APPENDIX A

Notice of Intent to Remediate and Report Notifications

Sunoco Inc.
3144 Passyunk Avenue
Philadelphia PA 19145-5299
215 339 2000

October 12, 2006

Mr. Robert Day-Lewis
Pennsylvania DEP
2 East Main Street
Norristown, PA 19401

Mr. Steve O'Neil
Pennsylvania DEP
2 East Main Street
Norristown, PA 19401

Re: Sunoco Inc. (R&M) Philadelphia Refinery
Philadelphia, Philadelphia County

Dear Mr. Day-Lewis and Mr. O'Neil:

In accordance with the Land Recycling and Environmental Remediation Standards Act (Act 2), enclosed are two copies of a Notice of Intent to Remediate (NIR) for the Sunoco Inc. (R&M) Philadelphia Refinery. This NIR covers remediation being done as part of the 2003 Consent Order and Agreement (CO&A) at Point Breeze, Girard Point and Schuylkill River Tank Farm. Remediation at Belmont Terminal, which is part of the CO&A, is not part of this NIR since this site is not subject to RCRA Corrective Action. Sunoco is considering submitting a separate NIR for this area under the Act 2 program only.

This NIR is being submitted with the intent to enter the Sunoco Philadelphia Refinery into the One Cleanup Program with PaDEP and the USEPA. All remediation work at the Philadelphia refinery will be completed under the 2003 Consent Order & Agreement (CO&A), however, RCRA Corrective Action measures will be addressed concurrently with work performed under the CO&A and within the Act 2 program.

Please call me at 610-859-1881 or email me at jroppenheim@sunocoinc.com with any questions or comments.

Best Regards,

James Oppenheim, PE
Sr. Environmental Consultant

Cc: Sunoco Legal Dept.
Philadelphia Refinery Environmental Central File
David Burke, PADEP
Walter Payne, PADEP
Hon Lee, USEPA Region III
Colleen Costello, Langan

Will remediation be to a site-specific standard ☒ or as a special industrial area ☐? If so, the municipality or municipalities must be provided 30-day comment period.
Remediator/Property Owner/Consultant. For each of these recipients of the approval of the final report, complete form below.

Remediator
Contact Person: James R. Oppenheim
Relationship to site (e.g. owner, remediator, participating in cleanup, consultant): Remediation Project Manager
Phone Number: (610) 859-1881
Company Name: Sunoco, Inc. (R&M)
Address (street, city, state, zip): 100 Green St., Marcus Hook, PA 19061
Email Address: jroppenheim@sunocoinc.com
Property Owner
Contact Person: Scott Baker
Relationship to site (e.g. owner, remediator, participating in cleanup, consultant): Environmental Manager
Phone Number: (215) 339-2074
Company Name: Sunoco, Inc. (R&M)
Address (street, city, state, zip): 3144 Passyunk Ave. Philadelphia, PA 19145
Email Address: sabaker@sunocoinc.com
Consultant
Contact Person: Colleen Costello
Relationship to site (e.g. owner, remediator, participating in cleanup, consultant): Consultant
Phone Number: (215) 864-0640
Company Name: Langan Engineering and Environmental Services
Address (street, city, state, zip): 30 South 17th St., Suite 1500, Philadelphia, PA 19103
Email Address: ccostello@langan.com

Preparer of Notice of Intent to Remediate:

Name: James Oppenheim

Title: Project Manager

Address: 100 Green Street
Marcus Hook, PA 19061

Telephone: (610) 859-1881

Email Address: jroppenheim@sunocoinc.com

Email Image File of Site Map showing property lines and general area of site(s) to be remediated to: (landrecycling@state.pa.us)

Sunoco Inc.
3144 Passyunk Avenue
Philadelphia PA 19145-5299
215 339 2000

October 12, 2006

Manager
Philadelphia Department of Public Health
Environmental Health Services
321 University Avenue
Philadelphia, PA 19104

Re: Sunoco, Inc. (R&M) Philadelphia Refinery
Philadelphia, Philadelphia County

Dear Sir/Madam:

The Land Recycling and Environmental Remediation Standards Act (Act 2) requires that a Notice of Intent to Remediate (NIR) be provided to the municipality in which the site is located when a site is being remediated to a site-specific Standard. The municipality is afforded a 30-day comment period. In accordance with this provision of the Act, Sunoco, Inc. (R&M) is formally notifying you of its intent to remediate the subject site under Act 2. A copy of the NIR, which will be sent to the Pennsylvania Department of Environmental Protection (PaDEP), is enclosed. This notice will also be published in the Pennsylvania Bulletin, and a summary of the notice appeared in the Philadelphia Daily News on October 16, 2006.

Publication of this notice in the Philadelphia Daily News initiates the 30-day public and municipal comment period. During the next thirty days, your municipality may request to become involved in the development of the remediation plans for the site. If the municipality wishes to become involved in this project, please send your comments to Sunoco to my attention.

Please call me at (610) 859-1881 if you have any questions concerning the proposed remediation.

Best Regards,

James R. Oppenheim, P.E.
Senior Environmental Consultant

Cc: Sunoco Legal Dept.
Philadelphia Refinery Environmental Central File
Steve O'Neil, PaDEP
Colleen Costello, Langan

Will remediation be to a site-specific standard ☒ or as a special industrial area ☐? If so, the municipality or municipalities must be provided 30-day comment period.
Remediator/Property Owner/Consultant. For each of these recipients of the approval of the final report, complete form below.

Remediator
Contact Person: James R. Oppenheim
Relationship to site (e.g. owner, remediator, participating in cleanup, consultant): Remediation Project Manager
Phone Number: (610) 859-1881
Company Name: Sunoco, Inc. (R&M)
Address (street, city, state, zip): 100 Green St., Marcus Hook, PA 19061
Email Address: jroppenheim@sunocoinc.com
Property Owner
Contact Person: Scott Baker
Relationship to site (e.g. owner, remediator, participating in cleanup, consultant): Environmental Manager
Phone Number: (215) 339-2074
Company Name: Sunoco, Inc. (R&M)
Address (street, city, state, zip): 3144 Passyunk Ave. Philadelphia, PA 19145
Email Address: sabaker@sunocoinc.com
Consultant
Contact Person: Colleen Costello
Relationship to site (e.g. owner, remediator, participating in cleanup, consultant): Consultant
Phone Number: (215) 864-0640
Company Name: Langan Engineering and Environmental Services
Address (street, city, state, zip): 30 South 17th St., Suite 1500, Philadelphia, PA 19103
Email Address: ccostello@langan.com

Preparer of Notice of Intent to Remediate:

Name: James Oppenheim
Title: Project Manager
Address: 100 Green Street
Marcus Hook, PA 19061
Telephone: (610) 859-1881
Email Address: jroppenheim@sunocoinc.com

Email Image File of Site Map showing property lines and general area of site(s) to be remediated to: (landrecycling@state.pa.us)

Proof of Publication in The Philadelphia Daily News
Under Act. No 587, Approved May 16, 1929

STATE OF PENNSYLVANIA
COUNTY OF PHILADELPHIA

Anna Dickerson being duly sworn, deposes and says that **The Philadelphia Daily News** is a newspaper published daily, except Sunday, at Philadelphia, Pennsylvania, and was established in said city in 1925, since which date said newspaper has been regularly issued in said County, and that a copy of the printed notice of publication is attached hereto exactly as the same was printed and published in the regular editions and issues of the said newspaper on the following dates:

October 16, 2006

Affiant further deposes and says that he is an employee of the publisher of said newspaper and has been authorized to verify the foregoing statement and that he is not interested in the subject matter of the aforesaid notice of publication, and that all allegations in the foregoing statement as to time, place and character of publication are true.

Anna Dickerson

Sworn to and subscribed before me this 16th day of October, 2006

Mary Anne Logan
Notary Public

My Commission Expires:

NOTARIAL SEAL
Mary Anne Logan, Notary Public
City of Philadelphia, Phila. County
My Commission Expires March 30, 2009

Copy of Notice of Publication

Newspaper Notice of Intent to Remediate to an Environmental Standard. (Sections 302(e)(1)(ii), 303(h)(1)(ii), 304(n)(1)(i), and 305(c)(1))

Pursuant to the Land Recycling and Environmental Remediation Standards Act (Act), the act of May 19, 1995, P.L. 4, No. 1995-2, notice is hereby given that Sunoco Inc.(R&M) has submitted to the Pennsylvania Department of Environmental Protection a Notice of Intent to Remediate a site located at 3144 Passyunk Ave., Philadelphia, Philadelphia County, Pennsylvania. This Notice of Intent to Remediate states that the site is a petroleum refinery. It has been determined that petroleum compounds have impacted soil and groundwater at the site. Sunoco, Inc. (R&M) has indicated that proposed remediation measures will include source reduction and engineered boundary controls. The proposed future use of the property is industrial for continued operation as a petroleum refinery.

Sunoco Inc. (R&M) plans to use the site-specific remediation standard at the site. The Act provides for a 30-day public comment period for site-specific standard remediation. The 30-day comment period is initiated with the publication of this notice. Until November 16, 2006, the City of Philadelphia may submit a request to Sunoco Inc. (R&M) to be involved in the development of the remediation and reuse plans for the site. The City of Philadelphia may also submit a request to Sunoco Inc. (R&M) during this 30-day comment period to develop and implement a public involvement plan. Copies of these requests and of any comments should also be submitted to the Department of Environmental Protection at 2 East Main Street, Norristown, PA 19401 to the attention of Mr. Walter Payne. All correspondence with Sunoco Inc. (R&M) should be addressed to the Public Relations Dept., Sunoco Inc. (R&M) at 3144 Passyunk Ave, Philadelphia, PA, 19145.

LEGAL NOTICES

Newspaper Notice of Intent to Remediate
to an Environmental Standard.
(Sections 302(e)(1)(ii), 303(h)(1)(ii),
304(n)(1)(i), and 305(c)(1))

Pursuant to the Land Recycling and Environmental Remediation Standards Act (Act), the act of May 19, 1995, P.L. 4, No. 1995-2., notice is hereby given that Sunoco Inc.(R&M) has submitted to the Pennsylvania Department of Environmental Protection a Notice of Intent to Remediate a site located at 3144 Passyunk Ave., Philadelphia, Philadelphia County, Pennsylvania. This Notice of Intent to Remediate states that the site is a petroleum refinery. It has been determined that petroleum compounds have impacted soil and groundwater at the site. Sunoco Inc. (R&M) has indicated that proposed remediation measures will include source reduction and engineered boundary controls. The proposed future use of the property is industrial for continued operation as a petroleum refinery.

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Appeared in: ***Philadelphia Inquirer & Philadelphia Daily News*** on Monday, 10/16/2006

Back

LANGAN
ENGINEERING & ENVIRONMENTAL SERVICES

David T. Gockel, P.E., P.P.
George P. Kelley, P.E.
George E. Derrick, P.E.
Michael A. Semeraro, Jr., P.E.
Nicholas De Rose, P.G.
Andrew J. Ciancia, P.E.
George E. Leventis, P.E.
Rudolph P. Frizzi, P.E., G.E.
Ronald A. Fuerst, C.L.A.
Colleen Costello, P.G.
Cristina M. González, P.E.
Gerald J. Zambrella, C.E.M.
Gregory M. Elko, P.E.
Steven Ueland, P.E.

Caryn L. Barnes
Gerard M. Coscia, P.E.
Jason S. Engelhardt, P.E.
Edward H. Geibert, M.S.
Christopher M. Hager, P.E.
John J. McElroy, Jr., Ph.D., P.E.
Michael D. Szura, C.L.A., A.S.L.A.
Stewart H. Abrams, P.E.
Brian M. Conlon, P.E.
Jeffrey A. Smith, P.G.

May 04, 2011

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Manager
Philadelphia Department of Public Health
Environmental Health Services
321 University Avenue
Philadelphia, Pennsylvania 19104

RE: Notice of Submittal of Site Characterization/ Remedial Investigation Report
Area of Interest (AOI) 8
Sunoco, Inc. (R&M) Philadelphia Refinery
Philadelphia, Philadelphia County, Pennsylvania
Langan Project No.: 2574601

Dear Sir/Madam:

Notice is hereby given that Sunoco, Inc. (R&M) (Sunoco) is in the process of submitting a Site Characterization/Remedial Investigation Report to the Pennsylvania Department of Environmental Protection for AOI 8 located at the Sunoco Philadelphia Refinery, Philadelphia, Philadelphia County, Pennsylvania. The report indicates that the remediation planned will attain compliance with a combination of site-specific and the statewide health cleanup standards.

This notice is made under the provision of the Land Recycling and Environmental Standards Act, the Act of May 19, 1995, P.L. #4, No. 2.

Sincerely,
Langan Engineering and Environmental Services, Inc.

Colleen Costello

Colleen Costello, P.G.
Senior Principal

cc: Jim Oppenheim, Sunoco
Kevin Dunleavy, Sunoco

\\langan.com\data\DT\data6\2574601\Office Data\Reports\Repackaged SCR_RIR\AOI 8\Appendices\Appendix A - NIR and Public Notices\RIR Municipal Notice_042511.DOC

Proof of Publication in The Philadelphia Daily News
Under Act. No 587, Approved May 16, 1929

STATE OF PENNSYLVANIA
COUNTY OF PHILADELPHIA

Anna Dickerson being duly sworn, deposes and says that **The Philadelphia Daily News** is a newspaper published daily, except Sunday, at Philadelphia, Pennsylvania, and was established in said city in 1925, since which date said newspaper has been regularly issued in said County, and that a copy of the printed notice of publication is attached hereto exactly as the same was printed and published in the regular editions and issues of the said newspaper on the following dates:

May 23, 2011

Affiant further deposes and says that she is an employee of the publisher of said newspaper and has been authorized to verify the foregoing statement and that she is not interested in the subject matter of the aforesaid notice of publication, and that all allegations in the foregoing statement as to time, place and character of publication are true.

Anna Dickerson

Sworn to and subscribed before me this 23rd day of May, 2011.

Mary Anne Logan
Notary Public

My Commission Expires:

NOTARIAL SEAL
Mary Anne Logan, Notary Public
City of Philadelphia, Phila. County
My Commission Expires March 30, 2013

Copy of Notice of Publication

Notification of Receipt of Site Characterization / Remedial Investigation Report
Notice is hereby given that Sunoco Inc. (R&M) (Sunoco) is in the process of submitting a Site Characterization / Remedial Investigation Report to the Pennsylvania Department of Environmental Protection (PADEP), Southeast Regional Office for Area of Interest (AOI 8) located at the Sunoco Philadelphia Refinery, Philadelphia, Pennsylvania. Sunoco has indicated in the report that site characterization activities have been completed at AOI 8 in accordance with the Land Recycling and Environmental Remediation Standards Act and the 2004 Memorandum of Agreement between the PADEP and U.S. Environmental Protection Agency (EPA) (a.k.a., the PA One Cleanup Program). This notice is made under the provision of the Land Recycling and Environmental Remediation Standards Act, the Act of May 19, 1995, P.L. #4, No. 2.

SENDER: *COMPLETE THIS SECTION*

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Manager
Philadelphia Dept. of Public Health
Environmental Health Services
321 University Avenue
Philadelphia, Pennsylvania 19104

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X Dawn Galloway ☑ Agent ☐ Addressee

B. Received by *(Printed Name)*

C. Date of Delivery 5/6/11

D. Is delivery address different from Item 1? ☐ Yes
If YES, enter delivery address below: ☑ No

3. Service Type
☑ Certified Mail ☐ Express Mail
☐ Registered ☑ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? *(Extra Fee)* ☐ Yes

2. Article Number *(Transfer from service label)* 7010 1870 0001 9784 1237

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

7010 1870 0001 9784 1237

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Sent To Manager
Philadelphia Dept. of Public Health
Street, Apt. No., or PO Box No. Environmental Health Services
321 University Avenue
City, State, ZIP+4 Philadelphia, Pennsylvania 19104

PS Form 3800, August 2006 See Reverse for Instructions

LANGAN

Technical Excellence
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June 11, 2013

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Manager
Philadelphia Department of Public Health
Environmental Health Services
321 University Avenue
Philadelphia, Pennsylvania 19104

Re: Remedial Investigation Report
Area of Interest (AOI) 6
Philadelphia Energy Solutions (PES) Facility
Philadelphia, Philadelphia County, Pennsylvania
Langan Project No.: 2574601

Dear Sir/Madam:

Notice is hereby given that Sunoco, Inc. (R&M) (Sunoco) is in the process of submitting a Remedial Investigation Report to the Pennsylvania Department of Environmental Protection for AOI 6 located at the Philadelphia Energy Solutions Refining and Marketing LLC Facility, Philadelphia County, Philadelphia, PA. The report is being submitted in accordance with the site-specific remediation standards.

This notice is made under the provision of the Land Recycling and Environmental Standards Act, the Act of May 19, 1995, P.L. #4, No. 2.

Please call me at (215) 491-6500 if you have any questions concerning the proposed remediation.

Sincerely,
Langan Engineering and Environmental Services, Inc.

Patrick Troy
Staff Geologist

cc: Jim Oppenheim, Sunoco
Kevin Dunleavy, Sunoco
Charles Barksdale, PES
Jason Hanna, Langan

\\langan.com\data\DT\data6\2574601\Office Data\Reports\Repackaged SCR_RIR\AOI 6\Appendices\Appendix A - Public Notices\SCR_RIR Notices\2013_0611_Philadelphia Department of Public Health_AOI 6 RIR Notices.docx

SENDER: COMPLETE THIS SECTION

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Manager
Philadelphia Dept. of Public Health
Environmental Health Services
321 University Avenue
Philadelphia, Pennsylvania 19104

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X [signature] ☑ Agent ☐ Addressee

B. Received by (Printed Name) [illegible] C. Date of Delivery 6/12/13

D. Is delivery address different from Item 1? ☐ Yes
If YES, enter delivery address below: ☑ No

PHILA. PUBLIC HEALTH DESK
JUN 12 2013

3. Service Type
☑ Certified Mail ☐ Express Mail
☐ Registered ☑ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (Extra Fee) ☐ Yes

2. Article Number (Transfer from service label) 7011 1570 0000 0620 7454

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

7011 1570 0000 0620 7454

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Restricted Delivery Fee (Endorsement Required)	
Total Postage & Fees	$ 6.11

WESTERN PA 1820 JUN 11 2013 Postmark Here

Sent To Manager
Philadelphia Dept. of Public Health
Street, Apt. No.; or PO Box No. Environmental Health Services
321 University Avenue
City, State, ZIP+4 Philadelphia, Pennsylvania 19104

PS Form 3800, August 2006 See Reverse for Instructions

Cindy

June 11, 2013

VIA EMAIL- ADS@PHILLYNEWS.COM

Legal Advertising Department – Daily News
P.O. Box 8263 – 4th Floor
Philadelphia, PA 19101
Attn: Mary Anne Logan

Re: Remedial Investigation Report
Area of Interest (AOI) 6
Philadelphia Energy Solutions (PES) Facility
Philadelphia, Philadelphia County, Pennsylvania
Langan Project No.: 2574601

On behalf of Sunoco, Inc. (R&M), Langan Engineering and Environmental Services, Inc. requests that the following Public Notice be published in the Philadelphia Daily News under the legal notices section.

Notification of Submittal of a Remedial Investigation Report

Notice is hereby given that Sunoco, Inc. (R&M) *(remediator) is in the process of submitting a Remedial Investigation Report to the Pennsylvania Department of Environmental Protection (PADEP), Southeast Regional Office for Area of Interest 6 (AOI 6) located at the Philadelphia Energy Solutions Refining and Marketing LLC (PES) Facility, Philadelphia County, Philadelphia, PA.*

The report is being submitted in accordance with the site-specific remediation standards established under the Land Recycling and Environmental Remediation Standards Act. This notice is made under the provision of the Land Recycling and Environmental Remediation Standards Act, the Act of May 19, 1995, P.L. #4, No. 2.

Please publish the notice as soon as possible and fax the proof of publication to me at (215) 491-6501. Please also mail the hard copy of the proof of publication and your invoice to my attention at the following address:

Langan Engineering & Environmental Services
Attn: Patrick Troy
2700 Kelly Road, Warrington, Pa. 18976

Should you have any questions or comments regarding the request, please contact me at (215) 491-6542.

Sincerely,
Langan Engineering and Environmental Services, Inc.

Patrick Troy
Staff Geologist

cc: Jim Oppenheim, Sunoco
Kevin Dunleavy, Sunoco
Charles Barksdale, PES
Jason Hanna, Langan

\\langan.com\data\DT\data6\2574601\Office Data\Reports\Repackaged SCR_RIR\AOI 6\Appendices\Appendix A - Public Notices\SCR_RIR Notices\2013_0611_AOI 6_SCR_RIR Newspaper Notification.docx

Proof of Publication in The Philadelphia Daily News
Under Act. No 587, Approved May 16, 1929

STATE OF PENNSYLVANIA
COUNTY OF PHILADELPHIA

Florence Devlin being duly sworn, deposes and says that **The Philadelphia Daily News** is a newspaper published daily, except Sunday, at Philadelphia, Pennsylvania, and was established in said city in 1925, since which date said newspaper has been regularly issued in said County, and that a copy of the printed notice of publication is attached hereto exactly as the same was printed and published in the regular editions and issues of the said newspaper on the following dates:

June 14, 2013

Affiant further deposes and says that she is an employee of the publisher of said newspaper and has been authorized to verify the foregoing statement and that she is not interested in the subject matter of the aforesaid notice of publication, and that all allegations in the foregoing statement as to time, place and character of publication are true.

Florence Devlin

Sworn to and subscribed before me this 14th day of June, 2013.

Mary Anne Logan
Notary Public

My Commission Expires:

COMMONWEALTH OF PENNSYLVANIA
NOTARIAL SEAL
MARY ANNE LOGAN, Notary Public
City of Philadelphia, Phila. County
My Commission Expires March 30, 2017

Copy of Notice of Publication

Notification of Submittal of a Remedial Investigation Report
Notice is hereby given that Sunoco, Inc. (R&M) (remediator) is in the process of submitting a Remedial Investigation Report to the Pennsylvania Department of Environmental Protection (PADEP), Southeast Regional Office for Area of Interest 6 (AOI 6) located at the Philadelphia Energy Solutions Refining and Marketing LLC (PES) Facility, Philadelphia County, Philadelphia, PA.
The report is being submitted in accordance with the site-specific remediation standards established under the Land Recycling and Environmental Remediation Standards Act. This notice is made under the provision of the Land Recycling and Environmental Remediation Standards Act, the Act of May 19, 1995, P.L. #4, No. 2.

APPENDIX B

Soil Boring Logs and Monitoring Well Construction Summaries

SOIL BORING LOGS

Aquaterra Technologies, Inc.
Subsurface Log: BH-01-06

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: SWMU 92 **Permit No.:** NA
Philadelphia, PA
Boring Number: BH-01-06 **Log By:** M.B. Spancake **Date:** 22-Mar-06
Drilling Method: Hand Auger **Sample Method:** Hand Auger **Borehole Dia:** 3"
Water Level (Init): 1.5'

Construction Details

Total Boring Depth: 2' BGS **Backfill:** NA ☐ = Backfill

Completion Details: Backfilled

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology
0	0-0.5'		0.5'	Brown silt and coarse sand with small gravel and fill material
0.5'	0.5-1'		0.5'	Same as above, small cobble/large pebble present. Becoming moist
1'	1-1.5'		0.5'	Moist to wet gray-brown sandy gravel
1.5'	1.5-2'		0.5'	Wet gray coarse sandy gravel and some fill material
2'				Not Sampled

Aquaterra Technologies, Inc.
Subsurface Log: BH-02-06

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: SWMU 92 **Permit No.:** NA
Philadelphia, PA
Boring Number: BH-02-06 **Log By:** M.B. Spancake **Date:** 22-Mar-06
Drilling Method: Hand Auger **Sample Method:** Hand Auger **Borehole Dia:** 3"
Water Level (Init): 1'

Construction Details

Total Boring Depth: 2' BGS **Backfill:** NA ☐ = Backfill

Completion Details: Backfilled

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology
0	0-0.5'		0.5'	Brown sandy gravel and fill material.
0.5'	0.5-1'		0.5'	Brown sandy gravel and pebble, moist to wet at bottom
1'	1-1.5'		0.5'	Wet brown sandy gravel and pebble
1.5'	1.5-2'		0.5'	Same, with a black waxy sludge material, very thick.
2'				

Note: Highlighted cell indicates soil sample interval submitted for laboratory analysis of SWMU Site COC's

Aquaterra Technologies, Inc.
Subsurface Log: BH-03-06

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: SWMU 92 **Permit No.:** NA
Philadelphia, PA
Boring Number: BH-03-06 **Log By:** M.B. Spancake **Date:** 22-Mar-06
Drilling Method: Hand Auger **Sample Method:** Hand Auger **Borehole Dia:** 3"
Water Level (Init): 1'

Construction Details

Total Boring Depth: 2' BGS **Backfill:** NA = Backfill

Completion Details: Backfilled

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology
0	0-0.5'		0.5'	Brown sandy gravel with brick fragments
0.5'	0.5-1'		0.5'	Same, becoming wet
1'	1-1.5'		0.5'	Wet gray brown sandy gravel
1.5'	1.5-2'		0.5'	Same, with a black waxy sludge material, very thick.
2'				

Note: Highlighted cell indicates soil sample interval submitted for laboratory analysis of SWMU Site COC's

Aquaterra Technologies, Inc.
Subsurface Log: BH-04-06

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: SWMU 92 **Permit No.:** NA
Philadelphia, PA
Boring Number: BH-04-06 **Log By:** M.B. Spancake **Date:** 20-Mar-06
Drilling Method: Hand Auger **Sample Method:** Hand Auger **Borehole Dia:** 3"
Water Level (Init): NA

Construction Details

Total Boring Depth: 2' BGS **Backfill:** NA ☐ = Backfill

Completion Details: Backfilled

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology
0	0-0.5'		0.5'	Gray silt and gravel with coarse sand. Cobble and brick fragments present
0.5'	0.5-1'		0.5'	Same as above
1'	1-1.5'		0.5'	Same as above to 1.25' BGS. Changing to a compact gray silt with trace clay
1.5'	1.5-2'		0.5'	Gray silt with trace clay with some lighter gray banding evident
2'				Not Sampled

Aquaterra Technologies, Inc.
Subsurface Log: BH-05-06

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: SWMU 92 **Permit No.:** NA
Philadelphia, PA
Boring Number: BH-05-06 **Log By:** M.B. Spancake **Date:** 22-Mar-06
Drilling Method: Hand Auger **Sample Method:** Hand Auger **Borehole Dia:** 3"
Water Level (Init): NA

Construction Details

Total Boring Depth: 2' BGS **Backfill:** NA [ ] = Backfill

Completion Details: Backfilled

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology
0	0-0.5'		0.5'	Brownish gray silty coarse sand and gravel, slightly moist
0.5'	0.5-1'		0.5'	Same as above
1'	1-1.5'		0.5'	Gray to dark gray silt and medium sand with gravel. Glass and brick fragements
1.5'	1.5-2'		0.5'	Same as above
2'				Not Sampled

Aquaterra Technologies, Inc.
Subsurface Log: BH-06-06

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: SWMU 92 **Permit No.:** NA
Philadelphia, PA
Boring Number: BH-06-06 **Log By:** M.B. Spancake **Date:** 22-Mar-06
Drilling Method: Hand Auger **Sample Method:** Hand Auger **Borehole Dia:** 3"
Water Level (Init): 0.25'

Construction Details

Total Boring Depth: 2' BGS **Backfill:** NA [ ] = Backfill

Completion Details: Backfilled

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology
0	0-0.5'		0.5'	Wet brownish gray sandy gravel
0.5'	0.5-1'		0.5'	Same as above
1'	1-1.5'		0.5'	Wet gray sandy gravel with brick and wood fragments
1.5'	1.5-2'		0.5'	Same as above
2'				Not Sampled

Aquaterra Technologies, Inc.
Subsurface Log: BH-07-06

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: SWMU 92 **Permit No.:** NA
Philadelphia, PA
Boring Number: BH-07-06 **Log By:** M.B. Spancake **Date:** 22-Mar-06
Drilling Method: Hand Auger **Sample Method:** Hand Auger **Borehole Dia:** 3"
Water Level (Init): 0.25'

Construction Details

Total Boring Depth: 1.5' BGS **Backfill:** NA [ ] = Backfill

Completion Details: Backfilled

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology
0	0-0.5'		0.5'	Wet gray sandy gravel
0.5'	0.5-1'		0.5'	Same as above
1'	1-1.5'		0.5'	Same as above, auger refusal at 1.5' BGS
1.5'			0.5'	Not Sampled

Aquaterra Technologies, Inc.
Subsurface Log: BH-08-06

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: SWMU 92 **Permit No.:** NA
Philadelphia, PA
Boring Number: BH-08-06 **Log By:** M.B. Spancake **Date:** 20-Mar-06
Drilling Method: Hand Auger **Sample Method:** Hand Auger **Borehole Dia:** 3"
Water Level (Init): NA

Construction Details

Total Boring Depth: 2' BGS **Backfill:** NA [ ] = Backfill

Completion Details: Backfilled

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology
0	0-0.5'		0.5'	Gravel in a brown silt with high organic content, slight clay , brown in color
0.5'	0.5-1'		0.5'	Same as above with more gravel present and trace coarse sand, becoming gray in color
1'	1-1.5'		0.5'	Gray/brown silty sand with glass and wood fragments
1.5'	1.5-2'		0.5'	Dark gray silty sand and gravel with glass and wood fragments.
2'				Not Sampled

Aquaterra Technologies, Inc.
Subsurface Log: BH-09-06

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: SWMU 92 **Permit No.:** NA
Philadelphia, PA
Boring Number: BH-09-06 **Log By:** M.B. Spancake **Date:** 20-Mar-06
Drilling Method: Hand Auger **Sample Method:** Hand Auger **Borehole Dia:** 3"
Water Level (Init): NA

Construction Details

Total Boring Depth: 2' BGS **Backfill:** NA [ ] = Backfill

Completion Details: Backfilled

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology
0	0-0.5'		0.5'	Brown silt and fill stone with brick fragments
0.5'	0.5-1'		0.5'	Dark brown silt and gravel with coarse sand and rock fragments. Some wood debris present
1'	1-1.5'		0.5'	Same as above, slightly moist. Becoming dark brown/gray in color
1.5'	1.5-2'		0.5'	Brick fill and large cobble in dark gray silt and sand with small gravel. Color changes to lighter gray with brown mottling at bottom.
2'				Not Sampled

Aquaterra Technologies, Inc.
Subsurface Log: BH-10-06

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: SWMU 92 **Permit No.:** NA
Philadelphia, PA
Boring Number: BH-10-06 **Log By:** M.B. Spancake **Date:** 22-Mar-06
Drilling Method: Hand Auger **Sample Method:** Hand Auger **Borehole Dia:** 3"
Water Level (Init): NA

Construction Details

Total Boring Depth: 2' BGS **Backfill:** NA [ ] = Backfill

Completion Details: Backfilled

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology
0	0-0.5'		0.5'	Brownish gray silt and coarse sandy gravel
0.5'	0.5-1'		0.5'	Same as above, trace clay
1'	1-1.5'		0.5'	Gray silt and coarse sand with gravel and small pebble
1.5'	1.5-2'		0.5'	Same as above, changing to a silty gray clay, slightly moist
2'				Not Sampled

