
SITE CHARACTERIZATION REPORT

AOI 4

**SUNOCO, INC. (R&M)
PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA**



**Sunoco, Inc.
1801 Market Street
Ten Penn Center
Philadelphia, Pennsylvania 19103-1699**

**August 29, 2005
2574601**

TABLE OF CONTENTS

	<u>Page No.</u>
1.0 INTRODUCTION.....	1
2.0 ENVIRONMENTAL SETTING	2
2.1 CURRENT AND HISTORIC USE	2
2.2 GEOLOGY	2
2.3 HYDROGEOLOGY	4
2.4 SURFACE WATER	5
3.0 SITE HISTORY AND BACKGROUND	6
4.0 SELECTION OF COMPOUNDS OF CONCERN AND APPLICABLE STANDARDS.....	8
5.0 SITE CHARACTERIZATION ACTIVITIES	9
5.1 SHALLOW SOIL BORINGS AND SAMPLING	9
5.2 INSTALLATION OF GROUNDWATER MONITORING WELLS.....	9
5.2.1 Trenton Gravel (Intermediate) Groundwater Monitoring Wells	10
5.2.2 Lower Sand (Deep) Groundwater Monitoring Wells	10
5.3 GROUNDWATER MONITORING	12
5.4 GROUNDWATER SAMPLING	12
5.5 LNAPL SAMPLING	13
5.6 SURVEYING ACTIVITIES	15
6.0 SITE CHARACTERIZATION ANALYTICAL RESULTS	17
6.1 SOIL RESULTS.....	17
6.2 GROUNDWATER RESULTS.....	17
6.3 LNAPL CHARACTERIZATION RESULTS	18
7.0 REMEDIAL SYSTEM UPDATE.....	19
7.1 LNAPL RECOVERY SYSTEMS.....	19
7.2 PROPOSED RECOVERY SYSTEM.....	19
8.0 FATE AND TRANSPORT ANALYSIS.....	20
8.1 SOIL.....	20
8.2 GROUNDWATER	20
8.3 LNAPL	21
9.0 SITE CONCEPTUAL MODEL.....	22
9.1 DESCRIPTION AND SITE USE	22
9.2 GEOLOGY AND HYDROGEOLOGY	22
9.3 COMPOUNDS OF CONCERN	23
9.4 LNAPL DISTRIBUTION AND LNAPL MOBILITY.....	23
9.5 FATE AND TRANSPORT OF COCs.....	23
9.6 POTENTIAL MIGRATION PATHWAYS AND SITE RECEPTORS	24

10.0	HUMAN HEALTH EXPOSURE ASSESSMENT/RISK ASSESSMENT	25
10.1	SURFACE WATER /SEDIMENT.....	26
10.2	SURFICIAL SOILS (0-2 FEET BELOW GRADE)	26
10.2.1	<i>Soil to Groundwater</i>	26
10.2.2	<i>Direct Contact Exposure</i>	26
10.3	GROUNDWATER	26
10.4	LNAPL	27
10.5	VAPOR	27
11.0	ECOLOGICAL ASSESSMENT	28
12.0	CONCLUSIONS AND RECOMMENDATIONS.....	29
13.0	REFERENCES	30

LIST OF TABLES

Table 1	Compounds of Concern
Table 2	Summary of Soil Analytical Results
Table 3	Well Summary
Table 4	Summary of AOI 4 Groundwater and LNAPL Elevations
Table 5	Summary of Groundwater Analytical Results: Fill/Alluvium and Trenton Gravel Wells
Table 6	Summary of Groundwater Analytical Results: Lower Sand Wells
Table 7	API Calculated LNAPL Specific Volume and Calculated Seepage Velocity Summary

LIST OF FIGURES

Figure 1	Site Boundary with AOI 4 Highlighted
Figure 2	Site Plan
Figure 3	Completed Activities
Figure 4	Cross Section Location Map
Figure 5	Geologic Cross Section P-P'
Figure 6	Fill/Alluvium and Trenton Gravel Groundwater Elevations
Figure 7	Lower Sand Groundwater Elevations
Figure 8	Summary of Groundwater Sample Exceedances: Fill/Alluvium and Trenton Gravel Wells in AOI 4 and Apparent LNAPL Occurrence
Figure 9	Apparent LNAPL Thickness
Figure 10	Fate and Transport Results Summary: Fill/Alluvium and Trenton Gravel Wells
Figure 11	Wells With Greatest Calculated LNAPL Mobility Values

LIST OF APPENDICES

Appendix A	Current and Historic Use Figures in AOI 4
Appendix B	Soil Boring Logs/Monitoring Well Construction Summaries
Appendix C	Soil and Groundwater Analytical Reports
Appendix D	Field Sampling Reports
Appendix E	LNAPL Sampling Analytical Data and Modeling Procedures
Appendix F	Fate and Transport Modeling Procedures
Appendix G	Summary of AOI 4 Groundwater and LNAPL Elevations Used for Groundwater Contouring

1.0 INTRODUCTION

Sunoco Inc. (R&M) (Sunoco) and the Pennsylvania Department of Environmental Protection (PADEP) entered into a Consent Order & Agreement (CO&A) in December 2003 with respect to remedial activities associated with Sunoco's Philadelphia Refinery (Refinery). In accordance with the CO&A, a Current Conditions Report and Comprehensive Remedial Plan (CCR), dated June 30, 2004, was prepared by Sunoco. The CCR proposed Phase II site characterization and corrective action activities for the Refinery, including preparation of Site Characterization Reports for eleven individual Areas of Interest (AOIs). The CCR presented a prioritization of all AOIs based on specific risk factors. Based on this prioritization, AOI 4 was identified by Sunoco as the second area of the Refinery to be investigated.

Sunoco prepared a Site Characterization Work Plan (Work Plan) for AOIs 1 and 4 in January 2005 which was approved by the PADEP in March 2005. This Work Plan summarized proposed activities to be completed to characterize AOIs 1 and 4 in accordance with the objectives of the CCR.

This Site Characterization Report (SCR) has been prepared exclusively for AOI 4, and documents the results of the activities that were performed for AOI 4 in accordance with the Work Plan.

2.0 ENVIRONMENTAL SETTING

AOI 4 is bordered by Hartranft Street to the North, 26th Street to the East, Penrose Avenue to the South, and AOI 3 to the West (Figures 1 and 2). AOI 4 encompasses approximately 90 acres.

2.1 Current and Historic Use

Currently, AOI 4 is comprised of primarily Crude Oil and Gas Oil aboveground storage tanks (ASTs). Numerous below ground pipelines are active within AOI 4; this is the largest storage area in the refinery. Several pump houses are also present in AOI 4. As shown in the Current Use figure included in Appendix A, roads and tank berms are covered by surfaces which prevent direct contact with site soils.

Appendix I of the CCR described the current and historic usage for the Point Breeze South Yard, which includes AOI 4. These figures are still representative of current and historic usage in AOI 4. Therefore no significant modifications were made to the Point Breeze South Yard Current and Historic Use Figures.

2.2 Geology

The following paragraphs describe the geologic units encountered during Site characterization activities in AOI 4 beginning with the deepest units to the most shallow units:

Wissahickon Formation – Bedrock beneath AOI 4 is identified as the Wissahickon Schist. This formation beneath AOI 4 is a metamorphosed greenish-gray micaceous schist and quartzite. In most areas of AOI 4, the competent bedrock of the Wissahickon Formation is overlain by weathered bedrock consisting of a micaceous clay, which

becomes increasingly sandy as the degree of weathering lessens and competent bedrock is encountered.

Lower Sand Unit of the PRM - The Wissahickon Formation is overlain by the Lower Sand, which is the lowest member of the Potomac-Raritan Magothy System. The Lower Sand beneath AOI 4 is a green, brown, orange and/or red fine gravel and coarse sand that grades upward into medium to fine sands and may contain layers of silts and clay. Throughout AOI 4, the Lower Sand is overlain by the Middle/Lower Clay, as indicated by borings S-59D, S-38D, and S-119D.

Middle/Lower Clay - The Lower Sand is overlain by the Middle/Lower Clay unit. The Middle/Lower Clay is characterized by very low permeability reddish-brown, brown or gray clays, and may be sandy in places (Paulachok, 1991). Evidence of the Middle/Lower Clay unit was found along the eastern border of AOI 4, but this unit was found to be discontinuous in AOI 4.

Trenton Gravel - The Trenton Gravel overlies the Middle/Lower Clay beneath AOI 4. During Site characterization activities, the Trenton Gravel was observed as a very heterogeneous unit comprised of predominantly brown, reddish-brown, and gray sand and gravel, with minor amounts of silts and clays.

Recent Fill/Alluvium - Overlying the Trenton Gravel is recent fill/alluvium. The alluvium deposits generally consist of dark gray organic clayey mud or silt and fine sand. Fill type has historically varied across AOI 4 from various gravels to cinder ash.

As part of the Site characterization activities, 11 Trenton Gravel monitoring wells and two Lower Sand monitoring wells were installed in AOI 4 (Figure 3). The Trenton Gravel wells were installed to depths of up to 32 feet below grade. The Lower Sand wells were advanced to a maximum depth of 92 feet below grade for geologic characterization, however the well screens were set in the upper 15 feet of the Lower Sand unit at a maximum depth of up to 72 feet below grade. The data from these wells were combined with historical site information and utilized to generate an updated cross section (P-P') for AOI 4. The cross section location key for P-P' is provided as Figure 4 and the cross section is provided as Figure 5. Based on recent and historical characterization activities, the following observations can be made concerning AOI 4:

- The Fill/Alluvium, Trenton Gravel, Middle/Lower Clay, and the Lower Sand units all exist beneath AOI 4, but the Middle/Lower Clay is not continuous;
- The thickness of the Fill/Alluvium materials beneath AOI 4 ranges between 5-15 feet;
- The thickness of the Trenton Gravel beneath AOI 4 ranges between 15-45 feet;
- The thickness of the discontinuous Middle/Lower Clay at the eastern border of AOI 4 is approximately 2-20 feet;
- The thickness of the Lower Sand beneath AOI 4 is approximately 15-45 feet;

2.3 Hydrogeology

Groundwater gauging data collected by Aquaterra in August 2005 was used to generate a groundwater flow figure for the Fill/Alluvium and Trenton Gravel (Intermediate) zone in

AOI 4 (Figure 6). This groundwater elevation data is provided as Appendix G. Groundwater flow in the northwestern portion of AOI 4 is towards the northwest, groundwater flow in the northeastern portion of AOI 4 is towards the east. Groundwater in the southern half of AOI 4 is influenced by a groundwater mound centered in the vicinity of well S-31. This mound may be due to the presence of fire water lines in this area. There is not a significant off-site component of flow in the southern portion of AOI 4.

Four Lower Sand wells are located in AOI 4: S-38I, S-38D, S-59D and S-119D. S-38I is screened in the upper portion of the Lower Sand and S-38D is screened in the lower portion of the Lower Sand and possibly into weathered bedrock. Groundwater gauging data collected by Aquaterra in August 2005 and provided in Appendix G was used to generate a groundwater flow figure for the Lower Sand (deep) zone in AOI 4 (Figure 7). Groundwater flow in the deep zone in AOI 4 is towards the southeast. Groundwater elevations in all four Lower Sand wells were lower than elevations observed in nearby Trenton Gravel wells, indicating a downward vertical gradient exists between the Trenton Gravel and the Lower Sand in AOI 4.

No aquifer testing was performed in AOI 4 since sufficient data was available from former aquifer tests (pumping tests, recovery tests, and slug tests) performed in similar geologic materials in AOI 1 by others (SECOR, 2003; USGS, 2001; URS, 2002; Chevron USA, Inc., 1992; USGS, 1988). The geometric mean of hydraulic conductivity values calculated using recovery data in Well RW-406 by SECOR in 2003 (SECOR, 2003) appears to be most representative of the Trenton Gravel. This value was calculated to be 24 feet/day and was used as representative of the Trenton Gravel in AOI 4 since the physical descriptions of the Trenton Gravel between AOI 1 and AOI 4 are consistent.

2.4 Surface Water

No surface water features are located in AOI 4. The nearest surface water body to AOI 4 is the Schuylkill River which is located approximately 1200 feet west of AOI 4. AOI 3 lies between the Schuylkill River and AOI 4.

3.0 SITE HISTORY AND BACKGROUND

The Sunoco Philadelphia Refinery is located on approximately 672 acres in southwest Philadelphia. The Facility has a long history of petroleum transportation, storage, and processing. The oldest portion of the Facility started petroleum related activities in the 1860's, when the Atlantic Refining Company established an oil distribution center. In the 1900's, crude oil processing began and full-scale gasoline production was initiated during World War II. In addition to refining crude oil, various chemicals, such as acids and ammonia, were also produced at the site for a time. Current operations at the refinery are limited to the production of fuels and basic petrochemicals for the chemical industry.

AOI 4 comprises the southeast portion of the Point Breeze Process Area South Yard (Figure 2). Results of a RCRA Facility Investigation (RFI) for the Point Breeze Process Area are summarized in a report by ENSR Consulting and Engineering (ENSR) dated September 1992. The primary purpose of the RFI was to examine potential contaminant releases to surrounding soils/sediments, surface water, and groundwater within three areas of the Point Breeze Processing Area. The investigation included the completion of soil borings and monitoring wells; sampling of groundwater and surface water sediments; sampling of waste materials, sampling of subsurface soils; geophysical surveys; bathymetric surveys, tidal surveys, and monthly water level monitoring.

The following activities were performed to support the development of the AOI 4 Work Plan for Site Characterization:

- Aquaterra performed one round of gauging and sampling in AOI 4 between October 12, 2004 and October 21, 2004 and an additional round of gauging in August 2005. Groundwater samples were collected from all accessible AOI 4 wells, with the exception of recovery wells and wells which contained measurable LNAPL. The samples were submitted to STL for analysis of Site COCs. The results of these samples are presented in Table 2 of the Work Plan.

- Recent reports generated for areas within AOI 4 were reviewed and the data evaluated to refine proposed Site characterization activities. These reports included:
 - *Aboveground Storage Tank No.846 Site Assessment Revised Report*, prepared by SECOR, dated January 20, 2004,
 - *26th Street Border Progress Report, January 1, 2003 through March 31, 2004*, prepared by SECOR, and
 - *Storage Tanks PB-880 and PB-881 Site Assessment Report*, dated October 6, 2004, prepared by SECOR.

- Semi-annual gauging of all wells and annual groundwater sampling of twenty perimeter monitoring wells was completed by HANDEX in accordance with the ongoing sitewide sampling program. Relevant data from these events was utilized in preparation of this report.

4.0 SELECTION OF COMPOUNDS OF CONCERN AND APPLICABLE STANDARDS

The compounds of concern (COCs) for soil and groundwater are listed in Table 1 of this report. These COCs are the same as those listed in the Work Plan and the CCR.

The following sections describe the applicable standards that were used in evaluating the Site characterization data.

Soil

Surface (0-2 feet) soil samples were collected at areas that are not covered with materials that prevent direct access in accordance with the Work Plan and screened against the non-residential statewide health medium-specific concentrations (MSCs) for soil (0-2 feet). Samples from these areas were compared to the non-residential statewide health MSCs for soil (2-15 feet). As summarized in the CCR, where statewide health MSCs are exceeded, Sunoco will apply either the site specific pathway elimination option or calculated risk-based site-specific standards for soil samples that exceed the statewide health MSCs. No calculated risk based numbers were generated for AOI 4 soils since no soil results exceeded the statewide health MSCs.

Groundwater

Groundwater sample results were screened against the non-residential, used-aquifer (TDS<2,500) statewide health groundwater MSCs. As summarized in the CCR, where statewide health MSCs are exceeded, Sunoco will apply either the site specific pathway elimination option or calculated risk-based site-specific standards for groundwater samples that exceed the statewide health MSCs. No calculated risk based numbers were generated for AOI 4 groundwater since the exceedances of the statewide health MSCs will be addressed by engineering controls, natural attenuation and pathway elimination.

5.0 SITE CHARACTERIZATION ACTIVITIES

The following sections summarize the Site characterization activities that were performed in AOI 4 in support of this report. All on-site activities were performed during April and May 2005 by Aquaterra.

5.1 Shallow Soil Borings and Sampling

A total of ten soil samples were collected at monitoring well boring locations shown on Figure 3 utilizing a stainless steel hand auger. Soil borings were advanced to a maximum depth of two feet below grade at each location. At well locations S-222, S-223, S-224, gravel was encountered between zero and two feet below the ground surface. Therefore, shallow soil samples were collected from borings advanced in the immediate vicinity of these wells as shown in Figure 3.

Prior to advancement, the hand auger was decontaminated by washing in an alconox and distilled water solution and then rinsed using distilled water. Soil samples were collected in laboratory-prepared bottleware and immediately placed on ice. Soil samples were submitted to Lancaster Laboratories, Inc. (LLI) of Lancaster, Pennsylvania for analysis of site COCs. A summary of the soil analytical results is provided as Table 2 and the results are discussed in Section 6.1. The laboratory analytical reports are provided as Appendix C.

5.2 Installation of Groundwater Monitoring Wells

Well installation activities were performed between March and June 2005. Intermediate wells were installed to monitor the Trenton Gravel unit and Deep wells were installed to monitor the Lower Sand unit. The well installation activities are discussed in detail in the following sections.

5.2.1 Trenton Gravel (Intermediate) Groundwater Monitoring Wells

Parratt Wolff, Inc of Syracuse, New York installed 12 Intermediate monitoring wells within the Trenton Gravel under the direct supervision of Aquaterra. All wells were installed and constructed in accordance with the Work Plan. Locations of these wells are shown on Figure 3. Prior to installation of the monitoring wells, a PA One Call was performed for marking out utilities. Monitoring well locations were cleared to a depth between six to ten feet below grade utilizing hydro excavation services provide by Environmental Industrial Services Corporation (EISCO) of Swedesboro, New Jersey. The Trenton Gravel wells were advanced utilizing 8.25-inch inside diameter hollow stem augers and split spoon samplers to record lithology. Split spoon samples were collected at five foot intervals throughout the borings, from 10 feet below grade to completion of the borehole. Monitoring wells were constructed to a maximum depth of 32 feet below grade with the screen interval of 15 feet set within the Trenton Gravel. Boring logs depicting monitoring well construction details and lithology are provided as Appendix B. Monitoring wells were constructed with a flush mount manhole cover or with three feet of stickup steel casing for protection. Well construction details are provided in Table 3.

Augers were steam-cleaned between boreholes to eliminate cross contamination. Following construction, the wells were developed using a submersible pump until recovered water was sediment free or a minimum of three well volumes was pumped from the well.

5.2.2 Lower Sand (Deep) Groundwater Monitoring Wells

Parratt Wolff installed two Deep monitoring wells within the Lower Sand in AOI 4 under the direct supervision of Aquaterra. These wells were screened to monitor the Lower Sand unit beneath the site. Locations of these wells are shown on Figure 3. Prior to installation of monitoring wells, a PA One Call was performed for marking out utilities. Monitoring well locations were cleared to a

depth between six to ten feet below grade utilizing hydro excavation services provide by EISCO. The Lower Sand wells were installed using a combination of 8.25-inch inside diameter hollow stem augers and mud rotary techniques with split spoon samplers. Augers and continuous split spoons were advanced into the middle clay no more than ten feet. Once the augers were advanced into the middle clay, 4-inch steel casing was set into the borehole and grouted in place to prevent vertical migration of groundwater from shallower water-bearing zones. The grout was allowed to set for at least one week before initiating the remaining drilling activities.

Once grout had set, mud-rotary drilling techniques were used to advance the borehole to bedrock using a bentonite-based fluid to keep the borehole open. The mud-rotary roller bit was advanced to the bottom of the steel casing at which point continuous split spoon sampling was resumed. Continuous split spoon sampling was performed until the Lower Sand was encountered. Once it was determined that the Lower Sand was encountered, split spoon samples were collected at five foot intervals until bedrock was encountered. Monitoring wells were constructed using 2-inch diameter PVC 0.020 slot screens and 2-inch diameter PVC risers. The screened interval at each well was set in the upper 15 feet of the Lower Sand Unit. The annular space beneath the screened interval was sealed with bentonite chips.

Boring logs depicting monitoring well construction details and lithology are provided as Appendix B. Monitoring wells were constructed with a flush mount manhole cover or with three feet of stickup steel casing for protection. Well construction details are provided in Table 3. Augers were steam-cleaned between boreholes to eliminate cross contamination. Following construction of the wells, the wells were developed using a submersible pump until recovered water was sediment free or a minimum of three well volumes was pumped from the well.

5.3 Groundwater Monitoring

On May 9 through May 11, 2005, Handex performed monitoring well gauging activities to collect liquid levels from monitoring wells within AOI-4 as part of the semi-annual refinery well gauging program. Monitoring wells were gauged for depth to water, and if applicable, depth to product in accordance with the Work Plan. All well gauging readings are summarized in Table 4.

The groundwater monitoring data from Aquaterra's August 2005 gauging event (Appendix G) for the fill/alluvium and Trenton Gravel wells in AOI 4 were used to generate a formational groundwater elevation contour map provided as Figure 6. Groundwater flow in the northwestern portion of AOI 4 is towards the northwest; groundwater flow in the northeastern portion of AOI 4 is towards the east. Groundwater in the southern half of AOI 4 is influenced by a groundwater mound centered in the vicinity of well S-31. This mound may be due to the presence of fire water lines in this area. Sunoco intends to further investigate the mounding conditions at S-31. There is not a significant off-site component of flow in the southern portion of AOI 4.

Four Lower Sand wells are located in AOI 4: S-38I, S-38D, S-59D and S-119D. S-38I is screened in the upper portion of the Lower Sand and S-38D is screened in the lower portion of the Lower Sand and possibly into weathered bedrock. Groundwater gauging data collected by Aquaterra in August 2005 was used to generate a groundwater flow figure for the Lower Sand (deep) zone in AOI 4 (Figure 7). Groundwater flow in the deep zone in AOI 4 is towards the southeast. Groundwater elevations in all four Lower Sand wells were lower than elevations observed in nearby Trenton Gravel wells, indicating a downward vertical gradient exists between the Trenton Gravel and the Lower Sand in AOI 4.

5.4 Groundwater Sampling

Aquaterra performed groundwater sampling activities for AOI-4 between April 28 and May 6, 2005. Wells S-96, S-223, S-224 and S-225 were sampled on August 1, 2005. All

groundwater sampling activities were completed in accordance with the Work Plan. Gauging data collected in April 2005 by Aquaterra was used in calculating the amount of water to be purged prior to sampling the monitoring wells. Three well volumes were purged from each well prior to sampling to remove stagnant water from the well and obtain a representative sample. Monitoring wells were sampled from least-to-most impacted based on historical groundwater analytical data. Well purging was performed by using either a submersible pump with disposable polyethylene tubing or by hand bailing using a disposable bailer. If a submersible pump was used for purging, the pump was decontaminated by rinsing in a distilled water andalconox solution and then rinsing in distilled water. Purge water was treated onsite using granular activated carbon. Well sampling data is presented in Appendix D.

Subsequent to purging, monitoring wells were allowed to recharge for no more than two hours prior to sampling. Samples were obtained by lowering a disposable bailer slowly into the well to minimize excess agitation. The bailer was filled with water from the top of the water table and retrieved. Samples were then collected in laboratory-prepared bottleware and immediately placed on ice. Samples were submitted to Lancaster Laboratories for analysis of site COCs. Once the sample was obtained, the bailer, bailer cord, and nitrile gloves used to obtain the sample were discarded. Sample date, time, number, and site name were recorded on the Chain-of-Custody and in field books. A summary of groundwater analytical results is presented in Tables 5 and 6 and laboratory analytical reports are included as Appendix C.

5.5 LNAPL Sampling

Aquaterra collected light non-aqueous phase liquid (LNAPL) samples from a total of six monitoring wells, including three newly installed monitoring wells. LNAPL samples were collected using a direct sampling or swabbing method. For direct sampling (ability to collect >10mL of LNAPL), a bailer was lowered into the well until it was approximately one foot below the water surface. The bailer was then retrieved and the LNAPL sample was placed in an unpreserved vial. For the swabbing method (<10mL of LNAPL), the bailer was lowered into the well as previously described. Once the bailer

was retrieved, a piece of sorbent pad was used to absorb the LNAPL present in the bailer from the surface of the groundwater sample. The swab was then placed into an unpreserved vial. The bailer, bailer cord, and nitrile gloves used for sampling each well were discarded after each sample was collected. Samples were packaged in certified hazardous material shipping boxes and sent via FedEx priority overnight to Torkelson Laboratories of Tulsa, Oklahoma for characterization. LNAPL characterization data included product types, density, proportions of product, degree of weathering, and similarities to other samples. Table E1 in Appendix E summarizes the LNAPL characterization results for all samples collected in AOI 4 and previous results from wells in AOI 4.

Aquaterra collected an additional LNAPL sample and groundwater sample from monitoring well S-34 (AOI 4) on May 3, 2005 to obtain AOI 4-specific LNAPL/soil saturation data for use with LNAPL modeling. Prior to collection of the LNAPL and groundwater samples, the well was gauged to determine depth to product, water, and product thickness. Samples were collected using Teflon®-lined polyethylene tubing and a peristaltic pump. The polyethylene tubing was lowered into the monitoring well and into the LNAPL layer. The peristaltic pump was set at a low flow rate during collection of the sample. A minimum of 200mL of LNAPL was collected in unpreserved laboratory-prepared bottleware. Once the LNAPL sample was collected, the polyethylene tubing was slowly lowered into the groundwater where no LNAPL was present. The polyethylene tubing was lowered no further than one foot below the bottom of the LNAPL/groundwater interface. A groundwater sample was then collected in unpreserved laboratory bottleware making sure no LNAPL was present in the sample.

Samples were then packaged in certified hazardous material shipping boxes and sent via FedEx priority overnight to PTS GeoLabs of Santa Fe Springs, California. The samples were analyzed via ASTM D445 and D1481 for fluid density of LNAPL and groundwater; surface tension of LNAPL and groundwater; viscosity of groundwater at 50°F, 60°F, and 100°F; and, viscosity of oil at 50°F, 60°F, and 100°F; interfacial tension of LNAPL to groundwater by ASTM D971, intrinsic permeability to both water by API RP 40/EPA 9100/ASTM D5084, LNAPL by API RP 40 and drainage capillary pressure by API

RP 40/ASTMD425M/EPA 9100. The results of the analyses were used to support the LNAPL modeling for AOI 4 which is discussed in Appendix E.

Aquaterra also collected one soil sample from a boring advanced adjacent to well S-34 to obtain additional site-specific LNAPL/soil saturation data for use with LNAPL modeling. Four continuous six-inch soil intervals were collected from the LNAPL-saturated area in this boring (20-22 feet beneath the ground surface) and were placed in brass soil rings with waxed end caps. The samples were then packaged in certified hazardous material shipping boxes and sent via FedEx priority overnight to PTS GeoLabs for photographing under white light and ultra-violet light. The six-inch sample interval with most LNAPL fluorescence (20.5-21 feet) was targeted and analyzed for the LNAPL parameters. Based on this depth of LNAPL saturation in soil, well S-34 is appropriately screened to intercept and monitor LNAPL in this area (screened 17-27 feet below the ground surface).

The samples were analyzed for pore space phase saturation (API RP 40) and porosity (API RP 40); grain size (ASTM D422 or D4464); Atterberg limits (ASTM D4318); total organic carbon by Walkly-Black; intrinsic permeability to both water (API RP 40/EPA9100/ASTM D5084) and LNAPL (API RP 40); and drainage capillary pressure (API RP 40/ASTM D425M/EPA 9100). The results of the analyses were used to support the LNAPL modeling discussed in Appendix E.

5.6 Surveying Activities

Re-Survey of S-27, S-31 and S-97

On May 16, 2005, Langan surveyors re-surveyed the casing and ground surface elevations at wells S-27, S-31 and S-97 in AOI 4 to verify these elevations and to determine if incorrect survey data was causing the historic groundwater mounding conditions observed at these areas. Variations in the survey data were observed and the new survey data for these wells was used to calculate water elevations in Table 4 and Figure 6.

Surveying of Newly Installed Monitoring Wells and Soil Boring Locations

Following completion of installation activities, the newly installed monitoring wells and the soil boring locations were surveyed by Langan to establish the location and elevation of the inner and outer casing and ground surface at each point. All well elevations were determined to the nearest 0.01 foot relative to mean sea level. All survey activities were performed by a Pennsylvania-licensed surveyor and tied to the NAVD 88 datum. The new survey data for these points is presented in Table 3.

6.0 SITE CHARACTERIZATION ANALYTICAL RESULTS

The following sections discuss the analytical results of the site characterization activities performed in AOI 4.

6.1 Soil Results

The results of the soil samples collected during this investigation are provided in Table 2. All of the soil samples were collected between zero and two feet below the ground surface and no saturated soils were observed at these depths. The results of the soil samples were screened against the non-residential MSCs for soil. Based on the results, no concentrations of COCs in soil exceeded the applicable MSCs.

6.2 Groundwater Results

Fill/Alluvium and Trenton Gravel Wells

The results of the groundwater samples collected from monitoring wells in the Fill/Alluvium and Trenton Gravel formations are provided in Table 5. The results were screened against the non-residential used aquifer (TDS>2,500) groundwater MSCs; exceedances of the MSCs are illustrated in Figure 8.

General comments regarding the results of the groundwater samples are summarized in the following:

- COCs which were detected in AOI 4 groundwater which exceed the non-residential MSCs include: benzene, toluene, ethylbenzene, ethylene dibromide, 1,2-dichloroethane, MTBE, chrysene, and naphthalene.
- Cumene, fluorene, phenanthrene, pyrene, total xylenes and total lead were not detected in AOI 4 groundwater at concentrations exceeding the non-residential MSCs.

Lower Sand Wells

The results of the groundwater samples collected from monitoring wells in the Lower Sand are provided in Table 6. The results were screened against the non-residential used aquifer (TDS>2,500) groundwater MSCs; no COCs exceeded the MSCs in the groundwater samples.

6.3 LNAPL Characterization Results

LNAPL characterization results are presented in a summary table in Table E1 of Appendix E. This table includes previous LNAPL characterization data for AOI 4 which was gathered as part of the CCR, and new data collected during the AOI 4 Site characterization activities. The LNAPL types for all wells in AOI 4 and the apparent thickness of LNAPL measured during Handex's May 2005 gauging event are illustrated in Figure 9.

The new LNAPL characterization data, along with the additional soil, LNAPL and groundwater data collected at select locations as described in Section 5.5, were used to model LNAPL for determining specific volume and mobility, which are summarized on Table 7 and Figure 11. LNAPL modeling procedures are described in detail in Appendix E. Major conclusions regarding the results of the LNAPL characterization and modeling are discussed below:

- Three different types or mixtures of LNAPL were identified in AOI 4. The LNAPL types include middle distillate, middle distillate/light-end feedstocks and gasoline/middle distillate.
- The absence of LNAPL along the majority of the AOI 4 boundary correlates with the lack of COC concentrations in exceedance of the MSC in the majority of the wells along the AOI 4 border.

7.0 REMEDIAL SYSTEM UPDATE

7.1 LNAPL Recovery Systems

Two active recovery wells, S-30 and S-36, are located in AOI 4. The remediation program consists of LNAPL recovery only from these wells. Sunoco is currently evaluating the expansion of the LNAPL recovery system in the vicinity of S-36 to include two additional LNAPL bearing wells into the same product recovery system. Completion of this remediation system is planned for the 4th quarter of 2005. The system will consist of four recovery wells, S-30, S-34, S-35 and S-36, equipped with pneumatic submersible skimming pumps.

7.2 Proposed Recovery System

A groundwater control/recovery system will be evaluated in the southern portion of the AOI 4 near S-223. Sunoco anticipates submitting a Work Plan for the groundwater remediation system to the PADEP in the 1st Quarter 2006 with an anticipated installation in 4th Quarter 2006 dependent upon discharge permitting.

8.0 FATE AND TRANSPORT ANALYSIS

The following sections describe fate and transport modeling activities performed as part of AOI 4 Site characterization.

8.1 Soil

No fate and transport modeling was completed for the soil analytical results since there were no exceedances of the PADEP non-residential MSCs.

8.2 Groundwater

Fate and transport calculations were completed for groundwater in AOI 4 to support refinement of the Site Conceptual Model and the Exposure Assessment. Appendix F discusses the details of the fate and transport modeling activities in AOI 4. The results of the modeling are discussed below:

- As shown in Figure 8, four wells along the AOI 4 eastern boundary (S-26, S-40, S-223, and S-224) have concentrations of COCs in groundwater which exceed their respective MSCs and are not delineated by AOI 4 boundary wells. Therefore, concentrations of COCs in these wells which exceeded the MSC were modeled for a 30 year simulation period. The results of the modeling indicate that dissolved phase COCs extend, or have the potential to extend off-site along 26th Street in the vicinity of Well S-40, and off-site along Penrose Avenue in the vicinity of Wells S-223, and S-224, as illustrated in Figure 10.
- The maximum offsite distance for this potential migration of dissolved COCs in fill/alluvium and Trenton Gravel wells is approximately 959 feet (based on benzene in Well S-223).

- No fate and transport modeling was completed for the Deep groundwater since no COCs were detected in AOI 4 deep wells at concentrations which exceed the non-residential groundwater MSCs.

8.3 LNAPL

As discussed in Section 5.5 of this report, additional LNAPL data was collected to further refine LNAPL type, occurrence, volume and mobility throughout AOI 4, and to support LNAPL modeling activities discussed in Appendix E.

For the LNAPL modeling at AOI 4, Langan utilized the American Petroleum Institute (API) Publication Number 4682, "Free-Product Recovery of Petroleum Hydrocarbon Liquids," dated June 1999, as a guide for assessing LNAPL volume and mobility. Site-specific LNAPL data were collected as described in Section 5.5 of this report and used as input parameters for modeling where applicable. These parameters and the API model were utilized to estimate the specific volume and mobility of LNAPL at AOI 4 as discussed in Appendix E. The calculated LNAPL specific volume and seepage velocity for all wells included in the modeling is presented in Table 7. The results of this modeling refined the LNAPL volumes and mobilities that were presented in the CCR. These data indicated that LNAPL with the greatest mobility is located in S-29, S-30, S-33, S-34, S-35, and S-103 (Figure 11).

9.0 SITE CONCEPTUAL MODEL

A preliminary site conceptual model (SCM) for the Refinery was presented in the CCR. Data collected from the Site characterization activities performed in AOI 4 were used to refine the SCM for this area. The SCM for AOI 4 is described below:

9.1 Description and Site Use

AOI 4 is bordered by Hartranft Street to the North, 26th Street to the East, Penrose Avenue to the South, and AOI 3 to the West (Figures 1 and 2) and encompasses approximately 90 acres. Currently, AOI 4 is comprised of primarily Crude Oil and Gas Oil ASTs. Numerous below ground pipelines are active within AOI 4; this is the largest storage area in the refinery.

9.2 Geology and Hydrogeology

The following summarizes the relevant information concerning geology and hydrogeology in AOI 4:

- The Fill/Alluvium, Trenton Gravel, Middle/Lower Clay, and the Lower Sand all exist beneath AOI 4, but the Middle Clay/Lower Clay is not continuous;
- Groundwater flow in the Fill/Alluvium and Trenton Gravel zone is generally not towards the off-site boundaries in AOI 4 as shown in Figure 6;
- Groundwater flow in the Lower Sand (Deep) zone is towards the southeast as shown in Figure 7; and
- Vertical groundwater flow between the Trenton Gravel and the Lower Sand is downward.

9.3 Compounds of Concern

The following summarizes the relevant information concerning COCs in AOI 4:

- There are no COCs for shallow soil.
- The COCs for groundwater include benzene, toluene, ethylbenzene, ethylene dibromide, 1,2-dichloroethane, MTBE, chrysene, and naphthalene.
- There are no COCs for deep groundwater.

9.4 LNAPL Distribution and LNAPL Mobility

The following summarizes the relevant information concerning LNAPL distribution in AOI 4:

- Three LNAPL types or mixtures have been identified in AOI 4 (Gasoline, Middle Distillate, and Light-end Feedstocks). The apparent thickness and specific volumes of each LNAPL plume in AOI 4 are provided in Figure 9 and Table 7, respectively.
- LNAPL in AOI 4 with the greatest potential mobility (Figure 11) is located in the vicinity of Wells S-29, S-30, S-33, S-34, S-35, and S-103.
- The majority of LNAPL in AOI 4 is within the AOI boundaries, with the exception of S-223 area where it has the potential to extend off-site.

9.5 Fate and Transport of COCs

The following summarizes the relevant information concerning the results of the fate and transport of the dissolved phase COCs in groundwater in AOI 4:

- Dissolved phase COCs extend, or have the potential to extend off-site along 26th Street in the vicinity of Well S-40, and off-site along Penrose Avenue in the vicinity of Wells S-223, and S-224, as illustrated in Figure 10.

- No fate and transport modeling was completed for the deep groundwater unit since no COCs were detected in groundwater from deep wells at concentrations exceeding the non-residential MSCs.

9.6 Potential Migration Pathways and Site Receptors

The following summarizes the relevant information concerning the potential pathways and site receptors for AOI 4.

- Figure 16 of the CCR illustrated general areas of the Refinery that are covered with surfaces that prevent direct contact with site soils. Throughout the Site characterization activities for AOI 4, this figure was refined to increase accuracy. This updated figure is provided as Figure A3 in Attachment A. Only a small area in the southwest corner of AOI 4 was modified and shown as an uncovered area.
- AOI 4 is located within a fenced secured area, to prevent unauthorized access. Direct contact to site soils is governed by on-site procedures and PPE requirements.
- No human health groundwater receptors exist for the Refinery.
- All of AOI 4 operates under OSHA regulations with periodic air monitoring.
- LNAPL and dissolved COCs in groundwater extend, or have the potential to extend off-site in the vicinity of wells S-40, S-223, and S-224.

10.0 HUMAN HEALTH EXPOSURE ASSESSMENT/RISK ASSESSMENT

Based on the current and future intended non-residential site use, an exposure assessment was conducted for all compounds which exceeded the non-residential statewide health standards. Potential human health exposures for the Refinery are for an industrial worker scenario. Potential human health receptors for AOI 4 include direct contact with soils, groundwater, and LNAPL. Direct contact issues with soil, groundwater and LNAPL for the industrial scenario are addressed through Sunoco's established excavation procedures, PPE requirements and soil handling procedures described in Appendix K of the CCR. Since direct contact to surface soils could occur outside of excavation activities, shallow soil samples were collected at areas in AOI 4 that were covered by soils that prevented direct contact for evaluation of this potential exposure pathway.

The following table serves to summarize potential pathways that can be reasonably expected under the current and intended future non-residential use for the site. The table lists potentially contaminated media, potential receptors for these media, and a summary of whether any potential pathways exist at the site from the media to these receptors. A more detailed evaluation of each of these pathways is presented in the following sections.

Potential for Complete Exposure Pathways

Contaminated Media	Residents	Workers	DayCare	Construction	Trespassers	Recreation	Food
Groundwater	Na	No ⁽¹⁾	Na	No ⁽³⁾	No	Na	Na
Air (indoor)	Na	No	Na	No	No	Na	Na
Soil <2 feet bgs.	Na	No	Na	No	No	Na	Na
Surface Water	Na	Na	Na	Na	Na	Na	Na
Sediment	Na	Na	Na	Na	Na	Na	Na
LNAPL	Na	No ⁽¹⁾	Na	No ⁽⁴⁾	Na	Na	Na

Notes:

- (1) No complete groundwater or LNAPL pathways exist for workers that are not addressed through on-site procedures and PPE.
 - (2) No complete pathway for site soil > 2 feet deep due to on-site procedures and PPE.
 - (3) No complete groundwater or LNAPL pathway exists for construction workers due to PPE requirements and Standard Operating Procedures.
 - (4) No complete pathway exists for site soil > 2 feet deep due to PPE requirements and Standard Operating Procedures.
- Na - Not applicable.
 No - No potential complete exposure pathway
 Yes - Potential complete exposure pathway

10.1 Surface Water /Sediment

No surface water/sediments are located in AOI 4. Groundwater in AOI 4 does not interface with surface water/sediment, therefore there are no potential surface water receptors and/or exposure pathways in AOI 4.

10.2 Surficial Soils (0-2 Feet Below Grade)

10.2.1 Soil to Groundwater

No COCs in surface soil were detected at concentrations exceeding the MSCs. The soil to groundwater pathway is being addressed through the groundwater pathway discussed in Section 10.3.

10.2.2 Direct Contact Exposure

No COCs in surface soil were detected at concentrations exceeding the PADEP non-residential direct contact MSCs.

10.3 Groundwater

Benzene, toluene, ethylbenzene, ethylene dibromide, 1,2-dichloroethane, MTBE, chrysene, and naphthalene have been detected in exceedance of the non-residential MSCs. Previous investigations (URS, 2002) verified that no wells within 1.5 miles of the Refinery are used for drinking water or agricultural use. There are no complete direct contact exposure pathways for groundwater within AOI 4 because of on-site procedures and required PPE. Based on fate and transport calculations, the plume has the potential to extend offsite in the vicinity of wells S-40, S-223, and S-224. There is no potential direct contact exposure to impacted groundwater due to the depth of groundwater moving off-site, which is greater than 15 feet below grade.

10.4 LNAPL

There are no complete direct contact exposure pathways for LNAPL within AOI 4 because of on-site procedures and required PPE. There are no complete direct contact pathways for LNAPL off-site due to the depth to potential LNAPL, which is greater than 15 feet below grade.

10.5 Vapor

There are no complete indoor air vapor pathways from site soils, groundwater or LNAPL. No soils results exceeded the screening criteria in the PADEP's vapor guidance. Indoor air samples were collected at the only identified potential indoor air receptor (#15 Pumphouse) in accordance with the on-site OSHA sampling program. Site COCs were not above OSHA PELs in all of the indoor air samples that were collected in the #15 Pumphouse.

No potential indoor air receptors were identified offsite within the projected offsite distance of the dissolved groundwater plumes, but to be conservative, the dissolved groundwater concentrations that have the potential migrate offsite were evaluated in accordance with the PADEP vapor guidance. This was accomplished by screening the QD model-predicted offsite COC concentrations in groundwater from monitoring wells S-40, S-26, S-222 and S-223 against the residential volatilization into indoor air screen default values for groundwater listed in the current PADEP vapor guidance. Based on the results of this evaluation, there is no complete vapor pathway from the potential off-site migration of groundwater at these locations. Since LNAPL is not predicted to extend offsite there is no potential for indoor air vapor impacts from LNAPL to offsite receptors.

11.0 ECOLOGICAL ASSESSMENT

The majority of AOI 4 is impervious or covered with gravel (Figure A3 in Appendix A) and the non-covered portions of AOI 4 are not likely to serve as a breeding area, migratory stopover, or primary habitat for wildlife. In 2002, a survey of endangered, threatened and special concern wildlife was conducted by reviewing maps provided at the Pennsylvania Department of Conservation and Natural Resources. No endangered, threatened and special concern wildlife were identified using these maps or during historical investigations. Based on this information, there are no ecological receptors of concern for AOI 4 and no related assessment was necessary.

12.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the completed activities, the following conclusions and recommendations have been developed:

- Soil to groundwater issues are addressed through lack of completed pathways. Based on the shallow soil sample results, there are no direct contact issues.
- The LNAPL in the vicinity of S-30 and S-36 will be addressed by the ongoing remedial activities with the addition of two more recovery wells in the 4th Quarter 2005.
- Potential offsite impacts identified along the southern AOI 4 boundary in the vicinity of wells S-221, and S-124 will be addressed through a remedial system with a target installation of 2006. All other potential offsite impacts will be addressed through natural attenuation and pathway elimination.

13.0 REFERENCES

U.S. Department of the Interior, Geohydrology and Ground-Water Resources of Philadelphia, Pennsylvania, U.S. Geological Survey, Water-Supply Paper 2346.

Schreffler, C. L., 2001, U.S. Department of the Interior, Simulation of Ground-Water Flow in the Potomac-Raritan-Magothy Aquifer System Near the Defense Supply Center Philadelphia, and the Point Breeze Refinery, Southern Philadelphia County, Pennsylvania, Water-Resources Investigations Report 01-4218, 20 pp.

URS Corporation, 2002, Act 2 Combined Report, Philadelphia Energy Center, Sunoco Philadelphia Refinery, Girard Point Processing Area.

Moffitt, G. R., Chevron, 1992, RCRA Verification Investigation Final Report.

Sloto, R. A., 1988, Simulation of Ground-Water Flow in the Lower Sand Unit of the Potomac-Raritan-Magothy Aquifer System, Philadelphia, Pennsylvania, U.S. Geological Survey, Water-Resources Investigations Report 86-4055.

Pennsylvania Department of Environmental Protection, 2003, Document Number 253-0300-100, Land Recycling Program Technical Guidance Manual – Section IV.A.4. Vapor Intrusion Into Buildings From Groundwater and Soil Under the Act 2 Statewide Health Standard.

TABLES

Table 1
Compounds of Concern
AOI 4 Site Characterization Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

SOIL	
METALS	CAS No.
Lead (total)	7439-92-1
VOLATILE ORGANIC COMPOUNDS	CAS No.
1,2-dichloroethane	107-06-2
Benzene	71-43-2
Cumene	98-82-8
Ethylbenzene	100-41-4
Ethylene dibromide	106-93-4
Methyl tertiary butyl ether	1634-04-4
Toluene	108-88-3
Xylenes (total)	1330-20-7
SEMI-VOLATILE ORGANIC COMPOUNDS	CAS No.
Anthracene	120-12-7
Benzo(a)anthracene	56-55-3
Benzo (g,h,i) perylene	191-24-2
Benzo(a)pyrene	50-32-8
Benzo(b)fluoranthene	205-99-2
Chrysene	218-01-9
Fluorene	86-73-7
Naphthalene	91-20-3
Phenanthrene	85-01-8
Pyrene	129-00-0

Notes:

1. Constituents are from Pennsylvania Corrective Action Process (CAP) Regulation Amendments effective December 1, 2001; provided in Chapter VI, Section E (pgs. 29-30) of PADEP Document, *Closure Requirements for Underground Storage Tank Systems*, effective April 1, 1998.

Table 1 (continued)
Compounds of Concern
AOI 4 Site Characterization Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

GROUNDWATER	
METALS	CAS No.
Lead (dissolved)	7439-92-1
VOLATILE ORGANIC COMPOUNDS	CAS No.
1,2-dichloroethane	107-06-2
Benzene	71-43-2
Cumene	98-82-8
Ethylbenzene	100-41-4
Ethylene dibromide	106-93-4
Methyl tertiary butyl ether	1634-04-4
Toluene	108-88-3
Xylenes (total)	1330-20-7
SEMI-VOLATILE ORGANIC COMPOUNDS	CAS No.
Chrysene	218-01-9
Fluorene	86-73-7
Naphthalene	91-20-3
Phenanthrene	85-01-8
Pyrene	129-00-0

Notes:

1. Constituents are from Pennsylvania Corrective Action Process (CAP) Regulation Amendments effective December 1, 2001; provided in Chapter VI, Section E (pgs. 29-30) of PADEP Document, *Closure Requirements for Underground Storage Tank Systems*, effective April 1, 1998.

Table 2
Summary of Soil Analytical Results
Sunoco Philadelphia Refinery - AOI 4
Philadelphia, Pennsylvania

	CAS No	PADEP Non-Residential		Location ID Sample ID Sample Matrix Sample Interval Sample Date	S-119D BHS119D-040105-1-1.5 Soil 1-1.5 4/1/2005			S-216 BH-S216-032505-1-1.5 Soil 1.5-2.0 3/25/2005			S-217 BH-S217-040105-1-1.5 Soil 1.5-2.0 4/1/2005			S-219 BH-S219-032505-1-1.5 Soil 1.5-2.0 3/25/2005			S-220 BH-S220-040105-1-1.5 Soil 1.5-2.0 4/1/2005			S-221 BH-S221-032505-1.5-2 Soil 1.5-2.0 3/25/2005			S-222 BH-S222-080405-1-1.5 Soil 1-1.5 8/4/2005			S-223 BH-S223-080405-1.5-2 Soil 1.5-2.0 8/4/2005			S-224 BH-S224-080405-1-1.5 Soil 1-1.5 8/4/2005			S-229 BH-S229-032505-1.5-2 Soil 1.5-2.0 3/25/2005			
		MSCs			Unit	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL
		0-2' Dry	2'-15' Dry																																
Volatile Organic Compounds																																			
Ethylene dibromide (EDB)	106-93-4	5	5	ug/kg	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	6	ND	U	5	ND	U	5	
1,2-Dichloroethane	107-06-2	500	500	ug/kg	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	6	ND	U	5	ND	U	5	
Benzene	71-43-2	500	500	ug/kg	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	6	ND	U	5	ND	U	5	
Ethylbenzene	100-41-4	70000	70000	ug/kg	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	6	ND	U	5	ND	U	5	
Cumene	98-82-8	1600000	1600000	ug/kg	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	6	ND	U	5	ND	U	5	
Methyl Tertiary Butyl Ether	1634-04-4	2000	2000	ug/kg	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	6	ND	U	5	14		5	
Toluene	108-88-3	100000	100000	ug/kg	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	6	ND	U	5	ND	U	5	
Xylene (Total)	1330-20-7	1000000	1000000	ug/kg	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	6	ND	U	5	ND	U	5	
Semi Volatile Organic Compounds																																			
Chrysene	218-01-9	230000	230000	ug/kg	ND	U	380	ND	U	380	ND	U	400	ND	U	400	ND	U	410	ND	U	390	ND	U	190	ND	U	230	490		190	ND	U	370	
Anthracene	120-12-7	350000	350000	ug/kg	ND	U	380	ND	U	380	ND	U	400	ND	U	400	ND	U	410	ND	U	390	ND	U	190	ND	U	230	ND	U	190	ND	U	370	
Benzo(a)anthracene	56-55-3	110000	320000	ug/kg	ND	U	380	ND	U	380	ND	U	400	ND	U	400	ND	U	410	ND	U	390	ND	U	190	ND	U	230	490		190	ND	U	370	
Benzo(a)pyrene	50-32-8	11000	46000	ug/kg	ND	U	380	ND	U	380	ND	U	400	ND	U	400	ND	U	410	460		390	ND	U	190	ND	U	230	550		190	ND	U	370	
Benzo(b)fluoranthene	205-99-2	110000	170000	ug/kg	ND	U	380	ND	U	380	ND	U	400	ND	U	400	ND	U	410	560		390	ND	U	190	ND	U	230	700		190	ND	U	370	
Benzo(g,h,i)perylene	191-24-2	180000	180000	ug/kg	ND	U	380	ND	U	380	ND	U	400	ND	U	400	ND	U	410	ND	U	390	ND	U	190	ND	U	230	430		190	ND	U	370	
Fluorene	86-73-7	3800000	3800000	ug/kg	ND	U	380	ND	U	380	ND	U	400	ND	U	400	ND	U	410	ND	U	390	ND	U	190	ND	U	230	ND	U	190	ND	U	370	
Naphthalene	91-20-3	25000	25000	ug/kg	ND	U	380	ND	U	380	ND	U	400	ND	U	400	ND	U	410	ND	U	390	ND	U	190	ND	U	230	ND	U	190	ND	U	370	
Phenanthrene	85-01-8	10000000	10000000	ug/kg	ND	U	380	ND	U	380	ND	U	400	ND	U	400	460		410	390		390	ND	U	190	ND	U	230	300		190	ND	U	370	
Pyrene	129-00-0	2200000	2200000	ug/kg	ND	U	380	ND	U	380	ND	U	400	ND	U	400	ND	U	410	530		390	ND	U	190	ND	U	230	900		190	ND	U	370	
Metals																																			
Lead (Total)	7439-92-1	450000	450000	ug/kg	24900		2240	60800		2260	10200		2390	8990		2370	7580		2360	102000		2290	143000		2210	18200		2730	192000		2240	16700		2160	

Notes:
PADEP - Pennsylvania Department of Environmental Protection
ug/kg - Microgram per kilogram
MSC - PADEP's Medium Specific Concentration for Soil
RL - Reporting Limit
(1) All Soil Samples Collected and Analyzed were Unsaturated
ND - Not Detected

Qualifiers:
Q - Qualifier
U - The Analyte Was Analyzed But Not Detected

Exceedance Summary:
10 - Reporting Limit Exceeds the PADEP Non-Residential Soil MSC
10 - Compound Exceeds the PADEP Non-Residential Soil MSC

Table 3
Well Summary
AOI 4 Site Characterization Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Well ID	Former Well ID ²	AOI #	Well Type ³	Well Classification (Shallow, Intermediate, Deep)	Soil Boring Log Available (Y/N)	Construction Detail Available (Y/N)	Date of Well Completion	Well Construction Details ^{1,4}							
								Well Completion Depth (ft. bgs)	Well Diameter (in)	Casing Elevation (ft. msl) (NGVD 29)	Ground Surface Elevation ¹ (ft.) (NAVD88)	Top of Screen Elevation (ft) (NAVD88)	Bottom of Screen Elevation (ft) (NAVD88)	Depth to Screen (ft. bgs)	Screen Length (ft.)
AS-9	--	4	Piezometer	--	Y	Y	2/15/82	33.25	3	19.51	--	--	--	23.25	10
MW-1	--	4	Temporary Well Point Location	Shallow	Y	Y	5/29/03	20	--	--	11.54	9.04	-5.96	2.5	15
MW-3	--	4	Temporary Well Point Location	Shallow	Y	Y	5/29/03	20	--	--	11.45	8.45	-6.55	3	15
MW-4	--	4	Temporary Well Point Location	Shallow	Y	Y	5/29/03	16	--	--	--	--	--	7	10
S-102	--	4	Monitoring Well	Shallow	Y	Y	10/17/95	20	2	20.39	15.63	10.63	-4.37	5	15
S-103	--	4	Monitoring Well	Shallow	Y	Y	10/17/95	25	2	28.31	23.55	13.55	-1.45	10	15
S-104	--	4	Monitoring Well	Shallow	Y	Y	10/17/95	20	2	20.38	15.05	5.05	-4.95	10	10
S-111	--	4	Monitoring Well	Shallow	Y	Y	7/23/96	39.58	2	--	19.46	14.96	-20.04	4.5	35
S-119	MW-E	4	Monitoring Well	Intermediate	Y	Y	8/15/02	34	4	--	23.82	9.82	-10.18	14	20
S-119D		4	Monitoring Well	Deep	Y	Y	4/4/05	72	2	25.1	--	-31.9	-46.9	57	15
S-120	MW-F	4	Monitoring Well	Intermediate	Y	Y	8/16/02	30	4	--	16.47	6.47	-13.53	10	20
S-121	MW-G	4	Monitoring Well	Intermediate	Y	Y	8/22/02	30	4	--	18.53	8.53	-11.47	10	20
S-122	MW-H	4	Monitoring Well	Intermediate	Y	Y	8/19/02	34.6	4	--	25.05	10.05	-9.95	15	20
S-123	MW-I	4	Monitoring Well	Intermediate	Y	Y	8/20/02	30	4	--	19.23	9.23	-10.77	10	20
S-124	MW-J	4	Monitoring Well	Intermediate	Y	Y	8/22/02	30	4	--	20.46	10.46	-9.54	10	20
S-26	SM-33	4	Monitoring Well	Intermediate	Y	N	12/17/84	24	--	--	17.6	--	--	--	--
S-27	SM-42	4	Monitoring Well	Intermediate	Y	Y	3/19/85	34.75	--	--	22	--	#VALUE!	--	30
S-28	SM-29	4	Monitoring Well	Shallow	Y	N	12/17/84	25	--	--	22.66	--	--	--	--
S-29	59	4	Monitoring Well	Intermediate	Y	Y	12/8/86	40	--	--	21.83	3.83	-18.17	18	22
S-30	--	4	Recovery Well - Active	--	--	--	--	--	--	--	21.64	--	--	--	--
S-31	SM-53	4	Monitoring Well	Shallow	Y	N	7/31/85	25	--	--	21.24	--	--	--	--
S-32	SM-27	4	Monitoring Well	Shallow	Y	N	12/17/84	25	--	--	21.29	--	--	--	--
S-33	SM-54	4	Monitoring Well	Shallow	Y	N	7/30/85	28	--	--	21.25	--	--	--	--
S-34	PN-1	4	Monitoring Well	Shallow	Y	Y	5/25/87	29	6	--	21.46	4.46	-5.54	17	10
S-35	PN-2	4	Monitoring Well	Shallow	Y	Y	5/28/87	29	6	--	21.74	4.74	-5.26	17	10
S-36	SM-34	4	Monitoring Well	Shallow	Y	N	12/18/84	21.5	--	--	21.91	--	--	--	--
S-37	SM-25	4	Monitoring Well	Shallow	Y	N	12/17/85	30	--	--	27.99	--	--	--	--
S-38	SM-31	4	Monitoring Well	Shallow	Y	N	12/19/84	23.2	--	--	15.97	--	--	--	--
S-38D	--	4	Monitoring Well	Deep	N	N	3/14/94	130	2	21	15.88	-104.12	-114.12	120	10
S-38I	--	4	Monitoring Well	Deep	N	N	3/17/94	80	2	21	15.84	-54.16	-64.16	70	10
S-39	AS-7	4	Monitoring Well	Intermediate	Y	Y	2/4/84	37	3	22.08	21.25	-3.75	-15.25	25	11.5
S-40	SM-55	4	Monitoring Well	Shallow	Y	N	7/31/85	28	--	--	21.67	--	--	--	--
S-55	SM-20	4	Monitoring Well	Shallow	Y	N	12/17/84	19.6	--	--	12.93	--	--	--	--
S-56	62	4	Monitoring Well	Shallow	Y	Y	12/13/86	29	2	--	13.45	-0.55	-15.55	14	15
S-57	SM-24	4	Monitoring Well	Shallow	Y	N	12/18/84	14	--	--	10.13	--	--	--	--
S-58	RW-1	4	Recovery Well - Inactive	--	Y	Y	6/23/87	33	--	--	--	--	--	10	20
S-58D		4	Monitoring Well	Deep	Y	Y	4/13/05	56	2	17.15	--	-23.88	-38.88	41	15
S-67	SM-22	4	--	--	Y	--	12/18/84	20	--	--	--	--	--	--	--
S-96	--	4	Monitoring Well	Shallow	--	--	--	--	--	15.94	--	--	--	--	--
S-97	--	4	Monitoring Well	Shallow	Y	Y	4/4/94	35	4	33.33	28.74	8.74	-6.26	20	15
S-115	--	4	Abandoned	--	--	--	--	--	--	--	18.43	--	--	--	--
S-216	--	4	Monitoring Well	Intermediate	Y	Y	4/19/05	26	4	15.76	--	4.76	-10.24	11	15
S-217	--	4	Monitoring Well	Intermediate	Y	Y	3/29/05	27	4	11.53	--	-0.47	-15.47	12	15
S-218	--	4	Monitoring Well	Intermediate	Y	Y	4/20/05	30	4	25.74	--	10.74	-4.26	15	15
S-219	--	4	Monitoring Well	Intermediate	Y	Y	3/25/05	27	4	23.09	--	11.09	-3.91	12	15
S-220	--	4	Monitoring Well	Intermediate	Y	Y	4/20/05	30	4	20.81	--	5.81	-9.19	15	15
S-221	--	4	Monitoring Well	Intermediate	Y	Y	4/21/05	30	4	22.98	--	7.98	-7.02	15	15
S-222	--	4	Monitoring Well	Intermediate	Y	Y	006/09/05	28	4	16.3	16.89	3.3	-11.7	13	15
S-223	--	4	Monitoring Well	Intermediate	Y	Y	6/8/05	30	4	15.88	16.48	1.48	-13.52	15	15
S-224	--	4	Monitoring Well	Intermediate	Y	Y	6/6/05	32	4	16.04	16.54	4.54	-15.46	12	20
S-225	--	4	Monitoring Well	Intermediate	Y	Y	3/29/05	27	4	16.86	--	4.86	-10.14	12	15
S-229	--	4	Monitoring Well	Intermediate	Y	Y	3/23/05	30	4	22.73	--	7.73	-7.27	15	15
PH-66	--	4	Abandoned	--	--	--	--	--	--	--	--	--	--	--	--
PH-67	--	4	Abandoned	--	--	--	--	--	--	--	--	--	--	--	--

-- Data could not be located or determined based on available reports
Abandoned wells.

NOTES:

AOI - Area of Interest
ft. - feet
bgs - below ground surface
in. - inches
msl - elevation relative to mean sea level

1. Well construction details were taken directly from well boring logs provided by Handex, Aquaterra, or collected from available historic reports. Where no well boring logs exist, no well construction or lithologic data exist.
2. Former well IDs were derived from handwritten notes on the logs themselves or the referenced report.
3. Well type was chosen based on the formation in which the well was screened. Wells screened within the Lower Sand were classified as deep wells. Based on their total depth, wells screened above the Middle Clay were classified as either a shallow or intermediate well.
4. Top of Inner Casing (TIC) and other relevant elevation datum for wells were obtained from J.M. Stewart Surveying, Inc., dated May 21, 2003, or Langan's Survey, May 2005. The surveys are based on the Horizontal Datum: Pennsylvania State Plane Coordinates NAD 83 / South, Zone, Vertical Datum: NAVD 88

Table 4
Summary of AOI 4 Groundwater and LNAPL Elevations
AOI 4 Site Characterization Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Monitoring Point ID	AOI	Specific Gravity (g/cc)		Notes	Depth to Product	Depth to Water ³ (ft)	LNAPL Thickness ³ (ft)	LNAPL Elevation ³ (ft amsl)	GW Elevation ^{3,4} (ft amsl)	Corrected GW Elevation (ft amsl)
		S.G. ¹	Source ²							
AOI 4										
MW-1	AOI 4				NM	NM	NA	NA	NA	NA
MW-3	AOI 4				NM	NM	NA	NA	NA	NA
MW-4	AOI 4				NM	NM	NA	NA	NA	NA
S-102	AOI 4				NP	17.09	0	NA	1.13	1.13
S-103	AOI 4	0.7978	S-103		24.72	24.90	0.18	1.39	1.21	1.35
S-104	AOI 4	0.8787	S-104		16.67	17.17	0.50	1.44	0.94	1.38
S-111	AOI 4				NM	NM	0	NA	NA	NA
S-119	AOI 4				NP	25.46	0	NA	1.14	1.14
S-119D ⁶	AOI 4				NP	25.41	0	NA	-0.31	-0.31
S-120	AOI 4				NP	18.14	0	NA	1.68	1.68
S-121	AOI 4				NP	19.45	0	NA	1.67	1.67
S-122	AOI 4				NP	23.96	0	NA	1.75	1.75
S-123	AOI 4				NP	20.58	0	NA	1.55	1.55
S-124	AOI 4	0.8223	S-124		21.52	21.85	0.33	1.68	1.35	1.62
S-26	AOI 4				NP	19.00	0	NA	1.76	1.76
S-27	AOI 4				NP	23.10	0	NA	1.73	1.73
S-28	AOI 4				NP	22.59	0	NA	3.15	3.15
S-29	AOI 4	0.8550	S-29		19.92	26.28	6.36	3.38	-2.98	2.46
S-30	AOI 4	0.8550	S-29		20.66	27.81	7.15	2.47	-4.68	1.43
S-31	AOI 4				NP	18.05	0	NA	3.65	3.65
S-32	AOI 4	0.8665	S-32		22.77	22.78	0.01	1.43	1.42	1.43
S-33	AOI 4	0.8575	S-33		20.37	21.22	0.85	1.08	0.23	0.96
S-34	AOI 4	0.8575	S-33		22.29	22.95	0.66	1.01	0.35	0.92
S-35	AOI 4	0.8665	S-35		23.66	24.34	0.68	1.03	0.35	0.94
S-36	AOI 4	0.8575	S-33		23.25	23.30	0.05	0.98	0.93	0.97
S-37	AOI 4	0.8639	S-37		24.81	24.93	0.12	1.09	0.97	1.07
S-38	AOI 4				NP	17.39	0	NA	1.56	1.56
S-38D ⁶	AOI 4				NP	19.27	0	NA	-1.57	-1.57
S-38I	AOI 4				NP	18.10	0	NA	0.09	0.09
S-39	AOI 4				NP	21.15	0	NA	1.73	1.73
S-40	AOI 4				NP	23.30	0	NA	1.16	1.16
S-55	AOI 4				NM	NM	NA	NA	NA	NA
S-56	AOI 4	0.8684	S-56		14.62	14.63	0.01	0.38	0.37	0.38
S-57	AOI 4	0.8620	S-57		11.52	11.90	0.38	0.98	0.60	0.93
S-58	AOI 4				NM	NM	NA	NA	NA	NA
S-59D ⁶	AOI 4				NP	17.11	0	NA	0.01	0.01
S-67	AOI 4				NM	NM	NA	NA	NM	NM
S-96	AOI 4				NP	18.64	0	NA	1.13	1.13
S-97	AOI 4	0.8653	S-97		NP	28.04	0	NA	1.51	1.51
S-216	AOI 4				NP	14.48	0	NA	1.28	1.28
S-217	AOI 4	0.8578	S-33		10.84	10.85	0.01	0.69	0.68	0.69
S-218	AOI 4				NP	24.14	0	NA	1.60	1.60
S-219	AOI 4				NP	21.46	0	NA	1.63	1.63
S-220	AOI 4	0.8550	S-29		19.02	19.10	0.08	1.79	1.71	1.78
S-221	AOI 4	0.8223	S-124		21.34	21.35	0.01	1.64	1.63	1.64
S-222	AOI 4				NP	16.79	0	0	-0.49	-0.49
S-223	AOI 4				NP	15.62	0	0	0.26	0.26
S-224	AOI 4				NP	15.80	0	0	0.24	0.24
S-225	AOI 4				NP	15.45	0	NA	1.41	1.41
S-229	AOI 4				NP	21.87	0	NA	0.86	0.86

Notes:

- Specific Gravity (S.G.) values were determined from LNAPL samples taken by Aquaterra on February 27th and March 1st, 2004, or from samples collected by SECOR in 1999-2000.
- For wells with no direct S.G. measurements, the S.G. value in the nearest well with a direct S.G. was used.
- Depth to Water and Depth to LNAPL provided by Handex May 9th-11th, 2005.
- All Groundwater elevations collected during the month of May 2005. Only wells accessible during gauging event are listed.
- Elevations for S-56, S-222, S-223, S-244 collected on 08/01/05
- Elevation for deep wells collected on 7/26/05

AOI = Area of Interest

g/cc = grams per cubic centimeter

LNAPL = Light Non-Aqueous Phase Liquid

amsl = above mean sea level

GW = Groundwater

F = Film or trace product

NA = Not applicable

NM = Not Measured

NP = No Product

Table 5
Summary of Groundwater Analytical Results:
Fill/Alluvium and Trenton Gravel Wells
Sunoco Philadelphia Refinery - AOI 4
Philadelphia, Pennsylvania

	CAS No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	Sample ID Sample Date Sample Matrix Unit	S225-042805 4/28/2005 Groundwater ug/l			S216-042805 4/28/2005 Groundwater ug/l			S218-042805 4/28/2005 Groundwater ug/l			S219-042805 4/28/2005 Groundwater ug/l			S222-080105 8/1/2005 Groundwater ug/l			S223-080105 8/1/2005 Groundwater ug/l			S224-080105 8/1/2005 Groundwater ug/l			S229-042805 4/28/2005 Groundwater ug/l			S31-050205* 5/2/2005 Groundwater ug/l			S27-050205 5/2/2005 Groundwater ug/l			S26-050205 5/2/2005 Groundwater ug/l			S40-050305 5/3/2005 Groundwater ug/l			S96-080105 8/1/2005 Groundwater ug/l			S119-050305 5/3/2005 Groundwater ug/l		
Volatile Organic Compounds			Unit	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL			
Ethylene dibromide (EDB)	106-93-4	0.05	ug/l	ND	U	0.029	0.029	U	0.029	0.052		0.029	ND	U	0.029	ND	U	0.029	ND	U	0.029	ND	U	0.029	0.033		0.029	ND	U	0.028	ND	U	0.029	ND	U	0.03	ND	U	0.029	ND	U	0.028			
1,2-Dichloroethane	107-06-2	5	ug/l	ND	U	5	ND	U	10	ND	U	50	ND	U	5	ND	U	5	ND	U	5	ND	U	10	ND	U	50	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5			
Benzene	71-43-2	5	ug/l	24		5	290		10	2200		50	23		5	ND	U	5	6,100		500	2,000		130	1900		50	53		5	ND	U	5	ND	U	5	370		25	ND	U	5			
Ethylbenzene	100-41-4	700	ug/l	ND	U	5	110		10	1300		50	ND	U	5	ND	U	5	1,300		50	690		130	350		50	39		5	ND	U	5	ND	U	5	21		5	ND	U	5			
Cumene	98-82-8	2300	ug/l	87		5	73		10	ND	U	50	ND	U	5	ND	U	5	ND	U	50	ND	U	44	10	150		50	6		5	ND	U	5	40		5	ND	U	5	ND	U	5		
Methyl Tertiary Butyl Ether	1634-04-4	20	ug/l	ND	U	5	210		10	ND	U	50	ND	U	5	ND	U	5	ND	U	50	ND	U	10	ND	U	50	170		5	ND	U	5	32		5	ND	U	5	ND	U	5			
Toluene	108-88-3	1000	ug/l	10		5	48		10	360		50	ND	U	5	ND	U	5	9,600		500	2,800		130	ND	U	50	40		5	ND	U	5	14		5	ND	U	5	ND	U	5			
Xylene (Total)	1330-20-7	10000	ug/l	11		5	240		10	2400		50	6		5	10		5	6,900		50	3,500		130	630		50	150		5	ND	U	5	10		5	ND	U	5	ND	U	5			
Semi-Volatile Organic Compounds																																													
Chrysene	218-01-9	1.9	ug/l	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	6	ND	U	5	ND	U	5	ND	U	10	NA			ND	U	10	ND	U	10	ND	U	10	ND	U	5			
Fluorene	86-73-7	1900	ug/l	56		10	60		10	ND	U	10	ND	U	10	ND	U	6	ND	U	5	ND	U	5	11		10	NA			ND	U	10	ND	U	10	ND	U	10	ND	U	5			
Naphthalene	91-20-3	100	ug/l	ND	U	10	150		50	250		51	ND	U	10	ND	U	6	430		26	ND	U	5	220		51	NA			14		10	ND	U	10	ND	U	10	ND	U	5			
Phenanthrene	85-01-8	1100	ug/l	71		10	87		10	ND	U	10	ND	U	10	ND	U	6	ND	U	5	ND	U	5	15		10	NA			ND	U	10	ND	U	10	16		10	ND	U	5			
Pyrene	129-00-0	130	ug/l	ND	U	10	10		10	ND	U	10	ND	U	10	ND	U	6	ND	U	5	ND	U	5	ND	U	10	NA			ND	U	10	ND	U	10	ND	U	10	ND	U	5			
Metals																																													
Lead (Total)	7439-92-1	5	ug/l	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	0.18	ND	U	0.18	1.4		1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	0.18	ND	U	1

Notes:
PADEP - Pennsylvania Department of Environmental Protection
ug/l - Micrograms Per Liter
MSC - PADEP's Medium Specific Concentration for Impact to Groundwater
RL - Reporting Limit
ND - Not Detected
* Due to limited sample volume in S-31 SVOCS were not collected for analysis

Qualifiers:
Q - Qualifier
U - The Analyte Was Analyzed But Not Detected

Exceedance Summary:
10 - Reporting Limit Exceeds the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500
10 - Compound Exceeds the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500

Table 5
Summary of Groundwater Analytical Results:
Fill/Alluvium and Trenton Gravel Wells
Sunoco Philadelphia Refinery - AOI 4
Philadelphia, Pennsylvania

	CAS No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	Sample ID Sample Date Sample Matrix Unit	S120-050305 5/3/2005 Groundwater ug/l			S122-050305 5/3/2005 Groundwater ug/l			S39-050305 5/3/2005 Groundwater ug/l			S38-050305 5/3/2005 Groundwater ug/l			S28-050405 5/4/2005 Groundwater ug/l			S123-050405 5/4/2005 Groundwater ug/l			S97-050405 5/4/2005 Groundwater ug/l			S121-050405 5/4/2005 Groundwater ug/l			MW1-050605 5/6/2005 Groundwater ug/l			S102-050605 5/6/2005 Groundwater ug/l			MW4-050605 5/6/2005 Groundwater ug/l				
Volatile Organic Compounds			Unit	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL		
Ethylene dibromide (EDB)	106-93-4	0.05	ug/l	ND	U	0.029	ND	U	0.029	ND	U	0.029	ND	U	0.029	ND	U	0.028	ND	U	0.028	ND	U	0.028	ND	U	0.028	ND	U	0.028	ND	U	0.028	ND	U	0.028		
1,2-Dichloroethane	107-06-2	5	ug/l	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5		
Benzene	71-43-2	5	ug/l	ND	U	5	ND	U	5	ND	U	5	ND	U	5	51	5	8	5	600	50	ND	U	5	100	5	5	ND	U	5	ND	U	5	ND	U	5		
Ethylbenzene	100-41-4	700	ug/l	ND	U	5	ND	U	5	ND	U	5	ND	U	5	12	5	68	5	63	50	ND	U	5	19	5	5	ND	U	5	ND	U	5	ND	U	5		
Cumene	98-82-8	2300	ug/l	ND	U	5	ND	U	5	ND	U	5	ND	U	5	6	5	10	5	ND	U	50	ND	U	5	10	5	5	ND	U	5	ND	U	5	ND	U	5	
Methyl Tertiary Butyl Ether	1634-04-4	20	ug/l	ND	U	5	ND	U	5	ND	U	5	ND	U	5	270	25	ND	U	5	ND	U	50	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5
Toluene	108-88-3	1000	ug/l	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	190	5	ND	U	50	ND	U	5	10	5	5	ND	U	5	ND	U	5	ND	U	5	
Xylene (Total)	1330-20-7	10000	ug/l	ND	U	5	ND	U	5	ND	U	5	ND	U	5	13	5	250	5	230	50	ND	U	5	27	5	5	ND	U	5	ND	U	5	ND	U	5		
Semi-Volatile Organic Compounds																																						
Chrysene	218-01-9	1.9	ug/l	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10		
Fluorene	86-73-7	1900	ug/l	ND	U	10	ND	U	10	ND	U	10	ND	U	10	12	10	13	10	25	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10		
Naphthalene	91-20-3	100	ug/l	ND	U	10	ND	U	10	ND	U	10	ND	U	10	12	10	26	10	110	10	ND	U	10	32	10	10	ND	U	10	ND	U	10	ND	U	10		
Phenanthrene	85-01-8	1100	ug/l	ND	U	10	ND	U	10	ND	U	10	ND	U	10	26	10	34	10	47	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10		
Pyrene	129-00-0	130	ug/l	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10		
Metals																																						
Lead (Total)	7439-92-1	5	ug/l	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1		

Notes:
PADEP - Pennsylvania Department of Environmental Protection
ug/l - Micrograms Per Liter
MSC - PADEP's Medium Specific Concentration for Impact to Groundwater
RL - Reporting Limit
ND - Not Detected
* Due to limited sample volume in S-31 SVOCs were not collected for analysis

Qualifiers:
Q - Qualifier
U - The Analyte Was Analyzed But Not Detected

Exceedance Summary:
10 - Reporting Limit Exceeds the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<;
10 - Compound Exceeds the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,50

Table 6
Summary of Groundwater Analytical Results:
Lower Sand Wells
Sunoco Philadelphia Refinery - AOI 4
Philadelphia, Pennsylvania

	CAS No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	Sample ID Sample Date Sample Matrix Unit	S119D-050305 5/3/2005 Groundwater ug/l			S38I-050305 5/3/2005 Groundwater ug/l			S38D-050305 5/3/2005 Groundwater ug/l			S59D-050605 5/6/2005 Groundwater ug/l		
Volatile Organic Compounds			Unit	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL
Ethylene dibromide (EDB)	106-93-4	0.05	ug/l	ND	U	0.029	ND	U	0.029	ND	U	0.029	ND	U	0.028
1,2-Dichloroethane	107-06-2	5	ug/l	ND	U	5	ND	U	5	ND	U	5	ND	U	5
Benzene	71-43-2	5	ug/l	ND	U	5	ND	U	5	ND	U	5	ND	U	5
Ethylbenzene	100-41-4	700	ug/l	ND	U	5	ND	U	5	ND	U	5	ND	U	5
Cumene	98-82-8	2300	ug/l	ND	U	5	ND	U	5	ND	U	5	ND	U	5
Methyl Tertiary Butyl Ether	1634-04-4	20	ug/l	ND	U	5	ND	U	5	ND	U	5	ND	U	5
Toluene	108-88-3	1000	ug/l	ND	U	5	ND	U	5	ND	U	5	ND	U	5
Xylene (Total)	1330-20-7	10000	ug/l	ND	U	5	ND	U	5	ND	U	5	ND	U	5
Semi-Volatile Organic Compounds															
Chrysene	218-01-9	1.9	ug/l	ND	U	10	ND	U	10	ND	U	10	ND	U	10
Fluorene	86-73-7	1900	ug/l	ND	U	10	ND	U	10	ND	U	10	ND	U	10
Naphthalene	91-20-3	100	ug/l	ND	U	10	ND	U	10	ND	U	10	ND	U	10
Phenanthrene	85-01-8	1100	ug/l	ND	U	10	ND	U	10	ND	U	10	ND	U	10
Pyrene	129-00-0	130	ug/l	ND	U	10	ND	U	10	ND	U	10	ND	U	10
Metals															
Lead (Total)	7439-92-1	5	ug/l	ND	U	1	ND	U	1	ND	U	1	ND	U	1

Notes:

PADEP - Pennsylvania Department of Environmental Protection

ug/l - Micrograms Per Liter

MSC - PADEP's Medium Specific Concentration for Impact to Groundwater

RL - Reporting Limit

ND - Not Detected

Qualifiers:

Q - Qualifier

U - The Analyte Was Analyzed But Not Detected

Exceedance Summary:

10 - Reporting Limit Exceeds the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500

10 - Compound Exceeds the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500

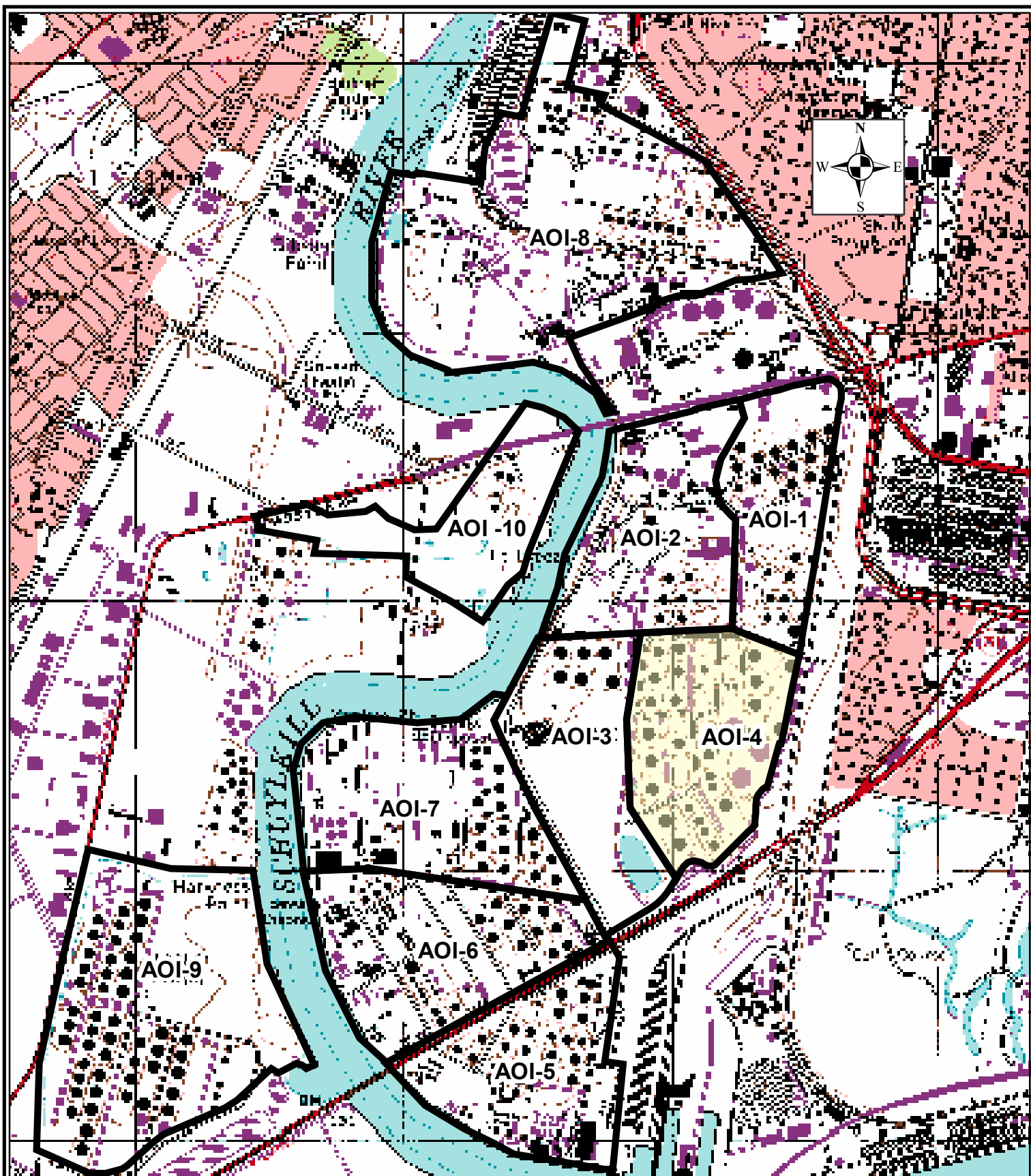
Table 7
API Calculated LNAPL Specific Volume and Calculated Seepage Velocity Summary
AOI 4: Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Well ID	LNAPL Thickness	Specific Volume	Relative Permeability	LNAPL Seepage Velocity
	feet	feet	unitless	cm/sec
S-103	0.18	2.16E-03	5.90E-03	1.59E-07
S-124	0.33	1.51E-03	2.63E-03	7.09E-08
S-217	0.01	4.05E-09	8.74E-12	3.89E-16
S-220	0.08	1.61E-04	7.62E-04	3.52E-08
S-221	0.01	1.23E-08	5.59E-11	2.49E-15
S-104	0.50	3.21E-03	4.56E-03	2.74E-08
S-29	6.36	2.20E+00	7.91E-01	8.25E-06
S-30	7.15	2.51E+00	8.08E-01	8.42E-06
S-32	0.01	3.84E-08	6.81E-08	4.10E-13
S-33	0.85	2.05E-02	2.89E-02	1.74E-07
S-34	0.66	1.05E-02	1.56E-02	1.69E-07
S-35	0.68	9.69E-03	1.40E-02	1.52E-07
S-36	0.05	4.64E-06	9.44E-06	1.02E-10
S-37	0.12	7.36E-05	1.28E-04	7.72E-10
S-56	0.01	1.26E-09	9.79E-13	1.02E-17
S-57	0.38	2.22E-03	3.23E-03	2.14E-08
S-97	0.01	1.40E-09	1.18E-12	1.23E-17

Notes:

1. Groundwater and LNAPL gauging event performed by Handex in May 2005
2. The Specific Volume and Seepage Velocity Values were calculated using the API model.
3. A groundwater gradient of 0.0035 was used in the calculation of these values.

