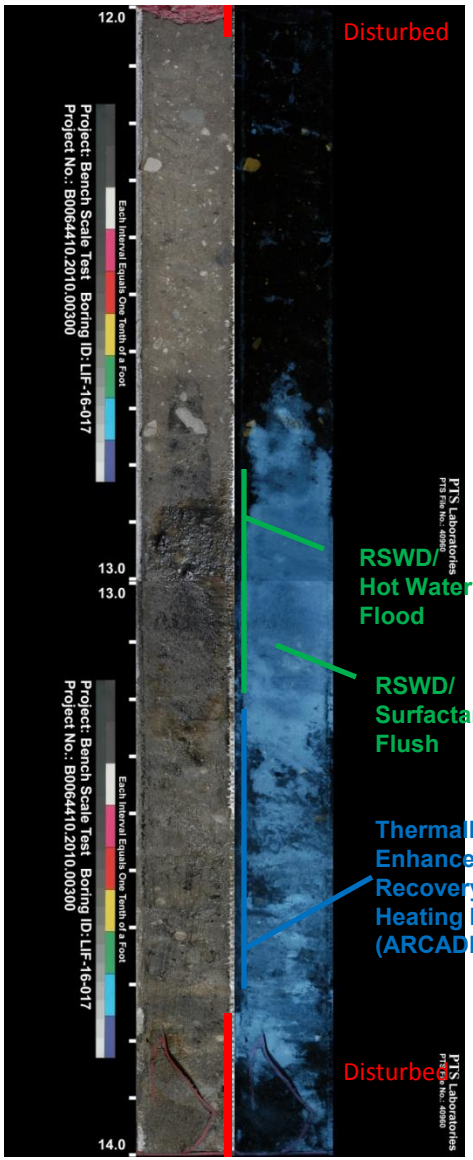
Soil samples collected at 12-14', 21.5-23' and 23-25' bgs for laboratory analysis
Groundwater encountered at 9.2' bgs

LIF-16-017 Photo
1/24/2011

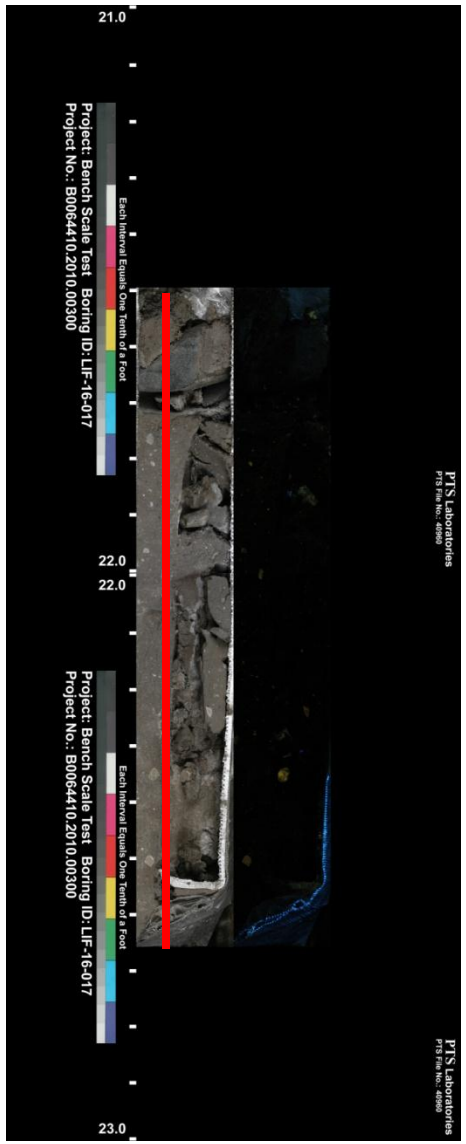
12'
14'
21'
23'
25'

LIF-16-017
1/24/2011

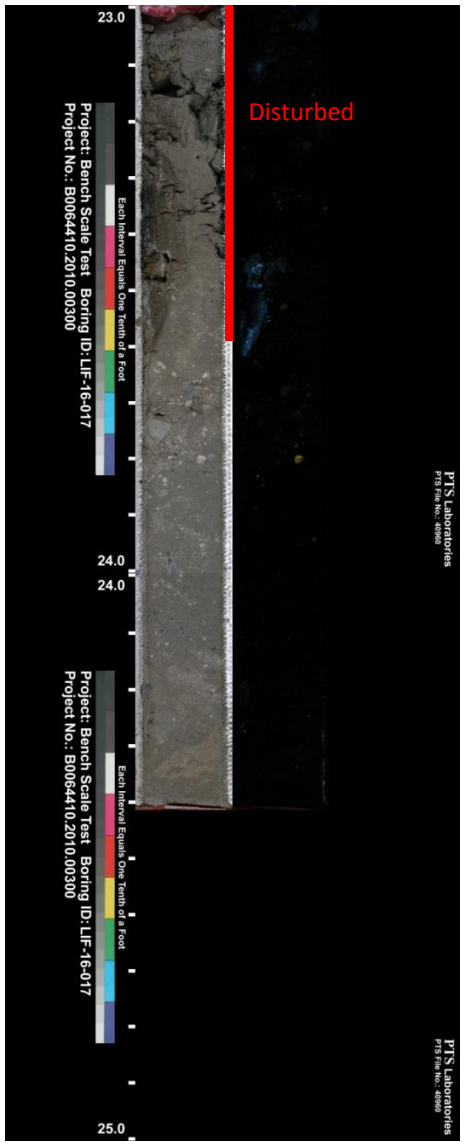
12-14’



21 -23’



23-25’



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Appendix **C**

ARCADIS Treatability Report

ARCADIS U.S., Inc.
4915 Prospectus Drive
Suite F
Durham
North Carolina 27713
Tel 919 544 4535
Fax 919 544 5690

MEMO

To:
Steve Gaito

Copies:
Project File

From:
Andy Baumeister
Dave Liles

Date:
February 2012

ARCADIS Project No.:
B0064410.2010

Subject:
LNAPL Remediation Technology Bench-Scale Testing
Buick City facility located in Flint, Michigan

---

1. Background

The ARCADIS Treatability Laboratory, located in Durham, North Carolina, conducted bench scale treatability studies to evaluate the removal of two different types of light non-aqueous phase liquids (LNAPLs) characterized as hydraulic oil and fuel oil from two field locations at the Buick City facility located in Flint, Michigan. Two separate treatability studies were conducted to investigate LNAPL destruction through the application of in situ chemical oxidation (ISCO), and LNAPL recovery through thermally-enhanced applications.

2. In-Situ Chemical Oxidation

2.1 Methods

Bench scale ISCO testing was initialized on June 14, 2011. Reactors consisting of Site groundwater and LNAPL only from sample locations AOI-12-MW-RFI-12-33-GW-041411 (hydraulic oil location, designated as AOI-12), and AOI-40-RFI-40-14R-GW 041411 (fuel oil location, designated as AOI-40) were established to study the efficacy of the following treatments to destroy free phase LNAPL from the Site:

1. Room temperature and heated control treatments (no oxidant added)

2. Klozür™ sodium persulfate ($Na_2S_2O_8$, CAS# 7775-27-1; 99.4% purity, obtained by FMC Corporation) chemically activated with ferrous iron chelated by citric acid (dosed to 400 grams per liter (g/L) sodium persulfate, 500 milligrams per liter (mg/L) ferrous iron and citric acid at 5:1 iron (Fe) to citric acid molar ratio)

3. Klozür™ sodium persulfate chemically activated with strong alkaline condition treatment (dosed to 400 g/L sodium persulfate, and sodium hydroxide (pH >11.5))

4. Klozür™ sodium persulfate thermally activated (dosed to 400 g/L sodium persulfate and temperature at 50°C)

5. Hydrogen peroxide chemically activated with Dissolvine® E-FE-13 ferrous iron chelated by Ethylenediaminetetraacetic acid (EDTA) ($C_{10}H_{12}FeN_2O_8Na$. $3H_2O$, CAS# 15708-41-5; 89% purity, obtained by FMC Corporation) (dosed to 80 g/L hydrogen peroxide, 100 mg/L ferrous iron as Fe EDTA at 1:1 Fe to EDTA molar ratio)

A total of twelve 250 mL clear-glass sample bottles with septum closure polypropylene caps were used as the experimental reactors (6 reactors per LNAPL type). Prior to the addition of any reagents, each reactor received 147 mL of homogenized location-specific groundwater and 10 mL of the respective location-specific LNAPL. To provide sufficient volume for visual observations of LNAPL treatment or other changes in appearance, a volume of 10 mL of LNAPL was determined to form a measureable LNAPL band at approximately 0.25 inches thick inside the 250 mL reactor . The reactors were then set on a roller table for 48 hours to allow dissolvable contaminants from the LNAPL to reach equilibrium in the groundwater. On June 16, 2011, each of the six reactors from both locations AOI-12 and AOI-40 were dosed with varying types and concentrations of oxidants, activators and chelating agents according to the experimental design in Table 1. Because different chemical additions occupied different volumes within the treatment vessels, deionized water (DIW) was added to account for these differences in volume.

Table 1. Experimental Design for LNAPL AOI-12 and AOI-40, Buick City ISCO Treatability Study

Reactor ID #	Oxidant Concentration	Activator	Chelant	Comments
1	0	0	None	Room Temp Control
2	0	50° C	None	High Temp Control
3	400 g/L NaP	500 mg/L Fe(II)	Citric Acid (5:1 molar ratio of iron:chelant)	200 g/L dose repeated 2 times
4	400 g/L NaP	NaOH (pH 12)	None	200 g/L dose repeated 2 times
5	400 g/L NaP	50° C	None	200 g/L dose repeated 2 times
6	H2O2 (8%)	100 mg/L	EDTA (1:1 molar ratio); using FeEDTA	

The reactors were then placed on a roller table for a fourteen day period to receive gentle agitation and ensure adequate contact between the LNAPL and the oxidants. Treatment reactors # 3, 4, and 5 received two sodium persulfate oxidant doses of 200 g/L administered twice throughout the fourteen day period, and all vessels were vented as necessary.