Aquaterra Technologies, Inc.
Subsurface Log: BH-11-06

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: SWMU 92 **Permit No.:** NA
Philadelphia, PA
Boring Number: BH-11-06 **Log By:** M.B. Spancake **Date:** 20-Mar-06
Drilling Method: Hand Auger **Sample Method:** Hand Auger **Borehole Dia:** 3"
Water Level (Init): 2'

Construction Details

Total Boring Depth: 2' BGS **Backfill:** NA [ ] = Backfill

Completion Details: Backfilled

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology
0	0-0.5'		0.5'	Brown silt and coarse sand with gravel and small rock
0.5'	0.5-1'		0.5'	Same as above with some wood fragments
1'	1-1.5'		0.5'	Change to a gray to dark gray sand and silt, moist
1.5'	1.5-2'		0.5'	Dark gray stained silt with trace gravel and sand. Moist to wet
2'				Not Sampled

Aquaterra Technologies, Inc.
Subsurface Log: BH-12-06

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: SWMU 92 **Permit No.:** NA
Philadelphia, PA
Boring Number: BH-12-06 **Log By:** M.B. Spancake **Date:** 20-Mar-06
Drilling Method: Hand Auger **Sample Method:** Hand Auger **Borehole Dia:** 3"
Water Level (Init): NA

Construction Details

Total Boring Depth: 2' BGS **Backfill:** NA [ ] = Backfill

Completion Details: Backfilled

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology
0	0-0.5'		0.5'	Brown silt and coarse sand with gravel. Glass fragments present
0.5'	0.5-1'		0.5'	Same as above with brick fragments
1'	1-1.5'		0.5'	Dark gray silt with trace clay, rock fragments and gravel present. Slightly moist
1.5'	1.5-2'		0.5'	Same as above with brick fragments.
2'				Not Sampled

Aquaterra Technologies, Inc.
Subsurface Log: BH-13-06

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: SWMU 92 **Permit No.:** NA
Philadelphia, PA
Boring Number: BH-13-06 **Log By:** M.B. Spancake **Date:** 22-Mar-06
Drilling Method: Hand Auger **Sample Method:** Hand Auger **Borehole Dia:** 3"
Water Level (Init): 2'

Construction Details

Total Boring Depth: 2' BGS **Backfill:** NA ☐ = Backfill

Completion Details: Backfilled

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology
0	0-0.5'		0.5'	Brown silt, rich in organic matter.
0.5'	0.5-1'		0.5'	Dark brown silt with rust/red colored scale in bottom 2"
1'	1-1.5'		0.5'	Gray silty clay with rust/red colored scale material, slightly moist
1.5'	1.5-2'		0.5'	Dark gray clayey silt, trace sand and black scale material. Moist to wet
2'				

Note: Highlighted cell indicates soil sample interval submitted for laboratory analysis of SWMU Site COC's

Aquaterra Technologies, Inc.
Subsurface Log: BH-14-06

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: SWMU 92 **Permit No.:** NA
Philadelphia, PA
Boring Number: BH-14-06 **Log By:** M.B. Spancake **Date:** 23-Mar-06
Drilling Method: Hand Auger **Sample Method:** Hand Auger **Borehole Dia:** 3"
Water Level (Init): NA

Construction Details

Total Boring Depth: 2' BGS **Backfill:** NA [ ] = Backfill

Completion Details: Backfilled

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology
0	0-0.5'		0.5'	Borwn silt, trace coarse sand and gravel and trace clay. Some orange/rust colored scale present
0.5'	0.5-1'		0.5'	Brown clayey silt with orange-red scale throughout. Trace sand and gravel
1'	1-1.5'		0.5'	Gray silty clay, some orange-red scale present
1.5'	1.5-2'		0.5'	Gray silty clay, slightly moist
2'				

Note: Highlighted cell indicates soil sample interval submitted for laboratory analysis of SWMU Site COC's

Aquaterra Technologies, Inc.
Subsurface Log: BH-15-06

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: SWMU 92 **Permit No.:** NA
Philadelphia, PA
Boring Number: BH-15-06 **Log By:** M.B. Spancake **Date:** 23-Mar-06
Drilling Method: Hand Auger **Sample Method:** Hand Auger **Borehole Dia:** 3"
Water Level (Init): NA

Construction Details

Total Boring Depth: 2' BGS **Backfill:** NA ☐ = Backfill

Completion Details: Backfilled

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology
0	0-0.5'		0.5'	Brown silt and gravel, brick fragments and fill material
0.5'	0.5-1'		0.5'	Dark brown silt and coarse sand with small gravel and rock
1'	1-1.5'		0.5'	Dark gray silty sand and gravel with brick fragments and fill material
1.5'	1.5-2'		0.5'	Gray green silt with trace clay
2'				Not Sampled

Aquaterra Technologies, Inc.
Subsurface Log: BH-16-06

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: SWMU 92 **Permit No.:** NA
Philadelphia, PA
Boring Number: BH-16-06 **Log By:** M.B. Spancake **Date:** 23-Mar-06
Drilling Method: Hand Auger **Sample Method:** Hand Auger **Borehole Dia:** 3"
Water Level (Init): NA

Construction Details

Total Boring Depth: 2' BGS **Backfill:** NA [ ] = Backfill

Completion Details: Backfilled

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology
0	0-0.5'		0.5'	Small gravel and trace medium sand in brown silt matrix
0.5'	0.5-1'		0.5'	Same, changing to gray silt with trace clay at 0.8' BGS
1'	1-1.5'		0.5'	Gray to dark gray clayey silt with lighter gray banding
1.5'	1.5-2'		0.5'	Dark gray silty clay with light gray banding
2'				Not Sampled

Aquaterra Technologies, Inc.
Subsurface Log: BH-17-06

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: SWMU 95 **Permit No.:** NA
Philadelphia, PA
Boring Number: BH-17-06 **Log By:** M.B. Spancake **Date:** 21-Mar-06
Drilling Method: Hand Auger **Sample Method:** Hand Auger **Borehole Dia:** 3"
Water Level (Init): 2'

Construction Details

Total Boring Depth: 2' BGS **Backfill:** NA [ ] = Backfill

Completion Details: Backfilled

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology
0	0-0.5'		0.5'	Brown gray silt and coarse sand with gravel and rock with
0.5'	0.5-1'		0.5'	Same as above with brick fragments
1'	1-1.5'		0.5'	Same as above
1.5'	1.5-2'		0.5'	Dark gray stained silt, trace clay. Moist. Changing to a dark gray medium sand at bottom. Wet and stained
2'				Not Sampled

Aquaterra Technologies, Inc.
Subsurface Log: BH-18-06

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: SWMU 95 **Permit No.:** NA
Philadelphia, PA
Boring Number: BH-18-06 **Log By:** M.B. Spancake **Date:** 21-Mar-06
Drilling Method: Hand Auger **Sample Method:** Hand Auger **Borehole Dia:** 3"
Water Level (Init): NA

Construction Details

Total Boring Depth: 2' BGS **Backfill:** NA ☐ = Backfill

Completion Details: Backfilled

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology
0	0-0.5'		0.5'	Brown silt and coarse sand with gravel
0.5'	0.5-1'		0.5'	Brownish gray silt and coarse sand with small gravel and fill material
1'	1-1.5'		0.5'	Dark gray silt with trace clay. Coarse sand and gravel present
1.5'	1.5-2'		0.5'	Dark gray stained silt with trace clay and some pebble
2'				Not Sampled

Aquaterra Technologies, Inc.
Subsurface Log: BH-19-06

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: SWMU 95 **Permit No.:** NA
Philadelphia, PA
Boring Number: BH-19-06 **Log By:** M.B. Spancake **Date:** 21-Mar-06
Drilling Method: Hand Auger **Sample Method:** Hand Auger **Borehole Dia:** 3"
Water Level (Init): NA

Construction Details

Total Boring Depth: 2' BGS **Backfill:** NA ☐ = Backfill

Completion Details: Backfilled

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology
0	0-0.5'		0.5'	Brown gray silt and coarse sand with small gravel and pebble
0.5'	0.5-1'		0.5'	Same as above with large cobble present
1'	1-1.5'		0.5'	Same as above
1.5'	1.5-2'		0.5'	Dark gray silt, trace gravel and trace clay. Moist
2'				Not Sampled

Aquaterra Technologies, Inc.
Subsurface Log: BH-20-06

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: SWMU 95 **Permit No.:** NA
Philadelphia, PA
Boring Number: BH-20-06 **Log By:** M.B. Spancake **Date:** 20-Mar-06
Drilling Method: Hand Auger **Sample Method:** Hand Auger **Borehole Dia:** 3"
Water Level (Init): 1.5'

Construction Details

Total Boring Depth: 1.5' BGS **Backfill:** NA ☐ = Backfill

Completion Details: Backfilled

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology
0	0-0.5'		0.5'	Brown silt, gravel and coarse sand with large rock and brick fill
0.5'	0.5-1'		0.5'	Same as above
1'	1-1.5'		0.5'	Coarse sand and gravel, moist to wet. Product saturated Refusal at 1.5' BGS
1.5'				

Note: Highlighted cell indicates soil sample interval submitted for laboratory analysis of non SWMU Site COC's

Aquaterra Technologies, Inc.
Subsurface Log: BH-21-06

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: SWMU 95 **Permit No.:** NA
Philadelphia, PA
Boring Number: BH-21-06 **Log By:** M.B. Spancake **Date:** 20-Mar-06
Drilling Method: Hand Auger **Sample Method:** Hand Auger **Borehole Dia:** 3"
Water Level (Init): 2'

Construction Details

Total Boring Depth: 2' BGS **Backfill:** NA [ ] = Backfill

Completion Details: Backfilled

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology
0	0-0.5'		0.5'	Brown silt and coarse sand with very small gravel
0.5'	0.5-1'		0.5'	Same as above with large rocks and brick fragments
1'	1-1.5'		0.5'	Gray brown medium to coarse sand with some gravel. Moist
1.5'	1.5-2'		0.5'	Same as above with some clay lenses. Moist to wet with product
2'				

Note: Highlighted cell indicates soil sample interval submitted for laboratory analysis of non SWMU Site COC's

Aquaterra Technologies, Inc.
Subsurface Log: BH-22-06

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: Unit 1732 Area **Permit No.:** NA
Philadelphia, PA
Boring Number: BH-22-06 **Log By:** M.B. Spancake **Date:** 21-Mar-06
Drilling Method: Hand Auger **Sample Method:** Hand Auger **Borehole Dia:** 3"
Water Level (Init): 2'

Construction Details

Total Boring Depth: 2' BGS **Backfill:** NA [ ] = Backfill

Completion Details: Backfilled

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology
0	0-0.5'		0.5'	Subangular base stone
0.5'	0.5-1'		0.5'	Same as above
1'	1-1.5'		0.5'	Dark gray silt and trace clay. Cobble and pebble present
1.5'	1.5-2'		0.5'	Tan coarse sand and small gravel. Wet at bottom
2'				

Note: Highlighted cell indicates soil sample interval submitted for laboratory analysis non SWMU Site COC's

Aquaterra Technologies, Inc.
Subsurface Log: BH-23-06

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: Unit 1732 Area **Permit No.:** NA
Philadelphia, PA
Boring Number: BH-23-06 **Log By:** M.B. Spancake **Date:** 21-Mar-06
Drilling Method: Hand Auger **Sample Method:** Hand Auger **Borehole Dia:** 3"
Water Level (Init): 1.5'

Construction Details

Total Boring Depth: 1.5' BGS **Backfill:** NA ☐ = Backfill

Completion Details: Backfilled

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology
0	0-0.5'		0.5'	Modified 2A base stone
0.5'	0.5-1'		0.5'	Same as above
1'	1-1.5'		0.5'	Black stained silty fine sand, moist to wet at 1.5' BGS
1.5'				Refusal at 1.5' BGS

Note: Highlighted cell indicates soil sample interval submitted for laboratory analysis of non SWMU Site COC's

Aquaterra Technologies, Inc.
Subsurface Log: BH-24-06

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: Unit 1732 Area **Permit No.:** NA
Philadelphia, PA
Boring Number: BH-24-06 **Log By:** M.B. Spancake **Date:** 21-Mar-06
Drilling Method: Hand Auger **Sample Method:** Hand Auger **Borehole Dia:** 3"
Water Level (Init): 1.5'

Construction Details

Total Boring Depth: 1.5' BGS **Backfill:** NA [ ] = Backfill

Completion Details: Backfilled

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology
0	0-0.5'		0.5'	Subangular base stone
0.5'	0.5-1'		0.5'	Black stained coarse sand and gravel, slightly moist
1'	1-1.5'		0.5'	Same as above, product saturated and wet
1.5'			0.5'	End boring

Note: Highlighted cell indicates soil sample interval submitted for laboratory analysis of non SWMU Site COC's

Aquaterra Technologies, Inc.
Subsurface Log: BH-25-06

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: SWMU 95 Area **Permit No.:** NA
Philadelphia, PA
Boring Number: BH-25-06 **Log By:** M.B. Spancake **Date:** 21-Mar-06
Drilling Method: Hand Auger **Sample Method:** Hand Auger **Borehole Dia:** 3"
Water Level (Init): 1.5'

Construction Details

Total Boring Depth: 1.5' BGS **Backfill:** NA ☐ = Backfill

Completion Details: Backfilled

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology
0	0-0.5'		0.5'	Subangular base stone
0.5'	0.5-1'		0.5'	Black stained coarse sand and gravel with small pebbles
1'	1-1.5'		0.5'	Black stained product saturated coarse sand and gravel and pebble. Wet
1.5'				

Note: Highlighted cell indicates soil sample interval submitted for laboratory analysis of non SWMU Site COC's

Aquaterra Technologies, Inc.
Subsurface Log: BH-26-06

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: Tank 797 Area **Permit No.:** NA
Philadelphia, PA
Boring Number: BH-26-06 **Log By:** M.B. Spancake **Date:** 24-Mar-06
Drilling Method: Hand Auger **Sample Method:** Hand Auger **Borehole Dia:** 3"
Water Level (Init): NA

Construction Details

Total Boring Depth: 1.1" BGS **Backfill:** NA [ ] = Backfill

Completion Details: Backfilled

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology
0	0-0.5'		0.5'	Brown silt and gravel with coarse sand changing to a greenish gray sandy silt and gravel
0.5'	0.5-1'		0.5'	Greenish gray sandy silt and gravel with rock fragments
1'	1-1.1'		0.1'	Refusal at 1.1' BGS. Several other locations attempted with refusal at shallower depths

Note: Highlighted cell indicates soil sample interval submitted for laboratory analysis of non SWMU Site COC's

Aquaterra Technologies, Inc.
Subsurface Log: BH-27-06

Project Name: Sunoco Philadelphia Refinery AOI - 6
Location: Tank 1010 Benzene Unit Area
Philadelphia, PA
Boring Number: BH-27-06
Drilling Method: Hand Auger

Owner: Sunoco, Inc. (R&M)
Permit No.: NA

Log By: M.B. Spancake
Sample Method: Hand Auger

Date: 23-Mar-06
Borehole Dia: 3"
Water Level (Init): 1.5'

Construction Details

Total Boring Depth: 2' BGS
Backfill: NA
[ ] = Backfill

Completion Details: Backfilled

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology
0	0-0.5'		0.5'	Tan coarse sand and brown silt
0.5'	0.5-1'		0.5'	Black stained coarse sand and small gravel
1'	1-1.5'		0.5'	Black stained sandy gravel, moist to wet at bottom. Some small cobble
1.5'	1.5-2'		0.5'	Wet gray sandy gravel and small cobble
2'				

Note: Highlighted cell indicates soil sample interval submitted for laboratory analysis of non SWMU Site COC's

Aquaterra Technologies, Inc.
Subsurface Log: BH-28-06

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: Tank 1010 Benzene Unit Area **Permit No.:** NA
Philadelphia, PA
Boring Number: BH-28-06 **Log By:** M.B. Spancake **Date:** 23-Mar-06
Drilling Method: Hand Auger **Sample Method:** Hand Auger **Borehole Dia:** 3"
Water Level (Init): NA

Construction Details

Total Boring Depth: 1.5' BGS **Backfill:** NA ☐ = Backfill

Completion Details: Backfilled

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology
0	0-0.5'		0.5'	Subangular base stone
0.5'	0.5-1'		0.5'	Same, changing to a dark brownish gray silt and gravel with brick fragments
1'	1-1.5'		0.5'	Same as above, refusal at 1.5' BGS
1.5'				

Note: Highlighted cell indicates soil sample interval submitted for laboratory analysis of non SWMU Site COC's

Aquaterra Technologies, Inc.
Subsurface Log: BH-29-06

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: Tank 1010 Benzene Unit Area **Permit No.:** NA
Philadelphia, PA
Boring Number: BH-29-06 **Log By:** M.B. Spancake **Date:** 21-Mar-06
Drilling Method: Hand Auger **Sample Method:** Hand Auger **Borehole Dia:** 3"
Water Level (Init): NA

Construction Details

Total Boring Depth: 2' BGS **Backfill:** NA [ ] = Backfill

Completion Details: Backfilled

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology
0	0-0.5'		0.5'	Fill stone and gravel in a brown silt and sand matrix
0.5'	0.5-1'		0.5'	Brown to dark brown silt and sand with gravel. Brick fragmenst and trace clay
1'	1-1.5'		0.5'	Brown to dark gray silt and sand, trace clay with gravel and rock fragments
1.5'	1.5-2'		0.5'	Same as above with brick fragments. Slightly moist with slight staining present
2'				

Note: Highlighted cell indicates soil sample interval submitted for laboratory analysis of non SWMU Site COC's

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-101**

Aquaterra Technologies, Inc

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**3.0'**
DATES DRILLED:	**4 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0					
	Sample taken @ 3.0' for laboratory analysis	1184 ppm	(Fill) clay, silt, gravel, gray - dark gray; wet @ 3.0'		

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-102**

Aquaterra Technologies, Inc

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**2.5'**
DATES DRILLED:	**4 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0					
	Sample taken @ 2.5' for laboratory analysis	290 ppm	(Fill) sand, silt, black; wet @ 2.5'		

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-104**

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Aquaterra Technologies, Inc.

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**1.0'**
DATES DRILLED:	**4 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0	Sample taken @ 1.0' for laboratory analysis	0.0 ppm	(Fill) sand, silt, clay, gravel, black - dark tan; wet @ 1.0'		

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-105**

Aquaterra Technologies, Inc

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**2.5'**
DATES DRILLED:	**3 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0					
	Sample taken @ 2.5' for laboratory analysis	3335 ppm	(Fill) clay, black; wet @ 2.5'		

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-106**

Aquaterra Technologies, Inc

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**2.5'**
DATES DRILLED:	**3 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0					
	Sample taken @ 1.5' for laboratory analysis	24.7 ppm	(Fill) clay, gravel, medium brown - red, brick		
	Sample taken @ 2.5' for laboratory analysis	6391 ppm	(Fill) sand, silt, black; wet @ 2.5'		

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-107**

Aquaterra Technologies, Inc

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**3.0'**
DATES DRILLED:	**3 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0					
	Sample taken @ 1.5' for laboratory analysis	4.9 ppm	(Fill) sand, silt, gravel, black		
	Sample taken @ 3.0' for laboratory analysis	4.2 ppm	(Fill) sand, silt, small gravels, brick; black - dark brown; wet @ 3.0'		

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-108**

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Aquaterra Technologies, Inc

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**2.5'**
DATES DRILLED:	**3 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0					
	Sample taken @ 1.0' for laboratory analysis	3375 ppm	(Fill) clay, sand, silt, brick, red, black - dark brown		
	Sample taken @ 2.5' for laboratory analysis	3287 ppm	(Fill) sand, gravel, black; wet @ 2.5'		

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-109**

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Aquaterra Technologies, Inc

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**3.0'**
DATES DRILLED:	**3 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0					
	Sample taken @ 3.0' for laboratory analysis	20.8 ppm	(Fill) clay, gravel, sand, fill, black; wet @ 3.0'		

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-110**

Aquaterra Technologies, Inc

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**3.5'**
DATES DRILLED:	**3 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0		97.1 ppm	(Fill) sand, silt, rock, black		
		805 ppm	(Fill) clay, sand, silt, black, brick		
	Sample taken @ 3.5' for laboratory analysis	1895 ppm	(Fill) clay, sand, silt, black; wet @ 3.5'		

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-111**

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Aquaterra Technologies, Inc

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**1.5'**
DATES DRILLED:	**3 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0					
	Sample taken @ 1.0' for laboratory analysis	1483 ppm	(Fill) sand, silt, black		
	Sample taken @ 1.5' for laboratory analysis	1606 ppm	(Fill) sand, silt, rock, black; wet @ 1.5'		

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-112**

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Aquaterra Technologies, Inc

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**1.0'**
DATES DRILLED:	**3 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0	Sample taken @ 1.0' for laboratory analysis	5.3 ppm	(Fill) sand, silt, gravel, black; wet @ 1.0'		

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-113**

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Aquaterra Technologies, Inc

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**1.0'**
DATES DRILLED:	**3 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0		192 ppm	(Fill) clay, silt, black; wet @ 1.0'		

Aquaterra Technologies, Inc

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-114**

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**3.5'**
DATES DRILLED:	**3 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0					
	Sample taken @ 1.5' for laboratory analysis	3.4 ppm	(Fill) rock, sand, silt, tan/light brown		
	Sample taken @ 3.5' for laboratory analysis	111 ppm	(Fill) clay, silt, gravel, black; wet @ 3.5'		

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-115**

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Aquaterra Technologies, Inc

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**2.0'**
DATES DRILLED:	**3 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0	Sample taken @ 2.0' for laboratory analysis		(Fill) sand, silt, gravel, black; wet @ 2.0'		

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-116**

Aquaterra Technologies, Inc

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**3.5'**
DATES DRILLED:	**3 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0					
	Sample taken @ 3.5' for laboratory analysis	489 ppm	(Fill) sand, silt, black; wet @ 3.5'		

Aquaterra Technologies, Inc.

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-117**

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**2.5'**
DATES DRILLED:	**3 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0					
	Sample taken @ 2.5' for laboratory analysis	15.2 ppm	(Fill) clay, sand, silt, gravel, light brown/tan; wet @ 2.5'		

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-118**

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Aquaterra Technologies, Inc

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**2.5'**
DATES DRILLED:	**4 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0					
	Sample taken @ 2.5' for laboratory analysis	22.4 ppm	(Fill) clay, sand, silt, gravel, black; wet @ 2.5'		

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-119**

Aquaterra Technologies, Inc

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**1.0'**
DATES DRILLED:	**4 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0	Sample taken @ 1.0' for laboratory analysis	0.0 ppm	(Fill) clay, sand, gravel, medium brown; wet @ 1.0'		

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-120**

Aquaterra Technologies, Inc

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**1.0'**
DATES DRILLED:	**4 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0	Sample taken @ 1.0' for laboratory analysis	0.0 ppm	(Fill) clay, gravel, sand, dark brown; wet @ 1.0'		

SUBSURFACE BORING LOG

Aquaterra Technologies, Inc

BOREHOLE NO. **BH-12-121**

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**2.5'**
DATES DRILLED:	**3 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0					
	Sample taken @ 2.5' for laboratory analysis	66.0 ppm	(Fill) sand, silt, gravel, black; wet @ 2.5'		

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-122**

Aquaterra Technologies, Inc

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**3.0'**
DATES DRILLED:	**3 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0					
	Sample taken @ 1.5' for laboratory analysis	56.8 ppm	(Fill) sand, silt, fill, dark brown/black		
	Sample taken @ 3.0' for laboratory analysis	110 ppm	(Fill) sand, silt, gravel, black; wet @ 3.0'		

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-123**

Aquaterra Technologies, Inc

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**2.5'**
DATES DRILLED:	**4 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0					
	Sample taken @ 1.5' for laboratory analysis	8.6 ppm	(Fill) silt, clay, gravel, black		
	Sample taken @ 2.5' for laboratory analysis	383 ppm	(Fill) sand, silt, clay, gravel, black; unable to reach soil/water interface due to obstruction		

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-124**

Aquaterra Technologies, Inc

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**3.5'**
DATES DRILLED:	**4 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0			inside tank dike with compacted clay lining from 1.0-1.5'		
	Sample taken @ 3.5' for laboratory analysis	2793 (MAX) ppm	(Fill) sand, silt, gravel, gray; wet @ 3.5'		

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-125**

Aquaterra Technologies, Inc

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**3.0'**
DATES DRILLED:	**4 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0			inside tank dike with compacted clay lining from 1.0-1.5'		
	Sample taken @ 3.0' for laboratory analysis	392 ppm	(Fill) gravel, sand, silt, fill, dark gray - orange; wet @ 3.0'		

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-126**

Aquaterra Technologies, Inc

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**3.0'**
DATES DRILLED:	**4 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0			inside tank dike with compacted clay lining from 1.0-1.5'		
	Sample taken @ 3.0' for laboratory analysis	2788 (MAX) ppm	(Fill) sand, silt, gravel, dark gray; wet @ 3.0'		

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-127**

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Aquaterra Technologies, Inc

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**3.0'**
DATES DRILLED:	**4 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0			inside tank dike with compacted clay lining from 1.0-1.5'		
	Sample taken @ 3.0' for laboratory analysis	2788 (MAX) ppm	(Fill) sand, silt, medium to small gravels, medium - dark brown; wet @ 3.0'		

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-128**

Aquaterra Technologies, Inc

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**3.5'**
DATES DRILLED:	**4 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0			inside tank dike with compacted clay lining from 1.0-1.5'		
	Sample taken @ 3.5' for laboratory analysis	2788 (MAX) ppm	(Fill) clay, sand, silt, medium brown; wet @ 3.5'		

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-129**

Aquaterra Technologies, Inc

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**3.0'**
DATES DRILLED:	**4 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0			inside tank dike with compacted clay lining from 1.0-1.5'		
	Sample taken @ 2.0' for laboratory analysis	2788 (MAX) ppm	(Fill) sand, silt, gravel, fill, gray		
	Sample taken @ 3.0' for laboratory analysis	2788 (MAX) ppm	(Fill) sand, silt, gravel, dark gray; wet @ 3.0'		sheen @ 3.0'

Aquaterra Technologies, Inc.

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-130**

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**2.0'**
DATES DRILLED:	**4 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0					
			inside tank dike with compacted clay lining from 1.0-1.5'		
	Sample taken @ 1.0' for laboratory analysis	70 ppm	(Fill) clay, rock, gravel, silt, black - tan; wet @ 2.0'		

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-131**

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Aquaterra Technologies, Inc

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**2.0'**
DATES DRILLED:	**4 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0					
	Sample taken @ 2.0' for laboratory analysis	60.9 ppm	(Fill) clay, sand, silt, gravel, black; wet @ 2.0'		

Aquaterra Technologies, Inc

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-135**

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**2.5'**
DATES DRILLED:	**5 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0					
	Sample taken @ 1.5' for laboratory analysis	0.0 ppm	(Fill) clay, sand, silt, gravel, light - dark brown		
	Sample taken @ 2.5' for laboratory analysis	3.0 ppm	(Fill) clay, black; wet @ 2.5'		

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-136**

Aquaterra Technologies, Inc

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**1.5'**
DATES DRILLED:	**5 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0					
	Sample taken @ 1.5' for laboratory analysis	0.0 ppm	(Fill) clay, silt, fill, medium brown - red; wet @ 1.5'		

Aquaterra Technologies, Inc

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-137**

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**1.0'**
DATES DRILLED:	**5 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0	Sample taken @ 1.0' for laboratory analysis	0.0 ppm	(Fill) clay, silt, fill, medium brown - orange; wet @ 1.0'		

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-138**

Aquaterra Technologies, Inc

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**2.5'**
DATES DRILLED:	**5 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0					
	Sample taken @ 1.0' for laboratory analysis	0.0 ppm	(Fill) clay, silt, sand, gravel, timber, dark brown		
	Sample taken @ 2.5' for laboratory analysis	0.0 ppm	(Fill) clay, sand, silt, fill, black; wet @ 2.5'		

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-139**

Page 1 of 1

Aquaterra Technologies, Inc

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**1.5'**
DATES DRILLED:	**5 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0					
	Sample taken @ 1.5' for laboratory analysis	0.0 ppm	(Fill) clay, silt, gravel, fill, black - dark brown; wet @ 1.5'		

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-140**

Aquaterra Technologies, Inc

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**0.5'**
DATES DRILLED:	**5 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0	Sample taken @ 0.5' for laboratory analysis	0.0 ppm	(Fill) clay, silt, rock, sand, black - dark brown; wet @ 0.5'		

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-144**

Aquaterra Technologies, Inc

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**0.5'**
DATES DRILLED:	**5 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0	Sample taken @ 0.5' for laboratory analysis	0.0 ppm	(Fill) sand, silt, gravel, light gray - tan; wet @ 0.5'		

Aquaterra
Technologies, Inc

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-144**

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	LITH-OLOGY	COMMENTS

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-146**

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Aquaterra Technologies, Inc

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**1.0'**
DATES DRILLED:	**5 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0	Sample taken @ 1.0' for laboratory analysis	0.0 ppm	(Fill) clay, gravel, silt, medium brown - orange; wet @ 0.5'		

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-147**

Aquaterra Technologies, Inc

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**1.5'**
DATES DRILLED:	**5 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0					
	Sample taken @ 1.5' for laboratory analysis	0.0 ppm	(Fill) rock, sand, silt, medium brown; wet @ 1.5'		

Aquaterra Technologies, Inc

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-148**

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**1.0'**
DATES DRILLED:	**5 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0	Sample taken @ 1.0' for laboratory analysis	0.0 ppm	(Fill) clay, sand, silt, medium brown; wet @ 1.5'		

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-12-149**

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Aquaterra Technologies, Inc

PROJECT:	**Philadelphia Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-6**	DRILLING METHOD	**Hand Auger (2" Diameter)**
JOB NO.:	-	SAMPLING METHOD	**Hand Auger**
LOGGED BY:	**Luke Mokrycki**	TOTAL DEPTH:	**3.0'**
DATES DRILLED:	**4 December 12**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	USCS	COMMENTS
0					
			inside tank dike with compacted clay lining from 1.0-1.5'		
	Sample taken @ 1.5' for laboratory analysis	50.4 ppm	(Fill) clay, gravel, orange - medium brown		
	Sample taken @ 3.0' for laboratory analysis	2788 (MAX) ppm	(Fill) clay, gravel, fill, black, tan, brown; wet @ 3.0'		

WELL CONSTRUCTION SUMMARIES

Aquaterra Technologies, Inc.
Subsurface Log: B-151

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: B-151 **Log By:** M.B. Spancake **Date:** 23-Feb-06
Casing Elevation: N/A **Driller:** Total Quality Drilling **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 8' **Slot Size:** 0.020 **Water Level (Init):** 3'
Casing Diameter: 4 inch **Length:** 5' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Construction Details

Total Well Depth: 13' (10' bgs) **Backfill:** NA
Screen Interval: 2'-10' **Cement/Grout Interval:** NA
Sand Pack Interval: 1'-10' **Bentonite Interval:** 0'-1'
Completion Details: 3' Stick up PVC **Sand Pack Type:** #2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0	0.5-1'	NA		Soft dig to 8' BGS Advance augers to 8' below ground surface and begin split spoons Wet fill stone at 3' BGS	
5					
	8-10'	38.2	1'	Wet sandy gravel changing to a gray clayey silt towards bottom	
10				End boring at 10' BGS	

Note: Highlighted cell indicates interval soil sample collected. Soil sample collected with hand auger on 1 March 2006.