FIGURES



USGS Topographic Map, Philadelphia, PA. Quadrangle, USGS 1995



Sunoco, Inc. (R&M)
Philadelphia Refinery
 3144 Passyunk Avenue
 Philadelphia, PA. 19145

Figure 1: Site Boundary with AOI 4 Highlighted
 AOI 4 Site Characterization Report

Philadelphia Sunoco Philadelphia Refinery Pennsylvania

Job Number

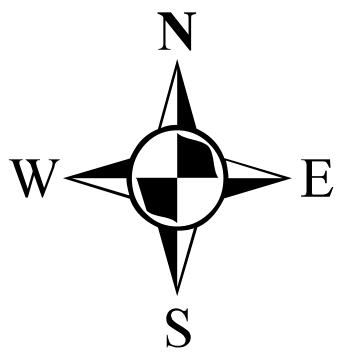
2574601

Scale: 1" = 1600'

0 800 1,600 Feet

Date

August 1, 2005



Legend

 AOI 4

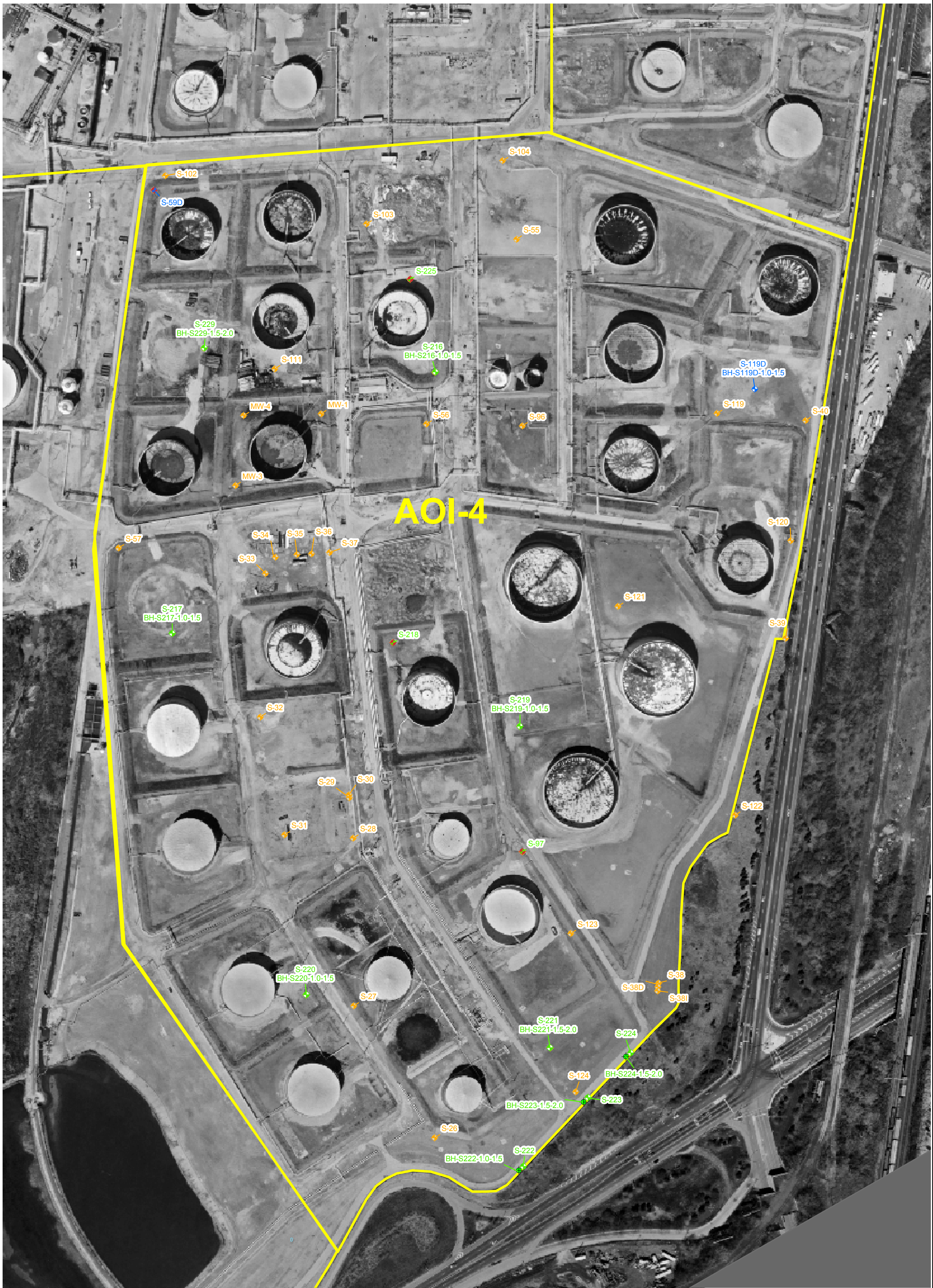
Figure 2: Site Plan
AOI 4 Site Characterization Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania



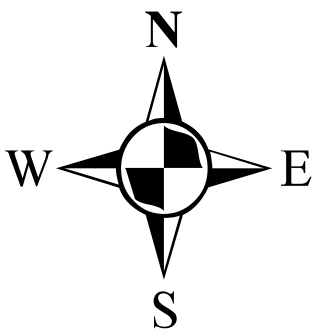
Sunoco, Inc. (R&M)
Philadelphia Refinery
3144 Passyunk Avenue
Philadelphia, PA.
19145

0 125 250
Feet

SCALE: (PLOT) 1"=100' BY: G.D. BY: JDB
August 22, 2006
JSC
JH
2574691



Legend



- | | |
|---|---|
| S-59D | S-206 |
| New Lower Sand Monitoring Well | New Trenton Gravel Monitoring Well |
| S-119D
BH-S119D-1.0-1.5 | S-206
BH-S206-1.0-1.5 |
| New Lower Sand Monitoring Well with Soil Sample | New Trenton Gravel Monitoring Well with Soil Boring |
| BH-S222-1.0-1.5 | S-76 |
| Shallow Soil Sample Locations | All Existing Monitoring Points |
| | |
| AOI Boundaries | |

Figure 3: Completed Activities
AOI 4 Site Characterization Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania



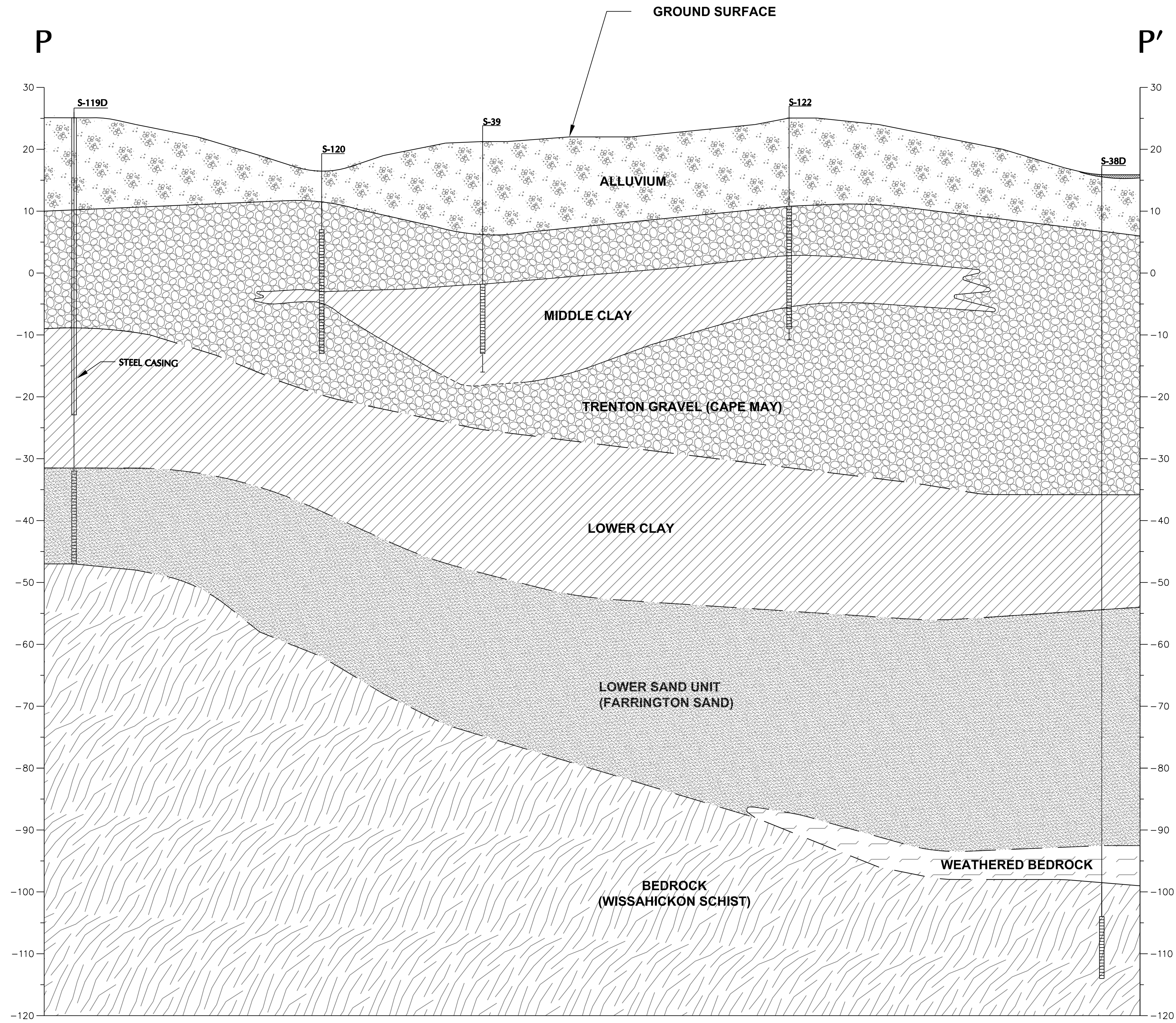
Sunoco, Inc. (R&M)
Philadelphia Refinery
3144 Passyunk Avenue
Philadelphia, PA.
19145

0 125 250
Feet

SCALE: 1" = 125'
DATE: JUN 25, 2005
DRN BY: JSC
CKD BY: JH
JOB#: 2574601

FEET ABOVE MEAN SEA LEVEL (MSL)

SCALE 1"=10'

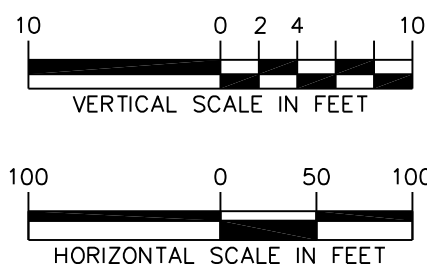


SCALE 1"=100'

LEGEND

- FILL
- ALLUVIUM
- SAND AND GRAVEL
- CLAY/SILT AND SOME SAND
- SAND
- WEATHERED BEDROCK
- BEDROCK

S-119D WELL ID
WELL SCREEN

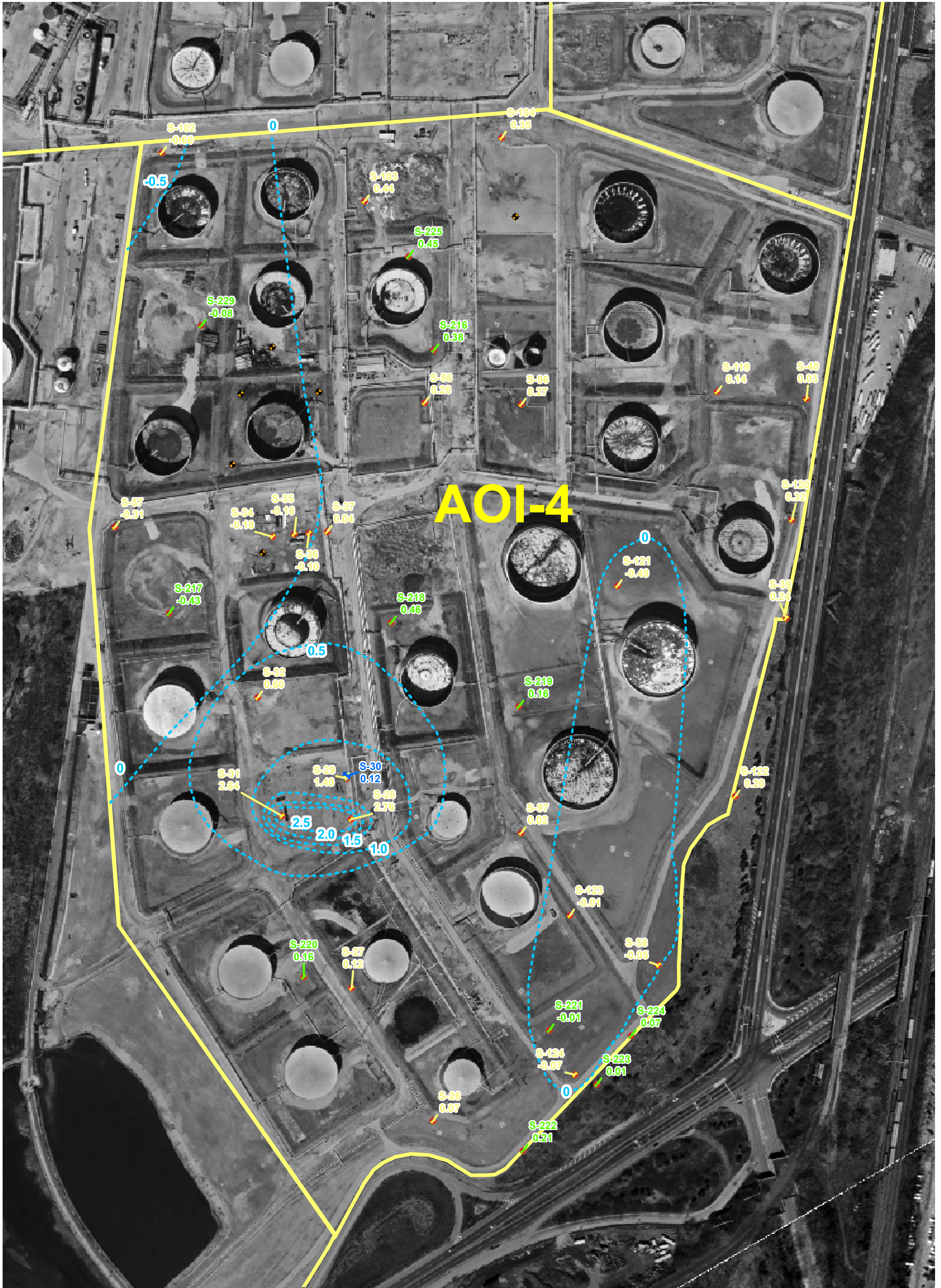


Project
SUNOCO, INC. (R & M)
PHILADELPHIA
PENNSYLVANIA

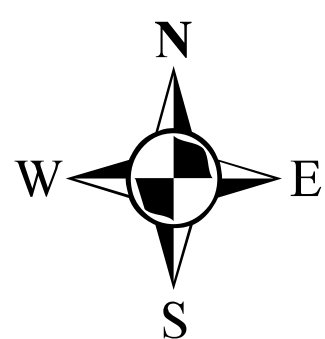
Drawing Title
**GEOLOGIC CROSS
SECTION P-P'**
**SUNOCO PHILADELPHIA REFINERY
AND BELMONT TERMINAL**

Project No. **2574601**
Date **10 AUGUST 05**
Scale **AS SHOWN**
Drn. By **AIC**
Last Revised **25 AUGUST 05**

Drawing No.
5
1 Of 1



AOI-4



Legend

AOI Boundaries

Inferred Groundwater Contour

S-34
7.87
S-34
7.97
S-75
4.27
S-75
4.27

Trenton Gravel Wells and Groundwater Elevations (ft amsl)

Trenton Gravel Recovery Wells and Groundwater Elevations (ft amsl)

Fill / Alluvium Wells and Groundwater Elevations (ft amsl)

Fill / Alluvium Recovery Wells and Groundwater Elevations (ft amsl)

Recovery Wells

Other Existing Wells

Other Existing Recovery Wells

Figure 6: Fill/Alluvium and Trenton Gravel Groundwater Elevations
AOI 4 Site Characterization Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

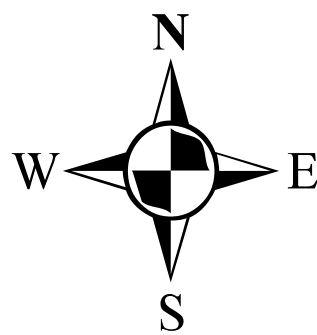
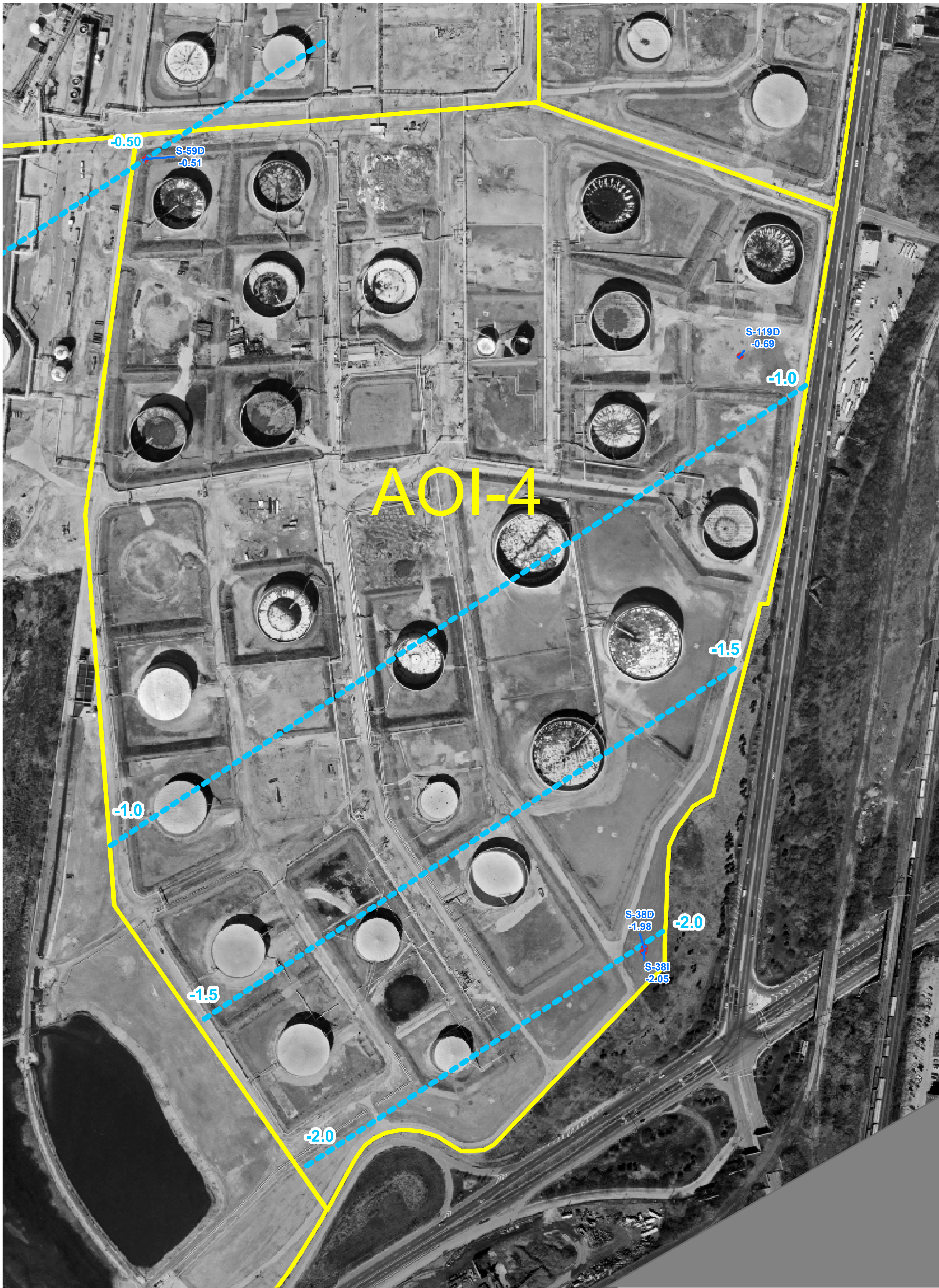


Sunoco, Inc. (R&M)
Philadelphia Refinery
3144 Passunk Avenue
Philadelphia, PA.
19145




0 125 250
Feet

SCALE: 1" = 125'
DATE: August 23, 2005
DRN BY: JSC
CHKD BY: JH
JOB#: 2574601

Notes:
1. Only wells with simulations extending beyond the refinery boundary are shown.



Legend

-  Lower Sand Wells and Groundwater Elevations (ft amsl)
-  AOI Boundaries
-  -1.5 Inferred Groundwater Contour

Notes:
1. All Groundwater elevations collected by Aquaterra, August 12, 2005.
Only wells accessible during gauging event are listed.

Figure 7: Lower Sand Groundwater Elevations
AOI 4 Site Characterization Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania



Sunoco, Inc. (R&M)
Philadelphia Refinery
3144 Passyunk Avenue
Philadelphia, PA.
19145

0 125 250
Feet

SCALE: 1" = 125'
DATE: August 22, 2005
DRI BY: JSC
CKD BY: JH
JOB#: 2574601



Legend

- Groundwater Sampling Location With No Exceedance Of PADEP MSC
- Groundwater Sampling Location With Exceedance Of PADEP MSC
- Groundwater Sampling Location Not Sampled (Active Recovery Well Or LNAPL Present)
- AOI 4 Boundary
- Gasoline / Middle Distillate
- Middle Distillate
- Middle Distillate / Light End Feed Stock

Notes:
1. Well S-97 historically contained LNAPL.

Compounds of Concern for Site Groundwater and Associated MSCs

	CAS No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500 (ug/l)
Volatile Organic Compounds		
Ethylene dibromide (EDB)	106-93-4	0.05
1,2-Dichloroethane	107-06-2	5
Benzene	71-43-2	5
Ethylbenzene	100-41-4	700
Cumene	98-82-8	2300
Methyl Tertiary Butyl Ether	1634-04-4	20
Toluene	108-88-3	1000
Xylene (Total)	1330-20-7	10000
Semi-Volatile Organic Compounds		
Chrysene	218-01-9	1.8
Fluorene	86-73-7	1900
Naphthalene	91-20-3	100
Phenanthrene	85-01-8	1100
Pyrene	129-00-0	130
Metals		
Lead (Total)	7439-92-1	5

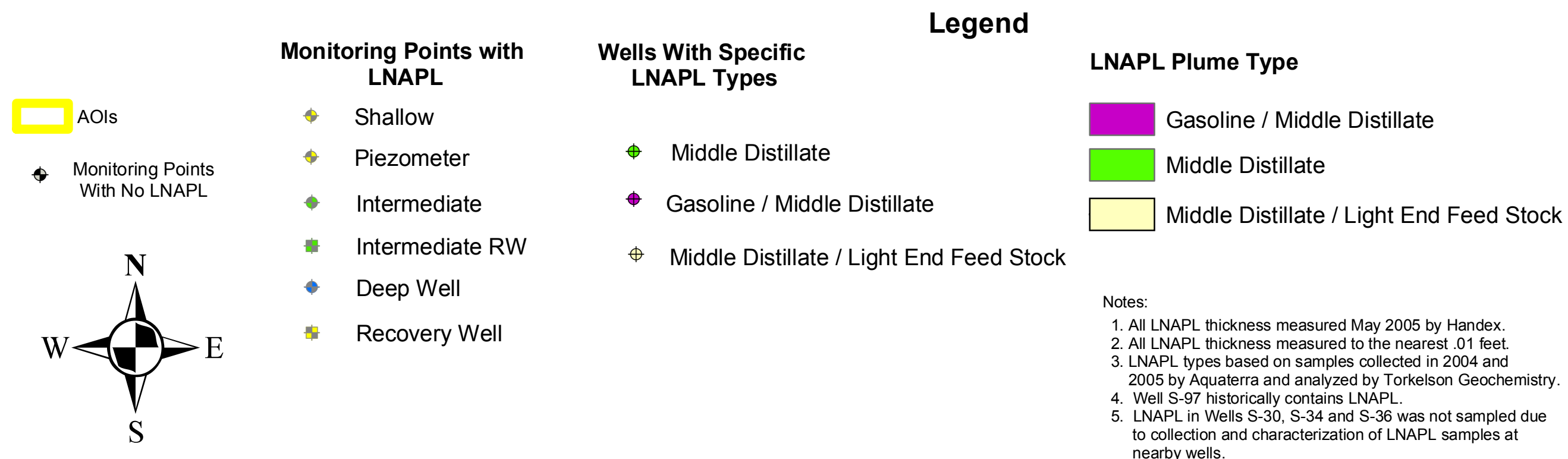
Figure 8: Summary of Groundwater Sample Exceedances: Fill/Alluvium and Trenton Gravel Wells in AOI 4 and Apparent LNAPL Occurrence AOI 4 Site Characterization Report Sunoco Philadelphia Refinery Philadelphia, Pennsylvania

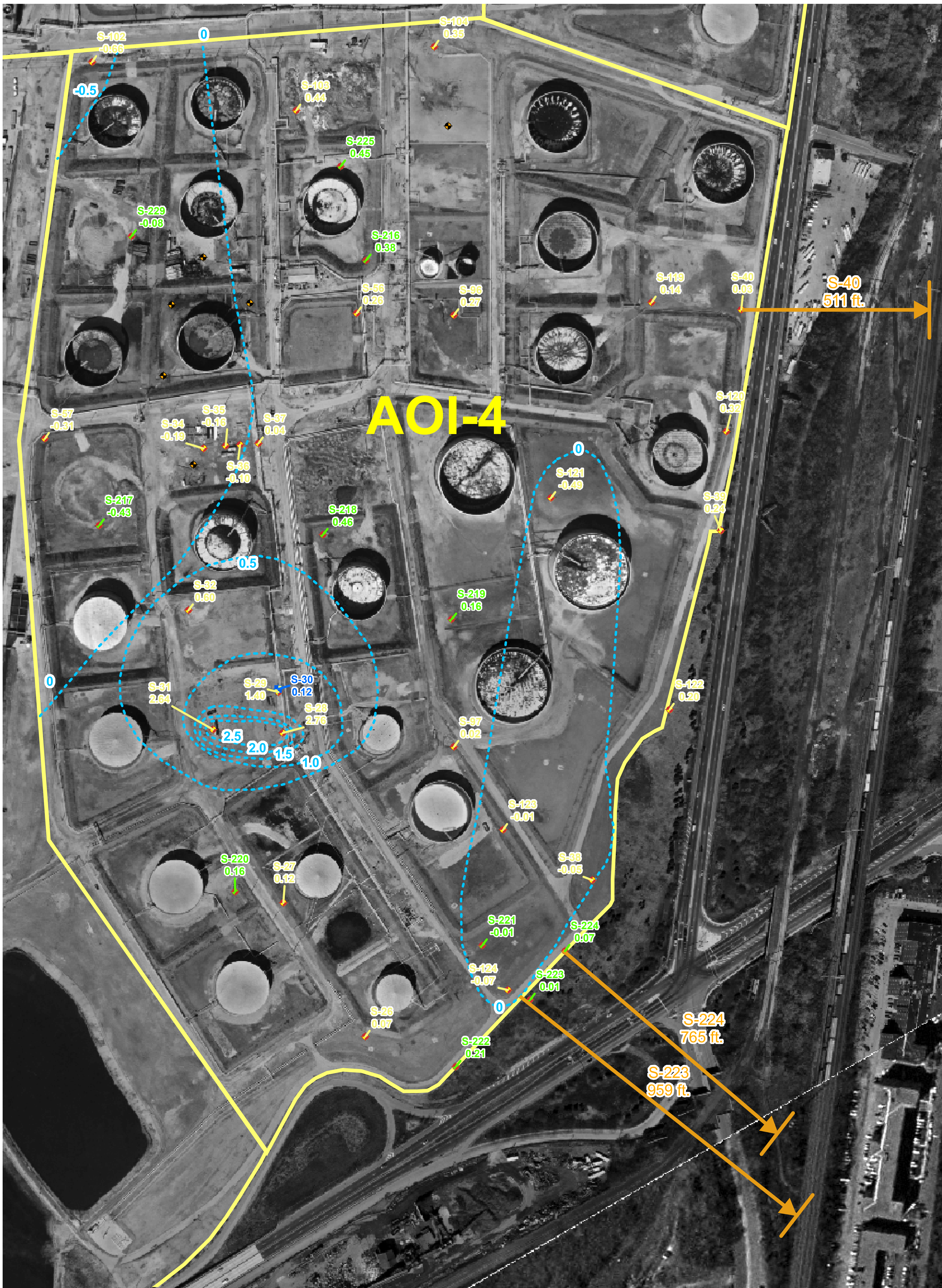


Sunoco, Inc. (R&M)
Philadelphia Refinery
3144 Passyunk Avenue
Philadelphia, PA.
19145

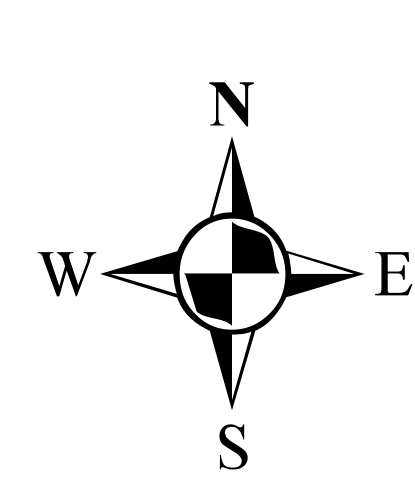

0 125 250 Feet



SCALE: 1" = 125'
DATE: August 8, 2006
DRN BY: JSC
CDD BY: JH
JOB#: 2574801









Legend


- 
-  AOI Boundaries


 Inferred Groundwater Contour
-  S-34 7.87
Trenton Gravel Wells and Groundwater Elevations (ft amsl)


 S-34 7.97
Trenton Gravel Recovery Wells and Groundwater Elevations (ft amsl)

 S-75 4.27
Fill / Alluvium Wells and Groundwater Elevations (ft amsl)

 S-75 4.27
Fill / Alluvium Recovery Wells and Groundwater Elevations (ft amsl)
-  Recovery Wells

 Other Existing Wells

 Other Existing Recovery Wells

 Approximate Extent of Dissolved Groundwater Concentrations above the MSC (Based on Quick Domenico Fate and Transport Model)

Notes:
1. Well S-26 simulation does not extend beyond the site boundary, therefore this simulation is not shown on this figure.

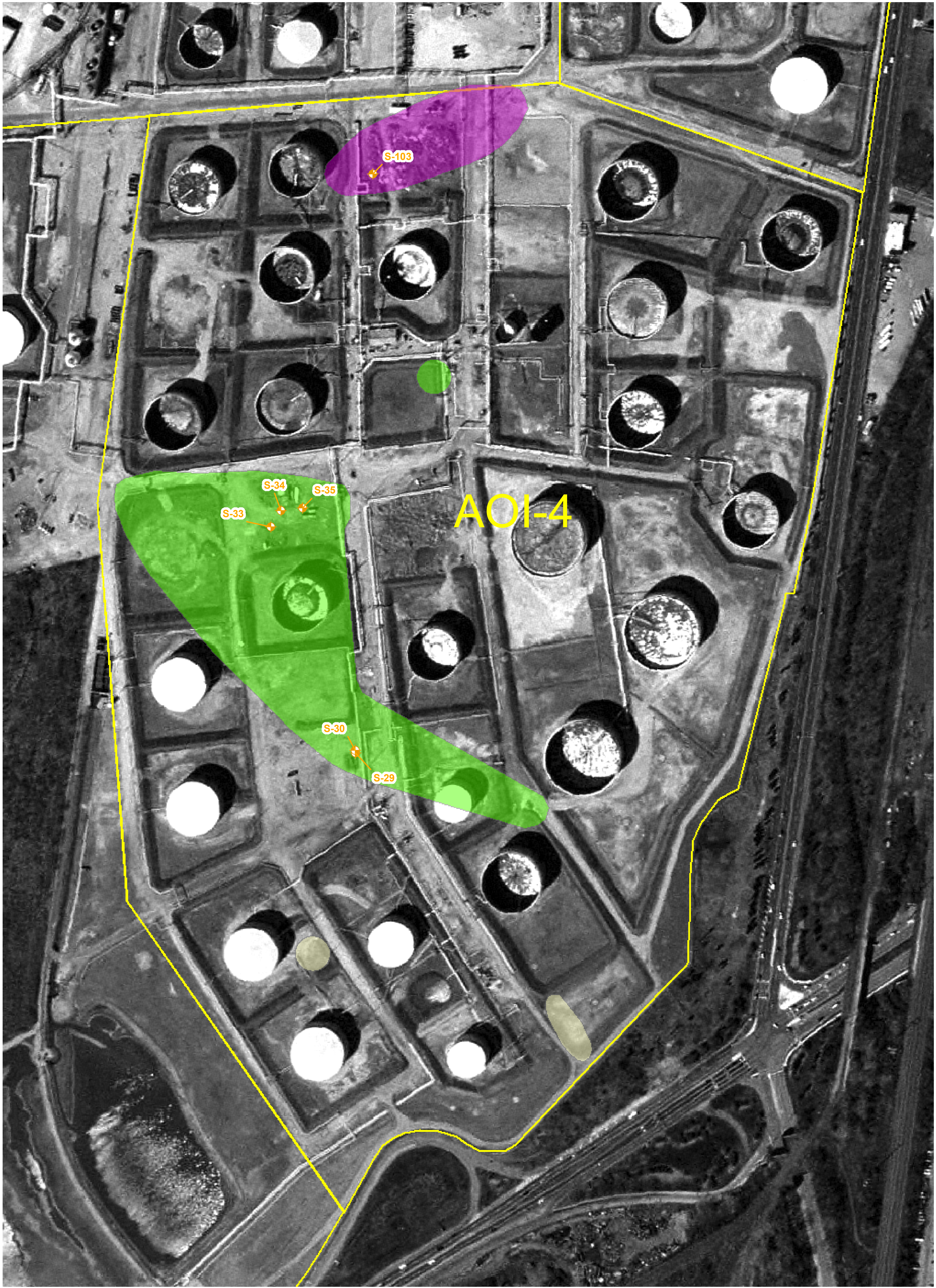
Figure 10: Fate and Transport Results and Summary:
Fill/Alluvium and Trenton Gravel Wells
AOI 4 Site Characterization Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania



Sunoco, Inc. (R&M)
Philadelphia Refinery
3144 Passyunk Avenue
Philadelphia, PA.
19145

0 125 250
Feet

SCALE: 1" = 125'
DATE: August 23, 2005
DRAWN BY: JSC
CHKD BY: JH
JOB#: 2574601



Legend

- LNAPL Plume Type**
- Gasoline / Middle Distillate
 - Middle Distillate
 - Middle Distillate / Light End Feed Stock

- Wells With Greatest Calculated LNAPL Mobility Values (Mobility Values Exceed 1×10^{-7} cm/sec)
- AOIs

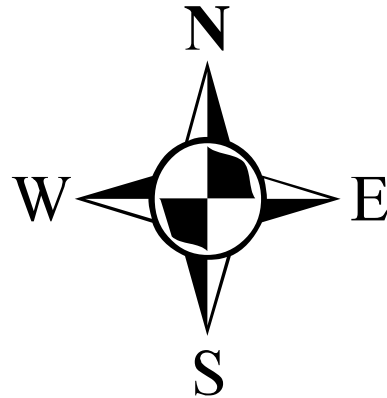


Figure 11: Wells With Greatest Calculated LNAPL Mobility Values
AOI 4 Site Characterization Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania



Sunoco, Inc. (R&M)
Philadelphia Refinery
3144 Passyunk Avenue
Philadelphia, PA.
19145

0 125 250 Feet

SCALE: 1" = 125'
DATE: August 8, 2005
DRN BY: JSC
CKD BY: JH
JOB#: 2574501


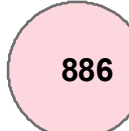

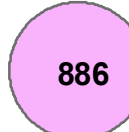


APPENDIX A



CURRENT AND HISTORIC USE FIGURES IN AOI 4



Legend

Tanks Contents

- | | |
|---|---|
|  Crude Oil |  Dewatering |
|  Intermediate Fuels |  Waste Water Treatment |
|  Light Fuels and Chemicals |  Removed Tanks |

- | |
|---|
|  AOI Boundaries |
|  Current Use Areas |

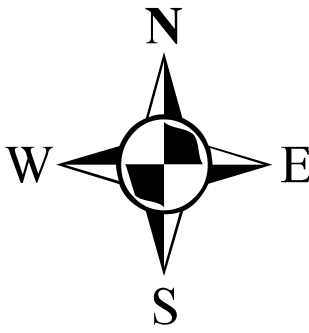


Figure A1: Current Use in AOI 4
AOI 4 Site Characterization Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania



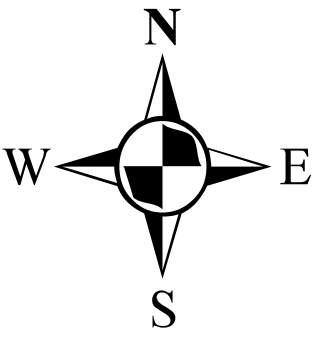
Sunoco, Inc. (R&M)
Philadelphia Refinery
3144 Passyunk Avenue
Philadelphia, PA.
19145

0 125 250
Feet

SCALE: 1" = 125'
DATE: August 23, 2005
DRN. BY: JSC
CKD. BY: JH
JOB#: 2574601



Legend



Historic Tankage



AOI Boundaries

Notes:
1. Historic usage derived from available historic documentation.

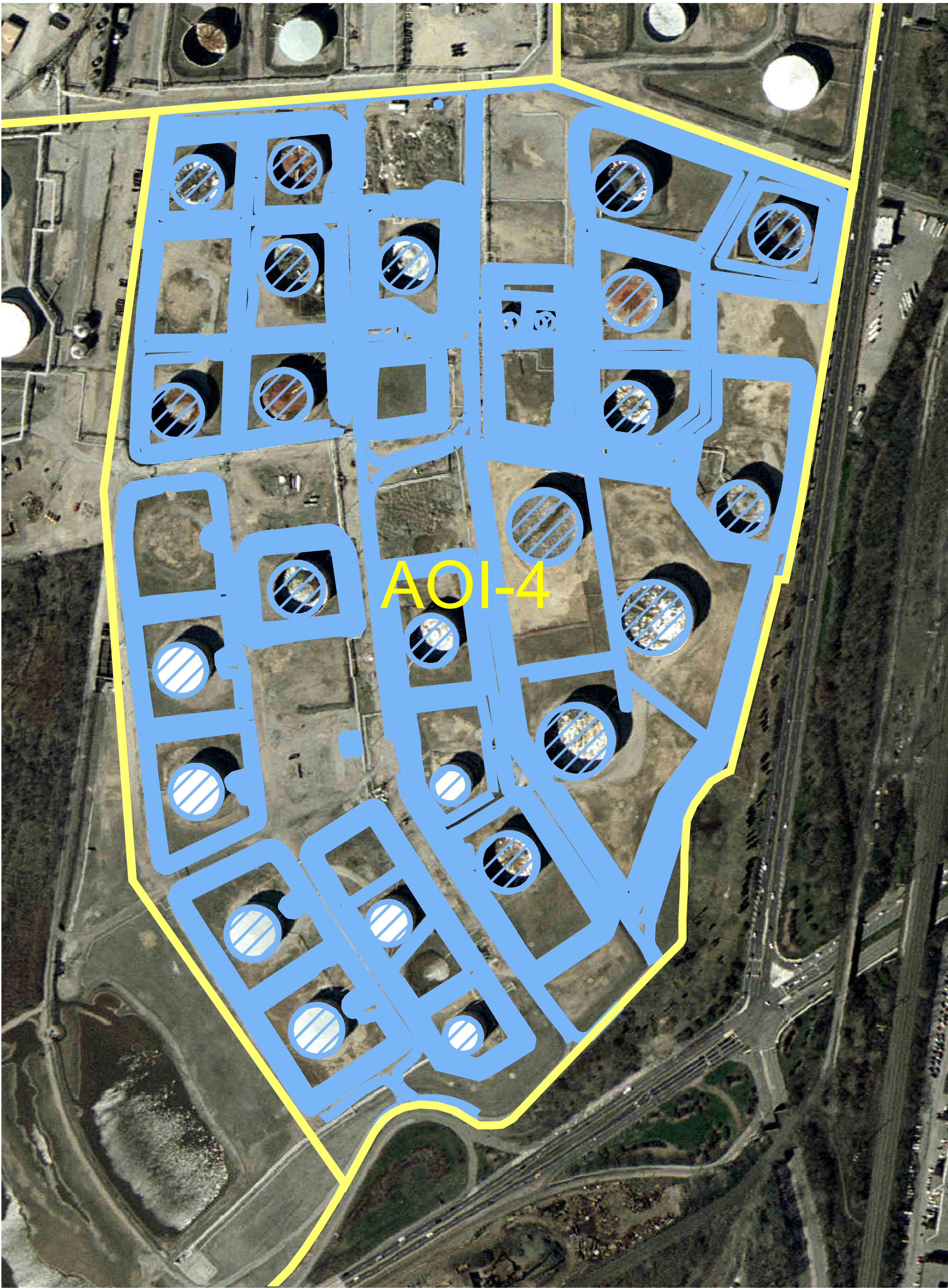
Figure A2: Historic Use in AOI 4
AOI 4 Site Characterization Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania



Sunoco, Inc. (R&M)
Philadelphia Refinery
3144 Passyunk Avenue
Philadelphia, PA.
19145




0 125 250
Feet

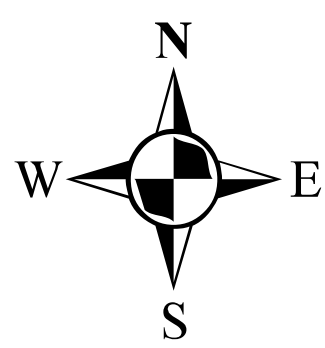
SCALE: 1" = 125'
DATE: August 23, 2005
DRN: BY: JSC
CKD: BY: CC
JOB #: 2574601



AOI-4

Legend

-  Impervious Surfaces
-  Impervious Surfaces
-  AOI Boundary



Notes:
1. Impervious surfaces estimated based on on-site observation.

Figure A3: Covered Surfaces Which Prevent Direct Contact with Soils
AOI 4 Site Characterization Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania



Sunoco, Inc. (R&M)
Philadelphia Refinery
3144 Passyunk Avenue
Philadelphia, PA.
19145

0 125 250
Feet

SCALE: 1" = 125'
DATE: August 23, 2005
DRN: BY: JSC
CKD: BY: CC
JOB #: 2574601

APPENDIX B

SOIL BORING LOGS/MONITORING WELL CONSTRUCTION SUMMARIES

Aquaterra Technologies, Inc.





Subsurface Log: S-216

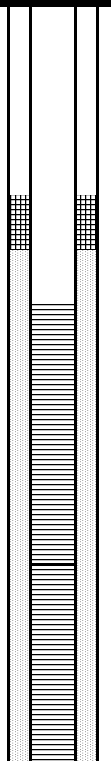
Project Name: Sunoco Philadelphia Refinery AOI - 4 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: S-216 **Log By:** M.B. Spancake **Date:** 19-Apr-05
Casing Elevation: N/A **Driller:** Parrat Wolff **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 15' **Slot Size:** 0.02 **Water Level (Init):** 16'
Casing Diameter: 4 inch **Length:** 20.5 **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Total Well Depth: 26' bgs
Screen Interval: 11'-26'
Sand Pack Interval: 9'-26'
Completion Details: 3' stick up

Construction Details
Backfill: 0'-7'
Cement/Grout Interval:
Bentonite Interval: 7'-9'
Sand Pack Type: #2

 = Backfill
 = Cement/Grout
 = Bentonite
 = Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0	1'-1.5'			Soft dig to 8' BGS. Advance augers to 10' BGS and begin continuous Hand auger to 1.5' BGS to collect soil sample on 3/25/05.	
5				Advance augers to 10' BGS and begin continuous split spoons	
10	10-12	21	1.5	Brown coarse sand and poorly sorted gravel, slight reddish color and slight moisture	
	12-14	21	1	Same as above, more red in color.	
	14-16	263	0.75	Reddish brown coarse sandy gravel, poorly sorted. Moist to wet.	
15	16-18	292	1.75	Same as above, wet.	
	18-20	358	1	Same as above.	
	20-22	318	1.25	Same as above	
	22-24	258	1.75	Same as above. Gravel is becoming larger. Large pebble in bottom of spoon	
	24-26	NA	0	No recovery. Advance to 26' BGS and set well.	
25			50 / 0.4		

Note: Highlighted cell indicates soil sample submitted for laboratory analysis.


Aquaterra Technologies, Inc.

Subsurface Log: S-217

Project Name: Sunoco Philadelphia Refinery AOI - 4 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: S-217 **Log By:** M.B. Spancake **Date:** 29-Mar-05
Casing Elevation: N/A **Driller:** Parrat Wolff **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 15' **Slot Size:** 0.02 **Water Level (Init):** NA
Casing Diameter: 4 inch **Length:** 15' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Construction Details
Total Well Depth: 27' bgs **Backfill:** 0'-7'
Screen Interval: 12'-27' **Cement/Grout Interval:**
Sand Pack Interval: 10'-27' **Bentonite Interval:** 7'-10'
Completion Details: 3' stickup **Sand Pack Type:** #2


 = Backfill
 = Cement/Grout
 = Bentonite
 = Sand

Depth (ft)	Sample Depth (ft)	OVN (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0	1-1.5'			Soft dig to 7' BGS. Hand auger to 1.5' BGS to collect soil sample on 4/1/05. Sample collected 5' from well location Advance augers to 10' below ground surface and begin split spoons every 5 feet.	
5				No lithology recorded. Driller indicated spoons recovered a sandy gravel matrix. Some spoons had more sand, some had more gravel.	
10	10-12	NA			
15	15-17	NA			
20	20-22	NA			
25	25-27	NA		Well set at 27' BGS.	

Note: Highlighted cell indicates soil sample submitted for laboratory analysis.

Aquaterra Technologies, Inc.


Subsurface Log: S-218

Project Name: Sunoco Philadelphia Refinery AOI - 4 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: S-218 **Log By:** M.B. Spancake **Date:** 20-Apr-05
Casing Elevation: N/A **Driller:** Parrat Wolff **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 15' **Slot Size:** 0.02 **Water Level (Init):** 25'
Casing Diameter: 4 inch **Length:** 18' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Total Well Depth: 30' bgs
Screen Interval: 15'-30'
Sand Pack Interval: 13'-30'
Completion Details: 3' Stick up

Construction Details
Backfill: 0-11'
Cement/Grout Interval:
Bentonite Interval: 11'-13'
Sand Pack Type: #2


 = Backfill
 = Cement/Grout
 = Bentonite
 = Sand

Depth (ft)	Sample Depth (ft)	OVm (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Soft dig to 10' BGS Advance augers to 10' below ground surface and begin split spoons every 5 feet.	
5					
10	10-12	NA	1.5 1-2-3-3	Moist to wet gray clayey silt, some fine sand	
15	15-17	NA	0.75 21-12-13-16	Gray coarse sandy gravel, slightly moist. Gravel is small.	
20	20-22	NA	1.25 20-17-15-15	Reddish brown coarse sandy gravel, slightly moist.	
25	25-27	NA	1 6-5-6-16	Wet brown medium sand and silt, some small gravel. Advance augers to 30' BGS and set well	
30					

Note: PID not working, therefore no readings available.

Aquaterra Technologies, Inc.





Subsurface Log: S-219

Project Name: Sunoco Philadelphia Refinery AOI - 4 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: S-219 **Log By:** M.B. Spancake **Date:** 25-Mar-05
Casing Elevation: N/A **Driller:** Parrat Wolff **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 15' **Slot Size:** 0.02 **Water Level (Init):** 16'
Casing Diameter: 4 inch **Length:** 15' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Total Well Depth: 27' bgs
Screen Interval: 12'-27'
Sand Pack Interval: 10'-27'
Completion Details: 3' Stick up

Construction Details
Backfill: 0'-7'
Cement/Grout Interval:
Bentonite Interval: 7'-10'
Sand Pack Type: #2

 = Backfill
 = Cement/Grout
 = Bentonite
 = Sand

Depth (ft)	Sample Depth (ft)	OVN (ppm)	Recovery (ft) / Blow Count	Lithology	Well Schematic
0	1-1.5			Soft dig to 10' BGS Hand auger to 1.5' BGS to collect soil sample.	
5				Advance augers to 10' below ground surface and begin split spoons every 5 feet.	
10	10-12	0	1 7-8-9-13	Brownish gray medium sand and some small gravel and pebble. Slightly moist	
15	15-17	0	1.5 4-4-4-5	Gray and brown silty clay, moist. Lense of wet fine sand and gravel at 16' BGS. Changing to a brown orange silty clay.	
20	20-22	0	0.5 10-9-9-9	Wet gray medium sandy gravel changing to a brown silty clay.	
25	25-27	0	1 8-13-13-11	Brown silty clay, moist. Changing to a coarse tan sandy gravel.	
30	30-32		2	Tan clay in top 6" of spoon changing to a medium to fine tan sand, wet. Set well at 27' BGS. Backfilled 27' - 32' with bentonite chips	

Note: Highlighted cell indicates soil sample submitted for laboratory analysis.

Aquaterra Technologies, Inc.





Subsurface Log: S-220

Project Name: Sunoco Philadelphia Refinery AOI - 4 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: S-220 **Log By:** M.B. Spancake **Date:** 20-Apr-05
Casing Elevation: N/A **Driller:** Parrat Wolff **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 15' **Slot Size:** 0.02 **Water Level (Init):** 20'
Casing Diameter: 4 inch **Length:** 18' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Total Well Depth: 30' bgs
Screen Interval: 15'-30'
Sand Pack Interval: 13'-30'
Completion Details: 3-foot Stickup

Construction Details
Backfill: 0'-10'
Cement/Grout Interval:
Bentonite Interval: 10'-13'
Sand Pack Type: #2

 = Backfill
 = Cement/Grout
 = Bentonite
 = Sand

Depth (ft)	Sample Depth (ft)	OVm (ppm)	Recovery (ft) / Blowcount	Lithology	Well Schematic
0	1'-1.5'			Soft dig to 10' BGS Hand auger to 1.5' BGS to collect soil sample on 4/1/05. Advance augers to 10' below ground surface and begin split spoons every 5'	
5					
10	10-12	NA	NA 7-7-3-3	Dry brown coarse sand and small gravel	
15	15-17	NA	NA 6-4-6-4	Same as above	
20	20-22	NA	NA 5-4-4-4	Wet grayish green coarse sandy gravel changing to a brown silt, moist and stiff	
25	25-27	NA	NA 2-4-6-6	Tan and brown clayey silt. Some fine to medium sand, slightly moist Advance augers to 30' BGS and set well.	
30					

Note: PID not working, therefore no readings available.

Note: Highlighted cell indicates soil sample submitted for laboratory analysis.

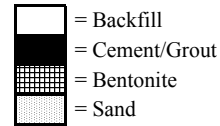
Aquaterra Technologies, Inc.

Subsurface Log: S-221

Project Name: Sunoco Philadelphia Refinery AOI - 4 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: S-221 **Log By:** M.B. Spancake **Date:** 21-Apr-05
Casing Elevation: N/A **Driller:** Parrat Wolff **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 15' **Slot Size:** 0.02 **Water Level (Init):** 22'
Casing Diameter: 4 inch **Length:** 18' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Total Well Depth: 30' bgs **Backfill:** 0'-10'
Screen Interval: 15'-30' **Cement/Grout Interval:**
Sand Pack Interval: 13'-30' **Bentonite Interval:** 10'-13'
Completion Details: 3' Stick up **Sand Pack Type:** #2



Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0	1.5'-2'			Soft dig to 8' BGS Hand auger to 2' BGS to collect soil sample on 3/25/05. Advance augers to 10' BGS and begin continuous split spoons	
5					
10	10-12	21	2	Wet gray clayey silt and some small gravel in top 6" Change to a stiff reddish brown clay, slightly moist.	
	12-14	NA	1.5	Stiff reddish brown silty clay, slight moisture	
	14-16	463	0.5	Slightly moist brown coarse sand and medium sized gravel.	
15	16-18	390	1	Fine and medium brown sand, some small gravel. Changing to a fine gray sand in bottom 4". Moist.	
	18-20	920	0.75	Wet coarse sandy gravel, large pebbles present. Gray in color.	
	20-22	NA	0	Large pebble in shoe of spoon. No Recovery	
	22-24	920	1.25	Wet reddish brown and gray coarse sand and medium to large poorly sorted gravel	
	24-26	801	1	Medium and coarse brown sand, wet.	
25	26-28	824	1.25	Same as above.	
	28-30	974	1.75	Same as above. Advance augers to 30' BGS and set well.	
30					

Note: Highlighted cell indicates soil sample submitted for laboratory analysis.





Aquaterra Technologies, Inc.

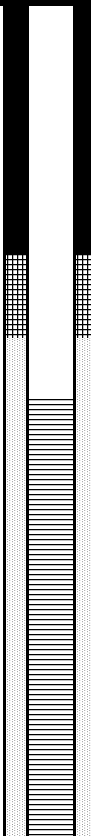
Subsurface Log: S-222

Project Name: Sunoco Philadelphia Refinery AOI - 4 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: S-222 **Log By:** M.B. Spancake **Date:** 9-Jun-05
Casing Elevation: N/A **Driller:** Total Quality Drilling **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 15' **Slot Size:** 0.02 **Water Level (Init):** NA
Casing Diameter: 4 inch **Length:** 13' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** **Rig Type:** HSA Rig

Construction Details
Total Well Depth: 28' bgs **Backfill:**
Screen Interval: 13'-28' **Cement/Grout Interval:** 0'-8'
Sand Pack Interval: 11'-28' **Bentonite Interval:** 8'-11'
Completion Details: Flushmount with manhole **Sand Pack Type:** #2


 = Backfill

 = Cement/Grout

 = Bentonite

 = Sand

Depth (ft)	Sample Depth (ft)	OVN (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Soft dig to 8' BGS Advance augers to 28' BGS and set well'	
5				Cuttings were brown silt and gravel No lithology recorded	
10					
15					
20					
25					


Aquaterra Technologies, Inc.

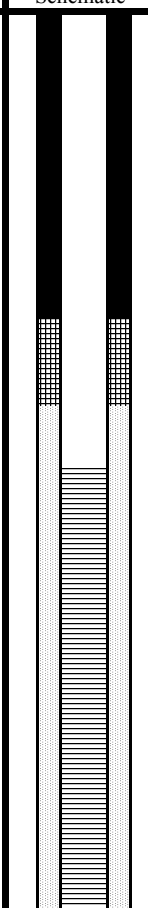
Subsurface Log: S-223

Project Name: Sunoco Philadelphia Refinery AOI - 4 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: S-223 **Log By:** M.B. Spancake **Date:** 8-Jun-05
Casing Elevation: N/A **Driller:** Total Quality Drilling **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 15' **Slot Size:** 0.02 **Water Level (Init):** NA
Casing Diameter: 4 inch **Length:** 15' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** **Rig Type:** HSA Rig

Construction Details
Backfill: **Total Well Depth:** 30' bgs
Cement/Grout Interval: 0'-10' **Screen Interval:** 15'-30'
Bentonite Interval: 10'-13' **Sand Pack Interval:** 13'-30'
Completion Details: Flushmount with manhole **Sand Pack Type:** #2


 = Backfill
 = Cement/Grout
 = Bentonite
 = Sand

Depth (ft)	Sample Depth (ft)	OVN (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Soft dig to 8' BGS Advance augers to 30' BGS and set well'	
5				Cuttings were brown silt and gravel No lithology recorded	
10					
15				Augers grinding from 12'- 17' BGS. Cuttings are brown sandy silt and coarse gravel	
20				Wet cuttings at 20' BGS	
25					
30				Well set at 30' BGS	


Aquaterra Technologies, Inc.

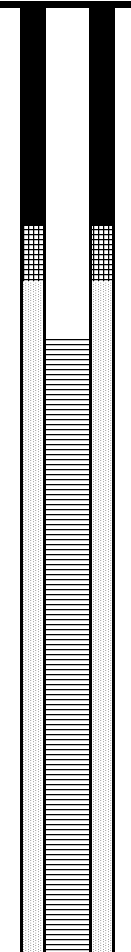
Subsurface Log: S-224

Project Name: Sunoco Philadelphia Refinery AOI - 4 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: S-224 **Log By:** M.B. Spancake **Date:** 6-Jun-05
Casing Elevation: N/A **Driller:** Total Quality Drilling **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 20' **Slot Size:** 0.02 **Water Level (Init):** NA
Casing Diameter: 4 inch **Length:** 12' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** **Rig Type:** HSA Rig

Construction Details
Total Well Depth: 32' bgs **Backfill:**
Screen Interval: 12'-32' **Cement/Grout Interval:** 0'-8'
Sand Pack Interval: 10'-32' **Bentonite Interval:** 8'-10'
Completion Details: Flushmount with manhole **Sand Pack Type:** #2

 = Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Soft dig to 8' BGS Advance augers to 32' BGS and set well	
5				No lithology recorded	
10					
15					
20					
25					
30					


Aquaterra Technologies, Inc.

Subsurface Log: S-225

Project Name: Sunoco Philadelphia Refinery AOI - 4 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: S-225 **Log By:** M.B. Spancake **Date:** #
Casing Elevation: N/A **Driller:** Parrat Wolff **Borehole Dia:** 8.25"
Screen Diameter: 4 inch **Length:** 15' **Slot Size:** 0.02 **Water Level (Init):** 17'
Casing Diameter: 4 inch **Length:** 15' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Total Well Depth: 27' bgs **Backfill:** 0'-7'
Screen Interval: 12'-27' **Cement/Grout Interval:**
Sand Pack Interval: 10'-27' **Bentonite Interval:** 7'-10'
Completion Details: 3' Stick up **Sand Pack Type:** #2

 = Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVN (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Soft dig to 10' BGS Advance augers to 10' below ground surface and begin split spoons every 5 feet.	
5					
10	10-12	280	1'	Tight brown sandy silt with small gravel. Slight staining present. Becoming more sandy towards bottom.	
15	15-17	326	0.75'	Reddish brown silt with coarse sandy gravel. Moist. Becoming wet towards bottom.	
20	20-22	362	1.25'	Wet brownish red coarse sandy gravel.	
25	25-27	26	2'	Wet gray clayey sand. Sand is fine grain. Slight color change to brown-gray at 26.5' BGS. Set well at 27' BGS.	

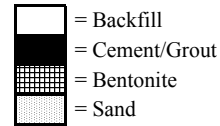
Aquaterra Technologies, Inc.

Subsurface Log: S-229

Project Name: Sunoco Philadelphia Refinery AOI - 4 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: S-229 **Log By:** M.B. Spancake **Date:** 23-Mar-05
Casing Elevation: N/A **Driller:** Parrat Wolff **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 15' **Slot Size:** 0.02 **Water Level (Init):** 20'
Casing Diameter: 4 inch **Length:** 15' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Total Well Depth: 30' bgs **Backfill:** 0-10'
Screen Interval: 15'-30' **Cement/Grout Interval:**
Sand Pack Interval: 13'-30' **Bentonite Interval:** 10'-13'
Completion Details: 3' Stick up **Sand Pack Type:** #2



Depth (ft)	Sample Depth (ft)	OVN (ppm)	Recovery (ft) / Blow Count	Lithology	Well Schematic
0	1.5'-2'			Soft dig to 10' BGS Hand auger to 2' BGS to collect soil sample. Advance augers to 10' below ground surface and begin continuous split spoons	
5					
10	10-12	0	0.5	Rock fragments in a brown sand and silt matrix, dry.	
12	12-14	0	1	Same as above, slight moisture	
14	14-16	0	1	Same as above	
16	16-18	11	1	Dry coarse sandy gravel	
18	18-20	14	0.5	Same as above, more large gravel and rock fragments present.	
20	20-22	NA	0.25	Wet brown gray sand, SPP present	
22	22-24	NA	1.25	Wet poorly sorted coarse sandy gravel changing to a fine to medium gray brown sand towards bottom. SPP present	
24	24-26	NA	1.5	Same as above, lense of fine to medium brown gray sand in bottom.	
26	26-28	NA	1	Wet coarse sandy gravel, poorly sorted, brownish gray in color.	
28	28-30	NA	2	Same as above	
30			13-19-23-40	Set well at 30' BGS	

No PID readings after 20' due to heavy rain.

Note: Highlighted cell indicates soil sample submitted for laboratory analysis.


Aquaterra Technologies, Inc.

Subsurface Log: S-119D

Project Name: Sunoco Philadelphia Refinery AOI - 4 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: S-119D **Log By:** M.B. Spancake **Date:** 3/22/05 & 4/7/05
Casing Elevation: N/A **Driller:** Parrat Wolff **Borehole Dia:** 8.25'
Screen Diameter: 2" **Length:** 15' **Slot Size:** 0.02 **Water Level (Init):** 57
Casing Diameter: 2" **Length:** 57' **Type:** PVC
Drilling Method: Hollow Stem Auger/ **Sample Method:** Split Spoon **Rig Type:** HSA Rig/Mud Rotary
Mud Rotary

Construction Details
Total Well Depth: 72' BGS
Screen Interval: 57'-72'
Sand Pack Interval: 55'-72'
Completion Details: Completed with 2' Steel stick-up
Bentonite Interval: 0-55'
Cement/Grout Interval:
Sand Pack Type: 62'-79'

 = Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVm (ppm)	Recovery (ft)/ Blow Count	Lithology	Well Schematic
0	1'-1.5'			Vacuum Utility Clearance to 9' below ground surface (bgs). Hand auger to 1.5' BGS to collect soil sample on 4/1/05. Advance augers to 10' BGS and begin split spoons	
5					
10	10-12	0	2	Moist gray silt, slight clay content with some brown silt banding	
			5-7-7-12		
	12-14	0	2	Same as above	
			12-17-15-21		
	14-16	0	1.25	Same as above in top 6", changing to a brown sandy silt for 4" Changing	
15			4-4-8-10	to a gray & brown medium to fine sandy silt.	
	16-18	0	1.25	Brown medium sand and gravel, pebble fragments. Dry	
			26-16-23-30		
	18-20	0	1.5	Moist gray silty clay in top 0.75' changing to a brownish orange fine to	
			3-8-12-12	medium sand with some gravel.	
20	20-22	0	1.25	Brown fine sand and poorly sorted gravel with layers of coarse tan and	
			9-11-13-18	gray sand, rock fragment in bottom of spoon	
	22-24	0	1	Same as above, more gravel and rock fragments present.	
			9-15-23-27		
	24-26	0	1.75	Brownish gray medium sand, wet. Some gravel in top 4"	
25			5-6-4-6		
	26-28	0	1.5	Wet brown fine sand and brown silt	
			3-9-16-23		
	28-30	0	1.25	Same as above, gravel and pebble fragments present	
			10-22-32-26		
30	30-32	0	1.25	Same as above. Weathered green serpentine rock fragments towards	
			20-23-25-31	bottom of spoon	
	32-34	0	1.5	Wet brown fine sand with some gravel and pebble fragments	
			24-26-31-30		
	34-36	0	1.75	Moist to dry dark gray clayey silt. Wet gray medium sand in bottom	
35			4-19-26-28	of spoon.	
	36-38	0	1.5	Wet gray medium sand	
			8-8-16-27		

Aquaterra Technologies, Inc.
Subsurface Log: S-119D (Continued)

Depth (ft)					Well Schematic
	38-40	0	2	Brown coarse sand in top 6" changing to a brownish gray moist to wet clay	
40	40-42	0	1-1-2-2 1	Same as above changing to a dark gray clayey silt, slightly moist.	
	42-44	0	0.75	Dark brown clayey silt, slightly moist.	
	44-46	0	1.5	Same as above	
45	46-48	0	1	Same as above	
	48-50	0	1.75	Same as above. Set 4" steel casing to 48' BGS. Grouted in place.	
			4-5-6-5	Drilling continued on 4/7/05	
50	50-52	0	2	Advance Mud rotary to 50' BGS and continue split spoons. Dark grayish brown clayey silt, slightly moist.	
	52-54	0	2	Same as above	
			13-17-18-28		
55	54-56	0	2	Dark grayish brown silt changing to a dark grayish brown silt and fine sand in bottom 6" of spoon. Slightly moist	
	56-58	0	1.5	Moist brown silty fine sand in top 4" of spoon changing to a wet gray and tan coarse sand with some small gravel.	
	58-60	0	13-19-24-18	Advance mud rotary to 65' BGS and collect spoon	
60	60-62				
65	65-67	0	2	Greenish gray silt and fine sand, slight moisture. 1" lense of light gray medium sand at 66' BGS.	
			24-10-10-15	Advance to 70' BGS	
70	70-72	0	6"	White/light gray fine sand, wet and compact.	
			52-50 / 0.2	End boring, set well at 72' BGS	

Note: Highlighted cell indicates soil sample submitted for laboratory analysis.


Aquaterra Technologies, Inc.

Subsurface Log: S-59D

Project Name: Sunoco Philadelphia Refinery AOI - 4 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

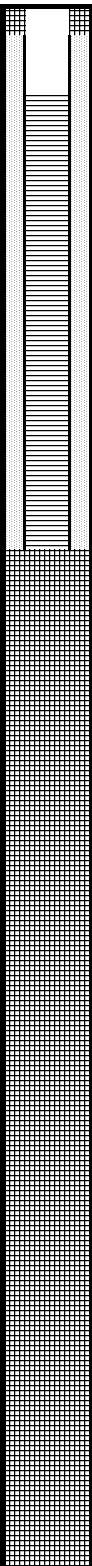
Boring Number: S-59D **Log By:** M.B. Spancake **Date:** 3/24 & 4/12 & 13/05
Casing Elevation: N/A **Driller:** Parrat Wolff **Borehole Dia:** 8.25'
Screen Diameter: 2" **Length:** 15' **Slot Size:** 0.02 **Water Level (Init):** 42'
Casing Diameter: 2" **Length:** 41' **Type:** PVC
Drilling Method: Hollow Stem Auger/ **Sample Method:** Split Spoon **Rig Type:** HSA/Mud rotary
Mud Rotary

Construction Details
Total Well Depth: 56' BGS
Screen Interval: 41'-56"
Sand Pack Interval: 39'-56'
Completion Details: Completed with 2' Steel stick-up
Bentonite Interval: 0'-39'
Cement/Grout Interval:
Sand Pack Type: # 2

 = Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVN (ppm)	Recovery (ft) / Blowcount	Lithology	Well Schematic
0				Vacuum Utility Clearance to 9' below ground surface (bgs). Advance augers to 10' BGS and begin continuous split spoons.	
5					
10	10-12	0	1.75 4-5-5-7	Brown stiff clay becoming slightly sandy towards the bottom	
	12-14	0	2 7-7-9-12	Brown sandy clay, sand is coarse grained. Moist.	
	14-16	80	0.5	Wet brown sandy gravel.	
15			32-32-50 / 0.4		
	16-18		0 50 / 0.1	No recovery	
	18-20	100	1.25 7-9-18-8	Reddish gray coarse sandy gravel, wet.	
20	20-22	186	0.75 8-14-14-15	Same as above	
	22-24	92	1.5 48-24-20-20	Same as above. Rock fragment in shoe of spoon. Less moisture content towards bottom.	
	24-26	17	0.75 10-16-30-40	Wet fine sand and large rock fragments. Most of recovery is large rock fragments	
25	26-28	NA	2 23-27-28-31	Wet gray coarse sandy gravel. Bottom 3" changing to a gray clayey silt and fine sand.	
	28-30	214	2 4-5-5-6	Wet medium gray sand and small gravel	
30	30-32	0	2 3-3-4-5	Moist dark gray clayey silt and fine sand	
	32-34	44	2 5-7-8-13	Moist gray fine sandy clay, changing in color to a brownish gray in the bottom 2"	
	34-36	0	1	Grayish tan clayey silt, slightly moist	
35	36-38	0	1.25 3-4-4-5	Greenish gray stiff clayey silt with fine sand. Slightly moist.	

Aquaterra Technologies, Inc.
Subsurface Log: S-59D (Continued)

Depth (ft)					Well Schematic
	38-40	0	1	Same as above. Set 4" steel casing at 38' BGS on 3/24/05 and grouted in place. Continue with mud rotary on 4/12/05	
40	40-42	0	5-7-7-9 1	Brown fine sand, slightly moist to becoming wet at bottom.	
	42-44	0	12-12-12-15 1.5	Wet brown and gray fine sand	
45			14-12-12-16	Advance to 50' BGS and collect spoons every 5'.	
50	50-52	NA	0 50/ 0.0	No recovery. Advance to 55' BGS.	
55	55-57	0	1.75 30-25-22-14	Coarse brown sand, large gravel and pebble present, wet.	
60	60-62			Borehole not staying open at this interval. Advance to 65' BGS.	
65	65-67	0	1 17-13-10-10	Gray and tan coarse sand and small poorly sorted gravel. Some large pebble fragments and a thin lense of reddish brown sandy silt at 61.5'	
70	70-72	0	1.25 11-11-12-15	Same as above.	
75	75-77	0	1 10-12-11-13	Coarse well sorted gravel, wet.	
80	80-82	0	1.5 22-14-24-21	Moist white saprolitic mica schist, dense and compact.	
85	85-87	0	1.25 17-19-14-15	Black and white saprolitic mica schist, dense and compact.	
90	90-92	0	1 21-16-17-19	Same as above. End boring and set well at 56' BGS. Backfilled annular space with bentonite chips.	





Aquaterra Technologies, Inc.
Subsurface Log: SS-S34-20'-22'-042105

Project Name: Sunoco Philadelphia Refinery AOI - 4 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: SS-S34-20'-22'-042105 **Log By:** M.B. Spancake **Date:** 21-Apr-05
Casing Elevation: N/A **Driller:** Parrat Wolff **Borehole Dia:** 8.25'
Screen Diameter: NA **Length:** NA **Slot Size:** NA **Water Level (Init):** NA
Casing Diameter: NA **Length:** NA **Type:** NA
Drilling Method: Hollow Stem Auger **Sample Method:** 3" Spoon with brass liners **Rig Type:** HSA Rig

Total Boring Depth: 22' bgs
Screen Interval: NA
Sand Pack Interval: NA
Completion Details: NA

Construction Details
Backfill: 0-22'
Cement/Grout Interval:
Bentonite Interval: NA
Sand Pack Type: #2

 = Backfill
 = Cement/Grout
 = Bentonite
 = Sand

Depth (ft)	Sample Depth (ft)	OVm (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic			
0				Soft dig to 10' BGS Advance augers to 20' below ground surface and collect 3" diameter spoon with (4) 6" brass liners for SPP saturated soil sample Boring is located 25' south of S-34.				
5								
10	10-12							
15	15-17							
20	20-22			Drove spoon 2' and collected soil sample. Sample was collected in four 6" long brass liners and sealed and placed on dry ice. Samples were submitted to PTS GeoLabs for SPP mobility testing in soils.				

APPENDIX C

SOIL AND GROUNDWATER ANALYTICAL REPORTS

ANALYTICAL RESULTS

Prepared for:

Langan
500 Hyde Park
Doylestown PA 18901

215-348-7101

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425**SAMPLE GROUP**

The sample group for this submittal is 937120. Samples arrived at the laboratory on Monday, March 28, 2005. The PO# for this group is SUNOCO PHILLY REFINER.

Client DescriptionBH-S219-032505-1-1.5 Grab Soil Sample
BH-S221-032505-1.5-2 Grab Soil Sample
BH-S229-032505-1.5-2 Grab Soil Sample
BH-S216-032505-1-1.5 Grab Soil Sample**Lancaster Labs Number**4491369
4491370
4491371
44913721 COPY TO Langan
1 COPY TO LL
ELECTRONIC SUN: Aquaterra Tech.
COPY TO
ELECTRONIC Langan
COPY TOAttn: Jason Hanna
Attn: Angela Miller
Attn: Brad Spancake

Attn: Dennis Webster

Questions? Contact your Client Services Representative
Angela M Miller at (717) 656-2300.

Respectfully Submitted,



Max E. Snavely
Senior Chemist

Lancaster Laboratories Sample No. SW 4491369

BH-S219-032505-1-1.5 Grab Soil Sample

SUN: Philadelphia Refinery AOI-4

Collected: 03/25/2005 11:20 by MBS

Account Number: 10132

Submitted: 03/28/2005 17:30

Reported: 04/05/2005 at 13:48

Discard: 05/06/2005

Langan

500 Hyde Park

Doylestown PA 18901

S219-

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Limit of Quantitation*	Dry Method Detection Limit	Units	Dilution Factor
06955	Lead	7439-92-1	8.99	2.37	1.10	mg/kg	1
00111	Moisture	n.a.	16.6	0.50	0.50	%	1
"Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis.							
07804	PAHs in Soil by GC/MS						
01195	Pyrene	129-00-0	< 400.	400.	40.	ug/kg	1
03761	Naphthalene	91-20-3	< 400.	400.	40.	ug/kg	1
03768	Fluorene	86-73-7	< 400.	400.	40.	ug/kg	1
03775	Phenanthrene	85-01-8	< 400.	400.	40.	ug/kg	1
03776	Anthracene	120-12-7	< 400.	400.	40.	ug/kg	1
03781	Benzo(a)anthracene	56-55-3	< 400.	400.	40.	ug/kg	1
03782	Chrysene	218-01-9	< 400.	400.	40.	ug/kg	1
03786	Benzo(b)fluoranthene	205-99-2	< 400.	400.	40.	ug/kg	1
03788	Benzo(a)pyrene	50-32-8	< 400.	400.	40.	ug/kg	1
03791	Benzo(g,h,i)perylene	191-24-2	< 400.	400.	40.	ug/kg	1
02308	UST-Soils by 8260B						
02016	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/kg	0.85
05460	Benzene	71-43-2	< 5.	5.	0.5	ug/kg	0.85
05461	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/kg	0.85
05466	Toluene	108-88-3	< 5.	5.	1.	ug/kg	0.85
05471	1,2-Dibromoethane	106-93-4	< 5.	5.	1.	ug/kg	0.85
05474	Ethylbenzene	100-41-4	< 5.	5.	1.	ug/kg	0.85
05479	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/kg	0.85
06301	Xylene (Total)	1330-20-7	< 5.	5.	1.	ug/kg	0.85

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06955	Lead	SW-846 6010B	1	03/31/2005 22:01	John P Hook	1
00111	Moisture	EPA 160.3 modified	1	04/01/2005 17:27	Scott W Freisher	1
07804	PAHs in Soil by GC/MS	SW-846 8270C	1	03/31/2005 03:02	Brian K Graham	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. SW 4491369

BH-S219-032505-1-1.5 Grab Soil Sample

SUN: Philadelphia Refinery AOI-4

Collected: 03/25/2005 11:20 by MBS

Account Number: 10132

Submitted: 03/28/2005 17:30

Langan

Reported: 04/05/2005 at 13:48

500 Hyde Park

Discard: 05/06/2005

Doylestown PA 18901

S219-

02308	UST-Soils by 8260B	SW-846 8260B	1	04/04/2005 12:49	Kenneth L Boley Jr	0.85
02392	GC/MS - Field Preserved NaHSO4	SW-846 5035	1	03/30/2005 14:19	Nadine Fegley	1
02392	GC/MS - Field Preserved NaHSO4	SW-846 5035	2	03/30/2005 14:20	Nadine Fegley	1
05708	SW SW846 ICP Digest	SW-846 3050B	1	03/31/2005 07:33	Denise Y Black	1
06171	GC/MS - Field Preserved MeOH	SW-846 5035	1	03/30/2005 13:53	Nadine Fegley	1
07806	BNA Soil Extraction	SW-846 3550B	1	03/30/2005 15:15	Ashley B Zook	1

Lancaster Laboratories Sample No. SW 4491370

BH-S221-032505-1.5-2 Grab Soil Sample
SUN: Philadelphia Refinery AOI-4

Collected: 03/25/2005 11:45 by MBS

Account Number: 10132

Submitted: 03/28/2005 17:30
Reported: 04/05/2005 at 13:48
Discard: 05/06/2005

Langan
500 Hyde Park
Doylestown PA 18901

S221-

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Limit of Quantitation*	Dry Method Detection Limit	Units	Dilution Factor
06955	Lead	7439-92-1	102.	2.29	1.07	mg/kg	1
00111	Moisture	n.a.	13.7	0.50	0.50	%	1
"Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis.							
07804	PAHs in Soil by GC/MS						
01195	Pyrene	129-00-0	530.	390.	39.	ug/kg	1
03761	Naphthalene	91-20-3	< 390.	390.	39.	ug/kg	1
03768	Fluorene	86-73-7	< 390.	390.	39.	ug/kg	1
03775	Phenanthrene	85-01-8	390.	390.	39.	ug/kg	1
03776	Anthracene	120-12-7	< 390.	390.	39.	ug/kg	1
03781	Benzo(a)anthracene	56-55-3	< 390.	390.	39.	ug/kg	1
03782	Chrysene	218-01-9	< 390.	390.	39.	ug/kg	1
03786	Benzo(b)fluoranthene	205-99-2	560.	390.	39.	ug/kg	1
03788	Benzo(a)pyrene	50-32-8	460.	390.	39.	ug/kg	1
03791	Benzo(g,h,i)perylene	191-24-2	< 390.	390.	39.	ug/kg	1
02308	UST-Soils by 8260B						
02016	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/kg	0.83
05460	Benzene	71-43-2	< 5.	5.	0.5	ug/kg	0.83
05461	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/kg	0.83
05466	Toluene	108-88-3	< 5.	5.	1.	ug/kg	0.83
05471	1,2-Dibromoethane	106-93-4	< 5.	5.	1.	ug/kg	0.83
05474	Ethylbenzene	100-41-4	< 5.	5.	1.	ug/kg	0.83
05479	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/kg	0.83
06301	Xylene (Total)	1330-20-7	< 5.	5.	1.	ug/kg	0.83
The GC/MS volatile internal standard peak areas were outside the QC limits for both the initial analysis and the re-analysis. The values reported here are from the initial analysis of the sample.							