The reactors were removed from the roller table on June 30, 2011 and the ARCADIS Treatability Laboratory conducted in-lab testing for total oxidant demand (TOD) and pH. TOD was determined by measuring the residual persulfate anion concentration by iodiometric titration with sodium thiosulfate (Kolthoff and Carr, 1953) using a 5 mL aliquot of sample extracted from each reactor by inserting a syringe needle through the septum closure. All bottles were vigorously shaken and inverted prior to drawing the samples so as to avoid extracting any free-phase LNAPL. pH was measured using full range EMD colorpHast pH indicator paper strips. LNAPL bands were also re-measured with a ruler, with no changes in LNAPL thickness observed. All reactors were then sent to TestAmerica in North Canton, Ohio, to be extracted in their entirety and analyzed for total petroleum hydrocarbons (TPH) by modified Method MDNRE 507.

2.2 Results

2.2.1 Total Oxidant Demand

The results of the TOD analysis are summarized in Table 2. TOD data from reactors # 1 and 2 (controls) from both AOI-40 and AOI-12 are not shown in the data chart, as there was no oxidant added to these reactors.

Table 2. Total Oxidant Demand

Total Oxidant Demand				
Sample ID	pH	Original Oxidant Addition	Oxidant Utilization	
	s.u.	(g/L)	(g/L)	% Utilization
#3 Iron Activated Fuel Oil	1	400	66.8	17%
#3 Iron Activated Hyd Oil	1	400	66.8	17%
#4 Alkaline Activated Fuel Oil	10	400	114.4	29%
#4 Alkaline Activated Hyd Oil	14	400	66.8	17%
#5 Heat Activated 50C Fuel Oil	1	400	328.6	82%
#5 Heat Activated 50C Hyd Oil	1	400	352.4	88%
#6 Fentons/EDTA Fuel Oil	7	80	79.9	100%
#6 Fentons/EDTA Hyd Oil	7	80	79.9	100%

The results of the TOD analysis illustrate that a portion of the sodium persulfate oxidant was utilized (between 17-88%) while the hydrogen peroxide present in the Fentons/EDTA oxidant treatments was utilized completely. Some activator chemistries applied with the sodium persulfate oxidant performed better than others as not only illustrated by percent utilization, but also with decreases in pH (persulfate consumption yields sulfuric acid). Treatment #'s 3, 5 and 6 performed similarly at both locations, while treatment #4 performed better with the AOI-40 fuel oil than the AOI-12 hydraulic oil as indicated by the larger decrease in pH and increase in percent utilization. Treatment #5 heat activated proved to be the best activator of sodium persulfate for both locations.

2.2.2 Total Petroleum Hydrocarbons

The results of TPH analysis at location AOI-40 (fuel oil) are presented in Table 3 and Figure 1 below.

Table 3. AOI-40 Total Petroleum Hydrocarbons

AOI-40 Fuel Oil: TPH Analysis			
Sample ID	Analyte		
	C10-C20	C20-C34	
	(µg/L)	(µg/L)	
#1 Room Temp Control	5,000,000	1,300,000	U
#2 50°C Control	5,100,000	1,200,000	U
#3 Iron Activated	5,200,000	1,100,000	U
#4 Alkaline Activated	4,900,000	1,000,000	U
#5 Heat Activated 50°C	4,300,000	1,100,000	U
#6 Fentons EDTA	5,500,000	1,300,000	U

U - Indicates the analyte was analyzed for but not detected

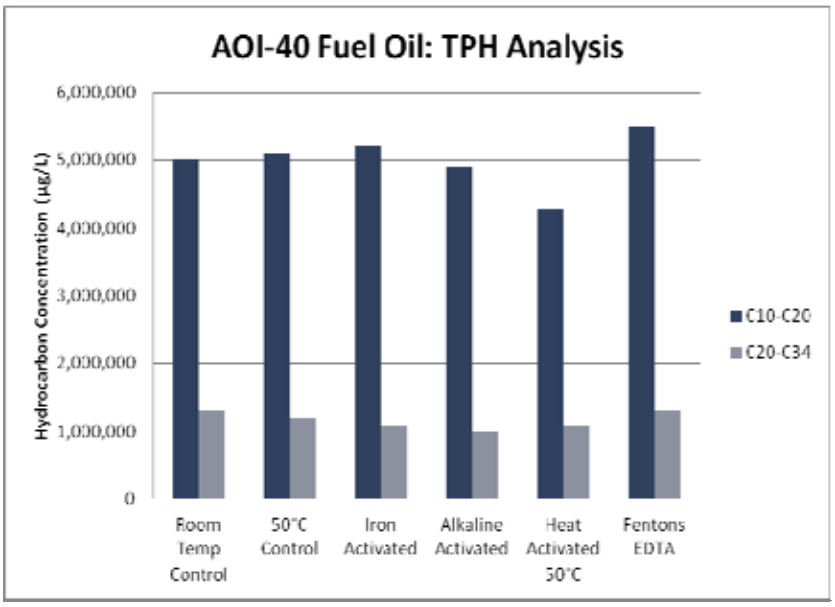


Figure 1. AOI-40 Total Petroleum Hydrocarbons

Both AOI-40 room temperature and heated control samples # 1 and 2 had similar concentrations of TPH C10-C20 and C20-C34 at an average of 5,050,000 and 1,250,000 micrograms per liter (µg/L) respectively. Using these averages, the following percentage differences were calculated for each treatment for comparison:

- Treatment #3, iron activated sodium persulfate, increased TPH C10-C20 by 3% and decreased C20-C34 by 12%.
- Treatment #4, alkaline activated sodium persulfate, decreased TPH C10-C20 by 3% and decreased C20-C34 by 12%.
- Treatment #5, thermally activated sodium persulfate, decreased TPH C10-C20 by 15% and decreased C20-C34 by 12%.
- Treatment #6, Fentons/EDTA, increased TPH C10-C20 by 9% and increased C20-C34 by 12%

The results of TPH analysis at location AOI-12 (hydraulic oil) are presented in Table 4 and Figure 2 below.

Table 4. AOI-12 Total Petroleum Hydrocarbons

AOI-12 Hydraulic Oil: TPH Analysis		
Sample ID	Analyte	
	C10-C20 (µg/L)	C20-C34 (µg/L)
#1 Room Temp Control	7,800,000	3,300,000
#2 50°C Control	8,800,000	3,700,000
#3 Iron Activated	8,000,000	3,900,000
#4 Alkaline Activated	7,200,000	3,300,000
#5 Heat Activated 50°C	7,900,000	3,900,000
#6 Fentons EDTA	7,800,000	3,400,000

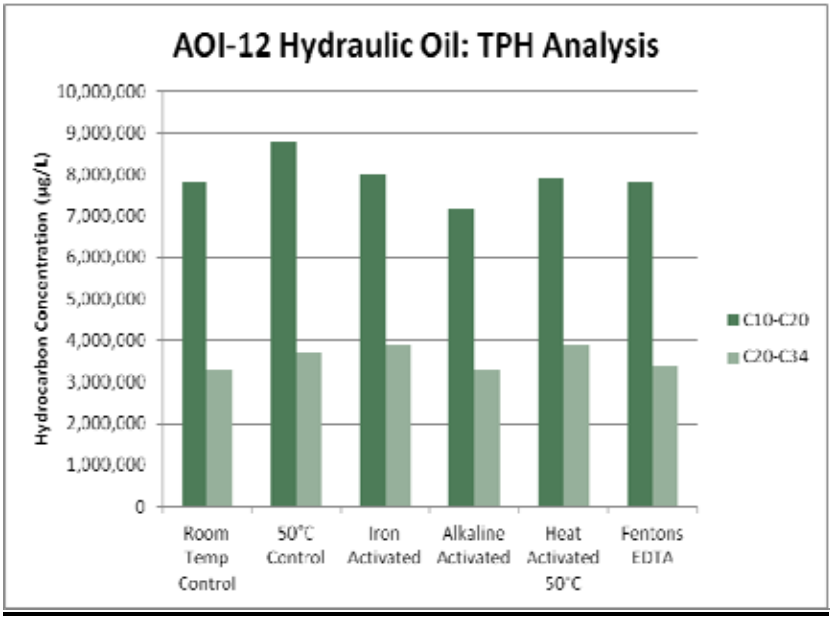


Figure 2. AOI-12 Total Petroleum Hydrocarbons

Both AOI-12 room temperature and heated control samples # 1 and 2 had similar concentrations of TPH C10-C20 and C20-C34 at an average of 8,300,000 and 3,500,000 micrograms per liter (µg/L) respectively. Using these averages, the following percentage differences were calculated for each treatment for comparison:

- Treatment #3, iron activated sodium persulfate, decreased TPH C10-C20 by 4% and increased C20-C34 by 11%.
- Treatment #4, alkaline activated sodium persulfate, decreased TPH C10-C20 by 14% and decreased C20-C34 by 6%.
- Treatment #5, thermally activated sodium persulfate decreased TPH C10-C20 by 5% and increased C20-C34 by 11%.
- Treatment #6, Fentons/EDTA, decreased TPH C10-C20 by 6% and decreased C20-C34 by 3%

2.3 Discussion

No significant reduction in TPH concentration was observed for any of the treatments from either AOI-40 or AOI-12, even though the oxidant concentration added to the reactors was much higher than would typically be used in the field. The mass of oxidant added approached being enough to completely oxidize the carbon present as TPH contaminants. The relative lack of oxidation is believed to be due to the fact that ISCO is primarily effective on dissolved-phase contaminants, rather than nonaqueous phase contaminants. For example, reactors # 3, 4, and 5 received a total concentration of 400 g/L sodium persulfate, which is roughly twenty times greater than typical concentrations used in the field, and demonstrated insignificant treatment of the free-phase LNAPL.