Aquaterra Technologies, Inc.
Subsurface Log: B-152

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: B-152 **Log By:** M.B. Spancake **Date:** 27-Feb-06
Casing Elevation: N/A **Driller:** Total Quality Drilling **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 8' **Slot Size:** 0.020 **Water Level (Init):** 4'
Casing Diameter: 4 inch **Length:** 2' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Construction Details

Total Well Depth: 10' **Backfill:** NA
Screen Interval: 2'-10' **Cement/Grout Interval:** NA
Sand Pack Interval: 1'-10' **Bentonite Interval:** 0'-1'
Completion Details: 8" Flushmount with manhole cover **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	
	1.5-2'	466		Advance augers to 8' below ground surface and begin split spoons	
				Wet fill stone at 4' BGS	
5					
	8-10'	NA	1'	Wet gray silty clay	
10				End boring at 10' BGS	

Note: Highlighted cell indicates interval soil sample collected. Soil sample collected with hand auger on 1 March 2006.

Aquaterra Technologies, Inc.
Subsurface Log: B-153

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: B-153 **Log By:** M.B. Spancake **Date:** 24-Feb-06
Casing Elevation: N/A **Driller:** Total Quality Drilling **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 8' **Slot Size:** 0.020 **Water Level (Init):** 3'
Casing Diameter: 4 inch **Length:** 2' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Construction Details

Total Well Depth: 10' **Backfill:** NA
Screen Interval: 2'-10' **Cement/Grout Interval:** NA
Sand Pack Interval: 1'-10' **Bentonite Interval:** 0'-1'
Completion Details: 8" Flushmount with manhole cover **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	
	1.5-2'	0		Advance augers to 8' below ground surface and begin split spoons Wet fill stone at 3' BGS	
5					
	8-10'	NA	1'	Black stained wet medium to coarse grained sand and gravel changing to a dark gray silty clay at bottom	
10				End boring at 10' BGS	

Note: Highlighted cell indicates interval soil sample collected. Soil sample collected with hand auger on 1 March 2006.

Aquaterra Technologies, Inc.
Subsurface Log: B-154

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: B-154 **Log By:** M.B. Spancake **Date:** 23-Feb-06
Casing Elevation: N/A **Driller:** Total Quality Drilling **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 8' **Slot Size:** 0.020 **Water Level (Init):** 3'
Casing Diameter: 4 inch **Length:** 5' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Construction Details

Total Well Depth: 13' (10' bgs) **Backfill:** NA
Screen Interval: 2'-10' **Cement/Grout Interval:** NA
Sand Pack Interval: 1'-10' **Bentonite Interval:** 0'-1'
Completion Details: 3' Stick up PVC **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	
	1-1.5'	NA		Advance augers to 8' below ground surface and begin split spoons	
				Wet fill stone at 3' BGS	
5					
	8-10'	NA	2"	Wet medium sand and gravel, gray in color. Rock fragment in shoe of spoon	
10				End boring at 10' BGS	

Note: Highlighted cell indicates interval soil sample collected. Soil sample collected with hand auger on 1 March 2006.

Aquaterra Technologies, Inc.
Subsurface Log: B-155

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: B-155 **Log By:** M.B. Spancake **Date:** 24-Feb-06
Casing Elevation: N/A **Driller:** Total Quality Drilling **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 8' **Slot Size:** 0.020 **Water Level (Init):** 3'
Casing Diameter: 4 inch **Length:** 5' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Construction Details

Total Well Depth: 13' (10' bgs) **Backfill:** NA
Screen Interval: 2'-10' **Cement/Grout Interval:** NA
Sand Pack Interval: 1'-10' **Bentonite Interval:** 0'-1'
Completion Details: 3' Stick up PVC **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	
	1.5-2'	18.2		Advance augers to 8' below ground surface and begin split spoons Wet fill stone at 3' BGS	
5					
	8-10'	NA	3"	Wet black sandy gravel. Change to a gray clay at bottom of spoon	
10				End boring at 10' BGS	

Note: Highlighted cell indicates interval soil sample collected. Soil sample collected with hand auger on 20 March 2006.

Aquaterra Technologies, Inc.
Subsurface Log: B-156

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: B-156 **Log By:** M.B. Spancake **Date:** 23-Feb-06
Casing Elevation: N/A **Driller:** Total Quality Drilling **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 8' **Slot Size:** 0.020 **Water Level (Init):** 3'
Casing Diameter: 4 inch **Length:** 5' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Construction Details

Total Well Depth: 13' (10' bgs) **Backfill:** NA
Screen Interval: 2'-10' **Cement/Grout Interval:** NA
Sand Pack Interval: 1'-10' **Bentonite Interval:** 0'-1'
Completion Details: 3' Stick up PVC **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	
	1-1.5'			Advance augers to 8' below ground surface and begin split spoons	
				Wet fill stone at 3' BGS	
5					
	8-10'	NA	2"	Wet black sandy gravel. Change to a brown and gray clay at bottom of spoon	
10				End boring at 10' BGS	

Note: Highlighted cell indicates interval soil sample collected. Soil sample collected with hand auger on 20 March 2006.

Aquaterra Technologies, Inc.
Subsurface Log: B-157

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: B-157 **Log By:** M.B. Spancake **Date:** 22-Feb-06
Casing Elevation: N/A **Driller:** Total Quality Drilling **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 10' **Slot Size:** 0.020 **Water Level (Init):** 3'
Casing Diameter: 4 inch **Length:** 2' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Construction Details

Total Well Depth: 12' **Backfill:** NA
Screen Interval: 2'-12' **Cement/Grout Interval:** NA
Sand Pack Interval: 1'-12' **Bentonite Interval:** 0'-1'
Completion Details: 8" Flushmount with manhole cover **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	
	1-1.5'	0		Advance augers to 8' below ground surface and begin split spoons Wet fill stone at 3' BGS	
5					
	8-10'	NA	0	No Recovery	
10	10-12	80.2	0.25'	Wet reddish gray fine sand and poorly sorted gravel, becoming clayey towards bottom End boring at 12' BGS	

Note: Highlighted cell indicates interval soil sample collected. Soil sample collected with hand auger on 1 March 2006.

Aquaterra Technologies, Inc.
Subsurface Log: B-158

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: B-158 **Log By:** M.B. Spancake **Date:** 22-Feb-06
Casing Elevation: N/A **Driller:** Total Quality Drilling **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 10' **Slot Size:** 0.020 **Water Level (Init):** 3'
Casing Diameter: 4 inch **Length:** 2' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Construction Details

Total Well Depth: 12' **Backfill:** NA
Screen Interval: 2'-12' **Cement/Grout Interval:** NA
Sand Pack Interval: 1'-12' **Bentonite Interval:** 0'-1'
Completion Details: 8" Flush mount and manhole cover **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 8' BGS and collect spoons Wet fill stone at 3' BGS	
5					
	8'-10'	26.7	0.25'	Wet, medium black sand and coarse gravel.	
10	10-12	77.9	0.25'	Same as above, changing to a gray silty clay at bottom End boring at 12' BGS	

Note: No soil sample collected from this location. Material encountered from 0'-2' was modified 2A fill stone for roadway

Aquaterra Technologies, Inc.
Subsurface Log: B-159

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: Unit 231, Philadelphia, PA **Permit No.:**
Boring Number: B-159 **Log By:** M.B. Spancake **Date:** 20-Apr-06
Casing Elevation: N/A **Driller:** Total Quality Drilling **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 8' **Slot Size:** 0.020 **Water Level (Init):** 3'
Casing Diameter: 4 inch **Length:** 2' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Cuttings **Rig Type:** HSA Rig

Construction Details

Total Well Depth: 10' **Backfill:** NA
Screen Interval: 2'-10' **Cement/Grout Interval:** NA
Sand Pack Interval: 1'-10' **Bentonite Interval:** 0'-1'
Completion Details: Flushmount with an 8" manhole cover **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 with backhoe Advance augers to 10' below ground surface and set well Wet modified stone at 3' BGS	
5				Cuttings wet gray sandy gravel	
10				Well set at 10' BGS	

Note: No soil sample collected. Material from 0-2' BGS consisted of modified 2A stone overtop concrete pad

Aquaterra Technologies, Inc.
Subsurface Log: B-160

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: B-160 **Log By:** M.B. Spancake **Date:** 27-Feb-06
Casing Elevation: N/A **Driller:** Total Quality Drilling **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 8' **Slot Size:** 0.020 **Water Level (Init):** 4'
Casing Diameter: 4 inch **Length:** 2' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Construction Details

Total Well Depth: 10' **Backfill:** NA
Screen Interval: 2'-10' **Cement/Grout Interval:** NA
Sand Pack Interval: 1'-10' **Bentonite Interval:** 0'-1'
Completion Details: 8" Flushmount with manhole cover **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	
	1-1.5'	0		Advance augers to 8' below ground surface and begin split spoons	
				Wet fill stone at 4' BGS	
5					
	8-10'	NA	0.25'	Wet gray silty clay with trace sand	
10				End boring at 10' BGS	

Note: Highlighted cell indicates interval soil sample collected. Soil sample collected with hand auger on 1 March 2006.

Aquaterra Technologies, Inc.
Subsurface Log: B-161

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: B-161 **Log By:** M.B. Spancake **Date:** 21-Feb-06
Casing Elevation: N/A **Driller:** Total Quality Drilling **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 10' **Slot Size:** 0.020 **Water Level (Init):** 3'
Casing Diameter: 4 inch **Length:** 5' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Construction Details

Total Well Depth: 15' (12' bgs) **Backfill:** NA
Screen Interval: 2'-12' **Cement/Grout Interval:** NA
Sand Pack Interval: 1'-12' **Bentonite Interval:** 0'-1'
Completion Details: 3' Stick up PVC **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 via hydroexcavation	
	1.5-2'	25.9		Advance augers to 8' below ground surface and collect spoon Wet modified stone at 3' BGS	
5					
	8-10'		0.25'	Wet, light gray fine sand and large gravel. Staining towards botton of spoon	
10	10-12'		1'	Same as above, gray clay in bottom of spoon	
				End boring at 12' BGS	

Note: Highlighted cell indicates interval soil sample collected. Soil sample collected with hand auger on 1 March 2006.

Aquaterra Technologies, Inc.
Subsurface Log: B-162

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: B-162 **Log By:** M.B. Spancake **Date:** 20-Feb-06
Casing Elevation: N/A **Driller:** Total Quality Drilling **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 13' **Slot Size:** 0.020 **Water Level (Init):** 3'
Casing Diameter: 4 inch **Length:** 5' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Cuttings **Rig Type:** HSA Rig

Construction Details

Total Well Depth: 18' **Backfill:** NA
Screen Interval: 2'-15' **Cement/Grout Interval:** NA
Sand Pack Interval: 1'-15' **Bentonite Interval:** 0'-1'
Completion Details: 3' PVC Stick up **Sand Pack Type:** #2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	Amount of Recovery (ft)	Lithology	Well Schematic
0	0'-5'	NA	Soft dig to 8' BGS via hydroexcavation	
	1'-1.5'		Advance augers to 15' and set well	
			Wet modified 2A stone at 3'	
5	5'-10'	NA	Modified 2A stone (backfill from hydroexcavation)	
10	10'-15'	1.25'	Dark gray clayey silt cuttings at 12' bgs.	
15			Well completed at 15' BGS	

Note: Highlighted cell indicates interval soil sample collected. Soil sample collected with hand auger on 1 March 2006.

Aquaterra Technologies, Inc.
Subsurface Log: B-163

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: B-163 **Log By:** M.B. Spancake **Date:** 28-Feb-06
Casing Elevation: N/A **Driller:** Total Quality Drilling **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 8' **Slot Size:** 0.020 **Water Level (Init):** 3'
Casing Diameter: 4 inch **Length:** 2' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Construction Details

Total Well Depth: 10' **Backfill:** NA
Screen Interval: 2'-10' **Cement/Grout Interval:** NA
Sand Pack Interval: 1'-10' **Bentonite Interval:** 0'-1'
Completion Details: 8" Flushmount with manhole cover **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 8' below ground surface and begin split spoons Wet fill stone at 3' BGS	
5					
	8-10'	NA	0	No recovery	
10				End boring at 10' BGS	

Note: No soil sample collected from this location from the 0-2' interval. Area is paved and or surrounded by modified 2A stone for roadway.

Aquaterra Technologies, Inc.
Subsurface Log: B-164

Project Name: Sunoco Philadelphia Refinery AOI - 6 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: B-164 **Log By:** M.B. Spancake **Date:** 21-Feb-06
Casing Elevation: N/A **Driller:** Total Quality Drilling **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 10' **Slot Size:** 0.020 **Water Level (Init):** 3'
Casing Diameter: 4 inch **Length:** 5' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Construction Details

Total Well Depth: 15' (12' bgs) **Backfill:** NA
Screen Interval: 2'-12' **Cement/Grout Interval:** NA
Sand Pack Interval: 1'-12' **Bentonite Interval:** 0'-1'
Completion Details: 3' Stick up PVC **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 via hydroexcavation	
	1.5-2'	322		Advance augers to 8' below ground surface and collect split spoons Wet fill stone at 3' BGS	
5					
	8'-10'	NA	0	No recovery	
10	10'-12'	NA	0.75	Wet fine gray sand and gravel in top 1" changing to a gray silty clay with organic debris End boring at 12' BGS	

Note: Highlighted cell indicates interval soil sample collected. Soil sample collected with hand auger on 1 March 2006.

MONITORING WELL LOG: B-165

PROJECT:	Sunoco (PES) Philadelphia Refinery	DRILLING CO.:	Total Quality Drilling
SITE LOCATION:	AOI-6	DRILLING METHOD:	Hollow Stem Auger
JOB NO.:	-	SAMPLING METHOD:	Hand Auger/Split Spoon
LOGGED BY:	Shaun Sykes	SCREEN/RISER DIAMETER:	4"
DATES DRILLED:	5 & 11 December 2012	WELLBORE DIAMETER:	6"
TOTAL DEPTH:	12'	ELEVATION:	(flush mount)

Depth (feet)	OVM (ppm)	USCS	LITHOLOGY	COMMENTS	WELL CONSTRUCTION	WELL DIAGRAM
0	103 ppm		Gravel, fill, bricks, dark brown/black, water @ 1.5-2', visible SPH, some wood	Sample collected @ 1.5-2' for laboratory analysis	4" PVC Casing 0-2'	
					Sand 1-12'	
-5				Cleared via vac truck to 10' on 5 December 2012, backfilled with sand	4" PVC Screen 2-12'	
				Drilled 11 December 2012		
-10	337 ppm		Black sandy clay and gravels, wet			

MONITORING WELL LOG: B-166

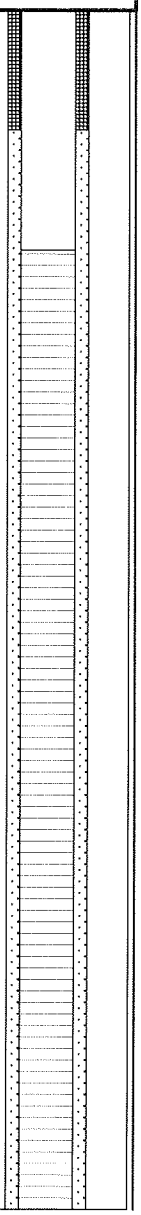
PROJECT:	Sunoco (PES) Philadelphia Refinery	DRILLING CO.:	Total Quality Drilling
SITE LOCATION:	AOI-6	DRILLING METHOD:	Hollow Stem Auger
JOB NO.:	-	SAMPLING METHOD:	Hand Auger/Split Spoon
LOGGED BY:	Shaun Sykes	SCREEN/RISER DIAMETER:	4"
DATES DRILLED:	13 & 18 December 2012	WELLBORE DIAMETER:	6"
TOTAL DEPTH:	12'	ELEVATION:	(flush mount)

Depth (feet)	OVM (ppm)	USCS	LITHOLOGY	COMMENTS	WELL CONSTRUCTION	WELL DIAGRAM
0			Asphalt 0-1', brick, gravel, glass, fill, orange/red silty sand, wet @ 3'			
	4.7 ppm			Sample collected @ 2' for laboratory analysis	4" PVC Casing 0-2'	
	0.6 ppm			Sample collected @ 3' for laboratory analysis	Sand 1-12'	
-5				Cleared via vac truck to 10' on 13 December 2012, backfilled with sand	4" PVC Screen 2-12'	
				Drilled 18 December 2012		
-10			Black/dark gray sand and gravel, wet, some glass/wood/brick (fill)			
	76.6 ppm					

MONITORING WELL LOG: B-167

PROJECT:	Sunoco (PES) Philadelphia Refinery	DRILLING CO.:	Total Quality Drilling
SITE LOCATION:	AOI-6	DRILLING METHOD:	Hollow Stem Auger
JOB NO.:	-	SAMPLING METHOD:	Hand Auger
LOGGED BY:	Shaun Sykes	SCREEN/RISER DIAMETER:	4"
DATES DRILLED:	13 & 17 December 2012	WELLBORE DIAMETER:	6"
TOTAL DEPTH:	10'	ELEVATION:	(flush mount)

Depth (feet)	OVM (ppm)	USCS	LITHOLOGY	COMMENTS	WELL CONSTRUCTION	WELL DIAGRAM
0			Asphalt 0-1', brick, wood, gravel, black silty sand, strong odor			
	461 ppm			Sample collected @ 2' for laboratory analysis	4" PVC Casing 0-2'	
				Wet @ 4'	Sand 1-12'	
	1329 ppm			Sample collected @ 4' for laboratory analysis		
-5				Cleared via vac truck to 10' on 13 December 2012, backfilled with sand	4" PVC Screen 2-10'	
				Drilled 17 December 2012		
-10						



MONITORING WELL LOG: B-168

PROJECT:	Sunoco (PES) Philadelphia Refinery	DRILLING CO.:	Total Quality Drilling
SITE LOCATION:	AOI-6	DRILLING METHOD:	Hollow Stem Auger
JOB NO.:	-	SAMPLING METHOD:	Hand Auger/Split Spoon
LOGGED BY:	Shaun Sykes	SCREEN/RISER DIAMETER:	4"
DATES DRILLED:	5 & 10 December 2012	WELLBORE DIAMETER:	6"
TOTAL DEPTH:	12'	ELEVATION:	(flush mount)

Depth (feet)	OVM (ppm)	USCS	LITHOLOGY	COMMENTS	WELL CONSTRUCTION	WELL DIAGRAM
0			Gravel, fill, brick, wood, water @ 1.5-2', visible SPH, black			
	0.5 ppm			Sample collected @ 1.5-2' for laboratory analysis	4" PVC Casing 0-2'	
					Sand 1-12'	
-5				Cleared via vac truck to 10' on 5 December 2012, backfilled with sand	4" PVC Screen 2-12'	
				Drilled 10 December 2012		
-10			Black sandy clay and gravels, wet			
	323 ppm					

MONITORING WELL LOG: B-169

PROJECT:	Sunoco (PES) Philadelphia Refinery	DRILLING CO.:	Total Quality Drilling
SITE LOCATION:	AOI-6	DRILLING METHOD:	Hollow Stem Auger
JOB NO.:	-	SAMPLING METHOD:	Hand Auger/Split Spoon
LOGGED BY:	Shaun Sykes	SCREEN/RISER DIAMETER:	4"
DATES DRILLED:	5 & 11 December 2012	WELLBORE DIAMETER:	6"
TOTAL DEPTH:	12'	ELEVATION:	(flush mount)

Depth (feet)	OVM (ppm)	USCS	LITHOLOGY	COMMENTS	WELL CONSTRUCTION	WELL DIAGRAM
0			Gravel, fill, brick, water at 1.5-2', visible SPH, some wood, black			
	0.7 ppm			Sample collected @ 1.5-2' for laboratory analysis	4" PVC Casing 0-2'	
					Sand 1-12'	
-5				Cleared via vac truck to 10' on 5 December 2012, backfilled with sand	4" PVC Screen 2-12'	
				Drilled 11 December 2012		
-10			Black sandy clay and gravels, wet			
	267 ppm					

MONITORING WELL LOG: B-170

PROJECT:	Sunoco (PES) Philadelphia Refinery	DRILLING CO.:	Total Quality Drilling
SITE LOCATION:	AOI-6	DRILLING METHOD:	Hollow Stem Auger
JOB NO.:	-	SAMPLING METHOD:	Hand Auger/Split Spoon
LOGGED BY:	Shaun Sykes	SCREEN/RISER DIAMETER:	4"
DATES DRILLED:	13 & 17 December 2012	WELLBORE DIAMETER:	6"
TOTAL DEPTH:	12'	ELEVATION:	(flush mount)

Depth (feet)	OVM (ppm)	USCS	LITHOLOGY	COMMENTS	WELL CONSTRUCTION	WELL DIAGRAM
0			Gravel, black sand and gravel, brick, wood, wet at 2', visible SPH			
	112 ppm			Sample collected @ 2' for laboratory analysis	4" PVC Casing 0-2'	
					Sand 1-12'	
-5				Cleared via vac truck to 10' on 13 December 2012, backfilled with sand	4" PVC Screen 2-12'	
				Drilled 17 December 2012		
-10			Black sand and gravel, brick, wood, clay, wet			

LOG of BORING and MONITORING WELL CONSTRUCTION DETAILS

Project : Chevron/Philadelphia Refinery

Boring/Well No. - B48D

Project No. 113-950-032

Date M.W. completed 11/6/86

Supervising D & M Geologist David Wagner

Location -	Chevron Refinery
Driller -	Lambert, Inc.
Drilling Completed -	11/6/86
Type of Rig -	Hollow Stem Auger

CONSTRUCTION DATA

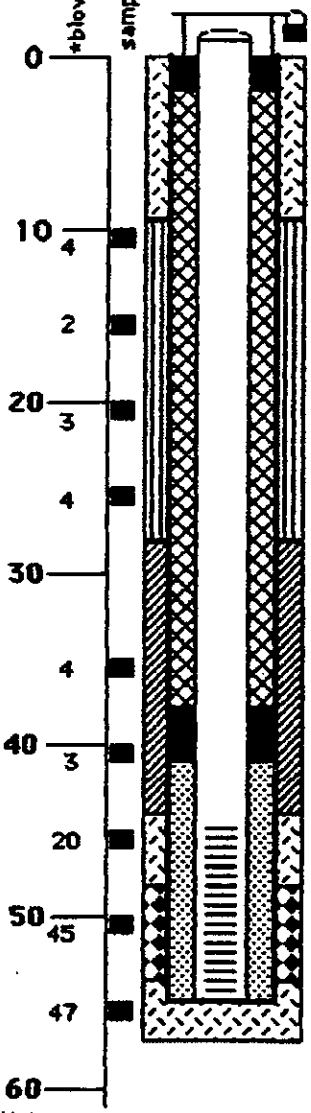
Borehole Diam. -	10"
Borehole Depth -	55'
Casing/Screen Type -	PVC
Casing Diam. -	4"
Casing Depth -	55'
Screen Setting -	45' - 55'
Slot Width -	0.02"
Type of Seal -	Bentonite
Type of Filterpack -	#2 Sand
Type of Grout -	

MEASUREMENTS(NGVD)

Top of Casing Elevation -	9.82'
Static Water Level Elevation -	-2.17'
Date Measured -	12/22/86
Surface Elevation -	8.90'

TEST DATA

Pump Type -	
Depth to Intake (ft) -	
Satic Water Level (ft) -	
Pumping Water Level (ft) -	
Drawdown (ft) -	
Length of Test (Hrs) -	



	Description
SW	Fine to coarse sand with little to some fine gravel, little clay and silt, very dark brown, soft, saturated; strong petroleum odor
ML	Silt with little clay, very dark brown, soft, very moist; micaceous; strong petroleum odor
	Increasing clay; some clay with abundant organics
	Increasing clay; silt and clay
	Decreasing clay; some clay and trace fine sand; organics; weak petroleum odor
CL	Clay with some silt, dark gray, soft, very moist; organics; very weak petroleum odor SHELBY TUBE taken from 30' to 31.5'
SW	Fine to coarse sand with some fine gravel, trace silt, reddish-brown, medium dense, saturated
GP	Fine gravel with little to some fine to coarse sand, trace silt and clay, dark reddish-brown, dense, saturated; micaceous
SW	Fine to coarse sand with some fine gravel, light reddish-brown to light reddish-gray, dense, saturated

WELL CONSTRUCTION KEY

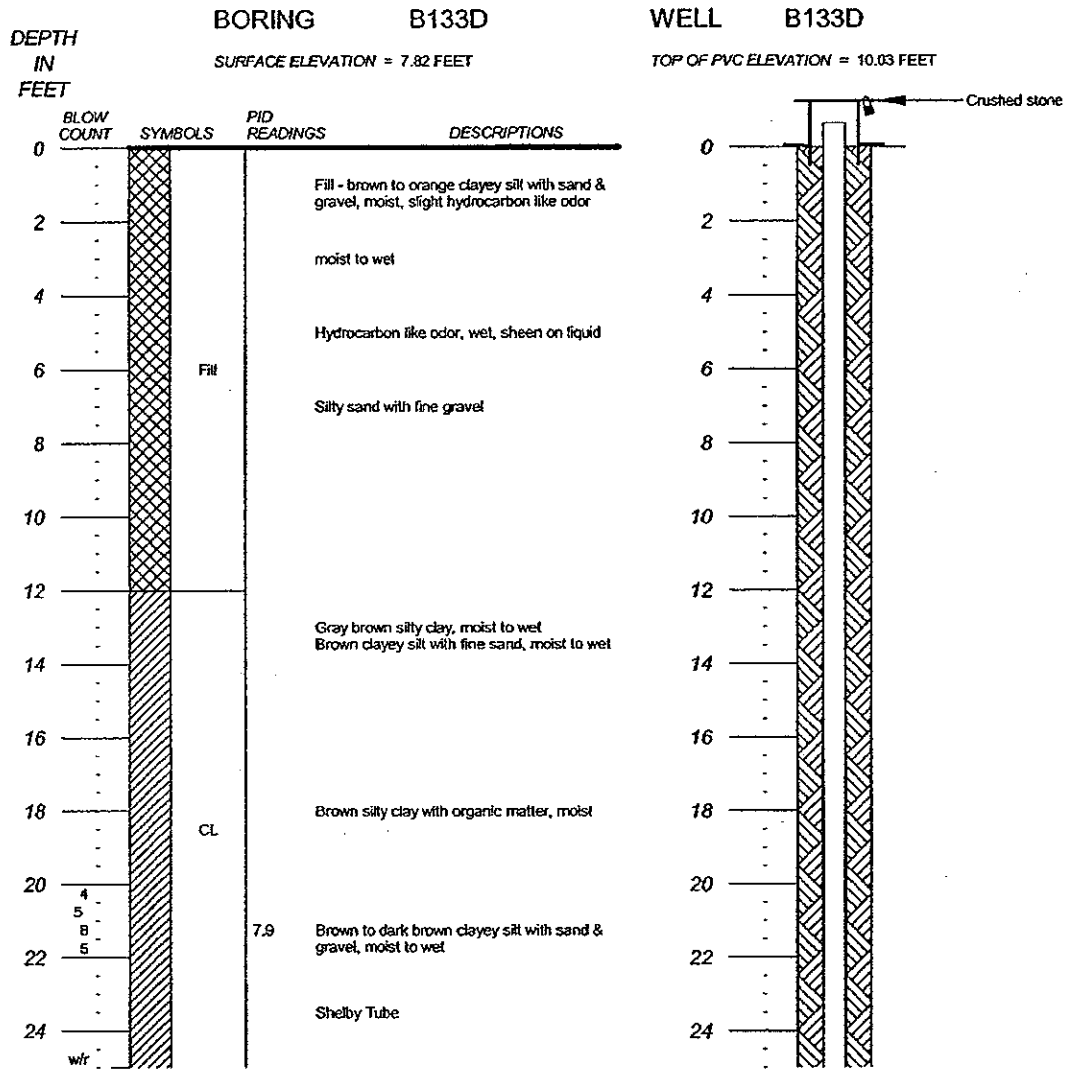
- FILTER PACK
- BENTONITE SEAL
- BENTONITE GROUT
- CAVE IN MATERIAL
- CONCRETE

Notes:

* Blows taken using a 140 lb hammer falling 30 inches.

** All soils classified by visual inspection.

DAMES & MOORE



LOG OF SOIL BORING AND MONITORING WELL DETAIL
Girard Point
Sunoco Philadelphia Refinery
Philadelphia, PA

NOTES:

1. Boring installed by CT&E on March 5, 2001.
2. Boring was advanced by hollow stem auger. Sampling was performed by split-spoon samplers.
3. Boring was logged by Neil Laird of URS.
4. A solid bar indicates that a soil sample was collected at that depth.
5. PID reading - photoionization detector (11.7 ev lamp); readings in parts per million with respect to background (field screening not performed).
6. A blow count refers to the number of blows required to drive a standard split-spoon sampler a distance of 6-inches using a 140-lb hammer falling 30 inches.