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Analysis Trial#	Date and Time	Analyst	Dilution Factor
---------	---------------	--------	-----------------	---------------	---------	-----------------

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. SW 4491370

BH-S221-032505-1.5-2 Grab Soil Sample

SUN: Philadelphia Refinery AOI-4

Collected: 03/25/2005 11:45 by MBS

Account Number: 10132

Submitted: 03/28/2005 17:30

Langan

Reported: 04/05/2005 at 13:48

500 Hyde Park

Discard: 05/06/2005

Doylestown PA 18901

S221-							
06955	Lead	SW-846 6010B	1	03/31/2005 22:05	John P Hook	1	
00111	Moisture	EPA 160.3 modified	1	04/01/2005 17:27	Scott W Freisher	1	
07804	PAHs in Soil by GC/MS	SW-846 8270C	1	03/31/2005 03:44	Brian K Graham	1	
02308	UST-Soils by 8260B	SW-846 8260B	1	04/04/2005 13:12	Kenneth L Boley Jr	0.83	
02392	GC/MS - Field Preserved NaHSO4	SW-846 5035	1	03/30/2005 14:21	Nadine Fegley	1	
02392	GC/MS - Field Preserved NaHSO4	SW-846 5035	2	03/30/2005 14:22	Nadine Fegley	1	
05708	SW SW846 ICP Digest	SW-846 3050B	1	03/31/2005 07:33	Denise Y Black	1	
06171	GC/MS - Field Preserved MeOH	SW-846 5035	1	03/30/2005 13:55	Nadine Fegley	1	
07806	BNA Soil Extraction	SW-846 3550B	1	03/30/2005 15:15	Ashley B Zook	1	

Lancaster Laboratories Sample No. SW 4491371
BH-S229-032505-1.5-2 Grab Soil Sample
SUN: Philadelphia Refinery AOI-4

Collected: 03/25/2005 12:25 by MBS

Account Number: 10132

Submitted: 03/28/2005 17:30

Langan

Reported: 04/05/2005 at 13:48

500 Hyde Park

Discard: 05/06/2005

Doylestown PA 18901

S229-

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Limit of Quantitation*	Dry Method Detection Limit	Units	Dilution Factor
06955	Lead	7439-92-1	16.7	2.16	1.01	mg/kg	1
00111	Moisture	n.a.	10.3	0.50	0.50	%	1
"Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis.							
07804	PAHs in Soil by GC/MS						
01195	Pyrene	129-00-0	< 370.	370.	37.	ug/kg	1
03761	Naphthalene	91-20-3	< 370.	370.	37.	ug/kg	1
03768	Fluorene	86-73-7	< 370.	370.	37.	ug/kg	1
03775	Phenanthrene	85-01-8	< 370.	370.	37.	ug/kg	1
03776	Anthracene	120-12-7	< 370.	370.	37.	ug/kg	1
03781	Benzo(a)anthracene	56-55-3	< 370.	370.	37.	ug/kg	1
03782	Chrysene	218-01-9	< 370.	370.	37.	ug/kg	1
03786	Benzo(b)fluoranthene	205-99-2	< 370.	370.	37.	ug/kg	1
03788	Benzo(a)pyrene	50-32-8	< 370.	370.	37.	ug/kg	1
03791	Benzo(g,h,i)perylene	191-24-2	< 370.	370.	37.	ug/kg	1
02308	UST-Soils by 8260B						
02016	Methyl Tertiary Butyl Ether	1634-04-4	14.	5.	0.5	ug/kg	0.81
05460	Benzene	71-43-2	< 5.	5.	0.5	ug/kg	0.81
05461	1,2-Dichloroethane	107-06-2	< 5.	5.	0.9	ug/kg	0.81
05466	Toluene	108-88-3	< 5.	5.	0.9	ug/kg	0.81
05471	1,2-Dibromoethane	106-93-4	< 5.	5.	0.9	ug/kg	0.81
05474	Ethylbenzene	100-41-4	< 5.	5.	0.9	ug/kg	0.81
05479	Isopropylbenzene	98-82-8	< 5.	5.	0.9	ug/kg	0.81
06301	Xylene (Total)	1330-20-7	< 5.	5.	0.9	ug/kg	0.81

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06955	Lead	SW-846 6010B	1	03/31/2005 22:09	John P Hook	1
00111	Moisture	EPA 160.3 modified	1	04/01/2005 17:27	Scott W Freisher	1
07804	PAHs in Soil by GC/MS	SW-846 8270C	1	03/31/2005 04:26	Brian K Graham	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. SW 4491371**BH-S229-032505-1.5-2 Grab Soil Sample****SUN: Philadelphia Refinery AOI-4**

Collected: 03/25/2005 12:25 by MBS

Account Number: 10132

Submitted: 03/28/2005 17:30

Langan

Reported: 04/05/2005 at 13:48

500 Hyde Park

Discard: 05/06/2005

Doylestown PA 18901

S229-

02308	UST-Soils by 8260B	SW-846 8260B	1	04/04/2005 13:35	Kenneth L Boley Jr	0.81
02392	GC/MS - Field Preserved NaHSO ₄	SW-846 5035	1	03/30/2005 14:24	Nadine Fegley	1
02392	GC/MS - Field Preserved NaHSO ₄	SW-846 5035	2	03/30/2005 14:25	Nadine Fegley	1
05708	SW SW846 ICP Digest	SW-846 3050B	1	03/31/2005 07:33	Denise Y Black	1
06171	GC/MS - Field Preserved MeOH	SW-846 5035	1	03/30/2005 13:56	Nadine Fegley	1
07806	BNA Soil Extraction	SW-846 3550B	1	03/30/2005 15:15	Ashley B Zook	1

Lancaster Laboratories Sample No. SW 4491372

BH-S216-032505-1-1.5 Grab Soil Sample
SUN: Philadelphia Refinery AOI-4

Collected: 03/25/2005 14:00 by MBS

Account Number: 10132

Submitted: 03/28/2005 17:30
Reported: 04/05/2005 at 13:48
Discard: 05/06/2005

Langan
500 Hyde Park
Doylestown PA 18901

S216-

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Limit of Quantitation*	Dry Method Detection Limit	Units	Dilution Factor
06955	Lead	7439-92-1	60.8	2.26	1.05	mg/kg	1
00111	Moisture	n.a.	12.4	0.50	0.50	%	1
"Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis.							
07804	PAHs in Soil by GC/MS						
01195	Pyrene	129-00-0	< 380.	380.	38.	ug/kg	1
03761	Naphthalene	91-20-3	< 380.	380.	38.	ug/kg	1
03768	Fluorene	86-73-7	< 380.	380.	38.	ug/kg	1
03775	Phenanthrene	85-01-8	< 380.	380.	38.	ug/kg	1
03776	Anthracene	120-12-7	< 380.	380.	38.	ug/kg	1
03781	Benzo(a)anthracene	56-55-3	< 380.	380.	38.	ug/kg	1
03782	Chrysene	218-01-9	< 380.	380.	38.	ug/kg	1
03786	Benzo(b)fluoranthene	205-99-2	< 380.	380.	38.	ug/kg	1
03788	Benzo(a)pyrene	50-32-8	< 380.	380.	38.	ug/kg	1
03791	Benzo(g,h,i)perylene	191-24-2	< 380.	380.	38.	ug/kg	1
02308	UST-Soils by 8260B						
02016	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/kg	0.83
05460	Benzene	71-43-2	< 5.	5.	0.5	ug/kg	0.83
05461	1,2-Dichloroethane	107-06-2	< 5.	5.	0.9	ug/kg	0.83
05466	Toluene	108-88-3	< 5.	5.	0.9	ug/kg	0.83
05471	1,2-Dibromoethane	106-93-4	< 5.	5.	0.9	ug/kg	0.83
05474	Ethylbenzene	100-41-4	< 5.	5.	0.9	ug/kg	0.83
05479	Isopropylbenzene	98-82-8	< 5.	5.	0.9	ug/kg	0.83
06301	Xylene (Total)	1330-20-7	< 5.	5.	0.9	ug/kg	0.83

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06955	Lead	SW-846 6010B	1	03/31/2005 22:12	John P Hook	1
00111	Moisture	EPA 160.3 modified	1	04/01/2005 17:27	Scott W Freisher	1
07804	PAHs in Soil by GC/MS	SW-846 8270C	1	03/31/2005 05:08	Brian K Graham	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. SW 4491372**BH-S216-032505-1-1.5 Grab Soil Sample****SUN: Philadelphia Refinery AOI-4**

Collected: 03/25/2005 14:00 by MBS

Account Number: 10132

Submitted: 03/28/2005 17:30

Langan

Reported: 04/05/2005 at 13:48

500 Hyde Park

Discard: 05/06/2005

Doylestown PA 18901

S216-

02308	UST-Soils by 8260B	SW-846 8260B	1	04/04/2005 13:57	Kenneth L Boley Jr	0.83
02392	GC/MS - Field Preserved NaHSO ₄	SW-846 5035	1	03/30/2005 14:26	Nadine Fegley	1
02392	GC/MS - Field Preserved NaHSO ₄	SW-846 5035	2	03/30/2005 14:28	Nadine Fegley	1
05708	SW SW846 ICP Digest	SW-846 3050B	1	03/31/2005 07:33	Denise Y Black	1
06171	GC/MS - Field Preserved MeOH	SW-846 5035	1	03/30/2005 13:59	Nadine Fegley	1
07806	BNA Soil Extraction	SW-846 3550B	1	03/30/2005 15:15	Ashley B Zook	1

Quality Control Summary

Client Name: Langan

Group Number: 937120

Reported: 04/05/05 at 01:48 PM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

Laboratory Compliance Quality Control

<u>Analysis Name</u>	<u>Blank Result</u>	<u>Blank LOQ**</u>	<u>Blank MDL</u>	<u>Report Units</u>	<u>LCS %REC</u>	<u>LCSD %REC</u>	<u>LCS/LCSD Limits</u>	<u>RPD</u>	<u>RPD Max</u>
Batch number: 05089SLD026	Sample number(s): 4491369-4491372								
Pyrene	< 330.	330.	33.	ug/kg	89		67-116		
Naphthalene	< 330.	330.	33.	ug/kg	88		70-103		
Fluorene	< 330.	330.	33.	ug/kg	88		66-115		
Phenanthrene	< 330.	330.	33.	ug/kg	92		70-107		
Anthracene	< 330.	330.	33.	ug/kg	88		69-109		
Benzo(a)anthracene	< 330.	330.	33.	ug/kg	94		73-111		
Chrysene	< 330.	330.	33.	ug/kg	95		72-110		
Benzo(b)fluoranthene	< 330.	330.	33.	ug/kg	104		68-116		
Benzo(a)pyrene	< 330.	330.	33.	ug/kg	111		72-117		
Benzo(g,h,i)perylene	< 330.	330.	33.	ug/kg	104		66-120		
Batch number: 050905708002	Sample number(s): 4491369-4491372								
Lead	< 2.00	2.00	0.930	mg/kg	95		86-109		
Batch number: 05091820002B	Sample number(s): 4491369-4491372								
Moisture					100		99-101		
Batch number: X050941AA	Sample number(s): 4491369-4491372								
Methyl Tertiary Butyl Ether	< 5.	5.	0.5	ug/kg	115		75-125		
Benzene	< 5.	5.	0.5	ug/kg	110		77-119		
1,2-Dichloroethane	< 5.	5.	1.	ug/kg	113		76-126		
Toluene	< 5.	5.	1.	ug/kg	107		81-116		
1,2-Dibromoethane	< 5.	5.	1.	ug/kg	102		77-114		
Ethylbenzene	< 5.	5.	1.	ug/kg	106		82-115		
Isopropylbenzene	< 5.	5.	1.	ug/kg	105		79-117		
Xylene (Total)	< 5.	5.	1.	ug/kg	104		82-117		

Sample Matrix Quality Control

<u>Analysis Name</u>	<u>MS %REC</u>	<u>MSD %REC</u>	<u>MS/MSD Limits</u>	<u>RPD</u>	<u>BKG MAX</u>	<u>DUP Conc</u>	<u>DUP RPD</u>	<u>Dup RPD Max</u>
Batch number: 05089SLD026	Sample number(s): 4491369-4491372							
Pyrene	78	81	40-145	3	30			
Naphthalene	83	90	38-132	8	30			
Fluorene	89	91	39-137	3	30			
Phenanthrene	87	88	42-137	1	30			
Anthracene	88	91	47-135	4	30			
Benzo(a)anthracene	88	93	42-137	5	30			
Chrysene	83	86	39-140	4	30			

*- Outside of specification

**- This limit was used in the evaluation of the final result for the blank

- (1) The result for one or both determinations was less than five times the LOQ.
- (2) The background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan

Group Number: 937120

Reported: 04/05/05 at 01:48 PM

Sample Matrix Quality Control

	MS	MSD	MS/MSD	RPD	BKG	DUP	DUP	Dup RPD
<u>Analysis Name</u>	<u>%REC</u>	<u>%REC</u>	<u>Limits</u>	<u>RPD</u>	<u>MAX</u>	<u>Conc</u>	<u>Conc</u>	<u>Max</u>
Benzo(b)fluoranthene	93	102	42-141	8	30			
Benzo(a)pyrene	103	116	38-142	11	30			
Benzo(g,h,i)perylene	103	113	32-150	9	30			
Batch number: 050905708002	Sample number(s): 4491369-4491372							
Lead	87	67*	75-125	7	20	103.	102.	1
Batch number: 05091820002B	Sample number(s): 4491369-4491372							
Moisture						19.6	19.8	1
Batch number: X050941AA	Sample number(s): 4491369-4491372							
Methyl Tertiary Butyl Ether	77	122	49-140	43*	30			
Benzene	(2)	(2)	67-123	39*	30			
1,2-Dichloroethane	83	125	62-130	39*	30			
Toluene	(2)	(2)	55-125	41*	30			
1,2-Dibromoethane	82	121*	62-116	37*	30			
Ethylbenzene	(2)	(2)	50-127	40*	30			
Isopropylbenzene	(2)	(2)	48-124	27	30			
Xylene (Total)	(2)	(2)	54-123	40*	30			

Surrogate Quality Control

Analysis Name: PAHs in Soil by GC/MS

Batch number: 05089SLD026

	Nitrobenzene-d5	2-Fluorobiphenyl	Terphenyl-d14
4491369	79	91	97
4491370	89	94	99
4491371	85	100	101
4491372	91	97	107
Blank	86	92	95
LCS	89	95	91
MS	85	95	88
MSD	90	98	92

Limits: 47-128 55-123 49-133

Analysis Name: UST-Soils by 8260B

Batch number: X050941AA

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4491369	91	84	91	89
4491370	94	89	102	78
4491371	91	87	92	90
4491372	91	86	92	89
Blank	91	85	91	90
LCS	91	88	91	89
MS	90	84	155*	249*
MSD	93	86	172*	244*

Limits: 70-129 70-121 70-130 70-128

*- Outside of specification

**-This limit was used in the evaluation of the final result for the blank

(1) The result for one or both determinations was less than five times the LOQ.

(2) The background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan

Group Number: 937120

Reported: 04/05/05 at 01:48 PM

Surrogate Quality Control

*- Outside of specification

**_-This limit was used in the evaluation of the final result for the blank

- (1) The result for one or both determinations was less than five times the LOQ.
- (2) The background result was more than four times the spike added.



For Lancaster Laboratories use only

Where quality is a science:

Acct. # 10132 Group# 937120 Sample # _____

Group# 937120 Sample # 4491369-27-

COC # 0075167

Please print. Instructions on reverse side correspond with circled numbers.

[illegible]

Lancaster Laboratories, Inc., 2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425
Copies: White and yellow should accompany samples to Lancaster, PA 17605-2425 (717) 656-2300

Explanation of Symbols and Abbreviations

The following defines common symbols and abbreviations used in reporting technical data:

N.D.	none detected	BMQL	Below Minimum Quantitation Level
TNTC	Too Numerous To Count	MPN	Most Probable Number
IU	International Units	CP Units	cobalt-chloroplatinate units
umhos/cm	micromhos/cm	NTU	nephelometric turbidity units
C	degrees Celsius	F	degrees Fahrenheit
meq	milliequivalents	lb.	pound(s)
g	gram(s)	kg	kilogram(s)
ug	microgram(s)	mg	milligram(s)
ml	milliliter(s)	l	liter(s)
m3	cubic meter(s)	ul	microliter(s)
<	less than - The number following the sign is the <u>limit of quantitation</u> , the smallest amount of analyte which can be reliably determined using this specific test.		
>	greater than		
J	estimated value – The result is \geq the Method Detection Limit (MDL) and $<$ the Limit of Quantitation (LOQ).		
ppm	parts per million - One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.		
ppb	parts per billion		
Dry weight basis	Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture. All other results are reported on an as-received basis.		

U.S. EPA CLP Data Qualifiers:

Organic Qualifiers		Inorganic Qualifiers	
A	TIC is a possible aldol-condensation product	B	Value is $<$ CRDL, but \geq IDL
B	Analyte was also detected in the blank	E	Estimated due to interference
C	Pesticide result confirmed by GC/MS	M	Duplicate injection precision not met
D	Compound quantitated on a diluted sample	N	Spike sample not within control limits
E	Concentration exceeds the calibration range of the instrument	S	Method of standard additions (MSA) used for calculation
N	Presumptive evidence of a compound (TICs only)	U	Compound was not detected
P	Concentration difference between primary and confirmation columns $>25\%$	W	Post digestion spike out of control limits
U	Compound was not detected	*	Duplicate analysis not within control limits
X,Y,Z	Defined in case narrative	+	Correlation coefficient for MSA <0.995

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Measurement uncertainty values, as applicable, are available upon request.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

WARRANTY AND LIMITS OF LIABILITY - In accepting analytical work, we warrant the accuracy of test results for the sample as submitted. THE FOREGOING EXPRESS WARRANTY IS EXCLUSIVE AND IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED. WE DISCLAIM ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING A WARRANTY OF FITNESS FOR PARTICULAR PURPOSE AND WARRANTY OF MERCHANTABILITY. IN NO EVENT SHALL LANCASTER LABORATORIES BE LIABLE FOR INDIRECT, SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOSS OF PROFIT OR GOODWILL REGARDLESS OF (A) THE NEGLIGENCE (EITHER SOLE OR CONCURRENT) OF LANCASTER LABORATORIES AND (B) WHETHER LANCASTER LABORATORIES HAS BEEN INFORMED OF THE POSSIBILITY OF SUCH DAMAGES. We accept no legal responsibility for the purposes for which the client uses the test results. No purchase order or other order for work shall be accepted by Lancaster Laboratories which includes any conditions that vary from the Standard Terms and Conditions of Lancaster Laboratories and we hereby object to any conflicting terms contained in any acceptance or order submitted by client.

ANALYTICAL RESULTS

Prepared for:

Langan
500 Hyde Park
Doylestown PA 18901

215-348-7101

Prepared by:

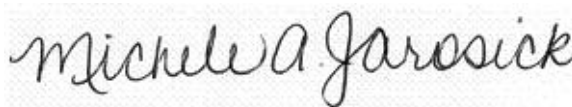
Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425**SAMPLE GROUP**

The sample group for this submittal is 937907. Samples arrived at the laboratory on Monday, April 04, 2005. The PO# for this group is SUNOCO PHILLY REFINER.

Client DescriptionBH-S217-040105-1-1.5 Grab Soil Sample
BH-S220-040105-1-1.5 Grab Soil Sample
BH-S119D-040105-1-1.5 Grab Soil Sample**Lancaster Labs Number**4495326
4495327
44953281 COPY TO Langan
ELECTRONIC SUN: Aquaterra Tech.
COPY TO
1 COPY TO LL
ELECTRONIC Langan
COPY TOAttn: Jason Hanna
Attn: Brad SpancakeAttn: Angela Miller
Attn: Dennis Webster

Questions? Contact your Client Services Representative
Angela M Miller at (717) 656-2300.

Respectfully Submitted,



Michele A. Jarosick
Senior Chemist, Coordinator

Lancaster Laboratories Sample No. SW 4495326

BH-S217-040105-1-1.5 Grab Soil Sample
SUN: Philadelphia Refinery AOI-4

Collected: 04/01/2005 08:40 by MBS

Account Number: 10132

Submitted: 04/04/2005 17:15
 Reported: 04/12/2005 at 14:06
 Discard: 05/13/2005

Langan
 500 Hyde Park
 Doylestown PA 18901

S217-

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Limit of Quantitation*	Dry Method Detection Limit	Units	Dilution Factor
06955	Lead	7439-92-1	10.2	2.39	1.11	mg/kg	1
00111	Moisture	n.a.	16.2	0.50	0.50	%	1
"Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis.							
07804	PAHs in Soil by GC/MS						
01195	Pyrene	129-00-0	< 400.	400.	40.	ug/kg	1
03761	Naphthalene	91-20-3	< 400.	400.	40.	ug/kg	1
03768	Fluorene	86-73-7	< 400.	400.	40.	ug/kg	1
03775	Phenanthrene	85-01-8	< 400.	400.	40.	ug/kg	1
03776	Anthracene	120-12-7	< 400.	400.	40.	ug/kg	1
03781	Benzo(a)anthracene	56-55-3	< 400.	400.	40.	ug/kg	1
03782	Chrysene	218-01-9	< 400.	400.	40.	ug/kg	1
03786	Benzo(b)fluoranthene	205-99-2	< 400.	400.	40.	ug/kg	1
03788	Benzo(a)pyrene	50-32-8	< 400.	400.	40.	ug/kg	1
03791	Benzo(g,h,i)perylene	191-24-2	< 400.	400.	40.	ug/kg	1
Matrix QC was performed on this sample for the GCMS semivolatile analysis. Please see the attached QC summary report for compounds showing a matrix bias.							
02308	UST-Soils by 8260B						
02016	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/kg	0.78
05460	Benzene	71-43-2	< 5.	5.	0.5	ug/kg	0.78
05461	1,2-Dichloroethane	107-06-2	< 5.	5.	0.9	ug/kg	0.78
05466	Toluene	108-88-3	< 5.	5.	0.9	ug/kg	0.78
05471	1,2-Dibromoethane	106-93-4	< 5.	5.	0.9	ug/kg	0.78
05474	Ethylbenzene	100-41-4	< 5.	5.	0.9	ug/kg	0.78
05479	Isopropylbenzene	98-82-8	< 5.	5.	0.9	ug/kg	0.78
06301	Xylene (Total)	1330-20-7	< 5.	5.	0.9	ug/kg	0.78

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
---------	---------------	--------	--------	------------------------	---------	-----------------

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. SW 4495326

BH-S217-040105-1-1.5 Grab Soil Sample

SUN: Philadelphia Refinery AOI-4

Collected: 04/01/2005 08:40 by MBS

Account Number: 10132

Submitted: 04/04/2005 17:15

Langan

Reported: 04/12/2005 at 14:06

500 Hyde Park

Discard: 05/13/2005

Doylestown PA 18901

S217-

06955	Lead	SW-846 6010B	1	04/07/2005 07:51	Joanne M Gates	1
00111	Moisture	EPA 160.3 modified	1	04/05/2005 15:30	Scott W Freisher	1
07804	PAHs in Soil by GC/MS	SW-846 8270C	1	04/06/2005 09:38	Mark A Clark	1
02308	UST-Soils by 8260B	SW-846 8260B	1	04/06/2005 17:49	Lauren C Marzario	0.78
02392	GC/MS - Field Preserved NaHSO4	SW-846 5035	1	04/05/2005 13:49	Nadine Fegley	1
02392	GC/MS - Field Preserved NaHSO4	SW-846 5035	2	04/05/2005 13:54	Nadine Fegley	1
02392	GC/MS - Field Preserved NaHSO4	SW-846 5035	3	04/05/2005 13:55	Nadine Fegley	1
05708	SW SW846 ICP Digest	SW-846 3050B	1	04/05/2005 20:35	Annamaria Stipkovits	1
06171	GC/MS - Field Preserved MeOH	SW-846 5035	1	04/05/2005 13:49	Nadine Fegley	1
07806	BNA Soil Extraction	SW-846 3550B	1	04/05/2005 18:00	Sally L Appleyard	1

Lancaster Laboratories Sample No. SW 4495327
BH-S220-040105-1-1.5 Grab Soil Sample
SUN: Philadelphia Refinery AOI-4

Collected: 04/01/2005 09:00 by MBS

Account Number: 10132

Submitted: 04/04/2005 17:15

Langan

Reported: 04/12/2005 at 14:06

500 Hyde Park

Discard: 05/13/2005

Doylestown PA 18901

-S220

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Limit of Quantitation*	Dry Method Detection Limit	Units	Dilution Factor
06955	Lead	7439-92-1	7.58	2.36	1.10	mg/kg	1
00111	Moisture	n.a.	17.7	0.50	0.50	%	1
"Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis.							
07804	PAHs in Soil by GC/MS						
01195	Pyrene	129-00-0	< 410.	410.	41.	ug/kg	1
03761	Naphthalene	91-20-3	< 410.	410.	41.	ug/kg	1
03768	Fluorene	86-73-7	< 410.	410.	41.	ug/kg	1
03775	Phenanthrene	85-01-8	460.	410.	41.	ug/kg	1
03776	Anthracene	120-12-7	< 410.	410.	41.	ug/kg	1
03781	Benzo(a)anthracene	56-55-3	< 410.	410.	41.	ug/kg	1
03782	Chrysene	218-01-9	< 410.	410.	41.	ug/kg	1
03786	Benzo(b)fluoranthene	205-99-2	< 410.	410.	41.	ug/kg	1
03788	Benzo(a)pyrene	50-32-8	< 410.	410.	41.	ug/kg	1
03791	Benzo(g,h,i)perylene	191-24-2	< 410.	410.	41.	ug/kg	1
02308	UST-Soils by 8260B						
02016	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/kg	0.83
05460	Benzene	71-43-2	< 5.	5.	0.5	ug/kg	0.83
05461	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/kg	0.83
05466	Toluene	108-88-3	< 5.	5.	1.	ug/kg	0.83
05471	1,2-Dibromoethane	106-93-4	< 5.	5.	1.	ug/kg	0.83
05474	Ethylbenzene	100-41-4	< 5.	5.	1.	ug/kg	0.83
05479	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/kg	0.83
06301	Xylene (Total)	1330-20-7	< 5.	5.	1.	ug/kg	0.83

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06955	Lead	SW-846 6010B	1	04/07/2005 07:55	Joanne M Gates	1
00111	Moisture	EPA 160.3 modified	1	04/05/2005 15:30	Scott W Freisher	1
07804	PAHs in Soil by GC/MS	SW-846 8270C	1	04/06/2005 16:16	Mark A Clark	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. SW 4495327

BH-S220-040105-1-1.5 Grab Soil Sample

SUN: Philadelphia Refinery AOI-4

Collected: 04/01/2005 09:00 by MBS

Account Number: 10132

Submitted: 04/04/2005 17:15

Langan

Reported: 04/12/2005 at 14:06

500 Hyde Park

Discard: 05/13/2005

Doylestown PA 18901

-S220

02308	UST-Soils by 8260B	SW-846 8260B	1	04/06/2005 18:11	Lauren C Marzario	0.83
02392	GC/MS - Field Preserved	SW-846 5035	1	04/05/2005 13:47	Nadine Fegley	1
	NaHSO4					
02392	GC/MS - Field Preserved	SW-846 5035	2	04/05/2005 13:56	Nadine Fegley	1
	NaHSO4					
02392	GC/MS - Field Preserved	SW-846 5035	3	04/05/2005 13:57	Nadine Fegley	1
	NaHSO4					
05708	SW SW846 ICP Digest	SW-846 3050B	1	04/05/2005 20:35	Annamaria Stipkovits	1
06171	GC/MS - Field Preserved	SW-846 5035	1	04/05/2005 13:47	Nadine Fegley	1
	MeOH					
07806	BNA Soil Extraction	SW-846 3550B	1	04/05/2005 18:00	Sally L Appleyard	1

Lancaster Laboratories Sample No. SW 4495328

BH-S119D-040105-1-1.5 Grab Soil Sample

SUN: Philadelphia Refinery AOI-4

Collected: 04/01/2005 09:20

by MBS

Account Number: 10132

Submitted: 04/04/2005 17:15

Reported: 04/12/2005 at 14:07

Discard: 05/13/2005

Langan

500 Hyde Park

Doylestown PA 18901

S119D

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Limit of Quantitation*	Dry Method Detection Limit	Units	Dilution Factor
06955	Lead	7439-92-1	24.9	2.24	1.04	mg/kg	1
00111	Moisture	n.a.	13.4	0.50	0.50	%	1
"Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis.							
07804	PAHs in Soil by GC/MS						
01195	Pyrene	129-00-0	< 380.	380.	38.	ug/kg	1
03761	Naphthalene	91-20-3	< 380.	380.	38.	ug/kg	1
03768	Fluorene	86-73-7	< 380.	380.	38.	ug/kg	1
03775	Phenanthrene	85-01-8	< 380.	380.	38.	ug/kg	1
03776	Anthracene	120-12-7	< 380.	380.	38.	ug/kg	1
03781	Benzo(a)anthracene	56-55-3	< 380.	380.	38.	ug/kg	1
03782	Chrysene	218-01-9	< 380.	380.	38.	ug/kg	1
03786	Benzo(b)fluoranthene	205-99-2	< 380.	380.	38.	ug/kg	1
03788	Benzo(a)pyrene	50-32-8	< 380.	380.	38.	ug/kg	1
03791	Benzo(g,h,i)perylene	191-24-2	< 380.	380.	38.	ug/kg	1
02308	UST-Soils by 8260B						
02016	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/kg	0.84
05460	Benzene	71-43-2	< 5.	5.	0.5	ug/kg	0.84
05461	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/kg	0.84
05466	Toluene	108-88-3	< 5.	5.	1.	ug/kg	0.84
05471	1,2-Dibromoethane	106-93-4	< 5.	5.	1.	ug/kg	0.84
05474	Ethylbenzene	100-41-4	< 5.	5.	1.	ug/kg	0.84
05479	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/kg	0.84
06301	Xylene (Total)	1330-20-7	< 5.	5.	1.	ug/kg	0.84

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06955	Lead	SW-846 6010B	1	04/07/2005 08:08	Joanne M Gates	1
00111	Moisture	EPA 160.3 modified	1	04/05/2005 15:30	Scott W Freisher	1
07804	PAHs in Soil by GC/MS	SW-846 8270C	1	04/06/2005 20:43	Jolene M Graham	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. SW 4495328

BH-S119D-040105-1-1.5 Grab Soil Sample

SUN: Philadelphia Refinery AOI-4

Collected: 04/01/2005 09:20 by MBS

Account Number: 10132

Submitted: 04/04/2005 17:15

Langan

Reported: 04/12/2005 at 14:07

500 Hyde Park

Discard: 05/13/2005

Doylestown PA 18901

S119D

02308	UST-Soils by 8260B	SW-846 8260B	1	04/06/2005 18:34	Lauren C Marzario	0.84
02392	GC/MS - Field Preserved	SW-846 5035	1	04/05/2005 13:45	Nadine Fegley	1
	NaHSO4					
02392	GC/MS - Field Preserved	SW-846 5035	2	04/05/2005 13:58	Nadine Fegley	1
	NaHSO4					
02392	GC/MS - Field Preserved	SW-846 5035	3	04/05/2005 13:59	Nadine Fegley	1
	NaHSO4					
05708	SW SW846 ICP Digest	SW-846 3050B	1	04/05/2005 20:35	Annamaria Stipkovits	1
06171	GC/MS - Field Preserved	SW-846 5035	1	04/05/2005 13:45	Nadine Fegley	1
	MeOH					
07806	BNA Soil Extraction	SW-846 3550B	1	04/05/2005 18:00	Sally L Appleyard	1

Quality Control Summary

Client Name: Langan

Group Number: 937907

Reported: 04/12/05 at 02:07 PM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

Laboratory Compliance Quality Control

<u>Analysis Name</u>	<u>Blank Result</u>	<u>Blank LOQ**</u>	<u>Blank MDL</u>	<u>Report Units</u>	<u>LCS %REC</u>	<u>LCSD %REC</u>	<u>LCS/LCSD Limits</u>	<u>RPD</u>	<u>RPD Max</u>
Batch number: 050955708003 Lead	Sample number(s): 4495326-4495328 < 2.00 2.00 0.930 mg/kg				101		86-109		
Batch number: 05095820003B Moisture	Sample number(s): 4495326-4495328				100		99-101		
Batch number: 05095SLB026 Pyrene	Sample number(s): 4495326-4495328 < 330. 330. 33. ug/kg				86		67-116		
Naphthalene	< 330. 330. 33. ug/kg				83		70-103		
Fluorene	< 330. 330. 33. ug/kg				87		66-115		
Phenanthrene	< 330. 330. 33. ug/kg				96		70-107		
Anthracene	< 330. 330. 33. ug/kg				90		69-109		
Benzo(a)anthracene	< 330. 330. 33. ug/kg				92		73-111		
Chrysene	< 330. 330. 33. ug/kg				90		72-110		
Benzo(b)fluoranthene	< 330. 330. 33. ug/kg				73		68-116		
Benzo(a)pyrene	< 330. 330. 33. ug/kg				85		72-117		
Benzo(g,h,i)perylene	< 330. 330. 33. ug/kg				92		66-120		
Batch number: X050962AA Methyl Tertiary Butyl Ether	Sample number(s): 4495326-4495328 < 5. 5. 0.5 ug/kg				110		75-125		
Benzene	< 5. 5. 0.5 ug/kg				110		77-119		
1,2-Dichloroethane	< 5. 5. 1. ug/kg				111		76-126		
Toluene	< 5. 5. 1. ug/kg				110		81-116		
1,2-Dibromoethane	< 5. 5. 1. ug/kg				98		77-114		
Ethylbenzene	< 5. 5. 1. ug/kg				109		82-115		
Isopropylbenzene	< 5. 5. 1. ug/kg				109		79-117		
Xylene (Total)	< 5. 5. 1. ug/kg				108		82-117		

Sample Matrix Quality Control

<u>Analysis Name</u>	<u>MS %REC</u>	<u>MSD %REC</u>	<u>MS/MSD Limits</u>	<u>RPD</u>	<u>BKG MAX</u>	<u>DUP Conc</u>	<u>DUP RPD</u>	<u>Dup RPD Max</u>
Batch number: 050955708003 Lead	Sample number(s): 4495326-4495328 99 99 75-125 0 20				13.0	12.3	6	20
Batch number: 05095820003B Moisture	Sample number(s): 4495326-4495328				53.3	52.8	1	15
Batch number: 05095SLB026 Pyrene	Sample number(s): 4495326-4495328 89 88 40-145 2 30							

*- Outside of specification

**-This limit was used in the evaluation of the final result for the blank

- (1) The result for one or both determinations was less than five times the LOQ.
- (2) The background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan
Reported: 04/12/05 at 02:07 PM

Group Number: 937907

Sample Matrix Quality Control

	MS	MSD	MS/MSD	RPD	BKG	DUP	DUP	Dup RPD
<u>Analysis Name</u>	<u>%REC</u>	<u>%REC</u>	<u>Limits</u>	<u>RPD</u>	<u>MAX</u>	<u>Conc</u>	<u>Conc</u>	<u>Max</u>
Naphthalene	86	87	38-132	1	30			
Fluorene	90	87	39-137	3	30			
Phenanthrene	96	96	42-137	0	30			
Anthracene	90	92	47-135	2	30			
Benzo(a)anthracene	97	96	42-137	0	30			
Chrysene	94	93	39-140	1	30			
Benzo(b)fluoranthene	193*	169*	42-141	13	30			
Benzo(a)pyrene	220*	185*	38-142	18	30			
Benzo(g,h,i)perylene	230*	194*	32-150	17	30			
Batch number: X050962AA Sample number(s): 4495326-4495328								
Methyl Tertiary Butyl Ether	117	134	49-140	13	30			
Benzene	147*	310*	67-123	69*	30			
1,2-Dichloroethane	116	119	62-130	4	30			
Toluene	114	124	55-125	8	30			
1,2-Dibromoethane	97	99	62-116	3	30			
Ethylbenzene	110	120	50-127	9	30			
Isopropylbenzene	118	265*	48-124	78*	30			
Xylene (Total)	103	123	54-123	18	30			

Surrogate Quality Control

Analysis Name: PAHs in Soil by GC/MS
Batch number: 05095SLB026

	Nitrobenzene-d5	2-Fluorobiphenyl	Terphenyl-d14
4495326	93	91	121
4495327	99	98	113
4495328	90	90	113
Blank	89	88	109
LCS	91	88	105
MS	95	95	114
MSD	91	93	112
Limits:	47-128	55-123	49-133

Analysis Name: UST-Soils by 8260B
Batch number: X050962AA

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4495326	91	85	92	88
4495327	91	84	93	88
4495328	91	88	92	89
Blank	90	81	93	88
LCS	91	85	92	89
MS	91	86	95	82
MSD	91	87	96	84
Limits:	70-129	70-121	70-130	70-128

*- Outside of specification

** - This limit was used in the evaluation of the final result for the blank

- (1) The result for one or both determinations was less than five times the LOQ.
- (2) The background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan

Group Number: 937907

Reported: 04/12/05 at 02:07 PM

*- Outside of specification

**_-This limit was used in the evaluation of the final result for the blank

- (1) The result for one or both determinations was less than five times the LOQ.
- (2) The background result was more than four times the spike added.

Analysis Request / Environmental Services Chain of Custody



For Lancaster Laboratories use only
 Acct. # 10132 Group # 937907 Sample # 4495326-4 **COC #** 0080771

Please print. Instructions on reverse side correspond with circled numbers.

1 Client: <u>Sun-Aquaterne</u> Acct. #: _____ Project Name: <u>Sun-Philadelphia Refinery</u> PWSID #: _____ Project Manager: <u>Kevin Martin / Jason Harris</u> P.O. #: _____ Sampler: <u>M. Brad Sparake</u> Quote #: _____ Name of state where samples were collected: <u>PA</u>		2 Sample Identification Date Collected: <u>4/1/05</u> Time Collected: <u>0840</u> <u>BH-S217-040105-1-1.5</u> <u>BH-S220-040105-1-1.5</u> <u>BH-S119D-040105-1-1.5</u>		3 Sample Matrix Soil <input checked="" type="checkbox"/> Sediment <input checked="" type="checkbox"/> Water <input checked="" type="checkbox"/> Other <input type="checkbox"/>		4 Analytes Requested Total Lead 8270 Anthracene Benz(a)anthracene Benz(a)pyrene Benz(b)fluoranthene Chrysene Fluorene Naphthalene Phenanthrene Pyrene % Moisture		5 For Lab Use Only FSC: _____ SCR #: _____		6 Remarks <u>1.7°C</u> <u>4/4/05</u> <u>m</u>	
7 Turnaround Time Requested (TAT) (please circle): <u>Normal</u> Rush (Rush TAT is subject to Lancaster Laboratories approval and surcharge.) Date results are needed: _____ Rush results requested by (please circle): _____ Phone _____ Fax _____ E-mail _____ Phone #: _____ Fax #: _____ E-mail address: _____		8 Data Package Options (please circle if required) QC Summary Type VI (Raw Data) <u>Yes</u> No Type I (Tier I) GLP Type II (Tier II) Other Type III (NJ Red. Del.) Type IV (CLP) Site-specific QC required? Yes <u>No</u> (If yes, indicate QC sample and submit triplicate volume.) Internal Chain of Custody required? Yes <u>No</u>		9 Relinquished by: <u>M. Brad Sparake</u> Date: <u>3-25-05</u> Time: <u>1300</u> Relinquished by: <u>M. Brad Sparake</u> Date: <u>3-25-05</u> Time: <u>1300</u> Relinquished by: <u>M. Brad Sparake</u> Date: <u>4/1/05</u> Time: <u>1530</u> Relinquished by: <u>AT Sparake</u> Date: <u>4/1/05</u> Time: <u>1010</u> Relinquished by: <u>M. Brad Sparake</u> Date: <u>4/1/05</u> Time: <u>1010</u>		10 Received by: <u>M. Brad Sparake</u> Date: <u>3-25-05</u> Time: <u>1300</u> Received by: <u>M. Brad Sparake</u> Date: <u>3-25-05</u> Time: <u>1300</u> Received by: <u>M. Brad Sparake</u> Date: <u>4/1/05</u> Time: <u>1530</u> Received by: <u>M. Brad Sparake</u> Date: <u>4/1/05</u> Time: <u>1010</u> Received by: <u>M. Brad Sparake</u> Date: <u>4/1/05</u> Time: <u>1010</u>					

Explanation of Symbols and Abbreviations

The following defines common symbols and abbreviations used in reporting technical data:

N.D.	none detected	BMQL	Below Minimum Quantitation Level
TNTC	Too Numerous To Count	MPN	Most Probable Number
IU	International Units	CP Units	cobalt-chloroplatinate units
umhos/cm	micromhos/cm	NTU	nephelometric turbidity units
C	degrees Celsius	F	degrees Fahrenheit
meq	milliequivalents	lb.	pound(s)
g	gram(s)	kg	kilogram(s)
ug	microgram(s)	mg	milligram(s)
ml	milliliter(s)	l	liter(s)
m3	cubic meter(s)	ul	microliter(s)
<	less than - The number following the sign is the <u>limit of quantitation</u> , the smallest amount of analyte which can be reliably determined using this specific test.		
>	greater than		
J	estimated value – The result is \geq the Method Detection Limit (MDL) and $<$ the Limit of Quantitation (LOQ).		
ppm	parts per million - One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.		
ppb	parts per billion		
Dry weight basis	Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture. All other results are reported on an as-received basis.		

U.S. EPA CLP Data Qualifiers:

Organic Qualifiers		Inorganic Qualifiers	
A	TIC is a possible aldol-condensation product	B	Value is $<$ CRDL, but \geq IDL
B	Analyte was also detected in the blank	E	Estimated due to interference
C	Pesticide result confirmed by GC/MS	M	Duplicate injection precision not met
D	Compound quantitated on a diluted sample	N	Spike sample not within control limits
E	Concentration exceeds the calibration range of the instrument	S	Method of standard additions (MSA) used for calculation
N	Presumptive evidence of a compound (TICs only)	U	Compound was not detected
P	Concentration difference between primary and confirmation columns $>25\%$	W	Post digestion spike out of control limits
U	Compound was not detected	*	Duplicate analysis not within control limits
X,Y,Z	Defined in case narrative	+	Correlation coefficient for MSA <0.995

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Measurement uncertainty values, as applicable, are available upon request.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

WARRANTY AND LIMITS OF LIABILITY - In accepting analytical work, we warrant the accuracy of test results for the sample as submitted. THE FOREGOING EXPRESS WARRANTY IS EXCLUSIVE AND IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED. WE DISCLAIM ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING A WARRANTY OF FITNESS FOR PARTICULAR PURPOSE AND WARRANTY OF MERCHANTABILITY. IN NO EVENT SHALL LANCASTER LABORATORIES BE LIABLE FOR INDIRECT, SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOSS OF PROFIT OR GOODWILL REGARDLESS OF (A) THE NEGLIGENCE (EITHER SOLE OR CONCURRENT) OF LANCASTER LABORATORIES AND (B) WHETHER LANCASTER LABORATORIES HAS BEEN INFORMED OF THE POSSIBILITY OF SUCH DAMAGES. We accept no legal responsibility for the purposes for which the client uses the test results. No purchase order or other order for work shall be accepted by Lancaster Laboratories which includes any conditions that vary from the Standard Terms and Conditions of Lancaster Laboratories and we hereby object to any conflicting terms contained in any acceptance or order submitted by client.

ANALYTICAL RESULTS

Prepared for:

Langan
500 Hyde Park
Doylestown PA 18901

215-348-7101

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425**SAMPLE GROUP**

The sample group for this submittal is 941574. Samples arrived at the laboratory on Friday, April 29, 2005.
The PO# for this group is SUNOCO PHILLY REFINER.

Client DescriptionS218-042805 Grab Water Sample
S219-042805 Grab Water Sample
S229-042805 Grab Water Sample
S225-042805 Grab Water Sample
S216-042805 Grab Water Sample**Lancaster Labs Number**4514707
4514708
4514709
4514710
4514711

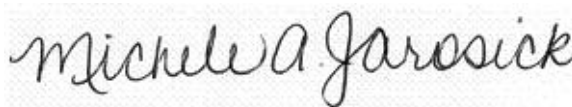
ELECTRONIC SUN: Aquaterra Tech.
COPY TO
1 COPY TO LL
1 COPY TO Langan
ELECTRONIC Langan
COPY TO

Attn: Brad Spancake

Attn: Angela Miller
Attn: Jason Hanna
Attn: Dennis Webster

Questions? Contact your Client Services Representative
Angela M Miller at (717) 656-2300.

Respectfully Submitted,



Michele A. Jarosick
Senior Chemist, Coordinator

Lancaster Laboratories Sample No. WW 4514707

S218-042805 Grab Water Sample
SUN: Philadelphia Refinery AOI-4

Collected: 04/28/2005 12:45 by MH

Account Number: 10132

Submitted: 04/29/2005 17:15
Reported: 05/06/2005 at 16:42
Discard: 06/06/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-218

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation*	As Received Method Detection Limit	Units	Dilution Factor
06035	Lead	7439-92-1	< 0.0010	0.0010	0.00021	mg/l	1
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	0.052	0.029	0.0098	ug/l	1
07805	PAHs in Water by GC/MS						
03947	Naphthalene	91-20-3	250.	51.	5.	ug/l	5
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
Due to insufficient sample, the reporting limits for the GC/MS semivolatile compounds were raised.							
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 50.	50.	5.	ug/l	10
05401	Benzene	71-43-2	2,200.	50.	5.	ug/l	10
05402	1,2-Dichloroethane	107-06-2	< 50.	50.	10.	ug/l	10
05407	Toluene	108-88-3	360.	50.	7.	ug/l	10
05415	Ethylbenzene	100-41-4	1,300.	50.	8.	ug/l	10
05420	Isopropylbenzene	98-82-8	< 50.	50.	10.	ug/l	10
06310	Xylene (Total)	1330-20-7	2,400.	50.	8.	ug/l	10
The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.							

Commonwealth of Pennsylvania Lab Certification No. 36-037

This sample was filtered in the lab for dissolved metals.

Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Analysis Trial#	Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/04/2005 22:40	David K Beck	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4514707

S218-042805 Grab Water Sample

SUN: Philadelphia Refinery AOI-4

Collected: 04/28/2005 12:45 by MH

Account Number: 10132

Submitted: 04/29/2005 17:15

Langan

Reported: 05/06/2005 at 16:42

500 Hyde Park

Discard: 06/06/2005

Doylestown PA 18901

S-218

07879	EDB in Wastewater	SW-846 8011	1	05/03/2005 19:21	Richard A Shober	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/04/2005 15:05	Joseph M Gambler	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/04/2005 20:34	Jolene M Graham	5
02302	UST-Waters by 8260B	SW-846 8260B	1	05/02/2005 19:13	Emiley A King	10
01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/02/2005 19:13	Emiley A King	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/02/2005 22:00	James L Mertz	1
07786	EDB Extraction	SW-846 8011	1	05/02/2005 08:00	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	05/02/2005 09:00	Danette S Blystone	1

Lancaster Laboratories Sample No. WW 4514708

S219-042805 Grab Water Sample
SUN: Philadelphia Refinery AOI-4

Collected: 04/28/2005 12:20 by MH

Account Number: 10132

Submitted: 04/29/2005 17:15
Reported: 05/06/2005 at 16:42
Discard: 06/06/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-219

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation*	As Received Method Detection Limit	Units	Dilution Factor
06035	Lead	7439-92-1	< 0.0010	0.0010	0.00021	mg/l	1
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	< 0.029	0.029	0.0096	ug/l	1
07805	PAHs in Water by GC/MS						
03947	Naphthalene	91-20-3	< 10.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	23.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	6.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037

This sample was filtered in the lab for dissolved metals.

Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/04/2005 22:51	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	05/03/2005 19:51	Richard A Shober	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/04/2005 16:04	Joseph M Gambler	1
02302	UST-Waters by 8260B	SW-846 8260B	1	05/02/2005 19:38	Emiley A King	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/02/2005 19:38	Emiley A King	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/02/2005 22:00	James L Mertz	1
07786	EDB Extraction	SW-846 8011	1	05/02/2005 08:00	Deborah M Zimmerman	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4514708

S219-042805 Grab Water Sample

SUN: Philadelphia Refinery AOI-4

Collected: 04/28/2005 12:20 by MH

Account Number: 10132

Submitted: 04/29/2005 17:15

Langan

Reported: 05/06/2005 at 16:42

500 Hyde Park

Discard: 06/06/2005

Doylestown PA 18901

S-219

07807 BNA Water Extraction

SW-846 3510C

1 05/02/2005 09:00 Danette S Blystone

1

Lancaster Laboratories Sample No. WW 4514709

S229-042805 Grab Water Sample
SUN: Philadelphia Refinery AOI-4

Collected: 04/28/2005 13:05 by MH

Account Number: 10132

Submitted: 04/29/2005 17:15
Reported: 05/06/2005 at 16:42
Discard: 06/06/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-229

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation*	As Received Method Detection Limit	Units	Dilution Factor
06035	Lead	7439-92-1	< 0.0010	0.0010	0.00021	mg/l	1
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	0.033	0.029	0.0097	ug/l	1
07805	PAHs in Water by GC/MS						
03947	Naphthalene	91-20-3	220.	51.	5.	ug/l	5
03956	Fluorene	86-73-7	11.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	15.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 50.	50.	5.	ug/l	10
05401	Benzene	71-43-2	1,900.	50.	5.	ug/l	10
05402	1,2-Dichloroethane	107-06-2	< 50.	50.	10.	ug/l	10
05407	Toluene	108-88-3	< 50.	50.	7.	ug/l	10
05415	Ethylbenzene	100-41-4	350.	50.	8.	ug/l	10
05420	Isopropylbenzene	98-82-8	150.	50.	10.	ug/l	10
06310	Xylene (Total)	1330-20-7	630.	50.	8.	ug/l	10

The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.

Commonwealth of Pennsylvania Lab Certification No. 36-037

This sample was filtered in the lab for dissolved metals.

Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/04/2005 22:54	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	05/03/2005 20:20	Richard A Shober	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/04/2005 21:33	Jolene M Graham	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4514709**S229-042805 Grab Water Sample****SUN: Philadelphia Refinery AOI-4**

Collected: 04/28/2005 13:05 by MH

Account Number: 10132

Submitted: 04/29/2005 17:15

Langan

Reported: 05/06/2005 at 16:42

500 Hyde Park

Discard: 06/06/2005

Doylestown PA 18901

S-229

07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/05/2005 10:54	Brian K Graham	5
02302	UST-Waters by 8260B	SW-846 8260B	1	05/03/2005 06:45	Andrea D Moore	10
01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/03/2005 06:45	Andrea D Moore	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/02/2005 22:00	James L Mertz	1
07786	EDB Extraction	SW-846 8011	1	05/02/2005 08:00	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	05/02/2005 09:00	Danette S Blystone	1

Lancaster Laboratories Sample No. WW 4514710

S225-042805 Grab Water Sample
SUN: Philadelphia Refinery AOI-4

Collected: 04/28/2005 13:20 by MH

Account Number: 10132

Submitted: 04/29/2005 17:15
 Reported: 05/06/2005 at 16:42
 Discard: 06/06/2005

Langan
 500 Hyde Park
 Doylestown PA 18901

S-225

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation*	As Received Method Detection Limit	Units	Dilution Factor
06035	Lead	7439-92-1	< 0.0010	0.0010	0.00021	mg/l	1
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	< 0.029	0.029	0.0096	ug/l	1
07805	PAHs in Water by GC/MS						
03947	Naphthalene	91-20-3	< 10.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	56.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	71.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
The GC/MS semivolatiles internal standard peak areas were outside of the QC limits for both the initial injection and the re-injection. The values here are from the initial injection of the sample.							
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	24.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	10.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	87.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	11.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037

This sample was filtered in the lab for dissolved metals.

Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/04/2005 22:58	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	05/03/2005 20:50	Richard A Shober	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/04/2005 22:32	Jolene M Graham	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4514710**S225-042805 Grab Water Sample****SUN: Philadelphia Refinery AOI-4**

Collected: 04/28/2005 13:20 by MH

Account Number: 10132

Submitted: 04/29/2005 17:15

Langan

Reported: 05/06/2005 at 16:42

500 Hyde Park

Discard: 06/06/2005

Doylestown PA 18901

S-225

02302	UST-Waters by 8260B	SW-846 8260B	1	05/03/2005 22:21	Andrea D Moore	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/03/2005 22:21	Andrea D Moore	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/02/2005 22:00	James L Mertz	1
07786	EDB Extraction	SW-846 8011	1	05/02/2005 08:00	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	05/02/2005 09:00	Danette S Blystone	1

Lancaster Laboratories Sample No. WW 4514711

S216-042805 Grab Water Sample
SUN: Philadelphia Refinery AOI-4

Collected: 04/28/2005 13:40 by MH

Account Number: 10132

Submitted: 04/29/2005 17:15
Reported: 05/06/2005 at 16:42
Discard: 06/06/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-216

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation*	As Received Method Detection Limit	Units	Dilution Factor
06035	Lead	7439-92-1	< 0.0010	0.0010	0.00021	mg/l	1
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	< 0.029	0.029	0.0096	ug/l	1
07805	PAHs in Water by GC/MS						
03947	Naphthalene	91-20-3	150.	50.	5.	ug/l	5
03956	Fluorene	86-73-7	60.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	87.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	210.	10.	1.	ug/l	2
05401	Benzene	71-43-2	290.	10.	1.	ug/l	2
05402	1,2-Dichloroethane	107-06-2	< 10.	10.	2.	ug/l	2
05407	Toluene	108-88-3	48.	10.	1.	ug/l	2
05415	Ethylbenzene	100-41-4	110.	10.	2.	ug/l	2
05420	Isopropylbenzene	98-82-8	73.	10.	2.	ug/l	2
06310	Xylene (Total)	1330-20-7	240.	10.	2.	ug/l	2

The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.

Commonwealth of Pennsylvania Lab Certification No. 36-037

This sample was filtered in the lab for dissolved metals.

Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/04/2005 23:01	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	05/03/2005 21:20	Richard A Shober	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/05/2005 12:53	Brian K Graham	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4514711**S216-042805 Grab Water Sample****SUN: Philadelphia Refinery AOI-4**

Collected: 04/28/2005 13:40 by MH

Account Number: 10132

Submitted: 04/29/2005 17:15

Langan

Reported: 05/06/2005 at 16:42

500 Hyde Park

Discard: 06/06/2005

Doylestown PA 18901

S-216

07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/05/2005 13:52	Brian K Graham	5
02302	UST-Waters by 8260B	SW-846 8260B	1	05/03/2005 13:25	Andrea D Moore	2
01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/03/2005 13:25	Andrea D Moore	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/02/2005 22:00	James L Mertz	1
07786	EDB Extraction	SW-846 8011	1	05/02/2005 08:00	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	05/02/2005 09:00	Danette S Blystone	1

Quality Control Summary

Client Name: Langan

Group Number: 941574

Reported: 05/06/05 at 04:42 PM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

Laboratory Compliance Quality Control

<u>Analysis Name</u>	<u>Blank Result</u>	<u>Blank LOQ**</u>	<u>Blank MDL</u>	<u>Report Units</u>	<u>LCS %REC</u>	<u>LCSD %REC</u>	<u>LCS/LCSD Limits</u>	<u>RPD</u>	<u>RPD Max</u>
Batch number: 051200009A Ethylene dibromide	Sample number(s): 4514707-4514711 < 0.030	0.030	0.010	ug/l	92	92	60-140	0	20
Batch number: 05120WAC026 Naphthalene	Sample number(s): 4514707-4514711 < 10.	10.	1.	ug/l	73	82	58-108	12	30
Fluorene	< 10.	10.	1.	ug/l	91	99	61-116	9	30
Phenanthrene	< 10.	10.	1.	ug/l	89	94	68-111	5	30
Pyrene	< 10.	10.	1.	ug/l	93	96	68-114	3	30
Chrysene	< 10.	10.	1.	ug/l	87	91	70-111	4	30
Batch number: 051226050003A Lead	Sample number(s): 4514707-4514711 < 0.0010	0.0010	0.00021	mg/l	101		80-120		
Batch number: T051221AA Methyl Tertiary Butyl Ether	Sample number(s): 4514707-4514708 < 5.	5.	0.5	ug/l	97		77-127		
Benzene	< 5.	5.	0.5	ug/l	103		85-117		
1,2-Dichloroethane	< 5.	5.	1.	ug/l	109		77-132		
Toluene	< 5.	5.	0.7	ug/l	105		85-115		
Ethylbenzene	< 5.	5.	0.8	ug/l	99		82-119		
Isopropylbenzene	< 5.	5.	1.	ug/l	100		80-120		
Xylene (Total)	< 5.	5.	0.8	ug/l	101		83-113		
Batch number: T051222AA Methyl Tertiary Butyl Ether	Sample number(s): 4514709 < 5.	5.	0.5	ug/l	94		77-127		
Benzene	< 5.	5.	0.5	ug/l	103		85-117		
1,2-Dichloroethane	< 5.	5.	1.	ug/l	103		77-132		
Toluene	< 5.	5.	0.7	ug/l	103		85-115		
Ethylbenzene	< 5.	5.	0.8	ug/l	100		82-119		
Isopropylbenzene	< 5.	5.	1.	ug/l	100		80-120		
Xylene (Total)	< 5.	5.	0.8	ug/l	99		83-113		
Batch number: T051231AA Methyl Tertiary Butyl Ether	Sample number(s): 4514710-4514711 < 5.	5.	0.5	ug/l	97	95	77-127	2	30
Benzene	< 5.	5.	0.5	ug/l	108	103	85-117	6	30
1,2-Dichloroethane	< 5.	5.	1.	ug/l	114	109	77-132	4	30
Toluene	< 5.	5.	0.7	ug/l	105	100	85-115	4	30
Ethylbenzene	< 5.	5.	0.8	ug/l	95	94	82-119	1	30
Isopropylbenzene	< 5.	5.	1.	ug/l	95	93	80-120	2	30
Xylene (Total)	< 5.	5.	0.8	ug/l	96	93	83-113	3	30

Sample Matrix Quality Control

*- Outside of specification

**-This limit was used in the evaluation of the final result for the blank

- (1) The result for one or both determinations was less than five times the LOQ.
- (2) The background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan

Group Number: 941574

Reported: 05/06/05 at 04:42 PM

	MS	MSD	MS/MSD	RPD	BKG	DUP	DUP	Dup RPD
<u>Analysis Name</u>	<u>%REC</u>	<u>%REC</u>	<u>Limits</u>	<u>RPD</u>	<u>MAX</u>	<u>Conc</u>	<u>Conc</u>	<u>Max</u>
Batch number: 051200009A	Sample number(s): 4514707-4514711							
Ethylene dibromide	87		65-135			< 0.029	< 0.029	0 (1) 30
Batch number: 051226050003A	Sample number(s): 4514707-4514711							
Lead	98	98	75-125	0	20	0.0108	0.0107	1 20
Batch number: T051221AA	Sample number(s): 4514707-4514708							
Methyl Tertiary Butyl Ether	99	99	69-134	0	30			
Benzene	111	110	83-128	1	30			
1,2-Dichloroethane	119	117	73-136	1	30			
Toluene	107	106	83-127	1	30			
Ethylbenzene	95	96	82-129	0	30			
Isopropylbenzene	97	97	81-130	1	30			
Xylene (Total)	95	96	82-130	0	30			
Batch number: T051222AA	Sample number(s): 4514709							
Methyl Tertiary Butyl Ether	95	96	69-134	1	30			
Benzene	106	106	83-128	0	30			
1,2-Dichloroethane	105	106	73-136	1	30			
Toluene	108	106	83-127	2	30			
Ethylbenzene	99	97	82-129	1	30			
Isopropylbenzene	97	97	81-130	1	30			
Xylene (Total)	98	98	82-130	0	30			
Batch number: T051231AA	Sample number(s): 4514710-4514711							
Methyl Tertiary Butyl Ether	94		69-134					
Benzene	105		83-128					
1,2-Dichloroethane	108		73-136					
Toluene	108		83-127					
Ethylbenzene	101		82-129					
Isopropylbenzene	103		81-130					
Xylene (Total)	102		82-130					

Surrogate Quality Control

Analysis Name: EDB in Wastewater

Batch number: 051200009A

1,1,2,2-
Tetrachloroethane

4514707	106
4514708	72
4514709	88
4514710	70
4514711	77
Blank	101
DUP	92
LCS	93
LCSD	95
MS	117

Limits: 52-120

*- Outside of specification

**-This limit was used in the evaluation of the final result for the blank

(1) The result for one or both determinations was less than five times the LOQ.

(2) The background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan
Reported: 05/06/05 at 04:42 PM

Group Number: 941574

Surrogate Quality Control

Analysis Name: PAHs in Water by GC/MS
Batch number: 05120WAC026

Nitrobenzene-d5		2-Fluorobiphenyl	Terphenyl-d14
4514707	83	76	95
4514708	80	77	93
4514709	101	90	101
4514710	101	92	101
4514711	94	93	70
Blank	87	85	106
LCS	83	75	104
LCSD	86	89	110
Limits:	51-123	64-112	53-135

Analysis Name: UST-Waters by 8260B
Batch number: T051221AA

Dibromofluoromethane		1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4514707	94	90	94	98
4514708	93	89	95	100
Blank	97	94	93	98
LCS	94	92	96	101
MS	97	88	94	102
MSD	96	87	94	100
Limits:	81-120	82-112	85-112	83-113

Analysis Name: UST-Waters by 8260B
Batch number: T051222AA

Dibromofluoromethane		1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4514709	94	89	97	103
Blank	93	88	94	98
LCS	93	91	95	100
MS	92	87	96	100
MSD	92	92	95	98
Limits:	81-120	82-112	85-112	83-113

Analysis Name: UST-Waters by 8260B
Batch number: T051231AA

Dibromofluoromethane		1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4514710	102	91	95	111
4514711	94	91	95	104
Blank	96	88	93	97
LCS	94	87	93	99
LCSD	91	90	94	100
MS	93	87	94	100
Limits:	81-120	82-112	85-112	83-113

*- Outside of specification

** - This limit was used in the evaluation of the final result for the blank

- (1) The result for one or both determinations was less than five times the LOQ.
- (2) The background result was more than four times the spike added.



For Lancaster Laboratories use only

Acct. # 10132

Group#	Sample #
941574	4514707-11

COC # 0081319

Please print. Instructions on reverse side correspond with circled numbers.

Client: Sun-Agri-Industries Acct. #:

Project Name: Sun-Philadelphia Refinery AOT FWSID #:

Project Manager: K. Martin / T. Hanne P.O. #:

Sampler: NY Quote #:

Name of state where samples were collected: PA

Sample ID	Date Collected	Time Collected	Matrix	Prep	Analysis	Remarks
S218-042804	4-28-05	1245	Soil	GLP	EDC	Dissolved Pb Samples are unfiltered/unpreserved
S219-042804		1220	Soil	GLP	EDC	
S229-042804		1305	Soil	GLP	EDC	
S225-042804		1320	Soil	GLP	EDC	
S216-042804		1340	Soil	GLP	EDC	

Turnaround Time Requested (TAT) (please circle): Normal Rush

Date results are needed: 5DAX TAT

Rush results requested by (please circle): Phone Fax E-mail

Phone #: Fax #:

E-mail address:

QC Summary	Type VI (Raw Data)	SDG Complete?
Type I (Tier I)	GLP	Yes <u>NO</u>
Type II (Tier II)	Other	Yes <u>NO</u>
Type III (NJ Red. Del.)		Yes <u>NO</u>
Type IV (CLP)		Yes <u>NO</u>

Explanation of Symbols and Abbreviations

The following defines common symbols and abbreviations used in reporting technical data:

N.D.	none detected	BMQL	Below Minimum Quantitation Level
TNTC	Too Numerous To Count	MPN	Most Probable Number
IU	International Units	CP Units	cobalt-chloroplatinate units
umhos/cm	micromhos/cm	NTU	nephelometric turbidity units
C	degrees Celsius	F	degrees Fahrenheit
meq	milliequivalents	lb.	pound(s)
g	gram(s)	kg	kilogram(s)
ug	microgram(s)	mg	milligram(s)
ml	milliliter(s)	l	liter(s)
m3	cubic meter(s)	ul	microliter(s)
<	less than - The number following the sign is the <u>limit of quantitation</u> , the smallest amount of analyte which can be reliably determined using this specific test.		
>	greater than		
J	estimated value – The result is \geq the Method Detection Limit (MDL) and $<$ the Limit of Quantitation (LOQ).		
ppm	parts per million - One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.		
ppb	parts per billion		
Dry weight basis	Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture. All other results are reported on an as-received basis.		

U.S. EPA CLP Data Qualifiers:

Organic Qualifiers		Inorganic Qualifiers	
A	TIC is a possible aldol-condensation product	B	Value is $<$ CRDL, but \geq IDL
B	Analyte was also detected in the blank	E	Estimated due to interference
C	Pesticide result confirmed by GC/MS	M	Duplicate injection precision not met
D	Compound quantitated on a diluted sample	N	Spike sample not within control limits
E	Concentration exceeds the calibration range of the instrument	S	Method of standard additions (MSA) used for calculation
N	Presumptive evidence of a compound (TICs only)	U	Compound was not detected
P	Concentration difference between primary and confirmation columns $>25\%$	W	Post digestion spike out of control limits
U	Compound was not detected	*	Duplicate analysis not within control limits
X,Y,Z	Defined in case narrative	+	Correlation coefficient for MSA <0.995

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Measurement uncertainty values, as applicable, are available upon request.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

WARRANTY AND LIMITS OF LIABILITY - In accepting analytical work, we warrant the accuracy of test results for the sample as submitted. THE FOREGOING EXPRESS WARRANTY IS EXCLUSIVE AND IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED. WE DISCLAIM ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING A WARRANTY OF FITNESS FOR PARTICULAR PURPOSE AND WARRANTY OF MERCHANTABILITY. IN NO EVENT SHALL LANCASTER LABORATORIES BE LIABLE FOR INDIRECT, SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOSS OF PROFIT OR GOODWILL REGARDLESS OF (A) THE NEGLIGENCE (EITHER SOLE OR CONCURRENT) OF LANCASTER LABORATORIES AND (B) WHETHER LANCASTER LABORATORIES HAS BEEN INFORMED OF THE POSSIBILITY OF SUCH DAMAGES. We accept no legal responsibility for the purposes for which the client uses the test results. No purchase order or other order for work shall be accepted by Lancaster Laboratories which includes any conditions that vary from the Standard Terms and Conditions of Lancaster Laboratories and we hereby object to any conflicting terms contained in any acceptance or order submitted by client.

ANALYTICAL RESULTS

Prepared for:

Langan
500 Hyde Park
Doylestown PA 18901

215-348-7101

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425SAMPLE GROUP

The sample group for this submittal is 941914. Samples arrived at the laboratory on Tuesday, May 03, 2005. The PO# for this group is SUNOCO PHILLY REFINER.

Client DescriptionS31-050205 Grab Water Sample
S27-050205 Grab Water Sample
S26-050205 Grab Water SampleLancaster Labs Number4516620
4516621
4516622ELECTRONIC SUN: Aquaterra Tech.
COPY TO
1 COPY TO LL
1 COPY TO Langan
ELECTRONIC Langan
COPY TO

Attn: Brad Spancake

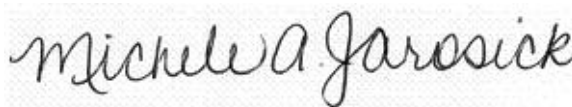
Attn: Angela Miller

Attn: Jason Hanna

Attn: Dennis Webster

Questions? Contact your Client Services Representative
Angela M Miller at (717) 656-2300.

Respectfully Submitted,



Michele A. Jarosick
Senior Chemist, Coordinator

Lancaster Laboratories Sample No. WW 4516620

S31-050205 Grab Water Sample
SUN: Philadelphia Refinery AOI-4

Collected: 05/02/2005 13:30 by MBS

Account Number: 10132

Submitted: 05/03/2005 16:35
Reported: 05/10/2005 at 15:14
Discard: 06/10/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-031

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation*	As Received Method Detection Limit	Units	Dilution Factor
06035	Lead	7439-92-1	< 0.0010	0.0010	0.00021	mg/l	1
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	< 0.028	0.028	0.0095	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	170.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	53.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	40.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	39.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	6.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	150.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037

This sample was filtered in the lab for dissolved metals.

Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/06/2005 23:04	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	05/06/2005 01:59	James H Place	1
02302	UST-Waters by 8260B	SW-846 8260B	1	05/06/2005 03:32	Andrea D Moore	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/06/2005 03:32	Andrea D Moore	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/05/2005 15:54	Megersa Deyessa	1
07786	EDB Extraction	SW-846 8011	1	05/05/2005 10:00	Joseph S Feister	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4516621

S27-050205 Grab Water Sample
SUN: Philadelphia Refinery AOI-4

Collected: 05/02/2005 14:10 by MBS

Account Number: 10132

Submitted: 05/03/2005 16:35
Reported: 05/10/2005 at 15:14
Discard: 06/10/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-027

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation*	As Received Method Detection Limit	Units	Dilution Factor
06035	Lead	7439-92-1	< 0.0010	0.0010	0.00021	mg/l	1
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	< 0.029	0.029	0.0095	ug/l	1
07805	PAHs in Water by GC/MS						
03947	Naphthalene	91-20-3	14.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	< 5.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	5.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	26.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037

This sample was filtered in the lab for dissolved metals.

Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/06/2005 23:06	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	05/06/2005 02:28	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/06/2005 20:08	Jolene M Graham	1
02302	UST-Waters by 8260B	SW-846 8260B	1	05/06/2005 03:56	Andrea D Moore	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/06/2005 03:56	Andrea D Moore	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/05/2005 15:54	Megersa Deyessa	1
07786	EDB Extraction	SW-846 8011	1	05/05/2005 10:00	Joseph S Feister	1

*=This limit was used in the evaluation of the final result



Analysis Report

2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 • 717-656-2300 Fax: 717-656-2681 • www.lancasterlabs.com

Page 2 of 2

Lancaster Laboratories Sample No. WW 4516621

S27-050205 Grab Water Sample

SUN: Philadelphia Refinery AOI-4

Collected: 05/02/2005 14:10 by MBS

Account Number: 10132

Submitted: 05/03/2005 16:35

Langan

Reported: 05/10/2005 at 15:14

500 Hyde Park

Discard: 06/10/2005

Doylestown PA 18901

S-027

07807 BNA Water Extraction

SW-846 3510C

1 05/04/2005 17:00 Olivia I Santiago

1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4516622

S26-050205 Grab Water Sample
SUN: Philadelphia Refinery AOI-4

Collected: 05/02/2005 15:00 by MBS

Account Number: 10132

Submitted: 05/03/2005 16:35
Reported: 05/10/2005 at 15:15
Discard: 06/10/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-026

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation*	As Received Method Detection Limit	Units	Dilution Factor
06035	Lead	7439-92-1	< 0.0010	0.0010	0.00021	mg/l	1
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	< 0.029	0.029	0.0097	ug/l	1
07805	PAHs in Water by GC/MS						
03947	Naphthalene	91-20-3	< 10.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	32.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	< 5.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	< 5.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037

This sample was filtered in the lab for dissolved metals.

Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/06/2005 23:09	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	05/06/2005 03:28	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/06/2005 21:07	Jolene M Graham	1
02302	UST-Waters by 8260B	SW-846 8260B	1	05/06/2005 04:21	Andrea D Moore	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/06/2005 04:21	Andrea D Moore	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/05/2005 15:54	Megersa Deyessa	1
07786	EDB Extraction	SW-846 8011	1	05/05/2005 10:00	Joseph S Feister	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4516622

S26-050205 Grab Water Sample

SUN: Philadelphia Refinery AOI-4

Collected: 05/02/2005 15:00 by MBS

Account Number: 10132

Submitted: 05/03/2005 16:35

Langan

Reported: 05/10/2005 at 15:15

500 Hyde Park

Discard: 06/10/2005

Doylestown PA 18901

S-026

07807 BNA Water Extraction

SW-846 3510C

1 05/04/2005 17:00 Olivia I Santiago

1

Quality Control Summary

Client Name: Langan

Group Number: 941914

Reported: 05/10/05 at 03:15 PM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

Laboratory Compliance Quality Control

<u>Analysis Name</u>	<u>Blank Result</u>	<u>Blank LOQ**</u>	<u>Blank MDL</u>	<u>Report Units</u>	<u>LCS %REC</u>	<u>LCSD %REC</u>	<u>LCS/LCSD Limits</u>	<u>RPD</u>	<u>RPD Max</u>
Batch number: 051240024A Ethylene dibromide	Sample number(s): 4516620-4516622 < 0.030 0.030 0.010 ug/l 100 100 60-140 0 20								
Batch number: 05124WAC026 Naphthalene	Sample number(s): 4516621-4516622 < 10. 10. 1. ug/l 88 87 58-108 1 30								
Fluorene	< 10. 10. 1. ug/l 100 95 61-116 4 30								
Phenanthrene	< 10. 10. 1. ug/l 97 99 68-111 2 30								
Pyrene	< 10. 10. 1. ug/l 88 90 68-114 2 30								
Chrysene	< 10. 10. 1. ug/l 91 94 70-111 3 30								
Batch number: 051256050001A Lead	Sample number(s): 4516620-4516622 < 0.0010 0.0010 0.00021 mg/l 100 80-120								
Batch number: T051252AA Methyl Tertiary Butyl Ether	Sample number(s): 4516620-4516622 < 5. 5. 0.5 ug/l 99 77-127								
Benzene	< 5. 5. 0.5 ug/l 109 85-117								
1,2-Dichloroethane	< 5. 5. 1. ug/l 117 77-132								
Toluene	< 5. 5. 0.7 ug/l 104 85-115								
Ethylbenzene	< 5. 5. 0.8 ug/l 97 82-119								
Isopropylbenzene	< 5. 5. 1. ug/l 97 80-120								
Xylene (Total)	< 5. 5. 0.8 ug/l 98 83-113								

Sample Matrix Quality Control

<u>Analysis Name</u>	<u>MS %REC</u>	<u>MSD %REC</u>	<u>MS/MSD Limits</u>	<u>RPD</u>	<u>BKG</u>	<u>DUP</u>	<u>DUP</u>	<u>Dup RPD</u>
Batch number: 051240024A Ethylene dibromide	Sample number(s): 4516620-4516622 84 65-135 < 0.028 < 0.029 0 (1) 30							
Batch number: 051256050001A Lead	Sample number(s): 4516620-4516622 100 101 75-125 1 20 < 0.0010 < 0.0010 25* (1) 20							
Batch number: T051252AA Methyl Tertiary Butyl Ether	Sample number(s): 4516620-4516622 104 107 69-134 4 30							
Benzene	115 115 83-128 0 30							
1,2-Dichloroethane	123 124 73-136 1 30							
Toluene	108 110 83-127 2 30							
Ethylbenzene	100 102 82-129 2 30							
Isopropylbenzene	98 102 81-130 5 30							
Xylene (Total)	100 100 82-130 0 30							

*- Outside of specification

**-This limit was used in the evaluation of the final result for the blank

(1) The result for one or both determinations was less than five times the LOQ.

(2) The background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan
Reported: 05/10/05 at 03:15 PM

Group Number: 941914

Sample Matrix Quality Control

	MS	MSD	MS/MSD	RPD	BKG	DUP	DUP	Dup
<u>Analysis Name</u>	<u>%REC</u>	<u>%REC</u>	<u>Limits</u>	<u>RPD</u>	<u>MAX</u>	<u>Conc</u>	<u>Conc</u>	<u>RPD</u>
								<u>Max</u>

Surrogate Quality Control

Analysis Name: EDB in Wastewater
Batch number: 051240024A
1,1,2,2-
Tetrachloroethane

4516620	82
4516621	106
4516622	117
Blank	102
DUP	75
LCS	104
LCSD	103
MS	96

Limits: 52-120

Analysis Name: PAHs in Water by GC/MS
Batch number: 05124WAC026

	Nitrobenzene-d5	2-Fluorobiphenyl	Terphenyl-d14
4516621	76	81	92
4516622	69	77	88
Blank	77	86	94
LCS	77	86	98
LCSD	76	86	102

Limits: 51-123 64-112 53-135

Analysis Name: UST-Waters by 8260B
Batch number: T051252AA

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4516620	94	90	94	102
4516621	92	87	93	102
4516622	94	88	94	103
Blank	98	88	92	98
LCS	95	86	92	100
MS	96	86	91	99
MSD	97	87	94	100

Limits: 81-120 82-112 85-112 83-113

*- Outside of specification

** - This limit was used in the evaluation of the final result for the blank

- (1) The result for one or both determinations was less than five times the LOQ.
- (2) The background result was more than four times the spike added.

Analysis Request / Environmental Services Chain of Custody



Lancaster Laboratories
Where quality is a science.

For Lancaster Laboratories use only

Acct. # 10132

Group # 941914

Sample # 4516620-22

COC # 0084325

Please print. Instructions on reverse side correspond with circled numbers.

cooler temp 1.1-1.6°C

Client: Sun-Aquaticus/Lancaster Acct. #: _____
Project Name: Sun-Philadelphia Refinery Proj. # AST-4
Project Manager: K. Martin J. Harris (Lancaster) P.O. #: _____
Sampler: M. Brad Spencake Quote #: _____
Name of state where samples were collected: PA

For Lab Use Only
FSC: _____
SCR #: _____

Remarks
Dissolved Pb sample is about 200ml of sample.
Dissolved Pb samples are unfiltered/unpreserved

3

4

5

6

7

Sample Identification	Date	Time	GLP	QC	Notes
S31-050205	5/2/05	1330	X	X	
S27-050205	5/2/05	1410	X	X	
S26-050205	5/2/05	1500	X	X	

8

9

10

11

12

7 Turnaround Time Requested (TAT) (please circle): (Normal) Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed: 5 Day TAT
Rush results requested by (please circle): Phone Fax E-mail
Phone #: _____ Fax #: _____
E-mail address: _____

8 Data Package Options (please circle if required)
QC Summary Type VI (Raw Data) Yes (No)
Type I (Tier I) GLP Site-specific QC required? Yes (No)
Type II (Tier II) Other (If yes, indicate QC sample and submit triplicate volume.)
Type III (NJ Red. Del.) Internal Chain of Custody required? Yes (No)
Type IV (CLP)

9

10

11

12

13

Explanation of Symbols and Abbreviations

The following defines common symbols and abbreviations used in reporting technical data:

N.D.	none detected	BMQL	Below Minimum Quantitation Level
TNTC	Too Numerous To Count	MPN	Most Probable Number
IU	International Units	CP Units	cobalt-chloroplatinate units
umhos/cm	micromhos/cm	NTU	nephelometric turbidity units
C	degrees Celsius	F	degrees Fahrenheit
meq	milliequivalents	lb.	pound(s)
g	gram(s)	kg	kilogram(s)
ug	microgram(s)	mg	milligram(s)
ml	milliliter(s)	l	liter(s)
m3	cubic meter(s)	ul	microliter(s)
<	less than - The number following the sign is the <u>limit of quantitation</u> , the smallest amount of analyte which can be reliably determined using this specific test.		
>	greater than		
J	estimated value – The result is \geq the Method Detection Limit (MDL) and $<$ the Limit of Quantitation (LOQ).		
ppm	parts per million - One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.		
ppb	parts per billion		
Dry weight basis	Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture. All other results are reported on an as-received basis.		