2.4 Surfactant Enhanced ISCO

2.4.1 Methods

In December, 2011, the Treatability Laboratory carried out additional ISCO testing which investigated the use of a surfactant to enhance LNAPL destruction with alkaline activated sodium persulfate. Two 250 mL reactors were created, one with LNAPL from AOI-40, and the other with LNAPL from AOI-12. Both reactors were set up with identical dosages of LNAPL, groundwater, deionized water, sodium persulfate, and sodium hydroxide as the #4 reactors in Table 1 above, but with the addition of 2% Aerosol OT (AOT) surfactant (Sigma-Aldrich 98% dioctyl sulfosuccinate sodium salt, CAS # 577-11-7) by weight. AOT was selected because it demonstrated the largest reduction in interfacial tension (IFT) of the LNAPL following testing performed by PTS Laboratories.

In order to ensure consistency and comparability between the reactors from the initial ISCO phase and the surfactant phase, both reactors received 200 g/L, or half of the final target concentration of sodium persulfate during initial setup. The reactors were then placed on a roller table for gentle agitation for seven days, after which a second dose of 200 g/L sodium persulfate was added to each. The reactors were again placed on the roller table for an additional seven days of gentle agitation and mixing.

After fourteen total days of agitation the reactors were removed from the roller table, and a 5 mL sample was obtained from each for in-lab TOD analysis using the syringe extraction method described in section

2.1 above. Both reactors were then sent to TestAmerica North Canton to be extracted in their entirety and analyzed for total petroleum hydrocarbons (TPH) by modified Method MDNRE 507.

2.4.2. Results

Results of TOD testing are presented in Table 5.

Table 5. Surfactant-Enhanced Total Oxidant Demand

Surfactant-Enhanced ISCO: Total Oxidant Demand			
Sample ID	Original Oxidant Addition (g/L)	Oxidant Utilization (g/L)	% Utilization
AOI-40	400	138.2	35%
AOI-12	400	126.3	32%

Both the AOI-40 and AOI-12 reactors with the AOT exhibited greater oxidant utilization than the identical reactors without surfactant from phase 1. Oxidant utilization increased by 6% in the AOI-40 reactor, and by 15% in the AOI-12 reactor with the addition of 2% AOT surfactant by weight. It is possible that some of the oxidant consumption occurred as a result of the oxidant chemically attacking the surfactant molecules present.

The results of TPH analysis are presented in Table 6 below. For comparative purposes, the TPH results of the Room Temp Control and Alkaline Activated from the initial ISCO testing phase have also been added to this table.

Table 6. Surfactant-Enhanced Total Petroleum Hydrocarbons

Surfactant-Enhanced ISCO: Total Petroleum Hydrocarbons			
Treatment:	Room Temp Control (8/2/2011)	Alkaline Activated (8/2/2011)	Surfactant + Alkaline Activated (1/13/2012)
AOI-40			
C10-C20 TPH (µg/L)	5,000,000	4,900,000	6,400,000
C20-C34 TPH (µg/L)	1,300,000	1,000,000	2,100,000
AOI-12			
C10-C20 TPH (µg/L)	7,800,000	7,200,000	11,000,000
C20-C34 TPH (µg/L)	3,300,000	3,300,000	7,000,000

TPH C10-C20 concentrations in the AOI-40 surfactant-enhanced treatment were 28% greater than in the Room Temp Control and 31% greater than in the Alkaline Activated treatment from initial testing. TPH C20-C34 concentrations in the AOI-40 surfactant-enhanced treatment were 62% greater than in the Room Temp Control and 110% greater than in the Alkaline Activated treatment from initial testing.

TPH C10-C20 concentrations in the AOI-12 surfactant-enhanced treatment were 41% greater than in the Room Temp Control and 53% greater than in the Alkaline Activated treatment from initial testing. TPH C20-C-34 concentrations in the AOI-12 surfactant-enhanced treatment were 112% greater than in both the Room Temp Control and the Alkaline Activated treatment from initial testing.

2.4.3. Discussion

The addition of AOT surfactant serves to reduce the interfacial tension between the LNAPL and enhance the solubility of the LNAPL into groundwater. The testing performed at the ARCADIS Treatability Laboratory does not allow for the quantification of an increase in solubility of the LNAPL, however, it does demonstrate that regardless of any effect on LNAPL solubility, the addition of AOT does not improve LNAPL destruction with sodium persulfate under alkaline activation conditions.

While there was an increase in TOD when compared with the alkaline activated reactors from initial testing, there was no observable destruction of LNAPL with the addition of AOT surfactant in either reactor during surfactant-enhanced ISCO testing.

One potential cause for the increase in TOD for both AOI-40 and AOI-12 is that the AOT acted as an additional oxidant demand for the sodium persulfate, leaving less sodium persulfate to interact with LNAPL. This would lead the percent utilization values in Table 5 to be skewed artificially high.

3. Thermally-Enhanced LNAPL Recovery

3.1 Methods and Reactor Design

The ARCADIS Treatability Laboratory conducted bench scale testing to determine the efficacy of thermally enhanced LNAPL recovery at the Buick City Site. Soil cores from locations LIF-16-017 (12-24) (fuel oil location) and LIF-12-010 (18-20) (hydraulic oil location) were received at the ARCADIS laboratory located in Durham, North Carolina, and the in situ density of each soil was calculated by determining the mass of soil inside the known volume of the soil core. Both soils were characterized as dark brown hard clay with some pebbles, and no visible LNAPL present. Soils were individually homogenized by hand using stainless steel utensils and pebbles larger than 3/8 inch were removed. Duplicate subsamples of each soil were submitted to TestAmerica in North Canton, Ohio, for baseline TPH analysis by modified Method 8015/MDNRE 507. Homogenized soils were separately packed into two custom-built eight-inch long, two-inch diameter stainless steel pipe reactors at a calculated rate to achieve the target in-situ densities for

each location, 2.4 g/cm3 for LIF-16-017 (12-24), and 2.2 g/cm3 for LIF-12-010 (18-20), previously determined from undisturbed core samples. Each soil reactor was heated on separate occasions as described below.

Both ends of each pipe were capped with specially made, stainless steel, NPT-threaded caps. The top cap fitted with a stainless steel cup joint to attach dean stark distillation glassware, and the bottom cap fitted with a 1/4" stainless steel female Swagelok fitting to attach a nitrogen gas line (Figure 3). Glass wool was inserted on the inside both caps to prevent soil particles from exiting through any reactor fittings. Before heating, each filled and capped steel pipe was placed vertically on a brick inside a fume hood and supported by a stainless steel rack system by means of an adjustable chain clamp. . A dean stark distillation glassware assembly was attached to the cup joint on the top cap of the steel pipe reactor by an adjustable metal clamp, and was further supported by a separate clamp connected directly to the supporting rack system. A glass condenser, through which cool tap water flowed, was attached to the top of the dean stark glassware. Two individual six foot lengths of 1 inch-wide heat tape were used to heat each test vessels. One length was used to wrap the stainless steel pipe, while the other was used to wrap the dean-stark glassware. Each heat tape was connected to a dedicated variac to maintain a controlled target temperature through the heating period. . A thermocouple probe was inserted into the top of the dean stark glassware and into the cup joint of the stainless steel reactor cap to provide continuous monitoring of the soil temperature. Finally, the entire setup was wrapped in fiberglass insulation to prevent heat loss (Figure 4). Each reactor was separately heated at a target temperature of approximately 380°C for a testing period of three days. During both test periods, the temperature, distillate volume and any visual observations were noted and are reported in Sections 3.2 and 3.3.

3.2 LIF-16-017 (12-24) Testing

On August 30, 2011, 1,024 grams of homogenized soil from boring LIF-16-017 (12-14) (fuel oil location) was assembled in a stainless steel pipe reactor as described in section 3.1. Thermal testing was initiated on August 31, 2011, and significant observations are described as follows:

- 8/31/2011, 9:00 - At a temperature of 230°C, approximately 0.25 mL of pale-yellow hydrocarbon distillate was observed accumulating in the graduated portion of the dean stark glassware.

- 9:45 - At a temperature of 300°C, there was approximately 0.5 mL of dark yellow/brown hydrocarbon distillate and approximately 0.5 mL of water in the graduated portion of the dean stark glassware. Smoke or vapor was observed escaping from underneath the fiberglass insulation that covered the stainless steel pipe.

- 10:10 - At a temperature of 323°C, there was approximately 1 mL of hydrocarbon distillate over approximately 0.75 mL of water. Smoke continued to escape from beneath the fiberglass insulation.

- 14:24 - At a temperature of 331°C, additional fiberglass insulation was wrapped around the dean stark glassware and thermocouple to improve heat trapping.

- 14:37 – At a temperature of 417°C, there was approximately 2 mL distillate on top of 2 mL water.

- 15:19 – At a temperature of 401°C, there was approximately 2.5 mL hydrocarbon distillate on top of 2 mL water.

- 9/3/2011, 10:35 – Testing ceased.