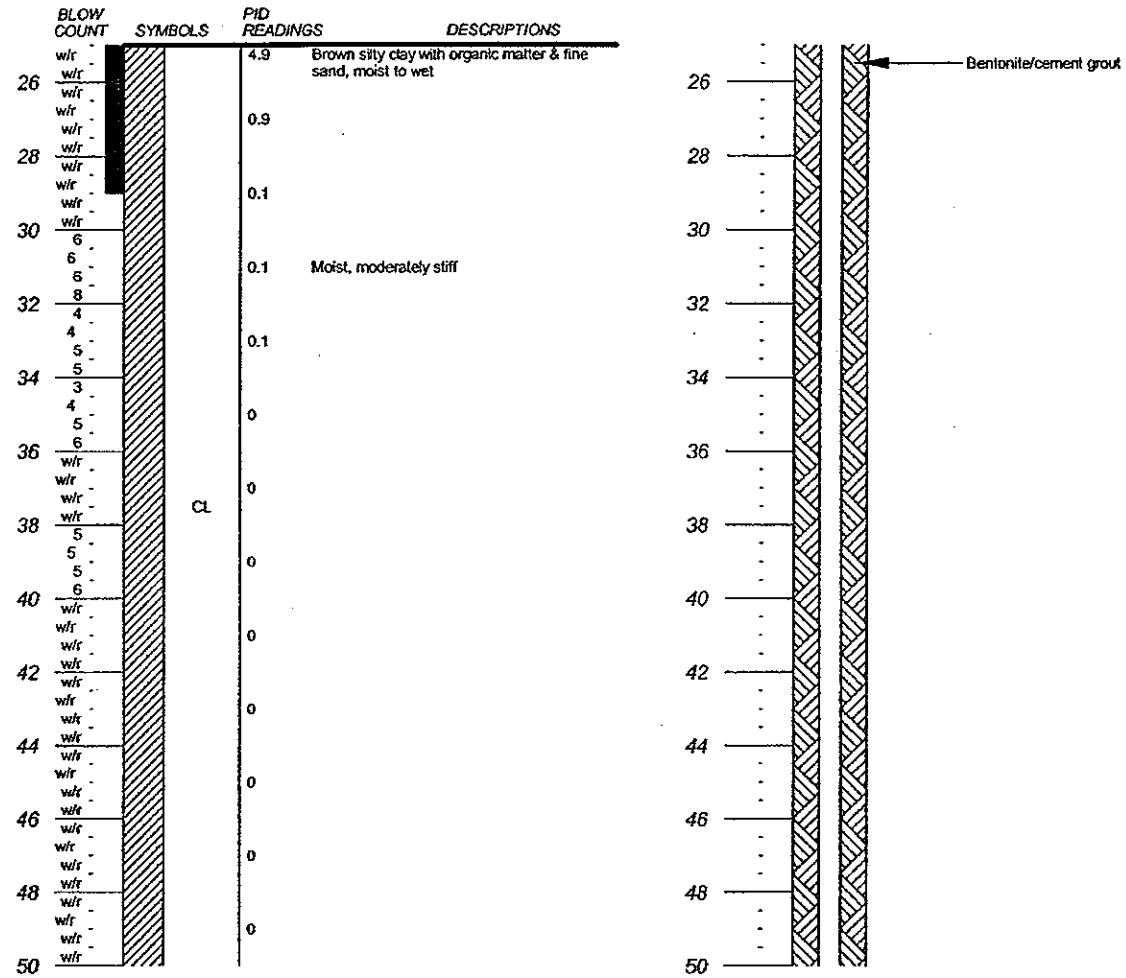
URS

BORING B133D

SURFACE ELEVATION = 7.82 FEET

WELL B133D

TOP OF PVC ELEVATION = 10.03 FEET



LOG OF SOIL BORING AND MONITORING WELL DETAIL
Girard Point
Sunoco Philadelphia Refinery
Philadelphia, PA

NOTES:

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2. Boring was advanced by hollow stem auger. Sampling was performed by split-spoon samplers.
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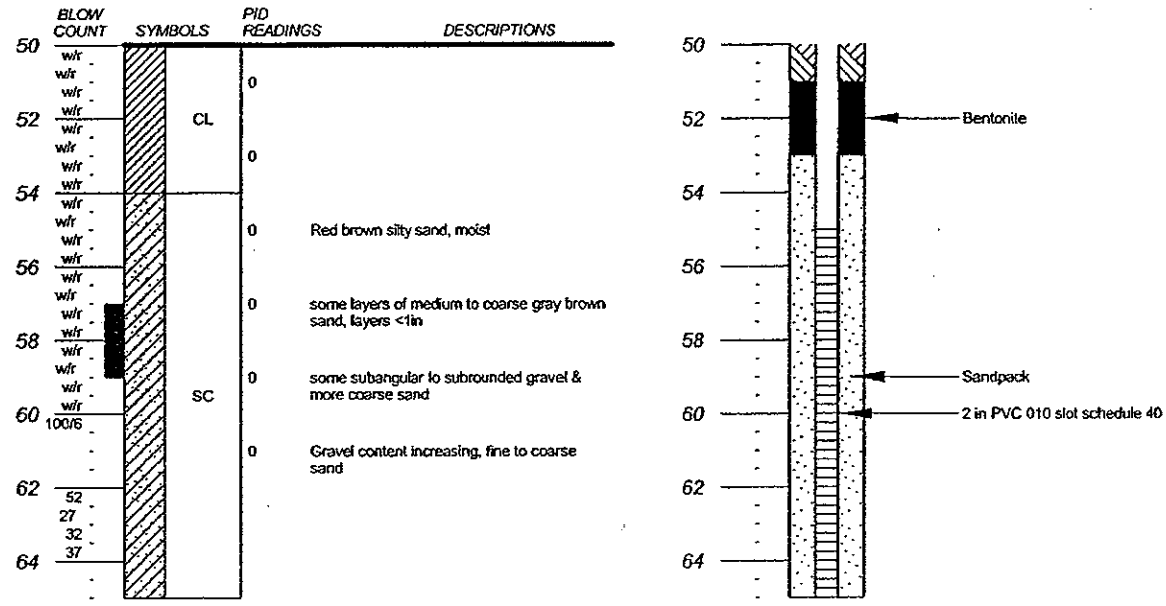
URS

BORING B133D

SURFACE ELEVATION = 7.82 FEET

WELL B133D

TOP OF PVC ELEVATION = 10.03 FEET



TOTAL DEPTH - 65 FEET BGS

LOG OF SOIL BORING AND MONITORING WELL DETAIL
Girard Point
Sunoco Philadelphia Refinery
Philadelphia, PA

NOTES:

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5. PID reading - photoionization detector (11.7 ev lamp); readings in parts per million with respect to background (field screening not performed).
6. A blow count refers to the number of blows required to drive a standard split-spoon sampler a distance of 6-inches using a 140-lb hammer falling 30 inches.

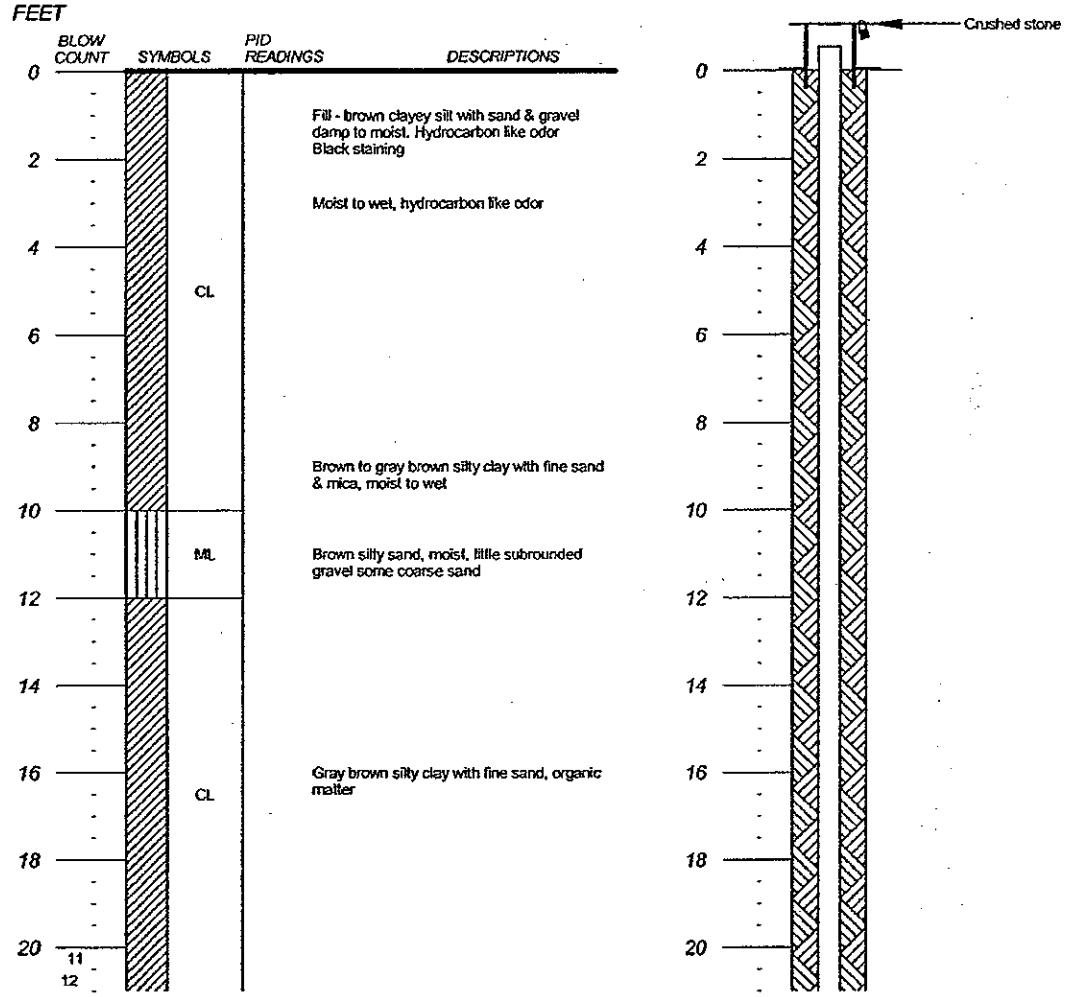
URS

BORING B134D

SURFACE ELEVATION = 7.11 FEET

WELL B134D

TOP OF PVC ELEVATION = 9.73 FEET



LOG OF SOIL BORING AND MONITORING WELL DETAIL
Girard Point
Sunoco Philadelphia Refinery
Philadelphia, PA

NOTES:

1. Boring installed by CT&E on March 1, 2001.
2. Boring was advanced by hollow stem auger. Sampling was performed by split-spoon samplers.
3. Boring was logged by Neil Laird of URS.
4. A solid bar indicates that a soil sample was collected at that depth.
5. PID reading - photolonization detector (11.7 ev lamp); readings in parts per million with respect to background (field screening not performed).
6. A blow count refers to the number of blows required to drive a standard split-spoon sampler a distance of 6-inches using a 140-lb hammer falling 30 inches.

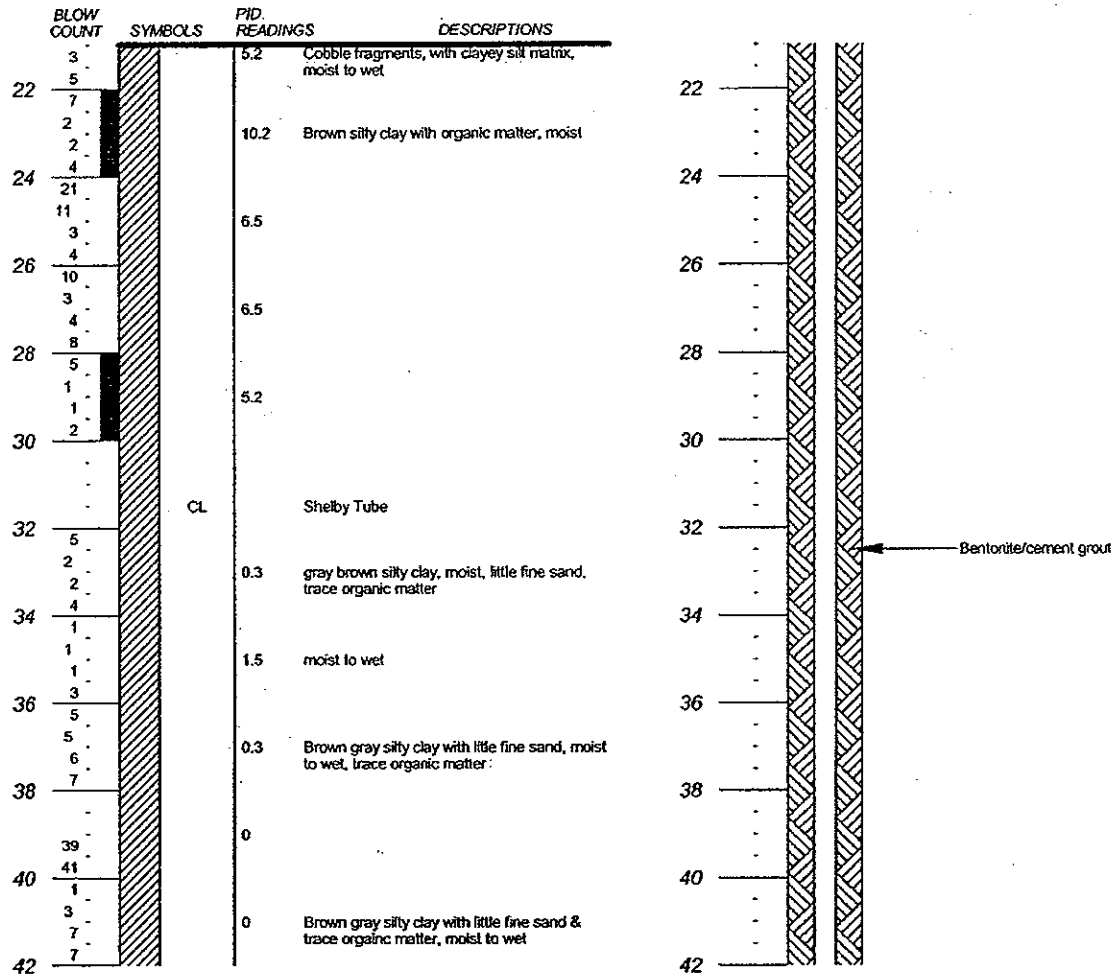
URS

BORING B134D

WELL B134D

SURFACE ELEVATION = 7.11 FEET

TOP OF PVC ELEVATION = 9.73 FEET



LOG OF SOIL BORING AND MONITORING WELL DETAIL
Girard Point
Sunoco Philadelphia Refinery
Philadelphia, PA

NOTES:

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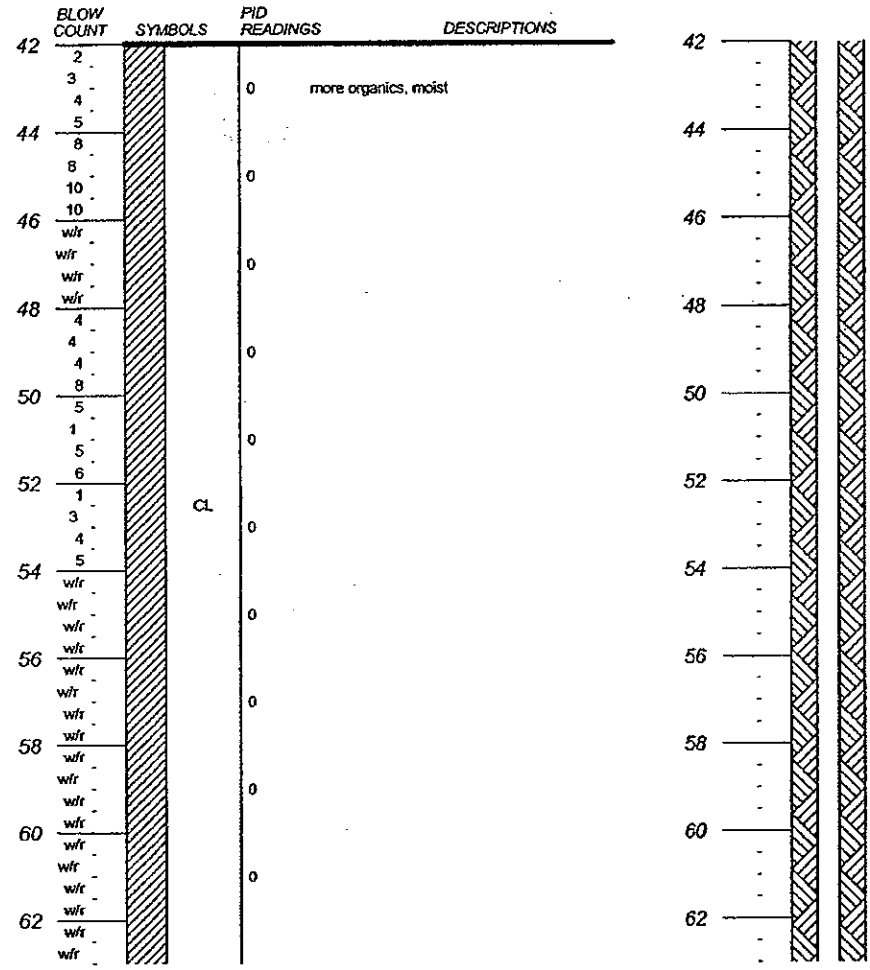
URS

BORING B134D

SURFACE ELEVATION = 7.11 FEET

WELL B134D

TOP OF PVC ELEVATION = 9.73 FEET



LOG OF SOIL BORING AND MONITORING WELL DETAIL

Girard Point

Sunoco Philadelphia Refinery

Philadelphia, PA

NOTES:

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4. A solid bar indicates that a soil sample was collected at that depth.
5. PID reading - photoionization detector (11.7 ev lamp); readings in parts per million with respect to background (field screening not performed).
6. A blow count refers to the number of blows required to drive a standard split-spoon sampler a distance of 6-inches using a 140-lb hammer falling 30 inches.

URS

APPENDIX C

Soil and Groundwater Analytical Reports (on CD)

APPENDIX D

Groundwater Sampling Field Summary Report – January 2013

Table D-1
Summary of January 2013 Groundwater Sampling Field Parameters
AOI-6
PES Facility
Philadelphia, Pennsylvania

Well Information					Pre-Purge					Post purge				
Location ID	Depth to Bottom (ft bgs)	Depth to Water (ft btic)[1]	Depth to Product (ft btic)	Product Thickness (ft)	COND	DO	ORP	PH	TEMP	COND	DO	ORP	PH	TEMP
					us/cm	mg/l	mV	su	deg c	us/cm	mg/l	mv	su	deg c
B-115	17.65	2.44	NP	NP	460	1.77	19.1	7.56	14.96	444	2.67	8.5	7.2	15.26
B-116	7.45	5.6	NP	NP	361	4.52	-3.1	7.05	15.15	369	1.84	1.9	7.6	15.31
B-117	NM	5.15	4.66	0.49	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
B-123	18	3.82	NP	NP	281	35.46	-3.6	7.09	14.19	276	2.29	-0.5	7.17	14.26
B-124	NM	4.74	4.7	0.04	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
B-125	18	4.78	NP	NP	4187	1.09	-35	7.06	11.72	4417	1.73	-39.7	6.68	13.41
B-126	18	4.86	NP	NP	1302	1.49	-35.1	0.65	12.45	1100	1.03	-74.7	6.98	12.04
B-129	NM	10.31	5.12	5.19	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
B-130	NM	5.21	4.98	0.23	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
B-131	18	4.6	NP	NP	1007	1.21	-46.1	7.14	10.61	977	1.74	-36.9	7.11	11.04
B-132	NM	4.46	4.44	0.02	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
B-133	15	4.84	NP	NP	637	0.66	-24.1	6.65	11.39	549	2.75	-20.3	6.63	11.36
B-134	15	4.26	NP	NP	624	1.64	-74	7.62	10.49	580	1.03	-34.5	6.76	10.18
B-135	13	4.38	NP	NP	598	5.07	686.7	-6.87	9.46	545	1.01	-46.6	6.76	10.15
B-136	NM	4.34	4.19	0.15	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
B-137	NM	3.58	3.48	0.1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
B-138	NM	3.56	3.5	0.06	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
B-139	NM	5.09	5.05	0.04	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
B-140	NM	NM	NP	NP	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
B-141	NM	2.54	2.52	0.02	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
B-142	NM	6.58	6.56	0.02	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
B-143	NM	4.4	4.37	0.03	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
B-144	15	4.24	NP	NP	225	0.79	5.3	6.82	10.79	1	23.02	4.9	7.28	10.53
B-145	15	3.68	NP	NP	313	0.68	6.7	7.28	12.82	280	0.77	4.4	7.19	12.53
B-147	NM	5.2	5.19	0.01	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
B-148	NM	5.17	4.97	0.2	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
B-149	13	2.27	NP	NP	650	0.3	-34.7	7.02	9.97	669	1.19	-19.9	6.6	11.08
B-150	NM	2.89	2.88	0.01	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
B-151	13	2.54	NP	NP	524	0.94	-46.6	2.19	9.77	511	0.98	-45.9	0.82	9.1
B-152	11	0.11	NP	NP	379	1.13	-34.9	6.81	9.13	597	0.99	-80.6	6.6	7.91
B-153	11	2.34	NP	NP	10.91	1.68	25.9	6.7	9.83	1816	1.81	-37.5	6.7	11.59
B-154	13	2.21	NP	NP	427	0.68	-72.1	7.11	9.27	736	0.97	-78.3	6.66	11.4
B-155	13	3.71	NP	NP	753	1.58	-47	6.52	12.24	770	1.26	-38.6	6.52	12.41
B-156	13	4.96	NP	NP	785	1.01	-18.4	6.9	10.55	980	1.41	-33.8	6.74	12.73
B-158	12	1.61	NP	NP	595	2.7	-45.2	7.42	11.7	573	5.83	-20.2	7.48	11.75
B-159	NM	NM	NP	NP	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
B-160	10.75	4.46	NP	NP	375	1.53	-5.2	8.33	15.17	361	1.89	-9	7.3	17.21
B-161	NM	3.52	3.51	0.01	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
B-162	NM	NM	NP	NP	312	6.37	11.6	6.67	12.5	287	4.03	3.6	6.36	10.2
B-163	11	1.57	NP	NP	438	1.09	-32.1	6.93	14.34	543	1.43	-31.3	6.78	13.25
B-164	15	3.76	NP	NP	395	3.84	-23.7	7.57	10.01	400	5.02	17.5	7.34	11.51
B-165	12	2.42	NP	NP	470	1.74	-111.6	7.16	13.26	870	4.94	-54.1	7.08	13.6
B-166	13.05	2.25	NP	NP	733	10	17.7	7.07	15.78	25	20.98	16.3	7.2	14.99
B-167	8.8	1.91	NP	NP	262	8.4	3.1	7.95	10.65	298	73.71	22.2	7.68	10.02
B-168	12	2.12	NP	NP	1544	1.38	-34.8	7.3	10.94	1695	3.55	-22.8	7.16	11.9
B-169	11.5	2.95	NP	NP	1283	1.24	10.6	7.98	9.33	1570	1.39	-12.9	7.81	10.02
B-170	12	1.11	NP	NP	1227	1.94	17.6	8.27	16.01	2240	1.57	-16.36	8.45	10.15
B-39	10	0.27	NP	NP	382	0.96	11.5	7.44	8.99	760	3.25	-6.3	6.78	10.22
B-43	NM	3.47	3.14	0.33	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
B-45	15	NM	NP	NP	3322	2.5	129.1	7.05	11.51	1144	1.24	-116	7.28	10.72
B-46	14.7	0.8	NP	NP	378	36.61	17.8	8.16	15.8	0.322	2.08	12.9	6.95	15.52
B-47	NM	3.5	3	0.5	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
B-48	12.9	0.2	NP	NP	703	12.44	16.9	7.2	13.39	507	4.81	23.9	6.83	14.21
B-92	18	4.72	NP	NP	357	14.28	9.8	7.89	12.75	311	4.24	-3.7	6.79	13.3
B-94	16.95	6.91	NP	NP	759	3.77	12.2	7.17	15.88	958	2.55	11.9	7.58	16.19
RW-9	NM	NM	NP	NP	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
SUMP-1	2.94	2.87	NP	NP	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
U-1	9	6.87	NP	NP	110	5.81	7.3	7.71	9.28	NS	NS	NS	NS	NS
U-2	NM	NM	NP	NP	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
U-3	NM	8.42	7.05	1.37	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
U-4	9.7	3.81	NP	NP	310	1.16	-17.8	7.58	7.08	300	19.05	0.8	7.25	4.68
U-5	9.67	7.81	NP	NP	228	43.46	-30.2	8.6	8.17	NS	NS	NS	NS	NS
URS-1	NM	NM	NP	NP	418	1.29	54.3	7.49	9.43	449	3.49	14.8	7.17	9.77
URS-2	15.44	5.17	NP	NP	322	6.18	-17.3	7.72	13.27	322	9.55	58.2	8.28	12.98
URS-3	NM	NM	NP	NP	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
URS-4	NM	NM	NP	NP	711	0.41	-18.4	6.72	11.1	721	0.77	-33.8	6.72	12.2
URS-5	NM	NM	NP	NP	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
WP9-3	2.25	2.01	NP	NP	356	17.02	37.7	7.89	5.25	NS	NS	NS	NS	NS
WP9-4	9.02	6.25	NP	NP	122	15.77	28.9	8.42	9.05	NS	NS	NS	NS	NS
WPM-11	NM	NM	NP	NP	4381	1.31	19.7	7.28	8.78	4388	0.7	-7	7.36	8.99
WPM-2	NM	NM	NP	NP	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
WPM-3	NM	NM	NP	NP	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Notes:
1. Measured prior to purging
Groundwater quality readings collected using a YSI
A minimum of 3 well volumes were purged at each well location, unless well went dry during purging
All wells were sampled using poly bailers
ft btic - Feet below top of inner casing
ft bgs - Feet below ground surface
mg/L - Milligrams per Liter
deg c - Degrees celsius
mV - Milli volts
uS/cm - Micro siemens per centimeter
su - Standard units
NM - Not measured
NP - No measurable (>0.01 ft) product
NS-P - Not sampled due to measurable (>0.01 ft) product

APPENDIX E

Regulated Storage Tanks – Supplemental Site Characterization Report

SUPPLEMENTAL SITE CHARACTERIZATION REPORT ABOVEGROUND STORAGE TANKS GP-201, GP 250, GP-U-677, 797 AND GP-U-1088 AREA OF INTEREST 6

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September 3, 2013
2574601

SUPPLEMENTAL SITE CHARACTERIZATION REPORT ABOVEGROUND STORAGE TANKS GP-201, GP 250, GP-U-677, 797 AND GP-U-1088 AOI 6

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1.0 INTRODUCTION

This Supplemental Site Characterization Report (SCR) has been prepared to document closure and/or corrective action activities that have been completed for aboveground storage tanks (ASTs) GP-201, GP-250, GP-U-677, 797, and GP-U-1088 within Area of Interest (AOI) 6 in the Philadelphia Energy Solutions Refining and Marketing LLC (PES) facility, herein referred to as facility. This Supplemental SCR is an attachment to the overall AOI 6 Site Characterization/Remedial Investigation Report (SCR/RIR) that is being submitted to the Pennsylvania Department of Environmental Protection (PADEP) and the Environmental Protection Agency (EPA) in accordance with PA One Cleanup Program. The purpose of the supplemental SCR is to document the status of each tank and to summarize the previous and more-recent supplemental closure and/or corrective action work completed by the previous owner Sunoco Inc. (R&M) (Sunoco) in these tank areas. All of this work has been completed pursuant to the requirements of 25 Pa Code Chapter 245. Where applicable, the more-recent supplemental investigation work considered other investigation work completed at the facility under the PA One Cleanup Program.

As referenced in the AOI 6 SCR/RIR, numerous ASTs were removed from AOI 6 prior to August 5, 1989. Conditions in tank areas where tanks were removed prior to August 5, 1989 are being characterized under the PA One Cleanup Program investigation and are discussed in the AOI 6 SCR/RIR. Two tanks in AOI 6 (GP U 677 and GP 797) have been closed-in-place. Closure documentation and/or corrective action reports were previously prepared for these tanks. Three existing tanks, GP 201, GP-250 and GP U 1088, have had previous releases. SCR's, prepared consistent with the requirements of 25 Pa. Code §245.310, were previously prepared for these release incidents. Refer to Appendix A of this Supplemental SCR for previous correspondence between the PADEP and Sunoco regarding these ASTs.

1.1 Objective

Since August 5, 1989, three ASTs in AOI 6 have had releases, and two have been closed-in-place. These ASTs include:

- AST GP-201 (aka GP T-201) – Existing - with release;
- AST GP 250 – Existing - with release;
- AST GP-U-677 – Closed-in-place – no release;

- AST 797 – Closed-in-place - with release; and
- AST GP-U-1088 – Existing – with release.

The purpose of the Supplemental SCR is to document the status of each tank and to summarize the previous and more-recent supplemental closure and/or corrective action work completed by Sunoco in these tank areas.

1.2 Scope of Work Summary

This Supplemental SCR is focused on the work completed for AOI 6 ASTs GP-201, GP-250, GP-U-677, 797, and GP-U-1088. No supplemental site characterization work was completed in the areas of ASTs GP-201 and GP-U-1088 because previous corrective action work completed by others was deemed approved by the PADEP and Corrective Action Program requirements were deemed to be fulfilled.

For AOI 6 ASTs GP-250, GP-U-677, 797, additional site characterization activities were completed as part of the larger and more-recent AOI 6 site characterization effort to supplement previously-existing site characterization work performed by others. These supplemental activities are described in this report relative to the tank areas, and in the AOI 6 SCR/RIR. Soil and groundwater samples were analyzed for the site constituents of concern (COCs) as provided in Table 1. The COCs for the investigation activities include the current constituents from the Corrective Action Process (CAP) Regulation Amendments effective December 1, 2001 (as amended).

2.0 SITE LOCATION AND DESCRIPTION

The PES facility is located in southwest Philadelphia. AOI 6, also known as the Girard Point Fuels Processing Area, is located on the east side of the Schuylkill River. AOI 6 is comprised of a wedge-shaped section from Lanier Avenue to the Schuylkill River and encompasses approximately 100 acres. The boundary of AOI 6 is shown in Figures 1 and 2. A sheet pile bulkhead, which is keyed into the Middle Clay Unit, extends along the entire western boundary of the AOI, between the AOI and the Schuylkill River. The extent of the wall and the locations of ASTs GP-201, GP-250, GP-U-677, 797, and GP-U-1088 are shown in Figure 2.

2.1 Site Description

The PES 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 was established as an oil distribution center. In the 1900s, 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.

Historically, this area of the facility consisted of numerous ASTs containing benzene, toluene, naphtha and other fuel stocks. A sulfuric acid plant was located along the northern boundary of the AOI. A gasoline treating unit, two reformer units, a BDDA (soap) unit, and a thermal hydro-dealkylation unit were also located in this area. Currently, AOI 6 consists of udex and cumene units, reformer, tankage, boiler-houses and associated feed water treatment, maintenance buildings, lay-down yards, office buildings, the # 2 oil-water separator and remote Laboratory.

The 27 Pump House Total Fluids Recovery System is the only remediation system located in AOI-6. Installed in November 2001, the system included 12 total fluid recovery wells in the vicinity of the former 27 Pump House. The existing monitoring well network in AOI 6 includes a total of 64 wells and piezometers used investigate LNAPL and groundwater conditions. Groundwater gauging of select monitoring wells in AOI 6 occurs on an annual basis during the second quarter of each year. Annual gauging activities and results are reported to the PADEP and EPA in Quarterly Reports prepared by Sunoco. Sunoco also samples select perimeter wells in AOI 6 on an annual basis. Refer to the AOI 6 SCR/RIR for more detail regarding AOI 6 groundwater monitoring wells.

2.2 Topography and Physiography

The overall facility and AOI 6 falls within the Atlantic Coastal Plain Physiographic Province which is generally low-lying and relatively flat. Northwest of the Facility, bedrock outcrops along the Fall Line (the line between the area where bedrock outcrops to the west and the Coastal Plain sediments lay to the east); near the site, bedrock is

overlain with thick, unconsolidated deposits of layered sand and gravel, silts, and clays. These deposits are somewhat thin along the western portion of the Coastal Plain where bedrock is at shallower depths, and gradually thicken in a southeast direction to the coast, where these deposits are several thousand feet thick. Within the Facility, at the northwestern end of the Coastal Plain, existing boring information indicates the unconsolidated deposits to be generally less than 100 feet in thickness. Land surface topography at the Facility is relatively flat, with the land surface elevation being generally less than 30 feet above mean sea level. The flatness of the topography is representative of the Coastal Plain where alluvial sediments have been deposited by meandering streams and rivers with deposition ultimately controlled by the proximity to sea level. There are no significant areas of topographic relief within the Facility.

3.0 GEOLOGY AND HYDROGEOLOGY

3.1 Regional Geology and Hydrogeology

The regional aquifers underlying the Philadelphia area and the Coastal Plain have been studied extensively by the USGS and State Agencies. Site specific geology and hydrogeology were determined from site specific borings and wells.