U.S. EPA CLP Data Qualifiers:

Organic Qualifiers		Inorganic Qualifiers	
A	TIC is a possible aldol-condensation product	B	Value is $<$ CRDL, but \geq IDL
B	Analyte was also detected in the blank	E	Estimated due to interference
C	Pesticide result confirmed by GC/MS	M	Duplicate injection precision not met
D	Compound quantitated on a diluted sample	N	Spike sample not within control limits
E	Concentration exceeds the calibration range of the instrument	S	Method of standard additions (MSA) used for calculation
N	Presumptive evidence of a compound (TICs only)	U	Compound was not detected
P	Concentration difference between primary and confirmation columns $>25\%$	W	Post digestion spike out of control limits
U	Compound was not detected	*	Duplicate analysis not within control limits
X,Y,Z	Defined in case narrative	+	Correlation coefficient for MSA <0.995

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Measurement uncertainty values, as applicable, are available upon request.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

WARRANTY AND LIMITS OF LIABILITY - In accepting analytical work, we warrant the accuracy of test results for the sample as submitted. THE FOREGOING EXPRESS WARRANTY IS EXCLUSIVE AND IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED. WE DISCLAIM ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING A WARRANTY OF FITNESS FOR PARTICULAR PURPOSE AND WARRANTY OF MERCHANTABILITY. IN NO EVENT SHALL LANCASTER LABORATORIES BE LIABLE FOR INDIRECT, SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOSS OF PROFIT OR GOODWILL REGARDLESS OF (A) THE NEGLIGENCE (EITHER SOLE OR CONCURRENT) OF LANCASTER LABORATORIES AND (B) WHETHER LANCASTER LABORATORIES HAS BEEN INFORMED OF THE POSSIBILITY OF SUCH DAMAGES. We accept no legal responsibility for the purposes for which the client uses the test results. No purchase order or other order for work shall be accepted by Lancaster Laboratories which includes any conditions that vary from the Standard Terms and Conditions of Lancaster Laboratories and we hereby object to any conflicting terms contained in any acceptance or order submitted by client.

ANALYTICAL RESULTS

Prepared for:

Langan
500 Hyde Park
Doylestown PA 18901

215-348-7101

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425**SAMPLE GROUP**

The sample group for this submittal is 942136. Samples arrived at the laboratory on Wednesday, May 04, 2005. The PO# for this group is SUNOCO PHILLY REFINER.

Client Description

S119D-050305 Grab Water Sample
S119-050305 Grab Water Sample
S40-050305 Grab Water Sample
S120-050305 Grab Water Sample
S39-050305 Grab Water Sample
S122-050305 Grab Water Sample
S38D-050305 Grab Water Sample
S38I-050305 Grab Water Sample
S38-050305 Grab Water Sample
Trip_Blank Water Sample

Lancaster Labs Number

4517633
4517634
4517635
4517636
4517637
4517638
4517639
4517640
4517641
4517642

ELECTRONIC SUN: Aquaterra Tech.
COPY TO
1 COPY TO LL
1 COPY TO Langan
ELECTRONIC Langan
COPY TO

Attn: Brad Spancake

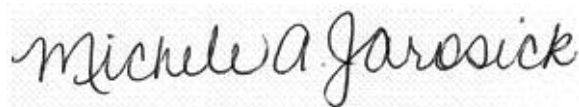
Attn: Angela Miller

Attn: Jason Hanna

Attn: Dennis Webster

Questions? Contact your Client Services Representative
Angela M Miller at (717) 656-2300.

Respectfully Submitted,



Michele A. Jarosick
Senior Chemist, Coordinator

Lancaster Laboratories Sample No. WW 4517633

S119D-050305 Grab Water Sample
SUN: Philadelphia Refinery AOI-4

Collected: 05/03/2005 11:40 by MBS

Account Number: 10132

Submitted: 05/04/2005 16:35
Reported: 05/11/2005 at 16:18
Discard: 06/11/2005

Langan
500 Hyde Park
Doylestown PA 18901

S119D

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation*	As Received Method Detection Limit	Units	Dilution Factor
06035	Lead	7439-92-1	< 0.0010	0.0010	0.00021	mg/l	1
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	< 0.029	0.029	0.0096	ug/l	1
07805	PAHs in Water by GC/MS						
03947	Naphthalene	91-20-3	< 10.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	< 5.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	< 5.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Analysis		Analyst	Dilution Factor
			Trial#	Date and Time		
06035	Lead	SW-846 6020	1	05/06/2005 21:07	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	05/06/2005 12:23	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/07/2005 02:03	Jolene M Graham	1
02302	UST-Waters by 8260B	SW-846 8260B	1	05/08/2005 12:21	Jason M Long	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/08/2005 12:21	Jason M Long	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/05/2005 18:55	James L Mertz	1
07786	EDB Extraction	SW-846 8011	1	05/05/2005 19:08	Amanda W Herr	1
07807	BNA Water Extraction	SW-846 3510C	1	05/06/2005 07:00	Mark P Mastropietro	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4517633

S119D-050305 Grab Water Sample
SUN: Philadelphia Refinery AOI-4

Collected: 05/03/2005 11:40 by MBS

Account Number: 10132

Submitted: 05/04/2005 16:35
Reported: 05/11/2005 at 16:18
Discard: 06/11/2005

Langan
500 Hyde Park
Doylestown PA 18901

S119D

Lancaster Laboratories Sample No. WW 4517634

S119-050305 Grab Water Sample
SUN: Philadelphia Refinery AOI-4

Collected: 05/03/2005 12:00 by MBS

Account Number: 10132

Submitted: 05/04/2005 16:35
 Reported: 05/11/2005 at 16:18
 Discard: 06/11/2005

Langan
 500 Hyde Park
 Doylestown PA 18901

S-119

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation*	As Received Method Detection Limit	Units	Dilution Factor
06035	Lead	7439-92-1	< 0.0010	0.0010	0.00021	mg/l	1
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	< 0.028	0.028	0.0095	ug/l	1
07805	PAHs in Water by GC/MS						
03947	Naphthalene	91-20-3	< 10.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	5.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	< 5.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
 This sample was filtered in the lab for dissolved metals.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/06/2005 21:11	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	05/06/2005 12:52	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/07/2005 03:02	Jolene M Graham	1
02302	UST-Waters by 8260B	SW-846 8260B	1	05/08/2005 13:03	Jason M Long	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/08/2005 13:03	Jason M Long	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/05/2005 18:55	James L Mertz	1
07786	EDB Extraction	SW-846 8011	1	05/05/2005 19:08	Amanda W Herr	1
07807	BNA Water Extraction	SW-846 3510C	1	05/06/2005 07:00	Mark P Mastropietro	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4517634

S119-050305 Grab Water Sample

SUN: Philadelphia Refinery AOI-4

Collected: 05/03/2005 12:00 by MBS

Account Number: 10132

Submitted: 05/04/2005 16:35

Langan

Reported: 05/11/2005 at 16:18

500 Hyde Park

Discard: 06/11/2005

Doylestown PA 18901

S-119

Lancaster Laboratories Sample No. WW 4517635

S40-050305 Grab Water Sample
SUN: Philadelphia Refinery AOI-4

Collected: 05/03/2005 12:15 by MBS

Account Number: 10132

Submitted: 05/04/2005 16:35
 Reported: 05/11/2005 at 16:18
 Discard: 06/11/2005

Langan
 500 Hyde Park
 Doylestown PA 18901

S-040

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation*	As Received Method Detection Limit	Units	Dilution Factor
06035	Lead	7439-92-1	< 0.0010	0.0010	0.00021	mg/l	1
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	< 0.030	0.030	0.0099	ug/l	1
07805	PAHs in Water by GC/MS						
03947	Naphthalene	91-20-3	< 10.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	16.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	370.	25.	3.	ug/l	5
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	14.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	21.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	40.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	10.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
 This sample was filtered in the lab for dissolved metals.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/06/2005 21:15	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	05/06/2005 13:22	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/07/2005 04:01	Jolene M Graham	1
02302	UST-Waters by 8260B	SW-846 8260B	1	05/08/2005 13:25	Jason M Long	1
02302	UST-Waters by 8260B	SW-846 8260B	1	05/08/2005 13:46	Jason M Long	5
01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/08/2005 13:25	Jason M Long	n.a.
01163	GC/MS VOA Water Prep	SW-846 5030B	2	05/08/2005 13:46	Jason M Long	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/05/2005 18:55	James L Mertz	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4517635

S40-050305 Grab Water Sample

SUN: Philadelphia Refinery AOI-4

Collected: 05/03/2005 12:15 by MBS

Account Number: 10132

Submitted: 05/04/2005 16:35

Langan

Reported: 05/11/2005 at 16:18

500 Hyde Park

Discard: 06/11/2005

Doylestown PA 18901

S-040

07786	EDB Extraction	SW-846 8011	1	05/05/2005 19:08	Amanda W Herr	1
07807	BNA Water Extraction	SW-846 3510C	1	05/06/2005 07:00	Mark P Mastropietro	1

Lancaster Laboratories Sample No. WW 4517636

S120-050305 Grab Water Sample
SUN: Philadelphia Refinery AOI-4

Collected: 05/03/2005 12:30 by MBS

Account Number: 10132

Submitted: 05/04/2005 16:35
Reported: 05/11/2005 at 16:19
Discard: 06/11/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-120

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation*	As Received Method Detection Limit	Units	Dilution Factor
06035	Lead	7439-92-1	< 0.0010	0.0010	0.00021	mg/l	1
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	< 0.029	0.029	0.0098	ug/l	1
07805	PAHs in Water by GC/MS						
03947	Naphthalene	91-20-3	< 10.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	< 5.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	< 5.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/06/2005 21:19	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	05/06/2005 14:21	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/09/2005 11:06	Joseph M Gambler	1
02302	UST-Waters by 8260B	SW-846 8260B	1	05/08/2005 14:07	Jason M Long	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/08/2005 14:07	Jason M Long	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/05/2005 18:55	James L Mertz	1
07786	EDB Extraction	SW-846 8011	1	05/05/2005 19:08	Amanda W Herr	1
07807	BNA Water Extraction	SW-846 3510C	1	05/06/2005 07:00	Mark P Mastropietro	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4517636

S120-050305 Grab Water Sample

SUN: Philadelphia Refinery AOI-4

Collected: 05/03/2005 12:30 by MBS

Account Number: 10132

Submitted: 05/04/2005 16:35

Langan

Reported: 05/11/2005 at 16:19

500 Hyde Park

Discard: 06/11/2005

Doylestown PA 18901

S-120

Lancaster Laboratories Sample No. WW 4517637

S39-050305 Grab Water Sample
SUN: Philadelphia Refinery AOI-4

Collected: 05/03/2005 12:45 by MBS

Account Number: 10132

Submitted: 05/04/2005 16:35
Reported: 05/11/2005 at 16:19
Discard: 06/11/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-039

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation*	As Received Method Detection Limit	Units	Dilution Factor
06035	Lead	7439-92-1	< 0.0010	0.0010	0.00021	mg/l	1
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	< 0.029	0.029	0.0097	ug/l	1
07805	PAHs in Water by GC/MS						
03947	Naphthalene	91-20-3	< 10.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	< 5.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	< 5.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/06/2005 21:22	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	05/06/2005 14:51	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/09/2005 12:05	Joseph M Gambler	1
02302	UST-Waters by 8260B	SW-846 8260B	1	05/08/2005 14:28	Jason M Long	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/08/2005 14:28	Jason M Long	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/05/2005 18:55	James L Mertz	1
07786	EDB Extraction	SW-846 8011	1	05/05/2005 19:08	Amanda W Herr	1
07807	BNA Water Extraction	SW-846 3510C	1	05/06/2005 07:00	Mark P Mastropietro	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4517637

S39-050305 Grab Water Sample

SUN: Philadelphia Refinery AOI-4

Collected: 05/03/2005 12:45 by MBS

Account Number: 10132

Submitted: 05/04/2005 16:35

Langan

Reported: 05/11/2005 at 16:19

500 Hyde Park

Discard: 06/11/2005

Doylestown PA 18901

S-039

Lancaster Laboratories Sample No. WW 4517638

S122-050305 Grab Water Sample
SUN: Philadelphia Refinery AOI-4

Collected: 05/03/2005 13:00 by MBS

Account Number: 10132

Submitted: 05/04/2005 16:35
Reported: 05/11/2005 at 16:19
Discard: 06/11/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-122

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation*	As Received Method Detection Limit	Units	Dilution Factor
06035	Lead	7439-92-1	< 0.0010	0.0010	0.00021	mg/l	1
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	< 0.029	0.029	0.0096	ug/l	1
07805	PAHs in Water by GC/MS						
03947	Naphthalene	91-20-3	< 10.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	< 5.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	< 5.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/06/2005 21:26	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	05/06/2005 15:21	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/09/2005 13:03	Joseph M Gambler	1
02302	UST-Waters by 8260B	SW-846 8260B	1	05/08/2005 14:49	Jason M Long	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/08/2005 14:49	Jason M Long	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/05/2005 18:55	James L Mertz	1
07786	EDB Extraction	SW-846 8011	1	05/05/2005 19:08	Amanda W Herr	1
07807	BNA Water Extraction	SW-846 3510C	1	05/06/2005 07:00	Mark P Mastropietro	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4517638

S122-050305 Grab Water Sample

SUN: Philadelphia Refinery AOI-4

Collected: 05/03/2005 13:00 by MBS

Account Number: 10132

Submitted: 05/04/2005 16:35

Langan

Reported: 05/11/2005 at 16:19

500 Hyde Park

Discard: 06/11/2005

Doylestown PA 18901

S-122

Lancaster Laboratories Sample No. WW 4517639

S38D-050305 Grab Water Sample
SUN: Philadelphia Refinery AOI-4

Collected: 05/03/2005 13:15 by MBS

Account Number: 10132

Submitted: 05/04/2005 16:35
Reported: 05/11/2005 at 16:19
Discard: 06/11/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-38D

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation*	As Received Method Detection Limit	Units	Dilution Factor
06035	Lead	7439-92-1	< 0.0010	0.0010	0.00021	mg/l	1
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	< 0.029	0.029	0.0097	ug/l	1
07805	PAHs in Water by GC/MS						
03947	Naphthalene	91-20-3	< 10.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	< 5.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	< 5.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/06/2005 21:30	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	05/06/2005 15:51	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/09/2005 14:02	Joseph M Gambler	1
02302	UST-Waters by 8260B	SW-846 8260B	1	05/08/2005 15:11	Jason M Long	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/08/2005 15:11	Jason M Long	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/05/2005 18:55	James L Mertz	1
07786	EDB Extraction	SW-846 8011	1	05/05/2005 19:08	Amanda W Herr	1
07807	BNA Water Extraction	SW-846 3510C	1	05/06/2005 07:00	Mark P Mastropietro	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4517639

S38D-050305 Grab Water Sample

SUN: Philadelphia Refinery AOI-4

Collected: 05/03/2005 13:15 by MBS

Account Number: 10132

Submitted: 05/04/2005 16:35

Langan

Reported: 05/11/2005 at 16:19

500 Hyde Park

Discard: 06/11/2005

Doylestown PA 18901

S-38D

Lancaster Laboratories Sample No. WW 4517640

S38I-050305 Grab Water Sample
SUN: Philadelphia Refinery AOI-4

Collected: 05/03/2005 13:30 by MBS

Account Number: 10132

Submitted: 05/04/2005 16:35
Reported: 05/11/2005 at 16:19
Discard: 06/11/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-38I

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation*	As Received Method Detection Limit	Units	Dilution Factor
06035	Lead	7439-92-1	< 0.0010	0.0010	0.00021	mg/l	1
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	< 0.029	0.029	0.0098	ug/l	1
07805	PAHs in Water by GC/MS						
03947	Naphthalene	91-20-3	< 10.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	< 5.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	< 5.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/06/2005 21:33	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	05/06/2005 16:21	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/09/2005 15:01	Joseph M Gambler	1
02302	UST-Waters by 8260B	SW-846 8260B	1	05/08/2005 15:32	Jason M Long	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/08/2005 15:32	Jason M Long	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/05/2005 18:55	James L Mertz	1
07786	EDB Extraction	SW-846 8011	1	05/05/2005 19:08	Amanda W Herr	1
07807	BNA Water Extraction	SW-846 3510C	1	05/06/2005 07:00	Mark P Mastropietro	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4517640

S38I-050305 Grab Water Sample

SUN: Philadelphia Refinery AOI-4

Collected: 05/03/2005 13:30 by MBS

Account Number: 10132

Submitted: 05/04/2005 16:35

Langan

Reported: 05/11/2005 at 16:19

500 Hyde Park

Discard: 06/11/2005

Doylestown PA 18901

S-38I

Lancaster Laboratories Sample No. WW 4517641

S38-050305 Grab Water Sample
SUN: Philadelphia Refinery AOI-4

Collected: 05/03/2005 13:45 by MBS

Account Number: 10132

Submitted: 05/04/2005 16:35
Reported: 05/11/2005 at 16:19
Discard: 06/11/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-038

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation*	As Received Method Detection Limit	Units	Dilution Factor
06035	Lead	7439-92-1	< 0.0010	0.0010	0.00021	mg/l	1
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	< 0.029	0.029	0.0097	ug/l	1
07805	PAHs in Water by GC/MS						
03947	Naphthalene	91-20-3	< 10.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	< 5.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	< 5.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/06/2005 21:44	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	05/06/2005 16:50	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/09/2005 15:59	Joseph M Gambler	1
02302	UST-Waters by 8260B	SW-846 8260B	1	05/08/2005 15:53	Jason M Long	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/08/2005 15:53	Jason M Long	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/05/2005 18:55	James L Mertz	1
07786	EDB Extraction	SW-846 8011	1	05/05/2005 19:08	Amanda W Herr	1
07807	BNA Water Extraction	SW-846 3510C	1	05/06/2005 07:00	Mark P Mastropietro	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4517641

S38-050305 Grab Water Sample

SUN: Philadelphia Refinery AOI-4

Collected: 05/03/2005 13:45 by MBS

Account Number: 10132

Submitted: 05/04/2005 16:35

Langan

Reported: 05/11/2005 at 16:19

500 Hyde Park

Discard: 06/11/2005

Doylestown PA 18901

S-038

Lancaster Laboratories Sample No. WW 4517642

Trip_Blank Water Sample
SUN: Philadelphia Refinery AOI-4

Collected: n.a.

Account Number: 10132

Submitted: 05/04/2005 16:35
Reported: 05/11/2005 at 16:19
Discard: 06/11/2005

Langan
500 Hyde Park
Doylestown PA 18901

AO4TB

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation*	As Received Method Detection Limit	Units	Dilution Factor
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	< 5.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	< 5.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
02302	UST-Waters by 8260B	SW-846 8260B	1	05/08/2005 16:19	Jason M Long	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/08/2005 16:19	Jason M Long	n.a.

*=This limit was used in the evaluation of the final result

Quality Control Summary

Client Name: Langan

Group Number: 942136

Reported: 05/11/05 at 04:19 PM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

Laboratory Compliance Quality Control

<u>Analysis Name</u>	<u>Blank Result</u>	<u>Blank LOQ**</u>	<u>Blank MDL</u>	<u>Report Units</u>	<u>LCS %REC</u>	<u>LCSD %REC</u>	<u>LCS/LCSD Limits</u>	<u>RPD</u>	<u>RPD Max</u>
Batch number: 051250004A Ethylene dibromide	Sample number(s): 4517633-4517641 < 0.030	0.030	0.010	ug/l	100	96	60-140	4	20
Batch number: 051256050003A Lead	Sample number(s): 4517633-4517641 < 0.0010	0.0010	0.00021	mg/l	101		80-120		
Batch number: 05125WAG026 Naphthalene	Sample number(s): 4517633-4517641 < 10.	10.	1.	ug/l	79	78	58-108	2	30
Fluorene	< 10.	10.	1.	ug/l	95	96	61-116	1	30
Phenanthrene	< 10.	10.	1.	ug/l	99	99	68-111	0	30
Pyrene	< 10.	10.	1.	ug/l	91	89	68-114	2	30
Chrysene	< 10.	10.	1.	ug/l	92	93	70-111	1	30
Batch number: P051281AA Methyl Tertiary Butyl Ether	Sample number(s): 4517633-4517642 < 5.	5.	0.5	ug/l	91	89	77-127	2	30
Benzene	< 5.	5.	0.5	ug/l	98	97	85-117	1	30
1,2-Dichloroethane	< 5.	5.	1.	ug/l	92	93	77-132	1	30
Toluene	< 5.	5.	0.7	ug/l	95	95	85-115	0	30
Ethylbenzene	< 5.	5.	0.8	ug/l	94	94	82-119	0	30
Isopropylbenzene	< 5.	5.	1.	ug/l	93	94	80-120	1	30
Xylene (Total)	< 5.	5.	0.8	ug/l	94	95	83-113	0	30

Sample Matrix Quality Control

<u>Analysis Name</u>	<u>MS %REC</u>	<u>MSD %REC</u>	<u>MS/MSD Limits</u>	<u>RPD</u>	<u>BKG</u>	<u>DUP</u>	<u>DUP</u>	<u>Dup RPD</u>
Batch number: 051250004A Ethylene dibromide	Sample number(s): 4517633-4517641 96		65-135		< 0.029	< 0.029	0 (1)	30
Batch number: 051256050003A Lead	Sample number(s): 4517633-4517641 99	102	75-125	3	< 0.0010	< 0.0010	34* (1)	20
Batch number: P051281AA Methyl Tertiary Butyl Ether	Sample number(s): 4517633-4517642 96		69-134					
Benzene	110		83-128					
1,2-Dichloroethane	102		73-136					
Toluene	103		83-127					
Ethylbenzene	99		82-129					
Isopropylbenzene	99		81-130					
Xylene (Total)	100		82-130					

*- Outside of specification

**-This limit was used in the evaluation of the final result for the blank

- (1) The result for one or both determinations was less than five times the LOQ.
- (2) The background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan
Reported: 05/11/05 at 04:19 PM

Group Number: 942136

Sample Matrix Quality Control

	MS	MSD	MS/MSD	RPD	BKG	DUP	DUP	Dup
<u>Analysis Name</u>	<u>%REC</u>	<u>%REC</u>	<u>Limits</u>	<u>RPD</u>	<u>MAX</u>	<u>Conc</u>	<u>Conc</u>	<u>RPD</u>
								<u>Max</u>

Surrogate Quality Control

Analysis Name: EDB in Wastewater
Batch number: 051250004A
1,1,2,2-
Tetrachloroethane

4517633	103
4517634	99
4517635	87
4517636	101
4517637	106
4517638	111
4517639	97
4517640	109
4517641	98
Blank	114
DUP	100
LCS	111
LCSD	110
MS	110

Limits: 52-120

Analysis Name: PAHs in Water by GC/MS
Batch number: 05125WAG026

	Nitrobenzene-d5	2-Fluorobiphenyl	Terphenyl-d14
4517633	74	78	86
4517634	85	86	90
4517635	83	82	86
4517636	74	83	90
4517637	74	85	91
4517638	76	81	90
4517639	81	88	91
4517640	78	88	90
4517641	75	83	86
Blank	76	81	99
LCS	79	80	101
LCSD	79	81	101

Limits: 51-123 64-112 53-135

Analysis Name: UST-Waters by 8260B
Batch number: P051281AA

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4517633	95	95	96	93
4517634	95	89	98	102
4517635	95	97	100	107

*- Outside of specification

** - This limit was used in the evaluation of the final result for the blank

- (1) The result for one or both determinations was less than five times the LOQ.
- (2) The background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan

Group Number: 942136

Reported: 05/11/05 at 04:19 PM

Surrogate Quality Control

4517636	96	93	97	95
4517637	97	91	97	91
4517638	95	93	93	94
4517639	97	90	98	93
4517640	96	93	96	93
4517641	100	96	97	92
4517642	96	90	97	93
Blank	96	92	97	93
LCS	93	92	97	94
LCSD	95	92	96	96
MS	100	96	96	95
Limits:	81-120	82-112	85-112	83-113

*- Outside of specification

** - This limit was used in the evaluation of the final result for the blank

- (1) The result for one or both determinations was less than five times the LOQ.
- (2) The background result was more than four times the spike added.

Analysis Request / Environmental Services Chain of Custody



For Lancaster Laboratories use only

COC # 0080450

Acct. # 10132 Group # 942136 Sample # 4517633-42

Please print. Instructions on reverse side correspond with circled numbers.

Cooler temp 1.4-2.1°C

1 Client: <u>Sun - Aquaterra / Lancaster</u> Acct. #: _____ Project Name: <u>Sun - Philadelphia Parkway AOC-4</u> PWSID #: _____ Project Manager: <u>K. Martin / J. Harris</u> P.O. #: _____ Sampler: <u>M. Bed Sparake</u> Quote #: _____ Name of state where samples were collected: <u>PA</u>		2 Sample Identification Sample ID: _____ Date Collected: _____ Sample Description: _____		3 Matrix <input checked="" type="checkbox"/> Composite <input type="checkbox"/> Soil <input type="checkbox"/> Water <input type="checkbox"/> Other <input type="checkbox"/> Fertilizer <input type="checkbox"/> Pesticide <input type="checkbox"/> Other		4 Total # of Containers: _____ Other: _____		5 Analysis Requested 8011 EMB 8270 Dissolved Pb 8270 Chlorine, Phosphate, Nitrate, Nitrite, Ammonia, Manganese, Molybdenum		6 Remarks Dissolved Pb samples are unfiltered/unpreserved	
7 Turnaround Time Requested (TAT) (please circle): Normal Rush (Rush TAT is subject to Lancaster Laboratories approval and surcharge.) Date results are needed: <u>5 Day TAT</u> Rush results requested by (please circle): Phone Fax E-mail Phone #: _____ Fax #: _____ E-mail address: _____		8 Data Package Options (please circle if required) QC Summary Type VI (Raw Data) Yes (No) Type I (Tier I) GLP Other Type II (Tier II) Type III (NJ Red. Del.) Type IV (CLP) Site-specific QC required? Yes (No) (If yes, indicate QC sample and submit triplicate volume.) Internal Chain of Custody required? Yes (No)		9 Relinquished by: _____ Relinquished by: _____ Relinquished by: _____ Relinquished by: _____ Relinquished by: _____		Date Time 5/3/05 10:20 5/4/05 11:15 5/4/05 16:35 _____ _____		Date Time 5/3/05 10:20 5/4/05 11:15 5/4/05 16:35 _____ _____		Date Time 5/3/05 10:20 5/4/05 11:15 5/4/05 16:35 _____ _____	

Explanation of Symbols and Abbreviations

The following defines common symbols and abbreviations used in reporting technical data:

N.D.	none detected	BMQL	Below Minimum Quantitation Level
TNTC	Too Numerous To Count	MPN	Most Probable Number
IU	International Units	CP Units	cobalt-chloroplatinate units
umhos/cm	micromhos/cm	NTU	nephelometric turbidity units
C	degrees Celsius	F	degrees Fahrenheit
meq	milliequivalents	lb.	pound(s)
g	gram(s)	kg	kilogram(s)
ug	microgram(s)	mg	milligram(s)
ml	milliliter(s)	l	liter(s)
m3	cubic meter(s)	ul	microliter(s)
<	less than - The number following the sign is the <u>limit of quantitation</u> , the smallest amount of analyte which can be reliably determined using this specific test.		
>	greater than		
J	estimated value – The result is \geq the Method Detection Limit (MDL) and $<$ the Limit of Quantitation (LOQ).		
ppm	parts per million - One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.		
ppb	parts per billion		
Dry weight basis	Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture. All other results are reported on an as-received basis.		

U.S. EPA CLP Data Qualifiers:

Organic Qualifiers		Inorganic Qualifiers	
A	TIC is a possible aldol-condensation product	B	Value is $<$ CRDL, but \geq IDL
B	Analyte was also detected in the blank	E	Estimated due to interference
C	Pesticide result confirmed by GC/MS	M	Duplicate injection precision not met
D	Compound quantitated on a diluted sample	N	Spike sample not within control limits
E	Concentration exceeds the calibration range of the instrument	S	Method of standard additions (MSA) used for calculation
N	Presumptive evidence of a compound (TICs only)	U	Compound was not detected
P	Concentration difference between primary and confirmation columns $>25\%$	W	Post digestion spike out of control limits
U	Compound was not detected	*	Duplicate analysis not within control limits
X,Y,Z	Defined in case narrative	+	Correlation coefficient for MSA <0.995

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Measurement uncertainty values, as applicable, are available upon request.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

WARRANTY AND LIMITS OF LIABILITY - In accepting analytical work, we warrant the accuracy of test results for the sample as submitted. THE FOREGOING EXPRESS WARRANTY IS EXCLUSIVE AND IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED. WE DISCLAIM ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING A WARRANTY OF FITNESS FOR PARTICULAR PURPOSE AND WARRANTY OF MERCHANTABILITY. IN NO EVENT SHALL LANCASTER LABORATORIES BE LIABLE FOR INDIRECT, SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOSS OF PROFIT OR GOODWILL REGARDLESS OF (A) THE NEGLIGENCE (EITHER SOLE OR CONCURRENT) OF LANCASTER LABORATORIES AND (B) WHETHER LANCASTER LABORATORIES HAS BEEN INFORMED OF THE POSSIBILITY OF SUCH DAMAGES. We accept no legal responsibility for the purposes for which the client uses the test results. No purchase order or other order for work shall be accepted by Lancaster Laboratories which includes any conditions that vary from the Standard Terms and Conditions of Lancaster Laboratories and we hereby object to any conflicting terms contained in any acceptance or order submitted by client.

ANALYTICAL RESULTS

Prepared for:

Langan
500 Hyde Park
Doylestown PA 18901

215-348-7101

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425**SAMPLE GROUP**

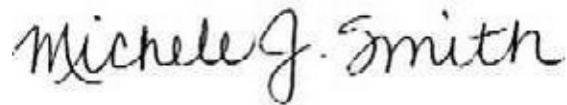
The sample group for this submittal is 942334. Samples arrived at the laboratory on Thursday, May 05, 2005. The PO# for this group is SUNOCO PHILLY REFINER.

Client DescriptionS97-050405 Grab Water Sample
S123-050405 Grab Water Sample
S28-050405 Grab Water Sample
S121-050405 Grab Water Sample**Lancaster Labs Number**4518610
4518611
4518612
4518613ELECTRONIC SUN: Aquaterra Tech.
COPY TO
1 COPY TO LL
1 COPY TO Langan
ELECTRONIC Langan
COPY TOAttn: Brad Spancake

Attn: Angela Miller
Attn: Jason Hanna
Attn: Dennis Webster

Questions? Contact your Client Services Representative
Angela M Miller at (717) 656-2300.

Respectfully Submitted,



Michele J. Smith
Group Leader

Lancaster Laboratories Sample No. WW 4518610

S97-050405 Grab Water Sample
SUN: Philadelphia Refinery AOI-4

Collected: 05/04/2005 12:40 by MBS

Account Number: 10132

Submitted: 05/05/2005 14:30
Reported: 05/17/2005 at 16:18
Discard: 06/17/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-097

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation*	As Received Method Detection Limit	Units	Dilution Factor
06035	Lead	7439-92-1	< 0.0010	0.0010	0.00021	mg/l	1
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	< 0.028	0.028	0.0094	ug/l	1
07805	PAHs in Water by GC/MS						
03947	Naphthalene	91-20-3	110.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	25.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	47.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 50.	50.	5.	ug/l	10
05401	Benzene	71-43-2	600.	50.	5.	ug/l	10
05402	1,2-Dichloroethane	107-06-2	< 50.	50.	10.	ug/l	10
05407	Toluene	108-88-3	< 50.	50.	7.	ug/l	10
05415	Ethylbenzene	100-41-4	63.	50.	8.	ug/l	10
05420	Isopropylbenzene	98-82-8	< 50.	50.	10.	ug/l	10
06310	Xylene (Total)	1330-20-7	230.	50.	8.	ug/l	10

Due to the level of benzene, the reporting limits for all GC/MS volatile compounds were raised.

Commonwealth of Pennsylvania Lab Certification No. 36-037

This sample was filtered in the lab for dissolved metals.

Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/10/2005 23:49	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	05/10/2005 06:41	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/09/2005 13:26	Joseph M Gambler	1
02302	UST-Waters by 8260B	SW-846 8260B	1	05/08/2005 16:40	Jason M Long	10

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4518610**S97-050405 Grab Water Sample****SUN: Philadelphia Refinery AOI-4**

Collected: 05/04/2005 12:40 by MBS

Account Number: 10132

Submitted: 05/05/2005 14:30

Langan

Reported: 05/17/2005 at 16:18

500 Hyde Park

Discard: 06/17/2005

Doylestown PA 18901

S-097

01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/08/2005 16:40	Jason M Long	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/08/2005 19:20	James L Mertz	1
07786	EDB Extraction	SW-846 8011	1	05/09/2005 12:10	Darin P Wagner	1
07807	BNA Water Extraction	SW-846 3510C	1	05/06/2005 21:00	Elia R Botrous	1

Lancaster Laboratories Sample No. WW 4518611

S123-050405 Grab Water Sample
SUN: Philadelphia Refinery AOI-4

Collected: 05/04/2005 12:50 by MBS

Account Number: 10132

Submitted: 05/05/2005 14:30
Reported: 05/17/2005 at 16:18
Discard: 06/17/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-123

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation*	As Received Method Detection Limit	Units	Dilution Factor
06035	Lead	7439-92-1	< 0.0010	0.0010	0.00021	mg/l	1
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	< 0.028	0.028	0.0094	ug/l	1
07805	PAHs in Water by GC/MS						
03947	Naphthalene	91-20-3	26.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	13.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	34.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	8.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	190.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	68.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	10.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	250.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037

This sample was filtered in the lab for dissolved metals.

Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/10/2005 23:53	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	05/10/2005 08:10	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/09/2005 14:18	Joseph M Gambler	1
02302	UST-Waters by 8260B	SW-846 8260B	1	05/08/2005 17:01	Jason M Long	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/08/2005 17:01	Jason M Long	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/08/2005 19:20	James L Mertz	1
07786	EDB Extraction	SW-846 8011	1	05/09/2005 12:10	Darin P Wagner	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4518611

S123-050405 Grab Water Sample

SUN: Philadelphia Refinery AOI-4

Collected: 05/04/2005 12:50 by MBS

Account Number: 10132

Submitted: 05/05/2005 14:30

Langan

Reported: 05/17/2005 at 16:18

500 Hyde Park

Discard: 06/17/2005

Doylestown PA 18901

S-123

07807 BNA Water Extraction

SW-846 3510C

1 05/06/2005 21:00 Elia R Botrous

1

Lancaster Laboratories Sample No. WW 4518612

S28-050405 Grab Water Sample
SUN: Philadelphia Refinery AOI-4

Collected: 05/04/2005 13:15 by MBS

Account Number: 10132

Submitted: 05/05/2005 14:30
Reported: 05/17/2005 at 16:18
Discard: 06/17/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-028

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation*	As Received Method Detection Limit	Units	Dilution Factor
06035	Lead	7439-92-1	< 0.0010	0.0010	0.00021	mg/l	1
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	< 0.029	0.029	0.0095	ug/l	1
07805	PAHs in Water by GC/MS						
03947	Naphthalene	91-20-3	12.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	12.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	26.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	270.	25.	3.	ug/l	5
05401	Benzene	71-43-2	51.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	12.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	6.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	13.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037

This sample was filtered in the lab for dissolved metals.

Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/10/2005 23:57	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	05/10/2005 09:10	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/09/2005 15:10	Joseph M Gambler	1
02302	UST-Waters by 8260B	SW-846 8260B	1	05/08/2005 17:22	Jason M Long	1
02302	UST-Waters by 8260B	SW-846 8260B	1	05/09/2005 20:39	Shawn J Rice	5
01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/08/2005 17:22	Jason M Long	n.a.
01163	GC/MS VOA Water Prep	SW-846 5030B	2	05/09/2005 20:39	Shawn J Rice	n.a.

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4518612

S28-050405 Grab Water Sample

SUN: Philadelphia Refinery AOI-4

Collected: 05/04/2005 13:15 by MBS

Account Number: 10132

Submitted: 05/05/2005 14:30

Langan

Reported: 05/17/2005 at 16:18

500 Hyde Park

Discard: 06/17/2005

Doylestown PA 18901

S-028

06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/08/2005 19:20	James L Mertz	1
07786	EDB Extraction	SW-846 8011	1	05/09/2005 12:10	Darin P Wagner	1
07807	BNA Water Extraction	SW-846 3510C	1	05/06/2005 21:00	Elia R Botrous	1

Lancaster Laboratories Sample No. WW 4518613

S121-050405 Grab Water Sample
SUN: Philadelphia Refinery AOI-4

Collected: 05/04/2005 14:00 by MBS

Account Number: 10132

Submitted: 05/05/2005 14:30
Reported: 05/17/2005 at 16:18
Discard: 06/17/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-121

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation*	As Received Method Detection Limit	Units	Dilution Factor
06035	Lead	7439-92-1	< 0.0010	0.0010	0.00021	mg/l	1
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	< 0.028	0.028	0.0094	ug/l	1
07805	PAHs in Water by GC/MS						
03947	Naphthalene	91-20-3	< 10.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	< 5.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	< 5.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037

This sample was filtered in the lab for dissolved metals.

Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/11/2005 00:01	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	05/10/2005 09:40	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/09/2005 16:03	Joseph M Gambler	1
02302	UST-Waters by 8260B	SW-846 8260B	1	05/08/2005 17:44	Jason M Long	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/08/2005 17:44	Jason M Long	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/08/2005 19:20	James L Mertz	1
07786	EDB Extraction	SW-846 8011	1	05/09/2005 12:10	Darin P Wagner	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4518613

S121-050405 Grab Water Sample

SUN: Philadelphia Refinery AOI-4

Collected: 05/04/2005 14:00 by MBS

Account Number: 10132

Submitted: 05/05/2005 14:30

Langan

Reported: 05/17/2005 at 16:18

500 Hyde Park

Discard: 06/17/2005

Doylestown PA 18901

S-121

07807 BNA Water Extraction

SW-846 3510C

1 05/06/2005 21:00 Elia R Botrous

1

Quality Control Summary

Client Name: Langan

Group Number: 942334

Reported: 05/17/05 at 04:19 PM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

Laboratory Compliance Quality Control

<u>Analysis Name</u>	<u>Blank Result</u>	<u>Blank LOQ**</u>	<u>Blank MDL</u>	<u>Report Units</u>	<u>LCS %REC</u>	<u>LCSD %REC</u>	<u>LCS/LCSD Limits</u>	<u>RPD</u>	<u>RPD Max</u>
Batch number: 05126WAF026	Sample number(s): 4518610-4518613								
Naphthalene	< 10.	10.	1.	ug/l	85	86	58-108	1	30
Fluorene	< 10.	10.	1.	ug/l	87	89	61-116	2	30
Phenanthrene	< 10.	10.	1.	ug/l	95	91	68-111	5	30
Pyrene	< 10.	10.	1.	ug/l	87	86	68-114	1	30
Chrysene	< 10.	10.	1.	ug/l	91	91	70-111	0	30
Batch number: 051280001A	Sample number(s): 4518610-4518613								
Ethylene dibromide	< 0.030	0.030	0.010	ug/l	100	100	60-140	0	20
Batch number: 051286050003A	Sample number(s): 4518610-4518613								
Lead	< 0.0010	0.0010	0.00021	mg/l	98		80-120		
Batch number: P051281AA	Sample number(s): 4518610-4518613								
Methyl Tertiary Butyl Ether	< 5.	5.	0.5	ug/l	91	89	77-127	2	30
Benzene	< 5.	5.	0.5	ug/l	98	97	85-117	1	30
1,2-Dichloroethane	< 5.	5.	1.	ug/l	92	93	77-132	1	30
Toluene	< 5.	5.	0.7	ug/l	95	95	85-115	0	30
Ethylbenzene	< 5.	5.	0.8	ug/l	94	94	82-119	0	30
Isopropylbenzene	< 5.	5.	1.	ug/l	93	94	80-120	1	30
Xylene (Total)	< 5.	5.	0.8	ug/l	94	95	83-113	0	30
Batch number: P051291AB	Sample number(s): 4518612								
Methyl Tertiary Butyl Ether	< 5.	5.	0.5	ug/l	91	89	77-127	2	30

Sample Matrix Quality Control

<u>Analysis Name</u>	<u>MS %REC</u>	<u>MSD %REC</u>	<u>MS/MSD Limits</u>	<u>RPD</u>	<u>BKG Conc</u>	<u>DUP Conc</u>	<u>DUP RPD</u>	<u>Dup RPD Max</u>
Batch number: 051280001A	Sample number(s): 4518610-4518613							
Ethylene dibromide	87		65-135		< 0.028	< 0.028	200* (1)	30
Batch number: 051286050003A	Sample number(s): 4518610-4518613							
Lead	100	98	75-125	2	< 0.0010	< 0.0010	15 (1)	20
Batch number: P051281AA	Sample number(s): 4518610-4518613							
Methyl Tertiary Butyl Ether	96		69-134					
Benzene	110		83-128					
1,2-Dichloroethane	102		73-136					
Toluene	103		83-127					

*- Outside of specification

**-This limit was used in the evaluation of the final result for the blank

(1) The result for one or both determinations was less than five times the LOQ.

(2) The background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan
Reported: 05/17/05 at 04:19 PM

Group Number: 942334

Sample Matrix Quality Control

	MS	MSD	MS/MSD	RPD	BKG	DUP	DUP	Dup RPD
<u>Analysis Name</u>	<u>%REC</u>	<u>%REC</u>	<u>Limits</u>	<u>RPD</u>	<u>MAX</u>	<u>Conc</u>	<u>Conc</u>	<u>Max</u>
Ethylbenzene	99		82-129					
Isopropylbenzene	99		81-130					
Xylene (Total)	100		82-130					

Batch number: P051291AB Sample number(s): 4518612
Methyl Tertiary Butyl Ether 87 69-134

Surrogate Quality Control

Analysis Name: PAHs in Water by GC/MS

Batch number: 05126WAF026

	Nitrobenzene-d5	2-Fluorobiphenyl	Terphenyl-d14
4518610	109	94	83
4518611	113	85	104
4518612	89	83	94
4518613	90	87	90
Blank	89	86	106
LCS	92	88	102
LCSD	91	94	104
Limits:	51-123	64-112	53-135

Analysis Name: EDB in Wastewater

Batch number: 051280001A

	1,1,2,2-Tetrachloroethane
4518610	119
4518611	107
4518612	89
4518613	95
Blank	104
DUP	104
LCS	106
LCSD	104
MS	119
Limits:	52-120

Analysis Name: UST-Waters by 8260B

Batch number: P051281AA

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4518610	92	91	97	96
4518611	100	93	100	101
4518612	92	88	99	96
4518613	98	88	97	95
Blank	96	92	97	93
LCS	93	92	97	94
LCSD	95	92	96	96

*- Outside of specification

** - This limit was used in the evaluation of the final result for the blank

- (1) The result for one or both determinations was less than five times the LOQ.
- (2) The background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan

Group Number: 942334

Reported: 05/17/05 at 04:19 PM

Surrogate Quality Control

MS	100	96	96	95
Limits:	81-120	82-112	85-112	83-113
Analysis Name: 8260 Master Scan (water)				
Batch number: P051291AB				
	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
Blank	93	92	97	94
LCS	95	93	95	96
LCSD	95	94	96	96
MS	95	90	95	96
Limits:	81-120	82-112	85-112	83-113

*- Outside of specification

** - This limit was used in the evaluation of the final result for the blank

- (1) The result for one or both determinations was less than five times the LOQ.
- (2) The background result was more than four times the spike added.



For Lancaster Laboratories use only

Acct. # 10132

Group# 942334 Sample # 4518610-13

COC # 0081524

Please print. Instructions on reverse side correspond with circled numbers. *Color form 3-1-4-100*

[illegible]

Explanation of Symbols and Abbreviations

The following defines common symbols and abbreviations used in reporting technical data:

N.D.	none detected	BMQL	Below Minimum Quantitation Level
TNTC	Too Numerous To Count	MPN	Most Probable Number
IU	International Units	CP Units	cobalt-chloroplatinate units
umhos/cm	micromhos/cm	NTU	nephelometric turbidity units
C	degrees Celsius	F	degrees Fahrenheit
meq	milliequivalents	lb.	pound(s)
g	gram(s)	kg	kilogram(s)
ug	microgram(s)	mg	milligram(s)
ml	milliliter(s)	l	liter(s)
m3	cubic meter(s)	ul	microliter(s)
<	less than - The number following the sign is the <u>limit of quantitation</u> , the smallest amount of analyte which can be reliably determined using this specific test.		
>	greater than		
J	estimated value – The result is \geq the Method Detection Limit (MDL) and $<$ the Limit of Quantitation (LOQ).		
ppm	parts per million - One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.		
ppb	parts per billion		
Dry weight basis	Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture. All other results are reported on an as-received basis.		

U.S. EPA CLP Data Qualifiers:

Organic Qualifiers		Inorganic Qualifiers	
A	TIC is a possible aldol-condensation product	B	Value is $<$ CRDL, but \geq IDL
B	Analyte was also detected in the blank	E	Estimated due to interference
C	Pesticide result confirmed by GC/MS	M	Duplicate injection precision not met
D	Compound quantitated on a diluted sample	N	Spike sample not within control limits
E	Concentration exceeds the calibration range of the instrument	S	Method of standard additions (MSA) used for calculation
N	Presumptive evidence of a compound (TICs only)	U	Compound was not detected
P	Concentration difference between primary and confirmation columns $>25\%$	W	Post digestion spike out of control limits
U	Compound was not detected	*	Duplicate analysis not within control limits
X,Y,Z	Defined in case narrative	+	Correlation coefficient for MSA <0.995

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Measurement uncertainty values, as applicable, are available upon request.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

WARRANTY AND LIMITS OF LIABILITY - In accepting analytical work, we warrant the accuracy of test results for the sample as submitted. THE FOREGOING EXPRESS WARRANTY IS EXCLUSIVE AND IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED. WE DISCLAIM ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING A WARRANTY OF FITNESS FOR PARTICULAR PURPOSE AND WARRANTY OF MERCHANTABILITY. IN NO EVENT SHALL LANCASTER LABORATORIES BE LIABLE FOR INDIRECT, SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOSS OF PROFIT OR GOODWILL REGARDLESS OF (A) THE NEGLIGENCE (EITHER SOLE OR CONCURRENT) OF LANCASTER LABORATORIES AND (B) WHETHER LANCASTER LABORATORIES HAS BEEN INFORMED OF THE POSSIBILITY OF SUCH DAMAGES. We accept no legal responsibility for the purposes for which the client uses the test results. No purchase order or other order for work shall be accepted by Lancaster Laboratories which includes any conditions that vary from the Standard Terms and Conditions of Lancaster Laboratories and we hereby object to any conflicting terms contained in any acceptance or order submitted by client.

ANALYTICAL RESULTS

Prepared for:

Langan
500 Hyde Park
Doylestown PA 18901

215-348-7101

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425**SAMPLE GROUP**

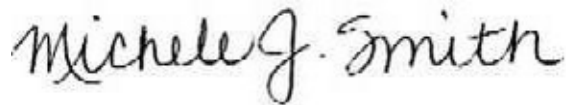
The sample group for this submittal is 942526. Samples arrived at the laboratory on Friday, May 06, 2005.
The PO# for this group is SUNOCO PHILLY REFINER.

Client DescriptionS102-050605 Grab Water Sample
S59D-050605 Grab Water Sample
MW1-050605 Grab Water Sample
MW4-050605 Grab Water Sample**Lancaster Labs Number**4519602
4519603
4519604
4519605ELECTRONIC SUN: Aquaterra Tech.
COPY TO
1 COPY TO LL
1 COPY TO Langan
ELECTRONIC Langan
COPY TOAttn: Brad Spancake

Attn: Angela Miller
Attn: Jason Hanna
Attn: Dennis Webster

Questions? Contact your Client Services Representative
Angela M Miller at (717) 656-2300.

Respectfully Submitted,



Michele J. Smith
Group Leader

Lancaster Laboratories Sample No. WW 4519602

S102-050605 Grab Water Sample
SUN: Philadelphia Refinery AOI-4

Collected: 05/06/2005 10:00 by MBS

Account Number: 10132

Submitted: 05/06/2005 18:40
Reported: 05/17/2005 at 16:24
Discard: 06/17/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-102

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation*	As Received Method Detection Limit	Units	Dilution Factor
06035	Lead	7439-92-1	< 0.0010	0.0010	0.00021	mg/l	1
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	< 0.028	0.028	0.0094	ug/l	1
07805	PAHs in Water by GC/MS						
03947	Naphthalene	91-20-3	< 10.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	< 5.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	< 5.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037

This sample was filtered in the lab for dissolved metals.

Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/13/2005 00:41	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	05/10/2005 10:09	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/10/2005 11:11	Joseph M Gambler	1
02302	UST-Waters by 8260B	SW-846 8260B	1	05/11/2005 11:03	Andrea D Moore	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/11/2005 11:03	Andrea D Moore	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/10/2005 18:15	James L Mertz	1
07786	EDB Extraction	SW-846 8011	1	05/09/2005 12:10	Darin P Wagner	1

*=This limit was used in the evaluation of the final result



Analysis Report

2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 • 717-656-2300 Fax: 717-656-2681 • www.lancasterlabs.com

Page 2 of 2

Lancaster Laboratories Sample No. WW 4519602

S102-050605 Grab Water Sample

SUN: Philadelphia Refinery AOI-4

Collected: 05/06/2005 10:00 by MBS

Account Number: 10132

Submitted: 05/06/2005 18:40

Langan

Reported: 05/17/2005 at 16:24

500 Hyde Park

Discard: 06/17/2005

Doylestown PA 18901

S-102

07807 BNA Water Extraction

SW-846 3510C

1 05/08/2005 10:00 Joseph S Feister

1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4519603

S59D-050605 Grab Water Sample
SUN: Philadelphia Refinery AOI-4

Collected: 05/06/2005 10:30 by MBS

Account Number: 10132

Submitted: 05/06/2005 18:40
Reported: 05/17/2005 at 16:24
Discard: 06/17/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-59D

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation*	As Received Method Detection Limit	Units	Dilution Factor
06035	Lead	7439-92-1	< 0.0010	0.0010	0.00021	mg/l	1
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	< 0.028	0.028	0.0093	ug/l	1
07805	PAHs in Water by GC/MS						
03947	Naphthalene	91-20-3	< 10.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	< 5.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	< 5.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037

This sample was filtered in the lab for dissolved metals.

Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/13/2005 00:45	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	05/10/2005 10:39	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/10/2005 12:03	Joseph M Gambler	1
02302	UST-Waters by 8260B	SW-846 8260B	1	05/11/2005 11:27	Andrea D Moore	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/11/2005 11:27	Andrea D Moore	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/10/2005 18:15	James L Mertz	1
07786	EDB Extraction	SW-846 8011	1	05/09/2005 12:10	Darin P Wagner	1

*=This limit was used in the evaluation of the final result



Analysis Report

2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 • 717-656-2300 Fax: 717-656-2681 • www.lancasterlabs.com

Page 2 of 2

Lancaster Laboratories Sample No. WW 4519603

S59D-050605 Grab Water Sample

SUN: Philadelphia Refinery AOI-4

Collected: 05/06/2005 10:30 by MBS

Account Number: 10132

Submitted: 05/06/2005 18:40

Langan

Reported: 05/17/2005 at 16:24

500 Hyde Park

Discard: 06/17/2005

Doylestown PA 18901

S-59D

07807 BNA Water Extraction

SW-846 3510C

1 05/08/2005 10:00 Joseph S Feister

1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4519604

MW1-050605 Grab Water Sample
SUN: Philadelphia Refinery AOI-4

Collected: 05/06/2005 11:20 by MBS

Account Number: 10132

Submitted: 05/06/2005 18:40
Reported: 05/17/2005 at 16:24
Discard: 06/17/2005

Langan
500 Hyde Park
Doylestown PA 18901

PRM01

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation*	As Received Method Detection Limit	Units	Dilution Factor
06035	Lead	7439-92-1	< 0.0010	0.0010	0.00021	mg/l	1
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	< 0.028	0.028	0.0093	ug/l	1
07805	PAHs in Water by GC/MS						
03947	Naphthalene	91-20-3	32.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	100.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	10.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	19.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	10.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	27.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037

This sample was filtered in the lab for dissolved metals.

Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/13/2005 00:49	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	05/10/2005 11:09	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/10/2005 12:54	Joseph M Gambler	1
02302	UST-Waters by 8260B	SW-846 8260B	1	05/11/2005 11:52	Andrea D Moore	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/11/2005 11:52	Andrea D Moore	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/10/2005 18:15	James L Mertz	1
07786	EDB Extraction	SW-846 8011	1	05/09/2005 12:10	Darin P Wagner	1

*=This limit was used in the evaluation of the final result



Analysis Report

2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 • 717-656-2300 Fax: 717-656-2681 • www.lancasterlabs.com

Page 2 of 2

Lancaster Laboratories Sample No. WW 4519604

MW1-050605 Grab Water Sample

SUN: Philadelphia Refinery AOI-4

Collected: 05/06/2005 11:20 by MBS

Account Number: 10132

Submitted: 05/06/2005 18:40

Langan

Reported: 05/17/2005 at 16:24

500 Hyde Park

Discard: 06/17/2005

Doylestown PA 18901

PRM01

07807 BNA Water Extraction

SW-846 3510C

1 05/08/2005 10:00 Joseph S Feister

1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4519605

MW4-050605 Grab Water Sample
SUN: Philadelphia Refinery AOI-4

Collected: 05/06/2005 11:40 by MBS

Account Number: 10132

Submitted: 05/06/2005 18:40
Reported: 05/17/2005 at 16:24
Discard: 06/17/2005

Langan
500 Hyde Park
Doylestown PA 18901

PRM04

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation*	As Received Method Detection Limit	Units	Dilution Factor
06035	Lead	7439-92-1	< 0.0010	0.0010	0.00021	mg/l	1
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	< 0.028	0.028	0.0094	ug/l	1
07805	PAHs in Water by GC/MS						
03947	Naphthalene	91-20-3	< 10.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	< 5.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	< 5.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037

This sample was filtered in the lab for dissolved metals.

Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/13/2005 00:53	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	05/10/2005 11:38	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/10/2005 13:46	Joseph M Gambler	1
02302	UST-Waters by 8260B	SW-846 8260B	1	05/11/2005 12:17	Andrea D Moore	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/11/2005 12:17	Andrea D Moore	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/10/2005 18:15	James L Mertz	1
07786	EDB Extraction	SW-846 8011	1	05/09/2005 12:10	Darin P Wagner	1

*=This limit was used in the evaluation of the final result



Analysis Report

2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 • 717-656-2300 Fax: 717-656-2681 • www.lancasterlabs.com

Page 2 of 2

Lancaster Laboratories Sample No. WW 4519605

MW4-050605 Grab Water Sample

SUN: Philadelphia Refinery AOI-4

Collected: 05/06/2005 11:40 by MBS

Account Number: 10132

Submitted: 05/06/2005 18:40

Langan

Reported: 05/17/2005 at 16:24

500 Hyde Park

Discard: 06/17/2005

Doylestown PA 18901

PRM04

07807 BNA Water Extraction

SW-846 3510C

1 05/08/2005 10:00 Joseph S Feister

1

*=This limit was used in the evaluation of the final result

Quality Control Summary

Client Name: Langan

Group Number: 942526

Reported: 05/17/05 at 04:24 PM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

Laboratory Compliance Quality Control

<u>Analysis Name</u>	<u>Blank Result</u>	<u>Blank LOQ**</u>	<u>Blank MDL</u>	<u>Report Units</u>	<u>LCS %REC</u>	<u>LCSD %REC</u>	<u>LCS/LCSD Limits</u>	<u>RPD</u>	<u>RPD Max</u>
Batch number: 05126WAH026	Sample number(s): 4519602-4519605								
Naphthalene	< 10.	10.	1.	ug/l	80	83	58-108	3	30
Fluorene	< 10.	10.	1.	ug/l	87	91	61-116	4	30
Phenanthrene	< 10.	10.	1.	ug/l	96	97	68-111	1	30
Pyrene	< 10.	10.	1.	ug/l	98	98	68-114	0	30
Chrysene	< 10.	10.	1.	ug/l	93	93	70-111	0	30
Batch number: 051280001A	Sample number(s): 4519602-4519605								
Ethylene dibromide	< 0.030	0.030	0.010	ug/l	100	100	60-140	0	20
Batch number: 051306050001A	Sample number(s): 4519602-4519605								
Lead	< 0.0010	0.0010	0.00021	mg/l	105		80-120		
Batch number: T051311AA	Sample number(s): 4519602-4519605								
Methyl Tertiary Butyl Ether	< 5.	5.	0.5	ug/l	99	98	77-127	0	30
Benzene	< 5.	5.	0.5	ug/l	111	108	85-117	2	30
1,2-Dichloroethane	< 5.	5.	1.	ug/l	113	111	77-132	1	30
Toluene	< 5.	5.	0.7	ug/l	101	101	85-115	0	30
Ethylbenzene	< 5.	5.	0.8	ug/l	91	90	82-119	1	30
Isopropylbenzene	< 5.	5.	1.	ug/l	91	90	80-120	1	30
Xylene (Total)	< 5.	5.	0.8	ug/l	92	91	83-113	1	30

Sample Matrix Quality Control

<u>Analysis Name</u>	<u>MS %REC</u>	<u>MSD %REC</u>	<u>MS/MSD Limits</u>	<u>RPD</u>	<u>BKG</u>	<u>DUP</u>	<u>DUP</u>	<u>Dup RPD</u>
Batch number: 051280001A	Sample number(s): 4519602-4519605							
Ethylene dibromide	87		65-135		< 0.028	< 0.028	200* (1)	30
Batch number: 051306050001A	Sample number(s): 4519602-4519605							
Lead	106	108	75-125	2	< 0.0010	< 0.0010	10 (1)	20
Batch number: T051311AA	Sample number(s): 4519602-4519605							
Methyl Tertiary Butyl Ether	103		69-134					
Benzene	119		83-128					
1,2-Dichloroethane	119		73-136					
Toluene	108		83-127					
Ethylbenzene	98		82-129					
Isopropylbenzene	97		81-130					
Xylene (Total)	98		82-130					

*- Outside of specification

**-This limit was used in the evaluation of the final result for the blank

(1) The result for one or both determinations was less than five times the LOQ.

(2) The background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan
Reported: 05/17/05 at 04:24 PM

Group Number: 942526

Sample Matrix Quality Control

	MS	MSD	MS/MSD	RPD	BKG	DUP	DUP	Dup
<u>Analysis Name</u>	<u>%REC</u>	<u>%REC</u>	<u>Limits</u>	<u>RPD</u>	<u>MAX</u>	<u>Conc</u>	<u>Conc</u>	<u>RPD</u>
								<u>Max</u>

Surrogate Quality Control

Analysis Name: PAHs in Water by GC/MS
Batch number: 05126WAH026

	Nitrobenzene-d5	2-Fluorobiphenyl	Terphenyl-d14
4519602	96	91	106
4519603	84	83	79
4519604	91	89	111
4519605	90	88	106
Blank	95	83	114
LCS	92	87	114
LCSD	93	88	116
Limits:	51-123	64-112	53-135

Analysis Name: EDB in Wastewater
Batch number: 051280001A

	1,1,2,2-Tetrachloroethane
4519602	101
4519603	91
4519604	108
4519605	100
Blank	104
DUP	104
LCS	106
LCSD	104
MS	119
Limits:	52-120

Analysis Name: UST-Waters by 8260B
Batch number: T051311AA

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4519602	99	91	89	98
4519603	101	89	90	94
4519604	101	89	90	98
4519605	99	88	89	95
Blank	98	89	88	93
LCS	97	88	91	97
LCSD	97	89	91	97
MS	99	89	91	96
Limits:	81-120	82-112	85-112	83-113

*- Outside of specification

** - This limit was used in the evaluation of the final result for the blank

- (1) The result for one or both determinations was less than five times the LOQ.
- (2) The background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan

Group Number: 942526

Reported: 05/17/05 at 04:24 PM

*- Outside of specification

** - This limit was used in the evaluation of the final result for the blank

- (1) The result for one or both determinations was less than five times the LOQ.
- (2) The background result was more than four times the spike added.



Lancaster Laboratories
Where quality is a science.

For Lancaster Laboratories use only

Acct. # 10132

Group#	Sample #
942526	

4519602-05

COC # 0081525

Please print. Instructions on reverse side correspond with circled numbers.

Cooler temp 3.3°C

Client: Sun-Aquatorne / Lanson Acct. #: _____
Project Name: #Sun-Philadelphia Refinery AOT-4 PWSID #: _____
Project Manager: K. Martin / J. Hanna P.O.#: _____
Sampler: M. Brad Spaccake Quote #: _____
Name of state where samples were collected: PA

3	Date	Time	
S102-050605	5/4/05	1000	X
S59D-050605	↓	1030	X
S3MW1-050605	↓	1120	X
MW4-050605	↓	1140	X

8200 BTX, MTBE, cumene
8011 EAB
10020 Dissolved Pb
8270 Fluorene, Phenanthrene, Anthracene, Naphthalene
8270 Fluorene, Phenanthrene, Anthracene, Naphthalene

Rel	Rel	Rel	Rel
<p>Turnaround Time Requested (TAT) (please circle): Normal Rush</p> <p>(Rush TAT is subject to Lancaster Laboratories approval and exchange.)</p> <p>Date results are needed: <u>5 day TAT</u></p> <p>Rush results requested by (please circle): Phone Fax E-mail</p> <p>Phone #: _____ Fax #: _____</p> <p>E-mail address: _____</p>			
<p>Data Package Options (please circle if required)</p> <p>QC Summary Type VI (Raw Data) SDG Complete?</p>		<p>Type I (Tier I) GLP Yes No</p> <p>Type II (Tier II) Other Yes No</p> <p>Type III (NJ Red. Del.) Internal Chain of Custody required? Yes No</p> <p>Type IV (CLP)</p>	

Inquired by	Date	Time	Received
<i>[Signature]</i>	5/14/85	1700	
Inquired by:	Date	Time	Received
<i>[Signature]</i>	5-15-85	1840	
Inquired by:	Date	Time	Received
Inquired by:	Date	Time	Received
Inquired by:	Date	Time	Received

Received by: <i>[Signature]</i>	Date	Time
	Date	Time
Received by: <i>[Signature]</i>	Date	Time
	Date	Time
Received by: <i>[Signature]</i>	Date	Time
	Date	Time
Received by: <i>[Signature]</i>	Date	Time
	Date	Time

Explanation of Symbols and Abbreviations

The following defines common symbols and abbreviations used in reporting technical data:

N.D.	none detected	BMQL	Below Minimum Quantitation Level
TNTC	Too Numerous To Count	MPN	Most Probable Number
IU	International Units	CP Units	cobalt-chloroplatinate units
umhos/cm	micromhos/cm	NTU	nephelometric turbidity units
C	degrees Celsius	F	degrees Fahrenheit
meq	milliequivalents	lb.	pound(s)
g	gram(s)	kg	kilogram(s)
ug	microgram(s)	mg	milligram(s)
ml	milliliter(s)	l	liter(s)
m3	cubic meter(s)	ul	microliter(s)
<	less than - The number following the sign is the <u>limit of quantitation</u> , the smallest amount of analyte which can be reliably determined using this specific test.		
>	greater than		
J	estimated value – The result is \geq the Method Detection Limit (MDL) and $<$ the Limit of Quantitation (LOQ).		
ppm	parts per million - One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.		
ppb	parts per billion		
Dry weight basis	Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture. All other results are reported on an as-received basis.		

U.S. EPA CLP Data Qualifiers:

Organic Qualifiers		Inorganic Qualifiers	
A	TIC is a possible aldol-condensation product	B	Value is $<$ CRDL, but \geq IDL
B	Analyte was also detected in the blank	E	Estimated due to interference
C	Pesticide result confirmed by GC/MS	M	Duplicate injection precision not met
D	Compound quantitated on a diluted sample	N	Spike sample not within control limits
E	Concentration exceeds the calibration range of the instrument	S	Method of standard additions (MSA) used for calculation
N	Presumptive evidence of a compound (TICs only)	U	Compound was not detected
P	Concentration difference between primary and confirmation columns $>25\%$	W	Post digestion spike out of control limits
U	Compound was not detected	*	Duplicate analysis not within control limits
X,Y,Z	Defined in case narrative	+	Correlation coefficient for MSA <0.995

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Measurement uncertainty values, as applicable, are available upon request.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

WARRANTY AND LIMITS OF LIABILITY - In accepting analytical work, we warrant the accuracy of test results for the sample as submitted. THE FOREGOING EXPRESS WARRANTY IS EXCLUSIVE AND IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED. WE DISCLAIM ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING A WARRANTY OF FITNESS FOR PARTICULAR PURPOSE AND WARRANTY OF MERCHANTABILITY. IN NO EVENT SHALL LANCASTER LABORATORIES BE LIABLE FOR INDIRECT, SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOSS OF PROFIT OR GOODWILL REGARDLESS OF (A) THE NEGLIGENCE (EITHER SOLE OR CONCURRENT) OF LANCASTER LABORATORIES AND (B) WHETHER LANCASTER LABORATORIES HAS BEEN INFORMED OF THE POSSIBILITY OF SUCH DAMAGES. We accept no legal responsibility for the purposes for which the client uses the test results. No purchase order or other order for work shall be accepted by Lancaster Laboratories which includes any conditions that vary from the Standard Terms and Conditions of Lancaster Laboratories and we hereby object to any conflicting terms contained in any acceptance or order submitted by client.

ANALYTICAL RESULTS

Prepared for:

Langan
500 Hyde Park
Doylestown PA 18901

215-348-7101

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425**SAMPLE GROUP**

The sample group for this submittal is 953719. Samples arrived at the laboratory on Tuesday, August 02, 2005. The PO# for this group is SUNOCO PHILLY REFINER.

Client DescriptionS-222-080105 Grab Water Sample
S-224-080105 Grab Water Sample
S-223-080105 Grab Water Sample
S96-080105 Grab Water Sample**Lancaster Labs Number**4575232
4575233
4575234
4575235ELECTRONIC SUN: Aquaterra Tech.
COPY TO
1 COPY TO LL
1 COPY TO Langan
ELECTRONIC Langan
COPY TO

Attn: Brad Spancake

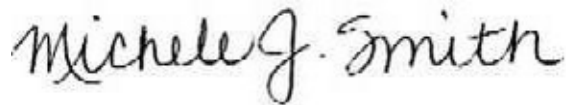
Attn: Angela Miller

Attn: Jason Hanna

Attn: Joseph Catricks

Questions? Contact your Client Services Representative
Angela M Miller at (717) 656-2300

Respectfully Submitted,



Michele J. Smith
Group Leader



Analysis Report

2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 • 717-656-2300 Fax: 717-656-2681 • www.lancasterlabs.com

Page 1 of 2

Lancaster Laboratories Sample No. WW 4575232

S-222-080105 Grab Water Sample
SUN: Philadelphia Refinery AOI-4

Collected: 08/01/2005 09:10 by MBS

Account Number: 10132

Submitted: 08/02/2005 17:10
Reported: 08/08/2005 at 13:36
Discard: 09/08/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-222

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation*	As Received Method Detection Limit	Units	Dilution Factor
06035	Lead	7439-92-1	< 0.0010	0.0010	0.00018	mg/l	1
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	< 0.029	0.029	0.0095	ug/l	1
07805	PAHs in Water by GC/MS						
03947	Naphthalene	91-20-3	< 6.	6.	1.	ug/l	1
03956	Fluorene	86-73-7	< 6.	6.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 6.	6.	1.	ug/l	1
03967	Pyrene	129-00-0	< 6.	6.	1.	ug/l	1
03971	Chrysene	218-01-9	< 6.	6.	1.	ug/l	1
Due to insufficient sample, the reporting limits for the GC/MS semivolatile compounds were raised.							
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	< 5.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	10.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037

This sample was filtered in the lab for dissolved metals.

Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	08/05/2005 20:34	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	08/04/2005 02:52	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	08/04/2005 00:36	Jolene M Graham	1
02302	UST-Waters by 8260B	SW-846 8260B	1	08/04/2005 00:10	Kelly E Brickley	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4575232**S-222-080105 Grab Water Sample****SUN: Philadelphia Refinery AOI-4**

Collected: 08/01/2005 09:10 by MBS

Account Number: 10132

Submitted: 08/02/2005 17:10

Langan

Reported: 08/08/2005 at 13:36

500 Hyde Park

Discard: 09/08/2005

Doylestown PA 18901

S-222

01163	GC/MS VOA Water Prep	SW-846 5030B	1	08/04/2005 00:10	Kelly E Brickley	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	08/04/2005 09:15	Helen L Schaeffer	1
07786	EDB Extraction	SW-846 8011	1	08/03/2005 13:00	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	08/02/2005 18:30	Olivia I Santiago	1

Lancaster Laboratories Sample No. WW 4575233

S-224-080105 Grab Water Sample
SUN: Philadelphia Refinery AOI-4

Collected: 08/01/2005 09:20 by MBS

Account Number: 10132

Submitted: 08/02/2005 17:10
Reported: 08/08/2005 at 13:36
Discard: 09/08/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-224

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation*	As Received Method Detection Limit	Units	Dilution Factor
06035	Lead	7439-92-1	0.0014	0.0010	0.00018	mg/l	1
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	< 0.029	0.029	0.0097	ug/l	1
07805	PAHs in Water by GC/MS						
03947	Naphthalene	91-20-3	100.	5.	1.	ug/l	1
03956	Fluorene	86-73-7	< 5.	5.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 5.	5.	1.	ug/l	1
03967	Pyrene	129-00-0	< 5.	5.	1.	ug/l	1
03971	Chrysene	218-01-9	< 5.	5.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 10.	10.	1.	ug/l	2
05401	Benzene	71-43-2	2,000.	130.	13.	ug/l	25
05402	1,2-Dichloroethane	107-06-2	< 10.	10.	2.	ug/l	2
05407	Toluene	108-88-3	2,800.	130.	18.	ug/l	25
05415	Ethylbenzene	100-41-4	690.	130.	20.	ug/l	25
05420	Isopropylbenzene	98-82-8	44.	10.	2.	ug/l	2
06310	Xylene (Total)	1330-20-7	3,500.	130.	20.	ug/l	25

The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.

Commonwealth of Pennsylvania Lab Certification No. 36-037

This sample was filtered in the lab for dissolved metals.

Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	08/05/2005 20:21	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	08/04/2005 03:52	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	08/04/2005 01:37	Jolene M Graham	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4575233

S-224-080105 Grab Water Sample
SUN: Philadelphia Refinery AOI-4

Collected: 08/01/2005 09:20 by MBS

Account Number: 10132

Submitted: 08/02/2005 17:10
 Reported: 08/08/2005 at 13:36
 Discard: 09/08/2005

Langan
 500 Hyde Park
 Doylestown PA 18901

S-224

02302	UST-Waters by 8260B	SW-846 8260B	1	08/04/2005 00:32	Kelly E Brickley	2
02302	UST-Waters by 8260B	SW-846 8260B	1	08/04/2005 00:55	Kelly E Brickley	25
01163	GC/MS VOA Water Prep	SW-846 5030B	1	08/04/2005 00:32	Kelly E Brickley	n.a.
01163	GC/MS VOA Water Prep	SW-846 5030B	2	08/04/2005 00:55	Kelly E Brickley	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	08/04/2005 09:15	Helen L Schaeffer	1
07786	EDB Extraction	SW-846 8011	1	08/03/2005 13:00	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	08/02/2005 18:30	Olivia I Santiago	1

Lancaster Laboratories Sample No. WW 4575234

S-223-080105 Grab Water Sample
SUN: Philadelphia Refinery AOI-4

Collected: 08/01/2005 09:30 by MBS

Account Number: 10132

Submitted: 08/02/2005 17:10
Reported: 08/08/2005 at 13:36
Discard: 09/08/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-223

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation*	As Received Method Detection Limit	Units	Dilution Factor
06035	Lead	7439-92-1	< 0.0010	0.0010	0.00018	mg/l	1
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	< 0.029	0.029	0.0096	ug/l	1
07805	PAHs in Water by GC/MS						
03947	Naphthalene	91-20-3	430.	26.	5.	ug/l	5
03956	Fluorene	86-73-7	< 5.	5.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 5.	5.	1.	ug/l	1
03967	Pyrene	129-00-0	< 5.	5.	1.	ug/l	1
03971	Chrysene	218-01-9	< 5.	5.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 50.	50.	5.	ug/l	10
05401	Benzene	71-43-2	6,100.	500.	50.	ug/l	100
05402	1,2-Dichloroethane	107-06-2	< 50.	50.	10.	ug/l	10
05407	Toluene	108-88-3	9,600.	500.	70.	ug/l	100
05415	Ethylbenzene	100-41-4	1,300.	50.	8.	ug/l	10
05420	Isopropylbenzene	98-82-8	< 50.	50.	10.	ug/l	10
06310	Xylene (Total)	1330-20-7	6,900.	50.	8.	ug/l	10

The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.

Commonwealth of Pennsylvania Lab Certification No. 36-037

This sample was filtered in the lab for dissolved metals.

Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	08/05/2005 20:37	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	08/04/2005 04:51	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	08/04/2005 02:38	Jolene M Graham	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4575234

S-223-080105 Grab Water Sample
SUN: Philadelphia Refinery AOI-4

Collected: 08/01/2005 09:30 by MBS

Account Number: 10132

Submitted: 08/02/2005 17:10
 Reported: 08/08/2005 at 13:36
 Discard: 09/08/2005

Langan
 500 Hyde Park
 Doylestown PA 18901

S-223

07805	PAHs in Water by GC/MS	SW-846 8270C	1	08/04/2005 11:40	William T Parker	5
02302	UST-Waters by 8260B	SW-846 8260B	1	08/04/2005 01:17	Kelly E Brickley	10
02302	UST-Waters by 8260B	SW-846 8260B	1	08/04/2005 01:39	Kelly E Brickley	100
01163	GC/MS VOA Water Prep	SW-846 5030B	1	08/04/2005 01:17	Kelly E Brickley	n.a.
01163	GC/MS VOA Water Prep	SW-846 5030B	2	08/04/2005 01:39	Kelly E Brickley	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	08/04/2005 09:15	Helen L Schaeffer	1
07786	EDB Extraction	SW-846 8011	1	08/03/2005 13:00	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	08/02/2005 18:30	Olivia I Santiago	1

Lancaster Laboratories Sample No. WW 4575235

S96-080105 Grab Water Sample
SUN: Philadelphia Refinery AOI-4

Collected: 08/01/2005 07:20 by MBS

Account Number: 10132

Submitted: 08/02/2005 17:10
Reported: 08/08/2005 at 13:37
Discard: 09/08/2005

Langan
500 Hyde Park
Doylestown PA 18901

S96--

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation*	As Received Method Detection Limit	Units	Dilution Factor
06035	Lead	7439-92-1	< 0.0010	0.0010	0.00018	mg/l	1
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	< 0.029	0.029	0.0097	ug/l	1
07805	PAHs in Water by GC/MS						
03947	Naphthalene	91-20-3	< 5.	5.	1.	ug/l	1
03956	Fluorene	86-73-7	< 5.	5.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 5.	5.	1.	ug/l	1
03967	Pyrene	129-00-0	< 5.	5.	1.	ug/l	1
03971	Chrysene	218-01-9	< 5.	5.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	< 5.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	< 5.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037

This sample was filtered in the lab for dissolved metals.

Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	08/05/2005 20:44	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	08/04/2005 05:21	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	08/04/2005 03:38	Jolene M Graham	1
02302	UST-Waters by 8260B	SW-846 8260B	1	08/04/2005 02:02	Kelly E Brickley	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	08/04/2005 02:02	Kelly E Brickley	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	08/04/2005 09:15	Helen L Schaeffer	1
07786	EDB Extraction	SW-846 8011	1	08/03/2005 13:00	Deborah M Zimmerman	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4575235

S96-080105 Grab Water Sample

SUN: Philadelphia Refinery AOI-4

Collected: 08/01/2005 07:20 by MBS

Account Number: 10132

Submitted: 08/02/2005 17:10

Langan

Reported: 08/08/2005 at 13:37

500 Hyde Park

Discard: 09/08/2005

Doylestown PA 18901

S96--

07807 BNA Water Extraction

SW-846 3510C

1 08/02/2005 18:30 Olivia I Santiago

1

Quality Control Summary

Client Name: Langan

Group Number: 953719

Reported: 08/08/05 at 01:37 PM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

Laboratory Compliance Quality Control

<u>Analysis Name</u>	<u>Blank Result</u>	<u>Blank LOQ**</u>	<u>Blank MDL</u>	<u>Report Units</u>	<u>LCS %REC</u>	<u>LCSD %REC</u>	<u>LCS/LCSD Limits</u>	<u>RPD</u>	<u>RPD Max</u>
Batch number: 052140034A Ethylene dibromide	Sample number(s): 4575232-4575235 < 0.030	0.030	0.010	ug/l	71	71	60-140	0	20
Batch number: 05214WAE026 Naphthalene	Sample number(s): 4575232-4575235 < 5.	5.	1.	ug/l	91	91	70-102	1	30
Fluorene	< 5.	5.	1.	ug/l	96	96	61-116	0	30
Phenanthrene	< 5.	5.	1.	ug/l	98	93	68-111	5	30
Pyrene	< 5.	5.	1.	ug/l	93	93	68-114	1	30
Chrysene	< 5.	5.	1.	ug/l	93	95	70-111	2	30
Batch number: 052166050001A Lead	Sample number(s): 4575232-4575235 < 0.0010	0.0010	0.00018	mg/l	105		80-120		
Batch number: L052153AA Methyl Tertiary Butyl Ether	Sample number(s): 4575232-4575235 < 5.	5.	0.5	ug/l	93	92	77-127	1	30
Benzene	< 5.	5.	0.5	ug/l	98	95	85-117	3	30
1,2-Dichloroethane	< 5.	5.	1.	ug/l	96	96	77-132	1	30
Toluene	< 5.	5.	0.7	ug/l	103	100	85-115	2	30
Ethylbenzene	< 5.	5.	0.8	ug/l	101	99	82-119	2	30
Isopropylbenzene	< 5.	5.	1.	ug/l	103	100	80-120	3	30
Xylene (Total)	< 5.	5.	0.8	ug/l	104	102	83-113	3	30

Sample Matrix Quality Control

<u>Analysis Name</u>	<u>MS %REC</u>	<u>MSD %REC</u>	<u>MS/MSD Limits</u>	<u>RPD</u>	<u>BKG</u>	<u>DUP</u>	<u>DUP</u>	<u>Dup RPD</u>
Batch number: 052140034A Ethylene dibromide	Sample number(s): 4575232-4575235 100		65-135		< 0.029	< 0.029	0 (1)	30
Batch number: 052166050001A Lead	Sample number(s): 4575232-4575235 103	103	78-120	0 20	0.0014	0.0014	3 (1)	20
Batch number: L052153AA Methyl Tertiary Butyl Ether	Sample number(s): 4575232-4575235 90		69-134					
Benzene	97		83-128					
1,2-Dichloroethane	93		73-136					
Toluene	100		83-127					
Ethylbenzene	100		82-129					
Isopropylbenzene	111		81-130					
Xylene (Total)	103		82-130					

*- Outside of specification

**-This limit was used in the evaluation of the final result for the blank

- (1) The result for one or both determinations was less than five times the LOQ.
- (2) The background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan
Reported: 08/08/05 at 01:37 PM

Group Number: 953719

Sample Matrix Quality Control

	MS	MSD	MS/MSD	RPD	BKG	DUP	DUP	Dup
<u>Analysis Name</u>	<u>%REC</u>	<u>%REC</u>	<u>Limits</u>	<u>RPD</u>	<u>MAX</u>	<u>Conc</u>	<u>Conc</u>	<u>RPD</u>
								<u>Max</u>

Surrogate Quality Control

Analysis Name: EDB in Wastewater
Batch number: 052140034A
1,1,2,2-
Tetrachloroethane

4575232	65
4575233	85
4575234	75
4575235	118
Blank	86
DUP	63
LCS	85
LCSD	85
MS	117

Limits: 52-120

Analysis Name: PAHs in Water by GC/MS
Batch number: 05214WAE026

	Nitrobenzene-d5	2-Fluorobiphenyl	Terphenyl-d14
4575232	76	97	101
4575233	77	100	105
4575234	71	96	106
4575235	75	96	104
Blank	75	93	101
LCS	79	97	103
LCSD	78	101	105

Limits: 51-123 64-112 52-151

Analysis Name: UST-Waters by 8260B
Batch number: L052153AA

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4575232	97	98	91	96
4575233	96	96	96	97
4575234	94	96	92	97
4575235	99	98	88	93
Blank	100	101	89	92
LCS	96	99	94	101
LCSD	97	101	94	102
MS	96	97	94	102

Limits: 81-120 82-112 85-112 83-113

*- Outside of specification

** - This limit was used in the evaluation of the final result for the blank

- (1) The result for one or both determinations was less than five times the LOQ.
- (2) The background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan

Group Number: 953719

Reported: 08/08/05 at 01:37 PM

*- Outside of specification

** - This limit was used in the evaluation of the final result for the blank

- (1) The result for one or both determinations was less than five times the LOQ.
- (2) The background result was more than four times the spike added.