Upon completion of the thermally enhanced LNAPL recovery period, a total of 2.5 mL hydrocarbon distillate and 2 mL water was collected from location LIF-16-017 (12-14) (Figure 5). All resulting distillate was collected in a 20 mL glass vial and the reactor was disassembled and the treated soil extracted from the pipe reactor and homogenized in a stainless steel bowl with stainless steel implements. Duplicate soil samples were sent to TestAmerica for TPH analysis by modified Method 8015/MDNRE 507.

3.3 LIF-12-010 (18-20) Testing

On October 19, 2011, 1,015 grams of homogenized soil from boring LIF-12-010 (18-20) (hydraulic oil location) was assembled in a stainless steel pipe reactor as described in section 3.1. Thermal testing was initiated on October 25, 2011, and significant observations are described as follows:

- 10/25/2011, 13:13 – At a temperature of 103°C, water was observed collecting in the graduated portion of the dean stark glassware.

- 13:30 – At a temperature of 162°C, 25 mL of water had collected in the dean stark glassware and was subsequently transferred into a 40 mL glass vial. Water continues to collect in the dean stark glassware.

- 13:45 – At a temperature of 233°C, a small yellow band of hydrocarbon distillate was observed on top of approximately 10 mL water.

- 14:01 – At a temperature of 290°C, 12.5 mL water was transferred from the dean stark glassware into a 20 mL glass vial. Approximately 0,25 mL hydrocarbon distillate remains on top of approximately 0.5 mL water.

- 14:54 – At a temperature of 425°C, there was approximately 1.5 mL of hydrocarbon distillate on top of 1 mL of water.

- 15:51 – At a temperature of 402°C, there was approximately 2 mL of hydrocarbon distillate on top of 1 mL of water.

- 10/28/2011, 14:05 – Testing ceased.

Upon completion of the thermally enhanced LNAPL recovery period, a total of 1.75 mL hydrocarbon distillate and 38.5 mL water was collected from location LIF-12-010 (18-20) (Figure 6). All resulting distillate was collected into three glass vials and the reactor was disassembled and the treated soil was extracted from the pipe reactor and homogenized in a stainless steel bowl with stainless steel implements.. Duplicate soil samples were sent to TestAmerica for TPH analysis by modified Method 8015/MDNRE 507.

3.4 Results

3.4.1 Total Petroleum Hydrocarbons

The results of the TPH analysis for sample LIF-16-017 (12-14) are presented in Table 7. Duplicate untreated baseline soil from this location had an average C10-C20 TPH concentration of 3,400 milligrams per kilogram (mg/kg), and an average C20-C34 TPH concentration of 13,000 mg/kg. After thermal testing, the duplicate sample had an average concentration of less than 17 mg/kg for both C10-C20 and C-20-C34 TPH. This translates into an average percent reduction of 99.5% and 99.9% for C10-C20 TPH and C20-C34 TPH respectively. Because the duplicate C10-C20 and C20-C34 TPH concentrations in the treated soil sample were not detected in the sample, the reporting limit concentration of 17 mg/kg was used to calculate percent reduction.

Table 7. LIF-016-017 (12-14) Total Petroleum Hydrocarbons

LIF-16-017 (12-14) Total Petroleum Hydrocarbons								
Sample ID	Baseline		Heated				Percent Reduction	
	TPH, C10-C20 (mg/kg)	TPH, C20-C34 (mg/kg)	TPH, C10-C20 (mg/kg)		TPH, C20-C34 (mg/kg)		TPH, C10-C20	TPH, C20-C34
LIF-16-017 (12-14)	3,500	14,000	<	17	<	17	99.51%	99.88%
LIF-16-017 (12-14) Dup	3,300	12,000	<	17	<	17	99.48%	99.86%
Average	**3,400**	**13,000**	**<**	**17**	**<**	**17**	**99.50%**	**99.87%**

The results of the TPH analysis for sample LIF-12-010 (18-20) are presented in Table 8. Duplicate untreated baseline soil from this location had an average C10-C20 TPH concentration of 680 mg/kg, and an average C20-C34 TPH concentration of 3,350 mg/kg. Post thermal testing, the duplicate sample had an average C10-C20 TPH concentration of less than 84 mg/kg and an average C-20-C34 TPH concentration of 1,350 mg/kg. This translates into an average percent reduction of 87.6% and 60.0% for C10-C20 TPH and C20-C34 TPH respectively. Because the duplicate C10-C20 TPH concentrations in the

treated soil sample were not detected in the sample, the reporting limit concentration of 84 mg/kg was used to calculate percent reduction.

Table 8. LIF-12-010 (18-20) Total Petroleum Hydrocarbons

LIF-12-010 (18-20) Total Petroleum Hydrocarbons								
Sample ID	Baseline		Heated				Percent Reduction	
	TPH, C10-C20	TPH, C20-C34	TPH, C10-C20		TPH, C20-C34		TPH, C10-C20	TPH, C20-C34
	(mg/kg)	(mg/kg)	(mg/kg)		(mg/kg)			
LIF-12-010 (18-20)	660	3,200	<	84		1,100	87.27%	65.63%
LIF-12-010 (18-20) Dup	700	3,500	<	84		1,600	88.00%	54.29%
Average	**680**	**3,350**	**<**	**84**		**1,350**	**87.64%**	**59.96%**

3.5 Discussion

The smoke or vapor observed escaping from the bottom of the fiberglass insulation during testing on LIF-16-017 was most likely due to inadequate thread sealing between the stainless steel pipe and bottom cap. Because there was a significant amount of solidified hydrocarbon mass baked onto the dean-stark glassware and condenser at the end of testing, the final distillate volumes recovered are likely lower than the actual mass removed by heating.

Figure 1 Stainless Steel Pipe, Caps, and Dean-Stark Glassware.

Figure 4. Insulated Thermal Testing Setup**.**

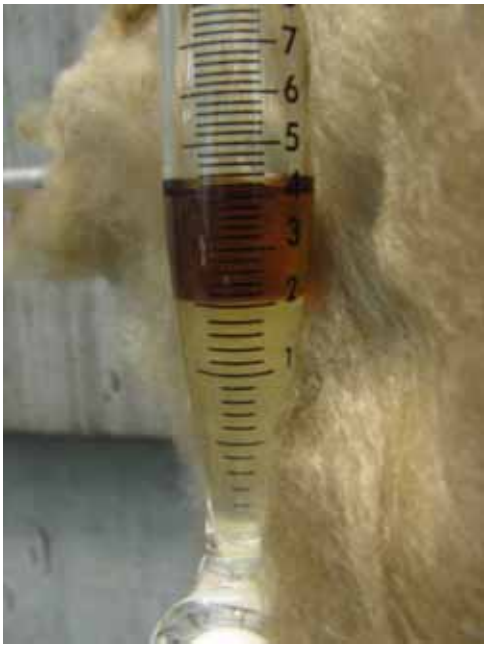


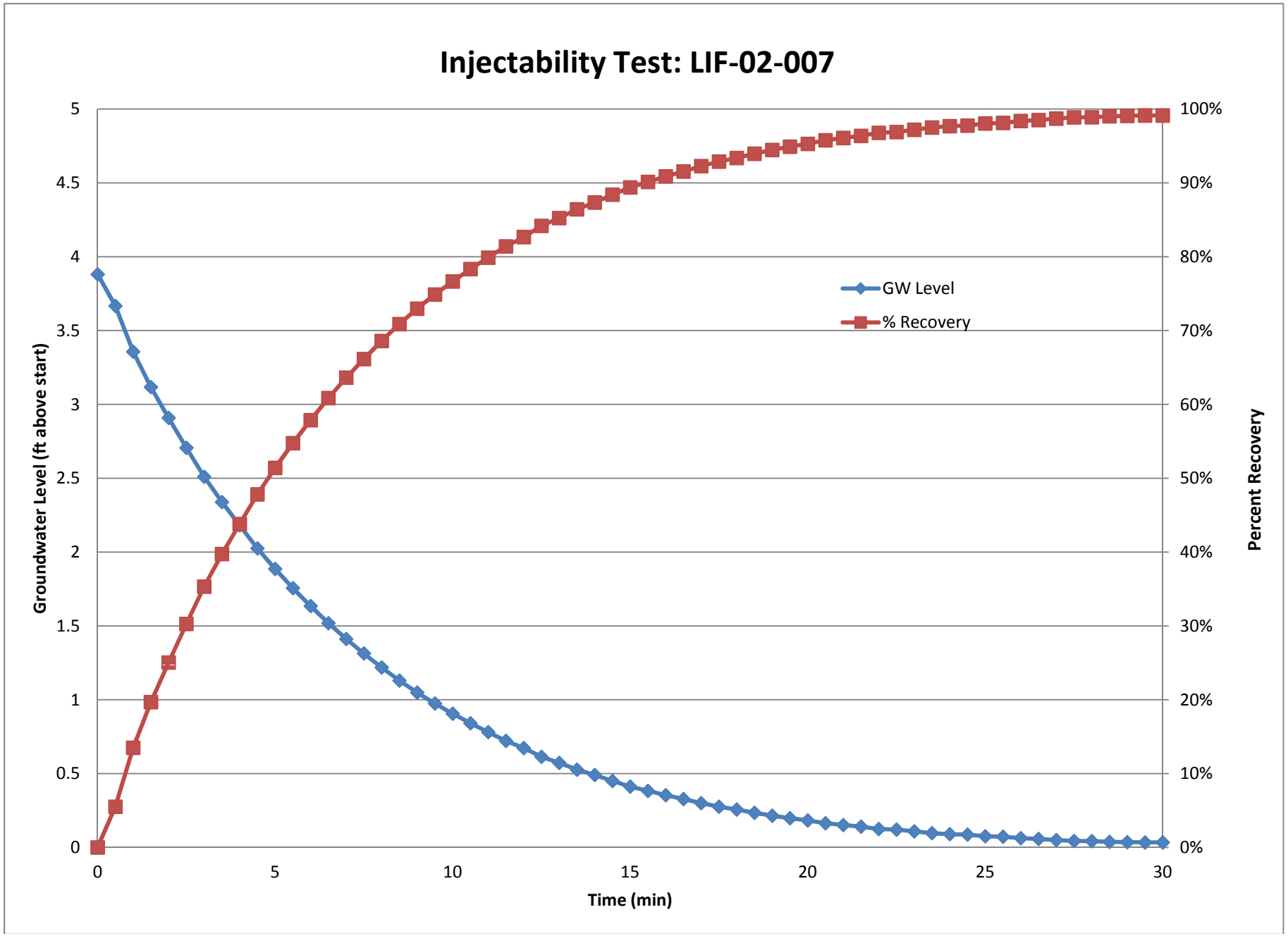
Figure 5. Distillate collected from LIF-16-017 (12-24)