The geology of the facility is composed of several different units, which can be generally characterized as: filled land in many portions of the site; unconsolidated sand, gravel, silt, and clay, which occur as layered and differentiated units, and bedrock. The following summary discussion presents a description of each of the geologic units at the site in terms of geologic history, lithology, and regional hydrogeology.

Wissahickon Formation - According to the American Institute of Professional Geologists mapping (Bennison, 1976), the oldest geologic unit underlying the site is the Wissahickon Formation of lower Cambrian age (540-570 million years). This formation is a metamorphosed micaceous schist and quartzite into which igneous bodies have intruded (Greenman, et al, 1961). The surface of the Wissahickon Formation was eroded by the paleo-Schuylkill River, which formed 4 channels (troughs) which fed the paleo-Delaware River. Greenman, et. al 1961, mapped the Point Breeze Trough within

the PES facility. Work completed by CVM in 1985 reportedly verified the existence of this trough at the Facility.

The Wissahickon Formation is overlain by an extensive confining unit derived from the weathering of the bedrock. Near its top, the confining unit is predominately a micaceous, soft clay which grades downward, becoming increasingly sandy as the degree of weathering of the crystalline formation lessens and competent bedrock is reached. The clay layer acts as a confining layer to the water-bearing fractures of the Wissahickon Formation. Where the clay layer is present, the Wissahickon Formation behaves as an artesian aquifer, with flow generally to the southeast away from the Fall Line at a steep gradient.

Lower Sand Unit of the PRM - At the Facility, the Wissahickon Formation is overlain by the Lower Sand, which is the lowest member of the Potomac-Raritan Magothy System (upper Cretaceous age; 65 to 98 million years). The Lower Sand is a fine gravel and course sand that grades upward into medium to fine sands and contains a few layers of clay (Greenman and others, 1961). The Lower Sand is yellowish gray to yellowish brown in color and is generally overlain by the Lower and Middle Clay.

The Lower Sand is generally separated hydraulically from surface waters (i.e., Delaware River and Schuylkill River) and the surficial unconfined aquifer by superjacent, confining clays (Lower and Middle Clays). Where these confining clay layers are absent, the Lower Sand is hydraulically connected to the overlying Trenton Gravels unconfined aquifer, so that both units may behave as one hydrologic and geochemical unit.

Middle/Lower Clay - The Middle Clay member of the Raritan Formation is the most extensive clay layer in the Philadelphia area. Regionally, the thickness of the Middle Clay ranges from 0 to 60 feet, with thicknesses commonly greater than 20 feet. The Middle and Lower Clay units appear to become one unit beneath the facility and therefore it is called the Middle/Lower Clay in this document, whereas this unit has been referred to as the Middle Clay or Lower Clay in historical reports. The Middle/Lower Clay appears to have been eroded away in parts of the Facility, particularly under AOI 10 (West Yard) and potentially in portions of AOI 8 (North Yard) and AOIs 1-4 (South Yard). The Middle/Lower Clay is characterized by a very low permeability and forms an effective

barrier to groundwater flow. Shelby tube samples were collected in the Middle/Lower Clay in 2001 by URS. The results of the Atterburg limits and grain size analysis classified the Middle/Lower clay as Silty Sand, Elastic Silt and a Fat Clay.

Trenton Gravels - The Trenton Gravel overlies the Middle/Lower Clay and Lower Sand with thicknesses up to 80 feet and a typical thickness of 40 feet. The Trenton Gravel is of Pleistocene Age (Ice Age; less than 2 million years) and is a very heterogeneous unit comprised of a predominant brown to gray sand, gravel and minor amounts of clay (Owens and Minard, 1979). Along the Schuylkill River, most of the Pleistocene formations have been eroded away, and based on all deep borings performed to date in AOI 6, the Trenton Gravel is not present throughout AOI 6.

Recent Alluvium - Overlying the Trenton Gravels Formation is recent alluvium with depths up to 78 feet. These deposits generally consist of dark gray organic clayey mud or silt and fine sand. Based on available data it is unclear if the alluvium exists throughout AOI 3. The recent alluvium is unimportant as a water source because it is significantly less permeable that the subjacent aquifers. The alluvium acts, however, as a leaky confining bed, impeding flow of groundwater to the lower aquifers. Where it overlies the Trenton Gravels, the recent alluvium may cause the Trenton Gravel to respond as an artesian aquifer. The primary hydrologic features in the vicinity of the site include the Schuylkill and Delaware Rivers. Groundwater flow in the fill/alluvium and in the Trenton Gravel is generally toward the south-southwest toward the Schuylkill River, however, there is south-southeast component of flow toward the confluence of the Delaware and Schuylkill Rivers.

3.2 Site Specific Geology and Hydrogeology

Geologic unit descriptions are provided in Section 3.1 above, a geologic cross-section location plan is displayed in Figure 3, and a geologic cross-section plan is provided in Figure 4. The following summarizes relevant information concerning geology and hydrogeology in AOI 6.

- The Fill/Alluvium, Middle/Lower Clay, and the Lower Sand all exist beneath AOI 6, the Trenton Gravel is absent beneath AOI 6 as shown in Figure 4;

- Unconfined groundwater conditions exist in the fill/alluvium at shallow depths (approximately 1.5 to 16 feet beneath the ground surface);
- The sheet pile wall along the border of AOI 6 and the Schuylkill River is keyed into the Middle/Lower Clay and acts as a boundary for shallow groundwater flow; and
- Groundwater flow in the shallow/intermediate zone in AOI 6 west of the divide is towards the west-southwest and east of the divide is defined by a groundwater depression as shown in Figure 5.

For a more detailed description of the geology and hydrology related to AOI 6, refer to the AOI 6 SCR/RIR.

4.0 SUMMARY OF PREVIOUS INVESTIGATIONS AND REMEDIATION EFFORTS

This section summarizes previous site assessment/characterizations and/or corrective action work completed for AOI 6 ASTs GP-201, GP-250, GP-U-677, 797, and GP-U-1088.

4.1 AST GP-201

Sunoco conducted previous interim remedial measures under the Corrective Action Program in response to a reported release of approximately 265 gallons of sulfuric acid in the area of AST GP-201. As summarized in a Secor International, Inc. (SECOR) report dated June 3, 2008 (provided in Appendix A), the sulfuric acid release impacted approximately 25 cubic yards of soil which Sunoco subsequently treated with sodium carbonate. SECOR then proceeded to conduct site assessment activities on March 26, 2008, by completing 7 soil borings and collecting surface soil samples from 0 to 0.5 feet below ground surface (bgs) analyzed for pH. The soil sample results indicated that the reported pH concentrations ranged from 7.89 to 9.00 standard units. The PADEP does not have a cleanup standard established for pH and the reported results are within typical soil pH range. The SECOR surface soil locations are displayed on Figure 2 of the SECOR report within Appendix A. Historical soil sample analytical results from SECOR's 2008 report are provided in Table 1 of the SECOR report within Appendix A. Refer to Appendix A for additional information regarding the previous investigation.

4.2 AST GP-U-1088

Sunoco conducted previous interim remedial measures pursuant to the Corrective Action Program in response to a reported release of approximately 61 gallons of sodium hydroxide on December 31, 2007, in the area of AST GP-U-108. As summarized in a SECOR report dated June 24, 2008 (provided in Appendix A), the sodium hydroxide release impacted approximately 10 cubic yards of soil which Sunoco subsequently treated by flushing/rinsing the impacted area. SECOR then proceeded to conduct site assessment activities on March 26, 2008 by completing 8 soil borings and collecting surface soil samples from 0 to 0.5 feet bgs analyzed for pH. The soil sample results indicated that the reported pH concentrations ranged from 10.1 to 11.6 standard units where 6 of the soil samples had a reported PH concentration below 10.7 standard units. The PADEP does not have a cleanup standard established for pH and the reported results are below a high pH value of 12.4 standard units that soils can demonstrate after being treated with alkaline chemicals.

The SECOR surface soil locations are displayed on Figure 2 of the SECOR report within Appendix A. Historical soil sample analytical results from SECOR's 2008 report are provided in Table 1 of the SECOR report within Appendix A. Refer to Appendix A for additional information regarding the previous investigation.

4.3 AST GP-250

Previous interim remedial measures pursuant to the Corrective Action Program were conducted by Sunoco in response to a reported release of approximately 600 gallons of light fuel oil from AST GP-250 located within AOI 6. As summarized in a SECOR report dated July, 19, 2007 (provided in Appendix A), the fuel oil release impacted approximately 40 cubic yards of surface soil which Sunoco subsequently removed. SECOR then proceeded to conduct site assessment activities on May 15, 2007, and July 3, 2007 by completing 8 soil borings and collecting surface soil samples from 0 to 0.5 feet bgs. The surface soil samples were analyzed for the Act 2 short-list for jet fuel and kerosene.

The soil sample results indicated that only lead concentrations were above the PADEP non-residential surface soil medium-specific concentration (MSC), non-residential subsurface soil MSC, or used aquifer soil to groundwater MSC in two of the eight soil samples. Stantec also analyzed the above-mentioned soil samples by the Synthetic Precipitation Leaching Procedure (SPLP) for lead and the result of one of the samples was above the PADEP non-residential used aquifer (TDS<2,500 mg/l) groundwater MSC. The SECOR boring locations are displayed on Figure 6. Historical soil sample analytical results from SECOR's 2007 report are provided in Table 2 and displayed on Figure 6. Refer to Appendix A for additional information regarding the previous investigation.

4.4 AST GP-U-677

Sunoco informed the PADEP of their intent to formally close in place AST GP-U-677 with correspondence and a Closure Notification Form submitted to the PADEP by Sunoco on February 24, 2011. As such, Stantec Consulting Corporation (Stantec) submitted a closure assessment report to the PADEP, dated August 22, 2011, (provided in Appendix A) to adhere to the PA Code Title 25, Chapter 245 requirements. AST GP-U-677 was designed to be a 158,340 gallon tank that measured 30 feet in diameter. The AST was historically used to store Number 6 Fuel Oil and there were no reported release s associate with the tank.

Stantec performed soil boring installation and soil sampling activities on June 8, 2011. Stantec collected five shallow soil samples and one groundwater sample as part of their closure assessment conducted in accordance with 25 Pa Code §245.561. Stantec installed four soil borings around the perimeter of AST GP-U-677 and one soil boring beneath to the aboveground delivery piping associated with the tank. The soil samples were collected from approximately 0.0 to 2.0 feet bgs above the soil to groundwater interface. The soil sample results indicated that all COCs were below the PADEP non-residential used aquifer soil MSC, except for ethylene dibromide (EDB) and lead. The Stantec boring locations are displayed on Figure 7. Historical soil sample analytical results from Stantec's 2011 report are provided in Table 2 and displayed on Figure 7. Refer to Appendix A for additional information regarding the previous investigation and assessment.

Stantec collected a groundwater sample from one nearby groundwater monitoring well (B-95) in the vicinity of AST GP-U-677. The groundwater sample was collected by bailer following purging of the well and light non-aqueous phase liquid (LNAPL) was not observed within the well. The groundwater sample results were compared to the PADEP residential used aquifer (TDS<2,500 mg/l) groundwater MSCs. The results revealed no reported exceedances of COCs. The location of groundwater monitoring well B-95 is displayed on Figure 5. Historical groundwater analytical results are provided in Table 2 of Stantec's 2011 report in Appendix A. Refer to Appendix A for additional information regarding the previous investigation and assessment.

4.5 AST 797

Sunoco submitted a closure assessment report (provided in Appendix A) to the PADEP for AST 797 that was prepared by SECOR and dated July 10, 2002. SECOR subsequently submitted a SCR for AST 797 to the PADEP dated December 12, 2002, to further characterize the release from this tank. These reports were submitted to the PADEP pursuant to the PA Code Title 25, Chapter 245 requirements. AST 797 is a 42,000-gallon AST that measures 20 feet in diameter and is closed-in-place. The AST was historically used to store benzene and cumene.

SECOR initially collected 5 shallow soil samples from 4 separate soil borings as part of their July 2002 closure assessment. The soil samples were collected from approximately 1.0 to 1.5 feet bgs in all four of the soil borings with a second soil sample collected at 2.0 feet bgs in one of the soil borings. These sample depths were selected due to encountering groundwater at 1.5 feet bgs in three of the four soil borings and auger refusal at 2 feet bgs in the soil boring with two samples. The soil sample results indicated that reported concentrations of benzene (all 5 soil samples), ethylbenzene (1 sample) and toluene (4 samples) had concentrations greater than the PADEP non-residential used aquifer soil to groundwater MSC. Also that reported concentrations of benzene in two of the samples had concentrations above the PADEP non-residential surface soil direct contact MSC. The SECOR boring locations are displayed on Figure 8. Historical soil sample analytical results from SECOR's 2002 closure assessment report

are provided in Table 2 and displayed on Figure 8. Refer to Appendix A for additional information regarding the previous investigation and assessment.

SECOR initiated further site characterization activities on September 16, 2002, by completing three soil borings around the perimeter of the diked area for AST 797. Monitoring wells were installed at these soil boring locations. SECOR also performed fate and transport modeling and a preliminary ecological screening analysis. Refer to Appendix A for soil boring/monitoring well installation and sampling procedures, fate and transport modeling details, and ecological screening information.

The soil borings/monitoring wells were located laterally and downgradient from the direction of groundwater flow from AST 797. The soil boring samples were collected as a surface soil samples (1.0 to 1.5 feet bgs) due to the shallow groundwater that was encountered at 2 to 3 feet bgs in each boring. The soil sample results indicated that the all three of the soil samples had reported concentrations of benzene greater than the PADEP non-residential soil to groundwater used aquifer soil MSC and the non-residential surface soil direct contact MSC. One soil sample had a reported concentration of toluene greater than its respective MSC. The soil samples were also analyzed by SPLP analyses for benzene and toluene and resulting concentrations exceeded non-residential groundwater MSCs.

Groundwater samples were collected during two separate sampling events on October 17 and November 19, 2002 from three groundwater monitoring wells (MW-1, MW-2, and MW-3). LNAPL was not observed within any of the wells during either sampling event. Groundwater sample results were screened against PADEP non-residential used aquifer (TDS<2,500 mg/l) groundwater MSCs. The samples exhibited concentrations of benzene above the MSC in all three wells during both sampling events. Toluene was also reported above the non-residential groundwater MSC in MW-3 in both sampling events. Historical groundwater analytical results are provided in Tables 4-5 and 4-6 of SECOR's 2002 report in Appendix A. Refer to Appendix A for additional information regarding the previous investigation and assessment.

Groundwater fate and transport modeling conducted by SECOR indicated that benzene and toluene concentrations would not exceed groundwater MSCs at the property

boundary for a 30 year simulated time frame. SECOR also completed a preliminary ecological screening that concluded, given the current and future use at the site, surface soil and groundwater do not pose significant ecological concerns to off-site receptors.

5.0 SUPPLEMENTAL SOIL SAMPLING ACTIVITIES

The following sections summarize the additional site characterization activities completed by Langan in AOI 6 to supplement previously-completed work at ASTs GP-250, GP-U-677 and 797. All soil samples were analyzed for the site COCs as provided in Table 1. Field work standard operating procedures (SOPs) used for the supplement work are provided as attachments to the SCR/RIR. For additional detail of the AOI-wide site characterization activities completed, refer to the AOI 6 SCR/RIR.

5.1 AST GP-250

The soil characterization activities for AST GP-250 included advancement of 4 soil borings in the former tank area and collection of soil samples for laboratory analysis of COCs. Soil samples were collected at each soil boring location with a TerraCore sampler at depths ranging between 0 to 1.5 feet bgs. The Langan soil boring/sample locations are displayed on Figure 6. LNAPL was not encountered within any of the 4 soil boring locations.

5.2 AST GP-U-677

Langan attempted to obtain soil samples from one soil boring location at AST GP-U-677; however, no samples were obtained as groundwater was encountered at approximately 1 to 1.5 feet below ground surface. LNAPL was not encountered within the soil boring location.

5.3 AST 797

Supplemental soil characterization activities for AST 797 included advancement of 5 soil borings in the former tank area and collection of 6 soil samples for laboratory analysis of COCs. Soil samples were collected at each soil boring location with a TerraCore sample

at depths ranging between 1.5 to 3.5 feet bgs where both a surface and subsurface soil sample was collected from one of the soil borings. The Langan soil boring/sample locations are displayed on Figure 8. LNAPL was not encountered within any of the 5 soil boring locations.

6.0 SOIL SAMPLING RESULTS

6.1 AST GP-250

The soil sample results for AST GP-250 included soil samples BH-12-147, BH-12-148, BH-13-06 and BH-14-06. Analytical results are displayed in Table 2 and Figure 6. Exceedances for lead of the PADEP non-residential MSC were exhibited in BH-12-148 and BH-14-06 (745 milligrams/kilogram (mg/kg) and 1,040 mg/kg, respectively). There were no other exceedances of PADEP non-residential MSCs.

6.2 AST GP-U-677

There are no additional soil characterization results for AST GP-U-677 as Langan was unable to obtain additional soil samples due to the shallow depth of groundwater.

6.3 AST 797

Soil samples for AST 797 included BH-12-125 through BH-12-129. Analytical results are displayed in Tables 2 and 3 and Figure 8. Exceedances for benzene and toluene of the PADEP non-residential MSCs were exhibited in four of the five soil samples. The surface soil sample from boring BH-12-125 contained no reported exceedences of site COCs.

7.0 LNAPL CHARACTERIZATION

Previous site characterization activities and reports have included LNAPL investigations and results that have allowed for the detection of separate LNAPL plumes within the subsurface of AOI 6. The results have assisted with the calculations of LNAPL specific volume and mobility.

More detailed information for the LNAPL investigations, results, and conclusions are presented in the AOI 6 SCR/RIR. Below is a summary of major conclusions regarding the results of the LNAPL characterization and modeling from the AOI 6 SCR/RIR:

- Four different types or mixtures of LNAPL were identified in AOI 6. These include gasoline, middle distillate, middle distillate/residual oil mixture, and residual oil.
- The presence of LNAPL within AOI 6 correlates with the COC concentrations in exceedance of the MSC in the majority of the wells in AOI 6; and
- Wells with the highest LNAPL are located within the 27 Pump House area as discussed in the CCR. All of these wells are located in the area of fluids capture by the remedial pumping at the 27 Pump House area. Since the modeling was completed in 2006, product recovery in the 26th Street Pump House area has ceased due to the lack of recoverable product.

LNAPL and other groundwater conditions in AOI 6 are illustrated in Figure 5. Based on the location of LNAPL in AOI 6, and the LNAPL types, the following can be concluded with regard to ASTs GP-250, GP-U-677, and 797:

<u>GP-250</u>

- Wells in the vicinity of GP-250 do not contain LNAPL.

<u>GP-U-677</u>

- Wells in the vicinity of GP-U-677 do not contain LNAPL.

<u>797</u>

- A gasoline plume exists in the vicinity of Tank 797; however Tank 797 was used to store benzene and cumene, and not gasoline.

8.0 SUPPLEMENTAL GROUNDWATER INVESTIGATION

The groundwater monitoring well network in AOI 6 includes 64 monitoring points. Groundwater gauging of select monitoring wells in AOI 6 occurs on an annual basis during the

second quarter of each year. Annual gauging activities and results are reported to the PADEP and EPA in Quarterly Reports prepared by Sunoco. Sunoco also samples select perimeter wells in AOI 6 on an annual basis. Refer to the AOI 6 SCR/RIR for more detail regarding AOI 6 groundwater monitoring wells, gauging, aquifer testing, groundwater sampling and groundwater analytical results. Monitoring well and environmental groundwater sampling SOPs are provided as attachments to the SCR/RIR.

The most-recent groundwater gauging and sampling of all accessible wells in AOI 6 was completed as part of the AOI 6 SCR/RIR characterization work during December 2012 and January 2013. The groundwater conditions, as measured during these events, are illustrated in Figure 5. The following sections discuss groundwater conditions in the vicinity of ASTs GP-250, GP-U-677, and 797 based on these groundwater monitoring events:

8.1 AST GP-250

In the area of AST GP-250, the shallow groundwater flow in the fill/alluvium is towards a hydraulic low northeast of AST GP-250 as shown in Figure 5. The nearest well to AST GP-250 that had reported historical exceedance (VOCs) above the PADEP non-residential groundwater MSCs is B-167, which is upgradient of AST GP-250. Refer to Figure 5 and the AOI 6 SCR/RIR for further information on AOI-wide groundwater conditions.

8.2 AST GP-U-677

The shallow groundwater flow in the fill/alluvium in the area of AST GP-U-677 is towards the west as shown in Figure 5. The nearest wells to AST GP-U-677 that had reported historical exceedances (VOCs and SVOCs) above the PADEP non-residential groundwater MSCs are two upgradient wells (B-151 and B-152) and two downgradient wells (B-169 and B-130). Benzene exceeded the MSC in the upgradient wells as shown in Figure 5. LNAPL was observed in B-130 and benzene and benzo(a)pyrene exceeded their respective MSCs in B-129. Refer to Figure 5 and the AOI 6 SCR/RIR for further information on AOI-wide groundwater conditions.

8.3 AST 797

In the area of AST 797, the shallow groundwater flow in the fill/alluvium is towards the southwest as shown in Figure 5. A gasoline plume is located downgradient of AST 797 as shown in Figure 5; however, this is a gasoline plume and AST 797 stored benzene and cumene. Sunoco has historically recovered LNAPL from the 27 Pump House remediation system; however, this system has been temporarily turned off due to the lack of recoverable LNAPL. Refer to Figure 5 and the AOI 6 SCR/RIR for further information on AOI-wide groundwater conditions.

9.0 FATE AND TRANSPORT ANALYSIS

The results of previous characterization work completed in response to release assessments for ASTs GP-250, GP-U-677, and 797 were used in the fate and transport analysis for the AOI SCR/RIR. Please refer to Section 7.0 of the AOI 6 SCR/RIR for information about the analysis.

10.0 HUMAN HEALTH EXPOSURE ASSESSMENT/RISK ASSESSMENT

Historic and supplemental data relating to tank release assessments, in addition to other data collected in AOI 6 as part of the 2003 CO&A investigation, were evaluated relative to the site conceptual model to address potential exposure pathways. Based on the current and future intended non-residential site use, an exposure assessment was conducted for any compounds in shallow soils (0-2 feet bgs) or deep soils (2-15 feet bgs) that exceeded the non-residential statewide health soil MSC. Potential human health exposures for the facility are for an industrial worker scenario.

Direct contact exposure pathways to shallow soil, groundwater, and LNAPL is being evaluated under the industrial use scenario because PES has well-documented standards for personal protective equipment (PPE) and procedures for soil excavation and handling.

The following table serves as a summary of potential human health exposure pathways that can be reasonably expected under the current and intended future non-residential use for

AOI 6. The table lists potentially contaminated media, potential receptors for these media, and a summary of whether any potentially complete exposure pathways exist at AOI 6 from the media to these receptors.

Exposure Pathway Evaluation Summary

Contaminated Media	Residents	Workers	Day Care	Construction	Trespassers	Recreation	Food
Groundwater	NA	No(1)	NA	No (2)	No	NA	NA
Air (indoor)	NA	No (3)	NA	No(3)	No	NA	NA
Soil <2 feet bgs.	NA	Yes	NA	Yes	No	NA	NA
Soil >2 feet bgs.	NA	No(4)	NA	No(4)	No	NA	NA
Surface Water	NA	No(5)	NA	No(5)	NA	NA	NA
Sediment	NA	NA	NA	NA	NA	NA	NA
LNAPL	NA	No(1)	NA	No (2)	NA	NA	NA

Notes:

(1) No complete groundwater or LNAPL pathways exist for workers that are not addressed through on-site permitting procedures and PPE.
(2) No complete groundwater or LNAPL pathway exists for construction workers that are not addressed through on-site permitting procedures and PPE.
(3) No current complete pathway to indoor air exists based on the evaluation described in Section 9.0 of the AOI 6 SCR/RIR.
(4) No complete pathway exists for site soil >2 feet deep that are not addressed through on-site permitting procedures and PPE.
(5) No complete pathway exists for surface water or sediment that is not addressed through on-site permitting procedures and PPE.

Na - Not applicable
No - No potential complete exposure pathway
Yes – Potential complete exposure pathway

A more detailed evaluation of each of these potential human health exposure pathways is presented in the following sections by media. It is noted that the evaluation pertains to AOI-6 wide data that includes data collected at ASTs GP-250, GP-U-677, and 797 as part of previous and supplemental characterization work.

10.1 Soils (0-15 Feet Below Grade)

Direct Contact Exposure

Based on the AOI 6 data collected between 2006 and 2012, concentrations of benzene, benzo(a)pyrene, lead, naphthalene, toluene, ethylbenzene, ethylene dibromide, 1,2,4-trimethylbenzene (TMB) and 1,3,5-TMB were detected in shallow soils above the non-residential soil MSC and concentrations of benzene, lead, naphthalene, toluene, ethylbenzene, isopropylbenzene, 1,2,4-TMB, and 1,3,5-TMB were detected in deep soils above the non-residential soil MSC. To refine the list of compounds carried forward in

the risk assessment, the compounds listed above were further screened against the EPA Region III Risk-Based Concentrations (aka, EPA Regional Screening Levels [RSLs]) in accordance with Section IV of the PADEP's Technical Guidance Manual (TGM) (dated June 8, 2002). Based on this screening, concentrations of 1,3,5-TMB, toluene, ethylene dibromide and isopropylbenzene were below the EPA RSLs for industrial soil and were, therefore, eliminated from the risk assessment. Concentrations of benzene, lead naphthalene, benzo(a)pyrene, ethylbenzene and 1,2,4-TMB were above the EPA RSLs and were, therefore, further evaluated as outlined in the January 2013 Soil Screening Procedure for Philadelphia Energy Solutions memorandum (Sunoco 2013).

As described in the January 2013 memorandum, the compounds that exceeded both the non-residential statewide health standards and EPA RSLs were compared to the PADEP's Non-Residential Direct Contact MSC. To maintain conservatism, all soil samples (surface and subsurface) were screened against the more stringent 0-2 feet below grade direct contact criteria regardless of sample depth in the event that soils are re-used elsewhere on the Facility. Based on this screening, concentrations of naphthalene, ethylbenzene, and 1,2,4-TMB were eliminated from the risk assessment. The compounds identified for further risk assessment are benzene, benzo(a)pyrene, and lead. Benzene and benzo(a)pyrene are carcinogenic compounds and will be evaluated together. Since most lead-based human health effects data are based on blood-lead concentrations instead of external dose, the traditional approach for risk assessment is not applied to characterize exposure to lead. Consequently, exposure to lead is evaluated based on the predicted concentration of lead in the blood and is evaluated separately.

The total cumulative excess cancer risk is the combined risk of exposure to the exposure point concentrations (EPCs) of any carcinogenic compounds that fail the initial screening: for AOI 6 these compounds include benzene and benzo(a)pyrene. The exposure point concentration (EPC) is the representative concentration that is expected to be contacted by a receptor and is assumed to be universally present throughout the exposure area. Because soil at the facility may be moved, the exposure area is understood to extend from the surface to 15 feet bgs. As described in the January 2013 memorandum, the 95UCL was used as the EPC except in cases where the 95UCL is

higher than the maximum concentrations (USEPA 1989). If the maximum concentration is lower than the calculated 95UCL then the maximum concentration is used as the EPC. The 95UCL for benzene and benzo(a)pyrene in soil samples collected from 0 to 15 feet bgs was derived using USEPA's ProUCL Version 4.1 software. The ProUCL output is provided as Attachment G to the AOI 6 SCR/RIR.

Using the 95UCL, incremental cancer risk attributable to benzene was calculated to be 6E-06 and incremental cancer risk attributable to benzo(a)pyrene was calculated to be 5E-06 (Table H-1 in the AOI 6 SCR/RIR). The total cumulative excess cancer risk is the combined risk of exposure to benzene and benzo(a)pyrene and, in accordance with the TGM, should not exceed 10^{-4}. As presented in Table H-1, the total cumulative risk of exposure to the carcinogenic compounds benzene and benzo(a)pyrene is 1E-05 and within the PADEP's acceptable threshold; therefore, no remedies are required to address carcinogenic risks.

The site-specific screening level for lead was calculated based on ingestion as presented in 25 Pa. Code § 250.306(e), Appendix A, Table 7. As described in 25 Pa. Code § 250.306(e), the non-residential soil screening value for lead is based on the method presented in the report 'The Society for Environmental Geochemistry and Health (SEGH) Task Force Approach to the Assessment of Lead in Soil' (Wixson, 1991). The model used by the PADEP and developed by SEGH was also used to calculate the site specific criterion for the facility. Based on the SEGH model and PADEP's default parameters, PADEP's non-residential direct contact MSC default value for lead in surface soil is 1,000 mg/kg. To develop a site-specific criteria for lead, the values used by PADEP for the target blood lead concentration (T) and geometric mean background blood lead concentration (B) were revised in consideration of site-specific conditions and updated lead data collected by the US Center for Disease Control and Prevention (CDC). Revised values for these parameters are discussed in the following paragraphs.

As presented in Appendix G of the AOI 6 SCR/RIR, based on the revised parameters, the derived site-specific standard for lead in soil is 1,708 mg/kg for a facility worker. Four shallow soil samples (BH-29-06, BH-30-09, GPU677-SR-31-4 and GPU677-SR-31-5) and one deep soil sample (BH-12-110) have concentrations of lead above the site specific criteria; these areas will be delineated and addressed in the Clean-up Plan.

10.2 Groundwater

Historical results of the groundwater sampling indicated COCs at concentrations above their respective PADEP non-residential groundwater MSCs, including: benzene, chrysene, benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(g,h,i)perylene, 1,2,4-TMB, 1,3,5-TMB, toluene, pyrene, 1,2-dichloroethane, MTBE, naphthalene and lead. Based on the QD fate and transport analysis, there are no dissolved phase COCs in groundwater that appear to have the potential to extend beyond the facility boundary. Based on the groundwater evaluation, there appears to be no unacceptable risk to ecological receptors in the Schuylkill River.

Excavations in AOI 6 are governed by PES's permitting procedures which protect against potential exposures to groundwater that could be encountered in an excavation. Also, there are no complete direct contact exposure pathways for groundwater within AOI 6 because of on-site facility safety procedures and required PPE. Previous investigations and recent (2013) well searches verified that no monitoring wells located within 1.0 miles of the facility are used for drinking water or agricultural use.

10.3 LNAPL

There are no complete direct contact exposure pathways for LNAPL within AOI 6 because of on-site procedures and required PPE.

10.4 Vapor

The AOI 6 SCR/RIR discusses the indoor air assessment that Stantec completed for Sunoco in October 2012. As part of this assessment, indoor air was sampled in occupied buildings in AOI 6 that are not under positive pressure. The results were compared to the OSHA permissible exposure limits (PELs) because the facility is regulated by OSHA. All samples collected from buildings located in AOI 6 meet OSHA's PELs for the protection of worker health; therefore, the potential vapor intrusion pathway for existing buildings in AOI 6 is not evaluated further in the risk assessment.

11.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the completed closure and/or corrective action activities, the following conclusions and recommendations have been developed for ASTs GP-201, GP-250, GP-U-677, 797, and GP-U-1088 within AOI 6.