Analysis Request / Environmental Services Chain of Custody



For Lancaster Laboratories use only
 Act. # 1032 Group # 953719 Sample # 4575232-35 **COC #** 0087246

Please print. Instructions on reverse side correspond with circled numbers.

1 Client: <u>Sun. Pinta Aguatepec/Lancaster</u> Acct. #: Project Name: <u>San. Philadelphia Refinery</u> PWSID #: Project Manager: <u>Jason Hanna (Lancaster)</u> P.O. #: Sampler: <u>M. Brad Spence</u> Quote #: Name of state where samples were collected: <u>PA</u>		2 Sample Information Sample ID: <u>S-222-080105</u> Date Collected: <u>8/1/05</u> Time Collected: <u>0910</u> Sample ID: <u>S-224-080105</u> Date Collected: <u>8/1/05</u> Time Collected: <u>0920</u> Sample ID: <u>S-223-080105</u> Date Collected: <u>8/1/05</u> Time Collected: <u>0930</u> Sample ID: <u>S96-080105</u> Date Collected: <u>8/1/05</u> Time Collected: <u>0720</u>		3 Matrix <input checked="" type="checkbox"/> Water <input type="checkbox"/> Soil <input type="checkbox"/> Sediment <input type="checkbox"/> NPDs Applicable <input type="checkbox"/> POCs Applicable		4 Test # of Canisters 8270C Fluorene, Phenanthrene, Naphthalene 8270C Fluorene, Phenanthrene, Naphthalene 8270C Fluorene, Phenanthrene, Naphthalene 8270C Fluorene, Phenanthrene, Naphthalene		5 Analytes Requested 8270C Fluorene, Phenanthrene, Naphthalene 8270C Fluorene, Phenanthrene, Naphthalene 8270C Fluorene, Phenanthrene, Naphthalene 8270C Fluorene, Phenanthrene, Naphthalene		6 Remarks Dissolved Pb samples are unfiltered/unpreserved	
7 Turnaround Time Requested (TAT) (please circle): Normal (Rush) (Rush TAT is subject to Lancaster Laboratories approval and surcharge.) Date results are needed: <u>8/5/05</u> 3 DAY TAT Rush results requested by (please circle): Phone Fax E-mail Phone #: _____ Fax #: _____ E-mail address: <u>j.hanna@Lancaster.Com</u>		Relinquished by: <u>M. Brad Spence</u> Date: <u>8/1/05</u> Time: <u>1200</u> Relinquished by: <u>M. Brad Spence</u> Date: <u>8/2/05</u> Time: <u>1025</u> Relinquished by: <u>M. Brad Spence</u> Date: <u>8/2/05</u> Time: <u>17:00</u> Relinquished by: <u>M. Brad Spence</u> Date: _____ Time: _____ Relinquished by: _____ Date: _____ Time: _____		Received by: <u>Aguatepec Field</u> Date: <u>8/1/05</u> Time: <u>1200</u> Received by: <u>M. Brad Spence</u> Date: <u>8/2/05</u> Time: <u>1025</u> Received by: <u>M. Brad Spence</u> Date: <u>8/2/05</u> Time: <u>17:00</u> Received by: _____ Date: _____ Time: _____ Received by: _____ Date: _____ Time: _____		8 Data Package Options (please circle if required) QC Summary Type VI (Raw Data) SDG Complete? Yes No Type I (Tier I) GLP Site-specific QC required? Yes No Type II (Tier II) Other (If yes, indicate QC sample and submit triplicate volume.) Type III (NJ Red. Del.) Internal Chain of Custody required? Yes (No) Type IV (CLP)					

Explanation of Symbols and Abbreviations

The following defines common symbols and abbreviations used in reporting technical data:

N.D.	none detected	BMQL	Below Minimum Quantitation Level
TNTC	Too Numerous To Count	MPN	Most Probable Number
IU	International Units	CP Units	cobalt-chloroplatinate units
umhos/cm	micromhos/cm	NTU	nephelometric turbidity units
C	degrees Celsius	F	degrees Fahrenheit
meq	milliequivalents	lb.	pound(s)
g	gram(s)	kg	kilogram(s)
ug	microgram(s)	mg	milligram(s)
ml	milliliter(s)	l	liter(s)
m3	cubic meter(s)	ul	microliter(s)
<	less than - The number following the sign is the <u>limit of quantitation</u> , the smallest amount of analyte which can be reliably determined using this specific test.		
>	greater than		
J	estimated value – The result is \geq the Method Detection Limit (MDL) and $<$ the Limit of Quantitation (LOQ).		
ppm	parts per million - One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.		
ppb	parts per billion		
Dry weight basis	Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture. All other results are reported on an as-received basis.		

U.S. EPA CLP Data Qualifiers:

Organic Qualifiers		Inorganic Qualifiers	
A	TIC is a possible aldol-condensation product	B	Value is $<$ CRDL, but \geq IDL
B	Analyte was also detected in the blank	E	Estimated due to interference
C	Pesticide result confirmed by GC/MS	M	Duplicate injection precision not met
D	Compound quantitated on a diluted sample	N	Spike sample not within control limits
E	Concentration exceeds the calibration range of the instrument	S	Method of standard additions (MSA) used for calculation
N	Presumptive evidence of a compound (TICs only)	U	Compound was not detected
P	Concentration difference between primary and confirmation columns $>25\%$	W	Post digestion spike out of control limits
U	Compound was not detected	*	Duplicate analysis not within control limits
X,Y,Z	Defined in case narrative	+	Correlation coefficient for MSA <0.995

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Measurement uncertainty values, as applicable, are available upon request.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

WARRANTY AND LIMITS OF LIABILITY - In accepting analytical work, we warrant the accuracy of test results for the sample as submitted. THE FOREGOING EXPRESS WARRANTY IS EXCLUSIVE AND IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED. WE DISCLAIM ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING A WARRANTY OF FITNESS FOR PARTICULAR PURPOSE AND WARRANTY OF MERCHANTABILITY. IN NO EVENT SHALL LANCASTER LABORATORIES BE LIABLE FOR INDIRECT, SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOSS OF PROFIT OR GOODWILL REGARDLESS OF (A) THE NEGLIGENCE (EITHER SOLE OR CONCURRENT) OF LANCASTER LABORATORIES AND (B) WHETHER LANCASTER LABORATORIES HAS BEEN INFORMED OF THE POSSIBILITY OF SUCH DAMAGES. We accept no legal responsibility for the purposes for which the client uses the test results. No purchase order or other order for work shall be accepted by Lancaster Laboratories which includes any conditions that vary from the Standard Terms and Conditions of Lancaster Laboratories and we hereby object to any conflicting terms contained in any acceptance or order submitted by client.

ANALYTICAL RESULTS

Prepared for:

Langan
500 Hyde Park
Doylestown PA 18901

215-348-7101

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425**SAMPLE GROUP**

The sample group for this submittal is 954311. Samples arrived at the laboratory on Friday, August 05, 2005. The PO# for this group is SUNOCO PHILLY REFINER.

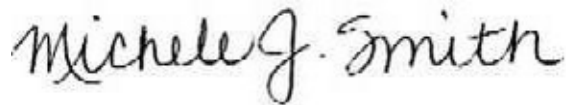
Client DescriptionBH-S222-080405-1-1.5 Grab Soil Sample
BH-S223-080405-1.5-2 Grab Soil Sample
BH-S224-080405-1-1.5 Grab Soil Sample**Lancaster Labs Number**4578229
4578230
4578231ELECTRONIC SUN: Aquaterra Tech.
COPY TO
1 COPY TO Langan
ELECTRONIC Langan
COPY TO

Attn: Brad Spancake

Attn: Jason Hanna
Attn: Joseph Catricks

Questions? Contact your Client Services Representative
Angela M Miller at (717) 656-2300

Respectfully Submitted,



Michele J. Smith
Group Leader

Lancaster Laboratories Sample No. SW 4578229

BH-S222-080405-1-1.5 Grab Soil Sample

SUN: Philadelphia Refinery AOI-4

Collected: 08/04/2005 10:45 by MBS

Account Number: 10132

Submitted: 08/05/2005 14:50

Langan

Reported: 08/11/2005 at 08:48

500 Hyde Park

Discard: 09/11/2005

Doylestown PA 18901

BH222

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Limit of Quantitation*	Dry Method Detection Limit	Units	Dilution Factor
06955	Lead	7439-92-1	143.	2.21	0.862	mg/kg	1
00111	Moisture	n.a.	13.0	0.50	0.50	%	1
"Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis.							
07804	PAHs in Soil by GC/MS						
01195	Pyrene	129-00-0	< 190.	190.	38.	ug/kg	1
03761	Naphthalene	91-20-3	< 190.	190.	38.	ug/kg	1
03768	Fluorene	86-73-7	< 190.	190.	38.	ug/kg	1
03775	Phenanthrene	85-01-8	< 190.	190.	38.	ug/kg	1
03776	Anthracene	120-12-7	< 190.	190.	38.	ug/kg	1
03781	Benzo(a)anthracene	56-55-3	< 190.	190.	38.	ug/kg	1
03782	Chrysene	218-01-9	< 190.	190.	38.	ug/kg	1
03786	Benzo(b)fluoranthene	205-99-2	< 190.	190.	38.	ug/kg	1
03788	Benzo(a)pyrene	50-32-8	< 190.	190.	38.	ug/kg	1
03791	Benzo(g,h,i)perylene	191-24-2	< 190.	190.	38.	ug/kg	1
02308	UST-Soils by 8260B						
02016	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/kg	0.89
05460	Benzene	71-43-2	< 5.	5.	0.5	ug/kg	0.89
05461	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/kg	0.89
05466	Toluene	108-88-3	< 5.	5.	1.	ug/kg	0.89
05471	1,2-Dibromoethane	106-93-4	< 5.	5.	1.	ug/kg	0.89
05474	Ethylbenzene	100-41-4	< 5.	5.	1.	ug/kg	0.89
05479	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/kg	0.89
06301	Xylene (Total)	1330-20-7	< 5.	5.	1.	ug/kg	0.89

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06955	Lead	SW-846 6010B	1	08/09/2005 10:37	Eric L Eby	1
00111	Moisture	EPA 160.3 modified	1	08/08/2005 17:14	Scott W Freisher	1
07804	PAHs in Soil by GC/MS	SW-846 8270C	1	08/08/2005 09:26	Chad A Moline	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. SW 4578229

BH-S222-080405-1-1.5 Grab Soil Sample

SUN: Philadelphia Refinery AOI-4

Collected: 08/04/2005 10:45 by MBS

Account Number: 10132

Submitted: 08/05/2005 14:50

Langan

Reported: 08/11/2005 at 08:48

500 Hyde Park

Discard: 09/11/2005

Doylestown PA 18901

BH222

02308	UST-Soils by 8260B	SW-846 8260B	1	08/08/2005 20:20	Kenneth L Boley Jr	0.89
05708	SW SW846 ICP Digest	SW-846 3050B	1	08/08/2005 16:00	Mirit S Shenouda	1
07806	BNA Soil Extraction	SW-846 3550B	1	08/05/2005 20:00	Maryan G Attalla	1
08389	GC/MS - LL Encore Prep	SW-846 5035	1	08/05/2005 17:10	Medina A Long	n.a.
08389	GC/MS - LL Encore Prep	SW-846 5035	2	08/05/2005 17:11	Medina A Long	n.a.
08389	GC/MS - LL Encore Prep	SW-846 5035	3	08/05/2005 17:12	Medina A Long	n.a.

Lancaster Laboratories Sample No. SW 4578230

BH-S223-080405-1.5-2 Grab Soil Sample
SUN: Philadelphia Refinery AOI-4

Collected: 08/04/2005 11:00 by MBS

Account Number: 10132

Submitted: 08/05/2005 14:50
Reported: 08/11/2005 at 08:48
Discard: 09/11/2005

Langan
500 Hyde Park
Doylestown PA 18901

BH223

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Limit of Quantitation*	Dry Method Detection Limit	Units	Dilution Factor
06955	Lead	7439-92-1	18.2	2.73	1.07	mg/kg	1
00111	Moisture	n.a.	28.3	0.50	0.50	%	1
"Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis.							
07804	PAHs in Soil by GC/MS						
01195	Pyrene	129-00-0	< 230.	230.	46.	ug/kg	1
03761	Naphthalene	91-20-3	< 230.	230.	46.	ug/kg	1
03768	Fluorene	86-73-7	< 230.	230.	46.	ug/kg	1
03775	Phenanthrene	85-01-8	< 230.	230.	46.	ug/kg	1
03776	Anthracene	120-12-7	< 230.	230.	46.	ug/kg	1
03781	Benzo(a)anthracene	56-55-3	< 230.	230.	46.	ug/kg	1
03782	Chrysene	218-01-9	< 230.	230.	46.	ug/kg	1
03786	Benzo(b)fluoranthene	205-99-2	< 230.	230.	46.	ug/kg	1
03788	Benzo(a)pyrene	50-32-8	< 230.	230.	46.	ug/kg	1
03791	Benzo(g,h,i)perylene	191-24-2	< 230.	230.	46.	ug/kg	1
02308	UST-Soils by 8260B						
02016	Methyl Tertiary Butyl Ether	1634-04-4	< 6.	6.	0.6	ug/kg	0.86
05460	Benzene	71-43-2	< 6.	6.	0.6	ug/kg	0.86
05461	1,2-Dichloroethane	107-06-2	< 6.	6.	1.	ug/kg	0.86
05466	Toluene	108-88-3	< 6.	6.	1.	ug/kg	0.86
05471	1,2-Dibromoethane	106-93-4	< 6.	6.	1.	ug/kg	0.86
05474	Ethylbenzene	100-41-4	< 6.	6.	1.	ug/kg	0.86
05479	Isopropylbenzene	98-82-8	< 6.	6.	1.	ug/kg	0.86
06301	Xylene (Total)	1330-20-7	< 6.	6.	1.	ug/kg	0.86

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06955	Lead	SW-846 6010B	1	08/09/2005 10:55	Eric L Eby	1
00111	Moisture	EPA 160.3 modified	1	08/08/2005 17:14	Scott W Freisher	1
07804	PAHs in Soil by GC/MS	SW-846 8270C	1	08/08/2005 09:47	Chad A Moline	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. SW 4578230

BH-S223-080405-1.5-2 Grab Soil Sample

SUN: Philadelphia Refinery AOI-4

Collected: 08/04/2005 11:00 by MBS

Account Number: 10132

Submitted: 08/05/2005 14:50

Langan

Reported: 08/11/2005 at 08:48

500 Hyde Park

Discard: 09/11/2005

Doylestown PA 18901

BH223

02308	UST-Soils by 8260B	SW-846 8260B	1	08/08/2005 19:34	Kenneth L Boley Jr	0.86
05708	SW SW846 ICP Digest	SW-846 3050B	1	08/08/2005 16:00	Mirit S Shenouda	1
07806	BNA Soil Extraction	SW-846 3550B	1	08/05/2005 20:00	Maryan G Attalla	1
08389	GC/MS - LL Encore Prep	SW-846 5035	1	08/05/2005 17:13	Medina A Long	n.a.
08389	GC/MS - LL Encore Prep	SW-846 5035	2	08/05/2005 17:14	Medina A Long	n.a.
08389	GC/MS - LL Encore Prep	SW-846 5035	3	08/05/2005 17:15	Medina A Long	n.a.

Lancaster Laboratories Sample No. SW 4578231
BH-S224-080405-1-1.5 Grab Soil Sample
SUN: Philadelphia Refinery AOI-4

Collected: 08/04/2005 11:25 by MBS

Account Number: 10132

Submitted: 08/05/2005 14:50

Langan

Reported: 08/11/2005 at 08:48

500 Hyde Park

Discard: 09/11/2005

Doylestown PA 18901

BH224

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Limit of Quantitation*	Dry Method Detection Limit	Units	Dilution Factor
06955	Lead	7439-92-1	192.	2.24	0.872	mg/kg	1
00111	Moisture	n.a.	12.3	0.50	0.50	%	1
"Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis.							
07804	PAHs in Soil by GC/MS						
01195	Pyrene	129-00-0	900.	190.	38.	ug/kg	1
03761	Naphthalene	91-20-3	< 190.	190.	38.	ug/kg	1
03768	Fluorene	86-73-7	< 190.	190.	38.	ug/kg	1
03775	Phenanthrene	85-01-8	300.	190.	38.	ug/kg	1
03776	Anthracene	120-12-7	< 190.	190.	38.	ug/kg	1
03781	Benzo(a)anthracene	56-55-3	490.	190.	38.	ug/kg	1
03782	Chrysene	218-01-9	490.	190.	38.	ug/kg	1
03786	Benzo(b)fluoranthene	205-99-2	700.	190.	38.	ug/kg	1
03788	Benzo(a)pyrene	50-32-8	550.	190.	38.	ug/kg	1
03791	Benzo(g,h,i)perylene	191-24-2	430.	190.	38.	ug/kg	1
02308	UST-Soils by 8260B						
02016	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/kg	0.85
05460	Benzene	71-43-2	< 5.	5.	0.5	ug/kg	0.85
05461	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/kg	0.85
05466	Toluene	108-88-3	< 5.	5.	1.	ug/kg	0.85
05471	1,2-Dibromoethane	106-93-4	< 5.	5.	1.	ug/kg	0.85
05474	Ethylbenzene	100-41-4	< 5.	5.	1.	ug/kg	0.85
05479	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/kg	0.85
06301	Xylene (Total)	1330-20-7	< 5.	5.	1.	ug/kg	0.85
The GC/MS volatile internal standard peak areas were outside the QC limits for both the initial analysis and the re-analysis. The values reported here are from the initial analysis of the sample.							

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Analysis Trial#	Date and Time	Analyst	Dilution Factor
---------	---------------	--------	-----------------	---------------	---------	-----------------

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. SW 4578231

BH-S224-080405-1-1.5 Grab Soil Sample

SUN: Philadelphia Refinery AOI-4

Collected: 08/04/2005 11:25 by MBS

Account Number: 10132

Submitted: 08/05/2005 14:50

Langan

Reported: 08/11/2005 at 08:48

500 Hyde Park

Discard: 09/11/2005

Doylestown PA 18901

BH224

06955	Lead	SW-846 6010B	1	08/09/2005 11:01	Eric L Eby	1
00111	Moisture	EPA 160.3 modified	2	08/09/2005 18:47	Scott W Freisher	1
07804	PAHs in Soil by GC/MS	SW-846 8270C	1	08/08/2005 10:08	Chad A Moline	1
02308	UST-Soils by 8260B	SW-846 8260B	1	08/09/2005 00:57	Kenneth L Boley Jr	0.85
05708	SW SW846 ICP Digest	SW-846 3050B	1	08/08/2005 16:00	Mirit S Shenouda	1
07806	BNA Soil Extraction	SW-846 3550B	1	08/05/2005 20:00	Maryan G Attalla	1
08389	GC/MS - LL Encore Prep	SW-846 5035	1	08/05/2005 17:16	Medina A Long	n.a.
08389	GC/MS - LL Encore Prep	SW-846 5035	2	08/05/2005 17:17	Medina A Long	n.a.
08389	GC/MS - LL Encore Prep	SW-846 5035	3	08/05/2005 17:18	Medina A Long	n.a.

Quality Control Summary

Client Name: Langan

Group Number: 954311

Reported: 08/11/05 at 08:48 AM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

Laboratory Compliance Quality Control

<u>Analysis Name</u>	<u>Blank Result</u>	<u>Blank LOQ**</u>	<u>Blank MDL</u>	<u>Report Units</u>	<u>LCS %REC</u>	<u>LCSD %REC</u>	<u>LCS/LCSD Limits</u>	<u>RPD</u>	<u>RPD Max</u>
Batch number: 05217SLD026	Sample number(s): 4578229-4578231								
Pyrene	< 170.	170.	33.	ug/kg	113		67-116		
Naphthalene	< 170.	170.	33.	ug/kg	90		70-103		
Fluorene	< 170.	170.	33.	ug/kg	93		66-115		
Phenanthrene	< 170.	170.	33.	ug/kg	102		70-107		
Anthracene	< 170.	170.	33.	ug/kg	97		69-109		
Benzo(a)anthracene	< 170.	170.	33.	ug/kg	101		73-111		
Chrysene	< 170.	170.	33.	ug/kg	95		72-110		
Benzo(b)fluoranthene	< 170.	170.	33.	ug/kg	90		68-117		
Benzo(a)pyrene	< 170.	170.	33.	ug/kg	101		72-117		
Benzo(g,h,i)perylene	< 170.	170.	33.	ug/kg	103		66-120		
Batch number: 052205708001	Sample number(s): 4578229-4578231								
Lead	< 2.00	2.00	0.780	mg/kg	93		80-120		
Batch number: 05220820001B	Sample number(s): 4578229-4578230								
Moisture					100		99-101		
Batch number: 05221820001A	Sample number(s): 4578231								
Moisture					100		99-101		
Batch number: X052201AA	Sample number(s): 4578229-4578231								
Methyl Tertiary Butyl Ether	< 5.	5.	0.5	ug/kg	88	84	75-125	4	30
Benzene	< 5.	5.	0.5	ug/kg	103	98	77-119	5	30
1,2-Dichloroethane	< 5.	5.	1.	ug/kg	90	87	76-126	3	30
Toluene	< 5.	5.	1.	ug/kg	101	98	81-116	3	30
1,2-Dibromoethane	< 5.	5.	1.	ug/kg	92	87	77-114	5	30
Ethylbenzene	< 5.	5.	1.	ug/kg	97	93	82-115	4	30
Isopropylbenzene	< 5.	5.	1.	ug/kg	94	89	79-117	5	30
Xylene (Total)	< 5.	5.	1.	ug/kg	96	92	82-117	4	30

Sample Matrix Quality Control

<u>Analysis Name</u>	<u>MS %REC</u>	<u>MSD %REC</u>	<u>MS/MSD Limits</u>	<u>RPD</u>	<u>BKG</u>	<u>DUP</u>	<u>DUP</u>	<u>Dup RPD</u>
	<u>MAX</u>	<u>Conc</u>	<u>Conc</u>	<u>MAX</u>	<u>Conc</u>	<u>Conc</u>	<u>RPD</u>	<u>Max</u>
Batch number: 05217SLD026	Sample number(s): 4578229-4578231							
Pyrene	100	100	25-159	1	30			
Naphthalene	80	84	54-121	5	30			
Fluorene	85	92	48-130	8	30			
Phenanthrene	94	98	28-155	4	30			

*- Outside of specification

**-This limit was used in the evaluation of the final result for the blank

- (1) The result for one or both determinations was less than five times the LOQ.
- (2) The background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan

Group Number: 954311

Reported: 08/11/05 at 08:48 AM

Sample Matrix Quality Control

	MS	MSD	MS/MSD	RPD	BKG	DUP	DUP	Dup RPD
<u>Analysis Name</u>	<u>%REC</u>	<u>%REC</u>	<u>Limits</u>	<u>RPD</u>	<u>MAX</u>	<u>Conc</u>	<u>Conc</u>	<u>Max</u>
Anthracene	93	96	47-135	3	30			
Benzo(a)anthracene	96	96	39-144	0	30			
Chrysene	91	92	38-144	1	30			
Benzo(b)fluoranthene	91	91	24-155	0	30			
Benzo(a)pyrene	98	97	38-142	0	30			
Benzo(g,h,i)perylene	99	96	32-150	3	30			
Batch number: 052205708001	Sample number(s): 4578229-4578231							
Lead	91	108	80-120	11	20	30.7	26.2	16
Batch number: 05220820001B	Sample number(s): 4578229-4578230							
Moisture						26.8	15.4	54*
Batch number: 05221820001A	Sample number(s): 4578231							
Moisture						12.3	13.8	12
Batch number: X052201AA	Sample number(s): 4578229-4578231							
Methyl Tertiary Butyl Ether	99		49-140					
Benzene	95		67-123					
1,2-Dichloroethane	82		62-130					
Toluene	84		55-125					
1,2-Dibromoethane	78		62-116					
Ethylbenzene	77		50-127					
Isopropylbenzene	72		48-124					
Xylene (Total)	75		54-123					

Surrogate Quality Control

Analysis Name: PAHs in Soil by GC/MS

Batch number: 05217SLD026

	Nitrobenzene-d5	2-Fluorobiphenyl	Terphenyl-d14
4578229	81	85	110
4578230	81	89	113
4578231	88	103	113
Blank	92	102	108
LCS	88	96	117
MS	82	93	105
MSD	81	92	105
Limits:	47-128	55-123	51-158

Analysis Name: UST-Soils by 8260B

Batch number: X052201AA

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4578229	86	84	94	81
4578230	84	83	91	85
4578231	84	81	98	75
Blank	83	82	90	86
LCS	85	83	90	85

*- Outside of specification

**-This limit was used in the evaluation of the final result for the blank

- (1) The result for one or both determinations was less than five times the LOQ.
- (2) The background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan

Group Number: 954311

Reported: 08/11/05 at 08:48 AM

Surrogate Quality Control

LCSD	84	82	90	84
MS	85	84	91	85
Limits:	70-129	70-121	70-130	70-128

*- Outside of specification

**-This limit was used in the evaluation of the final result for the blank

- (1) The result for one or both determinations was less than five times the LOQ.
- (2) The background result was more than four times the spike added.



Lancaster Laboratories
Where quality is a science.

For Lancaster Laboratories use only

Acct. # 10132

Group#

Sample # 4578229-31

COC # 0093020

Please print. Instructions on reverse side correspond with circled numbers.

Client: San-Aguatuna/Langen Acct. #: _____
Project Name/# San-Philippine Preliminary Acc-4 PWSID #: _____
Project Manager: Jason Hanna P.O.#: _____
Sampler: M. Brad Spence Quote #: _____
Name of state where samples were collected: PA

Date Collected	Time Collected	Grab
		3

[illegible]

Turnaround Time Requested (TAT) (please circle): Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed: 8/9/05 3 DAY TAT
Rush results requested by (please circle): Phone Fax E-mail
Phone #: _____ **Fax #:** _____
E-mail address: _____

Data Package Options (please circle if required)		SDG Complete?
QC Summary	Type VI (Raw Data)	
Type I (Tier I)	GLP	Yes <input checked="" type="radio"/> No <input type="radio"/>
Type II (Tier II)	Other	Yes <input checked="" type="radio"/> No <input type="radio"/>
Type III (NJ Red. Del.)		(If yes, indicate QC sample and submit triplicate volume.)
Type IV (GLP)		Internal Chain of Custody required? Yes <input checked="" type="radio"/> No <input type="radio"/>

Soil	Location / Depth	Other	Total # of Containers
			4
			5
			6

For Lab Use Only

FSC: _____

SCR #: _____

Remarks

to Moist
Phenanthrene, Pyrene
Chrysene, Naphthalene,
Benz(a)fluoranthene,
Dibenz(a,h)pyrene
Benzo(g,h,i)perylene.
Benzo(a)anthracene
870 Anthracene
Total Lead 6010B
8200B PAHs, EDC, FDB

[illegible]

Disinquired by:	Date	Time	Received by:	Date	Time
M. Broad	8/14/05	1330	Aquatic Fridge	8/14/05	1330
M. Broad	8/15/05	1310	Emma Chellman	8/15/05	1310
Emma Chellman	8/15/05	1450			
Emma Chellman					

Explanation of Symbols and Abbreviations

The following defines common symbols and abbreviations used in reporting technical data:

N.D.	none detected	BMQL	Below Minimum Quantitation Level
TNTC	Too Numerous To Count	MPN	Most Probable Number
IU	International Units	CP Units	cobalt-chloroplatinate units
umhos/cm	micromhos/cm	NTU	nephelometric turbidity units
C	degrees Celsius	F	degrees Fahrenheit
meq	milliequivalents	lb.	pound(s)
g	gram(s)	kg	kilogram(s)
ug	microgram(s)	mg	milligram(s)
ml	milliliter(s)	l	liter(s)
m3	cubic meter(s)	ul	microliter(s)
<	less than - The number following the sign is the <u>limit of quantitation</u> , the smallest amount of analyte which can be reliably determined using this specific test.		
>	greater than		
J	estimated value – The result is \geq the Method Detection Limit (MDL) and $<$ the Limit of Quantitation (LOQ).		
ppm	parts per million - One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.		
ppb	parts per billion		
Dry weight basis	Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture. All other results are reported on an as-received basis.		

U.S. EPA CLP Data Qualifiers:

Organic Qualifiers		Inorganic Qualifiers	
A	TIC is a possible aldol-condensation product	B	Value is $<$ CRDL, but \geq IDL
B	Analyte was also detected in the blank	E	Estimated due to interference
C	Pesticide result confirmed by GC/MS	M	Duplicate injection precision not met
D	Compound quantitated on a diluted sample	N	Spike sample not within control limits
E	Concentration exceeds the calibration range of the instrument	S	Method of standard additions (MSA) used for calculation
N	Presumptive evidence of a compound (TICs only)	U	Compound was not detected
P	Concentration difference between primary and confirmation columns $>25\%$	W	Post digestion spike out of control limits
U	Compound was not detected	*	Duplicate analysis not within control limits
X,Y,Z	Defined in case narrative	+	Correlation coefficient for MSA <0.995

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Measurement uncertainty values, as applicable, are available upon request.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

WARRANTY AND LIMITS OF LIABILITY - In accepting analytical work, we warrant the accuracy of test results for the sample as submitted. THE FOREGOING EXPRESS WARRANTY IS EXCLUSIVE AND IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED. WE DISCLAIM ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING A WARRANTY OF FITNESS FOR PARTICULAR PURPOSE AND WARRANTY OF MERCHANTABILITY. IN NO EVENT SHALL LANCASTER LABORATORIES BE LIABLE FOR INDIRECT, SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOSS OF PROFIT OR GOODWILL REGARDLESS OF (A) THE NEGLIGENCE (EITHER SOLE OR CONCURRENT) OF LANCASTER LABORATORIES AND (B) WHETHER LANCASTER LABORATORIES HAS BEEN INFORMED OF THE POSSIBILITY OF SUCH DAMAGES. We accept no legal responsibility for the purposes for which the client uses the test results. No purchase order or other order for work shall be accepted by Lancaster Laboratories which includes any conditions that vary from the Standard Terms and Conditions of Lancaster Laboratories and we hereby object to any conflicting terms contained in any acceptance or order submitted by client.

APPENDIX D

FIELD SAMPLING REPORTS

Appendix D - Field Sampling Reports

AOI-4

Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania



WELL IDENTIFICATION	SAMPLE DATE	DEPTH TO WATER (feet)	DEPTH TO BOTTOM (feet)	WATER COLUMN (feet)	CONVERSION FACTOR	GALLONS IN WELL	PURGE VOLUME (Gallons)
MW1	6-May-05	15.08	20	4.92	0.04	0.2	0.6
MW4	6-May-05	6.10	16	9.9	0.04	0.4	1.2
S102	6-May-05	17.67	20	2.33	0.65	1.5	4.5
S119	3-May-05	25.85	37	11.15	0.65	7.2	21.7
S120	3-May-05	18.07	30	11.93	0.65	7.8	23.3
S121	4-May-05	20.28	30	9.72	0.65	6.3	19.0
S122	3-May-05	23.88	34.6	10.72	0.65	7.0	20.9
S123	4-May-05	20.48	30	9.52	0.65	6.2	18.6
S26	2-May-05	18.92	24	5.08	0.16	0.8	2.4
S27	2-May-05	23.01	34.75	11.74	0.16	1.9	5.6
S28	4-May-05	22.67	25	2.33	0.16	0.4	1.1 (Purged 0.75 gallons, went dry)
S31	2-May-05	16.12	25	8.88	0.16	1.4	4.3 (Purged 2 gallons, went dry)
S38	3-May-05	17.30	23.2	5.9	0.16	0.9	2.8
S38D	3-May-05	18.15	130	111.85	0.16	17.9	53.7
S38I	3-May-05	18.68	80	61.32	0.16	9.8	29.4
S39	3-May-05	21.06	34	12.94	0.37	4.8	14.4
S40	3-May-05	22.27	28	5.73	0.16	0.9	2.8
S96	1-Aug-05	19.51	23	3.49	0.16	0.6	1.7 (Purged 0.5 gallons, went dry)
S97	4-May-05	27.98	35	7.02	0.65	4.6	13.7
S216	28-Apr-05	14.56	29	14.44	0.65	9.4	28.2
S218	28-Apr-05	24.09	33	8.91	0.65	5.8	17.4
S219	28-Apr-05	24.09	30	5.91	0.65	3.8	11.5
S222	1-Aug-05	16.79	28	11.21	0.65	7.3	21.9
S223	1-Aug-05	15.62	30	14.38	0.65	9.3	28.0
S224	1-Aug-05	15.80	32	16.2	0.65	10.5	31.6
S225	28-Apr-05	15.27	30	14.73	0.65	9.6	28.7
S229	28-Apr-05	22.70	33	10.3	0.65	6.7	20.1
S-119D	3-May-05	14.26	74	59.74	0.16	9.6	28.7
S59D	6-May-05	16.54	58	41.46	0.16	6.6	19.9

APPENDIX E

LNAPL SAMPLING ANALYTICAL DATA AND MODELING PROCEDURES

APPENDIX E
LNAPL SAMPLING ANALYTICAL DATA AND MODELING PROCEDURES
AOI 4: SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

E.0 LNAPL DISTRIBUTION AND MOBILITY ASSESSEMNT

LNAPL distribution and mobility characterization field activities discussed in this appendix and the Site Characterization Report were performed by Aquaterra during April 2005. The gauging of groundwater elevations and LNAPL thicknesses was performed by Handex during May 9 - 11, 2005.

E.1 LNAPL CHARACTERIZATION RESULTS

LNAPL characterization was performed on samples collected from six monitoring well locations in AOI 4 during April 2005. The characterization analyses were performed by Torkelson Geochemistry of Texas. Characterization results from eight samples previously collected in AOI 4 to support LNAPL volume and mobility calculations in the 2004 Current Conditions Report were incorporated into the LNAPL modeling completed for the AOI 4. The characterization data for these samples are summarized in Table E1. Chromatographic results indicate that three different types or mixtures of LNAPL were identified in AOI 4. The LNAPL types include middle distillate, middle distillate/light-end feedstocks and gasoline/middle distillate. The chromatograms can be found near the end of this Appendix. These classifications are summarized in Table E1 and generally on Figures 8 and 9. The most prevalent LNAPL type in a mixture, however, was used in the LNAPL modeling.

E.2 ANALYTICAL PROGRAM AND LNAPL MODELING PROCEDURE

Groundwater and LNAPL samples from S-34 and S-198 were collected for physical properties analysis including:

- Interfacial/surface tension,
- Viscosity,
- Specific gravity, and
- Density.

The physical properties of LNAPL and groundwater were entered into the API model as summarized in Table E2. Any location with LNAPL that has not been analyzed for fluid properties has been assigned values from the API database based upon LNAPL type present or by proximity to other locations with LNAPL data. The site-specific data, when compared to API database values, were found to be conservative in representing site conditions. The API model was then used to calculate the specific volume of LNAPL in the formation surrounding each well. These values are summarized in Table 7.

The API model also calculates relative permeability of LNAPL. Using site-specific viscosity values or surrogate values from the API or Environment Canada databases, the seepage velocity of LNAPL was then computed (Table E3) and the values are summarized in Table 7. The seepage velocity at which LNAPL flows is a strong indication of the mobility and recoverability of LNAPL from the subsurface.

E.3 APPARENT LNAPL THICKNESS

The apparent LNAPL thickness is the measured thickness of LNAPL at each monitoring well location. The maximum detected LNAPL thickness on site during the week of May 9 – 11, 2005 was observed in S-30 (an active LNAPL recovery well) at 7.15 feet. S-30 is located in the center of AOI 4 near S-29. Monitoring well S-29 was observed to have an apparent LNAPL thickness of 6.36 feet. Eight additional monitoring wells in AOI 4 contained detectable amounts of LNAPL greater than 0.10 feet but less than 1 foot in thickness. Two wells in AOI 4 had detectable

amounts of LNAPL greater 0.01 feet but less than 0.1 feet. Five wells have apparent thicknesses of 0.01 feet which is used to represent a sheen for API modeling purposes.

E.4 LNAPL SPECIFIC VOLUME

The specific volume is the amount of LNAPL in the surrounding formation, after taking into account soil and LNAPL properties (Table E1). The maximum calculated LNAPL specific volume in AOI 4 is found at S-30 at 2.51 feet. Monitoring well S-29 has a calculated specific volume of 2.20 feet. Three monitoring wells, S-33, S-34, and S-35 have specific volumes calculated to be 0.020 feet, 0.010 feet, and 0.011 feet, respectively. The remaining 12 locations with detectable LNAPL have specific volumes calculated to be less than one tenth of a foot in thickness.

E.5 LNAPL MOBILITY

A LNAPL seepage velocity was calculated for each monitoring well having a measurable thickness of LNAPL (Table 4). A hydraulic gradient of 0.0035 feet/feet was used; this gradient is the same as that used in the current fate and transport calculations. Calculated seepage velocities range from a minimum of 1.02×10^{-17} cm/sec at S-56 to a maximum of 8.42×10^{-6} cm/sec at S-30. LNAPL was considered to be mobile if its seepage velocity exceeds 1×10^{-7} cm/sec. Wells with LNAPL with seepage velocities which exceed this 1×10^{-7} cm/sec value are located at the center and western side of AOI 4 as shown in Figure 11.

TABLES

TABLE E1
LNAPL CHARACTERIZATION RESULTS SUMMARY
AOI 4: SUNOCO PHILADELPHIA REFINERY

Characterization Results Compiled for Current Conditions Report Interpretation of Product Type(s), Proportions and Weathering					
Well ID	Density (gm/ml @ 60°F)	LNAPL Type(s)	Torkleson LNAPL Type(s)	Proportions	Weathering
S-103	0.7978	Gasoline Middle Distillate	Avation Gasoline Middle Distillate	70 30	Extreme Extreme
S-104	0.8787	Middle Distillate	Middle Distillate	100	Extreme
S-124	0.8223	Light End Feed Stock Middle Distillate	Coker Naphtha Middle Distillate	40 60	High Moderate
S-29	0.8550	Middle Distillate	Middle Distillate	100	High
S-32	0.8665	Middle Distillate	Middle Distillate	100	Severely
S-33	0.8578	Gasoline Middle Distillate	Gasoline Middle Distillate	5 95	Extreme Extreme
S-56	0.8684	Gasoline Middle Distillate	Gasoline Middle Distillate	2 98	Extreme Extreme
S-97	0.8653	Middle Distillate	Middle Distillate	100	Severely
Characterization Results Compiled for AOI 4 Site Characterization Interpretation of Product Type(s), Proportions and Weathering					
Well ID	Density (gm/ml @ 60°F)	LNAPL Type(s)	Torkleson LNAPL Type(s)	Proportions	Weathering
S-35	0.8665	Middle Distillate	Middle Distillate	100	Extreme
S-37	0.8639	Gasoline Middle Distillate	Gasoline Middle Distillate	2 98	Unknown High
S-57	0.8620	Middle Distillate	Middle Distillate	100	Extreme
S-217	QNS	Gasoline and Light End Feed Stock Middle Distillate	Gasoline and Heavy Virgin Naptha Middle Distillate	61 39	Slight Slight
S-220	QNS	Gasoline and Light End Feed Stock Middle Distillate	Gasoline and Heavy Virgin Naptha Middle Distillate	70 30	Moderate High
S-221	QNS	Gasoline and Light End Feed Stock Middle Distillate	Gasoline and Heavy Virgin Naptha Middle Distillate	67 33	Slight Slight

Notes:

1. Characterization Data Provided by Torkelson Geochemistry of Tulsa, OK
2. QNS = Quantity Not Sufficient for Density Determination

Table E2
Input Data For American Petroleum Institute's van Genuchten - Mualem Model of LNAPL Distribution and Relative Permeability
AOI 4: Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Monitoring Point ID	LNAPL Density (g/ml @ 60°F)	LNAPL Thickness ³ (ft)	API Database					LNAPL Type or Source of Surrogate LNAPL Type (Torkelson Geochemistry)	API or Environment Canada Database		
	Density ^{1,2}		Porosity Well ID (unitless)	USCS Soil Type Surrounding Well Screen ⁴	van Genuchten "N" (unitless)	van Genuchten "a" (ft ⁻¹)	Irreducible Water Saturation (unitless)		Air/Water Surface Tension ⁴ (dynes/cm)	Air/LNAPL Surface Tension (dynes/cm)	LNAPL/Water Surface Tension (dynes/cm)
S-103	0.7978	0.18	0.426	SP	1.98	1.3500	0.321	Aviation Gasoline/Middle Distillate Mixture	65	23.84	12.11
S-124	0.8223	0.33	0.426	SP	1.98	1.3500	0.321	Coker Naphtha/Middile Distillate Mixture	65	26.9	22.3
S-217	0.8578	0.01	0.443	SW	3.26	2.8700	0.114	Gasoline/Middle Distillate Mixture	65.7	23.3	14.4
S-220	0.8550	0.08	0.426	SP	1.98	1.3500	0.321	Gasoline/Middle Distillate Mixture	65.7	23.3	14.4
S-221	0.8223	0.01	0.443	SW	3.26	2.8700	0.114	Gasoline/Middle Distillate Mixture	65.7	23.3	14.4
S-104	0.8787	0.50	0.426	SP	1.98	1.3500	0.321	Middle Distillate	57.7	28.6	16.6
S-29	0.8550	6.36	0.443	SW	3.26	2.8700	0.114	Middle Distillate	57.7	28.6	16.6
S-30	0.8550	7.15	0.443	SW	3.26	2.8700	0.114	Middle Distillate	57.7	28.6	16.6
S-32	0.8665	0.01	0.426	SP	1.98	1.3500	0.321	Middle Distillate	57.7	28.6	16.6
S-33	0.8578	0.85	0.426	SP	1.98	1.3500	0.321	Middle Distillate	57.7	28.6	16.6
S-34	0.8578	0.66	0.426	SP	1.98	1.3500	0.321	Middle Distillate	57.7	28.6	16.6
S-35	0.8665	0.68	0.426	SP	1.98	1.3500	0.321	Middle Distillate	57.7	28.6	16.6
S-36	0.8578	0.05	0.426	SP	1.98	1.3500	0.321	Middle Distillate	57.7	28.6	16.6
S-37	0.8639	0.12	0.426	SP	1.98	1.3500	0.321	Middle Distillate	57.7	28.6	16.6
S-56*	0.8684	0.01	0.443	SW	3.26	2.8700	0.114	Middle Distillate	57.7	28.6	16.6
S-57	0.8620	0.38	0.426	SP	1.98	1.3500	0.321	Middle Distillate	57.7	28.6	16.6
S-97*	0.8653	0.01	0.443	SW	3.26	2.8700	0.114	Middle Distillate	57.7	28.6	16.6

Notes:
1. Density values were determined from LNAPL samples taken by Aquaterra on February 27th and March 1st, 2004, or from samples collected by SECOR in 1999-2000.
2. For wells with no direct density measurements, the density value in the nearest well with a direct density was used.
3. Depth to Water and Depth to LNAPL provided by Handex May 9th-11th, 2005.
4. Determined from soil boring log. If a soil boring log was not available, the soil type in the nearest well with a soil boring log was used.
5. Determined by Torkelson Geochemistry. If a well with LNAPL present that was not fingerprinted, the LNAPL type in the nearest monitoring well that has been fingerprinted was used.
* Sufficeint quantity of LNAPL obtained for fingerprinting, but insufficient for LNAPL thickness measurement, therefore a value of 0.01 ft was assigned.

API = American Petroleum Institute
AOI = Area of Interest
USCS = Unified Soil Classification System
g/ml = grams per milliliter
LNAPL = Light Non-Aqueous Phase Liquid
amsl = above mean sea level

USCS Soil Descriptions (API Database)
SW = Well Graded Sand, Gravelly Sand
SP = Sand

Interfacial/Surface Tension Data Source	American Petroleum Institute LNAPL Parameters Database, 2003
Aviation Gasoline/Middle Distillate Mixture	Coker naphtha/middle distillate mixture from Environment Canada Database
Coker Naphtha/Middle Distillate Mixture	Middle distillate from S-34 (PTS Geolab Data, 2005)
Gasoline/Middle Distillate Mixture	Gasoline/middle distiallate mixture from S-198 (PTS Geolab Data, 2005)
Middle Distillate	

Table E3
LNAPL Seepage Velocity Parameter Input Table
AOI 4: Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Well Number	LNAPL Type or Source of Surrogate LNAPL Type	Effective Porosity of Soil	Porosity of Soil	Groundwater Density @ 70F (kg/m³)	Groundwater Kinematic Viscosity @70F (centistokes)	Groundwater Kinematic Viscosity @70F (m²/sec)	Groundwater Dynamic Viscosity @70F (N-s/m²)	Soil Permeability (m²)	Kro	Groundwater Gradient	Kinematic Viscosity of SPL (centistokes)	Kinematic Viscosity of SPL (m²/sec)	Dynamic Viscosity of SPL (N-s/m²)	SPL Density (kg/m3)	NAPL K @ 100% Saturation (m/day)	Corrected NAPL K (m/day)	NAPL Specific Discharge (m/day)	Final NAPL Seepage Velocity (ft/d)
	Torkelson Geochemistry	API Database	API Database	Literature Value or PTS	Literature Value or PTS	Calculated	Calculated	API Database	API Model	Groundwater Contour Map	PTS or Literature Value	Calculated	Calculated	PTS	Calculated	Calculated	Calculated	Calculated
S-103	Aviation Gasoline/Middle Distillate Mixture	0.426	SP	1000	1.000	1.000E-06	0.001	3.34E-12	0.006	0.0035	1.0000	1.000E-06	7.98E-04	797.8	2.831	1.670E-02	5.85E-05	4.50E-04
S-124	Coker Naphtha/Middle Distillate Mixture	0.426	SP	1000	1.000	1.000E-06	0.001	3.34E-12	0.003	0.0035	1.0000	1.000E-06	8.22E-04	822.3	2.831	7.449E-03	2.61E-05	2.01E-04
S-217	Gasoline/Middle Distillate Mixture	0.443	SW	998.3	1.070	1.070E-06	0.001	6.02E-12	8.74E-12	0.0035	1.0500	1.050E-06	9.01E-04	857.8	4.859	4.248E-11	1.49E-13	1.10E-12
S-220	Gasoline/Middle Distillate Mixture	0.426	SP	998.3	1.070	1.070E-06	0.001	6.02E-12	7.62E-04	0.0035	1.0500	1.050E-06	8.98E-04	855.0	4.859	3.704E-03	1.30E-05	9.99E-05
S-221	Gasoline/Middle Distillate Mixture	0.443	SW	998.3	1.070	1.070E-06	0.001	6.02E-12	5.59E-11	0.0035	1.0500	1.050E-06	8.63E-04	822.3	4.859	2.717E-10	9.51E-13	7.04E-12
S-104	Middle Distillate	0.426	SP	999.4	0.997	9.970E-07	0.001	3.34E-12	0.005	0.0035	4.4800	4.480E-06	3.94E-03	878.7	0.632	2.884E-03	1.01E-05	7.77E-05
S-29	Middle Distillate	0.443	SW	999.4	0.997	9.970E-07	0.001	6.02E-12	0.791	0.0035	4.4800	4.480E-06	3.83E-03	855.0	1.139	9.014E-01	3.15E-03	2.34E-02
S-30	Middle Distillate	0.443	SW	999.4	0.997	9.970E-07	0.001	6.02E-12	0.808	0.0035	4.4800	4.480E-06	3.83E-03	855.0	1.139	9.199E-01	3.22E-03	2.38E-02
S-32	Middle Distillate	0.426	SP	999.4	0.997	9.970E-07	0.001	3.34E-12	6.81E-08	0.0035	4.4800	4.480E-06	3.88E-03	866.5	0.632	4.306E-08	1.51E-10	1.16E-09
S-33	Middle Distillate	0.426	SP	999.4	0.997	9.970E-07	0.001	3.34E-12	0.029	0.0035	4.4800	4.480E-06	3.84E-03	857.8	0.632	1.828E-02	6.40E-05	4.93E-04
S-34	Middle Distillate	0.426	SP	999.4	0.997	9.970E-07	0.001	6.02E-12	0.016	0.0035	4.4800	4.480E-06	3.84E-03	857.8	1.139	1.778E-02	6.22E-05	4.79E-04
S-35	Middle Distillate	0.426	SP	999.4	0.997	9.970E-07	0.001	6.02E-12	0.014	0.0035	4.4800	4.480E-06	3.88E-03	866.5	1.139	1.595E-02	5.58E-05	4.30E-04
S-36	Middle Distillate	0.426	SP	999.4	0.997	9.970E-07	0.001	6.02E-12	9.44E-06	0.0035	4.4800	4.480E-06	3.84E-03	857.8	1.139	1.075E-05	3.76E-08	2.90E-07
S-37	Middle Distillate	0.426	SP	999.4	0.997	9.970E-07	0.001	3.34E-12	1.28E-04	0.0035	4.4800	4.480E-06	3.87E-03	863.9	0.632	8.112E-05	2.84E-07	2.19E-06
S-56	Middle Distillate	0.443	SW	999.4	0.997	9.970E-07	0.001	6.02E-12	9.79E-13	0.0035	4.4800	4.480E-06	3.89E-03	868.4	1.139	1.116E-12	3.90E-15	2.89E-14
S-57	Middle Distillate	0.426	SP	999.4	0.997	9.970E-07	0.001	3.34E-12	0.004	0.0035	4.4800	4.480E-06	3.86E-03	862.0	0.632	2.253E-03	7.89E-06	6.07E-05
S-97	Middle Distillate	0.443	SW	999.4	0.997	9.970E-07	0.001	6.02E-12	1.18E-12	0.0035	4.4800	4.480E-06	3.88E-03	865.3	1.139	1.339E-12	4.69E-15	3.47E-14

NOTES:
(1) arithmetic average of all values report by PTS from Shelby-tube sample analysis
kg/m³ = kilogram per cubic meter
m²/sec = square meters per secon
N-s/m² = Newton-seconds per square meter
m = meter
m/d = meter per day
ft/d = feet per day

LNAPL CHARACTERIZATION LABORATORY DATA

Acct. #: _____ Sample #: _____

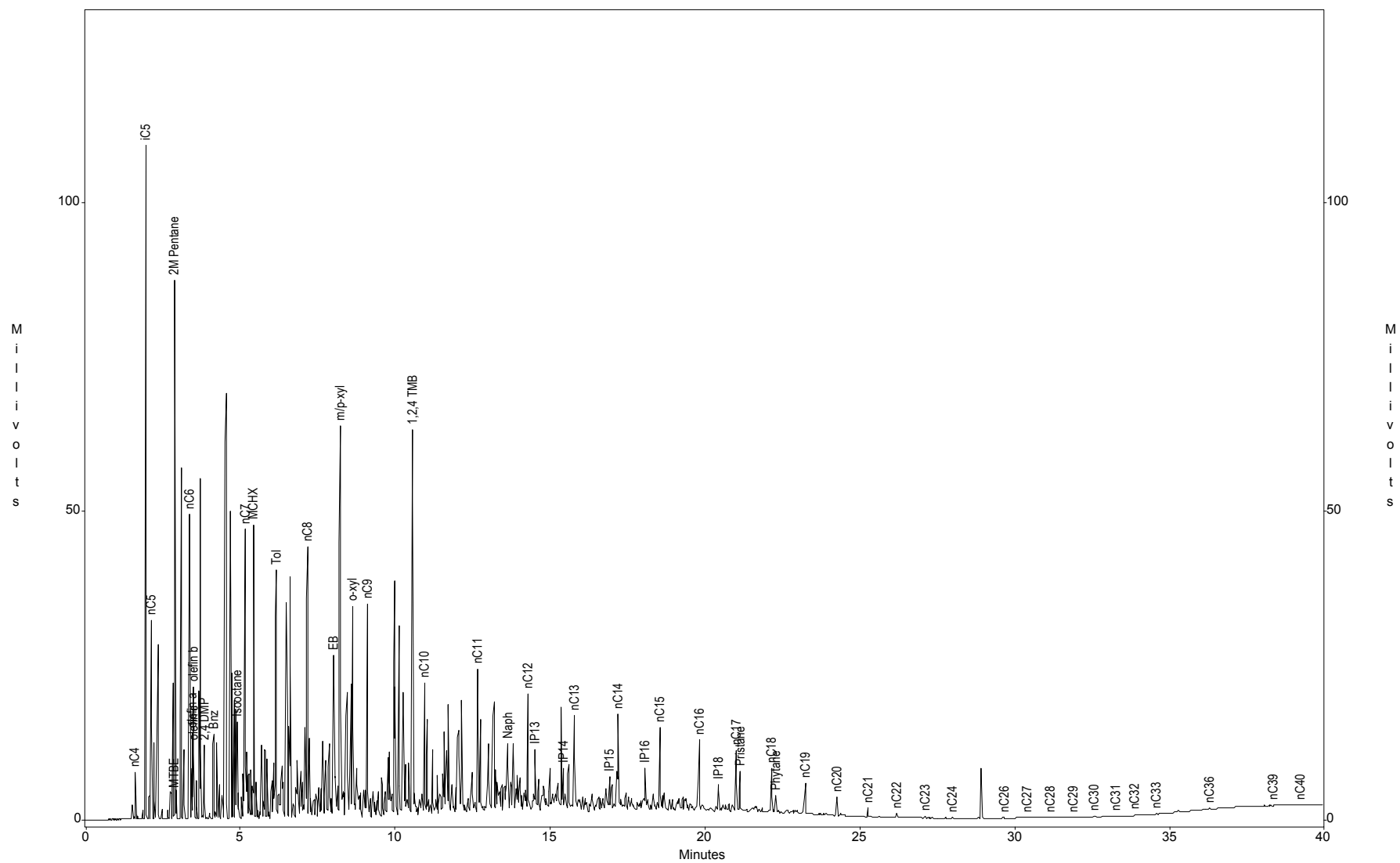
[illegible]

Sun - Philly Refinery AOI-4

Sample ID : S217-LNAPL-042705

Acquired : May 02, 2005 16:08:36

c:\ezchrom\chrom\05056\s217 -- Channel A

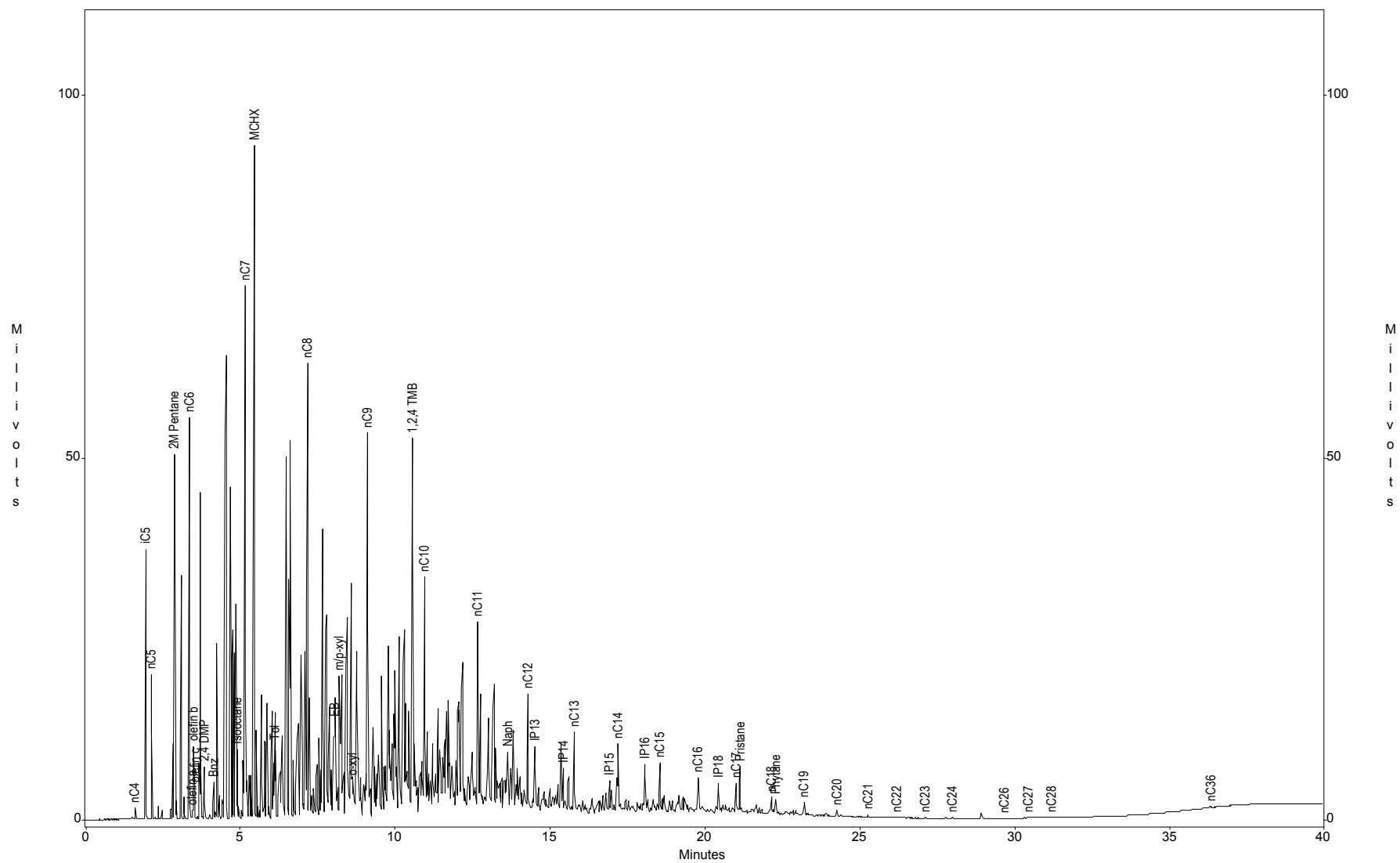


Sun - Philly Refinery AOI-4

Sample ID : S220-LNAPL-042705

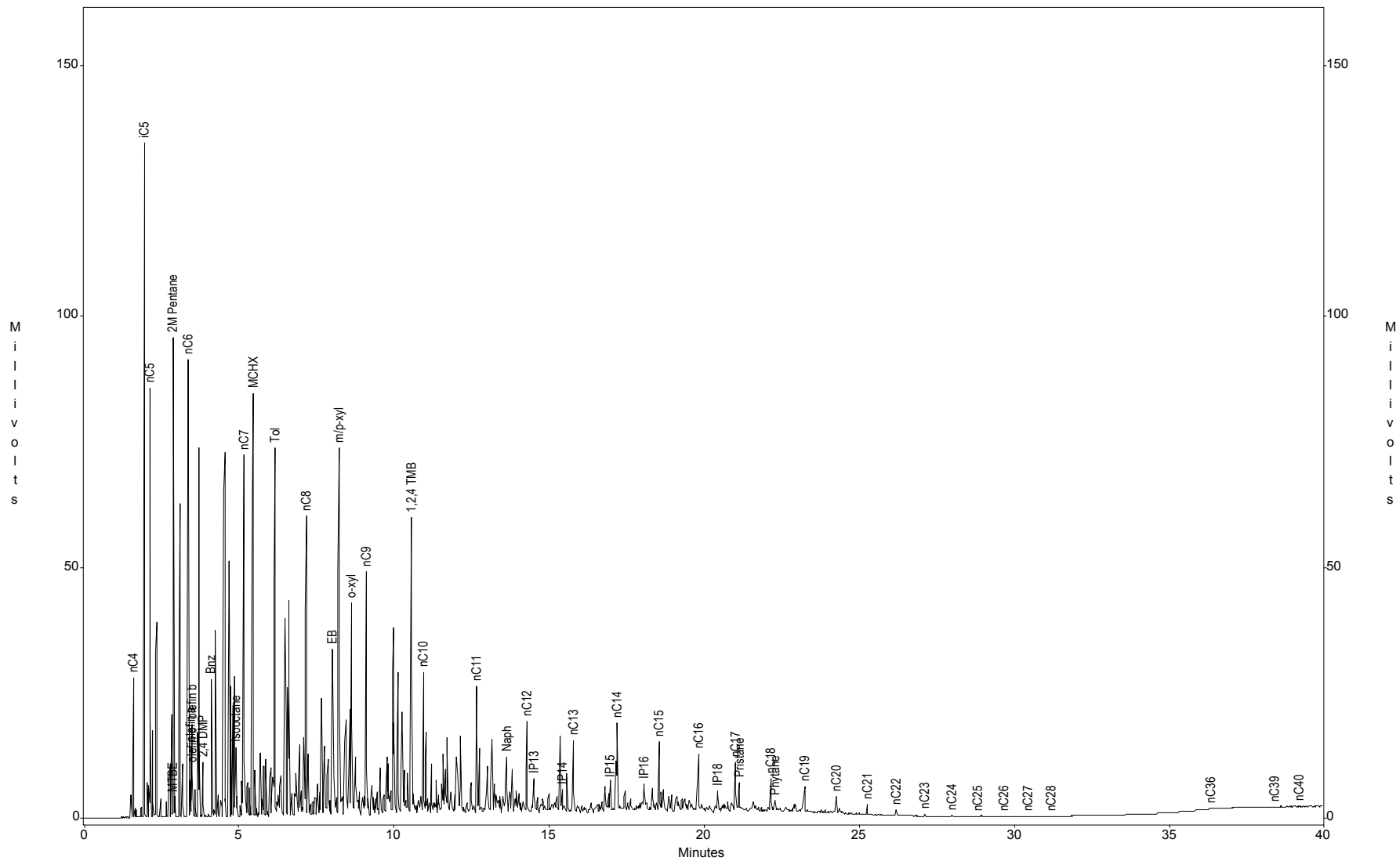
Acquired : May 02, 2005 16:57:29

c:\ezchrom\chrom\05056\s220 -- Channel A



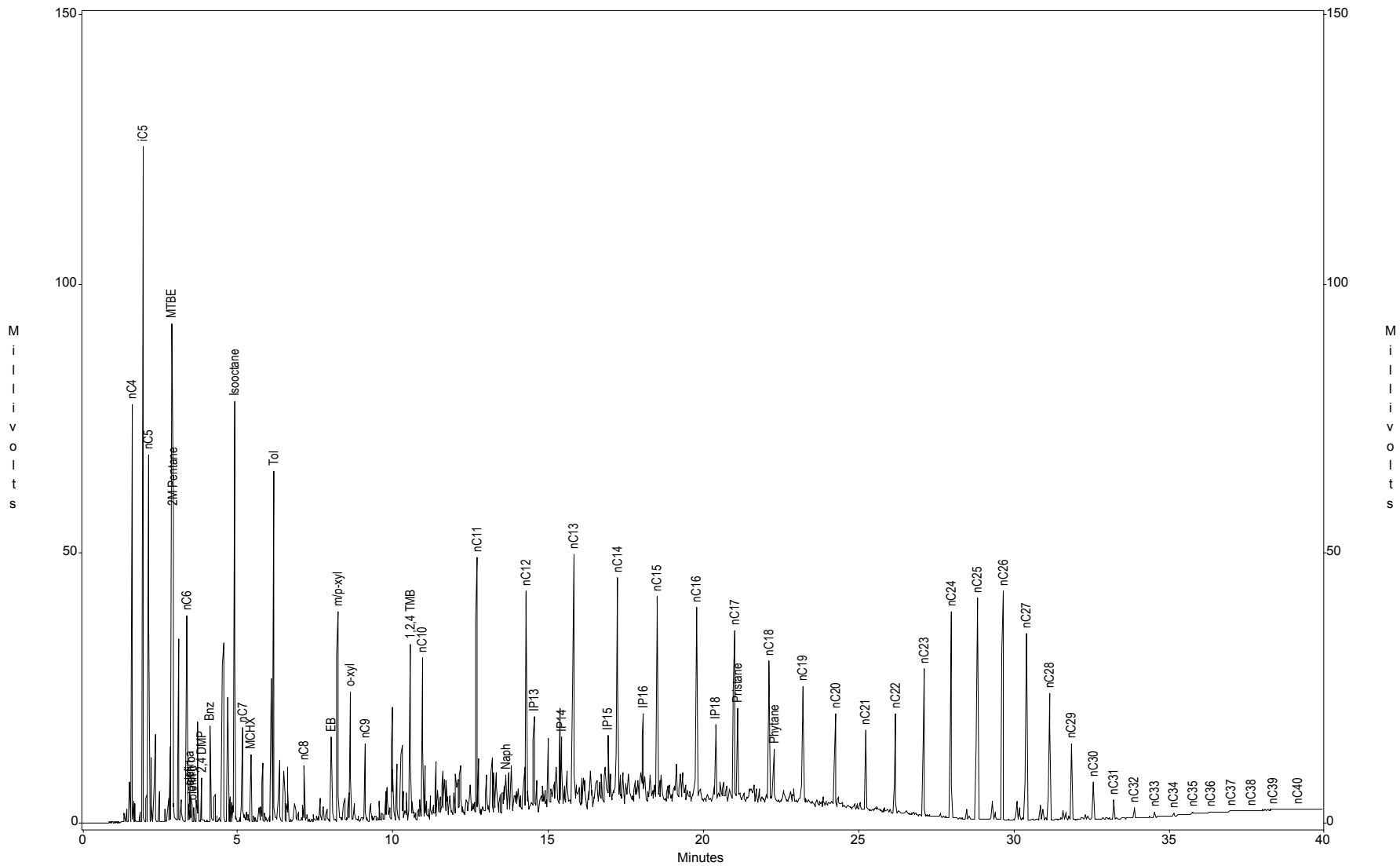
Sun - Philly Refinery AOI-4
Sample ID : S221-LNAPL-042705
Acquired : May 02, 2005 17:46:44

c:\ezchrom\chrom\05056\s221 -- Channel A



Sun - Philly Refinery AOI-4
Sample ID : Gas/Dies/Wax std
Acquired : May 02, 2005 14:22:33

c:\ezchrom\chrom\05056\gadiwax2.2 -- Channel A



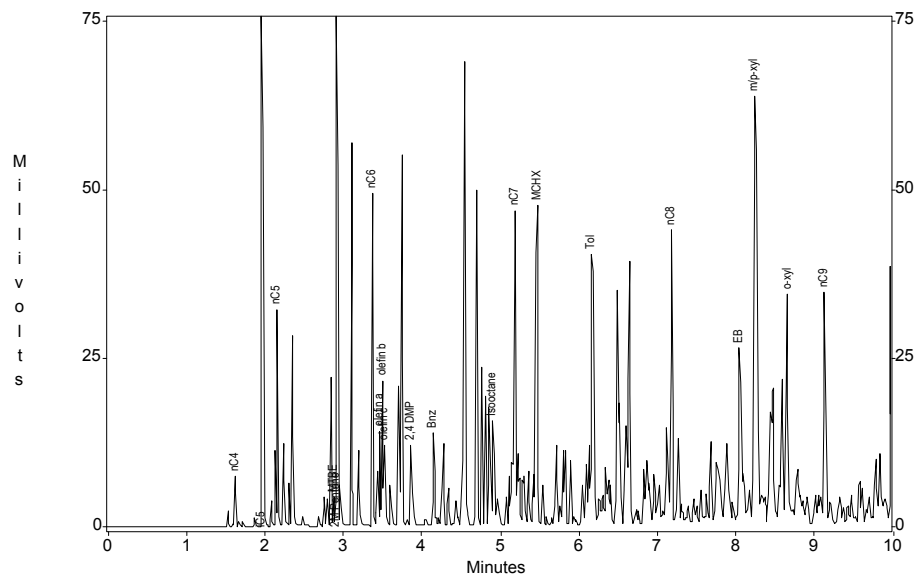
Channel A Results

Sun - Philly Refinery AOI-4

Sample ID : S217-LNAPL-042705

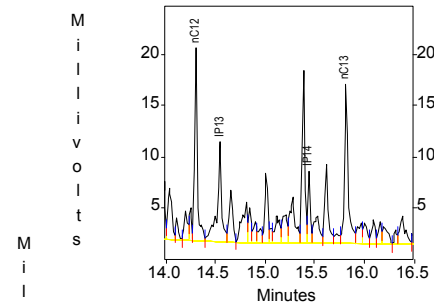
Acquired : May 02, 2005 16:08:36

c:\ezchrom\chrom\05056\s217 -- Channel A

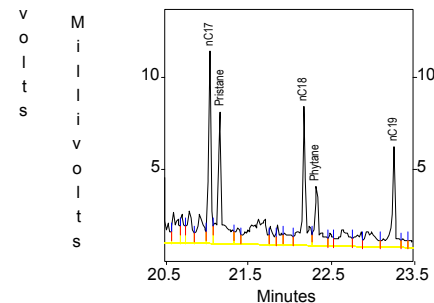


c:\ezchrom\chrom\05056\s217 -- Channel A

c:\ezchrom\chrom\05056\s217 -- Channel A



c:\ezchrom\chrom\05056\s217 -- Channel A



Millivolt

Millivolt

Millivolt

Peak	Area	Height
nC4	5312	7532
ic5	82090	109089
nC5	27278	32164
MTBE	4204	4150
2M Pentane	84575	87290
nC6	50401	49300
olefin a	16550	13968
olefin b	22085	21436
olefin c	15838	11970
2,4 DMP	18126	11964
Bnz	19761	13704
Isooctane	20030	15564
nC7	69278	46763
MCHX	65367	47425
Tol	61872	40276
nC8	62688	43837
EB	46202	26279
m/p-xyl	179497	63428
o-xyl	60130	34170
nC9	45218	33282
1,2,4 TMB	122565	62366
nC10	32246	21330
nC11	49061	23204
Naph	35610	10677
nC12	34941	18801
IP13	28502	9761
IP14	11489	6981
nC13	36794	15539
IP15	9717	5695
nC14	31797	15955
IP16	23711	7263
nC15	32583	13868
nC16	32137	12043
IP18	20323	4879
nC17	20303	10365
Pristane	25746	7049
nC18	21674	7495
Phytane	12041	3183
nC19	16412	5385
nC20	6995	3155
nC21	2885	1556
nC22	1387	777
nC23	711	353
nC24	464	199
nC25	0	0
nC26	206	94
nC27	801	138
nC28	887	120
nC29	136	57
nC30	373	101
nC31	100	48
nC32	271	60
nC33	213	44
nC34	0	0
nC35	0	0
nC36	768	222
nC37	0	0
nC38	0	0
nC39	80	21
nC40	58	22

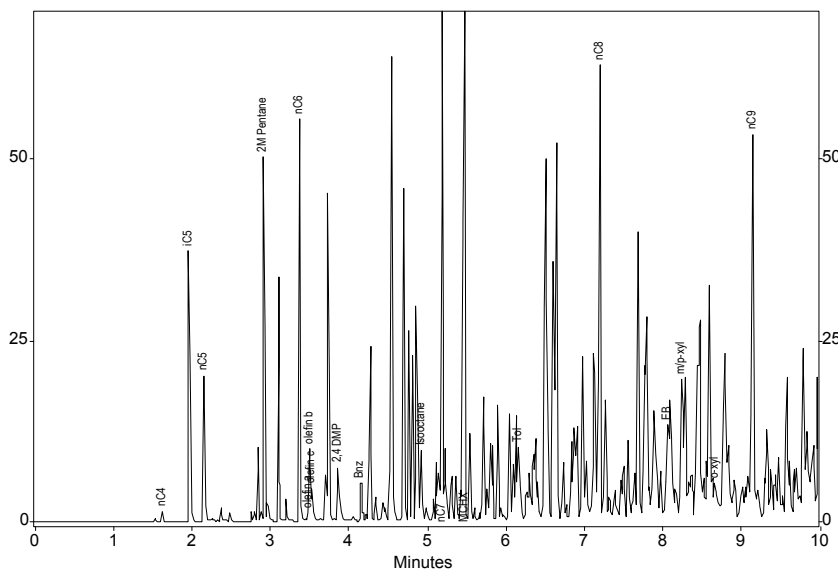
Channel A Results

Sun - Philly Refinery AOI-4

Sample ID : S220-LNAPL-042705

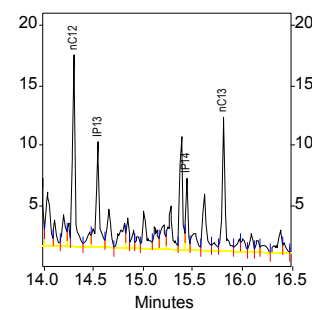
Acquired : May 02, 2005 16:57:29

c:\ezchrom\chrom\05056\s220 -- Channel A

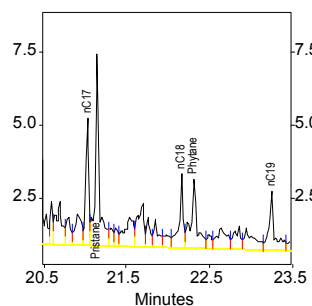
M
i
l
l
i
v
o
l
t
s

c:\ezchrom\chrom\05056\s220 -- Channel A

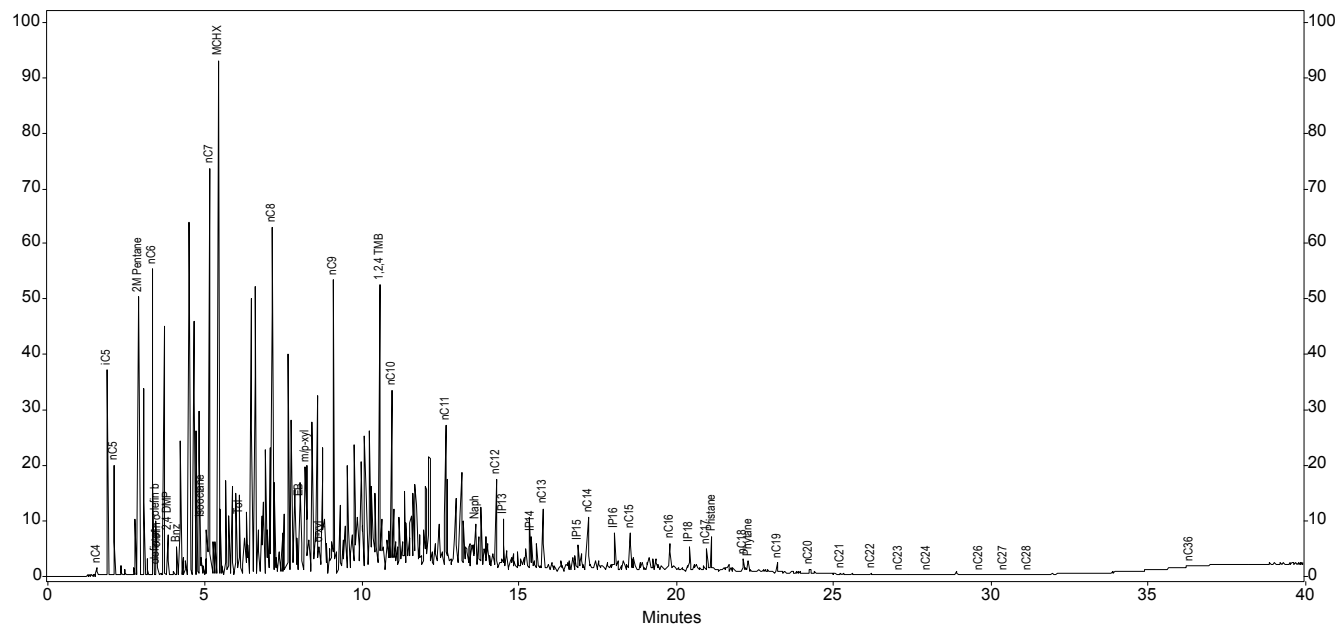
c:\ezchrom\chrom\05056\s220 -- Channel A

M
i
l
l
i
v
o
l
t
s

c:\ezchrom\chrom\05056\s220 -- Channel A

M
i
l
l
i
v
o
l
t
sM
i
l
l
i
v
o
l
t
s

Peak	Area	Height
nC4	1242	1497
iC5	31355	37222
nC5	19617	19956
MTBE	0	0
2M Pentane	50132	50228
nC6	57807	55340
olefin a	477	1140
olefin b	11457	9898
olefin c	6832	4337
2,4 DMP	10742	7203
Bnz	8292	5120
Isooctane	12401	9633
nC7	106802	73182
MCHX	142408	92457
To1	15282	9953
nC8	97846	62526
EB	28868	12969
m/p-xyl	28852	19252
o-xyl	15796	4838
nC9	86505	52845
1,2,4 TMB	104642	51476
nC10	54962	32146
nC11	52507	25375
Naph	22465	7741
nC12	28752	15938
IP13	20537	8776
IP14	9732	5943
nC13	21910	11117
IP15	8022	4572
nC14	20498	9576
IP16	18775	6939
nC15	19804	7041
nC16	18301	5101
IP18	19241	4459
nC17	9702	4377
Pristane	21090	6605
nC18	8400	2539
Phytane	11673	2345
nC19	9150	2003
nC20	2693	891
nC21	689	337
nC22	325	156
nC23	275	99
nC24	193	62
nC25	0	0
nC26	116	35
nC27	93	33
nC28	156	34
nC29	0	0
nC30	0	0
nC31	0	0
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	939	156
nC37	0	0
nC38	0	0
nC39	0	0
nC40	0	0