Figure 6. Distillate collected from LIF-12-010 (18-20)

ARCADIS

Appendix **D**

Injectability Test Results



Report Date: ##########
Application: WinSitu.exe
Application Version: 5.6.21.0

Log File Properties
File Name **LIF-02-007_2011-10-14_16-40-17-564.wsl**
Create Date ##########

Device Properties
Device Level TROLL 500
Site Default Site
Device Name
Serial Number 196279
Firmware Version 2.06
Hardware Version 3
Device Address 1
Device Comm Cfg 19200 8 Even 1 (Modbus-RTU)
Used Memory 3
Used Battery 0

Log Configuration
Log Name LIF-02-007
Created By cesnyder
Computer Name MI03L-CESNYDER
Application WinSitu.exe
Application Version 5.6.21.0
Create Date 10/14/2011 1:50:44 PM Eastern Daylight Time
Log Setup Time Zon Eastern Daylight Time
Notes Size(bytes) 4096
Overwrite when full Disabled
Scheduled Start Tim Manual Start
Scheduled Stop Tim No Stop Time
Type Fast Linear
Interval Days: 0 hrs: 00 mins: 00 secs: 30

Level Reference Settings At Log Creation
Level Measurement Mode Level Surface Elevation
Specific Gravity 0.999
Level Reference Mode: Set new reference
Level Reference Value: 0 (ft)
Level Reference Head Pressure 4.91149 (PSI)

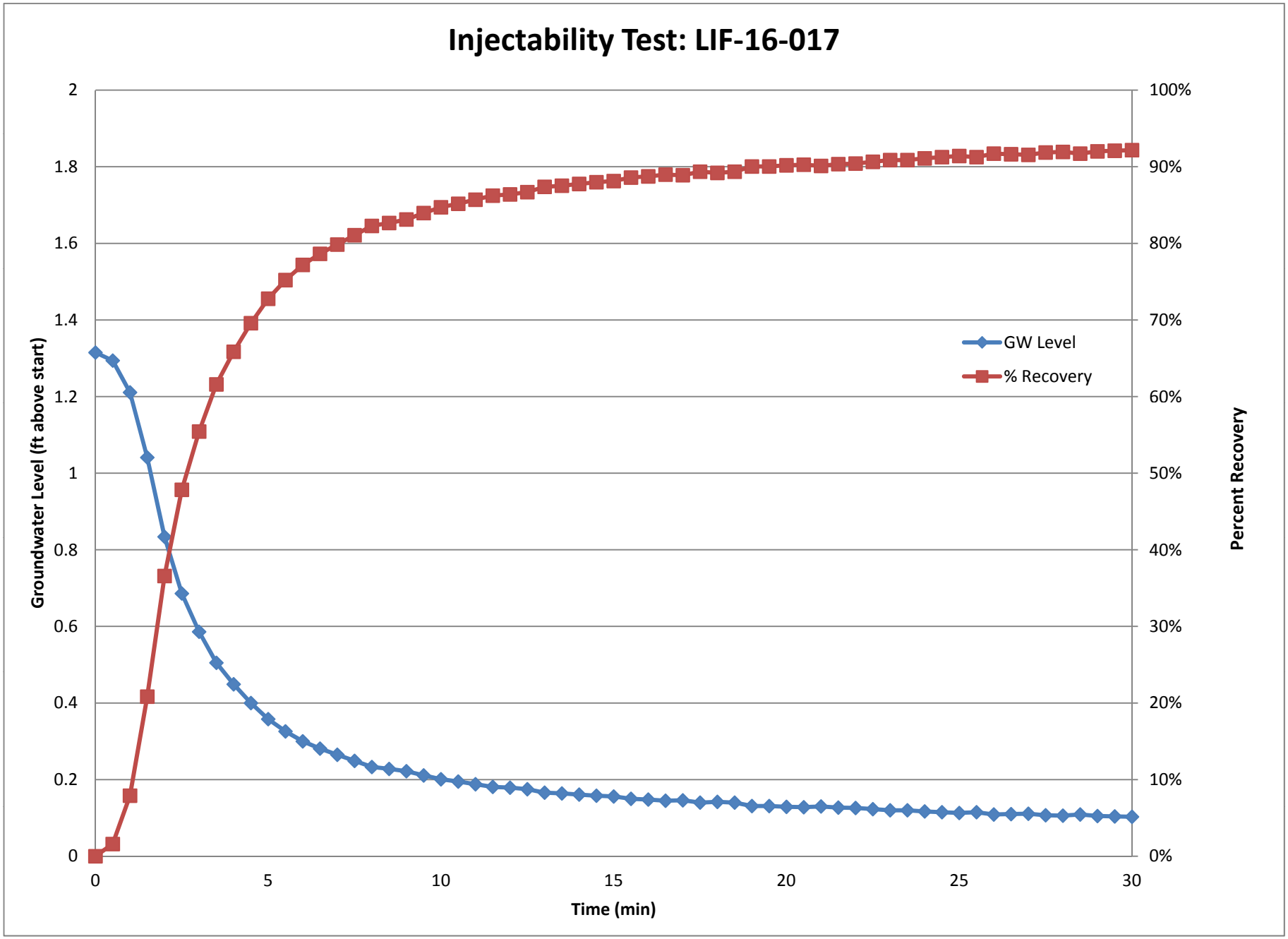
Other Log Settings
Depth of Probe: 11.3365 (ft)
Head Pressure: 4.90976 (PSI)
Temperature: 16.8669 (C)

Log Notes:
Date and Time Note
10/14/2011 13:50 Used Battery: 0% Used Memory: 6% User Name: cesnyder
10/14/2011 13:51 Manual Start Command
10/14/2011 16:40 Log Download - Used Battery: 0% Used Memory: 6% User Name: cesnyder

Log Data:
Record Count 339
Sensors 1
1 196279 Pressure/Temp 30 PSIG (21m/69ft)

Time Zone: Eastern Daylight Time

Date and Time	Elapsed Time Seconds	Sensor: Pres(G) 69ft SN#: 196279 Level Surface Elevation (ft)	Time	GW Level	% Recovery
10/14/2011 13:51	0	0.015			
10/14/2011 13:55	240.001	3.896	0	3.881	0%
10/14/2011 13:55	270.001	3.682	0.5	3.667	6%
10/14/2011 13:56	300.001	3.372	1	3.357	14%
10/14/2011 13:56	330.001	3.132	1.5	3.117	20%
10/14/2011 13:57	360.001	2.924	2	2.909	25%
10/14/2011 13:57	390.001	2.721	2.5	2.706	30%
10/14/2011 13:58	420.001	2.525	3	2.51	35%
10/14/2011 13:58	450.001	2.354	3.5	2.339	40%
10/14/2011 13:59	480.001	2.196	4	2.181	44%
10/14/2011 13:59	510.001	2.04	4.5	2.025	48%
10/14/2011 14:00	540.001	1.901	5	1.886	51%
10/14/2011 14:00	570.001	1.771	5.5	1.756	55%
10/14/2011 14:01	600.001	1.65	6	1.635	58%
10/14/2011 14:01	630.001	1.534	6.5	1.519	61%
10/14/2011 14:02	660.001	1.427	7	1.412	64%
10/14/2011 14:02	690.001	1.329	7.5	1.314	66%
10/14/2011 14:03	720.001	1.234	8	1.219	69%
10/14/2011 14:03	750.001	1.145	8.5	1.13	71%
10/14/2011 14:04	780.001	1.064	9	1.049	73%
10/14/2011 14:04	810.001	0.99	9.5	0.975	75%
10/14/2011 14:05	840.001	0.921	10	0.906	77%
10/14/2011 14:05	870.001	0.856	10.5	0.841	78%
10/14/2011 14:06	900.001	0.796	11	0.781	80%
10/14/2011 14:06	930.001	0.737	11.5	0.722	81%
10/14/2011 14:07	960.001	0.688	12	0.673	83%
10/14/2011 14:07	990.001	0.629	12.5	0.614	84%
10/14/2011 14:08	1020.001	0.588	13	0.573	85%
10/14/2011 14:08	1050.001	0.542	13.5	0.527	86%
10/14/2011 14:09	1080.001	0.506	14	0.491	87%
10/14/2011 14:09	1110.001	0.465	14.5	0.45	88%
10/14/2011 14:10	1140.001	0.427	15	0.412	89%
10/14/2011 14:10	1170.001	0.398	15.5	0.383	90%
10/14/2011 14:11	1200.001	0.369	16	0.354	91%
10/14/2011 14:11	1230.001	0.343	16.5	0.328	92%
10/14/2011 14:12	1260.001	0.315	17	0.3	92%
10/14/2011 14:12	1290.001	0.291	17.5	0.276	93%
10/14/2011 14:13	1320.001	0.272	18	0.257	93%
10/14/2011 14:13	1350.001	0.25	18.5	0.235	94%
10/14/2011 14:14	1380.001	0.23	19	0.215	94%
10/14/2011 14:14	1410.001	0.213	19.5	0.198	95%
10/14/2011 14:15	1440.001	0.198	20	0.183	95%
10/14/2011 14:15	1470.001	0.179	20.5	0.164	96%
10/14/2011 14:16	1500.001	0.167	21	0.152	96%
10/14/2011 14:16	1530.001	0.156	21.5	0.141	96%
10/14/2011 14:17	1560.001	0.14	22	0.125	97%
10/14/2011 14:17	1590.001	0.136	22.5	0.121	97%
10/14/2011 14:18	1620.001	0.124	23	0.109	97%
10/14/2011 14:18	1650.001	0.112	23.5	0.097	98%
10/14/2011 14:19	1680.001	0.105	24	0.09	98%
10/14/2011 14:19	1710.001	0.102	24.5	0.087	98%
10/14/2011 14:20	1740.001	0.091	25	0.076	98%
10/14/2011 14:20	1770.001	0.088	25.5	0.073	98%
10/14/2011 14:21	1800.001	0.078	26	0.063	98%
10/14/2011 14:21	1830.001	0.073	26.5	0.058	99%
10/14/2011 14:22	1860.001	0.065	27	0.05	99%
10/14/2011 14:22	1890.001	0.059	27.5	0.044	99%
10/14/2011 14:23	1920.001	0.058	28	0.043	99%
10/14/2011 14:23	1950.001	0.053	28.5	0.038	99%
10/14/2011 14:24	1980.001	0.051	29	0.036	99%
10/14/2011 14:24	2010.001	0.049	29.5	0.034	99%
10/14/2011 14:25	2040.001	0.049	30	0.034	99%