AST GP-201 and AST GP-U-1088

Site assessment and corrective action activities completed in response to the releases from these ASTs fulfilled the requirements of the corrective action process as documented in PADEP correspondences dated July 30, 2008 (for both AST GP-201 and AST GP-U-1088). Therefore, no further corrective action is required for these ASTs and the ASTs should be "administratively closed out."

AST GP-250

Based on the results of previous and supplemental characterization work completed in the vicinity of this tank pursuant to the requirements of the Corrective Action Program, including the results of fate and transport modeling and risk assessment completed, no remedies are required to address risks associated with the soil and groundwater conditions at AST 797. Therefore, no further corrective action is required and Sunoco requests the release from this tank be "administratively closed out."

AST GP-U-677

Based on the results of closure assessment work completed in the vicinity of this tank pursuant to the closure requirements of Chapter 245, no corrective action is required and Sunoco requests this tank be "administratively closed out."

AST 797

Based on the results of previous and supplemental characterization work completed in the vicinity of this tank pursuant to the requirements of the Corrective Action Program, including the results of fate and transport modeling and risk assessment completed, no remedies are required to address risks associated with the soil and groundwater conditions at AST 797. Therefore, no further corrective action is required and Sunoco requests the release from this tank be "administratively closed out."

TABLES

Table 1
Constituents of Concern
AOI 6
PES Facility
Philadelphia, Pennsylvania

METALS	CAS No.
Lead (dissolved)	7439-92-1

VOCs	CAS No.
1,2-Dichloroethane	107-06-2
1,2,4-Trimethylbenzene	95-63-6
1,3,5-Trimethylbenzene	108-67-8
Benzene	71-43-2
Cumene	98-82-8
Ethylbenzene	100-41-4
Methyl tertiary butyl ether	1634-04-4
Toluene	108-88-3
Xylenes (total)	1330-20-7
Ethylene dibromide	106-93-4

SVOCs/ PAHs	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 and the March 18, 2008 revised PADEP Petroleum Short List.

Table 2
Summary of Surface Soil Analytical Results
AOI 6 ASTs
AOI 6 Supplemental Site Characterization Report
PES Facility
Philadelphia, Pennsylvania

Chemical Name	CAS Number	PADEP Non-Res Surface Soil Direct Contact MSC[1]	PADEP Non-Res Soil to GW MSC[2]	PADEP Non-Res Surface Soil MSC[3]	EPA Industrial Soil RSL[4]	PADEP Non-Res Surface Soil Direct Contact MSC[1]	Location	AOI6 BH-12-129				AOI6 BH-12-147				AOI6 BH-12-148				AST-250-SS-1				AST-250-SS-2				AST-250-SS-3			
							Sample ID	BH-12-129_1.5-2'				BH-12-147_1-1.5'				BH-12-148_0-1'				AST-250-SS-1				AST-250-SS-2				AST-250-SS-3			
							Sample Matrix	Soil (unsaturated)				Soil (unsaturated)				Soil (unsaturated)				Soil (unsaturated)				Soil (unsaturated)				Soil (unsaturated)			
							Sample Depth	1.5-2				1-1.5				0-1				0-0.5				0-0.5				0-0.5			
							Sample Date	12/4/2012				12/5/2012				12/5/2012				5/15/2007				5/15/2007				5/15/2007			
							Unit	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF
Volatile Organic Compounds																															
1,2,4-Trimethylbenzene	95-63-6	560	35	35	260	560	mg/kg	0.705		0.24	1	ND	U	0.0044	1	ND	U	0.0053	1	NA				NA				NA			
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	3.7	0.005	0.005	0.17	3.7	mg/kg	ND	U	**0.048**	1	ND	U	0.00089	1	ND	U	0.0011	1	ND	UD	**0.081**	50	ND	UD	**0.097**	50	ND	UD	**0.088**	50
1,2-Dichloroethane	107-06-2	86	0.5	0.5	2.2	86	mg/kg	ND	U	0.048	1	ND	U	0.00089	1	ND	U	0.0011	1	ND	UD	0.081	50	ND	UD	0.097	50	ND	UD	0.088	50
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	480	9.3	9.3	10000	480	mg/kg	0.257		0.24	1	ND	U	0.0044	1	ND	U	0.0053	1	NA				NA				NA			
Benzene	71-43-2	290	0.5	0.5	5.4	290	mg/kg	**91.6**		**4.8**	1	ND	U	0.00089	1	ND	U	0.0011	1	ND	UD	0.081	50	ND	UD	0.097	50	ND	UD	0.088	50
Dimethyl Benzene/ Xylenes, Total	1330-20-7	8000	1000	1000	2700	8000	mg/kg	3.69		0.048	1	ND	U	0.00089	1	ND	U	0.0011	1	ND	UD	0.081	50	ND	UD	0.097	50	0.098	D	0.088	50
Ethylbenzene	100-41-4	10000	70	70	27	10000	mg/kg	0.837		0.048	1	ND	U	0.00089	1	ND	U	0.0011	1	ND	UD	0.081	50	ND	UD	0.097	50	ND	UD	0.088	50
Isopropylbenzene (Cumene)	98-82-8	10000	2500	2500	11000	10000	mg/kg	311		24	1	ND	U	0.0044	1	ND	U	0.0053	1	ND	UD	0.081	50	ND	UD	0.097	50	ND	UD	0.088	50
O-Xylene (1,2-Dimethylbenzene)	95-47-6	8000	1000	1000	3000	8000	mg/kg	NA				NA				NA				NA				NA				NA			
Tert-Butyl Methyl Ether	1634-04-4	3200	2	2	220	3200	mg/kg	ND	U	0.048	1	ND	U	0.00089	1	ND	U	0.0011	1	NA				NA				NA			
Toluene	108-88-3	10000	100	100	45000	10000	mg/kg	**116**		4.8	1	ND	U	0.00089	1	ND	U	0.0011	1	ND	UD	0.081	50	ND	UD	0.097	50	ND	UD	0.088	50
Xylenes (M & P)	XYLENES-MP	8000	1000	1000	2700	8000	mg/kg	NA				NA				NA				NA				NA				NA			
Semi-Volatile Organic Compounds																															
1-Bromo-4-Fluorobenzene Bromofluorobenzene)	460-00-4	NS	NS	NS	NS	NS	mg/kg	NA				NA				NA				500	D	0	50	NA				NA			
Anthracene	120-12-7	190000	350	350	170000	190000	mg/kg	ND	U	0.033	1	ND	U	0.034	1	0.155		0.041	1	NA				NA				NA			
Benzo(A)Anthracene	56-55-3	110	320	110	2.1	110	mg/kg	0.0699		0.033	1	0.0519		0.034	1	0.328		0.041	1	NA				NA				NA			
Benzo(A)Pyrene	50-32-8	11	46	11	0.21	11	mg/kg	0.0627		0.033	1	0.065		0.034	1	0.327		0.041	1	NA				NA				NA			
Benzo(B)Fluoranthene	205-99-2	110	170	110	2.1	110	mg/kg	0.0687		0.033	1	0.0787		0.034	1	0.334		0.041	1	NA				NA				NA			
Benzo(G,H,I)Perylene	191-24-2	170000	180	180	NS	170000	mg/kg	0.0498		0.033	1	0.0542		0.034	1	0.205		0.041	1	NA				NA				NA			
Chrysene	218-01-9	11000	230	230	210	11000	mg/kg	0.0711		0.033	1	0.0608		0.034	1	0.307		0.041	1	NA				NA				NA			
Fluorene	86-73-7	110000	3800	3800	22000	110000	mg/kg	ND	U	0.033	1	ND	U	0.034	1	ND	U	0.041	1	ND	U	0.35	1	ND	U	0.35	1	ND	U	0.37	1
Naphthalene	91-20-3	56000	25	25	18	56000	mg/kg	ND	U	0.24	1	ND	U	0.034	1	ND	U	0.041	1	0.052	JD	0.081	50	0.067	JD	0.097	50	0.31	D	0.088	50
Phenanthrene	85-01-8	190000	10000	10000	NS	190000	mg/kg	0.0395		0.033	1	ND	U	0.034	1	0.425		0.041	1	NA				NA				NA			
Pyrene	129-00-0	84000	2200	2200	17000	84000	mg/kg	0.121		0.033	1	0.0774		0.034	1	0.469		0.041	1	NA				NA				NA			
Metals																															
Lead	7439-92-1	1000	450	450	800	1000	mg/kg	48		2.1	1	286		2.3	1	**745**		2.3	1	**940**		0.54	1	30		0.53	1	100		0.54	1
Lead (TCLP)**	7439-92-1	NS	NS	NS	NS	5	mg/l	NA				NA				NA				NA				NA				NA			

Notes:

[1] PADEP Non-Residential Direct Contact MSC for surface soils (0-2 feet below ground surface) (last updated Jan. 2011).
[2] PADEP Non-Residential Soil to Groundwater MSC for unsaturated soils in a used aquifer with total dissolved solids less than 2500 mg/l (last updated Jan. 2011).
[3] Criteria shown in gray were used to determine the non-residential soil MSCs used to screen the sample results. The lowest, most conservative, value of the soil-to-groundwater or direct contact criteria was used as the value for screening purposes.
[4] EPA Industrial Soil Regional Screening Level (last updated November 2012).
** The criteria listed under the PADEP Non-Res Surface Soil Direct Contact MSC is based on the EPA Maximum Concentration of Contaminants for Toxicity Concentration.
CAS - Chemical Abstracts Service Registry Number
PADEP - Pennsylvania Department of Environmental Protection
mg/kg - milligram per kilogram
MSC - Medium Specific Concentration
DL - Lab detection limit (actual limit may be either the quantification or method detection limit)
ND - Not Detected
DF - Dilution Factor
Q - Lab Qualifier
NS - No Standard
NA - Not Analyzed
Result screened against Non-Residential Direct Contact MSC for surface soils only if the result also exceeds the PADEP MSC and EPA RSL.

Qualifiers:

U - The analyte was analyzed but not detected above the reporting limit.
J - Compound was detected below the quantification limit and above the method detection limit. The result should be considered estimated.

Exceedance Summary:

10	Reported result exceeds the PADEP Non-Residential Soil MSC
10	Reported result exceeds the PADEP Non-Residential Soil MSC and the EPA Industrial Soil RSL
10	Reported result exceeds the PADEP Soil MSC, EPA Industrial Soil RSL and the PADEP Non-Residential Direct Contact MSC for Surface Soils (0-2 feet below ground surface)
10	RL exceeds the PADEP Non-Residential Soil MSC

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Philadelphia, Pennsylvania

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							Sample ID	AST-250-SS-4				AST-250-SS-5				AST-250-SS-6				AST-250-SS-7				AST-250-SS-8				BH-13-06-032206-1-1.5			
							Sample Matrix	Soil (unsaturated)				Soil (unsaturated)				Soil (unsaturated)				Soil (unsaturated)				Soil (unsaturated)				Soil (unsaturated)			
							Sample Depth	0-0.5				0-0.5				0-0.5				0-0.5				0-0.5				1-1.5			
							Sample Date	5/15/2007				5/15/2007				5/15/2007				5/15/2007				5/15/2007				3/22/2006			
							Unit	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF
Volatile Organic Compounds																															
1,2,4-Trimethylbenzene	95-63-6	560	35	35	260	560	mg/kg	NA				NA				NA				NA				NA				NA			
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	3.7	0.005	0.005	0.17	3.7	mg/kg	ND	UD	**0.1**	50	ND	UD	**0.11**	50	ND	UD	**0.069**	50	ND	UD	**0.078**	50	ND	UD	**0.092**	50	NA			
1,2-Dichloroethane	107-06-2	86	0.5	0.5	2.2	86	mg/kg	ND	UD	0.1	50	ND	UD	0.11	50	ND	UD	0.069	50	ND	UD	0.078	50	ND	UD	0.092	50	NA			
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	480	9.3	9.3	10000	480	mg/kg	NA				NA				NA				NA				NA				NA			
Benzene	71-43-2	290	0.5	0.5	5.4	290	mg/kg	ND	UD	0.1	50	ND	UD	0.11	50	ND	UD	0.069	50	ND	UD	0.078	50	ND	UD	0.092	50	NA			
Dimethyl Benzene/ Xylenes, Total	1330-20-7	8000	1000	1000	2700	8000	mg/kg	0.87	D	0.1	50	ND	UD	0.11	50	ND	UD	0.069	50	ND	UD	0.078	50	ND	UD	0.092	50	NA			
Ethylbenzene	100-41-4	10000	70	70	27	10000	mg/kg	ND	UD	0.1	50	ND	UD	0.11	50	ND	UD	0.069	50	ND	UD	0.078	50	ND	UD	0.092	50	NA			
Isopropylbenzene (Cumene)	98-82-8	10000	2500	2500	11000	10000	mg/kg	0.12	D	0.1	50	ND	UD	0.11	50	ND	UD	0.069	50	ND	UD	0.078	50	ND	UD	0.092	50	NA			
O-Xylene (1,2-Dimethylbenzene)	95-47-6	8000	1000	1000	3000	8000	mg/kg	NA				NA				NA				NA				NA				NA			
Tert-Butyl Methyl Ether	1634-04-4	3200	2	2	220	3200	mg/kg	NA				NA				NA				NA				NA				NA			
Toluene	108-88-3	10000	100	100	45000	10000	mg/kg	ND	UD	0.1	50	ND	UD	0.11	50	ND	UD	0.069	50	ND	UD	0.078	50	ND	UD	0.092	50	NA			
Xylenes (M & P)	XYLENES-MP	8000	1000	1000	2700	8000	mg/kg	NA				NA				NA				NA				NA				NA			
Semi-Volatile Organic Compounds																															
1-Bromo-4-Fluorobenzene Bromofluorobenzene)	460-00-4	NS	NS	NS	NS	NS	mg/kg	NA				NA				NA				NA				NA				NA			
Anthracene	120-12-7	190000	350	350	170000	190000	mg/kg	NA				NA				NA				NA				NA				NA			
Benzo(A)Anthracene	56-55-3	110	320	110	2.1	110	mg/kg	NA				NA				NA				NA				NA				NA			
Benzo(A)Pyrene	50-32-8	11	46	11	0.21	11	mg/kg	NA				NA				NA				NA				NA				NA			
Benzo(B)Fluoranthene	205-99-2	110	170	110	2.1	110	mg/kg	NA				NA				NA				NA				NA				NA			
Benzo(G,H,I)Perylene	191-24-2	170000	180	180	NS	170000	mg/kg	NA				NA				NA				NA				NA				NA			
Chrysene	218-01-9	11000	230	230	210	11000	mg/kg	NA				NA				NA				NA				NA				NA			
Fluorene	86-73-7	110000	3800	3800	22000	110000	mg/kg	0.62		0.35	1	ND	U	0.36	1	ND	U	0.35	1	ND	U	0.35	1	ND	U	0.36	1	NA			
Naphthalene	91-20-3	56000	25	25	18	56000	mg/kg	4.2	D	0.1	50	0.081	JD	0.11	50	0.065	JD	0.069	50	0.055	JD	0.078	50	0.075	JD	0.092	50	NA			
Phenanthrene	85-01-8	190000	10000	10000	NS	190000	mg/kg	NA				NA				NA				NA				NA				NA			
Pyrene	129-00-0	84000	2200	2200	17000	84000	mg/kg	NA				NA				NA				NA				NA				NA			
Metals																															
Lead	7439-92-1	1000	450	450	800	1000	mg/kg	2.8		0.54	1	190		0.56	1	**1500**		0.58	1	140		0.59	1	13		0.54	1	283		3.15	1
Lead (TCLP)**	7439-92-1	NS	NS	NS	NS	5	mg/l	NA				NA				NA				NA				NA				NA			

Notes:

[1] PADEP Non-Residential Direct Contact MSC for surface soils (0-2 feet below ground surface) (last updated Jan. 2011).
[2] PADEP Non-Residential Soil to Groundwater MSC for unsaturated soils in a used aquifer with total dissolved solids less than 2500 mg/l (last updated Jan. 2011).
[3] Criteria shown in gray were used to determine the non-residential soil MSCs used to screen the sample results. The lowest, most conservative, value of the soil-to-groundwater or direct contact criteria was used as the value for screening purposes.
[4] EPA Industrial Soil Regional Screening Level (last updated November 2012).
** The criteria listed under the PADEP Non-Res Surface Soil Direct Contact MSC is based on the EPA Maximum Concentration of Contaminants for Toxicity Concentration.
CAS - Chemical Abstracts Service Registry Number
PADEP - Pennsylvania Department of Environmental Protection
mg/kg - milligram per kilogram
MSC - Medium Specific Concentration
DL - Lab detection limit (actual limit may be either the quantification or method detection limit)
ND - Not Detected
DF - Dilution Factor
Q - Lab Qualifier
NS - No Standard
NA - Not Analyzed
Result screened against Non-Residential Direct Contact MSC for surface soils only if the result also exceeds the PADEP MSC and EPA RSL.

Qualifiers:

U - The analyte was analyzed but not detected above the reporting limit.
J - Compound was detected below the quantification limit and above the method detection limit. The result should be considered estimated.

Exceedance Summary:

10	Reported result exceeds the PADEP Non-Residential Soil MSC
10	Reported result exceeds the PADEP Non-Residential Soil MSC and the EPA Industrial Soil RSL
10	Reported result exceeds the PADEP Soil MSC, EPA Industrial Soil RSL and the PADEP Non-Residential Direct Contact MSC for Surface Soils (0-2 feet below ground surface)
10	RL exceeds the PADEP Non-Residential Soil MSC

Table 2
Summary of Surface Soil Analytical Results
AOI 6 ASTs
AOI 6 Supplemental Site Characterization Report
PES Facility
Philadelphia, Pennsylvania

Chemical Name	CAS Number	PADEP Non-Res Surface Soil Direct Contact MSC[1]	PADEP Non-Res Soil to GW MSC[2]	PADEP Non-Res Surface Soil MSC[3]	EPA Industrial Soil RSL[4]	PADEP Non-Res Surface Soil Direct Contact MSC[1]	Location	BH-14-06				GP 797-HA-1				GP 797-HA-2				GP 797-HA-3				GP 797-HA-3				GP 797-HA-4			
							Sample ID	BH-14-06-032306-0.5-1				HA-1 (1-1.5)				HA-2 (1-1.5)				HA-3 (1-1.5)				HA-3 (2)				HA-4 (1-1.5)			
							Sample Matrix	Soil (unsaturated)				Soil (unsaturated)				Soil (unsaturated)				Soil (unsaturated)				Soil (unsaturated)				Soil (unsaturated)			
							Sample Depth	0.5-1				1-1.5				1-1.5				1-1.5				1.5-2				1-1.5			
							Sample Date	3/23/2006				8/29/2002				5/24/2002				5/24/2002				5/24/2002				5/24/2002			
							Unit	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF
Volatile Organic Compounds																															
1,2,4-Trimethylbenzene	95-63-6	560	35	35	260	560	mg/kg	NA				NA				NA				NA				NA				NA			
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	3.7	0.005	0.005	0.17	3.7	mg/kg	NA				NA				NA				NA				NA				NA			
1,2-Dichloroethane	107-06-2	86	0.5	0.5	2.2	86	mg/kg	NA				NA				NA				NA				NA				NA			
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	480	9.3	9.3	10000	480	mg/kg	NA				NA				NA				NA				NA				NA			
Benzene	71-43-2	290	0.5	0.5	5.4	290	mg/kg	NA				**920**	D	0.24	1	**28**	D	0.26	1	**310**	D	0.27	1	**170**	D	0.25	1	**190**	D	0.25	1
Dimethyl Benzene/ Xylenes, Total	1330-20-7	8000	1000	1000	2700	8000	mg/kg	NA				NA				NA				NA				NA				NA			
Ethylbenzene	100-41-4	10000	70	70	27	10000	mg/kg	NA				**80**	JD	0.24	1	0.85		0.26	1	37	JD	0.27	1	8.5		0.25	1	55	D	0.25	1
Isopropylbenzene (Cumene)	98-82-8	10000	2500	2500	11000	10000	mg/kg	NA				1600	D	0.24	1	17	D	0.26	1	1000	D	0.27	1	230	D	0.25	1	950	D	0.25	1
O-Xylene (1,2-Dimethylbenzene)	95-47-6	8000	1000	1000	3000	8000	mg/kg	NA				71	D	0.24	1	1.4		0.26	1	29	JD	0.27	1	7.7		0.25	1	50	JD	0.25	1
Tert-Butyl Methyl Ether	1634-04-4	3200	2	2	220	3200	mg/kg	NA				ND		0.24	1	ND		0.26	1	ND		0.27	1	ND		0.25	1	ND		0.25	1
Toluene	108-88-3	10000	100	100	45000	10000	mg/kg	NA				**1800**	D	0.24	1	11	D	0.26	1	**920**	D	0.27	1	**300**	D	0.25	1	**660**	D	0.25	1
Xylenes (M & P)	XYLENES-MP	8000	1000	1000	2700	8000	mg/kg	NA				310	D	0.24	1	4.5		0.26	1	140	D	0.27	1	29	D	0.25	1	210	D	0.25	1
Semi-Volatile Organic Compounds																															
1-Bromo-4-Fluorobenzene Bromofluorobenzene)	460-00-4	NS	NS	NS	NS	NS	mg/kg	NA				NA				NA				NA				NA				NA			
Anthracene	120-12-7	190000	350	350	170000	190000	mg/kg	NA				NA				NA				NA				NA				NA			
Benzo(A)Anthracene	56-55-3	110	320	110	2.1	110	mg/kg	NA				NA				NA				NA				NA				NA			
Benzo(A)Pyrene	50-32-8	11	46	11	0.21	11	mg/kg	NA				NA				NA				NA				NA				NA			
Benzo(B)Fluoranthene	205-99-2	110	170	110	2.1	110	mg/kg	NA				NA				NA				NA				NA				NA			
Benzo(G,H,I)Perylene	191-24-2	170000	180	180	NS	170000	mg/kg	NA				NA				NA				NA				NA				NA			
Chrysene	218-01-9	11000	230	230	210	11000	mg/kg	NA				NA				NA				NA				NA				NA			
Fluorene	86-73-7	110000	3800	3800	22000	110000	mg/kg	NA				NA				NA				NA				NA				NA			
Naphthalene	91-20-3	56000	25	25	18	56000	mg/kg	NA				0.65		0.24	1	ND		0.26	1	0.41		0.27	1	0.3		0.25	1	0.29		0.25	1
Phenanthrene	85-01-8	190000	10000	10000	NS	190000	mg/kg	NA				NA				NA				NA				NA				NA			
Pyrene	129-00-0	84000	2200	2200	17000	84000	mg/kg	NA				NA				NA				NA				NA				NA			
Metals																															
Lead	7439-92-1	1000	450	450	800	1000	mg/kg	**1040**		2.87	1	NA				NA				NA				NA				NA			
Lead (TCLP)**	7439-92-1	NS	NS	NS	NS	5	mg/l	1.12		0.02	1	NA				NA				NA				NA				NA			

Notes:

[1] PADEP Non-Residential Direct Contact MSC for surface soils (0-2 feet below ground surface) (last updated Jan. 2011).
[2] PADEP Non-Residential Soil to Groundwater MSC for unsaturated soils in a used aquifer with total dissolved solids less than 2500 mg/l (last updated Jan. 2011).
[3] Criteria shown in gray were used to determine the non-residential soil MSCs used to screen the sample results. The lowest, most conservative, value of the soil-to-groundwater or direct contact criteria was used as the value for screening purposes.
[4] EPA Industrial Soil Regional Screening Level (last updated November 2012).
** The criteria listed under the PADEP Non-Res Surface Soil Direct Contact MSC is based on the EPA Maximum Concentration of Contaminants for Toxicity Concentration.
CAS - Chemical Abstracts Service Registry Number
PADEP - Pennsylvania Department of Environmental Protection
mg/kg - milligram per kilogram
MSC - Medium Specific Concentration
DL - Lab detection limit (actual limit may be either the quantification or method detection limit)
ND - Not Detected
DF - Dilution Factor
Q - Lab Qualifier
NS - No Standard
NA - Not Analyzed
Result screened against Non-Residential Direct Contact MSC for surface soils only if the result also exceeds the PADEP MSC and EPA RSL.

Qualifiers:

U - The analyte was analyzed but not detected above the reporting limit.
J - Compound was detected below the quantification limit and above the method detection limit. The result should be considered estimated.

Exceedance Summary:

10	Reported result exceeds the PADEP Non-Residential Soil MSC
10	Reported result exceeds the PADEP Non-Residential Soil MSC and the EPA Industrial Soil RSL
10	Reported result exceeds the PADEP Soil MSC, EPA Industrial Soil RSL and the PADEP Non-Residential Direct Contact MSC for Surface Soils (0-2 feet below ground surface)
10	RL exceeds the PADEP Non-Residential Soil MSC

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Philadelphia, Pennsylvania

Chemical Name	CAS Number	PADEP Non-Res Surface Soil Direct Contact MSC[1]	PADEP Non-Res Soil to GW MSC[2]	PADEP Non-Res Surface Soil MSC[3]	EPA Industrial Soil RSL[4]	PADEP Non-Res Surface Soil Direct Contact MSC[1]	Location	GP 797-MW-1				GP 797-MW-2				GP 797-MW-3				GP U 677-1				GP U 677-2				GP U 677-3			
							Sample ID	MW-1(1-1.5)_09/17/2002				MW-2(1-1.5)_09/17/2002				MW-3(1-1.5)_09/16/2002				GP U 677-1_06/08/2011				GP U 677-2_06/08/2011				GP U 677-3_06/08/2011			
							Sample Matrix	Soil (unsaturated)				Soil (unsaturated)				Soil (unsaturated)				Soil (unsaturated)				Soil (unsaturated)				Soil (unsaturated)			
							Sample Depth	1-1.5				1-1.5				1-1.5				1.5-2				0.8-1.3				1.5-2			
							Sample Date	9/17/2002				9/17/2002				9/16/2002				6/8/2011				6/8/2011				6/8/2011			
							Unit	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF
Volatile Organic Compounds																															
1,2,4-Trimethylbenzene	95-63-6	560	35	35	260	560	mg/kg	NA				NA				NA				0.097	J	0.07	55.27	ND	U	0.001	0.9	ND	U	0.001	0.82
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	3.7	0.005	0.005	0.17	3.7	mg/kg	NA				NA				NA				**0.13**	J	**0.07**	55.27	ND	U	0.001	0.9	ND	U	0.001	0.82
1,2-Dichloroethane	107-06-2	86	0.5	0.5	2.2	86	mg/kg	NA				NA				NA				ND	U	0.07	55.27	ND	U	0.001	0.9	ND	U	0.001	0.82
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	480	9.3	9.3	10000	480	mg/kg	NA				NA				NA				ND	U	0.07	55.27	ND	U	0.001	0.9	ND	U	0.001	0.82
Benzene	71-43-2	290	0.5	0.5	5.4	290	mg/kg	**2.6**		0.31	48.26	**6.5**		0.33	47.53	**610**		**11**	1879.7	0.06	J	0.035	55.27	ND	U	0.0006	0.9	ND	U	0.0005	0.82
Dimethyl Benzene/ Xylenes, Total	1330-20-7	8000	1000	1000	2700	8000	mg/kg	3.5		0.31	48.26	0.86		0.33	47.53	67		1.1	187.97	0.42		0.07	55.27	ND	U	0.001	0.9	ND	U	0.001	0.82
Ethylbenzene	100-41-4	10000	70	70	27	10000	mg/kg	3.7		0.31	48.26	0.52		0.33	47.53	14		1.1	187.97	0.11	J	0.07	55.27	ND	U	0.001	0.9	ND	U	0.001	0.82
Isopropylbenzene (Cumene)	98-82-8	10000	2500	2500	11000	10000	mg/kg	60		1.6	241.31	190		3.3	475.29	270		11	1879.7	0.7		0.07	55.27	ND	U	0.001	0.9	ND	U	0.001	0.82
O-Xylene (1,2-Dimethylbenzene)	95-47-6	8000	1000	1000	3000	8000	mg/kg	NA				NA				NA				NA				NA				NA			
Tert-Butyl Methyl Ether	1634-04-4	3200	2	2	220	3200	mg/kg	ND	U	0.31	48.26	ND	U	0.33	47.53	ND	U	1.1	187.97	ND	U	0.035	55.27	ND	U	0.0006	0.9	ND	U	0.0005	0.82
Toluene	108-88-3	10000	100	100	45000	10000	mg/kg	1.6		0.31	48.26	ND	U	0.33	47.53	**300**		11	1879.7	0.12	J	0.07	55.27	ND	U	0.001	0.9	ND	U	0.001	0.82
Xylenes (M & P)	XYLENES-MP	8000	1000	1000	2700	8000	mg/kg	NA				NA				NA				NA				NA				NA			
Semi-Volatile Organic Compounds																															
1-Bromo-4-Fluorobenzene Bromofluorobenzene)	460-00-4	NS	NS	NS	NS	NS	mg/kg	NA				NA				NA				NA				NA				NA			
Anthracene	120-12-7	190000	350	350	170000	190000	mg/kg	NA				NA				NA				0.78		0.017	20	0.037	J	0.017	20	0.5		0.017	20
Benzo(A)Anthracene	56-55-3	110	320	110	2.1	110	mg/kg	NA				NA				NA				1		0.0084	20	0.11		0.0085	20	1.2		0.0086	20
Benzo(A)Pyrene	50-32-8	11	46	11	0.21	11	mg/kg	NA				NA				NA				1.2		0.0084	20	0.12		0.0085	20	1.2		0.0086	20
Benzo(B)Fluoranthene	205-99-2	110	170	110	2.1	110	mg/kg	NA				NA				NA				0.8		0.0067	20	0.091		0.0068	20	0.85		0.0069	20
Benzo(G,H,I)Perylene	191-24-2	170000	180	180	NS	170000	mg/kg	NA				NA				NA				1.7		0.051	20	0.19	J	0.051	20	1.5		0.051	20
Chrysene	218-01-9	11000	230	230	210	11000	mg/kg	NA				NA				NA				2		0.076	20	0.16		0.076	20	1.6		0.077	20
Fluorene	86-73-7	110000	3800	3800	22000	110000	mg/kg	NA				NA				NA				1.3		0.084	20	ND	U	0.085	20	0.39		0.086	20
Naphthalene	91-20-3	56000	25	25	18	56000	mg/kg	1.8		0.31	48.26	1.9		0.33	47.53	4.8		1.1	187.97	0.29	J	0.07	55.27	ND	U	0.001	0.9	ND	U	0.001	0.82
Phenanthrene	85-01-8	190000	10000	10000	NS	190000	mg/kg	NA				NA				NA				2.2		0.051	20	0.09	J	0.051	20	1.6		0.051	20
Pyrene	129-00-0	84000	2200	2200	17000	84000	mg/kg	NA				NA				NA				1.5		0.084	20	0.24	J	0.085	20	2.3		0.086	20
Metals																															
Lead	7439-92-1	1000	450	450	800	1000	mg/kg	NA				NA				NA				**453**		0.268	1	67		0.276	1	**451**		0.272	1
Lead (TCLP)**	7439-92-1	NS	NS	NS	NS	5	mg/l	NA				NA				NA				NA				NA				NA			

Notes:

[1] PADEP Non-Residential Direct Contact MSC for surface soils (0-2 feet below ground surface) (last updated Jan. 2011).
[2] PADEP Non-Residential Soil to Groundwater MSC for unsaturated soils in a used aquifer with total dissolved solids less than 2500 mg/l (last updated Jan. 2011).
[3] Criteria shown in gray were used to determine the non-residential soil MSCs used to screen the sample results. The lowest, most conservative, value of the soil-to-groundwater or direct contact criteria was used as the value for screening purposes.
[4] EPA Industrial Soil Regional Screening Level (last updated November 2012).
** The criteria listed under the PADEP Non-Res Surface Soil Direct Contact MSC is based on the EPA Maximum Concentration of Contaminants for Toxicity Concentration.
CAS - Chemical Abstracts Service Registry Number
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mg/kg - milligram per kilogram
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DL - Lab detection limit (actual limit may be either the quantification or method detection limit)
ND - Not Detected
DF - Dilution Factor
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NS - No Standard
NA - Not Analyzed
Result screened against Non-Residential Direct Contact MSC for surface soils only if the result also exceeds the PADEP MSC and EPA RSL.