M
i
l
l
i
v
o
l
t
sM
i
l
l
i
v
o
l
t
s

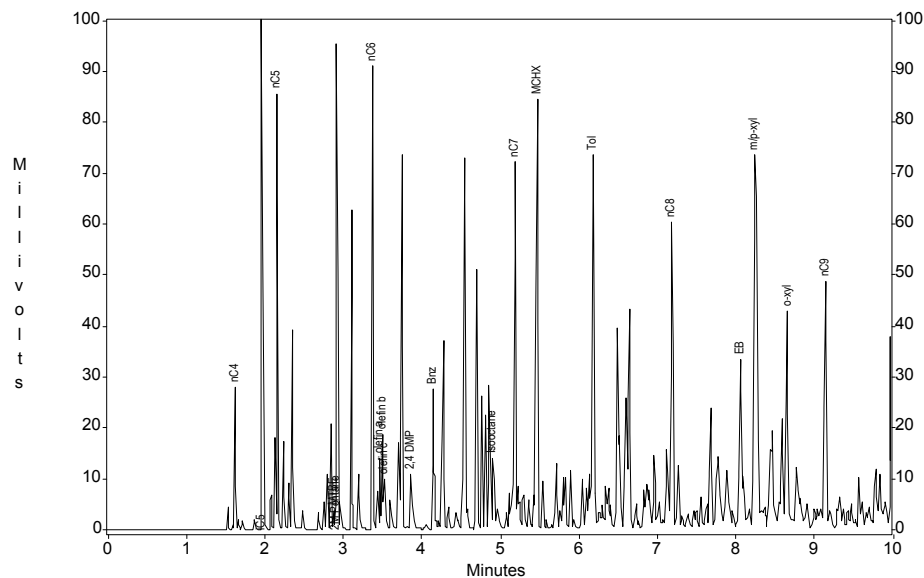
Channel A Results

Sun - Philly Refinery AOI-4

Sample ID : S221-LNAPL-042705

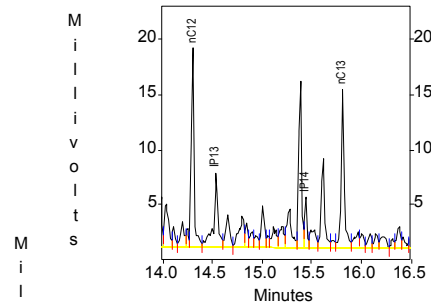
Acquired : May 02, 2005 17:46:44

c:\ezchrom\chrom\05056\s221 -- Channel A

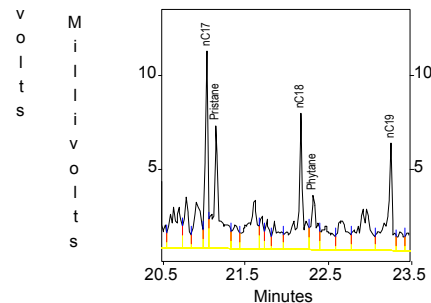


c:\ezchrom\chrom\05056\s221 -- Channel A

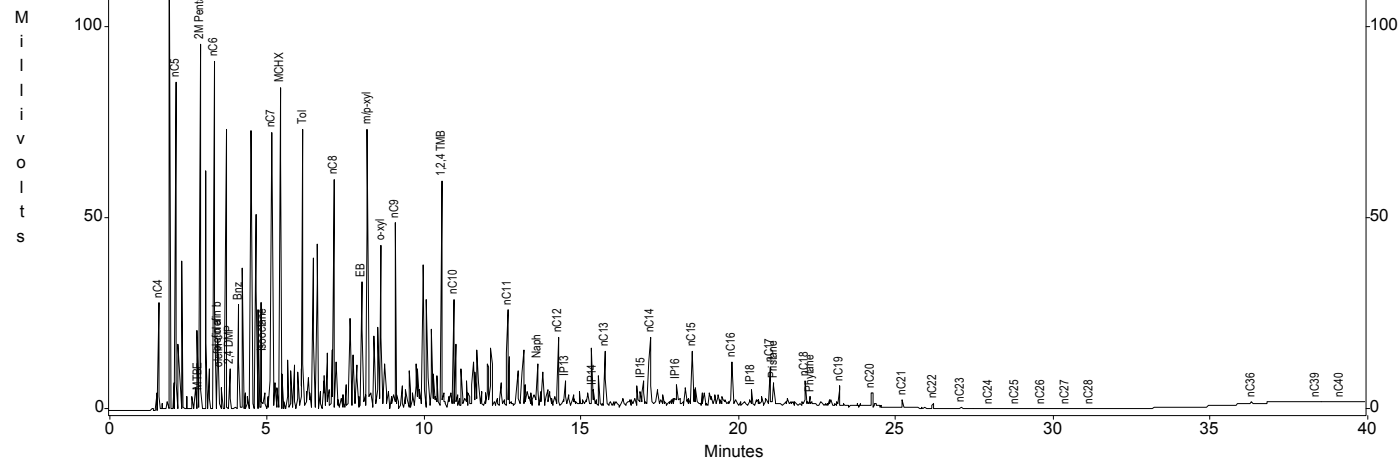
c:\ezchrom\chrom\05056\s221 -- Channel A



c:\ezchrom\chrom\05056\s221 -- Channel A

M
i
l
l
i
v
o
l
t
s

Peak	Area	Height
nC4	18763	27794
iC5	101329	134513
nC5	70101	85677
MTBE	3825	3802
2M Pentane	93345	95565
nC6	95802	91162
olefin a	16545	13924
olefin b	19489	18484
olefin c	13768	9801
2,4 DMP	16643	10825
Bnz	37603	27471
Isocotane	17580	13850
nC7	111999	72201
MCHX	126593	84259
Tol	111593	73397
nC8	90353	59968
EB	55919	33153
m/p-xyl	208252	73243
o-xyl	74740	42496
nC9	76850	48501
1,2,4 TMB	112799	58889
nC10	43515	27939
nC11	49443	25123
Naph	34112	11114
nC12	33028	18161
IP13	20516	6737
IP14	7621	4580
nC13	29187	14400
IP15	23983	6182
nC14	35704	18132
IP16	30489	5927
nC15	27158	14321
nC16	34465	11910
IP18	22392	4622
nC17	21621	10455
Pristane	30878	6428
nC18	30158	7193
Phytane	13121	2837
nC19	25197	5702
nC20	12964	3785
nC21	4972	2274
nC22	2599	1182
nC23	1038	450
nC24	479	174
nC25	198	69
nC26	143	43
nC27	99	31
nC28	106	22
nC29	0	0
nC30	0	0
nC31	0	0
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	1181	271
nC37	0	0
nC38	0	0
nC39	32	14
nC40	61	23

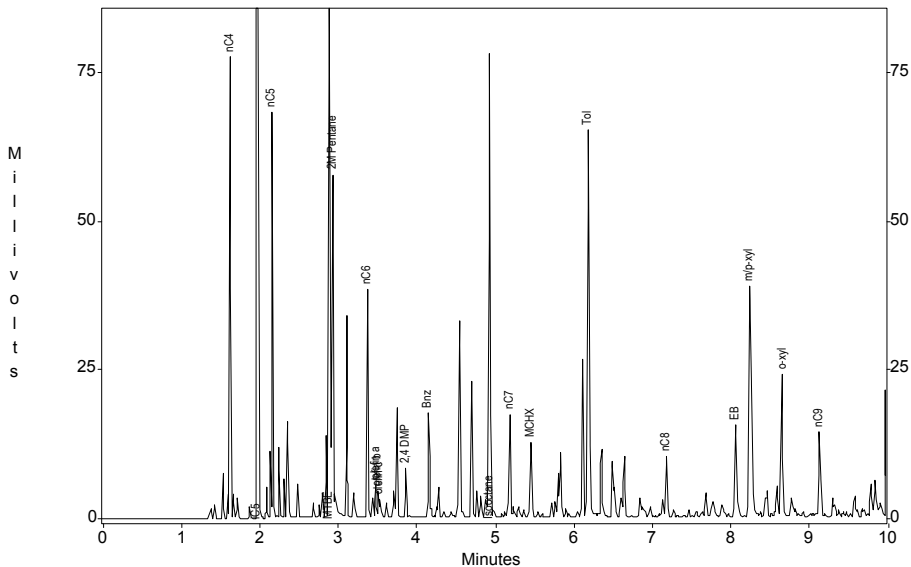


Sun - Philly Refinery AOI-4

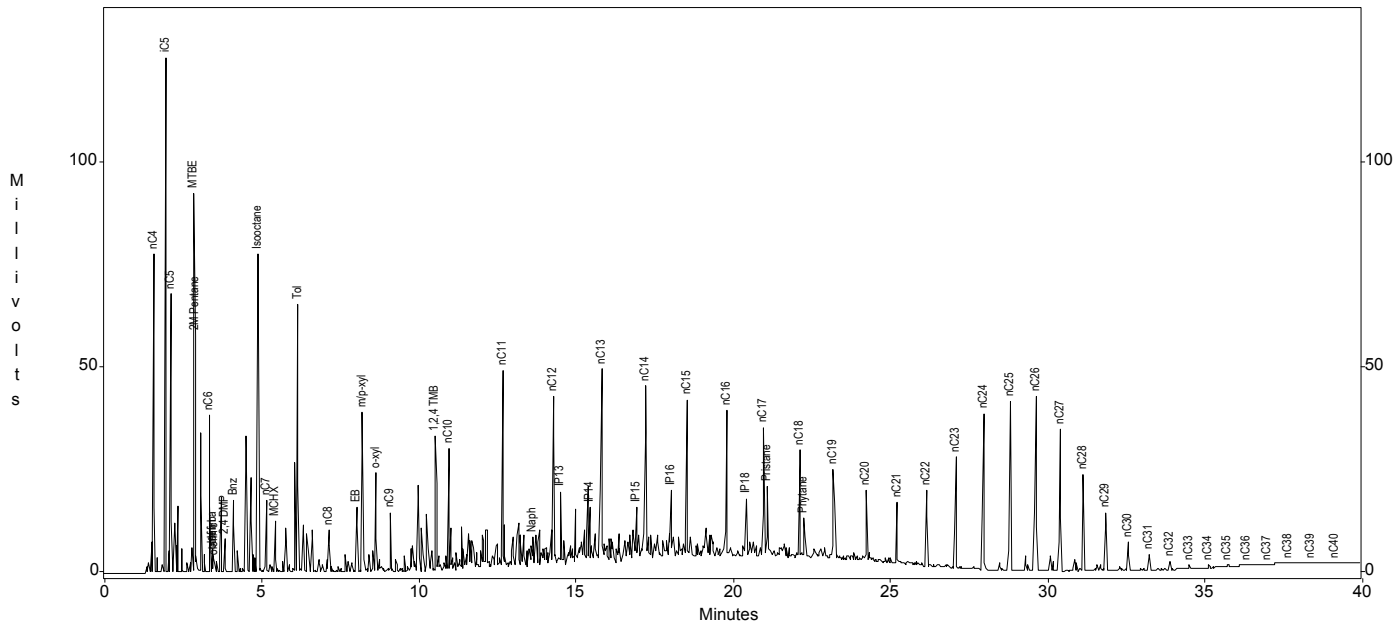
Sample ID : Gas/Dies/Wax std

Acquired : May 02, 2005 14:22:33

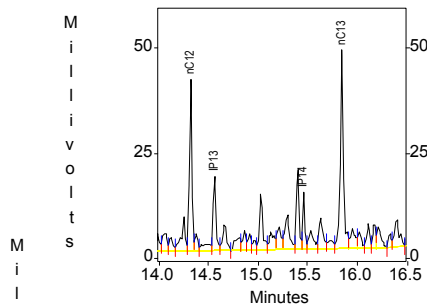
c:\ezchrom\chrom\05056\gadiwax2.2 -- Channel A



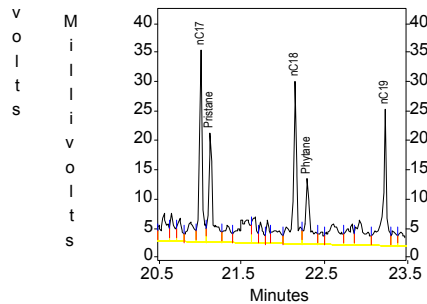
c:\ezchrom\chrom\05056\gadiwax2.2 -- Channel A



c:\ezchrom\chrom\05056\gadiwax2.2 -- Channel A



c:\ezchrom\chrom\05056\gadiwax2.2 -- Channel A



Channel A Results

Peak	Area	Height
nC4	50911	77665
iC5	92467	125502
nC5	53701	68026
MTBE	82102	92474
2M Pentane	58250	57758
nC6	38482	38353
olefin a	6616	5648
olefin b	5050	4575
olefin c	4401	3104
2,4 DMP	8901	8190
Bnz	25387	17698
Isocotane	104545	77906
nC7	22416	17428
MCHX	17182	12529
Tol	96080	65185
nC8	13479	10248
EB	26557	15600
m/p-xyl	59984	38981
o-xyl	37420	24035
nC9	21429	14237
1,2,4 TMB	57320	32734
nC10	46335	29893
nC11	83455	48070
Naph	21402	7152
nC12	76553	41198
IP13	34358	17917
IP14	23251	13757
nC13	109508	47554
IP15	15652	10901
nC14	86097	41533
IP16	34996	16847
nC15	81385	38795
nC16	97583	36860
IP18	40308	15471
nC17	77757	32889
Pristane	58572	18551
nC18	80146	27662
Phytane	39841	11245
nC19	73038	23201
nC20	41859	18379
nC21	39739	15674
nC22	37899	18771
nC23	59042	27380
nC24	90762	38208
nC25	108197	41028
nC26	110543	42472
nC27	83155	34660
nC28	51681	23452
nC29	29592	14097
nC30	14605	7049
nC31	7416	3609
nC32	3606	1797
nC33	1944	996
nC34	1064	517
nC35	581	284
nC36	794	145
nC37	491	78
nC38	160	50
nC39	127	36
nC40	124	26

Analysis Request/ Environmental Services Chain of Custody

Acct. #: _____ Sample #: _____

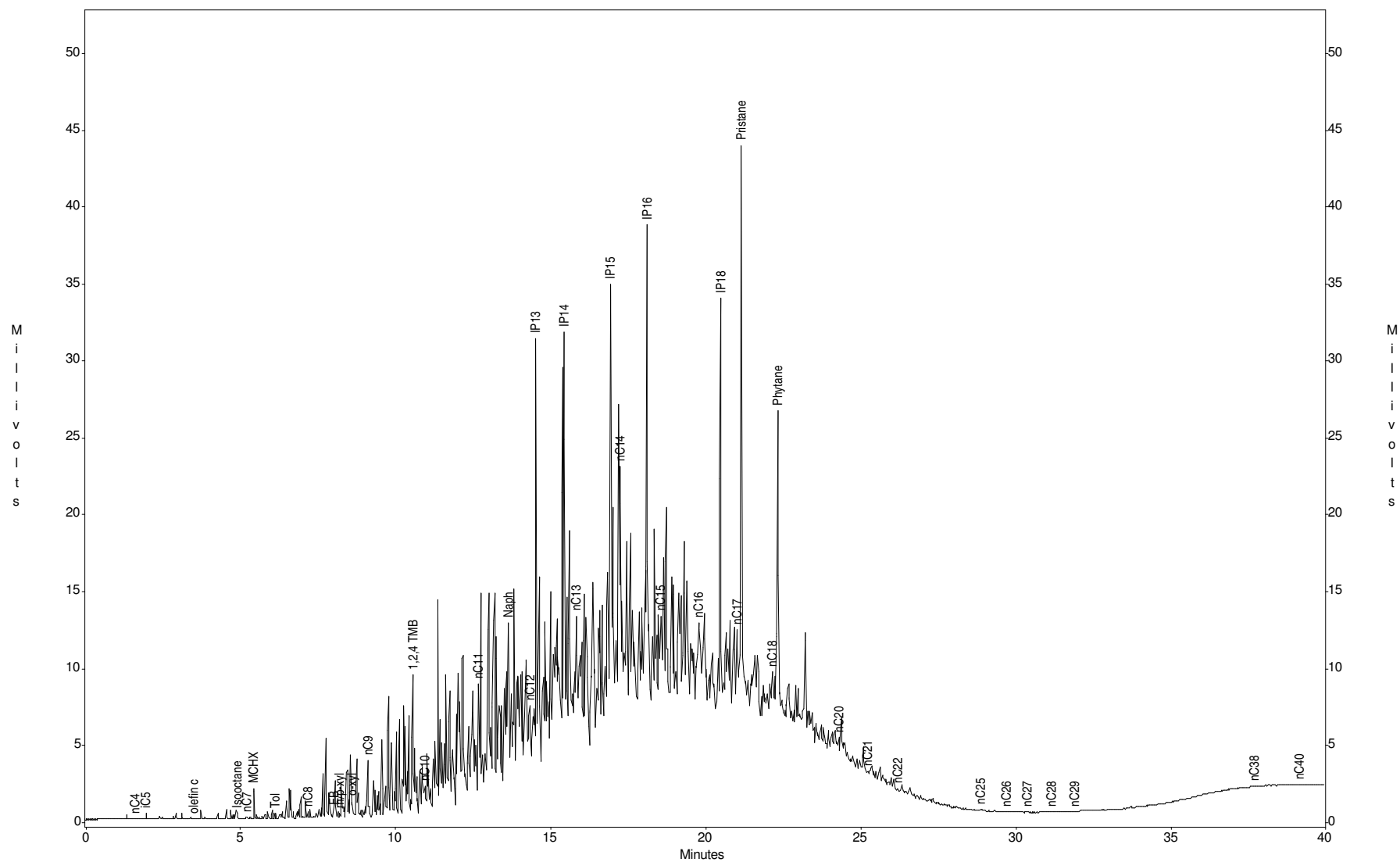
Client: <u>Langan Engineering</u>		Acct. #: _____		Matrix		Analyses Requested										For Lab Use Only	
Project Name/#: <u>Sun - Philadelphia Refinery/Philadelphia Terminal</u>		PWSID #: _____															
Project Manager: <u>K. Martin (Aquaterra) J. Hanna (Langan Eng)</u>		P.O. #: _____		<div style="display: flex;"> <div style="flex: 1;"> <div style="border: 1px solid black; padding: 2px;">Potable</div> <div style="border: 1px solid black; padding: 2px;">NPDES</div> </div> <div style="flex: 1;"> <div style="border: 1px solid black; padding: 2px;">Soil</div> <div style="border: 1px solid black; padding: 2px;">Water</div> <div style="border: 1px solid black; padding: 2px;">Other</div> </div> </div>		<div style="display: flex;"> <div style="flex: 1;">Total # of Containers</div> <div style="flex: 1;">GC Finger print</div> </div>										FSC: _____	
Sampler: <u>M. Brad Spancake</u>		Quote #: _____															
Name of State where samples were collected: <u>PA</u>				Composite												<div style="display: flex;"> <div style="flex: 1;">Remarks</div> <div style="flex: 1; font-size: small;">Temperature of samples upon receipt (if applicable)</div> </div>	
Sample Identification		Date Collected	Time Collected	Grab													
<u>S198-LNAPL-042005</u>		<u>4/20/05</u>	<u>1035</u>	X				X	1	X							
<u>S199-LNAPL-042005</u>			<u>1045</u>	X				X	1	X							
<u>S200-LNAPL-042005</u>			<u>1100</u>	X				X	1	X							
<u>S77-LNAPL-042005</u>			<u>1110</u>	X				X	1	X							
<u>S201-LNAPL-042005</u>			<u>1130</u>	X				X	1	X							
<u>S83-LNAPL-042005</u>			<u>1140</u>	X				X	1	X							
<u>S126-LNAPL-042005</u>			<u>1325</u>	X				X	1	X							
<u>S205-LNAPL-042005</u>			<u>1340</u>	X				X	1	X							
<u>S208-LNAPL-042005</u>			<u>1350</u>	X				X	1	X							
<u>S213-LNAPL-042005</u>		<u>↓</u>	<u>1400</u>	X				X	1	X							
Turnaround Time Requested (TAT) (please Circle): <u>Normal</u> Rush (Rush TAT is subject to Lancaster Laboratories approval and surcharge). Date results are needed: _____ Rush results requested by (please circle): Phone Fax Phone #: _____ Fax #: _____						Relinquished by: <u>M. Brad Spancake</u>		Date	Time	Received by: <u>Bruce T. Tolson</u>		Date	Time				
						Relinquished by: _____		Date	Time	Received by: _____		Date	Time				
						Relinquished by: _____		Date	Time	Received by: _____		Date	Time				
						Relinquished by: _____		Date	Time	Received by: _____		Date	Time				
						Relinquished by: _____		Date	Time	Received by: _____		Date	Time				
State-specific QC required? Yes No (If yes, indicated QC sample and submit triplicate volume) Internal Chain-of-Custody required? Yes No								Date	Time			Date	Time				

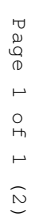
Acct. #: _____ Sample #: _____

Client: Langan Engineering						Acct. #:				Matrix		Analyses Requested								For Lab Use Only		
Project Name/#: Sun - Philadelphia Refinery/Bentley Terminal						PWSID #:														FSC:		
Project Manager: K. Martin (Aquaterra) J. Hanna (Langan Eng)						P.O. #:														SCR:		
Sampler: M. Brad Spancake						Quote #:																
Name of State where samples were collected: PA																						
Sample Identification	Date Collected	Time Collected	Grab	Composite	Soil	Potable Water	NPDOS	Other	Total # of Containers	GC fingerprint											Remarks	Temperature of samples upon receipt (if applicable)
S160-LNAPL-042005	4/29/05	1410	X					X	1	X												
S161-LNAPL-042005	4/29/05	1420	X					X	1	X												
S35-LNAPL-042105	4/21/05	1110	X					X	1	X												
S57-LNAPL-042105	4/21/05	1150	X					X	1	X												
S37-LNAPL-042105	4/21/05	1200	X					X	1	X												
			X					X	1													
			X					X	1													
			X					X	1													
			X					X	1													
			X					X	1													
Turnaround Time Requested (TAT) (please Circle): Normal Rush										Relinquished by:		Date	Time	Received by:		Date	Time					
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)														Bruce Torkelson		4-22-05	1000					
Date results are needed: _____										Relinquished by:		Date	Time	Received by:		Date	Time					
Rush results requested by (please circle): Phone Fax																						
Phone #: _____ Fax #: _____																						
										Relinquished by:		Date	Time	Received by:		Date	Time					
										Relinquished by:		Date	Time	Received by:		Date	Time					
										Relinquished by:		Date	Time	Received by:		Date	Time					
SDG Complete? Yes No										Relinquished by:		Date	Time	Received by:		Date	Time					
State-specific QC required? Yes No																						
(If yes, indicated QC sample and submit triplicate volume)																						
Internal Chain-of-Custody required? Yes No																						

Sun - Philadelphia Refinery
Sample ID : S35-LNAPL-042105
Acquired : Apr 26, 2005 10:07:40

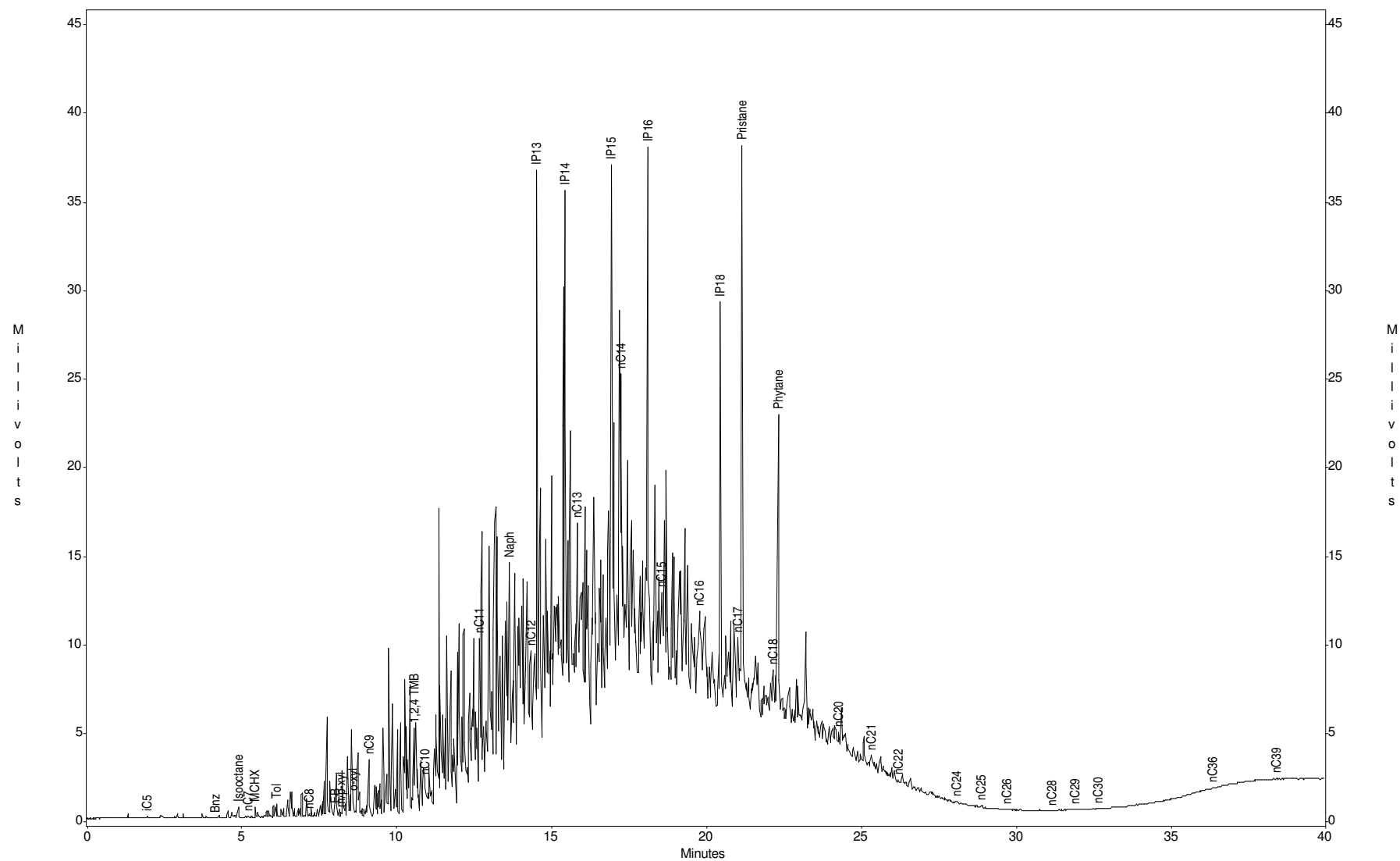
c:\ezchrom\chrom\05054\s35 -- Channel A

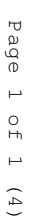




Sun - Philadelphia Refinery
Sample ID : S57-LNAPL-042105
Acquired : Apr 25, 2005 13:27:24

c:\ezchrom\chrom\05054\s57 -- Channel A

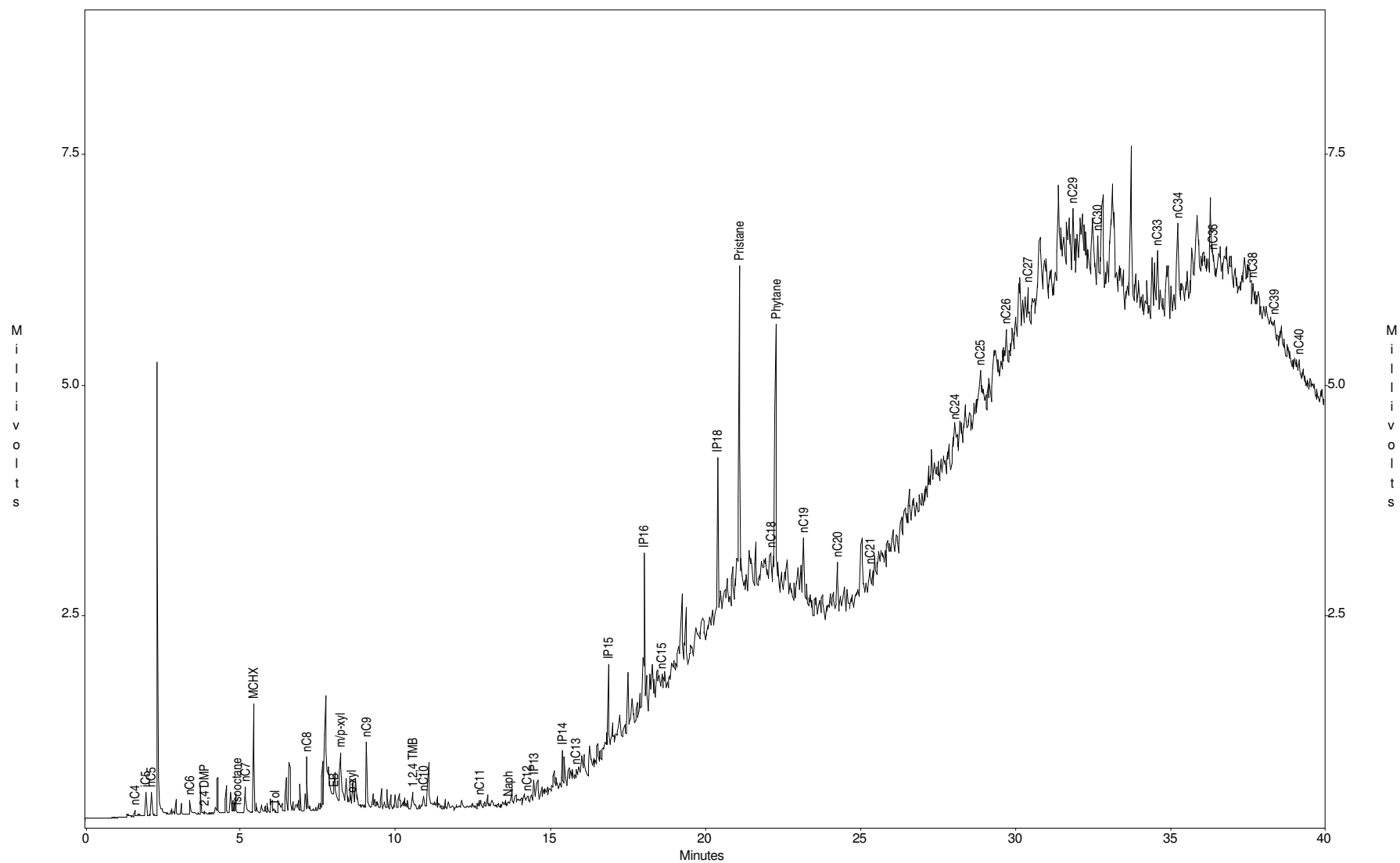






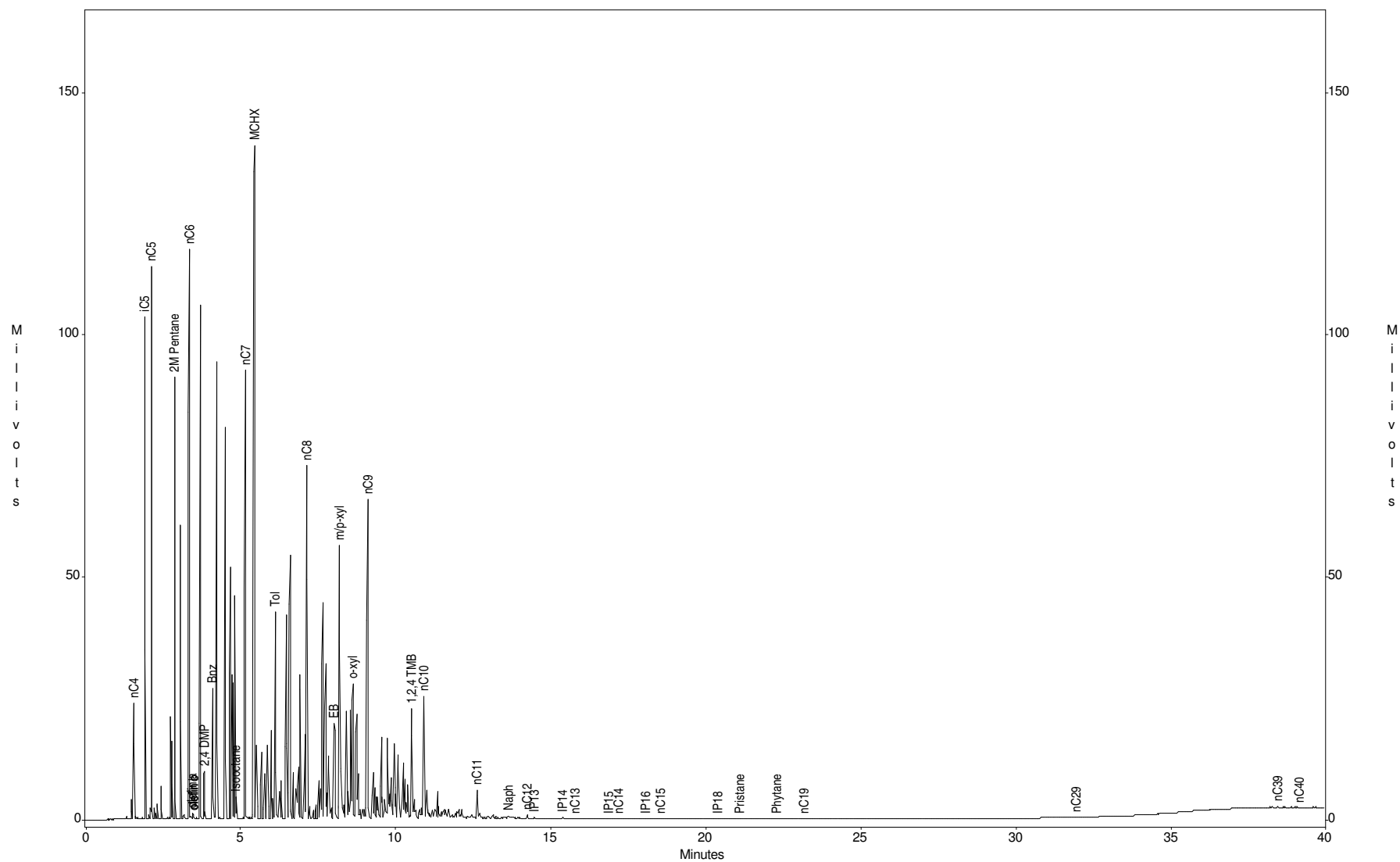
Sun - Philadelphia Refinery
Sample ID : S126-LNAPL-042005
Acquired : Apr 26, 2005 11:46:25

c:\ezchrom\chrom\05054\s126 -- Channel A



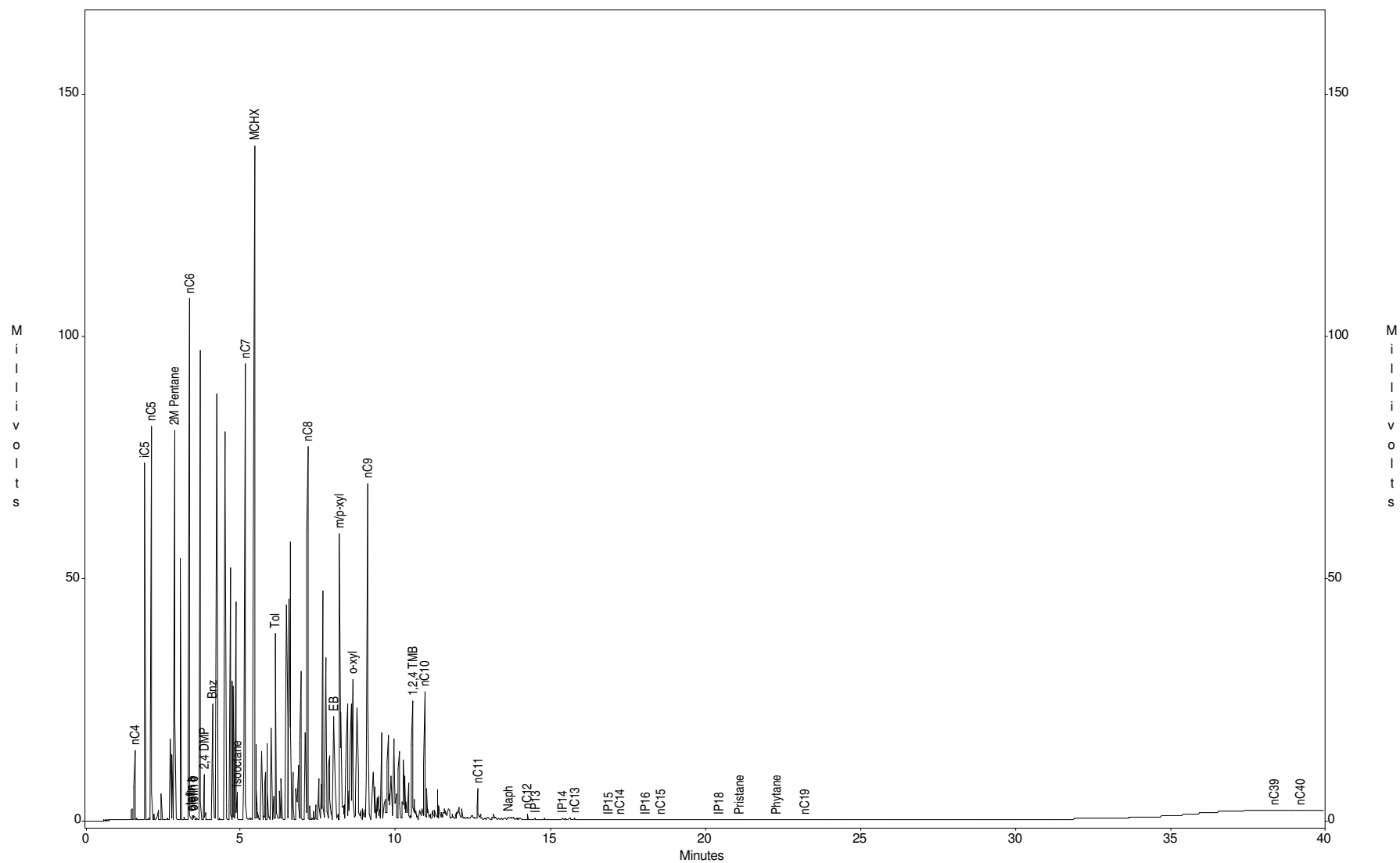
Sun - Philadelphia Refinery
Sample ID : S160-LNAPL-042005
Acquired : Apr 26, 2005 12:42:54

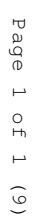
c:\ezchrom\chrom\05054\s160 -- Channel A

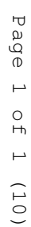


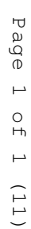
Sun - Philadelphia Refinery
Sample ID : S161-LNAPL-042005
Acquired : Apr 26, 2005 10:58:03

c:\ezchrom\chrom\05054\s161 -- Channel A







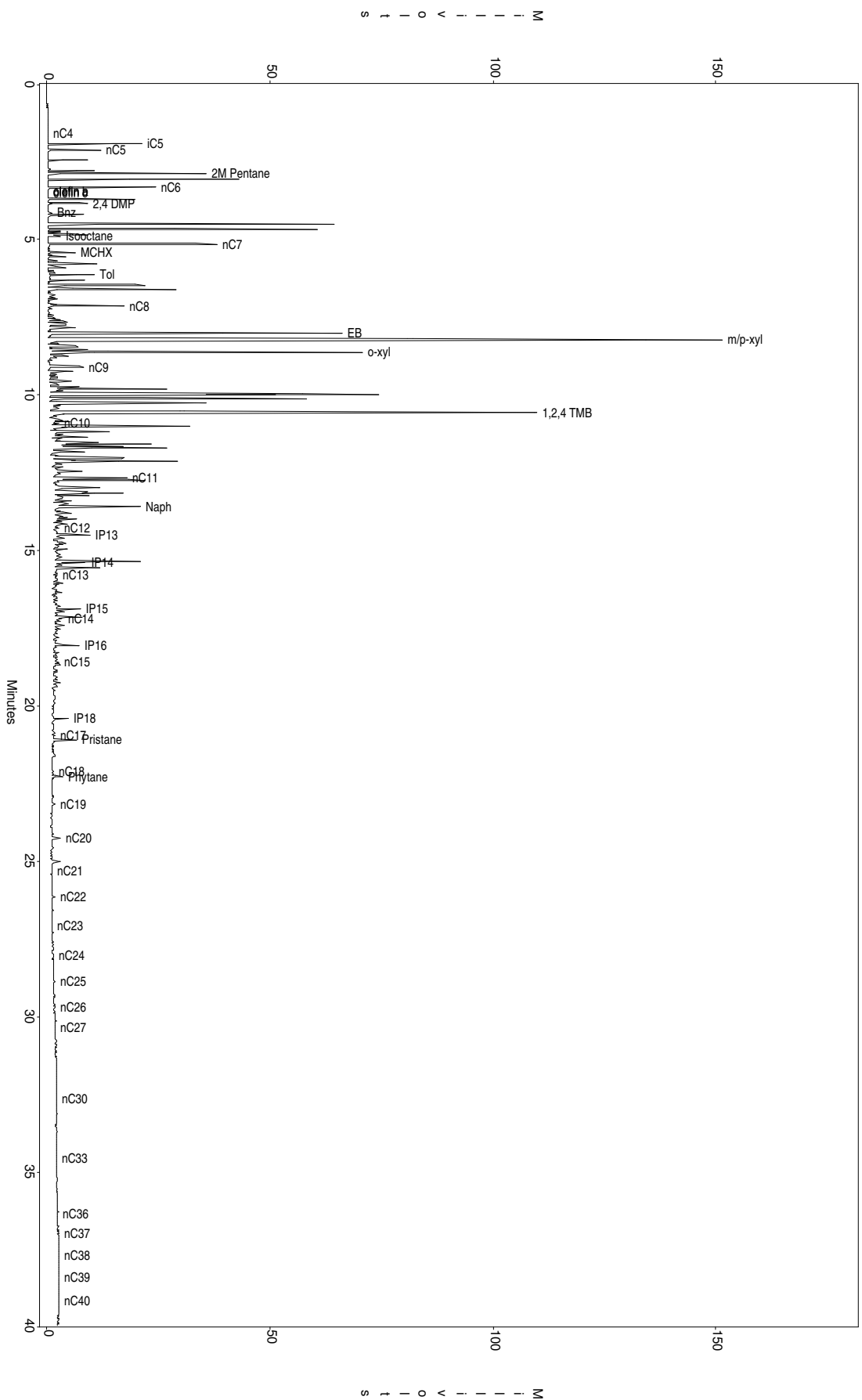


The chromatogram displays the separation of compounds in a diesel sample over a 40-minute period. The x-axis represents time in minutes, ranging from 0 to 40. The y-axis represents intensity, with a scale from 0 to 200. Numerous peaks are visible, each labeled with a chemical name or identifier. The peaks are generally ordered by their retention time, with earlier peaks corresponding to more volatile compounds. The following table provides a summary of the labeled peaks and their approximate retention times:

Compound	Approximate Retention Time (Minutes)
nC4	1.5
nC5	2.5
2M Pentane	3.5
nC6	4.5
2,4 DMP	5.5
Bnz	6.5
Isocetane	7.5
nC7	8.5
MCHX	9.5
Tol	10.5
nC8	11.5
EB	12.5
m/p-xyl	13.5
o-xyl	14.5
nC9	15.5
1,2,4 TMB	16.5
nC10	17.5
nC11	18.5
Naph	19.5
IP13	20.5
nC12	21.5
IP14	22.5
nC13	23.5
IP15	24.5
nC14	25.5
IP16	26.5
nC15	27.5
nC16	28.5
IP18	29.5
Pristane	30.5
nC17	31.5
Phytane	32.5
nC18	33.5
nC19	34.5
nC20	35.5
nC21	36.5
nC22	37.5
nC23	38.5
nC24	39.5
nC25	40.5
nC26	41.5
nC27	42.5
nC28	43.5
nC29	44.5
nC39	45.5
nC40	46.5

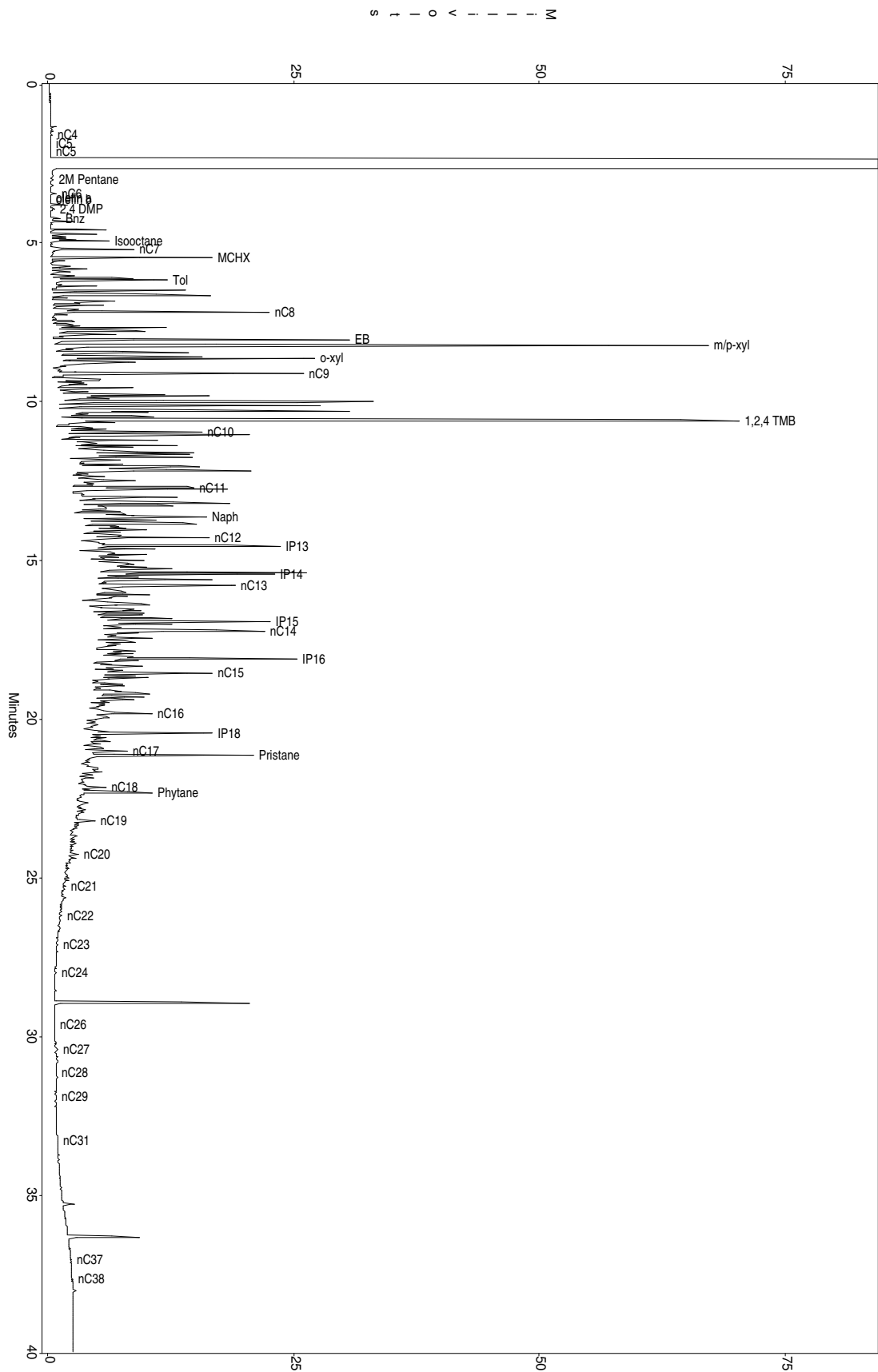
Sun - Philadelphia Refinery
 Sample ID : S205-LNAPL-042005
 Acquired : Apr 25, 2005 17:38:08

c:\ezchrom\chrom\05054\s205.2 -- Channel A



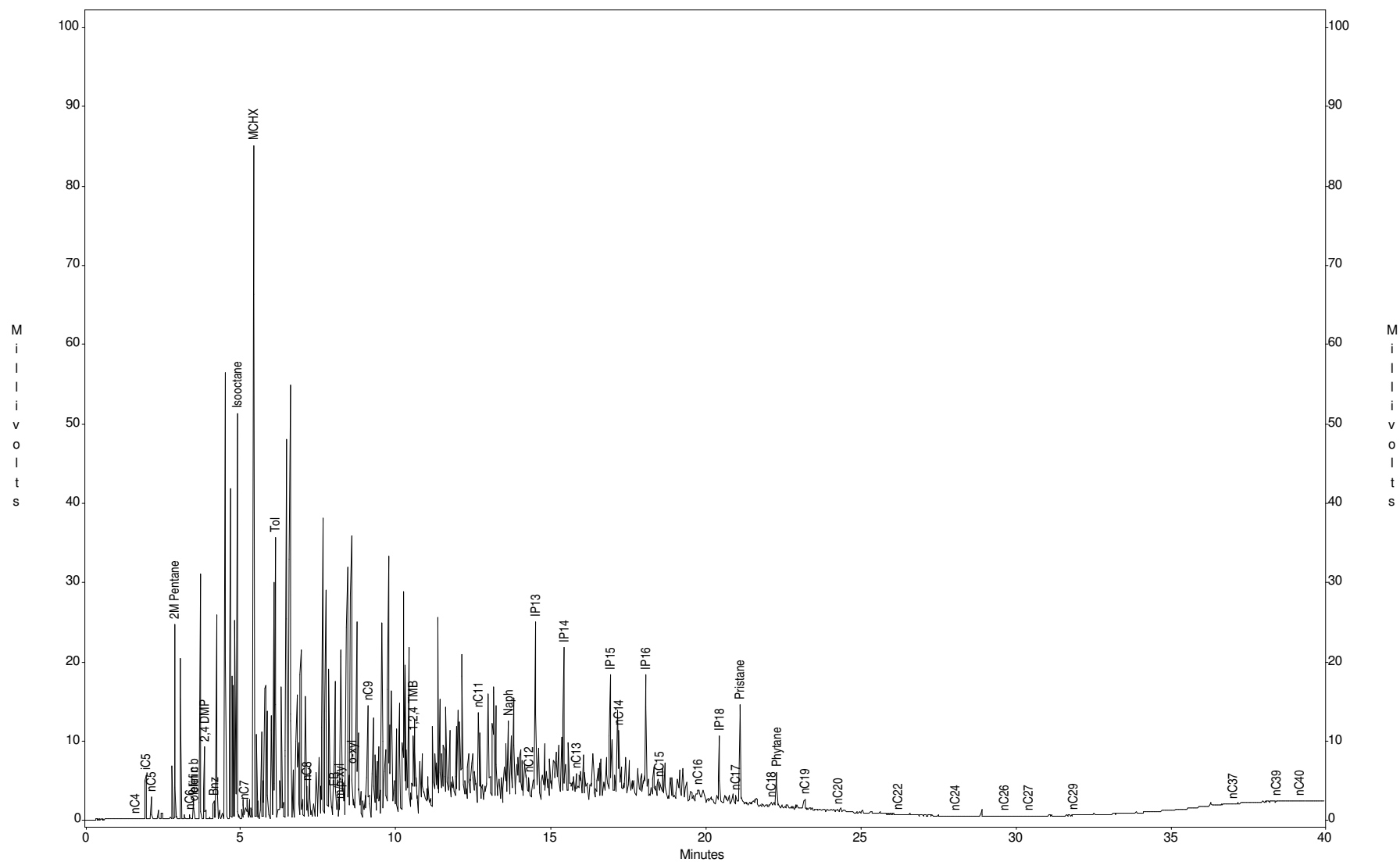
Sun - Philadelphia Refinery
Sample ID : S208-LNAPL-042005
Acquired : Apr 26, 2005 16:47:57

c:\ezchrom\chrom\05054\s208.s -- Channel A



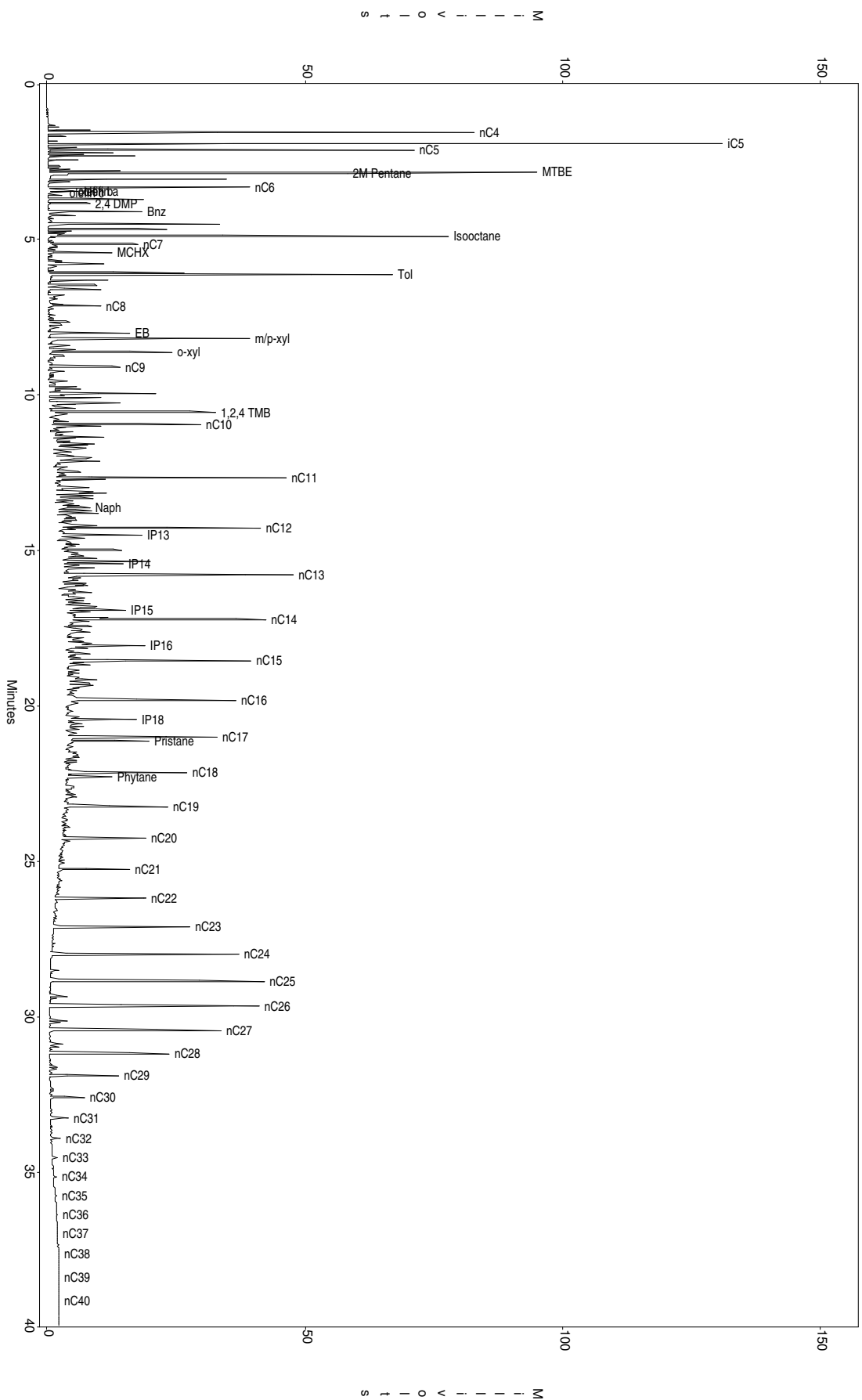
Sun - Philadelphia Refinery
Sample ID : S213-LNAPL-042005
Acquired : Apr 25, 2005 14:19:36

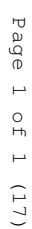
c:\ezchrom\chrom\05054\s213 -- Channel A



Sun - Philadelphia Refinery
 Sample ID : Gas/Dies/Wax std
 Acquired : Apr 25, 2005 11:00:43

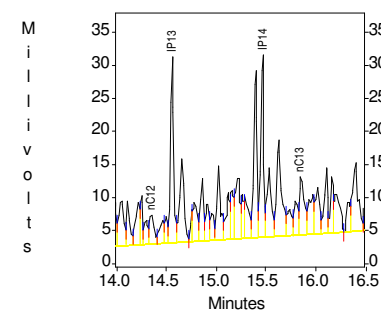
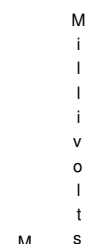
c:\ezchrom\chrom\05054\gadlwax2 -- Channel A



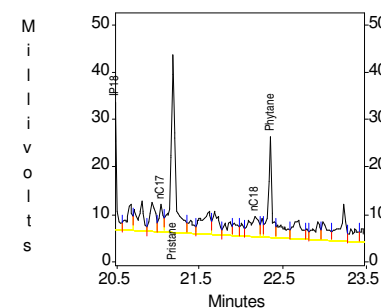
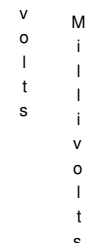


Acquired : Apr 26, 2005 10:07:40

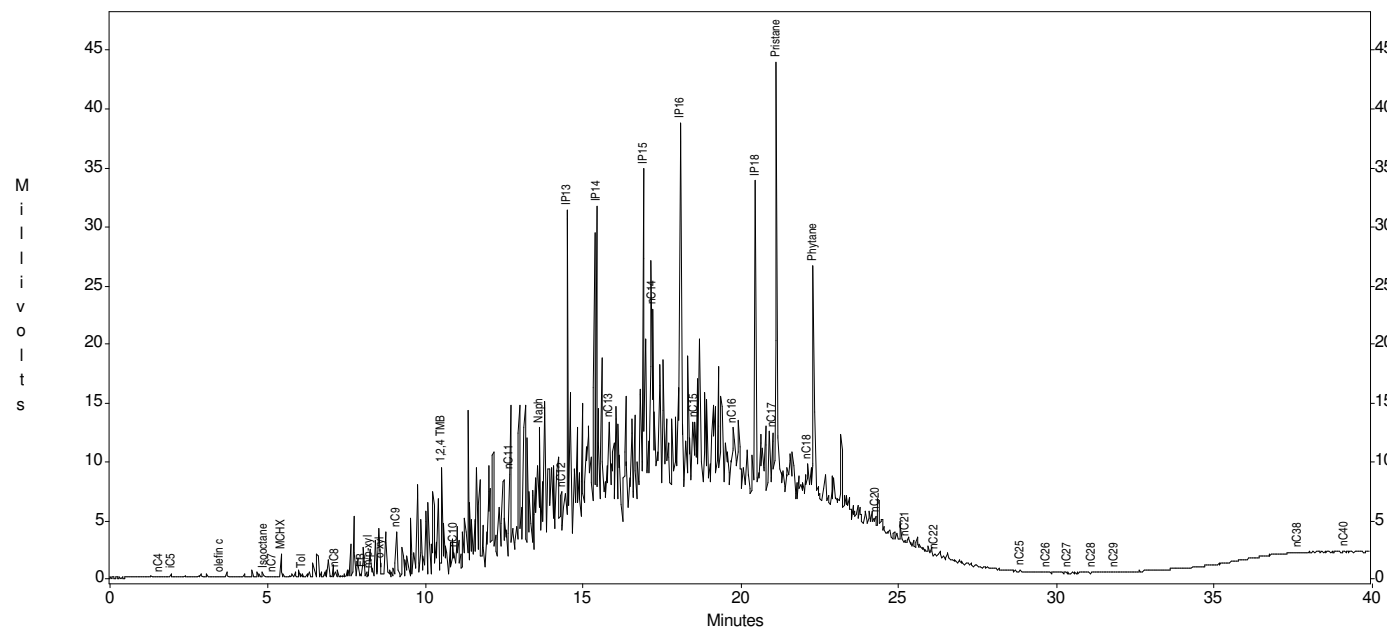
c:\ezchrom\chrom\05054\s35 -- Channel A



c:\ezchrom\chrom\05054\s35 -- Channel A



c:\ezchrom\chrom\05054\s35 -- Channel A



	Peak	Area	Height
M i l l i v o l t s	nC4	41	34
	iC5	406	360
	nC5	0	0
	MTBE	0	0
	2M Pentane	0	0
	nC6	0	0
	olefin a	0	0
	olefin b	0	0
	olefin c	18	11
	2,4 DMP	0	0
S	Bnz	0	0
	Isooctane	466	322
	nC7	284	96
	MCHX	2769	1919
	Tol	626	361
	nC8	866	397
	EB	729	459
	m/p-xyl	484	292
	o-xyl	1585	1120
	nC9	9779	3771
M i l l i v o l t s	1,2,4 TMB	22309	9072
	nC10	6760	1645
	nC11	15135	7186
	Naph	26883	10245
	nC12	15285	4283
	IP13	54748	27961
	IP14	50997	27544
	nC13	29918	8784
	IP15	54293	29055
	nC14	39758	16795
S	IP16	80530	31411
	nC15	20820	5379
	nC16	38935	5163
	IP18	65014	26798
	nC17	15677	5743
	Pristane	130209	37401
	nC18	31460	4108
	Phytane	62087	21228
	nC19	0	0
	nC20	5066	1762
M i l l i v o	nC21	2131	463
	nC22	627	183
	nC23	0	0
	nC24	0	0
	nC25	652	97
	nC26	154	57
	nC27	118	21
	nC28	84	23
	nC29	324	21
	nC30	0	0
M i l l i v o	nC31	0	0
	nC32	0	0
	nC33	0	0
	nC34	0	0
	nC35	0	0
	nC36	0	0
	nC37	0	0
	nC38	76	17
	nC39	0	0
	nC40	128	38

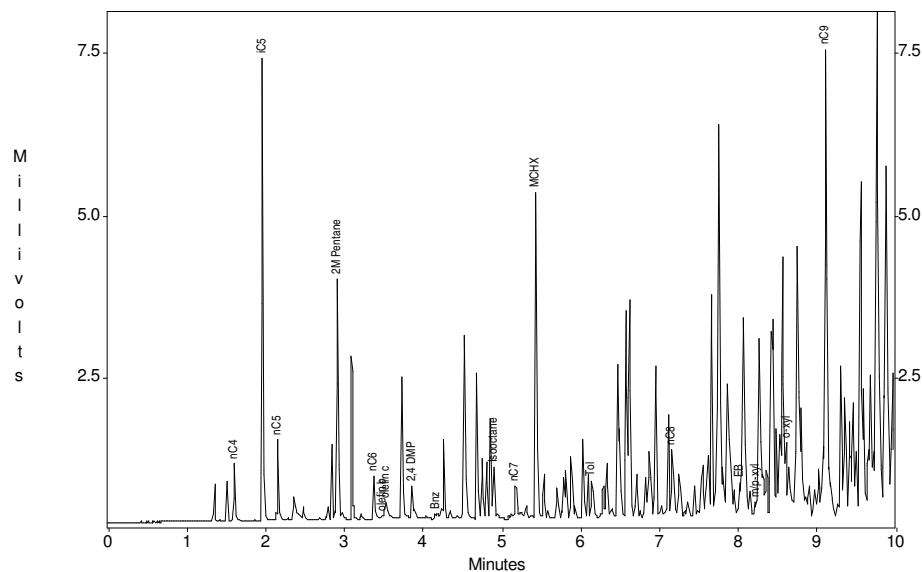
M
i
l
l
i
v
o
l
t
s

Sun - Philadelphia Refinery

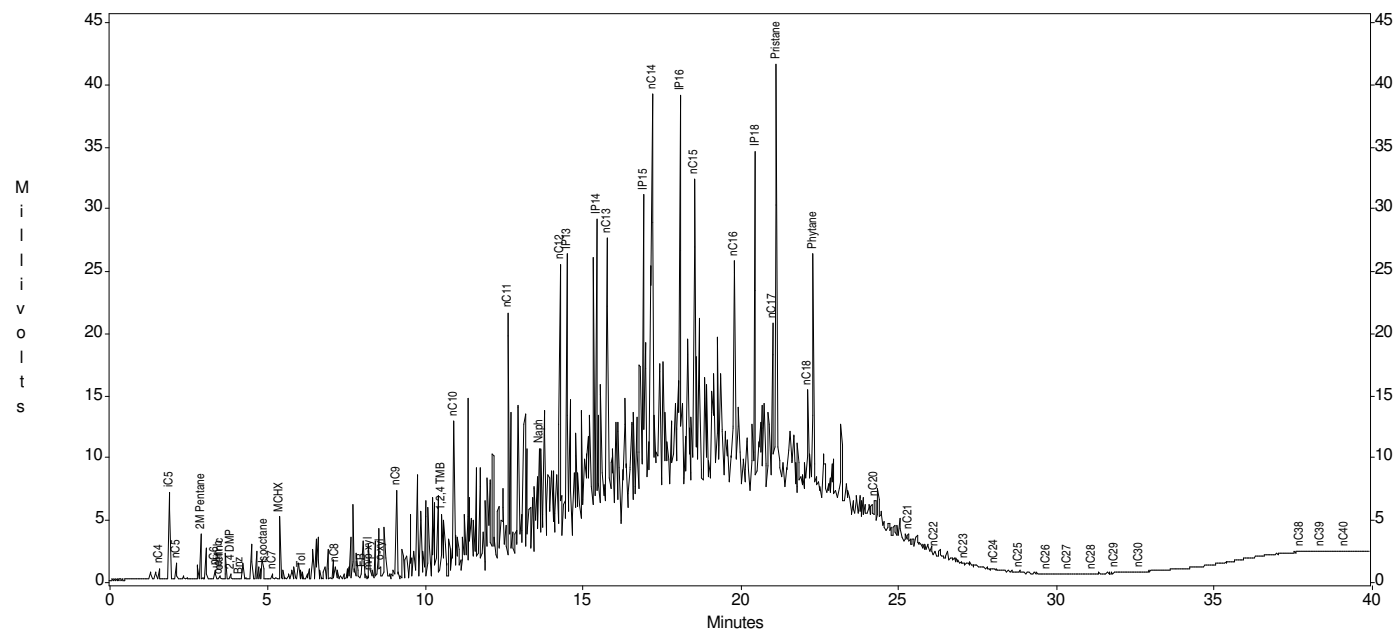
Sample ID : S37-LNAPL-042105

Acquired : Apr 25, 2005 18:27:23

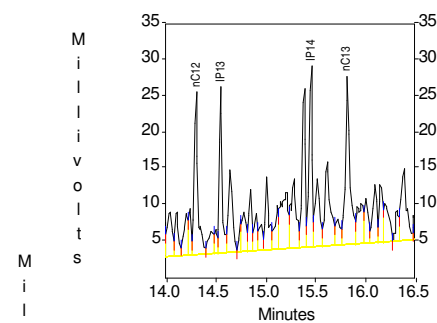
c:\ezchrom\chrom\05054\s37 -- Channel A



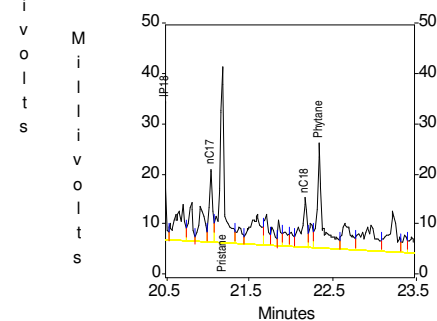
c:\ezchrom\chrom\05054\s37 -- Channel A



c:\ezchrom\chrom\05054\s37 -- Channel A



c:\ezchrom\chrom\05054\s37 -- Channel A



Channel A Results

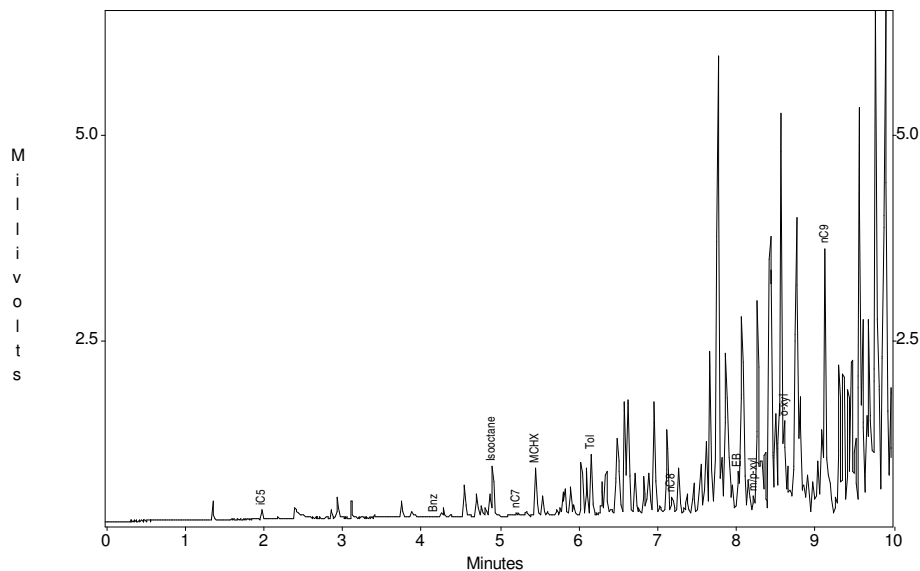
Peak	Area	Height
nC4	696	862
iC5	5974	7102
nC5	1458	1229
MTBE	0	0
2M Pentane	3971	3676
nC6	960	666
olefin a	0	0
olefin b	81	54
olefin c	268	247
2,4 DMP	651	511
Bnz	311	84
Isooctane	1040	792
nC7	995	490
MCHX	6694	4997
Tol	971	557
nC8	1810	1033
EB	824	511
m/p-xyl	325	214
o-xyl	1594	1136
nC9	14633	7149
1,2,4 TMB	15276	4858
nC10	21903	12425
nC11	38135	20066
Naph	19522	8247
nC12	50142	22469
IP13	47283	23108
IP14	45359	25177
nC13	71744	23324
IP15	47838	25543
nC14	73977	33261
IP16	73456	31971
nC15	58566	24531
nC16	64308	18143
IP18	65398	27484
nC17	36514	14196
Pristane	128561	35040
nC18	44957	9884
Phytane	88650	20881
nC19	0	0
nC20	7475	2775
nC21	6968	1053
nC22	1135	364
nC23	240	123
nC24	929	100
nC25	777	104
nC26	144	46
nC27	94	23
nC28	91	30
nC29	409	27
nC30	78	19
nC31	0	0
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	0	0
nC37	0	0
nC38	94	20
nC39	14	8
nC40	11	8

Sun - Philadelphia Refinery

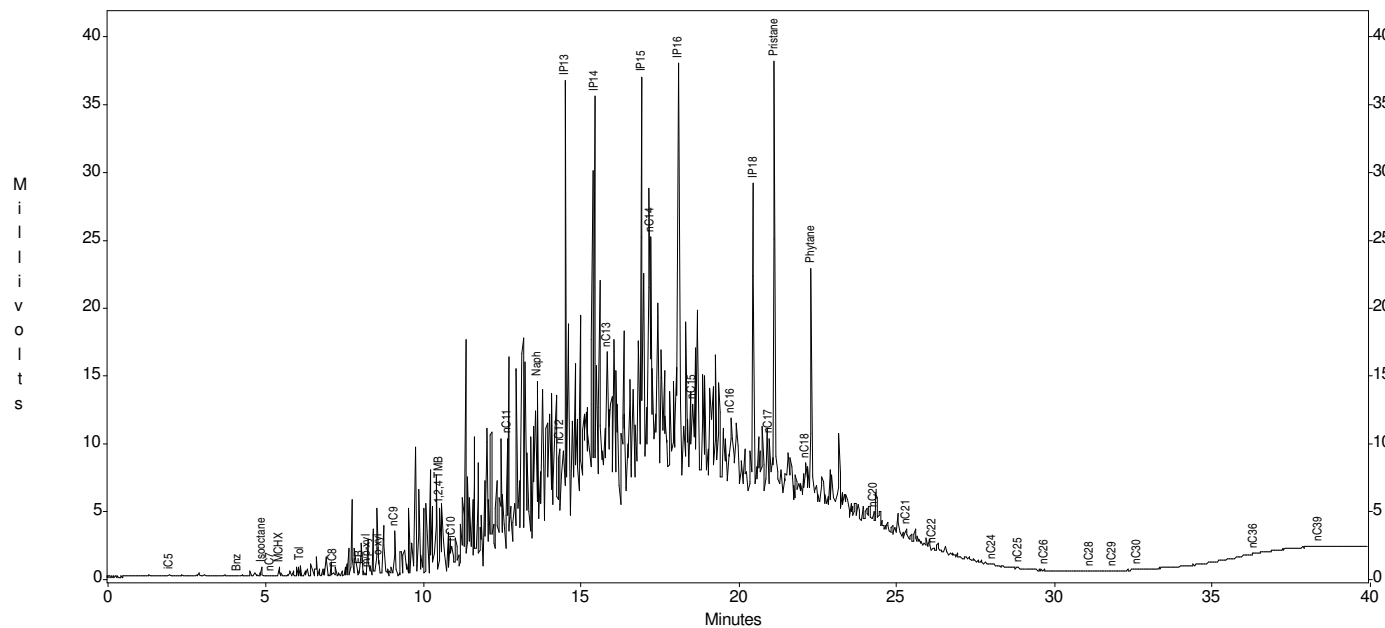
Sample ID : S57-LNAPL-042105

Acquired : Apr 25, 2005 13:27:24

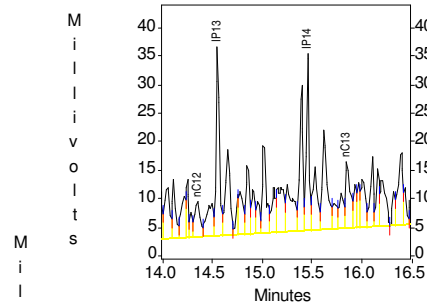
c:\ezchrom\chrom\05054\s57 -- Channel A



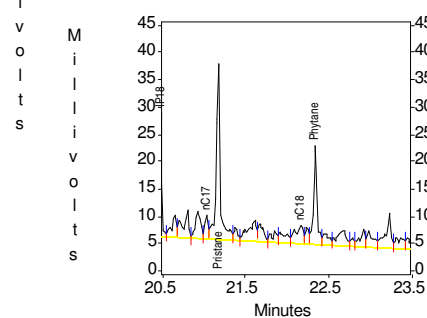
c:\ezchrom\chrom\05054\s57 -- Channel A



c:\ezchrom\chrom\05054\s57 -- Channel A



c:\ezchrom\chrom\05054\s57 -- Channel A



Channel A Results

Page 1 of 1 (3)

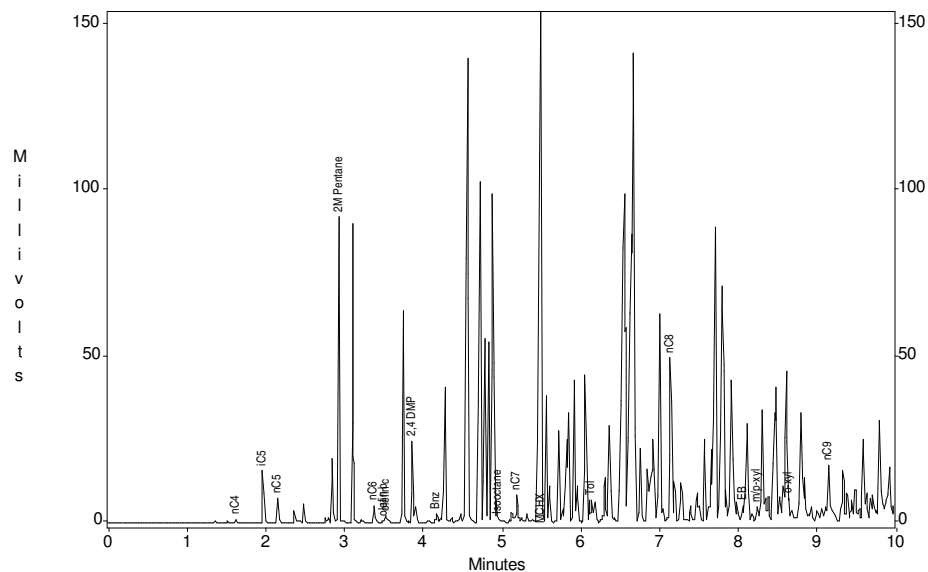
Peak	Area	Height
nC4	0	0
iC5	122	107
nC5	0	0
MTBE	0	0
2M Pentane	0	0
nC6	0	0
olefin a	0	0
olefin b	0	0
olefin c	0	0
2,4 DMP	0	0
Bnz	16	8
Isooctane	883	623
nC7	103	25
MCHX	927	580
Tol	1124	752
nC8	501	215
EB	861	517
m/p-xyl	351	218
o-xyl	1618	1141
nC9	8667	3248
1,2,4 TMB	12775	4769
nC10	6265	1719
nC11	18000	8477
Naph	28717	11767
nC12	21884	6134
IP13	68810	33052
IP14	57673	30993
nC13	39734	11800
IP15	58968	30891
nC14	43998	18867
IP16	100213	30750
nC15	20690	5153
nC16	36083	4848
IP18	54395	22906
nC17	12130	4448
Pristane	106010	32285
nC18	23752	3403
Phytane	50764	17975
nC19	0	0
nC20	4373	1476
nC21	6350	942
nC22	930	201
nC23	0	0
nC24	936	135
nC25	765	105
nC26	167	48
nC27	0	0
nC28	77	26
nC29	212	17
nC30	66	18
nC31	0	0
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	77	29
nC37	0	0
nC38	0	0
nC39	31	14
nC40	0	0

Sun - Philadelphia Refinery

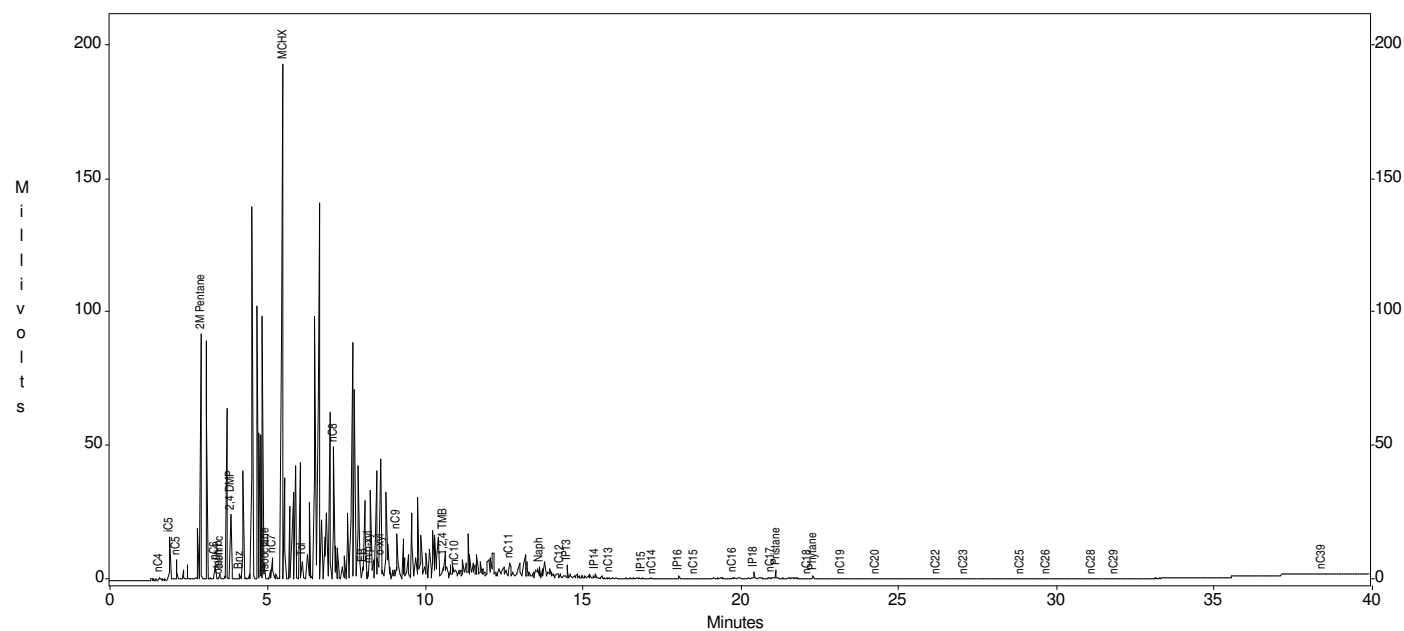
Sample ID : S77-LNAPL-042005

Acquired : Apr 26, 2005 09:19:05

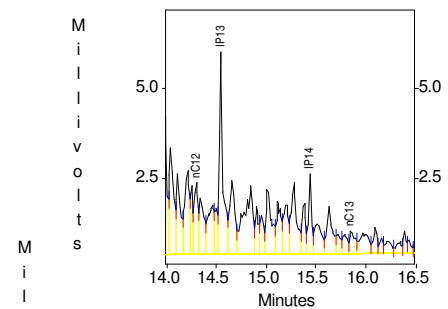
c:\ezchrom\chrom\05054\s77 -- Channel A



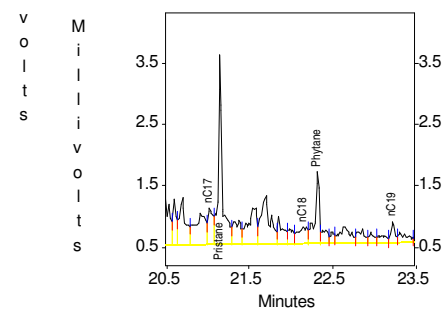
c:\ezchrom\chrom\05054\s77 -- Channel A



c:\ezchrom\chrom\05054\s77 -- Channel A



c:\ezchrom\chrom\05054\s77 -- Channel A



Channel A Results

Peak	Area	Height
nC4	745	844
iC5	13689	15662
nC5	7651	7314
MTBE	0	0
2M Pentane	91837	91850
nC6	6466	5229
olefin a	0	0
olefin b	484	462
olefin c	2620	2034
2,4 DMP	27698	24597
Bnz	3899	2383
Isooctane	943	986
nC7	13129	8196
MCHX	295413	192682
Tol	8617	6738
nC8	74654	49515
EB	8110	5042
m/p-xyl	8029	4457
o-xyl	8655	7248
nC9	51732	17271
1,2,4 TMB	24982	7530
nC10	11074	3189
nC11	15690	5922
Naph	10905	4571
nC12	4414	1969
IP13	14023	5603
IP14	4145	2198
nC13	2453	604
IP15	2007	937
nC14	793	351
IP16	3087	1278
nC15	1064	246
nC16	5553	462
IP18	11604	2649
nC17	2320	608
Pristane	10665	3093
nC18	2095	267
Phytane	4157	1173
nC19	1147	352
nC20	436	67
nC21	0	0
nC22	116	35
nC23	106	24
nC24	0	0
nC25	587	86
nC26	379	65
nC27	0	0
nC28	102	26
nC29	70	18
nC30	0	0
nC31	0	0
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	0	0
nC37	0	0
nC38	0	0
nC39	110	31
nC40	0	0