Report Date: 10/14/2011 16:15
Application: WinSitu.exe
Application Version: 5.6.21.0

Log File Properties
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Create Date 10/14/2011 16:15

Device Properties
Device Level TROLL 500
Site Default Site
Device Name
Serial Number 196195
Firmware Version 2.06
Hardware Version 3
Device Address 1
Device Comm Cfg 19200 8 Even 1 (Modbus-RTU)
Used Memory 3
Used Battery 0

Log Configuration
Log Name LIF-16-017
Created By cesnyder
Computer Name MI03L-CESNYDER
Application WinSitu.exe
Application Version 5.6.21.0
Create Date 10/14/2011 12:19:30 PM Eastern Daylight Time
Log Setup Time Zo Eastern Daylight Time
Notes Size(bytes) 4096
Overwrite when full Disabled
Scheduled Start Ti Manual Start
Scheduled Stop Tir No Stop Time
Type Fast Linear
Interval Days: 0 hrs: 00 mins: 00 secs: 30

Level Reference Settings At Log Creation
Level Measurement Mode Level Surface Elevation
Specific Gravity 0.999
Level Reference Mode: Set new reference
Level Reference Value: 0 (ft)
Level Reference Head Pressure 2.79855 (PSI)

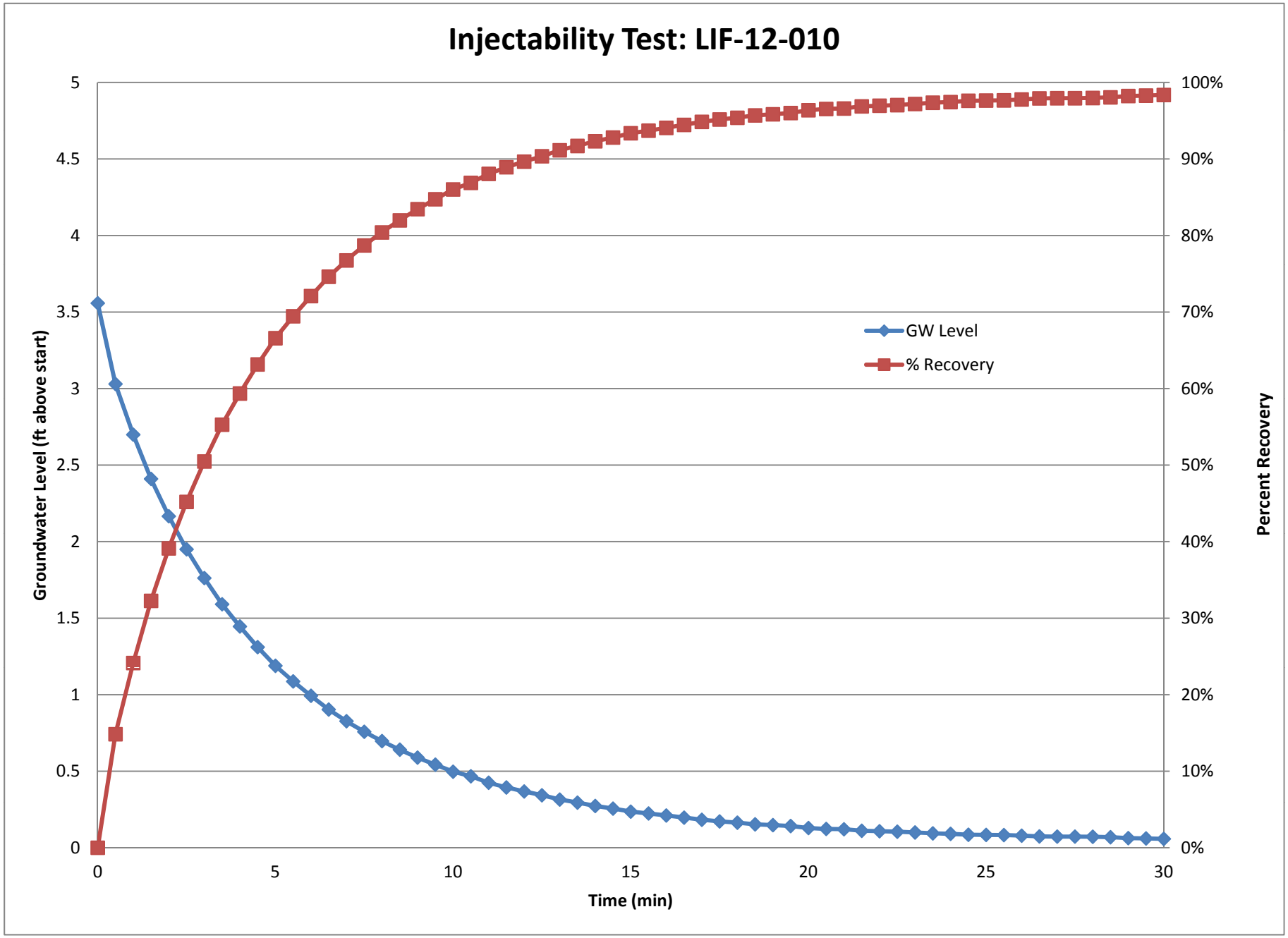
Other Log Settings
Depth of Probe: 6.45459 (ft)
Head Pressure: 2.79544 (PSI)
Temperature: 17.2162 (C)

Log Notes:
Date and Time Note
10/14/2011 12:19 Used Battery: 0% Used Memory: 6% User Name: cesnyder
10/14/2011 12:19 Manual Start Command
10/14/2011 16:11 Log Download - Used Battery: 0% Used Memory: 6% User Name: cesnyder
10/14/2011 16:14 Log Download - Used Battery: 0% Used Memory: 6% User Name: cesnyder

Log Data:
Record Count 471

Sensors 1
1 196195 Pressure/Temp 30 PSIG (21m/69ft)
Time Zone: Eastern Daylight Time