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U - The analyte was analyzed but not detected above the reporting limit.
J - Compound was detected below the quantification limit and above the method detection limit. The result should be considered estimated.

Exceedance Summary:

10	Reported result exceeds the PADEP Non-Residential Soil MSC
10	Reported result exceeds the PADEP Non-Residential Soil MSC and the EPA Industrial Soil RSL
10	Reported result exceeds the PADEP Soil MSC, EPA Industrial Soil RSL and the PADEP Non-Residential Direct Contact MSC for Surface Soils (0-2 feet below ground surface)
10	RL exceeds the PADEP Non-Residential Soil MSC

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Chemical Name	CAS Number	PADEP Non-Res Surface Soil Direct Contact MSC[1]	PADEP Non-Res Soil to GW MSC[2]	PADEP Non-Res Surface Soil MSC[3]	EPA Industrial Soil RSL[4]	PADEP Non-Res Surface Soil Direct Contact MSC[1]	Location	GP U 677-4				GP U 677-5			
							Sample ID	GP U 677-4_06/08/2011				GP U 677-5_06/08/2011			
							Sample Matrix	Soil (unsaturated)				Soil (unsaturated)			
							Sample Depth	0.3-0.8				0.8-1.3			
							Sample Date	6/8/2011				6/8/2011			
							Unit	Result	Q	DL	DF	Result	Q	DL	DF
Volatile Organic Compounds															
1,2,4-Trimethylbenzene	95-63-6	560	35	35	260	560	mg/kg	ND	U	0.001	0.98	0.056		0.001	1
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	3.7	0.005	0.005	0.17	3.7	mg/kg	ND	U	0.001	0.98	ND	U	0.001	1
1,2-Dichloroethane	107-06-2	86	0.5	0.5	2.2	86	mg/kg	ND	U	0.001	0.98	ND	U	0.001	1
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	480	9.3	9.3	10000	480	mg/kg	ND	U	0.001	0.98	0.046		0.001	1
Benzene	71-43-2	290	0.5	0.5	5.4	290	mg/kg	ND	U	0.0005	0.98	ND	U	0.0005	1
Dimethyl Benzene/ Xylenes, Total	1330-20-7	8000	1000	1000	2700	8000	mg/kg	ND	U	0.001	0.98	0.005		0.001	1
Ethylbenzene	100-41-4	10000	70	70	27	10000	mg/kg	ND	U	0.001	0.98	ND	U	0.001	1
Isopropylbenzene (Cumene)	98-82-8	10000	2500	2500	11000	10000	mg/kg	ND	U	0.001	0.98	ND	U	0.001	1
O-Xylene (1,2-Dimethylbenzene)	95-47-6	8000	1000	1000	3000	8000	mg/kg	NA				NA			
Tert-Butyl Methyl Ether	1634-04-4	3200	2	2	220	3200	mg/kg	ND	U	0.0005	0.98	ND	U	0.0005	1
Toluene	108-88-3	10000	100	100	45000	10000	mg/kg	ND	U	0.001	0.98	0.001	J	0.001	1
Xylenes (M & P)	XYLENES-MP	8000	1000	1000	2700	8000	mg/kg	NA				NA			
Semi-Volatile Organic Compounds															
1-Bromo-4-Fluorobenzene Bromofluorobenzene)	460-00-4	NS	NS	NS	NS	NS	mg/kg	NA				NA			
Anthracene	120-12-7	190000	350	350	170000	190000	mg/kg	ND	U	0.028	20	0.99		0.036	50
Benzo(A)Anthracene	56-55-3	110	320	110	2.1	110	mg/kg	0.031		0.0071	20	ND	U	0.59	50
Benzo(A)Pyrene	50-32-8	11	46	11	0.21	11	mg/kg	0.05		0.0071	20	0.62		0.018	50
Benzo(B)Fluoranthene	205-99-2	110	170	110	2.1	110	mg/kg	0.053		0.0057	20	0.81		0.014	50
Benzo(G,H,I)Perylene	191-24-2	170000	180	180	NS	170000	mg/kg	0.13	J	0.043	20	1.4		0.11	50
Chrysene	218-01-9	11000	230	230	210	11000	mg/kg	0.25		0.064	20	4.3		0.16	50
Fluorene	86-73-7	110000	3800	3800	22000	110000	mg/kg	ND	U	0.071	20	2.5		0.18	50
Naphthalene	91-20-3	56000	25	25	18	56000	mg/kg	ND	U	0.001	0.98	0.16		0.001	1
Phenanthrene	85-01-8	190000	10000	10000	NS	190000	mg/kg	0.095	J	0.043	20	5.2		0.11	50
Pyrene	129-00-0	84000	2200	2200	17000	84000	mg/kg	ND	U	0.37	20	ND	U	17	50
Metals															
Lead	7439-92-1	1000	450	450	800	1000	mg/kg	47.8		0.232	1	18.5		0.232	1
Lead (TCLP)**	7439-92-1	NS	NS	NS	NS	5	mg/l	NA				NA			

Notes:

[1] PADEP Non-Residential Direct Contact MSC for surface soils (0-2 feet below ground surface) (last updated Jan. 2011).
[2] PADEP Non-Residential Soil to Groundwater MSC for unsaturated soils in a used aquifer with total dissolved solids less than 2500 mg/l (last updated Jan. 2011).
[3] Criteria shown in gray were used to determine the non-residential soil MSCs used to screen the sample results. The lowest, most conservative, value of the soil-to-groundwater or direct contact criteria was used as the value for screening purposes.
[4] EPA Industrial Soil Regional Screening Level (last updated November 2012).
** The criteria listed under the PADEP Non-Res Surface Soil Direct Contact MSC is based on the EPA Maximum Concentration of Contaminants for Toxicity Concentration.
CAS - Chemical Abstracts Service Registry Number
PADEP - Pennsylvania Department of Environmental Protection
mg/kg - milligram per kilogram
MSC - Medium Specific Concentration
DL - Lab detection limit (actual limit may be either the quantification or method detection limit)
ND - Not Detected
DF - Dilution Factor
Q - Lab Qualifier
NS - No Standard
NA - Not Analyzed
Result screened against Non-Residential Direct Contact MSC for surface soils only if the result also exceeds the PADEP MSC and EPA RSL.

Qualifiers:

U - The analyte was analyzed but not detected above the reporting limit.
J - Compound was detected below the quantification limit and above the method detection limit. The result should be considered estimated.

Exceedance Summary:

10	Reported result exceeds the PADEP Non-Residential Soil MSC
10	Reported result exceeds the PADEP Non-Residential Soil MSC and the EPA Industrial Soil RSL
10	Reported result exceeds the PADEP Soil MSC, EPA Industrial Soil RSL and the PADEP Non-Residential Direct Contact MSC for Surface Soils (0-2 feet below ground surface)
10	RL exceeds the PADEP Non-Residential Soil MSC

Table 3
Summary of Subsurface Soil Analytical Results
AOI 6 ASTs
AOI 6 Supplemental Site Characterization Report
PES Facility
Philadelphia, Pennsylvania

Chemical Name	CAS Number	PADEP Non-Res Subsurface Soil Direct Contact MSC[1]	PADEP Non-Res Soil to GW MSC[2]	PADEP Non-Res Subsurface Soil MSC[3]	EPA Industrial Soil RSL[4]	PADEP Non-Res Surface Soil Direct Contact MSC[5]	Location	AOI6 BH-12-125				AOI6 BH-12-126				AOI6 BH-12-127				AOI6 BH-12-128				AOI6 BH-12-129			
							Sample ID	BH-12-125_2.5-3'				BH-12-126_2.5-3'				BH-12-127_2.5-3'				BH-12-128_3-3.5'				BH-12-129_2.5-3'			
							Sample Matrix	Soil (unsaturated)				Soil (unsaturated)				Soil (unsaturated)				Soil (unsaturated)				Soil (unsaturated)			
							Sample Depth	2.5-3				2.5-3				2.5-3				3-3.5				2.5-3			
							Sample Date	12/4/2012				12/4/2012				12/4/2012				12/4/2012				12/4/2012			
							Unit	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF
Volatile Organic Compounds																											
1,2,4-Trimethylbenzene	95-63-6	560	35	35	260	560	mg/kg	ND	U	12	1	4.62		1.3	1	3.04		0.25	1	6.32		0.25	1	9.43		1.4	1
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	3.7	0.005	0.005	0.17	3.7	mg/kg	ND	U	**2.5**	1	ND	U	**0.26**	1	ND	U	**0.05**	1	ND	U	**0.05**	1	ND	U	**0.27**	1
1,2-Dichloroethane	107-06-2	86	0.5	0.5	2.2	86	mg/kg	ND	U	**2.5**	1	ND	U	0.26	1	ND	U	0.05	1	ND	U	0.05	1	ND	U	0.27	1
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	480	9.3	9.3	10000	480	mg/kg	ND	U	**12**	1	2.08		1.3	1	1.41		0.25	1	2.92		0.25	1	3.38		1.4	1
Benzene	71-43-2	290	0.5	0.5	5.4	290	mg/kg	ND	U	**2.5**	1	**87.2**		**26**	5	**149**		**2.5**	1	**535**		**13**	50	**1850**		**54**	10
Dimethyl Benzene/ Xylenes, Total	1330-20-7	8000	1000	1000	2700	8000	mg/kg	ND	U	2.5	1	68.5		0.26	1	83.6		2.5	1	248		1.3	5	51.6		0.27	1
Ethylbenzene	100-41-4	10000	70	70	27	10000	mg/kg	ND	U	2.5	1	14.6		0.26	1	18.7		2.5	1	57.8		1.3	5	12.6		0.27	1
Isopropylbenzene (Cumene)	98-82-8	10000	2500	2500	11000	10000	mg/kg	64.2		12	1	678		130	5	374		13	1	919		63	50	**6600**		270	10
Tert-Butyl Methyl Ether	1634-04-4	3200	2	2	220	3200	mg/kg	ND	U	**2.5**	1	ND	U	0.26	1	ND	U	0.05	1	ND	U	0.05	1	ND	U	0.27	1
Toluene	108-88-3	10000	100	100	45000	10000	mg/kg	ND	U	2.5	1	**197**		26	5	**339**		2.5	1	**1050**		13	50	**2070**		54	10
Semi-Volatile Organic Compounds																											
Anthracene	120-12-7	190000	350	350	170000	190000	mg/kg	ND	U	0.035	1	ND	U	0.073	2	ND	U	0.032	1	ND	U	0.035	1	ND	U	0.07	2
Benzo(A)Anthracene	56-55-3	110	320	320	2.1	110	mg/kg	ND	U	0.035	1	ND	U	0.073	2	ND	U	0.032	1	ND	U	0.035	1	0.177		0.07	2
Benzo(A)Pyrene	50-32-8	11	46	46	0.21	11	mg/kg	ND	U	0.035	1	ND	U	0.073	2	ND	U	0.032	1	ND	U	0.035	1	0.121		0.07	2
Benzo(B)Fluoranthene	205-99-2	110	170	170	2.1	110	mg/kg	ND	U	0.035	1	ND	U	0.073	2	ND	U	0.032	1	ND	U	0.035	1	0.126		0.07	2
Benzo(G,H,I)Perylene	191-24-2	170000	180	180	NS	170000	mg/kg	ND	U	0.035	1	ND	U	0.073	2	ND	U	0.032	1	ND	U	0.035	1	0.0832		0.07	2
Chrysene	218-01-9	11000	230	230	210	11000	mg/kg	ND	U	0.035	1	0.085		0.073	2	ND	U	0.032	1	ND	U	0.035	1	0.243		0.07	2
Fluorene	86-73-7	110000	3800	3800	22000	110000	mg/kg	ND	U	0.035	1	ND	U	0.073	2	ND	U	0.032	1	ND	U	0.035	1	0.182		0.07	2
Naphthalene	91-20-3	56000	25	25	18	56000	mg/kg	ND	U	12	1	ND	U	1.3	1	ND	U	0.25	1	ND	U	0.25	1	ND	U	1.4	1
Phenanthrene	85-01-8	190000	10000	10000	NS	190000	mg/kg	ND	U	0.035	1	0.115		0.073	2	ND	U	0.032	1	ND	U	0.035	1	0.437		0.07	2
Pyrene	129-00-0	84000	2200	2200	17000	84000	mg/kg	0.036		0.035	1	0.123		0.073	2	ND	U	0.032	1	ND	U	0.035	1	0.406		0.07	2
Metals																											
Lead	7439-92-1	1000	450	450	800	1000	mg/kg	11.4		2.2	1	8.7		2.3	1	13.8		2.3	1	6.5		2.4	1	107		2.2	1

Notes:

[1] PADEP Non-Residential Direct Contact MSC for subsurface soils (2-15 feet below ground surface) (last updated Jan. 2011).
[2] PADEP Non-Residential Soil to Groundwater MSC for unsaturated soils in a used aquifer with total dissolved solids less than 2500 mg/l (last updated Jan. 2011).
[3] Criteria shown in gray were used to determine the non-residential soil MSCs used to screen the sample results. The lowest, most conservative, value of the soil-to-groundwater or direct contact criteria was used as the value for screening purposes.
[4] EPA Industrial Soil Regional Screening Level (last updated November 2012).
[5] PADEP Non-Residential Direct Contact MSC for surface soils (0-2 feet below ground surface) (last updated Jan. 2011).
CAS - Chemical Abstracts Service Registry Number
PADEP - Pennsylvania Department of Environmental Protection
mg/kg - milligram per kilogram
MSC - Medium Specific Concentration
DL - Lab detection limit (actual limit may be either the quantification or method detection limit)
ND - Not Detected
DF - Dilution Factor
Q - Lab Qualifier
NS - No Standard
NA - Not Analyzed
Result screened against Non-Residential Direct Contact MSC for surface soils only if the result also exceeds the PADEP MSC and EPA RSL.

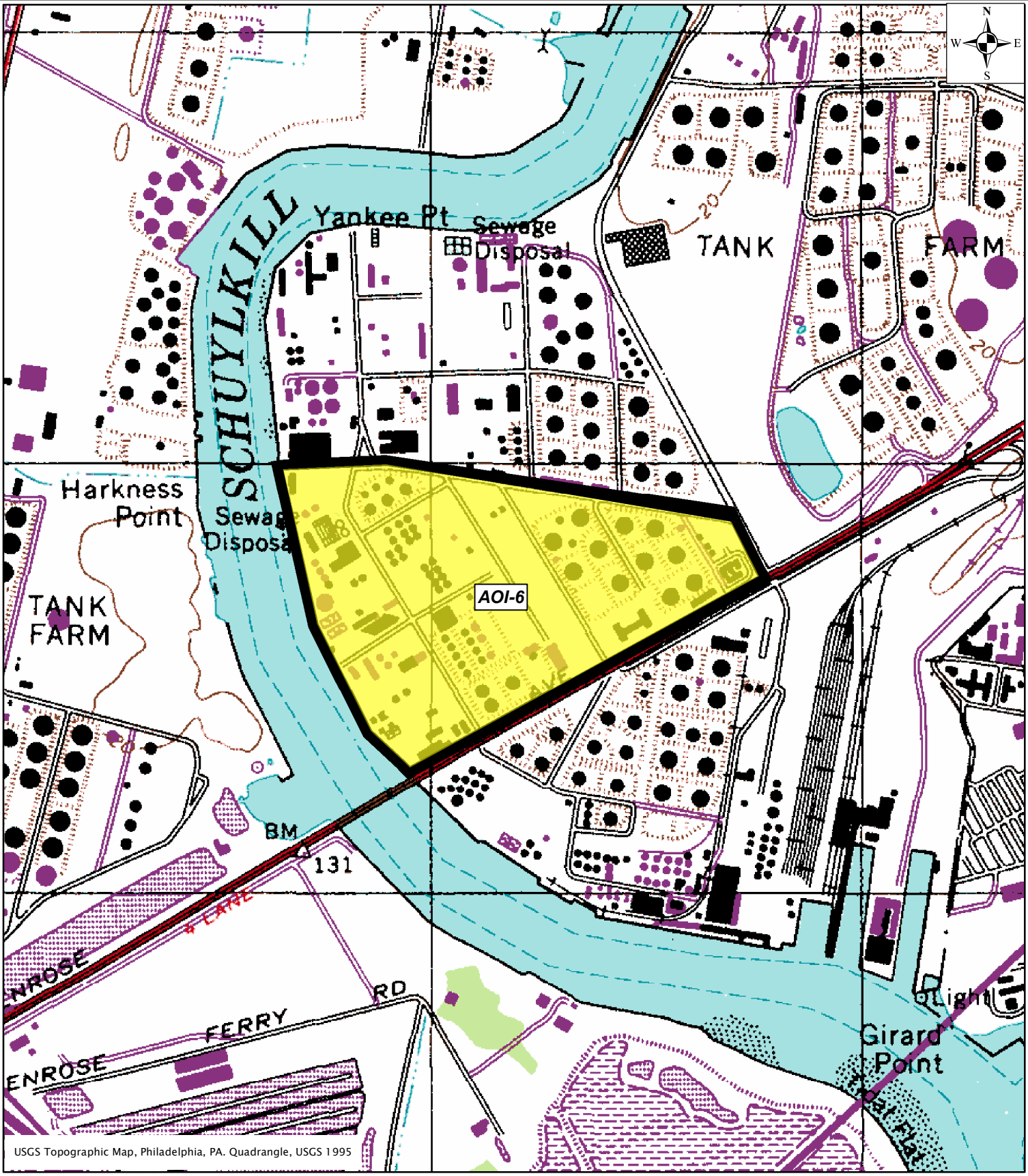
Qualifiers:

U - The analyte was analyzed but not detected above the reporting limit.
J - The analyte was positively identified below the reporting limit and the associated numerical value is the approximate concentration of the analyte in the sample.

Exceedance Summary:

10	Reported result exceeds the PADEP Non-Residential Soil MSC
10	Reported result exceeds the PADEP Non-Residential Soil MSC and the EPA Industrial Soil RSL
10	Reported result exceeds the PADEP Soil MSC, EPA Industrial Soil RSL and the PADEP Non-Residential Direct Contact MSC for Surface Soils (0-2 feet below ground surface)
10	RL exceeds the PADEP Non-Residential Soil MSC

FIGURES



SUNOCO

PHILADELPHIA ENERGY SOLUTIONS

Sunoco, Inc. (R&M)

PES Facility

3144 Passyunk Avenue
Philadelphia, PA. 19145

Figure 1: Site Location Map
AOI-6 Supplemental Site Characterization Report
PES Facility

Philadelphia Pennsylvania

Job Number	Scale: 1" = 1,000'	Date
2574601	0 500 1,000 Feet	June 18, 2013

Path: \\langan.com\data\DT\data6\2574601\ArcGIS\MapDocuments\AOI 6 Repackaged SCR\AOI 6 Tank SCR\Figure 1- Site Location Map_6-18-13.mxd

N
W E
S

Legend

- Tank Closed in Place (797)
- Tank With Release Assessment (250)
- Penrose Avenue Sewer
- Sheet Pile Wall
- AOIs

Notes:
1. Bing Maps aerial imagery provided by © 2010 Microsoft Corporation and its data suppliers and obtained under the licensing agreement with ESRI.

Figure 2: Site Plan
AOI 6 Supplemental Site Characterization Report
PES Facility
Philadelphia, Pennsylvania

SUNOCO
PHILADELPHIA ENERGY SOLUTIONS

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

0 150 300 Feet

SCALE: 1" = 150'
DATE: August 29, 2013
DRN. BY: MH
CKD. BY: PT
JOB#: 2574601

Q:\Data\2574601\ArcGIS\MapDocuments\AOI 6 Site Characterization\Figure 8 Summary of Non SWMUs Soil Sample Exceedances.mxd

N
W E
S

Legend

- Monitoring Wells in Q-Q' Cross Section
- Deep Monitoring Wells
- Shallow Monitoring Wells
- Shallow Piezometer
- Shallow Recovery Well
- Monitoring Well Abandoned/Damaged/ Unable to Locate
- 797 — Tank Closed in Place
- 250 — Tank With Release Assessment
- Q — Q' — AOI-6 Cross Section Location
- Sheet Pile Wall
- AOIs

Notes:
1. Bing Maps aerial imagery provided by © 2010 Microsoft Corporation and its data suppliers and obtained under the licensing agreement with ESRI.

Figure 3: Cross Section Location Plan
AOI-6 Supplemental Site Characterization Report
PES Facility
Philadelphia, Pennsylvania

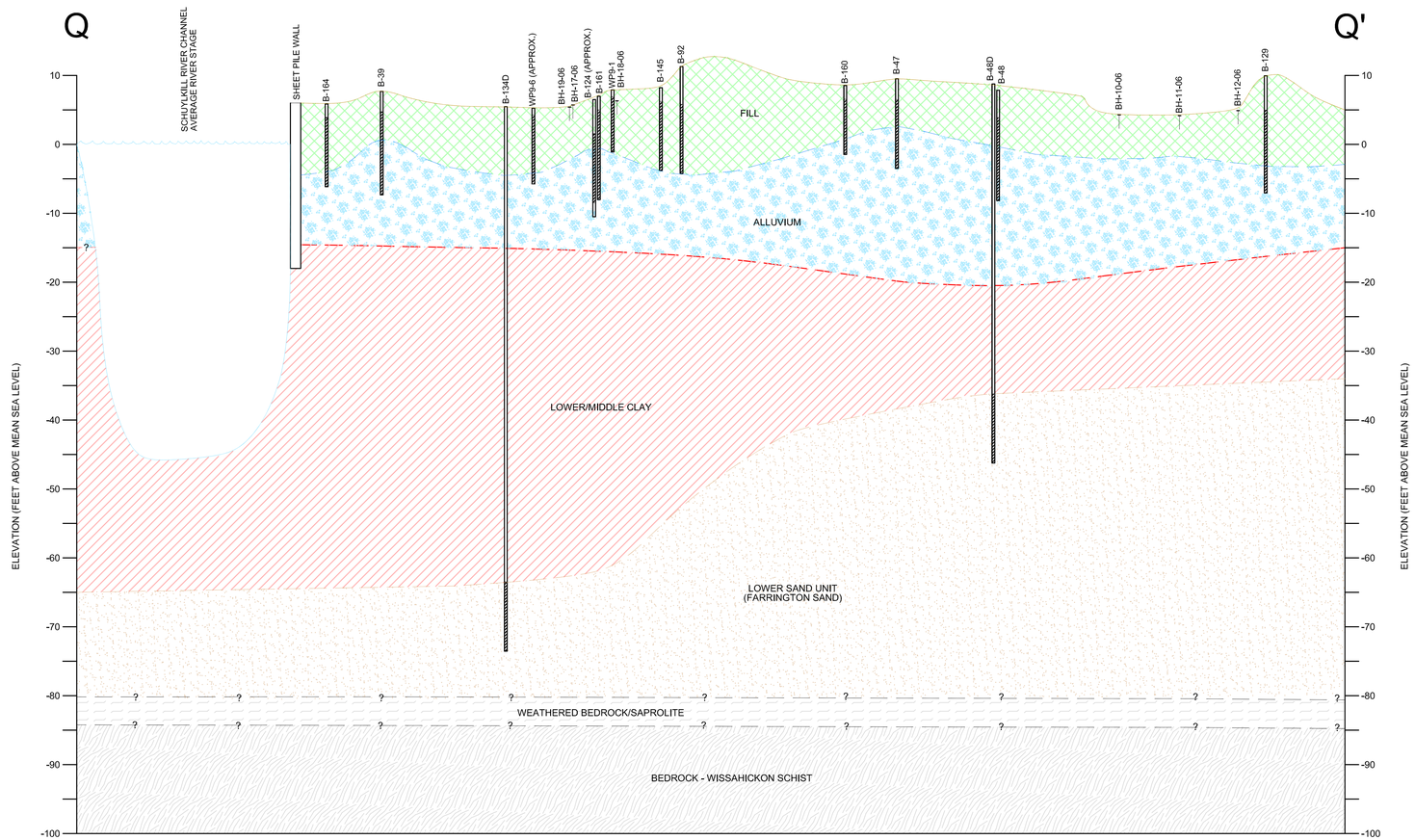
SUNOCO
PHILADELPHIA ENERGY SOLUTIONS

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

0 150 300 Feet

SCALE: 1" = 150'
DATE: August 29, 2013
DRN. BY: MH
CKD. BY: PT
JOB#: 2574601

Path: \\arcgis\com\data\UTdata\2574601\ArcGIS\MapDocuments\AOI 6 Repackaged SCR\AOI 6 Tank SCR\Figure 3 - Cross Section Location Plan_8-29-13.mxd



LEGEND:

- FILL
- ALLUVIUM
- CLAY
- SAND
- WEATHERED BEDROCK
- WISSAHICKON SCHIST
- B-129 LOCATION ID
- INFERRED CONTACTS
- WELL CASING
- WELL SCREEN
- SOIL BORING

NOTES:

1. DEPTH OF SCHUYLKILL RIVER FROM SIMULATION OF GROUNDWATER FLOW IN THE POTOMIC-RARITAN-MAGOTHY AQUIFER SYSTEM NEAR THE DEFENSE SUPPLY CENTER PHILADELPHIA, AND THE POINT BREEZE REFINERY, SOUTHERN PHILADELPHIA COUNTY, PENNSYLVANIA BY CURTIS L. SCHREFFLER DATED 2001.
2. DEPTH OF SHEET PILE WALL DETERMINED FROM FIGURE 3-8 GENERALIZED GEOLOGIC CROSS SECTION A-C DATED 13 NOVEMBER 1992 FROM DAMES & MOORE, RCRA VERIFICATION INVESTIGATION REPORT, CHEVRON REFINERY, 1992. CROSS SECTION RENAMED C-J.
3. CONTACT BETWEEN FILL AND ALLUVIUM IS APPROXIMATED BASED ON AVAILABLE HISTORIC WELL LOGS.

10 0 2 4 10
VERTICAL SCALE IN FEET

200 0 100 200
HORIZONTAL SCALE IN FEET

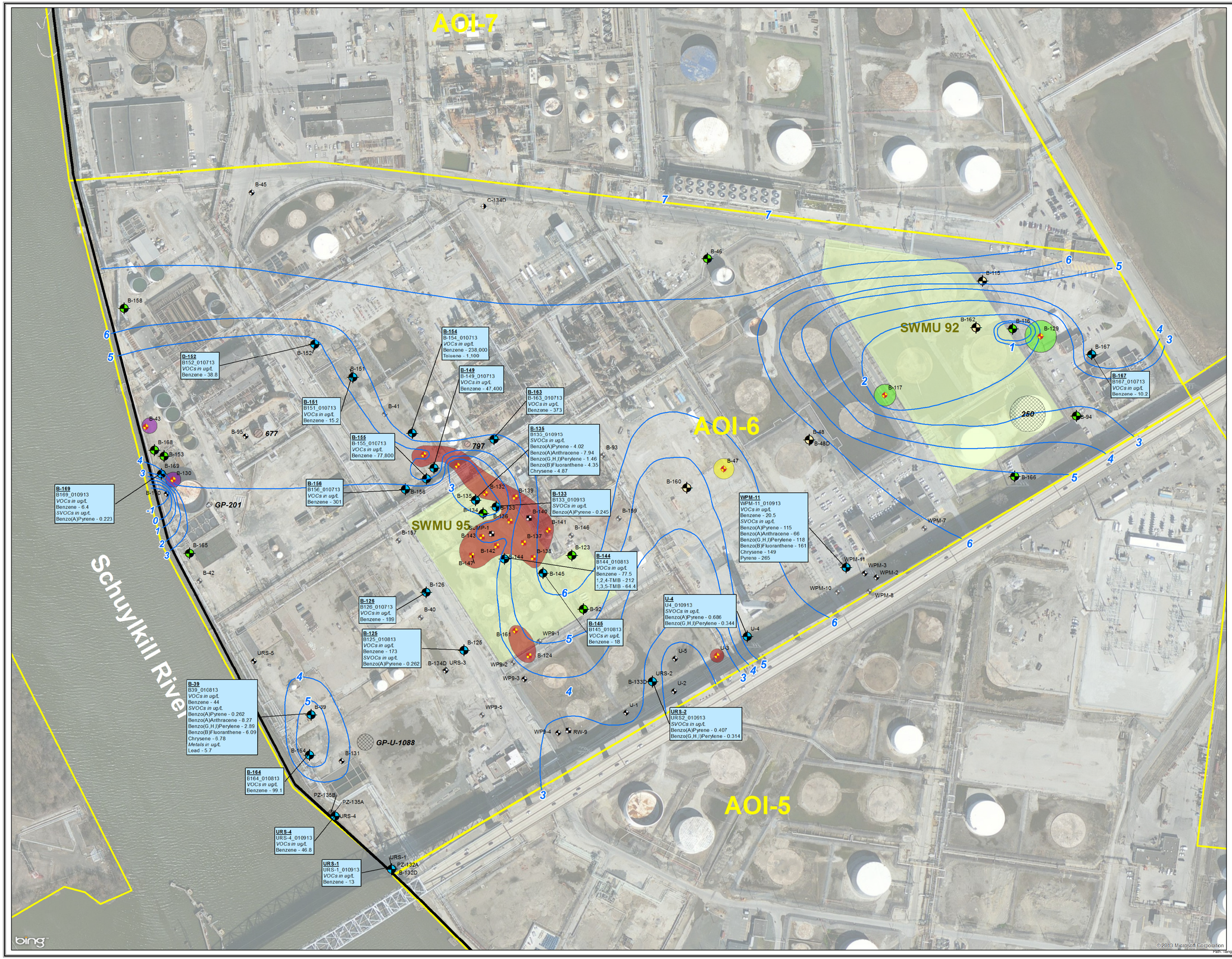
PHILADELPHIA ENERGY SOLUTIONS

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

Drawing Title
GEOLOGIC CROSS SECTION Q-Q'

Project No. 2574601	Figure No. 4
Date 6/11/2013	
Scale 1"=200' HOR. 1"=10' VER.	
Drn. By DMM/AE	
Last Revised X	Of

Filename: \\longan.com\data\PH\data6\2574601\CADD Drawings\Appendix E – Fig 4 Geologic Cross-Section Q-Q_rev8-27-13.dwg Date: 8/27/2013 Time: 9:36 User: mhagan Style Table: Longan.stb Layout: D Size Sheet (Bottom)



N
W E
S

Legend

- Shallow Monitoring Well and Groundwater Elevation (ft.)
- Shallow Recovery Well and Groundwater Elevation (ft.)
- Deep Monitoring Wells
- Shallow Piezometer
- Monitoring Well Abandoned/Damaged/Unable to Locate
- Shallow Monitoring Well with Apparent LNAPL Thickness (ft.)
- Shallow Recovery Well with Apparent LNAPL Thickness (ft.)
- Shallow Monitoring Well with No Exceedance of PADEP Non-Res GW MSCs
- Shallow Monitoring Well Location with No Exceedance of PADEP Non-Res GW MSCs (see Note 2)
- Shallow Monitoring Well Location with Exceedance of PADEP Non-Res GW MSCs
- Shallow Monitoring Well Location with Exceedances of PADEP GW MSCs and EPA RSLs
- Groundwater Elevation Contour (ft.)
- Sheet Pile Wall
- Tank Closed in Place (797)
- Tank With Release Assessment (269)
- Solid Waste Management Unit (SWMU)
- AOIs

LNAPL Types

- Gasoline
- Residual Oil and Middle Distillate
- Middle Distillate
- Residual Oil

B-167
B167_010713
VOCs in ug/L
Benzene - 10.2

Well ID
System Sample Name
Type of Exceedance
Exceedance - Exceedance Value

Notes:
1. Bing Maps aerial imagery provided by © 2010 Microsoft Corporation and its data suppliers and obtained under the licensing agreement with ESRI.
2. Groundwater sample usable for site characterization but cannot be used for delineation or to show attainment of an Act 2 standard.
3. Groundwater elevations and LNAPL plumes based on groundwater gauging data provided by Aquaterra, December 2012.