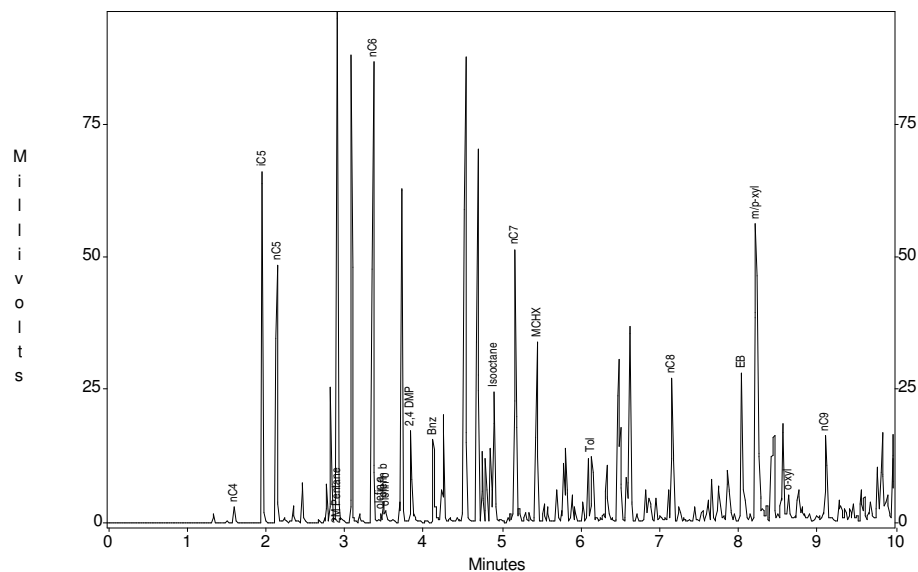
Channel A Results

Sun - Philadelphia Refinery

Sample ID : S83-LNAPL-042005

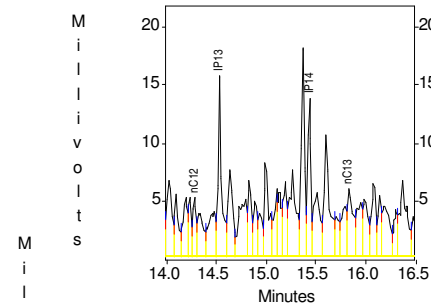
Acquired : Apr 25, 2005 15:59:15

c:\ezchrom\chrom\05054\s83 -- Channel A

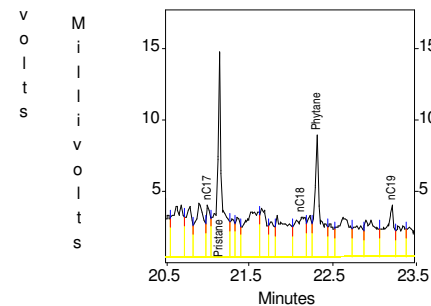


c:\ezchrom\chrom\05054\s83 -- Channel A

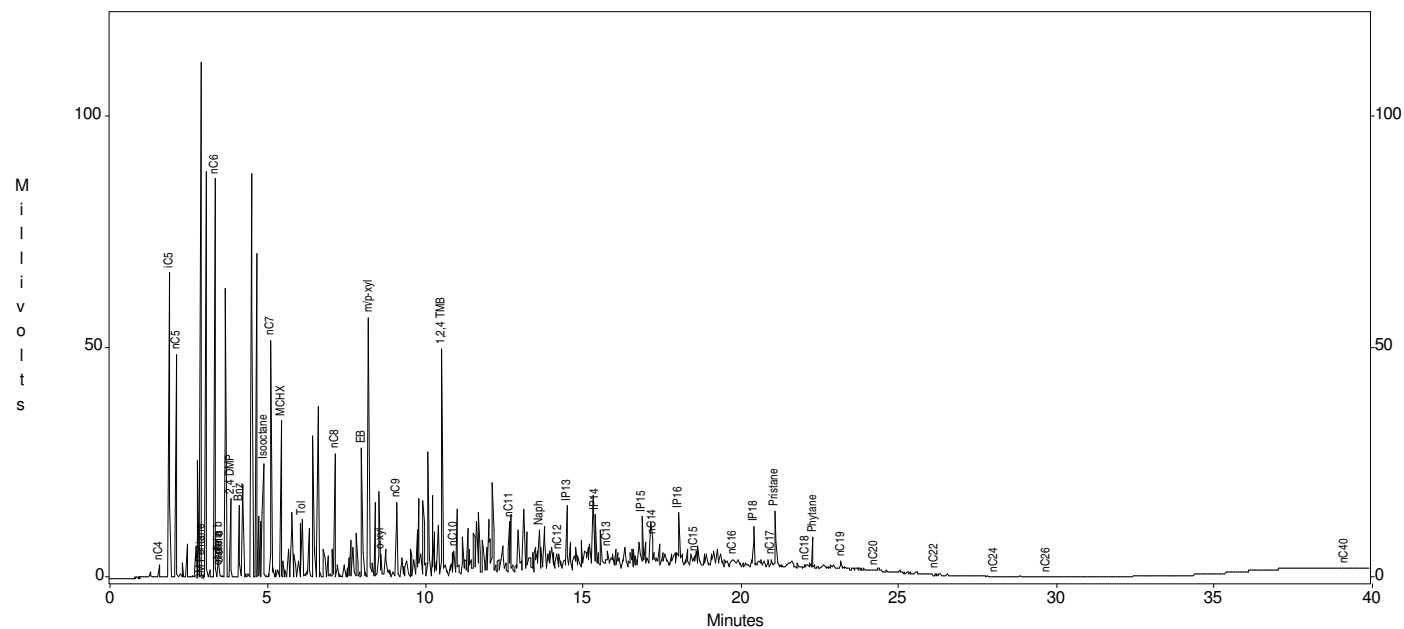
c:\ezchrom\chrom\05054\s83 -- Channel A



c:\ezchrom\chrom\05054\s83 -- Channel A

M
i
l
l
i
v
o
l
t
sM
i
l
l
i
v
o
l
t
s

Peak	Area	Height
nC4	2066	2854
iC5	50374	65890
nC5	40293	48420
MTBE	0	0
2M Pentane	107642	111457
nC6	90152	86494
olefin a	1667	1600
olefin b	4285	3836
olefin c	3676	2184
2,4 DMP	18936	17273
Bnz	23057	15537
Isooctane	28806	24518
nC7	67125	51384
MCHX	44103	33989
Tol	17135	12474
nC8	35807	26899
EB	50895	27882
m/p-xyl	140132	56086
o-xyl	9989	4963
nC9	27834	16313
1,2,4 TMB	95389	49607
nC10	12208	5858
nC11	26959	12025
Naph	26773	10298
nC12	10404	4951
IP13	37806	15492
IP14	25358	13482
nC13	21475	5724
IP15	26086	13307
nC14	23563	8254
IP16	31742	14153
nC15	20552	4545
nC16	43438	3967
IP18	56442	10970
nC17	11306	3697
Pristane	64122	14441
nC18	25754	2801
Phytane	39174	8532
nC19	26953	3600
nC20	9039	1648
nC21	0	0
nC22	3337	581
nC23	0	0
nC24	1950	171
nC25	0	0
nC26	147	18
nC27	0	0
nC28	0	0
nC29	0	0
nC30	0	0
nC31	0	0
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	0	0
nC37	0	0
nC38	0	0
nC39	0	0
nC40	61	14

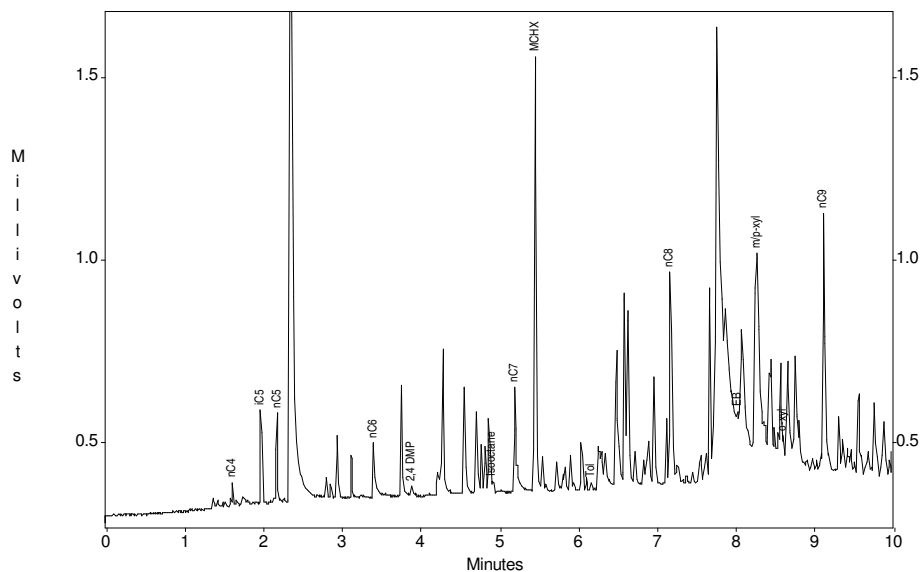


Sun - Philadelphia Refinery

Sample ID : S126-LNAPL-042005

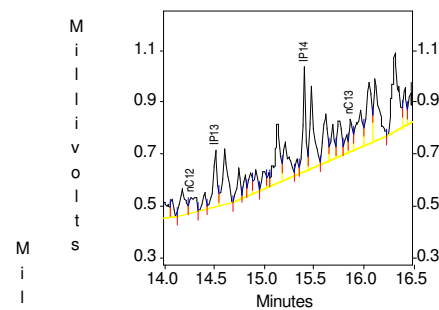
Acquired : Apr 26, 2005 11:46:25

c:\ezchrom\chrom\05054\s126 -- Channel A

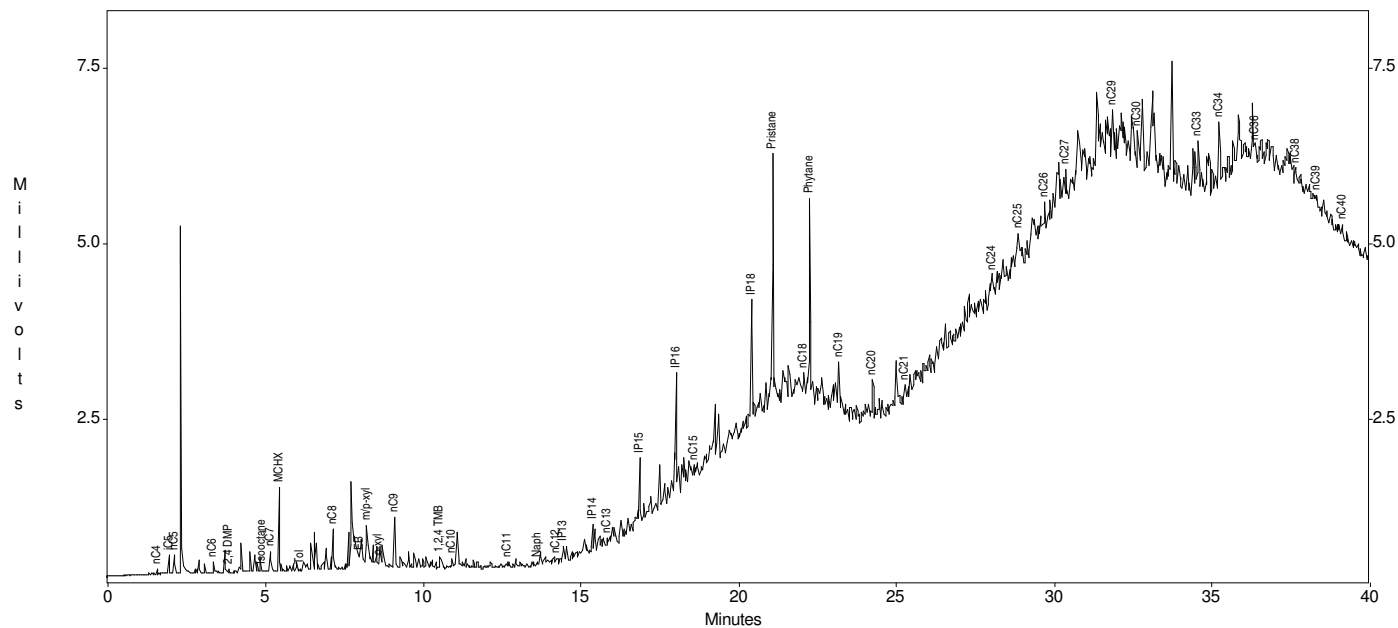
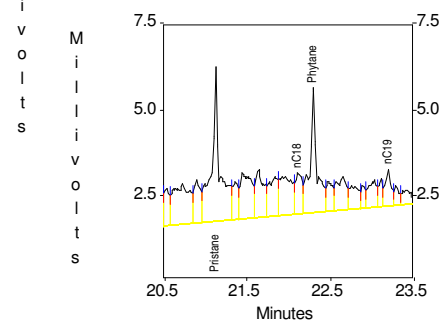


c:\ezchrom\chrom\05054\s126 -- Channel A

c:\ezchrom\chrom\05054\s126 -- Channel A



c:\ezchrom\chrom\05054\s126 -- Channel A

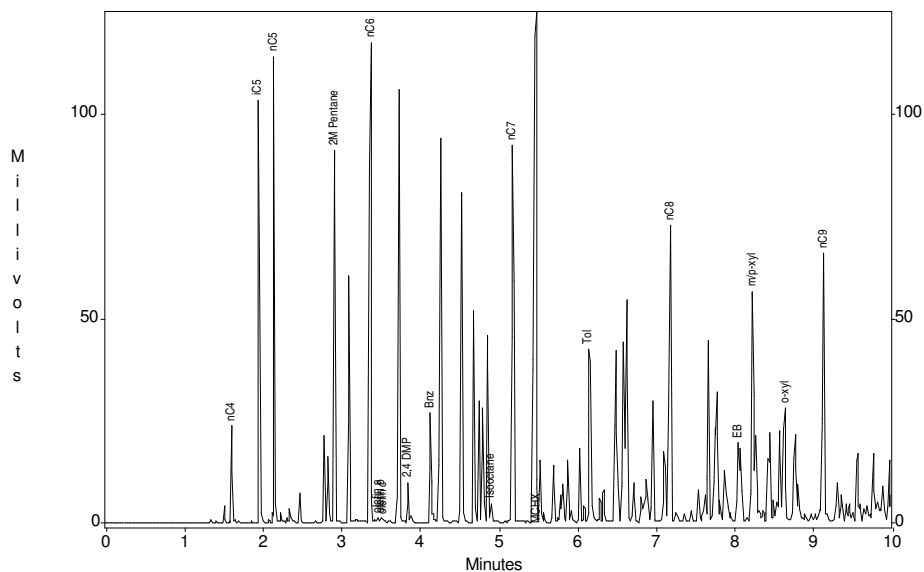


Channel A Results

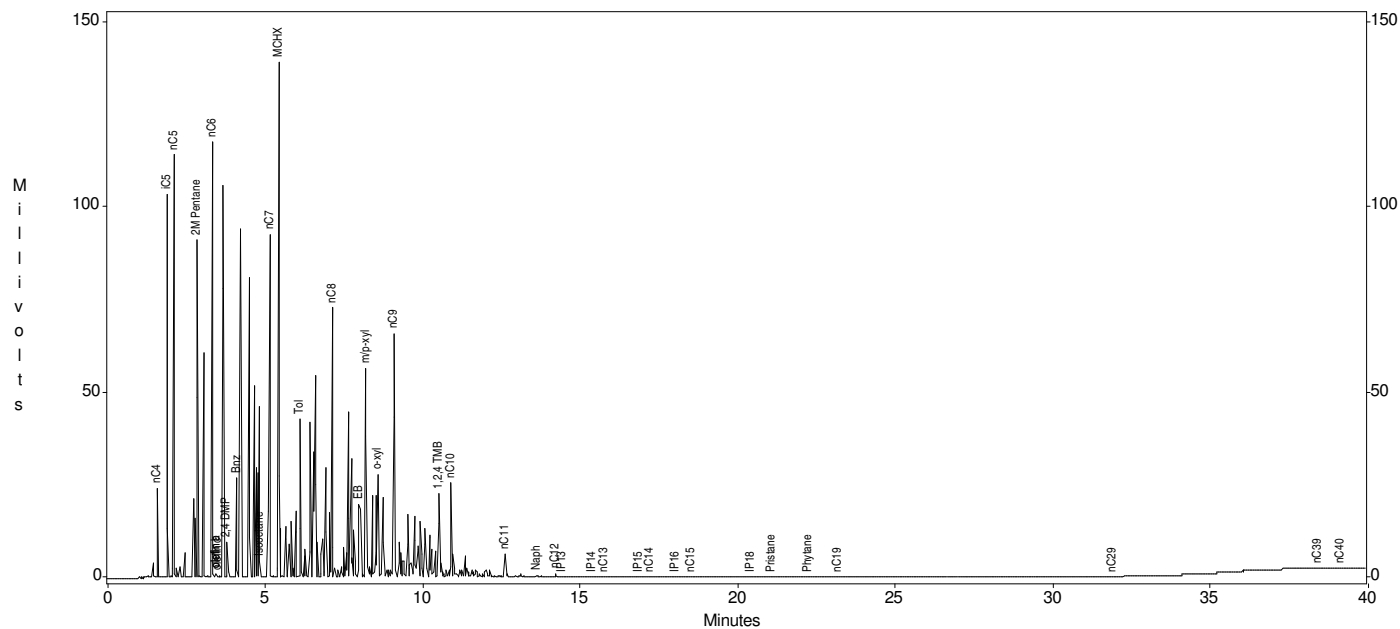
Peak	Area	Height
nC4	55	64
iC5	224	255
nC5	248	241
MTBE	0	0
2M Pentane	0	0
nC6	314	148
olefin a	0	0
olefin b	0	0
olefin c	0	0
2,4 DMP	57	28
Bnz	0	0
Isooctane	41	29
nC7	664	284
MCHX	1696	1184
Tol	44	23
nC8	1076	590
EB	369	206
m/p-xyl	2912	638
o-xyl	229	139
nC9	1823	744
1,2,4 TMB	805	189
nC10	503	150
nC11	201	92
Naph	122	47
nC12	308	64
IP13	585	220
IP14	811	407
nC13	314	130
IP15	2429	1062
nC14	0	0
IP16	7943	2021
nC15	2373	598
nC16	0	0
IP18	13607	2558
nC17	0	0
Pristane	32400	4496
nC18	6948	1171
Phytane	20520	3600
nC19	4828	1090
nC20	1972	600
nC21	798	230
nC22	0	0
nC23	0	0
nC24	3887	427
nC25	8620	587
nC26	5793	579
nC27	3081	676
nC28	0	0
nC29	2833	753
nC30	1569	512
nC31	0	0
nC32	0	0
nC33	1447	589
nC34	3994	877
nC35	0	0
nC36	179	121
nC37	0	0
nC38	632	198
nC39	339	102
nC40	374	147

Sun - Philadelphia Refinery
Sample ID : S160-LNAPL-042005
Acquired : Apr 26, 2005 12:42:54

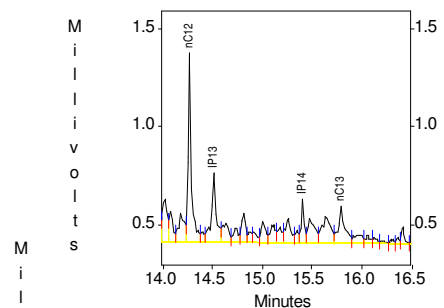
c:\ezchrom\chrom\05054\s160 -- Channel A



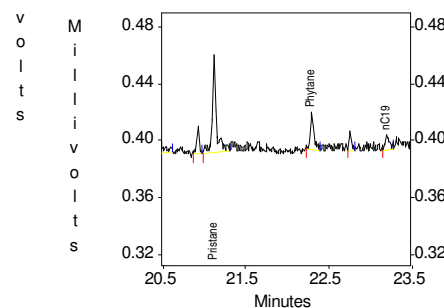
c:\ezchrom\chrom\05054\s160 -- Channel A



c:\ezchrom\chrom\05054\s160 -- Channel A



c:\ezchrom\chrom\05054\s160 -- Channel A

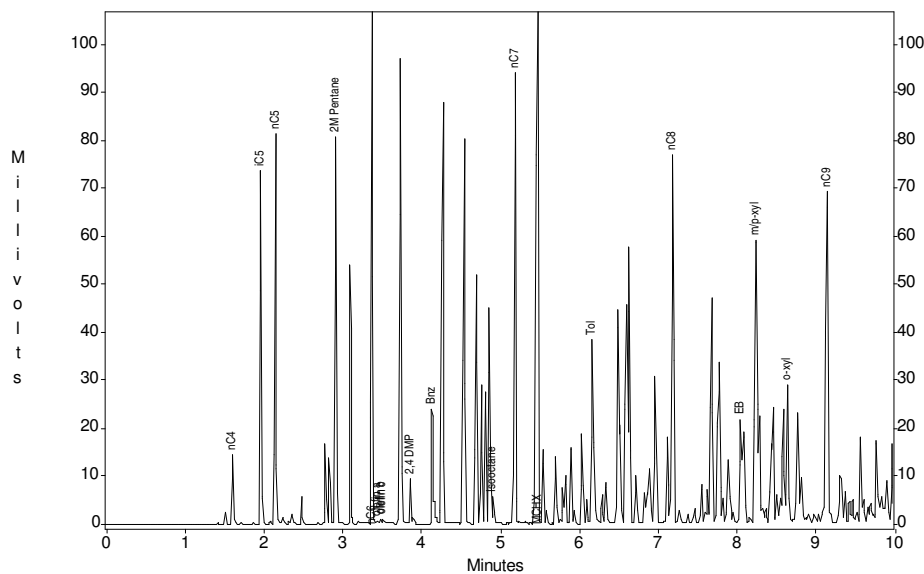


Channel A Results

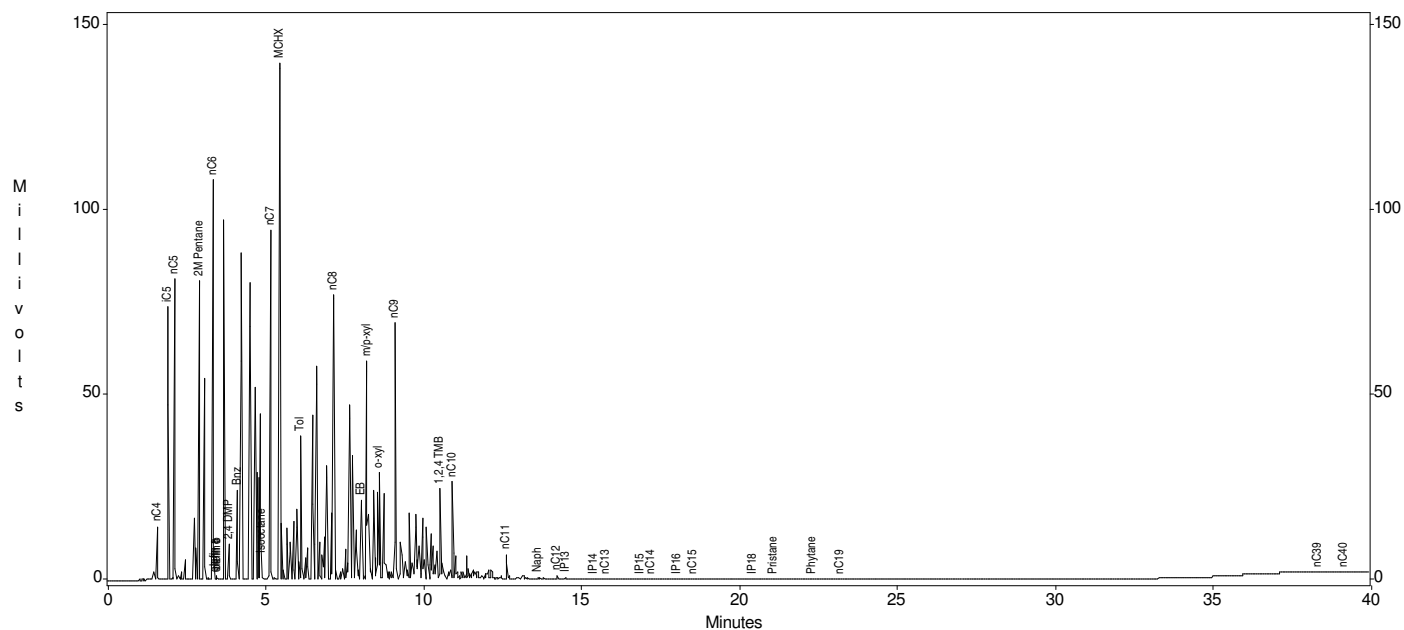
Peak	Area	Height
nC4	17505	23967
iC5	83014	103747
nC5	94147	114170
MTBE	0	0
2M Pentane	88607	91232
nC6	131411	117762
olefin a	1453	1132
olefin b	1311	1029
olefin c	1231	736
2,4 DMP	10702	9792
Bnz	37030	26891
Isocotane	6020	4629
nC7	135672	92543
MCHX	247161	139058
Tol	57997	42316
nC8	115677	72908
EB	36725	19658
m/p-xyl	120755	56499
o-xyl	48502	27868
nC9	130150	65886
1,2,4 TMB	42571	22635
nC10	39030	25359
nC11	10567	6046
Naph	1503	535
nC12	2110	968
IP13	1120	354
IP14	456	228
nC13	819	190
IP15	217	116
nC14	168	49
IP16	289	99
nC15	151	23
nC16	0	0
IP18	111	37
nC17	0	0
Pristane	221	69
nC18	0	0
Phytane	69	25
nC19	38	11
nC20	0	0
nC21	0	0
nC22	0	0
nC23	0	0
nC24	0	0
nC25	0	0
nC26	0	0
nC27	0	0
nC28	0	0
nC29	190	25
nC30	0	0
nC31	0	0
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	0	0
nC37	0	0
nC38	0	0
nC39	143	33
nC40	24	18

Sun - Philadelphia Refinery
Sample ID : S161-LNAPL-042005
Acquired : Apr 26, 2005 10:58:03

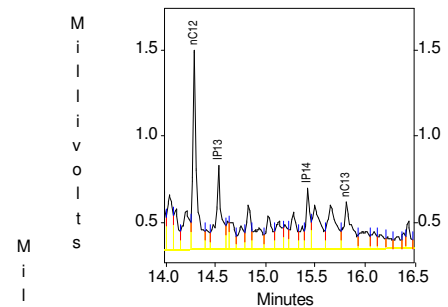
c:\ezchrom\chrom\05054\s161 -- Channel A



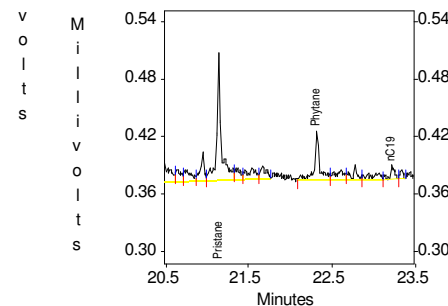
c:\ezchrom\chrom\05054\s161 -- Channel A



c:\ezchrom\chrom\05054\s161 -- Channel A



c:\ezchrom\chrom\05054\s161 -- Channel A



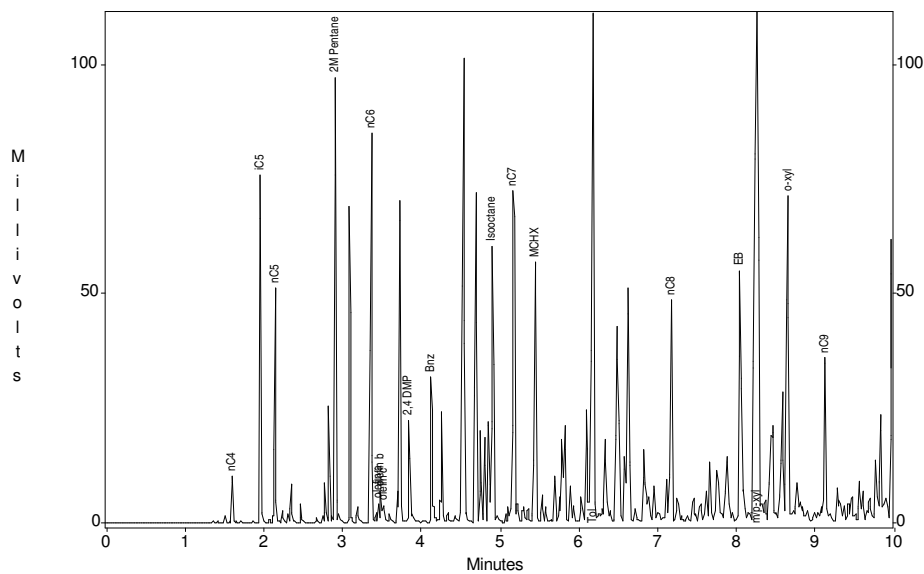
Peak	Area	Height
nC4	10594	14390
iC5	58797	73717
nC5	70252	81340
MTBE	0	0
2M Pentane	77472	80619
nC6	119053	107947
olefin a	888	592
olefin b	1274	946
olefin c	1181	922
2,4 DMP	10474	9443
Bnz	34391	24024
Isooctane	7607	5712
nC7	139225	94243
MCHX	248410	139452
Tol	57001	38639
nC8	124388	77219
EB	40561	21603
m/p-xyl	130505	59076
o-xyl	51681	29167
nC9	139055	69551
1,2,4 TMB	46970	24607
nC10	42072	26548
nC11	12049	6640
Naph	2042	685
nC12	2854	1154
IP13	1850	486
IP14	797	353
nC13	1372	268
IP15	581	215
nC14	1088	136
IP16	746	183
nC15	513	58
nC16	0	0
IP18	281	72
nC17	0	0
Pristane	490	133
nC18	0	0
Phytane	229	51
nC19	60	13
nC20	0	0
nC21	0	0
nC22	0	0
nC23	0	0
nC24	0	0
nC25	0	0
nC26	0	0
nC27	0	0
nC28	0	0
nC29	0	0
nC30	0	0
nC31	0	0
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	0	0
nC37	0	0
nC38	0	0
nC39	21	15
nC40	37	17

Sun - Philadelphia Refinery

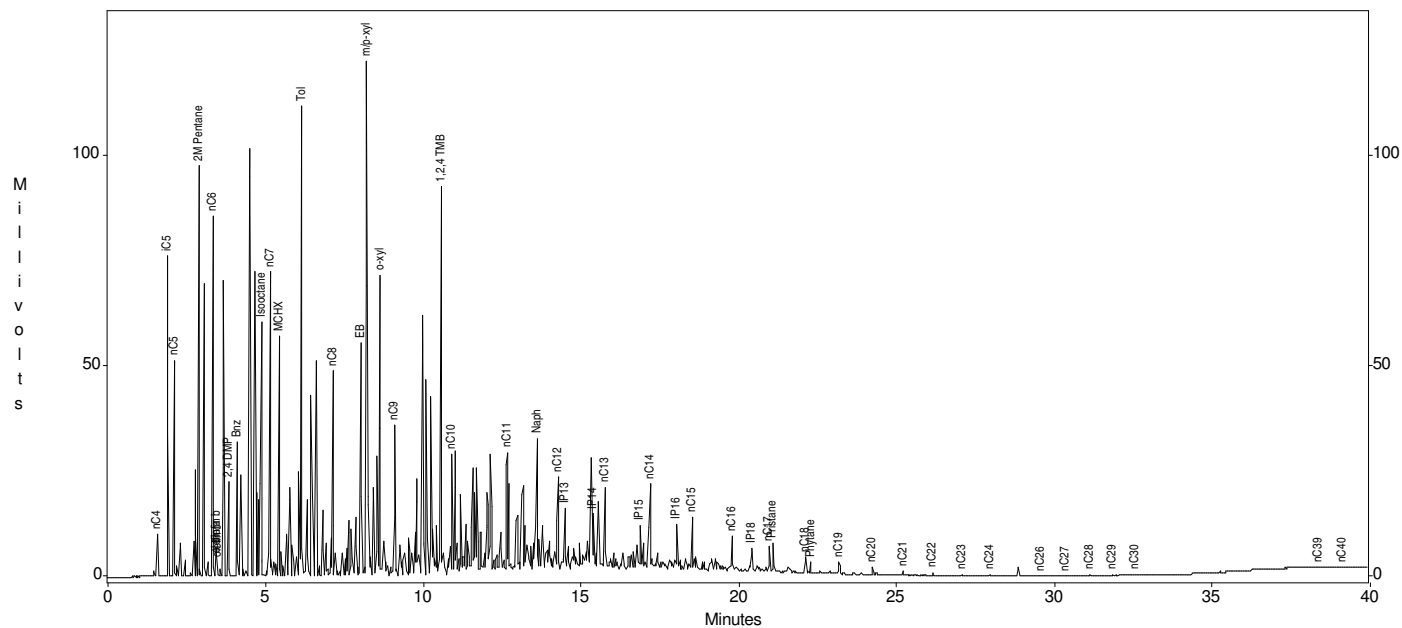
Sample ID : S198-LNAPL-042005

Acquired : Apr 25, 2005 15:11:04

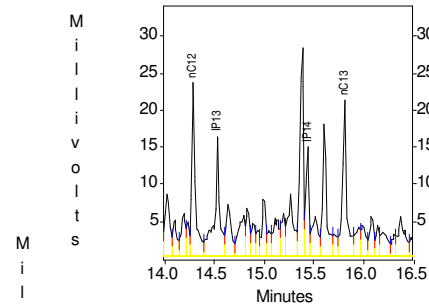
c:\ezchrom\chrom\05054\s198 -- Channel A



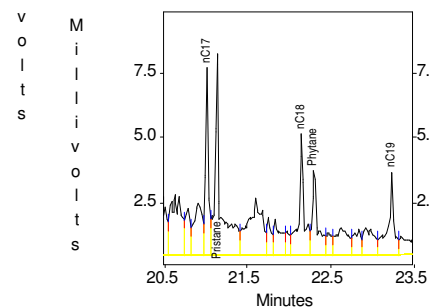
c:\ezchrom\chrom\05054\s198 -- Channel A



c:\ezchrom\chrom\05054\s198 -- Channel A



c:\ezchrom\chrom\05054\s198 -- Channel A



Channel A Results

Page 1 of 1 (9)

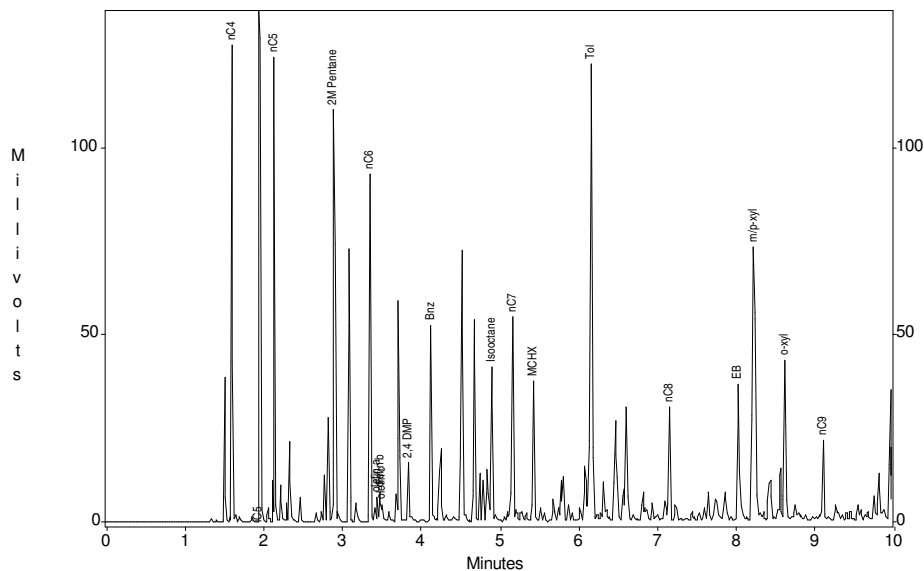
Peak	Area	Height
nC4	6805	10193
iC5	56062	76092
nC5	41370	51174
MTBE	0	0
2M Pentane	94987	97341
nC6	88612	85212
olefin a	4768	4149
olefin b	7273	6670
olefin c	5630	3602
2,4 DMP	24785	22357
Bnz	43426	31804
Isooctane	77664	60425
nC7	103956	72263
MCHX	76887	56499
Tol	185088	111104
nC8	70463	48501
EB	105627	55069
m/p-xyl	386115	121810
o-xyl	135212	71315
nC9	63724	35758
1,2,4 TMB	228975	92309
nC10	47999	28685
nC11	69618	29135
Naph	92168	32466
nC12	55621	23365
IP13	60906	16191
IP14	27028	14790
nC13	59351	21028
IP15	23022	11823
nC14	46462	21673
IP16	27950	12557
nC15	43063	13846
nC16	37188	9376
IP18	35271	6482
nC17	16510	7152
Pristane	39417	7725
nC18	19805	4642
Phytane	14102	3240
nC19	15548	3172
nC20	6030	2032
nC21	2868	1132
nC22	1681	622
nC23	802	316
nC24	377	172
nC25	0	0
nC26	340	94
nC27	405	102
nC28	407	90
nC29	213	46
nC30	197	29
nC31	0	0
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	0	0
nC37	0	0
nC38	0	0
nC39	47	15
nC40	18	11

Sun - Philadelphia Refinery

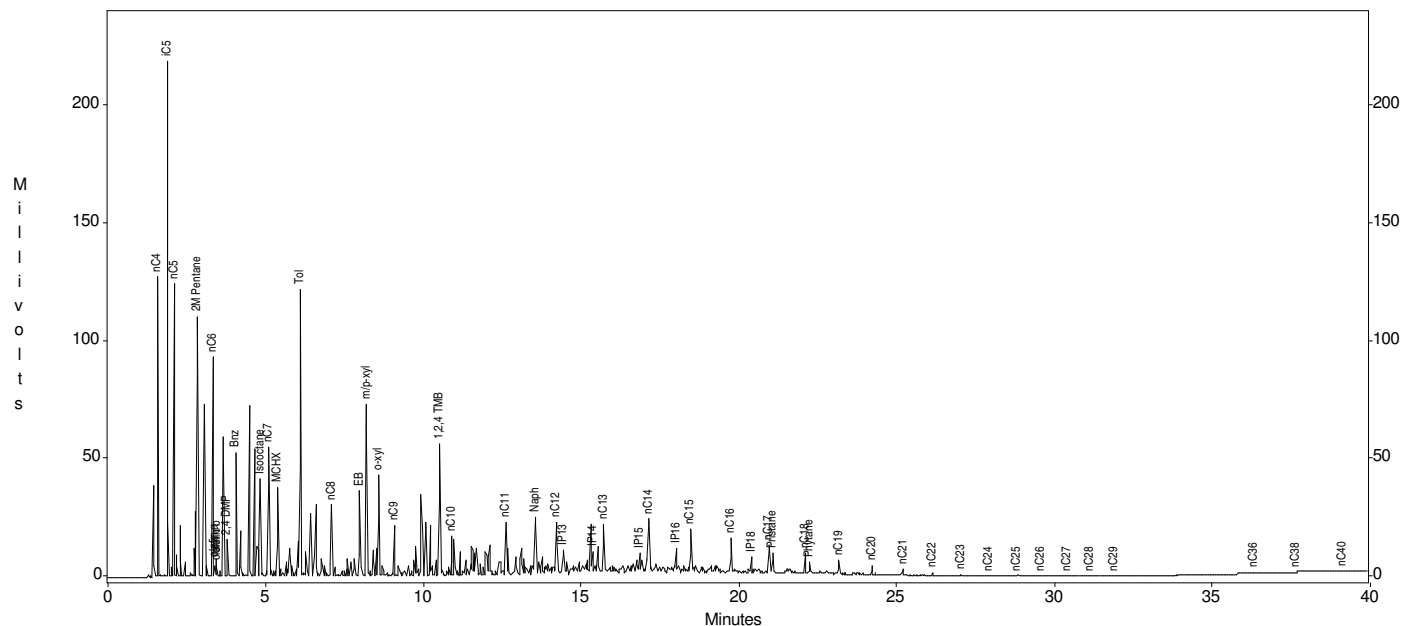
Sample ID : S199-LNAPL-042005

Acquired : Apr 26, 2005 14:20:57

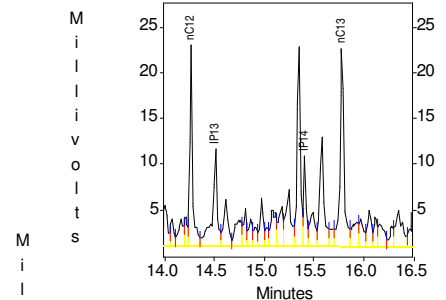
c:\ezchrom\chrom\05054\s199 -- Channel A



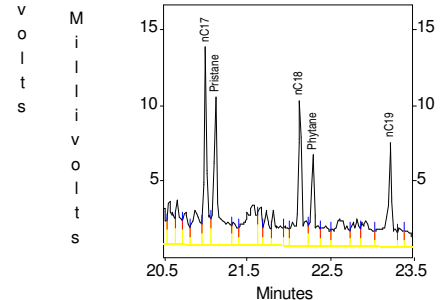
c:\ezchrom\chrom\05054\s199 -- Channel A



c:\ezchrom\chrom\05054\s199 -- Channel A



c:\ezchrom\chrom\05054\s199 -- Channel A



M
i
l
l
i
v
o
l
t
s

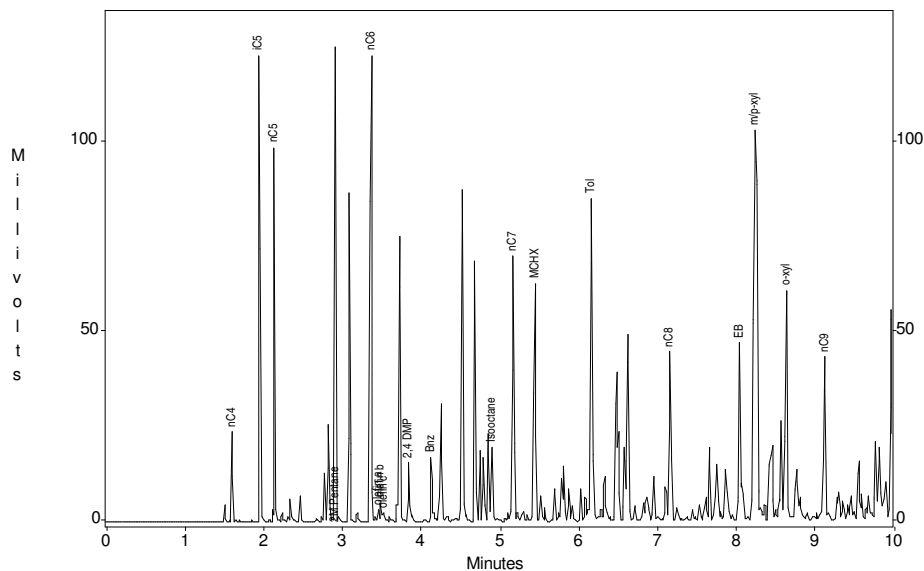
Peak	Area	Height
nC4	90952	127676
iC5	174049	218801
nC5	105932	124673
MTBE	0	0
2M Pentane	111384	110654
nC6	100959	93398
olefin a	7664	6471
olefin b	8672	7759
olefin c	6643	4393
2,4 DMP	19267	15861
Bnz	67979	52520
Isooctane	50589	41492
nC7	76748	55080
MCHX	50195	37642
Tol	218179	122448
nC8	41461	30343
EB	61977	36401
m/p-xyl	200649	73193
o-xyl	72197	43297
nC9	35760	21523
1,2,4 TMB	108568	56012
nC10	26484	17172
nC11	45669	21932
Naph	65046	24279
nC12	48352	21951
IP13	35607	10592
IP14	18471	9848
nC13	57127	21692
IP15	19234	9096
nC14	52138	24282
IP16	25743	11150
nC15	65275	19244
nC16	50196	15849
IP18	38985	7814
nC17	32388	13022
Pristane	38462	9661
nC18	33914	9513
Phytane	19600	5918
nC19	28849	6862
nC20	11066	4407
nC21	6730	2562
nC22	3572	1436
nC23	1769	669
nC24	666	329
nC25	320	167
nC26	274	108
nC27	217	63
nC28	148	46
nC29	148	26
nC30	0	0
nC31	0	0
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	111	36
nC37	0	0
nC38	71	25
nC39	0	0
nC40	42	14

Sun - Philadelphia Refinery

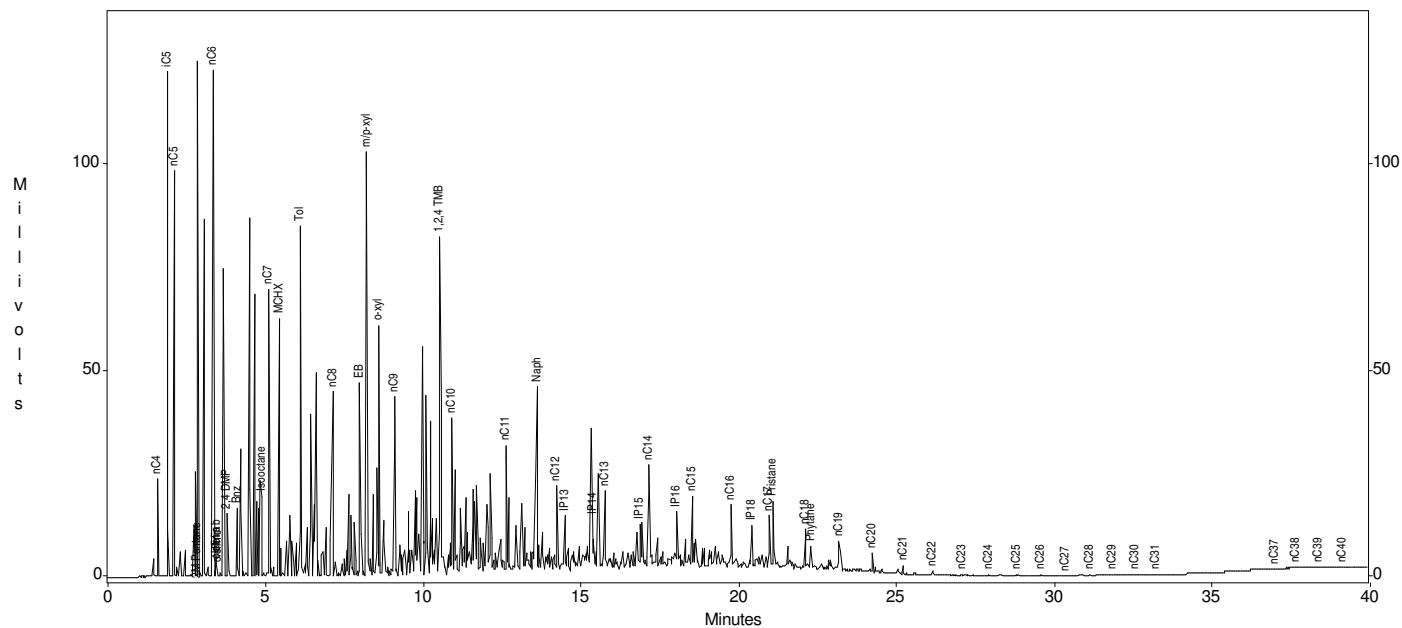
Sample ID : S200-LNAPL-042005

Acquired : Apr 25, 2005 12:38:28

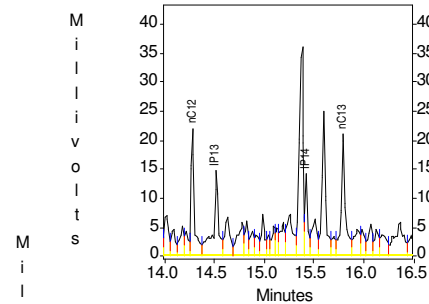
c:\ezchrom\chrom\05054\s200 -- Channel A



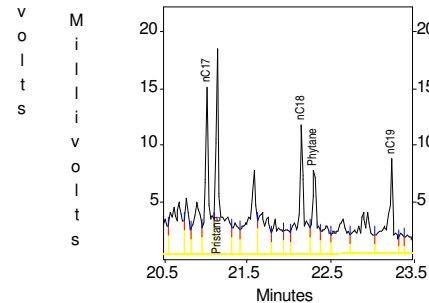
c:\ezchrom\chrom\05054\s200 -- Channel A



c:\ezchrom\chrom\05054\s200 -- Channel A



c:\ezchrom\chrom\05054\s200 -- Channel A



Millivolts

Millivolts

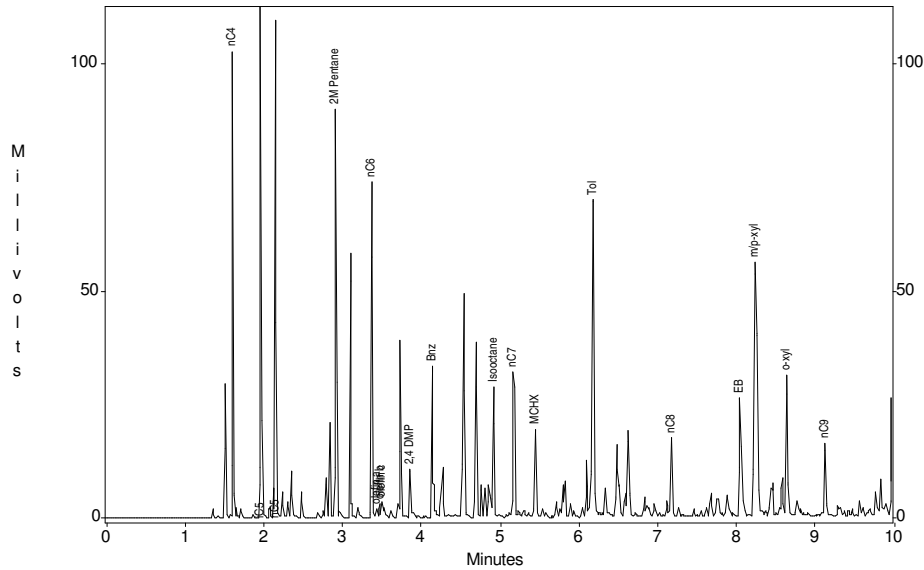
Millivolts

Sun - Philadelphia Refinery

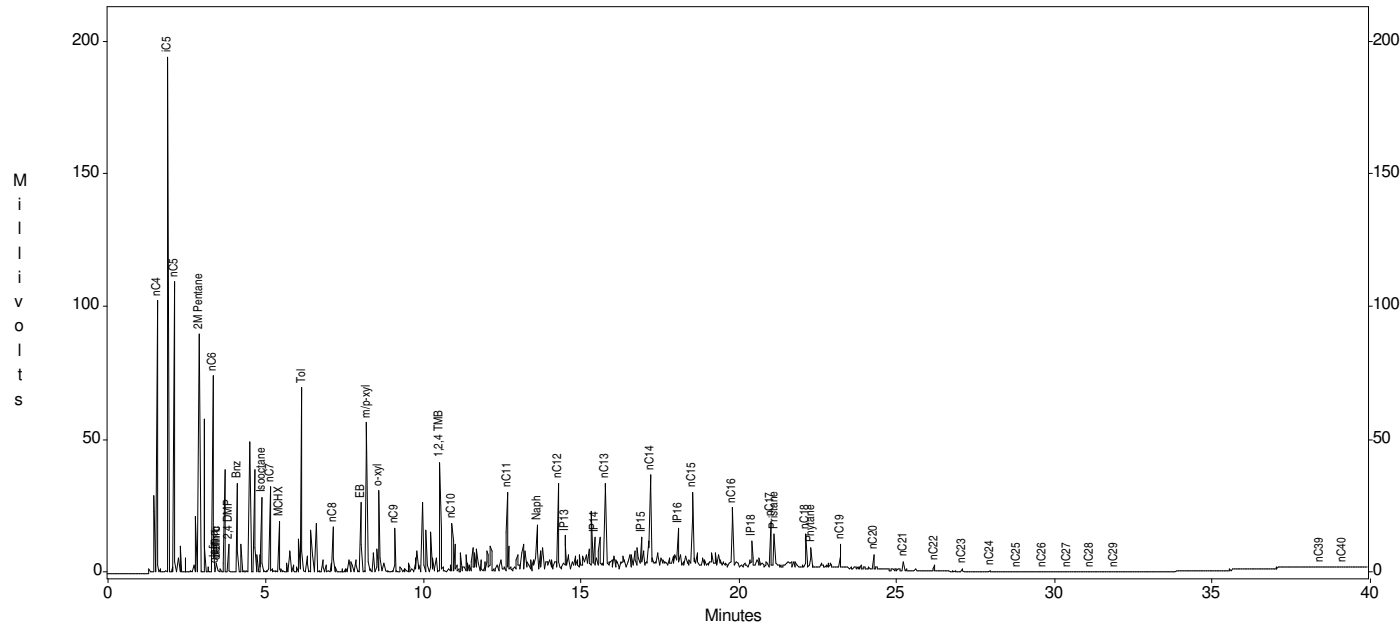
Sample ID : S201-LNAPL-042005

Acquired : Apr 26, 2005 15:10:11

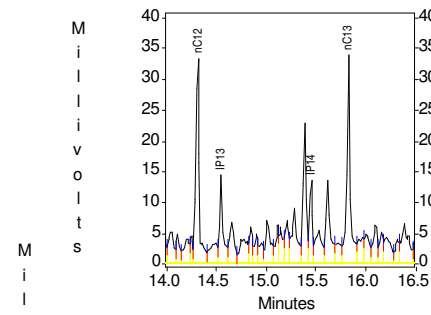
c:\ezchrom\chrom\05054\s201 -- Channel A



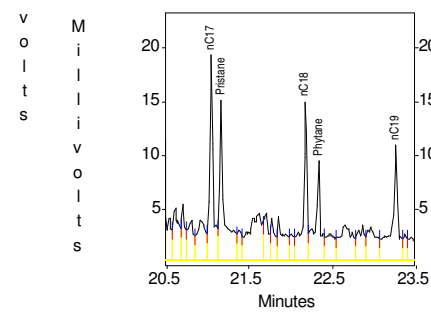
c:\ezchrom\chrom\05054\s201 -- Channel A



c:\ezchrom\chrom\05054\s201 -- Channel A



c:\ezchrom\chrom\05054\s201 -- Channel A

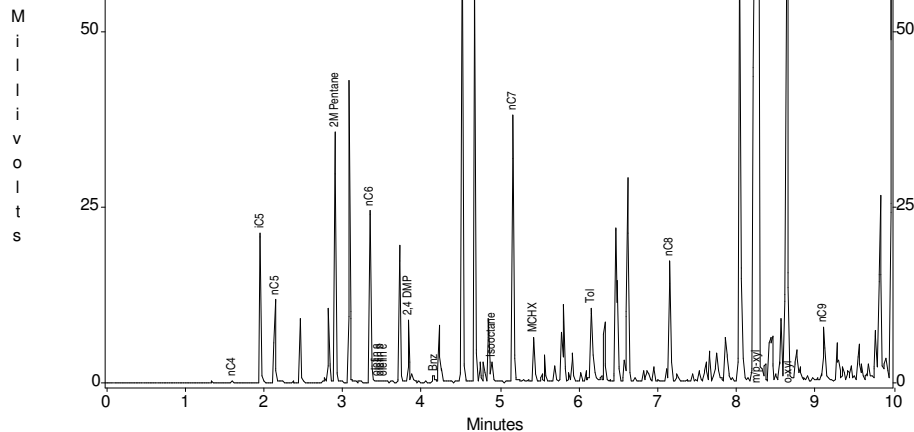


Millivolts

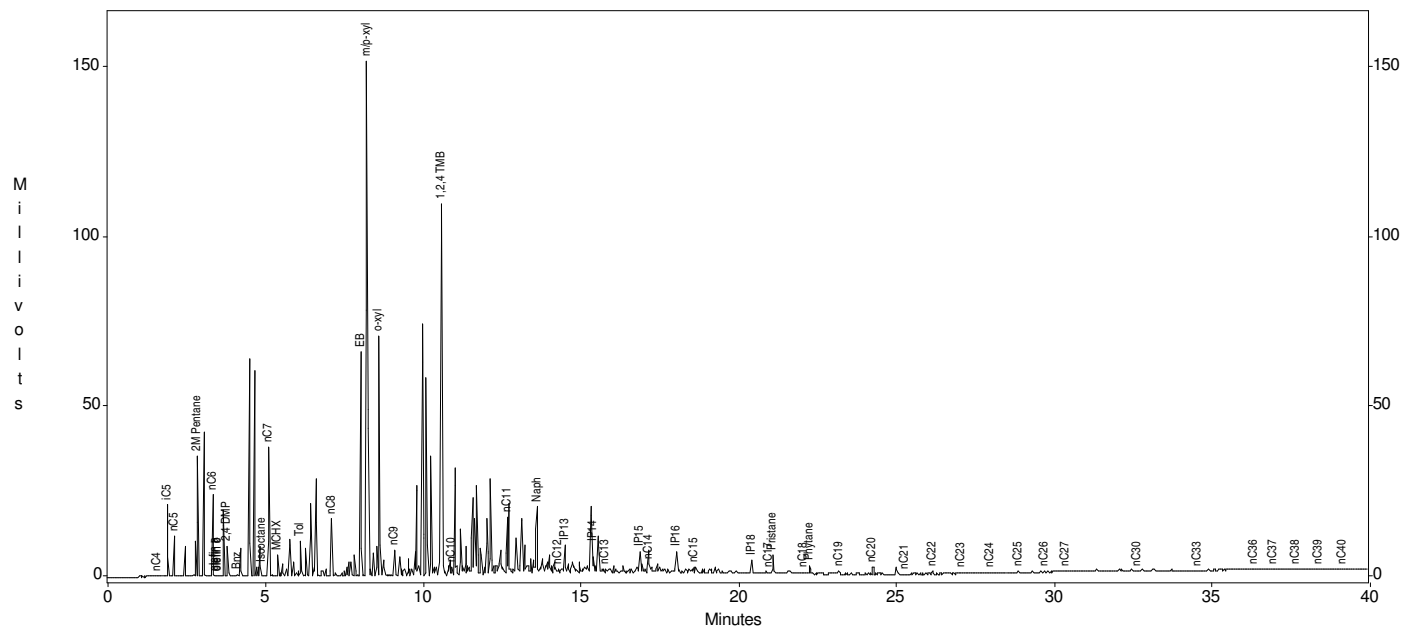
Peak	Area	Height
nC4	68792	102692
iC5	143867	193951
nC5	87884	109676
MTBE	0	0
2M Pentane	85546	90001
nC6	75128	74038
olefin a	2111	1846
olefin b	3942	3141
olefin c	4020	3521
2,4 DMP	11817	10555
Bnz	44718	33420
Isocotane	34262	28657
nC7	41504	32134
MCHX	25788	19423
Tol	105969	69952
nC8	22589	17270
EB	43298	26367
m/p-xyl	140769	56192
o-xyl	49082	31075
nC9	25181	16387
1,2,4 TMB	74115	41736
nC10	28657	18756
nC11	56326	30255
Naph	61462	17868
nC12	71983	33352
IP13	33811	14260
IP14	24419	13340
nC13	83454	33833
IP15	26663	13533
nC14	76434	37111
IP16	44752	16669
nC15	87372	30605
nC16	80114	24201
IP18	63981	12207
nC17	51179	19052
Pristane	63474	14796
nC18	46824	14724
Phytane	42353	9107
nC19	49739	10672
nC20	18390	6889
nC21	11344	4196
nC22	6343	2441
nC23	4992	1246
nC24	1626	590
nC25	1236	253
nC26	509	139
nC27	180	65
nC28	140	41
nC29	182	20
nC30	0	0
nC31	0	0
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	0	0
nC37	0	0
nC38	0	0
nC39	22	14
nC40	189	31

Sun - Philadelphia Refinery
Sample ID : S205-LNAPL-042005
Acquired : Apr 25, 2005 17:38:08

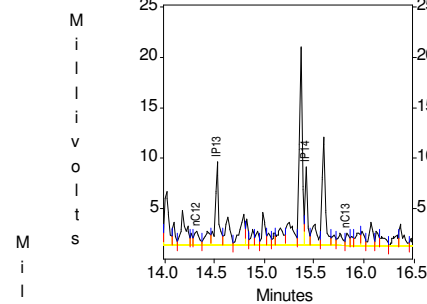
c:\ezchrom\chrom\05054\s205.2 -- Channel A



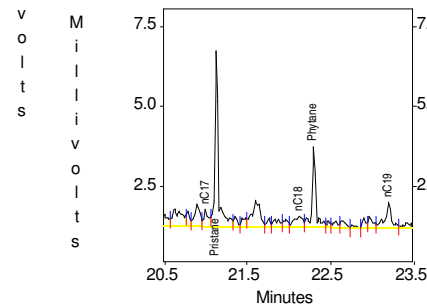
c:\ezchrom\chrom\05054\s205.2 -- Channel A



c:\ezchrom\chrom\05054\s205.2 -- Channel A



c:\ezchrom\chrom\05054\s205.2 -- Channel A



M
i
l
l
i
v
o
l
t
s

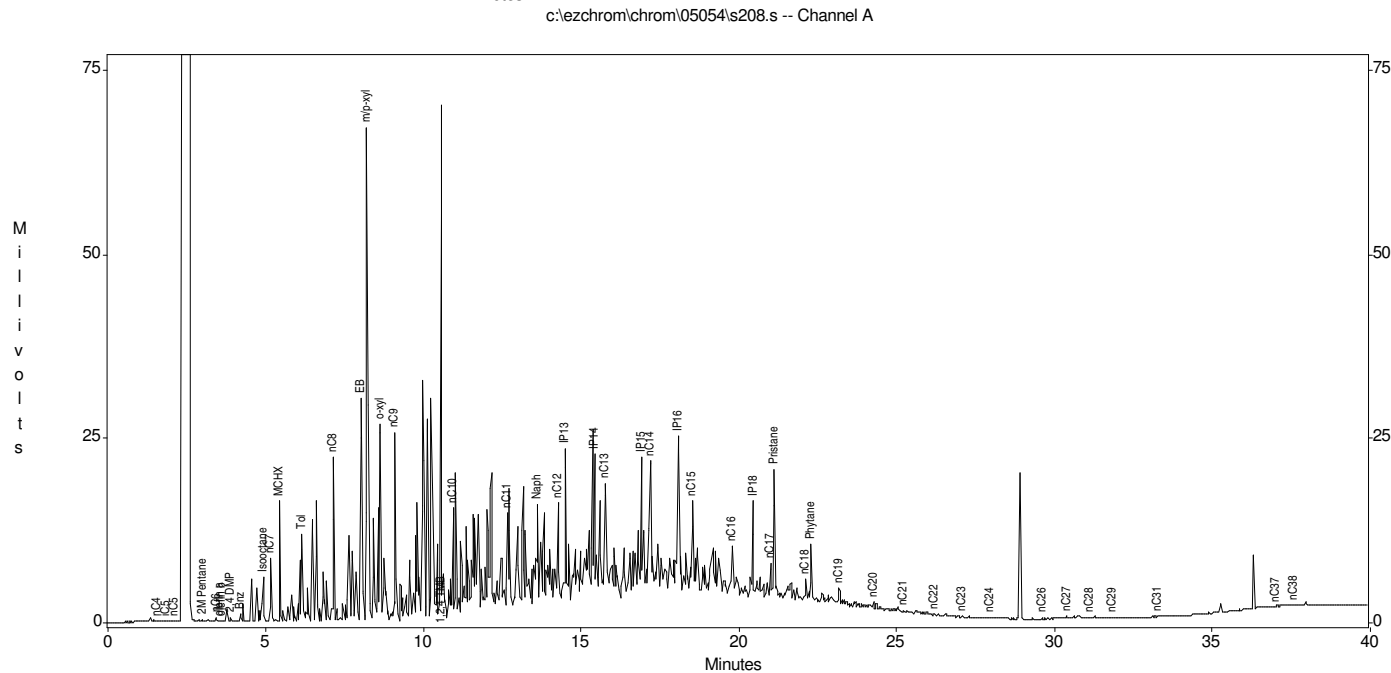
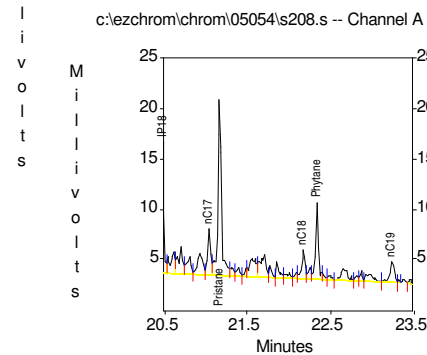
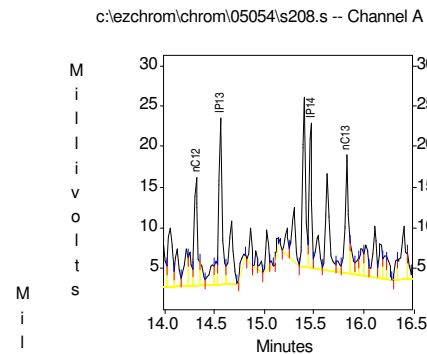
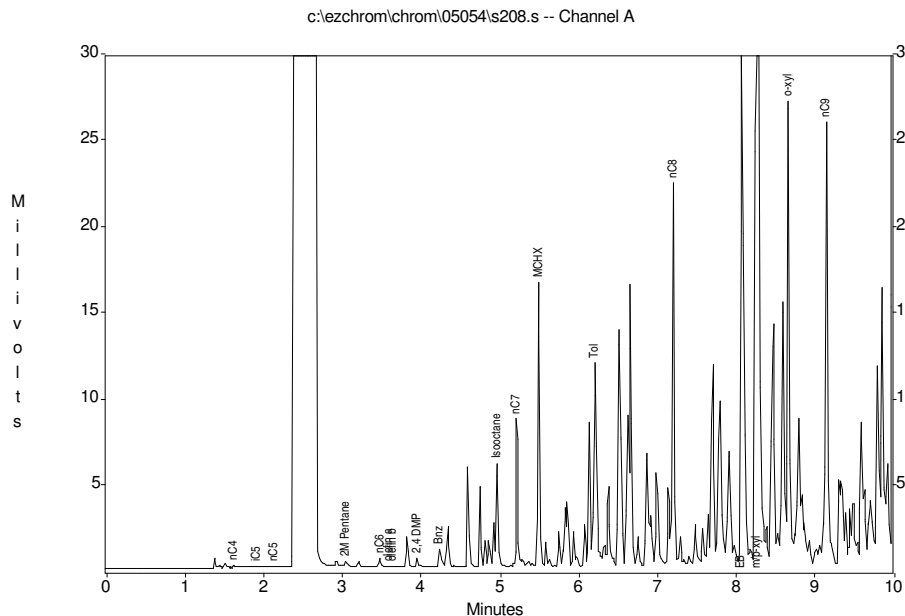
M
i
l
l
i
v
o
l
t
s

M
i
l
l
i
v
o
l
t
s

M
i
l
l
i
v
o
l
t
s

Peak	Area	Height
nC4	204	253
iC5	16906	21225
nC5	11104	11895
MTBE	0	0
2M Pentane	34500	35496
nC6	25682	24268
olefin a	153	100
olefin b	170	115
olefin c	299	240
2,4 DMP	9544	8853
Bnz	1711	901
Isooctane	4048	2865
nC7	45624	38063
MCHX	8580	6248
Tol	19741	10392
nC8	22260	17140
EB	109573	65993
m/p-xyl	496002	151358
o-xyl	125750	70567
nC9	16041	7812
1,2,4 TMB	284981	109548
nC10	6043	2257
nC11	28798	16591
Naph	44906	19685
nC12	4503	1445
IP13	20152	8378
IP14	12613	7765
nC13	3056	1260
IP15	11100	6527
nC14	6947	2561
IP16	17804	6161
nC15	3758	1681
nC16	0	0
IP18	11724	3711
nC17	1953	589
Pristane	16037	5499
nC18	2607	396
Phytane	7675	2560
nC19	4351	853
nC20	5036	2140
nC21	780	112
nC22	1751	697
nC23	279	61
nC24	1439	248
nC25	2842	298
nC26	829	218
nC27	825	165
nC28	0	0
nC29	0	0
nC30	378	108
nC31	0	0
nC32	0	0
nC33	371	116
nC34	0	0
nC35	0	0
nC36	21	21
nC37	28	11
nC38	137	24
nC39	34	8
nC40	48	22

Sun - Philadelphia Refinery
Sample ID : S208-LNAPL-042005
Acquired : Apr 26, 2005 16:47:57



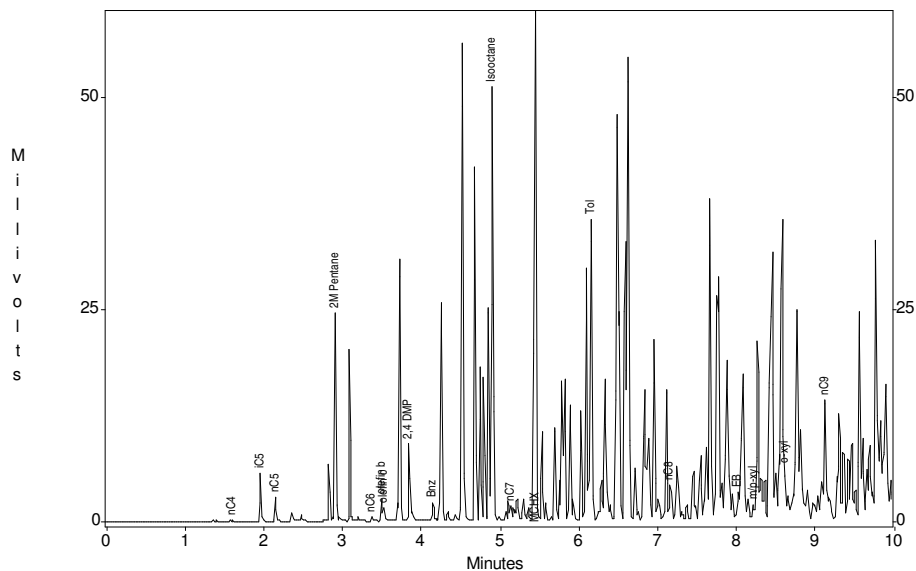
Peak	Area	Height
nC4	174	119
iC5	20	10
nC5	30	14
MTBE	0	0
2M Pentane	522	227
nC6	914	490
olefin a	34	22
olefin b	131	43
olefin c	0	0
2,4 DMP	757	483
Bnz	2122	1034
Isodane	9321	5918
nC7	13670	8542
MCHX	25149	16442
Tol	23584	11792
nC8	36187	22166
EB	54597	30320
m/p-xyl	193165	66902
o-xyl	52529	26770
nC9	47366	25594
1,2,4 TMB	157499	69554
nC10	28645	14798
nC11	39542	12935
Naph	45490	13611
nC12	28900	13467
IP13	46827	20611
IP14	30669	17915
nC13	33488	14700
IP15	34292	18450
nC14	44519	17659
IP16	47906	20613
nC15	22023	11159
nC16	22629	6481
IP18	32847	13050
nC17	11022	4633
Pristane	49324	17595
nC18	8214	2891
Phytane	18197	7653
nC19	8044	2056
nC20	2505	1038
nC21	1048	359
nC22	668	275
nC23	643	154
nC24	256	132
nC25	0	0
nC26	218	98
nC27	1501	315
nC28	1315	183
nC29	129	34
nC30	0	0
nC31	361	35
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	0	0
nC37	122	31
nC38	318	21
nC39	0	0
nC40	0	0

Sun - Philadelphia Refinery

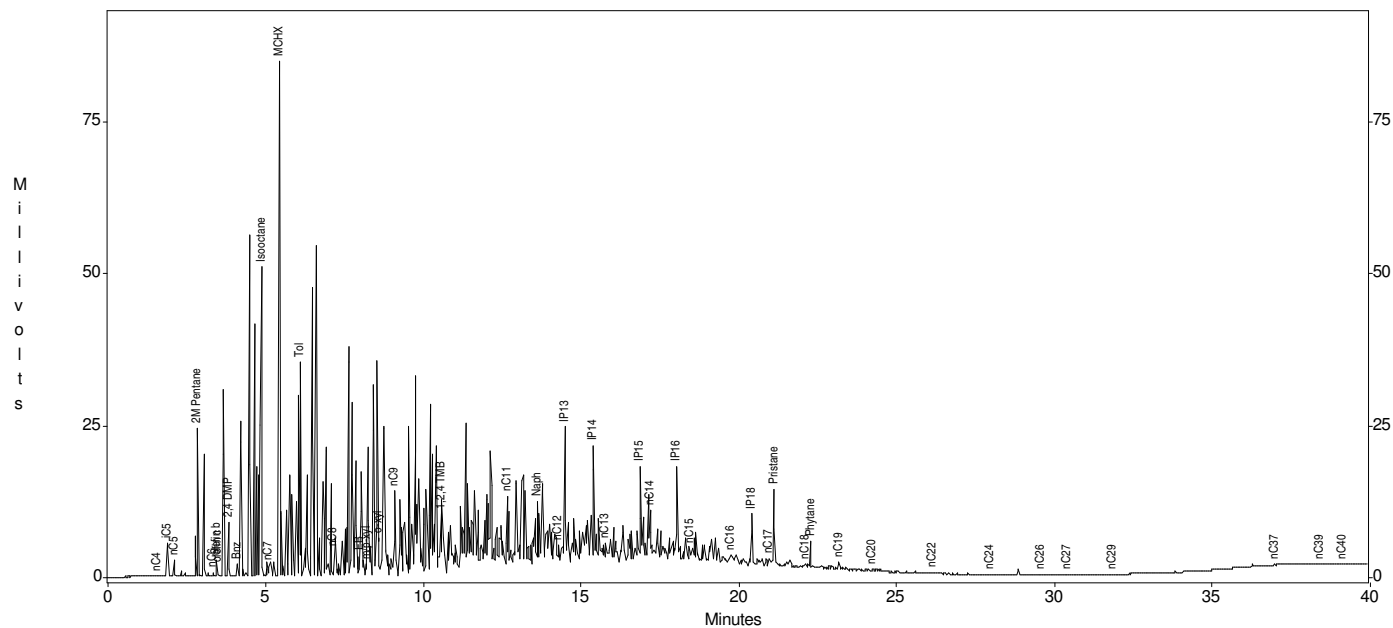
Sample ID : S213-LNAPL-042005

Acquired : Apr 25, 2005 14:19:36

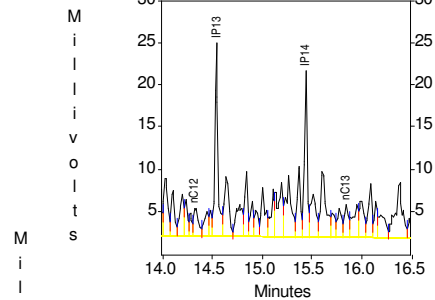
c:\ezchrom\chrom\05054\s213 -- Channel A



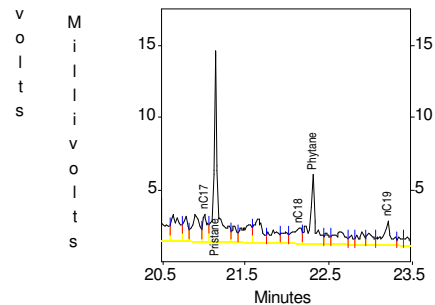
c:\ezchrom\chrom\05054\s213 -- Channel A



c:\ezchrom\chrom\05054\s213 -- Channel A



c:\ezchrom\chrom\05054\s213 -- Channel A



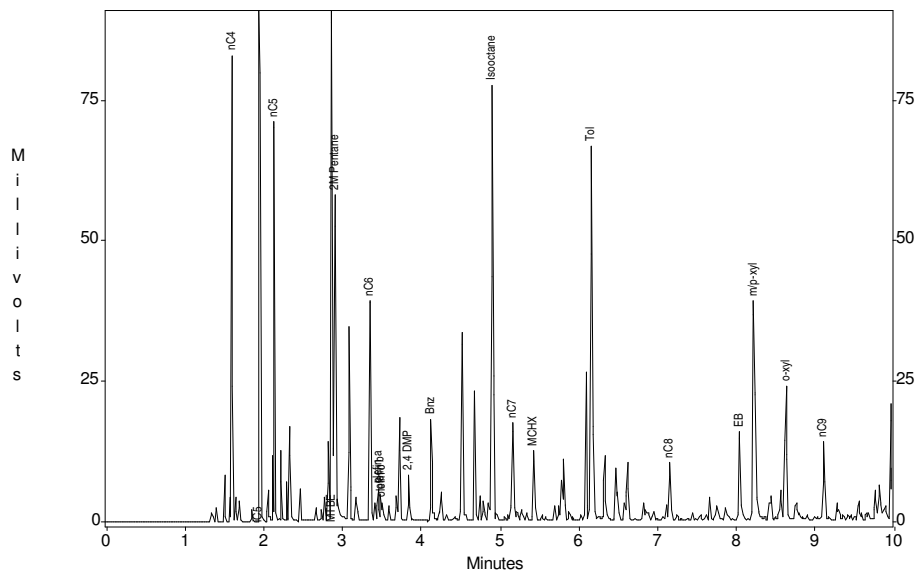
Peak	Area	Height
nC4	94	106
iC5	4592	5561
nC5	2791	2721
MTBE	0	0
2M Pentane	24136	24521
nC6	866	570
olefin a	0	0
olefin b	2886	2570
olefin c	2582	1541
2,4 DMP	10333	9088
Bnz	3686	2190
Isooctane	63352	51067
nC7	2321	1640
MCHX	125047	84842
Tol	47929	35344
nC8	6218	4005
EB	5604	3322
m/p-xyl	3034	1795
o-xyl	7513	6101
nC9	32049	13986
1,2,4 TMB	28623	9748
nC10	0	0
nC11	21032	11341
Naph	21025	10434
nC12	11633	3350
IP13	47928	23076
IP14	35852	19873
nC13	10652	3995
IP15	31192	16605
nC14	24150	9564
IP16	50710	16679
nC15	19279	3257
nC16	24288	2354
IP18	36379	9287
nC17	7271	1876
Pristane	43616	13342
nC18	8340	1081
Phytane	19781	4826
nC19	10329	1609
nC20	2502	451
nC21	0	0
nC22	274	59
nC23	0	0
nC24	499	52
nC25	0	0
nC26	216	71
nC27	234	58
nC28	0	0
nC29	455	51
nC30	0	0
nC31	0	0
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	0	0
nC37	103	28
nC38	0	0
nC39	71	31
nC40	112	29