Date and Time	Elapsed Time Seconds	Sensor: Pres(G) 69ft SN#: 196195 Level Surface Elevation (ft)	Time	GW Level	% Recovery
10/14/2011 12:20	30.001	0.003			
10/14/2011 12:35	930.001	1.318	0	1.315	0%
10/14/2011 12:35	960.001	1.297	0.5	1.294	2%
10/14/2011 12:36	990.001	1.214	1	1.211	8%
10/14/2011 12:36	1020.001	1.044	1.5	1.041	21%
10/14/2011 12:37	1050.001	0.837	2	0.834	37%
10/14/2011 12:37	1080.001	0.689	2.5	0.686	48%
10/14/2011 12:38	1110.001	0.589	3	0.586	55%
10/14/2011 12:38	1140.001	0.508	3.5	0.505	62%
10/14/2011 12:39	1170.001	0.452	4	0.449	66%
10/14/2011 12:39	1200.001	0.403	4.5	0.4	70%
10/14/2011 12:40	1230.001	0.361	5	0.358	73%
10/14/2011 12:40	1260.001	0.329	5.5	0.326	75%
10/14/2011 12:41	1290.001	0.303	6	0.3	77%
10/14/2011 12:41	1320.001	0.284	6.5	0.281	79%
10/14/2011 12:42	1350.001	0.268	7	0.265	80%
10/14/2011 12:42	1380.001	0.252	7.5	0.249	81%
10/14/2011 12:43	1410.001	0.236	8	0.233	82%
10/14/2011 12:43	1440.001	0.231	8.5	0.228	83%
10/14/2011 12:44	1470.001	0.225	9	0.222	83%
10/14/2011 12:44	1500.001	0.214	9.5	0.211	84%
10/14/2011 12:45	1530.001	0.204	10	0.201	85%
10/14/2011 12:45	1560.001	0.198	10.5	0.195	85%
10/14/2011 12:46	1590.001	0.191	11	0.188	86%
10/14/2011 12:46	1620.001	0.184	11.5	0.181	86%
10/14/2011 12:47	1650.001	0.182	12	0.179	86%
10/14/2011 12:47	1680.001	0.178	12.5	0.175	87%
10/14/2011 12:48	1710.001	0.169	13	0.166	87%
10/14/2011 12:48	1740.001	0.167	13.5	0.164	88%
10/14/2011 12:49	1770.001	0.164	14	0.161	88%
10/14/2011 12:49	1800.001	0.161	14.5	0.158	88%
10/14/2011 12:50	1830.001	0.159	15	0.156	88%
10/14/2011 12:50	1860.001	0.153	15.5	0.15	89%
10/14/2011 12:51	1890.001	0.151	16	0.148	89%
10/14/2011 12:51	1920.001	0.148	16.5	0.145	89%
10/14/2011 12:52	1950.001	0.149	17	0.146	89%
10/14/2011 12:52	1980.001	0.143	17.5	0.14	89%
10/14/2011 12:53	2010.001	0.145	18	0.142	89%
10/14/2011 12:53	2040.001	0.143	18.5	0.14	89%
10/14/2011 12:54	2070.001	0.134	19	0.131	90%
10/14/2011 12:54	2100.001	0.134	19.5	0.131	90%
10/14/2011 12:55	2130.001	0.132	20	0.129	90%
10/14/2011 12:55	2160.001	0.131	20.5	0.128	90%
10/14/2011 12:56	2190.001	0.133	21	0.13	90%
10/14/2011 12:56	2220.001	0.13	21.5	0.127	90%
10/14/2011 12:57	2250.001	0.129	22	0.126	90%
10/14/2011 12:57	2280.001	0.126	22.5	0.123	91%
10/14/2011 12:58	2310.001	0.123	23	0.12	91%
10/14/2011 12:58	2340.001	0.123	23.5	0.12	91%
10/14/2011 12:59	2370.001	0.12	24	0.117	91%
10/14/2011 12:59	2400.001	0.118	24.5	0.115	91%
10/14/2011 13:00	2430.001	0.116	25	0.113	91%
10/14/2011 13:00	2460.001	0.118	25.5	0.115	91%
10/14/2011 13:01	2490.001	0.112	26	0.109	92%
10/14/2011 13:01	2520.001	0.113	26.5	0.11	92%
10/14/2011 13:02	2550.001	0.114	27	0.111	92%
10/14/2011 13:02	2580.001	0.11	27.5	0.107	92%
10/14/2011 13:03	2610.001	0.109	28	0.106	92%
10/14/2011 13:03	2640.001	0.112	28.5	0.109	92%
10/14/2011 13:04	2670.001	0.108	29	0.105	92%
10/14/2011 13:04	2700.001	0.107	29.5	0.104	92%
10/14/2011 13:05	2730.001	0.106	30	0.103	92%



Report Date: 10/14/2011 17:10
Application: WinSitu.exe
Application Version: 5.6.21.0

Log File Properties
File Name **LIF-12-010_2011-10-14_17-10-15-722.wsl**
Create Date 10/14/2011 17:10

Device Properties
Device Level TROLL 500
Site Default Site
Device Name
Serial Number 196238
Firmware Version 2.06
Hardware Version 3
Device Address 1
Device Comm Cfg 19200 8 Even 1 (Modbus-RTU)
Used Memory 0
Used Battery 0

Log Configuration
Log Name LIF-12-010
Created By cesnyder
Computer Name MI03L-CESNYDER
Application WinSitu.exe
Application Version 5.6.21.0
Create Date 10/14/2011 3:36:48 PM Eastern Daylight Time
Log Setup Time Zor Eastern Daylight Time
Notes Size(bytes) 4096
Overwrite when full Disabled
Scheduled Start Tim Manual Start
Scheduled Stop Tim No Stop Time
Type Fast Linear
Interval Days: 0 hrs: 00 mins: 00 secs: 30

Level Reference Settings At Log Creation
Level Measurement Mode Level Surface Elevation
Specific Gravity 0.999
Level Reference Mode: Set new reference
Level Reference Value: 0 (ft)
Level Reference Head Pressure 4.48619 (PSI)

Other Log Settings
Depth of Probe: 10.3614 (ft)
Head Pressure: 4.48746 (PSI)
Temperature: 17.8749 (C)

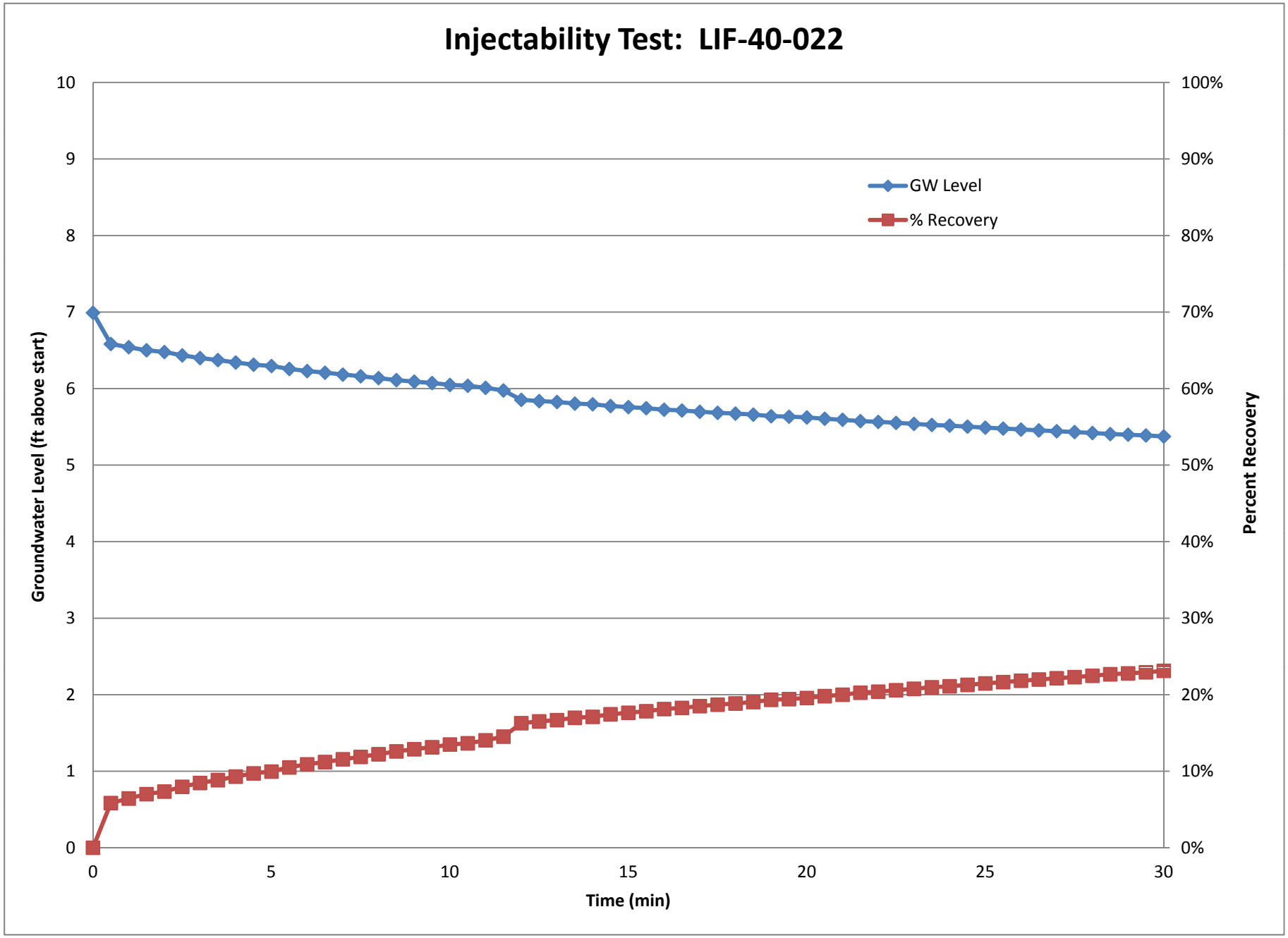
Log Notes:

Date and Time	Note
10/14/2011 15:36	Used Battery: 0% Used Memory: 3% User Name: cesnyder
10/14/2011 15:36	Manual Start Command
10/14/2011 17:10	Log Download - Used Battery: 0% Used Memory: 3% User Name: cesnyder

Log Data:
Record Count 187

Sensors 1
1 196238 Pressure/Temp 30 PSIG (21m/69ft)
Time Zone: Eastern Daylight Time

Date and Time	Elapsed Time Seconds	Sensor: Pres(G) 69ft SN#: 196238 Level Surface Elevation (ft)	Time	GW Level	% Recovery
10/14/2011 15:37	30	0.012			
10/14/2011 15:41	300	3.57	0	3.558	0%
10/14/2011 15:42	330	3.042	0.5	3.03	15%
10/14/2011 15:42	360	2.711	1	2.699	24%
10/14/2011 15:43	390	2.422	1.5	2.41	32%
10/14/2011 15:43	420	2.178	2	2.166	39%
10/14/2011 15:44	450	1.962	2.5	1.95	45%
10/14/2011 15:44	480	1.774	3	1.762	50%
10/14/2011 15:45	510	1.603	3.5	1.591	55%
10/14/2011 15:45	540	1.458	4	1.446	59%
10/14/2011 15:46	570	1.323	4.5	1.311	63%
10/14/2011 15:46	600	1.201	5	1.189	67%
10/14/2011 15:47	630	1.099	5.5	1.087	69%
10/14/2011 15:47	660	1.005	6	0.993	72%
10/14/2011 15:48	690	0.915	6.5	0.903	75%
10/14/2011 15:48	720	0.839	7	0.827	77%
10/14/2011 15:49	750	0.77	7.5	0.758	79%
10/14/2011 15:49	780	0.709	8	0.697	80%
10/14/2011 15:50	810	0.653	8.5	0.641	82%
10/14/2011 15:50	840	0.601	9	0.589	83%
10/14/2011 15:51	870	0.555	9.5	0.543	85%
10/14/2011 15:51	900	0.509	10	0.497	86%
10/14/2011 15:52	930	0.479	10.5	0.467	87%
10/14/2011 15:52	960	0.437	11	0.425	88%
10/14/2011 15:53	990	0.406	11.5	0.394	89%
10/14/2011 15:53	1020	0.38	12	0.368	90%
10/14/2011 15:54	1050	0.355	12.5	0.343	90%
10/14/2011 15:54	1080	0.327	13	0.315	91%
10/14/2011 15:55	1110	0.307	13.5	0.295	92%
10/14/2011 15:55	1140	0.285	14	0.273	92%
10/14/2011 15:56	1170	0.268	14.5	0.256	93%
10/14/2011 15:56	1200	0.248	15	0.236	93%
10/14/2011 15:57	1230	0.236	15.5	0.224	94%
10/14/2011 15:57	1260	0.223	16	0.211	94%
10/14/2011 15:58	1290	0.209	16.5	0.197	94%
10/14/2011 15:58	1320	0.195	17	0.183	95%
10/14/2011 15:59	1350	0.184	17.5	0.172	95%
10/14/2011 15:59	1380	0.176	18	0.164	95%
10/14/2011 16:00	1410	0.165	18.5	0.153	96%
10/14/2011 16:00	1440	0.16	19	0.148	96%
10/14/2011 16:01	1470	0.154	19.5	0.142	96%
10/14/2011 16:01	1500	0.141	20	0.129	96%
10/14/2011 16:02	1530	0.135	20.5	0.123	97%
10/14/2011 16:02	1560	0.133	21	0.121	97%
10/14/2011 16:03	1590	0.123	21.5	0.111	97%
10/14/2011 16:03	1620	0.12	22	0.108	97%
10/14/2011 16:04	1650	0.117	22.5	0.105	97%
10/14/2011 16:04	1680	0.112	23	0.1	97%
10/14/2011 16:05	1710	0.106	23.5	0.094	97%
10/14/2011 16:05	1740	0.103	24	0.091	97%
10/14/2011 16:06	1770	0.097	24.5	0.085	98%
10/14/2011 16:06	1800	0.096	25	0.084	98%
10/14/2011 16:07	1830	0.095	25.5	0.083	98%
10/14/2011 16:07	1860	0.091	26	0.079	98%
10/14/2011 16:08	1890	0.086	26.5	0.074	98%
10/14/2011 16:08	1920	0.085	27	0.073	98%
10/14/2011 16:09	1950	0.085	27.5	0.073	98%
10/14/2011 16:09	1980	0.084	28	0.072	98%
10/14/2011 16:10	2010	0.081	28.5	0.069	98%
10/14/2011 16:10	2040	0.075	29	0.063	98%
10/14/2011 16:11	2070	0.073	29.5	0.061	98%
10/14/2011 16:11	2100	0.07	30	0.058	98%



Report Date:	10/14/2011 16:55
Application:	WinSitu.exe
Application Version:	5.6.21.0

Log File Properties

File Name	**LIF-40-022_2011-10-14_16-54-58-799.wsl**
Create Date	10/14/2011 16:54

Device Properties

Device	Level TROLL 500			
Site	Default Site			
Device Name				
Serial Number	196194			
Firmware Version	2.06			
Hardware Version	3			
Device Address	1			
Device Comm Cfg	19200	8 Even		1 (Modbus-RTU)
Used Memory	0			
Used Battery	0			

Log Configuration

Log Name	LIF-40-022
Created By	cesnyder
Computer Name	MI03L-CESNYDER
Application	WinSitu.exe
Application Version	5.6.21.0
Create Date	10/14/2011 2:43:08 PM Eastern Daylight Time
Log Setup Time Zone	Eastern Daylight Time
Notes Size(bytes)	4096
Overwrite when full	Disabled
Scheduled Start Time	Manual Start
Scheduled Stop Time	No Stop Time
Type	Fast Linear
Interval	Days: 0 hrs: 00 mins: 00 secs: 30

Level Reference Settings At Log Creation

Level Measuren	Level Surface Elevation
Specific Gra	0.999
Level Referenc	Set new reference
Level Referenc	0 (ft)
Level Reference He	2.56018 (PSI)

Other Log Settings

Depth of Probe:	5.90704 (ft)
Head Pressure:	2.5583 (PSI)
Temperature:	16.237 (C)

Log Notes:

Date and Time	Note
10/14/2011 14:43	Used Battery: 0% Used Memory: 3% User Name: cesnyder
10/14/2011 14:43	Manual Start Command
10/14/2011 16:54	Log Download - Used Battery: 0% Used Memory: 3% User Name: cesnyder

Log Data:

Record Count	263		
Sensors	1		
	1	196194	Pressure/Temp 30 PSIG (21m/69ft)

Time Zone: Eastern Daylight Time

Date and Time	Elapsed Time Seconds	Sensor: Pres(G) 69ft SN#: 196194 Level Surface E	Time	GW Level	% Recovery
10/14/2011 14:44	30.001	0.008			
10/14/2011 14:57	810.001	6.999	0	6.991	0%
10/14/2011 14:57	840.001	6.591	0.5	6.583	6%
10/14/2011 14:58	870.001	6.549	1	6.541	6%
10/14/2011 14:58	900.001	6.509	1.5	6.501	7%
10/14/2011 14:59	930.001	6.486	2	6.478	7%
10/14/2011 14:59	960.001	6.442	2.5	6.434	8%
10/14/2011 15:00	990.001	6.407	3	6.399	8%
10/14/2011 15:00	1020.001	6.381	3.5	6.373	9%
10/14/2011 15:01	1050.001	6.349	4	6.341	9%
10/14/2011 15:01	1080.001	6.32	4.5	6.312	10%
10/14/2011 15:02	1110.001	6.303	5	6.295	10%
10/14/2011 15:02	1140.001	6.265	5.5	6.257	10%
10/14/2011 15:03	1170.001	6.237	6	6.229	11%
10/14/2011 15:03	1200.001	6.216	6.5	6.208	11%
10/14/2011 15:04	1230.001	6.191	7	6.183	12%
10/14/2011 15:04	1260.001	6.169	7.5	6.161	12%
10/14/2011 15:05	1290.001	6.145	8	6.137	12%
10/14/2011 15:05	1320.001	6.119	8.5	6.111	13%
10/14/2011 15:06	1350.001	6.099	9	6.091	13%
10/14/2011 15:06	1380.001	6.081	9.5	6.073	13%
10/14/2011 15:07	1410.001	6.056	10	6.048	13%
10/14/2011 15:07	1440.001	6.045	10.5	6.037	14%
10/14/2011 15:08	1470.001	6.018	11	6.01	14%
10/14/2011 15:08	1500.001	5.984	11.5	5.976	15%
10/14/2011 15:09	1530.001	5.861	12	5.853	16%
10/14/2011 15:09	1560.001	5.845	12.5	5.837	17%
10/14/2011 15:10	1590.001	5.833	13	5.825	17%
10/14/2011 15:10	1620.001	5.812	13.5	5.804	17%
10/14/2011 15:11	1650.001	5.803	14	5.795	17%
10/14/2011 15:11	1680.001	5.78	14.5	5.772	17%
10/14/2011 15:12	1710.001	5.766	15	5.758	18%
10/14/2011 15:12	1740.001	5.752	15.5	5.744	18%
10/14/2011 15:13	1770.001	5.732	16	5.724	18%
10/14/2011 15:13	1800.001	5.722	16.5	5.714	18%
10/14/2011 15:14	1830.001	5.705	17	5.697	19%
10/14/2011 15:14	1860.001	5.692	17.5	5.684	19%
10/14/2011 15:15	1890.001	5.681	18	5.673	19%
10/14/2011 15:15	1920.001	5.668	18.5	5.66	19%
10/14/2011 15:16	1950.001	5.647	19	5.639	19%
10/14/2011 15:16	1980.001	5.641	19.5	5.633	19%
10/14/2011 15:17	2010.001	5.631	20	5.623	20%
10/14/2011 15:17	2040.001	5.614	20.5	5.606	20%
10/14/2011 15:18	2070.001	5.601	21	5.593	20%
10/14/2011 15:18	2100.001	5.583	21.5	5.575	20%
10/14/2011 15:19	2130.001	5.573	22	5.565	20%
10/14/2011 15:19	2160.001	5.56	22.5	5.552	21%
10/14/2011 15:20	2190.001	5.547	23	5.539	21%
10/14/2011 15:20	2220.001	5.533	23.5	5.525	21%
10/14/2011 15:21	2250.001	5.524	24	5.516	21%
10/14/2011 15:21	2280.001	5.511	24.5	5.503	21%
10/14/2011 15:22	2310.001	5.498	25	5.49	21%
10/14/2011 15:22	2340.001	5.486	25.5	5.478	22%
10/14/2011 15:23	2370.001	5.473	26	5.465	22%
10/14/2011 15:23	2400.001	5.462	26.5	5.454	22%
10/14/2011 15:24	2430.001	5.451	27	5.443	22%
10/14/2011 15:24	2460.001	5.44	27.5	5.432	22%
10/14/2011 15:25	2490.001	5.428	28	5.42	22%
10/14/2011 15:25	2520.001	5.414	28.5	5.406	23%
10/14/2011 15:26	2550.001	5.406	29	5.398	23%
10/14/2011 15:26	2580.001	5.396	29.5	5.388	23%
10/14/2011 15:27	2610.001	5.383	30	5.375	23%