Sun - Philadelphia Refinery

Sample ID : Gas/Dies/Wax std

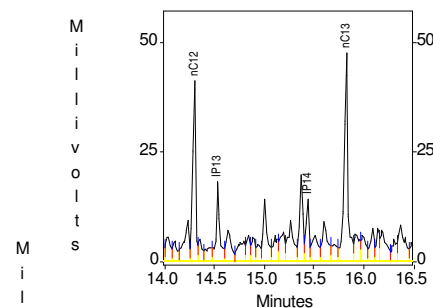
Acquired : Apr 25, 2005 11:00:43

c:\ezchrom\chrom\05054\gadiwax2 -- Channel A

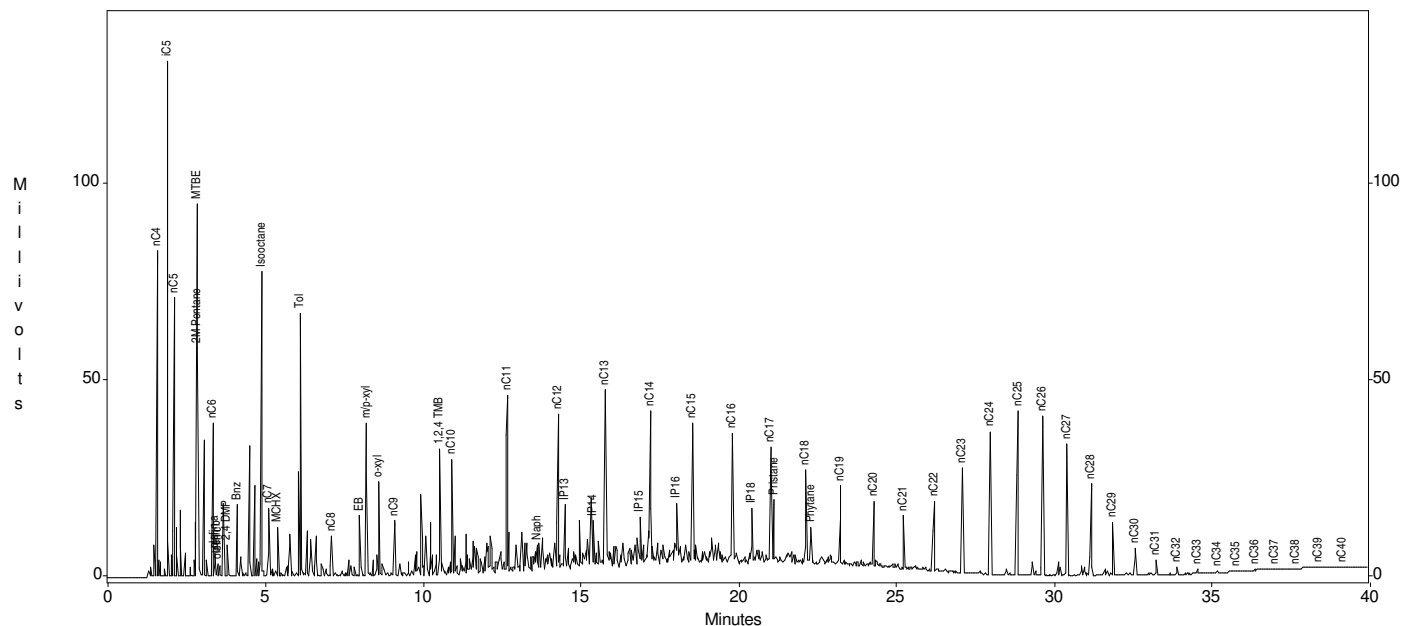
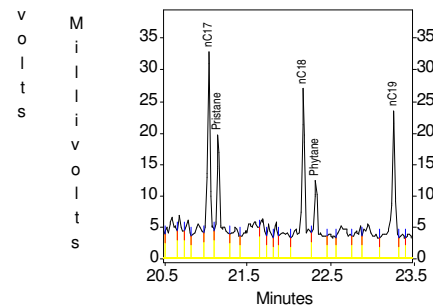


c:\ezchrom\chrom\05054\gadiwax2 -- Channel A

c:\ezchrom\chrom\05054\gadiwax2 -- Channel A



c:\ezchrom\chrom\05054\gadiwax2 -- Channel A



M
i
l
l
i
v
o
l
t
s

M
i
l
l
i
v
o
l
t
s

M
i
l
l
i
v
o
l
t
s

M
i
l
l
i
v
o
l
t
s

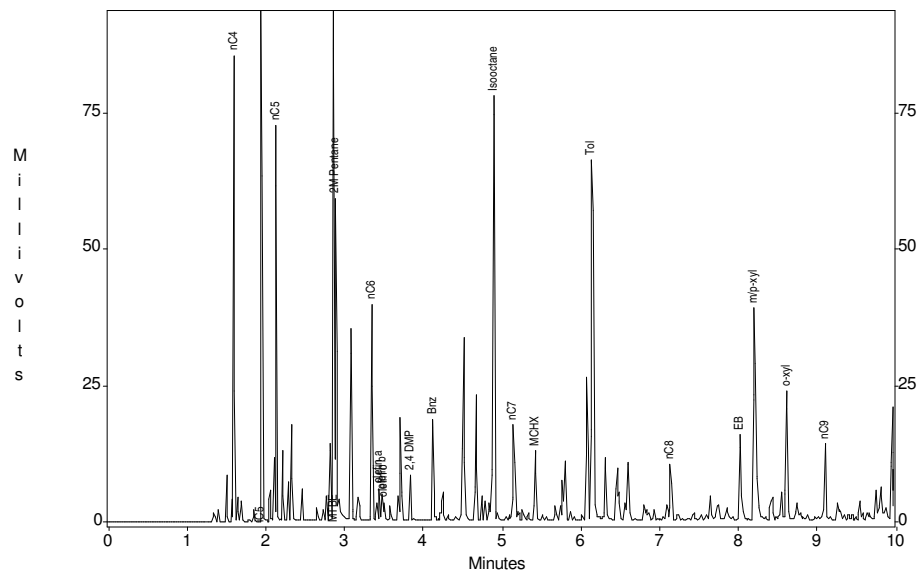
Peak	Area	Height
nC4	52712	82761
iC5	94084	131011
nC5	54568	71060
MTBE	82655	95046
2M Pentane	58774	58171
nC6	38824	39111
olefin a	6742	5840
olefin b	5214	4757
olefin c	4416	3160
2,4 DMP	8961	8315
Bnz	25452	18232
Isooctane	104367	77711
nC7	22494	17473
MCHX	17140	12448
Tol	97052	66784
nC8	13511	10241
EB	26743	15774
m/p-xyl	86073	39006
o-xyl	37782	23980
nC9	21437	14073
1,2,4 TMB	58401	32456
nC10	46420	29528
nC11	84142	46151
Naph	26657	8023
nC12	78431	41082
IP13	46228	18036
IP14	27609	14349
nC13	118993	47537
IP15	58525	15083
nC14	94325	42255
IP16	42113	18718
nC15	108937	39145
nC16	122429	36447
IP18	48206	17030
nC17	87727	32674
Pristane	76104	19285
nC18	101016	26820
Phytane	55545	12309
nC19	89924	23110
nC20	47803	18726
nC21	54916	15553
nC22	40896	18918
nC23	59034	27401
nC24	91857	36738
nC25	105012	41788
nC26	105659	40667
nC27	79570	33417
nC28	49673	23146
nC29	28543	13552
nC30	14195	6831
nC31	7309	3492
nC32	3575	1865
nC33	1869	963
nC34	1049	552
nC35	543	284
nC36	341	147
nC37	677	86
nC38	248	53
nC39	134	36
nC40	140	35

Sun - Philadelphia Refinery

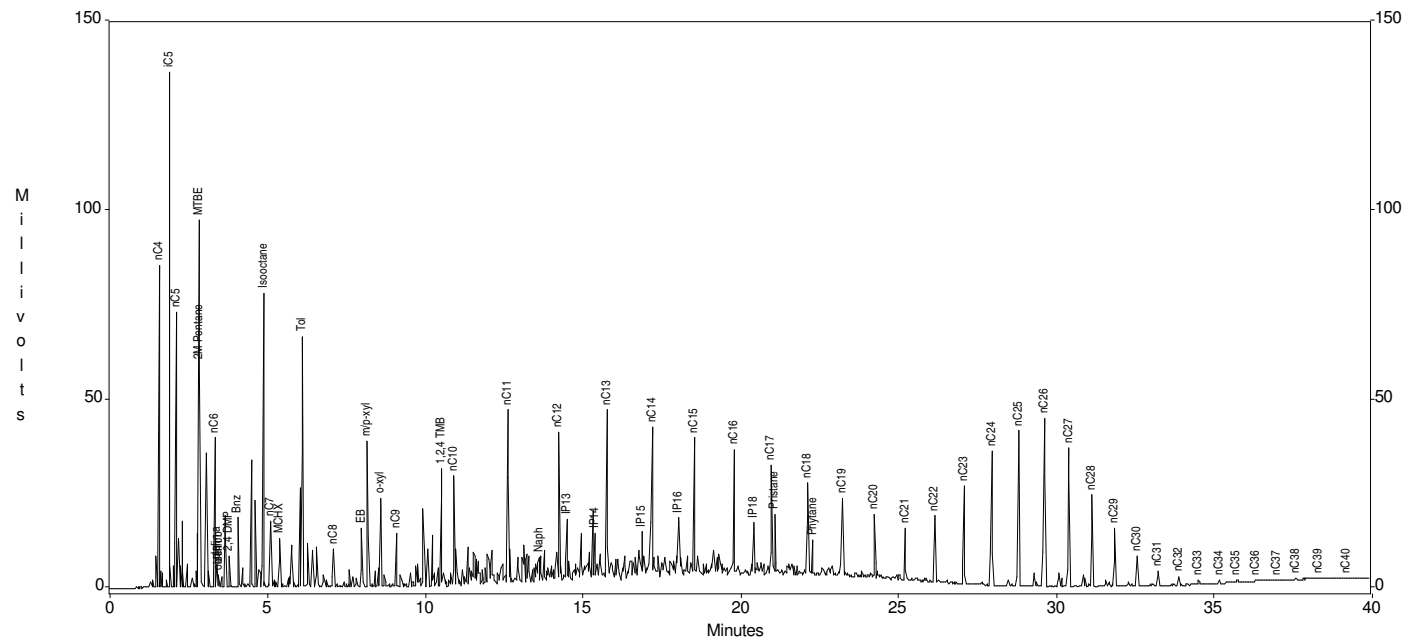
Sample ID : Gas/Dies/Wax std

Acquired : Apr 26, 2005 13:31:55

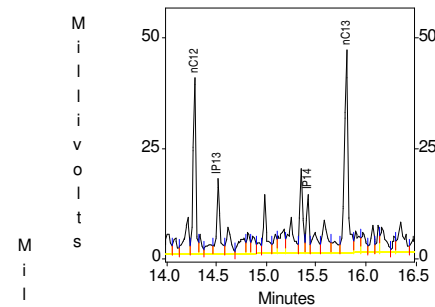
c:\ezchrom\chrom\05054\gadiwax.2 -- Channel A



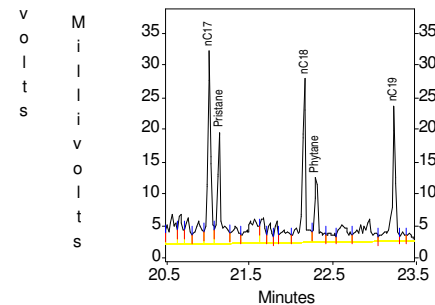
c:\ezchrom\chrom\05054\gadiwax.2 -- Channel A



c:\ezchrom\chrom\05054\gadiwax.2 -- Channel A



c:\ezchrom\chrom\05054\gadiwax.2 -- Channel A



M
i
l
l
i
v
o
l
t
s

M
i
l
l
i
v
o
l
t
s

M
i
l
l
i
v
o
l
t
s

M
i
l
l
i
v
o
l
t
s

Peak	Area	Height
nC4	53084	85426
iC5	95817	136245
nC5	55893	72926
MTBE	85734	97515
2M Pentane	59383	59281
nC6	39608	39784
olefin a	6897	5973
olefin b	5292	4883
olefin c	4618	3278
2,4 DMP	9213	8629
Bnz	26172	18623
Isodane	105503	78057
nC7	22798	17641
MCHX	17693	12823
Tol	96494	66386
nC8	13752	10396
EB	26529	15612
m/p-xyl	84051	38909
o-xyl	36817	23669
nC9	21189	14199
1,2,4 TMB	54943	31131
nC10	44584	29262
nC11	79918	46298
Naph	22170	6892
nC12	73338	39882
IP13	38492	16965
IP14	23623	13275
nC13	106713	45994
IP15	47725	13441
nC14	87170	40892
IP16	36490	16857
nC15	93901	38074
nC16	100974	34524
IP18	37357	15030
nC17	72725	29974
Pristane	52776	17091
nC18	68286	25333
Phytane	30874	9955
nC19	56538	20896
nC20	29938	16591
nC21	28896	13911
nC22	33440	17715
nC23	54953	25864
nC24	86914	35299
nC25	106002	41117
nC26	111313	44296
nC27	86445	36681
nC28	55291	24341
nC29	32329	15374
nC30	16254	8048
nC31	8376	3932
nC32	4202	2234
nC33	2232	1172
nC34	1267	636
nC35	733	343
nC36	453	184
nC37	252	104
nC38	254	66
nC39	98	35
nC40	32	20

RETC Output SS-S34-21-21.5.txt

```
*****
*
*      Analysis of soil hydraulic properties
*
*      Sunoco Philadelphia Refinery SS-S34-21-21.5
*
*      Mualem-based restriction, M=1-1/N
*      Analysis of retention data only
*      MType= 3      Method= 3
*
*****
```

INITial values of the coefficients

```
=====
No      Name      INITIAL value      Index
1      ThetaR      .0650      1
2      ThetaS      .4100      1
3      Alpha      .0750      1
4      n      1.8900      1
5      m      .4709      0
6      l      .5000      0
7      Ks      24.9600      0
```

Observed data

```
=====
Obs. No.      Pressure head      Water content      Weighting coefficient
1      .000      .3200      1.0000
2      5.810      .3200      1.0000
3      13.100      .3155      1.0000
4      23.300      .3062      1.0000
5      36.300      .2787      1.0000
6      52.300      .2144      1.0000
7      71.200      .1571      1.0000
8      93.000      .1398      1.0000
9      145.000      .1229      1.0000
10     209.000      .1120      1.0000
11     285.000      .1021      1.0000
12     372.000      .0954      1.0000
13     471.000      .0992      1.0000
14     581.000      .0861      1.0000
15     1308.000      .0794      1.0000
```

NIT	SSQ	ThetaR	ThetaS	Alpha	n
0	.02636	.0650	.4100	.0750	1.8900
1	.01513	.0637	.3126	.0186	1.7929
2	.00744	.1071	.3296	.0297	2.1756
3	.00691	.0941	.3188	.0168	2.8308
4	.00142	.0884	.3240	.0230	2.5540
5	.00093	.0930	.3215	.0217	2.9666
6	.00080	.0930	.3213	.0216	3.1358
7	.00079	.0934	.3210	.0215	3.2051
8	.00079	.0936	.3209	.0215	3.2257
9	.00079	.0937	.3209	.0215	3.2320
10	.00079	.0937	.3209	.0215	3.2339
11	.00079	.0937	.3209	.0215	3.2344

RETC Output SS-S34-21-21.5.txt
12 .00079 .0937 .3209 .0215 3.2346

Correlation matrix

	Theta 1	Theta 2	Alpha 3	n 4
1	1.0000			
2	-.1443	1.0000		
3	-.0908	.5946	1.0000	
4	.5407	-.3851	-.6652	1.0000

RSquared for regression of observed vs fitted values = .99403460

Nonlinear least-squares analysis: final results

Variable	Value	S.E.Coeff.	T-Value	95% Confidence limits	
				Lower	Upper
ThetaR	.09369	.00399	23.50	.0849	.1025
ThetaS	.32088	.00484	66.29	.3102	.3315
Alpha	.02146	.00117	18.27	.0189	.0241
n	3.23460	.29053	11.13	2.5951	3.8741

Observed abd fitted data

NO	P	log-P	WC-obs	WC-fit	WC-dev
1	.1000E-04	-5.0000	.3200	.3209	-.0009
2	.5810E+01	.7642	.3200	.3207	-.0007
3	.1310E+02	1.1173	.3155	.3183	-.0028
4	.2330E+02	1.3674	.3062	.3056	.0007
5	.3630E+02	1.5599	.2787	.2698	.0090
6	.5230E+02	1.7185	.2144	.2159	-.0015
7	.7120E+02	1.8525	.1571	.1690	-.0119
8	.9300E+02	1.9685	.1398	.1389	.0010
9	.1450E+03	2.1614	.1229	.1114	.0115
10	.2090E+03	2.3201	.1120	.1016	.0104
11	.2850E+03	2.4548	.1021	.0977	.0044
12	.3720E+03	2.5705	.0954	.0959	-.0005
13	.4710E+03	2.6730	.0992	.0950	.0042
14	.5810E+03	2.7642	.0861	.0945	-.0084
15	.1308E+04	3.1166	.0794	.0938	-.0145

Sum of squares of observed versus fitted values

	Unweighted	Weighted
Retention data	.00079	.00079
Cond/Diff data	.00000	.00000
All data	.00079	.00079

Soil hydraulic properties (MType = 3)

WC	P	logP	Cond	logK	Dif	logD
.0943	-.6742E+03	2.829	.1870E-07	-7.728	.9735E-02	-2.012

RETC Output SS-S34-21-21.5.txt

.0949	-.4943E+03	2.694	.1967E-06	-6.706	.3756E-01	-1.425
.0960	-.3624E+03	2.559	.2070E-05	-5.684	.1450E+00	-.839
.0983	-.2656E+03	2.424	.2179E-04	-4.662	.5605E+00	-.251
.1006	-.2213E+03	2.345	.8639E-04	-4.064	.1238E+01	.093
.1030	-.1944E+03	2.289	.2297E-03	-3.639	.2175E+01	.338
.1053	-.1757E+03	2.245	.4904E-03	-3.309	.3372E+01	.528
.1076	-.1617E+03	2.209	.9119E-03	-3.040	.4830E+01	.684
.1099	-.1507E+03	2.178	.1541E-02	-2.812	.6550E+01	.816
.1122	-.1418E+03	2.152	.2429E-02	-2.615	.8536E+01	.931
.1146	-.1343E+03	2.128	.3628E-02	-2.440	.1079E+02	1.033
.1169	-.1279E+03	2.107	.5197E-02	-2.284	.1332E+02	1.125
.1192	-.1223E+03	2.088	.7195E-02	-2.143	.1613E+02	1.208
.1215	-.1174E+03	2.070	.9686E-02	-2.014	.1922E+02	1.284
.1238	-.1131E+03	2.053	.1273E-01	-1.895	.2260E+02	1.354
.1261	-.1092E+03	2.038	.1641E-01	-1.785	.2628E+02	1.420
.1285	-.1057E+03	2.024	.2078E-01	-1.682	.3026E+02	1.481
.1308	-.1024E+03	2.010	.2593E-01	-1.586	.3455E+02	1.538
.1331	-.9946E+02	1.998	.3192E-01	-1.496	.3916E+02	1.593
.1354	-.9672E+02	1.986	.3885E-01	-1.411	.4409E+02	1.644
.1377	-.9419E+02	1.974	.4678E-01	-1.330	.4936E+02	1.693
.1401	-.9182E+02	1.963	.5581E-01	-1.253	.5498E+02	1.740
.1424	-.8961E+02	1.952	.6603E-01	-1.180	.6095E+02	1.785
.1447	-.8754E+02	1.942	.7752E-01	-1.111	.6729E+02	1.828
.1470	-.8559E+02	1.932	.9038E-01	-1.044	.7401E+02	1.869
.1493	-.8374E+02	1.923	.1047E+00	-.980	.8111E+02	1.909
.1516	-.8199E+02	1.914	.1206E+00	-.919	.8863E+02	1.948
.1540	-.8033E+02	1.905	.1382E+00	-.860	.9655E+02	1.985
.1563	-.7875E+02	1.896	.1575E+00	-.803	.1049E+03	2.021
.1586	-.7724E+02	1.888	.1787E+00	-.748	.1137E+03	2.056
.1609	-.7580E+02	1.880	.2019E+00	-.695	.1230E+03	2.090
.1632	-.7441E+02	1.872	.2273E+00	-.643	.1328E+03	2.123
.1656	-.7309E+02	1.864	.2548E+00	-.594	.1430E+03	2.155
.1679	-.7181E+02	1.856	.2847E+00	-.546	.1538E+03	2.187
.1702	-.7058E+02	1.849	.3171E+00	-.499	.1651E+03	2.218
.1725	-.6940E+02	1.841	.3521E+00	-.453	.1770E+03	2.248
.1748	-.6825E+02	1.834	.3899E+00	-.409	.1894E+03	2.277
.1771	-.6714E+02	1.827	.4305E+00	-.366	.2025E+03	2.306
.1795	-.6607E+02	1.820	.4742E+00	-.324	.2162E+03	2.335
.1818	-.6503E+02	1.813	.5210E+00	-.283	.2306E+03	2.363
.1841	-.6402E+02	1.806	.5711E+00	-.243	.2457E+03	2.390
.1864	-.6303E+02	1.800	.6248E+00	-.204	.2615E+03	2.418
.1887	-.6207E+02	1.793	.6820E+00	-.166	.2781E+03	2.444
.1911	-.6114E+02	1.786	.7431E+00	-.129	.2955E+03	2.471
.1934	-.6023E+02	1.780	.8082E+00	-.093	.3137E+03	2.497
.1957	-.5934E+02	1.773	.8774E+00	-.057	.3329E+03	2.522
.1980	-.5847E+02	1.767	.9509E+00	-.022	.3529E+03	2.548
.2003	-.5762E+02	1.761	.1029E+01	.012	.3739E+03	2.573
.2026	-.5678E+02	1.754	.1112E+01	.046	.3960E+03	2.598
.2050	-.5597E+02	1.748	.1200E+01	.079	.4192E+03	2.622
.2073	-.5516E+02	1.742	.1292E+01	.111	.4435E+03	2.647
.2096	-.5438E+02	1.735	.1391E+01	.143	.4690E+03	2.671
.2119	-.5360E+02	1.729	.1494E+01	.174	.4958E+03	2.695
.2142	-.5284E+02	1.723	.1604E+01	.205	.5240E+03	2.719
.2166	-.5209E+02	1.717	.1720E+01	.235	.5537E+03	2.743
.2189	-.5134E+02	1.710	.1842E+01	.265	.5849E+03	2.767
.2212	-.5061E+02	1.704	.1970E+01	.295	.6177E+03	2.791
.2235	-.4989E+02	1.698	.2106E+01	.323	.6523E+03	2.814
.2258	-.4918E+02	1.692	.2248E+01	.352	.6887E+03	2.838
.2281	-.4847E+02	1.685	.2398E+01	.380	.7272E+03	2.862

RETC Output SS-S34-21-21.5.txt

.2305	-.4777E+02	1.679	.2556E+01	.408	.7678E+03	2.885
.2328	-.4708E+02	1.673	.2722E+01	.435	.8107E+03	2.909
.2351	-.4639E+02	1.666	.2896E+01	.462	.8561E+03	2.933
.2374	-.4571E+02	1.660	.3079E+01	.488	.9042E+03	2.956
.2397	-.4503E+02	1.653	.3271E+01	.515	.9551E+03	2.980
.2421	-.4435E+02	1.647	.3472E+01	.541	.1009E+04	3.004
.2444	-.4368E+02	1.640	.3684E+01	.566	.1067E+04	3.028
.2467	-.4301E+02	1.634	.3906E+01	.592	.1128E+04	3.052
.2490	-.4234E+02	1.627	.4139E+01	.617	.1193E+04	3.077
.2513	-.4167E+02	1.620	.4383E+01	.642	.1262E+04	3.101
.2536	-.4100E+02	1.613	.4639E+01	.666	.1336E+04	3.126
.2560	-.4034E+02	1.606	.4908E+01	.691	.1416E+04	3.151
.2583	-.3967E+02	1.598	.5189E+01	.715	.1501E+04	3.176
.2606	-.3900E+02	1.591	.5484E+01	.739	.1593E+04	3.202
.2629	-.3832E+02	1.583	.5794E+01	.763	.1692E+04	3.228
.2652	-.3764E+02	1.576	.6118E+01	.787	.1798E+04	3.255
.2676	-.3696E+02	1.568	.6459E+01	.810	.1914E+04	3.282
.2699	-.3627E+02	1.560	.6816E+01	.834	.2039E+04	3.309
.2722	-.3557E+02	1.551	.7190E+01	.857	.2176E+04	3.338
.2745	-.3486E+02	1.542	.7584E+01	.880	.2326E+04	3.367
.2768	-.3415E+02	1.533	.7997E+01	.903	.2490E+04	3.396
.2791	-.3342E+02	1.524	.8431E+01	.926	.2671E+04	3.427
.2815	-.3268E+02	1.514	.8887E+01	.949	.2872E+04	3.458
.2838	-.3192E+02	1.504	.9367E+01	.972	.3095E+04	3.491
.2861	-.3114E+02	1.493	.9873E+01	.994	.3346E+04	3.525
.2884	-.3035E+02	1.482	.1041E+02	1.017	.3629E+04	3.560
.2907	-.2953E+02	1.470	.1097E+02	1.040	.3951E+04	3.597
.2931	-.2868E+02	1.458	.1156E+02	1.063	.4321E+04	3.636
.2954	-.2779E+02	1.444	.1220E+02	1.086	.4751E+04	3.677
.2977	-.2687E+02	1.429	.1286E+02	1.109	.5256E+04	3.721
.3000	-.2590E+02	1.413	.1358E+02	1.133	.5859E+04	3.768
.3023	-.2486E+02	1.396	.1434E+02	1.157	.6594E+04	3.819
.3046	-.2376E+02	1.376	.1516E+02	1.181	.7509E+04	3.876
.3070	-.2256E+02	1.353	.1604E+02	1.205	.8686E+04	3.939
.3093	-.2123E+02	1.327	.1700E+02	1.230	.1026E+05	4.011
.3116	-.1974E+02	1.295	.1805E+02	1.256	.1250E+05	4.097
.3139	-.1799E+02	1.255	.1922E+02	1.284	.1597E+05	4.203
.3162	-.1580E+02	1.199	.2057E+02	1.313	.2223E+05	4.347
.3186	-.1271E+02	1.104	.2221E+02	1.347	.3811E+05	4.581
.3197	-.1024E+02	1.010	.2325E+02	1.366	.6387E+05	4.805
.3203	-.8253E+01	.917	.2390E+02	1.378	.1055E+06	5.023
.3206	-.6213E+01	.793	.2440E+02	1.387	.2024E+06	5.306
.3209	-.3048E+01	.484	.2485E+02	1.395	.1010E+07	6.004
.3209	-.1496E+01	.175	.2494E+02	1.397	.4974E+07	6.697
.3209	.0000E+00		.2496E+02	1.397		

End of problem

=====

□

APPENDIX F

FATE AND TRANSPORT MODELING PROCEDURES

APPENDIX F
FATE AND TRANSPORT MODELING PROCEDURES
AOI 4: SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

F.1 INTRODUCTION

Fate and transport calculations were completed for groundwater in AOI 4 to evaluate potential migration pathways/potential impacts to receptors and to support development of the Site Conceptual Model. The Quick Domenico (QD - v2.0) spreadsheet model, developed by the PADEP, and site-specific data were used to complete the fate and transport calculations. Groundwater at four wells (S-26, S-40, S-223 and S-224) was modeled since concentrations of COCs in groundwater at these wells exceeds the MSC, and has the potential for off-site migration.

F.2 MODEL OVERVIEW

The QD Model is a Microsoft Excel spreadsheet application based on the analytical contaminant transport equation developed by P.A. Domenico in "*An Analytical Model For Multidimensional Transport of a Decaying Contaminant Species*," Journal of Hydrology, 91 (1987), pp. 49-58. The QD model calculates contaminant concentrations at any down-gradient location after a specified interval of time. The model incorporates the processes of advection, first order decay, retardation, and dispersion to describe fate and transport of compounds. In addition, the QD model displays the results as a two dimensional chart to facilitate interpretation of the results.

F.3 MODEL LIMITATIONS

Limitations of the QD model include:

- Groundwater flow is assumed to be steady state and one-dimensional;
- Aquifer properties are assumed to be reasonably uniform;
- Applicable only to unconsolidated aquifers;
- Intended for use primarily with dissolved organic compounds;

- Does not account for the transformation of parent compounds into daughter products as the result of biodegradation;
- Compounds are considered individually, and are assumed to not react with each other; and
- The contaminant source is limited to a single and continuous source concentration.

F.4 MODEL INPUT PARAMETERS

In preparation of this report, input values for the QD model were compiled from available site data. When no site data was available, estimated input values from the PA Code, Chapter 250, Appendix A, Table 5 or other acceptable literature source were utilized. The input parameters are discussed in greater detail in the sections that follow, and are summarized in the input tables preceding each model sheet in this appendix.

F.4.1 Source Concentration

Using the most-recent groundwater quality data, COC concentrations at selected wells were used as the source value. Table 5 and Figure 8 present a summary of the COC data used for the fate and transport modeling.

F.4.2 Distance to Location of Concern (x)

The distance to the location of concern is the distance along the plume centerline from the source to a point where a concentration is desired. The distance from the monitoring well to the point where the groundwater MSC would be attained (downgradient point of compliance) was selected as the distance for the fate and transport modeling. The downgradient point of compliance for AOI 4 is the AOI 4 borders along 26th Street to the east and Penrose Avenue to the south. The AOI 4 borders are shown in Figure 2.

F.4.3 Dispersivity

Dispersion describes the extent to which contaminants spread out from the source into areas that cannot be accounted for by advective transport alone. Initially these parameters are often estimated and then adjusted in order to calibrate a model to better fit actual field conditions. The three types of dispersion are:

- Longitudinal dispersivity (A_x) which occurs in the direction parallel to groundwater flow;
- Transverse dispersivity (A_y) which occurs in the same plane as longitudinal dispersivity but perpendicular to the direction of groundwater flow; and
- Vertical dispersivity (A_z) which occurs in the upward direction, normal to the plane in which longitudinal and transverse dispersivity occur (Vertical dispersivity is usually negligible and is typically omitted from most QD analyses).

Dispersivity estimates are difficult to quantify and are commonly estimated from the following relationships:

1. $A_x = X/10$ (where, X is the distance a contaminant has traveled by advective transport)
2. $A_y = A_x/10$
3. $A_z = A_x/20$ to $A_x/100$ (generally, it is recommended that A_z be a very small number (0.001) unless vertical monitoring can reliably justify a larger number. Additionally, a value of 0.0001 is suggested for uncalibrated or conceptual applications).

For the fate and transport modeling in AOI 4, the dispersivity values were estimated using the above relationships. The simulated distance of groundwater migration at concentrations exceeding the MSC was chosen as the value for X . In all cases, a value of 0.001 was used as a value for A_z .

F.4.4 Lambda

Lambda is the first order decay constant. It is determined by dividing .693 by the half-life of the compound (in days). The value can be calculated for stable or shrinking plumes and selected by trial and error to existing data for expanding plumes. QD is very sensitive to the lambda term. Lambda can vary from site to site for the same compound because subsurface conditions favorable to biodegradation vary from site to site. For compounds that are not biodegradable or at sites where biodegradation is not occurring use a lambda of zero. Default values for lambda were obtained from the list of lambda values in PA Code, Chapter 250, Appendix A, Table 5 and were used in the models.

F.4.5 Source Dimensions

Source width is the maximum width of the area measured perpendicular to the direction of groundwater flow. Source thickness is the thickness of the contaminated soils below the water table that contribute contamination to groundwater. In addition to the saturated zone, fluctuation in groundwater elevation may create a smear zone in the unsaturated portion of an aquifer. As an estimate of the thickness of the smear zone, average fluctuation can be used.

F.4.6 Hydraulic Conductivity (k)

The hydraulic conductivity of a geologic material is a measure of its ability to transmit water. No aquifer testing was performed in AOI 4 since sufficient aquifer testing data was available from former aquifer tests (pumping tests, recovery tests, and slug tests) performed in AOI 1 by others (SECOR, 2003; USGS, 2001; URS, 2002; Chevron USA, Inc., 1992; USGS, 1988). The hydraulic conductivity value used in AOI 4 for fate and transport modeling of the Fill/Alluvium and Trenton Gravel (Intermediate Wells) was 24 feet/day. This value is representative of the geometric mean of hydraulic conductivity values calculated using aquifer testing recovery data in Well RW-406 (AOI 1) by SECOR in 2003 (SECOR, 2003), and appears to be most representative of the Trenton Gravel. Since the composition of the Trenton Gravel in AOI 4 was consistent

with AOI 1, this value of hydraulic conductivity was chosen as representative for conditions in AOI 4.

F.4.7 Hydraulic Gradient

Hydraulic gradient is the change in hydraulic head relative to the distance between head measurement locations. The hydraulic gradient is measured parallel to the direction of ground water flow assuming horizontal flow and a uniform gradient. The hydraulic gradient used in the fate and transport modeling in AOI 4 was calculated using groundwater elevation data presented in Figure 6. The gradient in the northern portion of AOI 4 was calculated to be 0.00036 ft/ft. The gradient in the southern portion of AOI 4 was calculated to be 0.0035 ft/ft, therefore this value was chosen as the more conservative value and used in the modeling for AOI 4.

F.4.8 Porosity (n)

Porosity is measured as the ratio of the volume of void space in a geologic material to the total volume of material. Porosity values used in the fate and transport modeling for AOI 4 were based on historical geotechnical laboratory analysis of Trenton Gravel samples.

F.4.9 Soil Bulk Density (p_b)

Soil bulk density is the dry weight of a sample divided by the total volume of the sample in an undisturbed state. Soil bulk density can either be determined by a laboratory or by the equation

$$P_b = 2.65 * (1 - \text{porosity}).$$

The PADEP recommended default value of 1.8 g/cm³ was used in the fate and transport modeling for AOI 4 since no site-specific soil bulk density data was available..

F.4.10 Organic Carbon Partition Coefficient (K_{oc})

The organic carbon partition coefficient is chemical specific; the values used in the fate and transport modeling for AOI 4 were obtained from PA Code, Chapter 250, Appendix A, Table 5.

F.4.11 Fraction Organic Carbon (f_{oc})

The fraction of organic carbon is the organic carbon content of a soil. A laboratory using ASTM methods can determine this value. Samples for organic carbon are taken from the same soil horizon in which the contaminant occurs, but outside of the impacted area. Since no site specific fraction of organic carbon data was available for the site, the fate and transport modeling used the PA default recommended concentration of 0.005.

F.4.12 Plume Coordinates ('y' and 'z')

The plume coordinates, 'y' and 'z', define the horizontal and vertical extent of the impacted area, respectfully. For a solution on the centerline of the plume down gradient from the source, 'y' was set equal to zero. Additionally, to yield the highest concentration, which is located at the water table, 'z' was also set equal to zero.

F.4.13 Time (t)

'Time zero' is the point at which contamination was introduced into the aquifer. Time since 'time zero' is measured in days. A simulation time of 30 years was chosen for each well; this simulation time period is recommended by the PADEP.

F.4.14 Grid Dimensions

The grid dimensions form the window through which the plume is viewed and the locations where concentrations are calculated. The grid is determined by user specified length and width measurements from the source of the plume. Because plume dimensions and source concentrations varied greatly across the Facility, the grid dimensions selected for the fate and transport calculations were selected individually for

each source (well) and compound.

F.5 OUTPUT DATA AND RESULTS

The results of the QD Fate and Transport modeling task were used to predict potential impacts to potential down-gradient receptors. Copies of all QD model simulation spreadsheets are included at the end of this appendix. A summary of input values and output results are also provided in this Appendix and illustrated in Figure 10 of the report.

QUICK DOMENICO MODEL SPREADHSHEETS

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project
Prepared by
Date Prepared

2574601 - Sunoco Philadelphia Refinery
Allison Jelinek
8/29/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-26
Sample Date			5/2/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	305
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A _x	ft	5
Transverse Dispersivity	A _y	ft	0.5
Vertical Dispersivity	A _z	ft	0.0001
Hydraulic Conductivity	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p _b	g/cm ³	1.7225
Fraction of Organic Carbon	f _{OC}	decimal fraction	0.005
Time		days	10950
Length of Grid Dimension		ft	50
Width of Grid Dimension		ft	10

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			MTBE
Source Concentration (mg/l)		mg/l	0.0320
Lambda (per day)		day ⁻¹	0.00189863
KOC			12

0.001410031

Output (Concentration at the Downgradient Property Boundary in 30 years)					
Contaminant	GW MSC ¹ Residential (mg/l)	GW MSC ² Non-Residential (mg/l)	Concentration at Property Boundary (mg/l)	Distance to Property Boundary (ft)	Distance to Meet Residential GW MSC (ft)
Sim 1 - MTBE	0.02	0.02	1.41E-03	305	50

¹ ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

² ACT 2 TGM, Appendix A, Table 1 MSC for a Non-residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION, 1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO																																																																											
Project:	2574601 - Sunoco Philadelphia Refinery																																																																										
Date:	8/29/2005	Prepared by	Allison Jelinek																																																																								
		Contaminant	MTBE																																																																								
SOURCE	Ax	Ay	Az	LAMBDA	SOURCE	SOURCE	Time (days)																																																																				
CONC	(ft)	(ft)	(ft)		WIDTH	THICKNESS	(days)																																																																				
(MG/L)			>=.001	day-1	(ft)	(ft)																																																																					
	0	5.00E+00	5.00E-01	1.00E-04	0.00189863	100	15	10950																																																																			
Hydraulic	Hydraulic		Soil Bulk		Frac.	Retard-	V																																																																				
Cond	Gradient	Porosity	Density	KOC	Org. Carb.	ation	(=K*i/n*R)																																																																				
(ft/day)	(ft/ft)	(dec. frac.)	(g/cm ³)			(R)	(ft/day)																																																																				
	2.40E+01	0.0035	0.35	1.7225	12	5.00E-03	1.295285714	0.185287306																																																																			
<div> <div> Point Concentration <table border="1"> <thead> <tr> <th>x(ft)</th> <th>y(ft)</th> <th>z(ft)</th> </tr> </thead> <tbody> <tr> <td>305</td> <td>0</td> <td>0</td> </tr> </tbody> </table> </div> <div> <table border="1"> <thead> <tr> <th></th> <th>x(ft)</th> <th>y(ft)</th> <th>z(ft)</th> </tr> </thead> <tbody> <tr> <td>Conc. At</td> <td>305</td> <td>0</td> <td>0</td> </tr> <tr> <td>at</td> <td>10950</td> <td>days =</td> <td>#NAME?</td> </tr> <tr> <td></td> <td></td> <td></td> <td>mg/l</td> </tr> </tbody> </table> </div> </div>										x(ft)	y(ft)	z(ft)	305	0	0		x(ft)	y(ft)	z(ft)	Conc. At	305	0	0	at	10950	days =	#NAME?				mg/l																																												
x(ft)	y(ft)	z(ft)																																																																									
305	0	0																																																																									
	x(ft)	y(ft)	z(ft)																																																																								
Conc. At	305	0	0																																																																								
at	10950	days =	#NAME?																																																																								
			mg/l																																																																								
<div> <div> AREAL MODEL Length (ft) 50 Width (ft) 10 </div> <div> CALCULATION DOMAIN <table border="1"> <thead> <tr> <th></th> <th>5</th> <th>10</th> <th>15</th> <th>20</th> <th>25</th> <th>30</th> <th>35</th> <th>40</th> <th>45</th> <th>50</th> </tr> </thead> <tbody> <tr> <td>10</td> <td>0.030</td> <td>0.029</td> <td>0.028</td> <td>0.026</td> <td>0.025</td> <td>0.024</td> <td>0.023</td> <td>0.022</td> <td>0.021</td> <td>0.020</td> </tr> <tr> <td>5</td> <td>0.030</td> <td>0.029</td> <td>0.028</td> <td>0.026</td> <td>0.025</td> <td>0.024</td> <td>0.023</td> <td>0.022</td> <td>0.021</td> <td>0.020</td> </tr> <tr> <td>0</td> <td>0.030</td> <td>0.029</td> <td>0.028</td> <td>0.026</td> <td>0.025</td> <td>0.024</td> <td>0.023</td> <td>0.022</td> <td>0.021</td> <td>0.020</td> </tr> <tr> <td>-5</td> <td>0.030</td> <td>0.029</td> <td>0.028</td> <td>0.026</td> <td>0.025</td> <td>0.024</td> <td>0.023</td> <td>0.022</td> <td>0.021</td> <td>0.020</td> </tr> <tr> <td>-10</td> <td>0.030</td> <td>0.029</td> <td>0.028</td> <td>0.026</td> <td>0.025</td> <td>0.024</td> <td>0.023</td> <td>0.022</td> <td>0.021</td> <td>0.020</td> </tr> </tbody> </table> </div> </div>											5	10	15	20	25	30	35	40	45	50	10	0.030	0.029	0.028	0.026	0.025	0.024	0.023	0.022	0.021	0.020	5	0.030	0.029	0.028	0.026	0.025	0.024	0.023	0.022	0.021	0.020	0	0.030	0.029	0.028	0.026	0.025	0.024	0.023	0.022	0.021	0.020	-5	0.030	0.029	0.028	0.026	0.025	0.024	0.023	0.022	0.021	0.020	-10	0.030	0.029	0.028	0.026	0.025	0.024	0.023	0.022	0.021	0.020
	5	10	15	20	25	30	35	40	45	50																																																																	
10	0.030	0.029	0.028	0.026	0.025	0.024	0.023	0.022	0.021	0.020																																																																	
5	0.030	0.029	0.028	0.026	0.025	0.024	0.023	0.022	0.021	0.020																																																																	
0	0.030	0.029	0.028	0.026	0.025	0.024	0.023	0.022	0.021	0.020																																																																	
-5	0.030	0.029	0.028	0.026	0.025	0.024	0.023	0.022	0.021	0.020																																																																	
-10	0.030	0.029	0.028	0.026	0.025	0.024	0.023	0.022	0.021	0.020																																																																	
Field Data:	Centerline C Concentration																																																																										
	Distance from Source																																																																										

Centerline Plot (linear)

Centerline Plot (log)

NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF
"AN ANALYTICAL MODEL FOR
MULTIDIMENSIONAL TRANSPORT OF A
DECAYING CONTAMINANT SPECIES"
P.A. Domenico (1987)
Modified to Include Retardation

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project
Prepared by
Date Prepared

2574601 - Sunoco Philadelphia Refinery
Allison Jelinek
8/26/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-40
Sample Date			5/3/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	55
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	51.1
Transverse Dispersivity	A_y	ft	5.1
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivity	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	ρ_b	g/cm ³	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	10950
Length of Grid Dimension		ft	511
Width of Grid Dimension		ft	120

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.3700
Lambda (per day)		day ⁻¹	0.000958904
KOC			58

Output (Concentration at the Downgradient Property Boundary in 30 years)					
Contaminant	GW MSC ¹ Residential (mg/l)	GW MSC ² Non-Residential (mg/l)	Concentration at Property Boundary (mg/l)	Distance to Property Boundary (ft)	Distance to Meet Residential GW MSC (ft)
Sim 1 - Benzene	0.005	0.005	2.41E-01	55	511

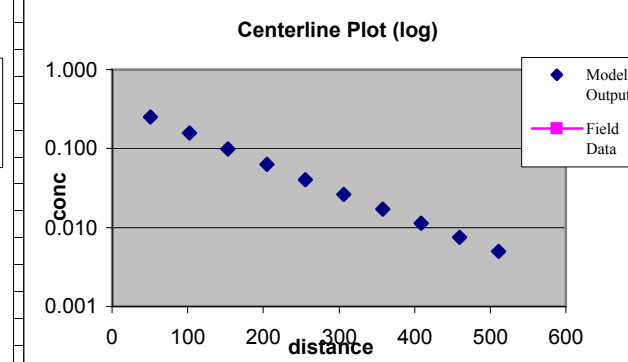
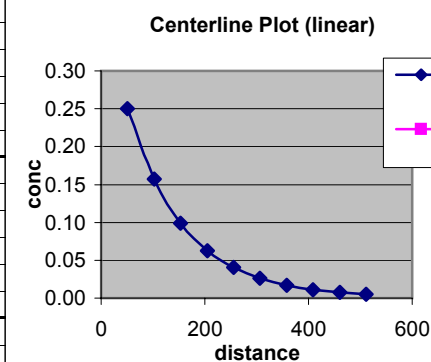
¹ ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

² ACT 2 TGM, Appendix A, Table 1 MSC for a Non-residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION, 1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO																																																																											
Project:	2574601 - Sunoco Philadelphia Refinery																																																																										
Date:	8/26/2005	Prepared by	Allison Jelinek																																																																								
		Contaminant	Benzene																																																																								
SOURCE	Ax	Ay	Az	LAMBDA	SOURCE	SOURCE	Time (days)																																																																				
CONC	(ft)	(ft)	(ft)		WIDTH	THICKNESS	(days)																																																																				
(MG/L)			>=.001	day-1	(ft)	(ft)																																																																					
	0	5.11E+01	5.11E+00	1.00E-04	0.0009589	100	15	10950																																																																			
Hydraulic	Hydraulic		Soil Bulk		Frac.	Retard-	V																																																																				
Cond	Gradient	Porosity	Density	KOC	Org. Carb.	ation	(=K*i/n*R)																																																																				
(ft/day)	(ft/ft)	(dec. frac.)	(g/cm ³)			(R)	(ft/day)																																																																				
	2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785																																																																			
<div> <div> Point Concentration <table border="1"> <thead> <tr> <th>x(ft)</th> <th>y(ft)</th> <th>z(ft)</th> </tr> </thead> <tbody> <tr> <td>55</td> <td>0</td> <td>0</td> </tr> </tbody> </table> </div> <div> <table border="1"> <thead> <tr> <th></th> <th>x(ft)</th> <th>y(ft)</th> <th>z(ft)</th> </tr> </thead> <tbody> <tr> <td>Conc. At</td> <td>55</td> <td>0</td> <td>0</td> </tr> <tr> <td>at</td> <td>10950</td> <td>days =</td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td>0.241</td> </tr> <tr> <td></td> <td></td> <td></td> <td>mg/l</td> </tr> </tbody> </table> </div> </div>										x(ft)	y(ft)	z(ft)	55	0	0		x(ft)	y(ft)	z(ft)	Conc. At	55	0	0	at	10950	days =					0.241				mg/l																																								
x(ft)	y(ft)	z(ft)																																																																									
55	0	0																																																																									
	x(ft)	y(ft)	z(ft)																																																																								
Conc. At	55	0	0																																																																								
at	10950	days =																																																																									
			0.241																																																																								
			mg/l																																																																								
<div> <div> AREAL MODEL Length (ft) 511 Width (ft) 120 </div> <div> CALCULATION DOMAIN <table border="1"> <thead> <tr> <th></th> <th>51.1</th> <th>102.2</th> <th>153.3</th> <th>204.4</th> <th>255.5</th> <th>306.6</th> <th>357.7</th> <th>408.8</th> <th>459.9</th> <th>511</th> </tr> </thead> <tbody> <tr> <td>120</td> <td>0.000</td> <td>0.003</td> <td>0.005</td> <td>0.005</td> <td>0.005</td> <td>0.004</td> <td>0.004</td> <td>0.003</td> <td>0.002</td> <td>0.002</td> </tr> <tr> <td>60</td> <td>0.085</td> <td>0.068</td> <td>0.049</td> <td>0.035</td> <td>0.024</td> <td>0.017</td> <td>0.012</td> <td>0.008</td> <td>0.005</td> <td>0.004</td> </tr> <tr> <td>0</td> <td>0.250</td> <td>0.157</td> <td>0.099</td> <td>0.063</td> <td>0.040</td> <td>0.026</td> <td>0.017</td> <td>0.011</td> <td>0.008</td> <td>0.005</td> </tr> <tr> <td>-60</td> <td>0.085</td> <td>0.068</td> <td>0.049</td> <td>0.035</td> <td>0.024</td> <td>0.017</td> <td>0.012</td> <td>0.008</td> <td>0.005</td> <td>0.004</td> </tr> <tr> <td>-120</td> <td>0.000</td> <td>0.003</td> <td>0.005</td> <td>0.005</td> <td>0.005</td> <td>0.004</td> <td>0.004</td> <td>0.003</td> <td>0.002</td> <td>0.002</td> </tr> </tbody> </table> </div> </div>											51.1	102.2	153.3	204.4	255.5	306.6	357.7	408.8	459.9	511	120	0.000	0.003	0.005	0.005	0.005	0.004	0.004	0.003	0.002	0.002	60	0.085	0.068	0.049	0.035	0.024	0.017	0.012	0.008	0.005	0.004	0	0.250	0.157	0.099	0.063	0.040	0.026	0.017	0.011	0.008	0.005	-60	0.085	0.068	0.049	0.035	0.024	0.017	0.012	0.008	0.005	0.004	-120	0.000	0.003	0.005	0.005	0.005	0.004	0.004	0.003	0.002	0.002
	51.1	102.2	153.3	204.4	255.5	306.6	357.7	408.8	459.9	511																																																																	
120	0.000	0.003	0.005	0.005	0.005	0.004	0.004	0.003	0.002	0.002																																																																	
60	0.085	0.068	0.049	0.035	0.024	0.017	0.012	0.008	0.005	0.004																																																																	
0	0.250	0.157	0.099	0.063	0.040	0.026	0.017	0.011	0.008	0.005																																																																	
-60	0.085	0.068	0.049	0.035	0.024	0.017	0.012	0.008	0.005	0.004																																																																	
-120	0.000	0.003	0.005	0.005	0.005	0.004	0.004	0.003	0.002	0.002																																																																	
Field Data:	Centerline C Concentration																																																																										
	Distance from Source																																																																										

NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF
"AN ANALYTICAL MODEL FOR
MULTIDIMENSIONAL TRANSPORT OF A
DECAYING CONTAMINANT SPECIES"
P.A. Domenico (1987)
Modified to Include Retardation



Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project
Prepared by
Date Prepared

2574601 - Sunoco Philadelphia Refinery
Allison Jelinek
8/26/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-223
Sample Date			8/1/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	1
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	95.9
Transverse Dispersivity	A_y	ft	9.6
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivity	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	ρ_b	g/cm ³	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	10950
Length of Grid Dimension		ft	959
Width of Grid Dimension		ft	255

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	6.1000
Lambda (per day)		day ⁻¹	0.000958904
KOC			58
Sim 2			
Contaminant			Ethylbenzene
Source Concentration (mg/l)		mg/l	1.3
Lambda (per day)		day ⁻¹	0.003041096
KOC			220
Sim 3			
Contaminant			Toluene
Source Concentration (mg/l)		mg/l	9.6
Lambda (per day)		day ⁻¹	0.024684932
KOC			130

Output (Concentration at the Downgradient Property Boundary in 30 years)					
Contaminant	GW MSC ¹ Residential (mg/l)	GW MSC ² Non-Residential (mg/l)	Concentration at Property Boundary (mg/l)	Distance to Property Boundary (ft)	Distance to Meet Residential GW MSC (ft)
Sim 1 - Benzene	0.005	0.005	6.06E+00	1	959
Sim 2 - Ethylbenzene	0.7	0.7	1.27E+00	1	1
Sim 3 - Toluene	1	1	9.02E+00	1	1

¹ ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

² ACT 2 TGM, Appendix A, Table 1 MSC for a Non-residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION, 1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO																																																																																						
Project:	2574601 - Sunoco Philadelphia Refinery																																																																																					
Date:	8/26/2005	Prepared by	Allison Jelinek																																																																																			
		Contaminant	Benzene																																																																																			
SOURCE	Ax	Ay	Az	LAMBDA	SOURCE	SOURCE	Time (days)																																																																															
CONC	(ft)	(ft)	(ft)		WIDTH	THICKNESS	(days)																																																																															
(MG/L)			>=.001	day-1	(ft)	(ft)																																																																																
6	9.59E+01	9.59E+00	1.00E-04	0.0009589	100	15	10950																																																																															
Hydraulic	Hydraulic		Soil Bulk		Frac.	Retard-	V																																																																															
Cond	Gradient	Porosity	Density	KOC	Org. Carb.	ation	(=K*i/n*R)																																																																															
(ft/day)	(ft/ft)	(dec. frac.)	(g/cm ³)			(R)	(ft/day)																																																																															
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785																																																																															
<div> <div> Point Concentration <table border="1"> <tr> <td>x(ft)</td> <td>y(ft)</td> <td>z(ft)</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td colspan="3"> <table border="1"> <tr> <td></td> <td>x(ft)</td> <td>y(ft)</td> <td>z(ft)</td> </tr> <tr> <td>Conc. At</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>at</td> <td>10950</td> <td>days =</td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td>6.063</td> </tr> <tr> <td></td> <td></td> <td></td> <td>mg/l</td> </tr> </table> </td> </tr> </table> </div> <div> <table border="1"> <tr> <td colspan="2">AREAL</td> <td colspan="2">CALCULATION</td> </tr> <tr> <td colspan="2">MODEL</td> <td colspan="2">DOMAIN</td> </tr> <tr> <td>Length (ft)</td> <td>959</td> <td></td> <td></td> </tr> <tr> <td>Width (ft)</td> <td>255</td> <td></td> <td></td> </tr> <tr> <td></td> <td>95.9</td> <td>191.8</td> <td>287.7</td> </tr> <tr> <td>255</td> <td>0.000</td> <td>0.001</td> <td>0.003</td> </tr> <tr> <td>127.5</td> <td>0.120</td> <td>0.187</td> <td>0.147</td> </tr> <tr> <td>0</td> <td>2.567</td> <td>1.115</td> <td>0.524</td> </tr> <tr> <td>-127.5</td> <td>0.120</td> <td>0.187</td> <td>0.147</td> </tr> <tr> <td>-255</td> <td>0.000</td> <td>0.001</td> <td>0.003</td> </tr> <tr> <td>Field Data:</td> <td colspan="3">Centerline C Concentration</td> </tr> <tr> <td></td> <td colspan="3">Distance from Source</td> </tr> </table> </div> </div>										x(ft)	y(ft)	z(ft)	1	0	0	<table border="1"> <tr> <td></td> <td>x(ft)</td> <td>y(ft)</td> <td>z(ft)</td> </tr> <tr> <td>Conc. At</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>at</td> <td>10950</td> <td>days =</td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td>6.063</td> </tr> <tr> <td></td> <td></td> <td></td> <td>mg/l</td> </tr> </table>				x(ft)	y(ft)	z(ft)	Conc. At	1	0	0	at	10950	days =					6.063				mg/l	AREAL		CALCULATION		MODEL		DOMAIN		Length (ft)	959			Width (ft)	255				95.9	191.8	287.7	255	0.000	0.001	0.003	127.5	0.120	0.187	0.147	0	2.567	1.115	0.524	-127.5	0.120	0.187	0.147	-255	0.000	0.001	0.003	Field Data:	Centerline C Concentration				Distance from Source		
x(ft)	y(ft)	z(ft)																																																																																				
1	0	0																																																																																				
<table border="1"> <tr> <td></td> <td>x(ft)</td> <td>y(ft)</td> <td>z(ft)</td> </tr> <tr> <td>Conc. At</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>at</td> <td>10950</td> <td>days =</td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td>6.063</td> </tr> <tr> <td></td> <td></td> <td></td> <td>mg/l</td> </tr> </table>				x(ft)	y(ft)	z(ft)	Conc. At	1	0	0	at	10950	days =					6.063				mg/l																																																																
	x(ft)	y(ft)	z(ft)																																																																																			
Conc. At	1	0	0																																																																																			
at	10950	days =																																																																																				
			6.063																																																																																			
			mg/l																																																																																			
AREAL		CALCULATION																																																																																				
MODEL		DOMAIN																																																																																				
Length (ft)	959																																																																																					
Width (ft)	255																																																																																					
	95.9	191.8	287.7																																																																																			
255	0.000	0.001	0.003																																																																																			
127.5	0.120	0.187	0.147																																																																																			
0	2.567	1.115	0.524																																																																																			
-127.5	0.120	0.187	0.147																																																																																			
-255	0.000	0.001	0.003																																																																																			
Field Data:	Centerline C Concentration																																																																																					
	Distance from Source																																																																																					

Centerline Plot (linear)

Centerline Plot (log)

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION, 1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO																																																																																	
Project:	2574601 - Sunoco Philadelphia Refinery																																																																																
Date:	8/26/2005	Prepared by	Allison Jelinek																																																																														
		Contaminant	Ethylbenzene																																																																														
SOURCE	Ax	Ay	Az	LAMBDA	SOURCE	SOURCE	Time (days)																																																																										
CONC	(ft)	(ft)	(ft)		WIDTH	THICKNESS	(days)																																																																										
(MG/L)			>=.001	day-1	(ft)	(ft)																																																																											
1	9.59E+01	9.59E+00	1.00E-04	0.0030411	100	15	10950																																																																										
Hydraulic	Hydraulic		Soil Bulk		Frac.	Retard-	V																																																																										
Cond	Gradient	Porosity	Density	KOC	Org. Carb.	ation	($=K*i/n*R$)																																																																										
(ft/day)	(ft/ft)	(dec. frac.)	(g/cm ³)			(R)	(ft/day)																																																																										
2.40E+01	0.0035	0.35	1.7225	220	5.00E-03	6.413571429	0.037420648																																																																										
<div> <div> <div>Point Concentration</div> <table border="1"> <thead> <tr> <th>x(ft)</th> <th>y(ft)</th> <th>z(ft)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>0</td> <td>0</td> </tr> </tbody> </table> <div> <div> <div>Conc. At</div> <div>at</div> </div> <div> <div>x(ft)</div> <div>10950</div> </div> <div> <div>y(ft)</div> <div>days =</div> </div> <div> <div>z(ft)</div> <div>0</div> </div> </div> <div> <div>mg/l</div> <div>1.269</div> </div> </div> </div> <div> <div>AREAL</div> <div>MODEL</div> <div>CALCULATION</div> <div>DOMAIN</div> <div>Length (ft)</div> <div>959</div> <div>Width (ft)</div> <div>255</div> </div> <table border="1"> <thead> <tr> <th></th> <th>95.9</th> <th>191.8</th> <th>287.7</th> <th>383.6</th> <th>479.5</th> <th>575.4</th> <th>671.3</th> <th>767.2</th> <th>863.1</th> <th>959</th> </tr> </thead> <tbody> <tr> <td>255</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> </tr> <tr> <td>127.5</td> <td>0.004</td> <td>0.001</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> </tr> <tr> <td>0</td> <td>0.095</td> <td>0.007</td> <td>0.001</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> </tr> <tr> <td>-127.5</td> <td>0.004</td> <td>0.001</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> </tr> <tr> <td>-255</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> </tr> </tbody> </table> <div> <div>Field Data:</div> <div>Centerline C Concentration</div> <div>Distance from Source</div> </div>										x(ft)	y(ft)	z(ft)	1	0	0		95.9	191.8	287.7	383.6	479.5	575.4	671.3	767.2	863.1	959	255	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	127.5	0.004	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0	0.095	0.007	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-127.5	0.004	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-255	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
x(ft)	y(ft)	z(ft)																																																																															
1	0	0																																																																															
	95.9	191.8	287.7	383.6	479.5	575.4	671.3	767.2	863.1	959																																																																							
255	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000																																																																							
127.5	0.004	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000																																																																							
0	0.095	0.007	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000																																																																							
-127.5	0.004	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000																																																																							
-255	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000																																																																							

Centerline Plot (linear)

Centerline Plot (log)

NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF
"AN ANALYTICAL MODEL FOR
MULTIDIMENSIONAL TRANSPORT OF A
DECAYING CONTAMINANT SPECIES"
P.A. Domenico (1987)
Modified to Include Retardation

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION, 1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO																																																																																																																										
Project:	2574601 - Sunoco Philadelphia Refinery																																																																																																																									
Date:	8/26/2005	Prepared by	Allison Jelinek																																																																																																																							
		Contaminant	Toluene																																																																																																																							
SOURCE	Ax	Ay	Az	LAMBDA	SOURCE	SOURCE	Time (days)																																																																																																																			
CONC	(ft)	(ft)	(ft)		WIDTH	THICKNESS	(days)																																																																																																																			
(MG/L)			>=.001	day-1	(ft)	(ft)																																																																																																																				
	10	9.59E+01	9.59E+00	1.00E-04	0.02468493	100	15	10950																																																																																																																		
Hydraulic	Hydraulic		Soil Bulk		Frac.	Retard-	V																																																																																																																			
Cond	Gradient	Porosity	Density	KOC	Org. Carb.	ation	(=K*i/n*R)																																																																																																																			
(ft/day)	(ft/ft)	(dec. frac.)	(g/cm ³)			(R)	(ft/day)																																																																																																																			
	2.40E+01	0.0035	0.35	1.7225	130	5.00E-03	4.198928571	0.057157438																																																																																																																		
<div> <div> <div>Point Concentration</div> <table border="1"> <thead> <tr> <th>x(ft)</th> <th>y(ft)</th> <th>z(ft)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>0</td> <td>0</td> </tr> </tbody> </table> <div> <table border="1"> <thead> <tr> <th></th> <th>x(ft)</th> <th>y(ft)</th> <th>z(ft)</th> </tr> </thead> <tbody> <tr> <td>Conc. At</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>at</td> <td>10950</td> <td>days =</td> <td>9.022</td> </tr> <tr> <td></td> <td></td> <td></td> <td>mg/l</td> </tr> </tbody> </table> </div> </div> <div> <div>AREAL</div> <div>MODEL</div> <div>CALCULATION</div> <div>DOMAIN</div> <table border="1"> <thead> <tr> <th></th> <th>Length (ft)</th> <th>Width (ft)</th> </tr> </thead> <tbody> <tr> <td></td> <td>959</td> <td>255</td> </tr> <tr> <td></td> <td>95.9</td> <td>191.8</td> </tr> <tr> <td></td> <td>287.7</td> <td>383.6</td> </tr> <tr> <td></td> <td>479.5</td> <td>575.4</td> </tr> <tr> <td></td> <td>671.3</td> <td>767.2</td> </tr> <tr> <td></td> <td>863.1</td> <td>959</td> </tr> </tbody> </table> <table border="1"> <tbody> <tr> <td>255</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> </tr> <tr> <td>127.5</td> <td>0.001</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> </tr> <tr> <td>0</td> <td>0.019</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> </tr> <tr> <td>-127.5</td> <td>0.001</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> </tr> <tr> <td>-255</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> </tr> </tbody> </table> </div> </div> <div> <div>Field Data:</div> <div>Centerline C Concentration</div> <div>Distance from Source</div> <table border="1"> <tbody> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> </div>										x(ft)	y(ft)	z(ft)	1	0	0		x(ft)	y(ft)	z(ft)	Conc. At	1	0	0	at	10950	days =	9.022				mg/l		Length (ft)	Width (ft)		959	255		95.9	191.8		287.7	383.6		479.5	575.4		671.3	767.2		863.1	959	255	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	127.5	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0	0.019	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-127.5	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-255	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000																				
x(ft)	y(ft)	z(ft)																																																																																																																								
1	0	0																																																																																																																								
	x(ft)	y(ft)	z(ft)																																																																																																																							
Conc. At	1	0	0																																																																																																																							
at	10950	days =	9.022																																																																																																																							
			mg/l																																																																																																																							
	Length (ft)	Width (ft)																																																																																																																								
	959	255																																																																																																																								
	95.9	191.8																																																																																																																								
	287.7	383.6																																																																																																																								
	479.5	575.4																																																																																																																								
	671.3	767.2																																																																																																																								
	863.1	959																																																																																																																								
255	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000																																																																																																																	
127.5	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000																																																																																																																	
0	0.019	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000																																																																																																																	
-127.5	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000																																																																																																																	
-255	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000																																																																																																																	

Centerline Plot (linear)

Centerline Plot (log)

NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF
"AN ANALYTICAL MODEL FOR
MULTIDIMENSIONAL TRANSPORT OF A
DECAYING CONTAMINANT SPECIES"
P.A. Domenico (1987)
Modified to Include Retardation

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project
Prepared by
Date Prepared

2574601 - Sunoco Philadelphia Refinery
Allison Jelinek
8/26/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-224
Sample Date			8/1/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	1
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A _x	ft	76.5
Transverse Dispersivity	A _y	ft	7.7
Vertical Dispersivity	A _z	ft	0.0001
Hydraulic Conductivity	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p _b	g/cm ³	1.7225
Fraction of Organic Carbon	f _{OC}	decimal fraction	0.005
Time		days	10950
Length of Grid Dimension		ft	765
Width of Grid Dimension		ft	191

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	2.0000
Lambda (per day)		day ⁻¹	0.000958904
KOC			58
Sim 2			
Contaminant			Toluene
Source Concentration (mg/l)		mg/l	2.8
Lambda (per day)		day ⁻¹	0.024684932
KOC			130

Output (Concentration at the Downgradient Property Boundary in 30 years)					
Contaminant	GW MSC ¹ Residential (mg/l)	GW MSC ² Non-Residential (mg/l)	Concentration at Property Boundary (mg/l)	Distance to Property Boundary (ft)	Distance to Meet Residential GW MSC (ft)
Sim 1 - Benzene	0.005	0.005	1.99E+00	1	765
Sim 2 - Toluene	1	1	2.61E+00	1	1

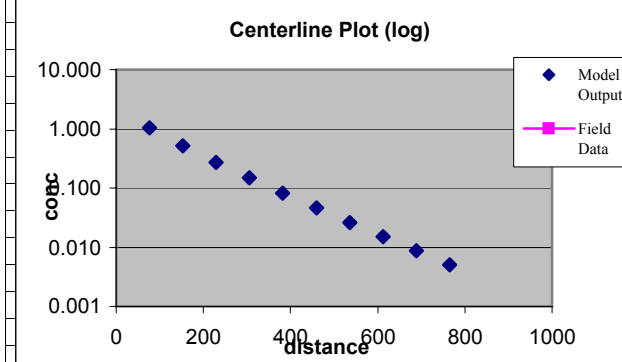
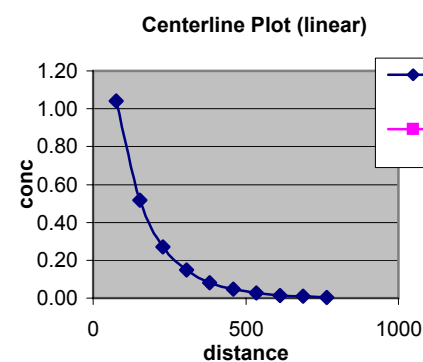
¹ ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

² ACT 2 TGM, Appendix A, Table 1 MSC for a Non-residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION, 1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO																																													
Project:	2574601 - Sunoco Philadelphia Refinery																																												
Date:	8/26/2005	Prepared by	Allison Jelinek																																										
		Contaminant	Benzene																																										
SOURCE	Ax	Ay	Az	LAMBDA	SOURCE	SOURCE	Time (days)																																						
CONC	(ft)	(ft)	(ft)		WIDTH	THICKNESS	(days)																																						
(MG/L)			>=.001	day-1	(ft)	(ft)																																							
	2	7.65E+01	7.65E+00	1.00E-04	0.0009589	100	15	10950																																					
Hydraulic	Hydraulic		Soil Bulk		Frac.	Retard-	V																																						
Cond	Gradient	Porosity	Density	KOC	Org. Carb.	ation	(=K*i/n*R)																																						
(ft/day)	(ft/ft)	(dec. frac.)	(g/cm ³)			(R)	(ft/day)																																						
	2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785																																					
<table border="1"> <thead> <tr> <th colspan="3">Point Concentration</th> </tr> <tr> <th>x(ft)</th> <th>y(ft)</th> <th>z(ft)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td colspan="3"> <table border="1"> <thead> <tr> <th></th> <th>x(ft)</th> <th>y(ft)</th> <th>z(ft)</th> </tr> </thead> <tbody> <tr> <td>Conc. At</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>at</td> <td>10950</td> <td>days =</td> <td>1.987</td> </tr> <tr> <td></td> <td></td> <td></td> <td>mg/l</td> </tr> </tbody> </table> </td> </tr> </tbody> </table>										Point Concentration			x(ft)	y(ft)	z(ft)	1	0	0	<table border="1"> <thead> <tr> <th></th> <th>x(ft)</th> <th>y(ft)</th> <th>z(ft)</th> </tr> </thead> <tbody> <tr> <td>Conc. At</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>at</td> <td>10950</td> <td>days =</td> <td>1.987</td> </tr> <tr> <td></td> <td></td> <td></td> <td>mg/l</td> </tr> </tbody> </table>				x(ft)	y(ft)	z(ft)	Conc. At	1	0	0	at	10950	days =	1.987				mg/l								
Point Concentration																																													
x(ft)	y(ft)	z(ft)																																											
1	0	0																																											
<table border="1"> <thead> <tr> <th></th> <th>x(ft)</th> <th>y(ft)</th> <th>z(ft)</th> </tr> </thead> <tbody> <tr> <td>Conc. At</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>at</td> <td>10950</td> <td>days =</td> <td>1.987</td> </tr> <tr> <td></td> <td></td> <td></td> <td>mg/l</td> </tr> </tbody> </table>				x(ft)	y(ft)	z(ft)	Conc. At	1	0	0	at	10950	days =	1.987				mg/l																											
	x(ft)	y(ft)	z(ft)																																										
Conc. At	1	0	0																																										
at	10950	days =	1.987																																										
			mg/l																																										
<table border="1"> <thead> <tr> <th colspan="2">AREAL MODEL</th> <th colspan="2">CALCULATION DOMAIN</th> </tr> </thead> <tbody> <tr> <td>Length (ft)</td> <td>765</td> <td></td> <td></td> </tr> <tr> <td>Width (ft)</td> <td>191</td> <td></td> <td></td> </tr> <tr> <td></td> <td>76.5</td> <td>153</td> <td>229.5</td> </tr> <tr> <td>191</td> <td>0.000</td> <td>0.001</td> <td>0.004</td> </tr> <tr> <td>95.5</td> <td>0.112</td> <td>0.128</td> <td>0.097</td> </tr> <tr> <td>0</td> <td>1.043</td> <td>0.518</td> <td>0.272</td> </tr> <tr> <td>-95.5</td> <td>0.112</td> <td>0.128</td> <td>0.097</td> </tr> <tr> <td>-191</td> <td>0.000</td> <td>0.001</td> <td>0.004</td> </tr> </tbody> </table>										AREAL MODEL		CALCULATION DOMAIN		Length (ft)	765			Width (ft)	191				76.5	153	229.5	191	0.000	0.001	0.004	95.5	0.112	0.128	0.097	0	1.043	0.518	0.272	-95.5	0.112	0.128	0.097	-191	0.000	0.001	0.004
AREAL MODEL		CALCULATION DOMAIN																																											
Length (ft)	765																																												
Width (ft)	191																																												
	76.5	153	229.5																																										
191	0.000	0.001	0.004																																										
95.5	0.112	0.128	0.097																																										
0	1.043	0.518	0.272																																										
-95.5	0.112	0.128	0.097																																										
-191	0.000	0.001	0.004																																										
Field Data: Centerline C Concentration																																													
Distance from Source																																													

NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF
"AN ANALYTICAL MODEL FOR
MULTIDIMENSIONAL TRANSPORT OF A
DECAYING CONTAMINANT SPECIES"
P.A. Domenico (1987)
Modified to Include Retardation



ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION, 1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO																																																																																	
Project:	2574601 - Sunoco Philadelphia Refinery																																																																																
Date:	8/26/2005	Prepared by	Allison Jelinek																																																																														
		Contaminant	Toluene																																																																														
SOURCE	Ax	Ay	Az	LAMBDA	SOURCE	SOURCE	Time (days)																																																																										
CONC	(ft)	(ft)	(ft)		WIDTH	THICKNESS	(days)																																																																										
(MG/L)			>=.001	day-1	(ft)	(ft)																																																																											
	3	7.65E+01	7.65E+00	1.00E-04	0.02468493	100	15	10950																																																																									
Hydraulic	Hydraulic		Soil Bulk		Frac.	Retard-	V																																																																										
Cond	Gradient	Porosity	Density	KOC	Org. Carb.	ation	($=K*i/n*R$)																																																																										
(ft/day)	(ft/ft)	(dec. frac.)	(g/cm ³)			(R)	(ft/day)																																																																										
	2.40E+01	0.0035	0.35	1.7225	130	5.00E-03	4.198928571	0.057157438																																																																									
<div> <div> <div>Point Concentration</div> <table border="1"> <thead> <tr> <th>x(ft)</th> <th>y(ft)</th> <th>z(ft)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>0</td> <td>0</td> </tr> </tbody> </table> <div> <div>Conc. At</div> <div>at</div> </div> <div> <div>x(ft)</div> <div>10950</div> </div> <div> <div>y(ft)</div> <div>days =</div> </div> <div> <div>z(ft)</div> <div>0</div> </div> <div> <div>mg/l</div> <div>2.614</div> </div> </div> </div> <div> <div>AREAL</div> <div>MODEL</div> </div> <div> <div>CALCULATION</div> <div>DOMAIN</div> </div> <div> <div>Length (ft)</div> <div>765</div> </div> <div> <div>Width (ft)</div> <div>191</div> </div> <table border="1"> <thead> <tr> <th></th> <th>76.5</th> <th>153</th> <th>229.5</th> <th>306</th> <th>382.5</th> <th>459</th> <th>535.5</th> <th>612</th> <th>688.5</th> <th>765</th> </tr> </thead> <tbody> <tr> <td>191</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> </tr> <tr> <td>95.5</td> <td>0.001</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> </tr> <tr> <td>0</td> <td>0.012</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> </tr> <tr> <td>-95.5</td> <td>0.001</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> </tr> <tr> <td>-191</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> </tr> </tbody> </table> <div> <div>Field Data:</div> <div>Centerline C Concentration</div> <div>Distance from Source</div> </div>										x(ft)	y(ft)	z(ft)	1	0	0		76.5	153	229.5	306	382.5	459	535.5	612	688.5	765	191	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	95.5	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0	0.012	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-95.5	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-191	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
x(ft)	y(ft)	z(ft)																																																																															
1	0	0																																																																															
	76.5	153	229.5	306	382.5	459	535.5	612	688.5	765																																																																							
191	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000																																																																							
95.5	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000																																																																							
0	0.012	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000																																																																							
-95.5	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000																																																																							
-191	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000																																																																							

Centerline Plot (linear)

Centerline Plot (log)

NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF
"AN ANALYTICAL MODEL FOR
MULTIDIMENSIONAL TRANSPORT OF A
DECAYING CONTAMINANT SPECIES"
P.A. Domenico (1987)
Modified to Include Retardation

APPENDIX G

SUMMARY OF AOI 4 GROUNDWATER AND LNAPL ELEVATIONS USED FOR GROUNDWATER CONTOURING

Appendix G
Summary of AOI 4 Groundwater and LNAPL Elevations Used for Groundwater Contouring
AOI 4 Site Characterization Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Monitoring Point ID	AOI	Specific Gravity (g/cc)		Notes	Depth to	Depth to	LNAPL	LNAPL	GW	Corrected GW
		S.G. ¹	Source ²		Product	Water ³ (ft)	Thickness ³ (ft)	Elevation ³ (ft amsl)	Elevation ³ (ft amsl)	Elevation (ft amsl)
AOI 4										
MW-1	AOI 4				NP	16.09	0	NA	NA	NA
MW-3	AOI 4				16.86	17.47	0.61	NA	NA	NA
MW-4	AOI 4				NP	7.31	NA	NA	NA	NA
S-102	AOI 4				NP	18.88	0	NA	-0.66	-0.66
S-103	AOI 4	0.7978	S-103		25.63	25.81	0.18	0.48	0.3	0.44
S-104	AOI 4	0.8787	S-104		17.62	18.74	1.12	0.49	-0.63	0.35
S-111	AOI 4				NM	NM	0	NA	NA	NA
S-119	AOI 4				NP	26.46	0	NA	0.14	0.14
S-119D	AOI 4				NP	25.79	0	NA	-0.69	-0.69
S-120	AOI 4				NP	19.5	0	NA	0.32	0.32
S-121	AOI 4				NP	21.61	0	NA	-0.49	-0.49
S-122	AOI 4				NP	25.51	0	NA	0.2	0.2
S-123	AOI 4				22.12	22.14	0.02	0.01	-0.01	-0.01
S-124	AOI 4	0.8223	S-124		23.09	24.08	0.99	0.11	-0.88	-0.07
S-26	AOI 4				NP	20.69	0	NA	0.07	0.07
S-27	AOI 4				NP	24.71	0	NA	0.12	0.12
S-28	AOI 4				NP	22.98	0	NA	2.76	2.76
S-29	AOI 4	0.8550	S-29		20.97	27.36	6.39	2.33	-4.06	1.4
S-30	AOI 4	0.8550	S-29		22.92	23.56	0.64	0.21	-0.43	0.12
S-31	AOI 4				NP	19.06	0	NA	2.64	2.64
S-32	AOI 4	0.8665	S-32		NP	23.6	0	NA	0.6	0.6
S-33	AOI 4	0.8575	S-33		NA	NA	0	NA	NA	NA
S-34	AOI 4	0.8575	S-33		23.34	24.4	1.06	-0.04	-1.1	-0.19
S-35	AOI 4	0.8665	S-35		24.75	25.53	0.78	-0.06	-0.84	-0.16
S-36	AOI 4	0.8575	S-33		24.29	24.54	0.25	-0.06	-0.31	-0.1
S-37	AOI 4	0.8639	S-37		25.85	25.92	0.07	0.05	-0.02	0.04
S-38	AOI 4				NP	19	0	NA	-0.05	-0.05
S-38D	AOI 4				NP	19.68	0	NA	-1.98	-1.98
S-38I	AOI 4				NP	20.24	0	NA	-2.05	-2.05
S-39	AOI 4				NP	22.64	0	NA	0.24	0.24
S-40	AOI 4				NP	24.43	0	NA	0.03	0.03
S-55	AOI 4				NM	NM	NA	NA	NA	NA
S-56	AOI 4	0.8684	S-56		14.74	14.75	0.01	0.26	0.25	0.26
S-57	AOI 4	0.8620	S-57		12.77	13.05	0.28	-0.27	-0.55	-0.31
S-58	AOI 4				NM	NM	NA	NA	NA	NA
S-59D	AOI 4				NP	17.63	0	NA	-0.51	-0.51
S-67	AOI 4				NM	NM	NA	NA	NM	NM
S-96	AOI 4				NP	19.5	0	NA	0.27	0.27
S-97	AOI 4	0.8653	S-97		29.53	29.54	0.01	0.02	0.01	0.02
S-216	AOI 4				NP	15.38	NP	NA	0.38	0.38
S-217	AOI 4	0.8578	S-33		11.96	11.99	0.03	-0.43	-0.46	-0.43
S-218	AOI 4				NP	25.28	NP	NA	0.46	0.46
S-219	AOI 4				NP	22.93	NP	NA	0.16	0.16
S-220	AOI 4	0.8550	S-29		20.59	20.97	0.38	0.22	-0.16	0.16
S-221	AOI 4	0.8223	S-124		22.7	24.34	1.64	0.28	-1.36	-0.01
S-222	AOI 4				NP	16.09	NP	0	0.21	0.21
S-223	AOI 4				NP	15.87	NP	0	0.01	0.01
S-224	AOI 4				NP	15.97	NP	0	0.07	0.07
S-225	AOI 4				NP	16.41	NP	NA	0.45	0.45
S-229	AOI 4				22.64	23.88	1.24	0.09	-1.15	-0.08

Notes:

1. Specific Gravity (S.G.) values were determined from LNAPL samples taken by Aquaterra on February 27th and March 1st, 2004, or from samples collected by SECOR in 1999-2000.

2. For wells with no direct S.G. measurements, the S.G. value in the nearest well with a direct S.G. was used.

3. Depth to Water and Depth to LNAPL provided by Aquaterra August 17, 2005.

AOI = Area of Interest

g/cc = grams per cubic centimeter

LNAPL = Light Non-Aqueous Phase Liquid

amsl = above mean sea level

GW = Groundwater

F = Film or trace product

NA = Not applicable

NM = Not Measured

NP = No Product