Figure 5: Shallow Groundwater Conditions in AOI-6
AOI-6 Supplemental Site Characterization Report
PES Facility
Philadelphia, Pennsylvania

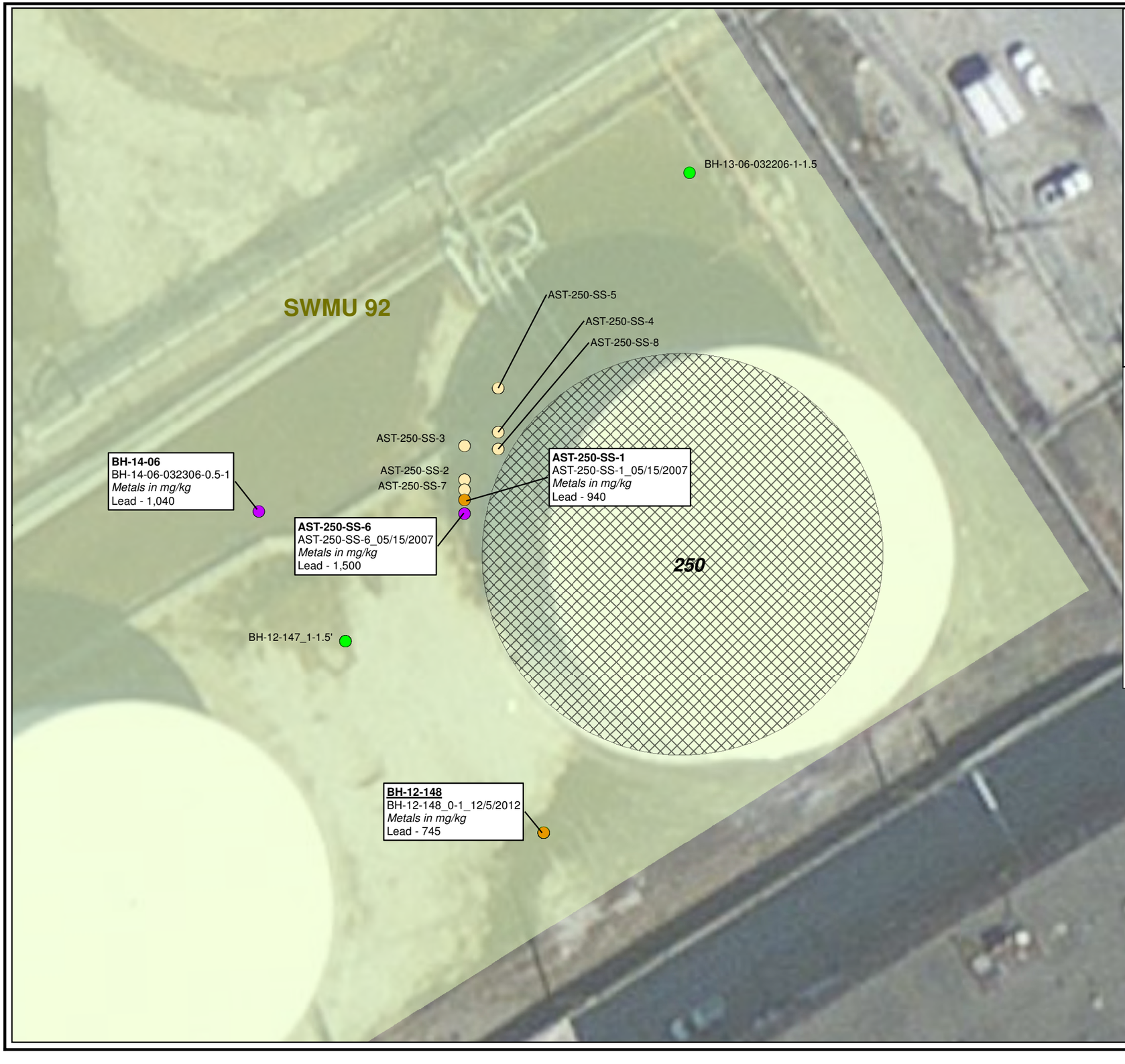
SUNOCO
PHILADELPHIA ENERGY SOLUTIONS

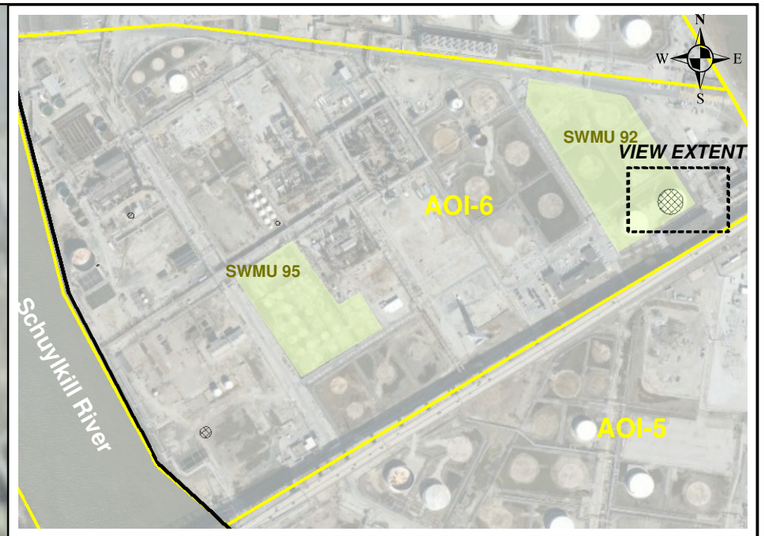
Sunoco, Inc. (R&M)
PES Facility
3144 Passyunk Avenue
Philadelphia, PA.
19145

0 150 300 Feet

SCALE: 1" = 150'
DATE: August 29, 2013
DRN. BY: MH
CKD. BY: PT
JOB#: 2574601

P:\PITTSNGN.COM\data\DT\data9\2574601\ArcGIS\MapDocuments\AOI 6 Repackaged SCR\AOI 6 Tank SCR\Figure 5 - Shallow GW Conditions_8-29-13.mxd





Legend

- Shallow Soil Boring Location with Exceedances of PADEP Non-Res Soil MSCs, PADEP Direct Contact MSCs, and EPA RSLs
- Shallow Soil Boring Location with Exceedance of PADEP Non-Res Soil MSCs
- Shallow Soil Boring Location with No Exceedance of PADEP Non-Res Soil MSCs (see note 2)
- Shallow Soil Boring Location with No Exceedances of PADEP Non-Res Soil MSCs
- Sheet Pile Wall
- AOIs
- Tank Closed in Place
- Tank With Release Assessment
- Solid Waste Management Unit (SWMU)

BH-14-06
BH-14-06-032306-0.5-1
Metals in mg/kg
Lead - 1,040

Well ID
System Sample Name
Type of Exceedance
Exceedance - Exceedance Value

Notes:
1. Bing Maps aerial imagery provided by © 2010 Microsoft Corporation and its data suppliers and obtained under the licensing agreement with ESRI.
2. Soil sample usable for site characterization but cannot be used for delineation or to show attainment of an Act 2 standard.

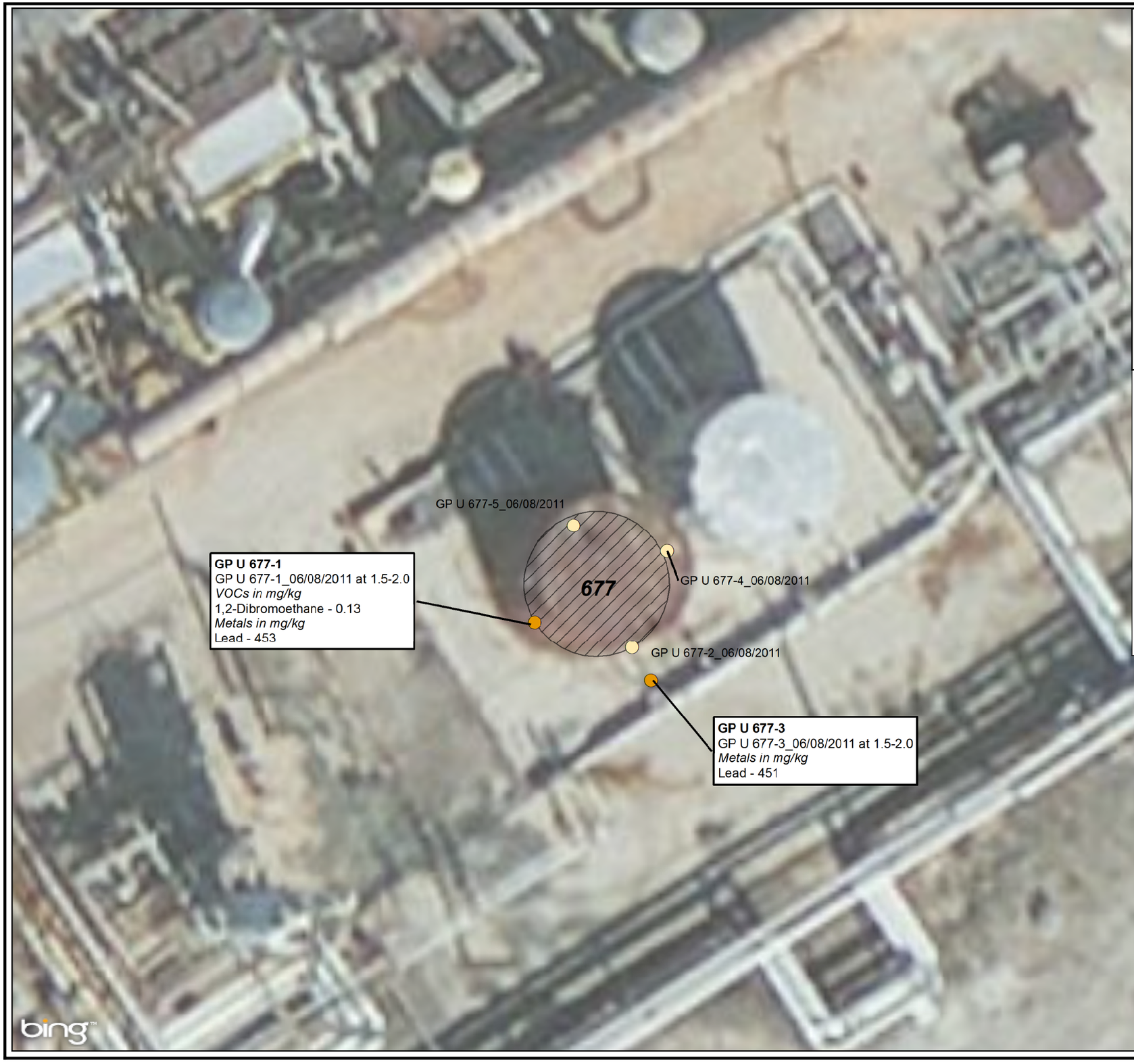
Figure 6: AST GP-250 Soil Sample Locations and Exceedances
AOI-6 Supplemental Site Characterization Report
PES Facility
Philadelphia, Pennsylvania

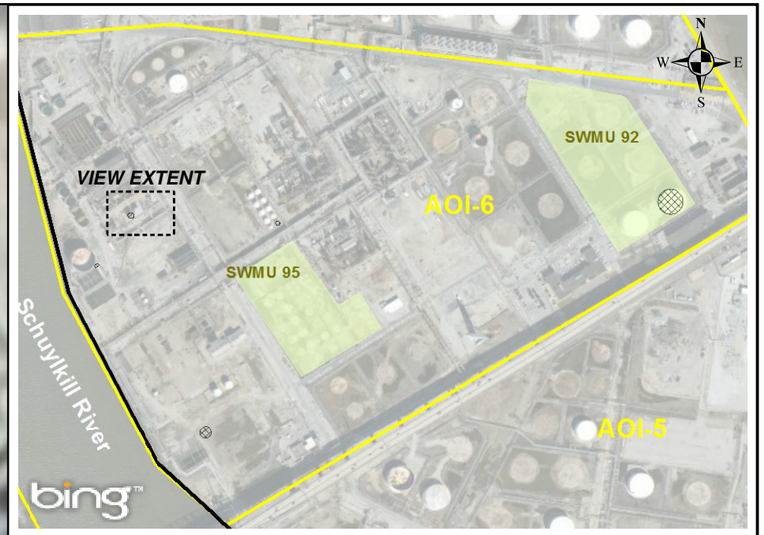
Sunoco, Inc. (R&M)
PES Facility
3144 Passyunk Avenue
Philadelphia, PA.
19145

0 30 60 Feet

SCALE: 1" = 30'
DATE: August 29, 2013
DRN. BY: MH
CKD. BY: PT
JOB#: 2574601

Path: \\group.com\data\DTGlobal\2574601\ArcGIS\MapDocuments\AOI 6 Repackaged SCR\AOI 6 Tank SCR\Figure 6 - AST GP 250 Soil Sample Locations 8-29-13.mxd





Legend

- Shallow Soil Boring Location with Exceedance of PADEP Non-Res Soil MSCs
- Shallow Soil Boring Location with No Exceedance of PADEP Non-Res Soil MSCs (see note 2)
- Sheet Pile Wall
- Solid Waste Management Unit (SWMU)
- AOIs
- Tank Closed in Place
- Tank With Release Assessment

GP U 677-3
GP U 677-3_06/08/2011 at 1.5-2.0
Metals in mg/kg
Lead - 451

Well ID
System Sample Name
Type of Exceedance
Exceedance - Exceedance Value

Notes:
1. Bing Maps aerial imagery provided by © 2010 Microsoft Corporation and its data suppliers and obtained under the licensing agreement with ESRI.
2. Soil sample usable for site characterization but cannot be used for delineation or to show attainment of an Act 2 standard.

Figure 7: AST GP-U-677 Soil Sample Locations and Exceedances
AOI-6 Supplemental Site Characterization Report
PES Facility
Philadelphia, Pennsylvania

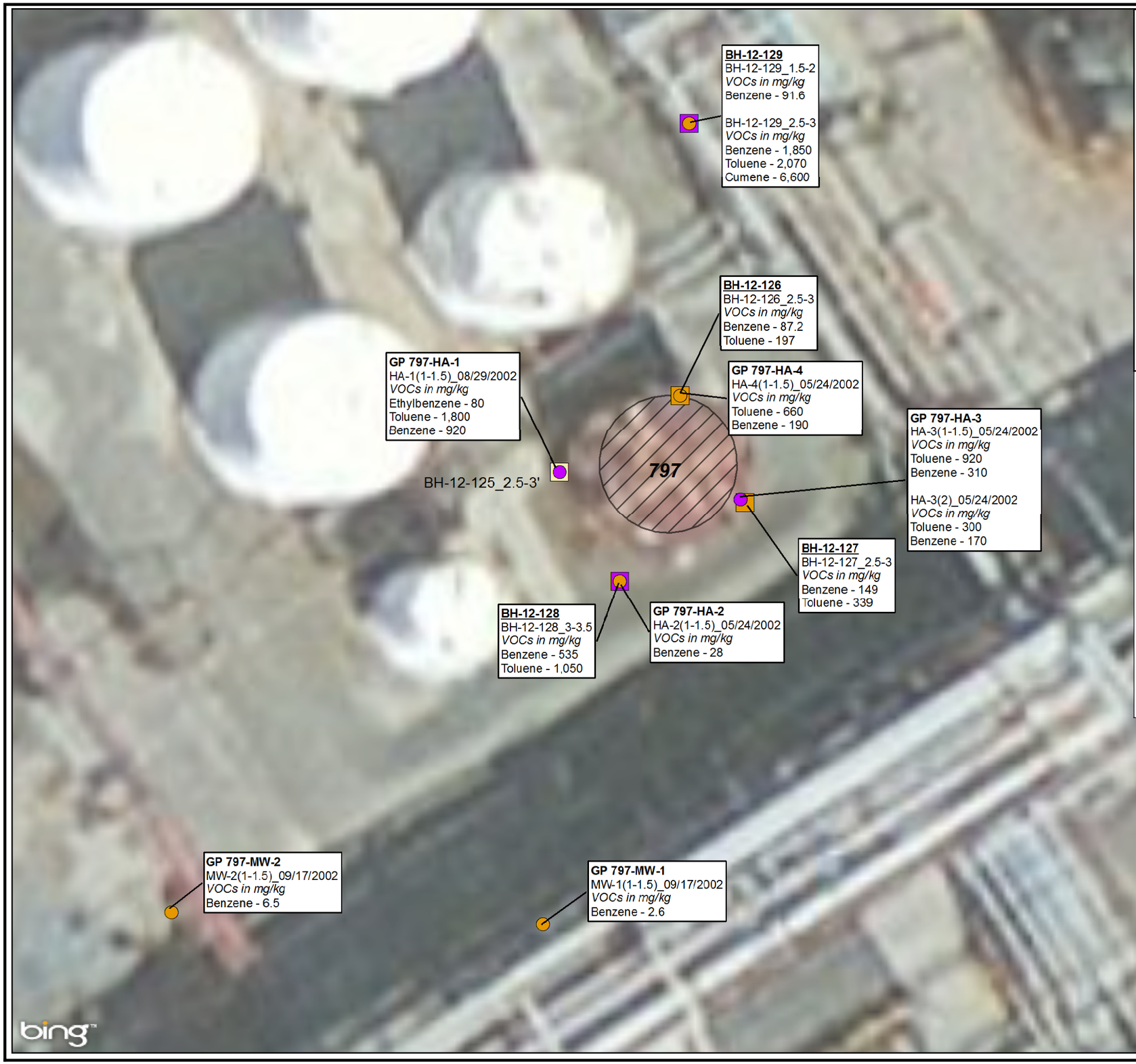
SUNOCO
PHILADELPHIA ENERGY SOLUTIONS

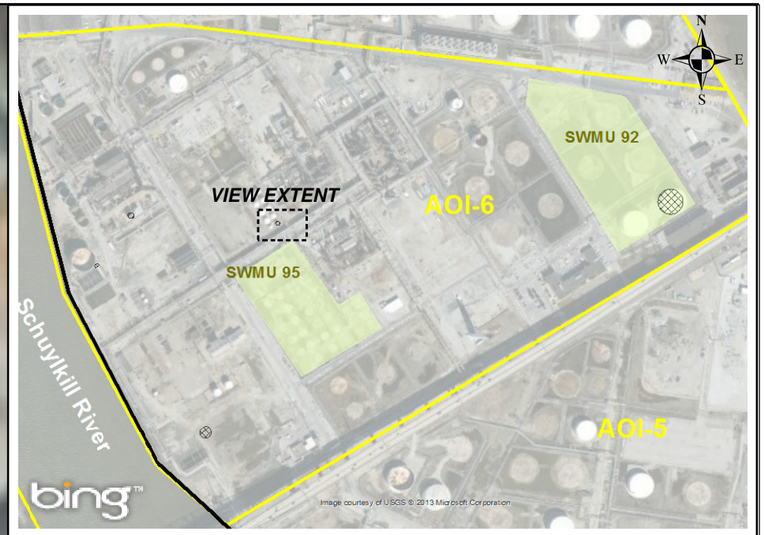
Sunoco, Inc. (R&M)
PES Facility
3144 Passyunk Avenue
Philadelphia, PA.
19145

0 20 40 Feet

SCALE: 1" = 20'
DATE: August 29, 2013
DRN. BY: MH
CKD. BY: PT
JOB#: 257460

Path: \\tcogan.com\data\DT\data6\257460\1\ArcGIS\MapDocuments\AOI 6 Repackaged SCR\AOI 6 Tank SCR\Figure 7 - AST GP 677 Soil Sample Locations 8-29-13.mxd





Legend

- Shallow Soil Boring Location with Exceedances of PADEP Non-Res Soil MSCs, PADEP Direct Contact MSCs, and EPA RSLs
- Shallow Soil Boring Location with Exceedance of PADEP Non-Res Soil MSCs
- Shallow Soil Boring Location with No Exceedance of PADEP Non-Res Soil MSCs (see note 2)
- Deep Soil Boring Location with Exceedances of PADEP Non-Res Soil MSCs, PADEP Direct Contact MSCs, and EPA RSLs
- Deep Soil Boring Location with Exceedances of PADEP Non-Res Soil MSCs
- Deep Soil Boring Location with No Exceedance of PADEP Non-Res Soil MSCs (see note 2)
- Tank Closed in Place
- Tank With Release Assessment
- Sheet Pile Wall
- Solid Waste Management Unit (SWMU)
- AOIs

GP 797-MW-2
MW-2(1-1.5)_09/17/2002
VOCs in mg/kg
Benzene - 6.5

Well ID
System Sample Name
Type of Exceedance
Exceedance - Exceedance Value

Notes:
1. Bing Maps aerial imagery provided by © 2010 Microsoft Corporation and its data suppliers and obtained under the licensing agreement with ESRI.
2. Soil sample usable for site characterization but cannot be used for delineation or to show attainment of an Act 2 standard.

Figure 8: AST 797 Soil Sample Locations and Exceedances
AOI-6 Supplemental Site Characterization Report
PES Facility
Philadelphia, Pennsylvania

SUNOCO
PHILADELPHIA ENERGY SOLUTIONS

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

0 30 Feet

SCALE: 1" = 15'
DATE: August 29, 2013
DRN. BY: MH
CKD. BY: PT
JOB#: 2574601

Path: \\langan.com\data\DT\data6\2574601\ArcGIS\MapDocuments\AOI 6 Repackaged SCR\AOI 6 Tank SCR\Figure 8 - AST GP 797 Soil Sample Locations_8-29-13.mxd

APPENDIX A

GENERAL CORRESPONDENCE

Philadelphia Refinery

FILE COPY

Sunoco Inc.
3144 Passyunk Avenue
Philadelphia PA 19145-5299
215 339 2000

Certified Mail Return Receipt Requested: 7002 0460 0003 1935 5094

March 16, 2006

Mr. Walter Payne
PA DEP - Southeast Region
Division of Storage Tanks
2 East Main Street
Norristown, PA 19401

RE: Request for Review & Approval of Alternative Confirmatory Sampling Plan for AST Closures
Sunoco, Inc. (R & S), 3144 Passyunk Ave, Philadelphia, PA 19145

Dear Mr. Payne:

As follow up to your recent discussion with Jim Oppenheim on tank closure confirmatory sampling, I am writing to request the use of an alternative sampling plan for obtaining under tank floor soil samples. The Philadelphia Refinery is commencing the permanent closure in place of 5 aboveground storage tanks. These closure activities are to proceed during the 1st half of 2006. Except as discussed below, closure activities are planned to conform to the October 12, 2002 PADEP Technical Document "Closure Requirements for Aboveground Storage Tank Systems."

On March 8, 2006 SECOR personnel attempted to obtain under tank floor samples at tank # PB 150 (PA Seq 036A) using a hand auger. Three tank floor coupons had previously been cut out to allow access to the under tank floor soil. During the sampling attempt, SECOR first penetrated a 6" layer of sand and then large fill stone was encountered. The hand auger could not penetrate this stone to the specified 5' depth. A geoprobe unit might have been able to penetrate to the required depth but because the tank shell is still in place, the geoprobe could not be used inside the tank. Therefore, in lieu of vertical beneath tank floor sampling, Sunoco proposes to perform angled borings using a geoprobe unit. The angled drilling would occur external to the tank shell and would be directed towards the center of the tank to a depth of at least 5 feet. The proposed alternative confirmatory sampling would involve both perimeter vertical sampling and perimeter angled borings. Per the PADEP technical document, additional soil sampling would be performed for any tank having underground or aboveground piping, or transfer pump/dispenser & loading rack systems. Analytical parameters are to follow PADEP protocol based on the substance stored.

March 16, 2006
Mr. Walter Payne
PA DEP - Southeast Region
Division of Storage Tanks
2 East Main Street
Norristown, PA 19401

Sunoco Phila Refinery Large AST's to be Closed in Place – 2006
Confirmatory Sampling Alternative Plan for Under Tank Samples

Tank No.	Capacity (gal)	Diam (ft)	Stored Product	Proposed Alternative Sampling Plan
PB 150	2,045,408	90	Lt Gas Oil	3 angled 3 perimeter
GP U2 1002	21,300	12	Recovered Oil	1 angled 2 perimeter
GP C1 1100	23,700	18	Recovered Oil	1 angled 2 perimeter
PB 119	2,751,000	102	Hvy Naphtha	3 angled 4 perimeter
PB 182	823,200	60	Recovered Oil	4 perimeter 2 angled

In addition to the above five AST's, two chemical additive tanks are to be permanently closed (demolished and removed) in 2006. Because these tanks are sited on operating unit concrete meeting the requirements for secondary and emergency containment per 245.542 (a),(b),(c),(d), we are requesting that confirmatory sampling be excluded. In lieu of soil sampling, visual inspection of the tank areas is proposed.

Tank No.	Capacity (gal)	Diam (ft)	Stored Product	Proposed Sampling
PB 3V-7	39,900	18	Carbonate additive	None
PB 3V-34	126,000	26	Sodium hydroxide solution	None

Please let us know at your earliest opportunity if the proposed sampling plan outlined in this letter is acceptable.

Should you have any questions or comments in reference to this matter please contact me at 215-339-2074.

March 16, 2006
Mr. Walter Payne
PA DEP - Southeast Region
Division of Storage Tanks
2 East Main Street
Norristown, PA 19401

Sincerely,

Scott A. Baker
Supervisor, Environmental Department

SAB/rmr

File: Tank (AST) Registrations Amended (Closure & Demo) 2006

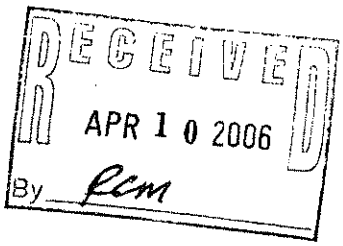
Pennsylvania Department of Environmental Protection

2 East Main Street
Norristown, PA 19401
April 5, 2006

Southeast Regional Office

Phone: 484-250-5960
Fax: 484-250-5961

Mr. Scott Baker
Supervisor, Environmental Department
Sunoco, Inc.
Point Breeze Philadelphia Refinery
3144 Passyunk Avenue
Philadelphia, PA 19145-5299



Re: ECP - Tanks Program
Sunoco Point Breeze Refinery
AST Removals
Facility ID No. 51-19781
EFACTS Site No. 242498
City of Philadelphia
- and –
Sunoco Girard Point Refinery
AST Removals
Facility ID No. 51-36558
EFACTS Site No. 456930
City of Philadelphia

Dear Mr. Baker:

The Pennsylvania Department of Environmental Protection (DEP) has received and reviewed the letter dated January 5, 2005, requesting an alternate soil sampling plan for Aboveground Storage Tanks (AST) closures at the Sunoco Point Breeze Refinery. They are PB 150 (a 90' diameter, 2,045,408 gallon, Light Gas Oil tank), PB 119 (a 102' diameter, 2,751,000 gallon, Heavy Naphtha tank), PB 182 (a 60' diameter, 823,000 gallon Recovered Oil tank), BP 3V-7 (a 18' diameter 39,000 gallon, Carbonate Additive tank), and PB-3V-34 (a 26' diameter 126,000 gallon, Sodium Hydroxide tank). Sunoco also wishes to close two ASTs at the Girard Point facility. They are GP U2 1002 (a 12' diameter, 21,300 gallon, Recovered Oil tank), and GP C1 1100 (an 18' diameter, 23,700 gallon, Recovered Oil tank).

DEP visited the refinery on March 28, 2005, observed the ASTs referenced in this letter, and discussed the closure plans with Mr. Ron Rosendorn and Mr. Jim Oppenheim. The larger tanks (PB 150, PB 119, and PB 182) have been disconnected from the feed lines and emptied.

Closure requirements for ASTs are described in the Technical Document titled "Closure Requirements for Aboveground Storage Tanks," dated October 12, 2002. This document suggests perimeter sampling of soils tied to the relative diameter of the AST. DEP prefers to employ the approach taken in this document to the perimeter sampling of the tanks to be closed.

The changes to the submitted plan are as follows:

PB 150	2,045,408	90	Light Gas Oil	3 angled & 6 perimeter samples
GP U2 1002	21,300	12	Recovered Oil	1 angled & 3 perimeter samples
GP U2 1100	23,700	18	Recovered Oil	1 angled & 3 perimeter samples
PB 119	2,751,000	102	Heavy Naphtha	3 angled & 6 perimeter samples
PB 182	823,000	60	Recovered Oil	2 angled & 5 perimeter samples
PB 3V-7	39,900	18	Carbonate Additive	No Sampling required
PB 3V-34	126,000	26	Sodium Hydroxide Solution	No Sampling required

With this letter, DEP approved the submitted sampling plan for the ASTs as referenced above and believes that it would satisfy the requirements for closure as described in Section 245.561. Please take into account varying Act 2 Statewide Health Standards associated with saturated soil samples.

If you have any questions or need further information regarding this matter, please contact the Environmental Cleanup Program.

Sincerely,

Walter J. Payne, P.G.
Licensed Professional Geologist
Environmental Cleanup Program
Southeast Regional Office

cc: Mr. Horvat, P.G.
Mr. Day-Lewis, P.G.
Ms. Nagle
Mr. Canigiani
Mr. S. Brown
Ms. Warren
Mr. Rosendorn – Sunoco PB
Mr. Oppenheim - Sunoco
City of Philadelphia
Regional File
30 (CD06)094-22

Pennsylvania Department of Environmental Protection

2 East Main Street
Norristown, PA 19401
February 26, 2008

Southeast Regional Office

Phone: 484-250-5960
Fax: 484-250-5961

Mr. Scott A. Baker, P.E.
Sunoco, Inc.
3144 Passyunk Avenue
Philadelphia, PA 19145

Re: Storage Tank Program
Facility ID No. 51-36558 & 51-19781
Sunoco Girard Point & Point Breeze Facilities
3144 Passyunk Avenue
Philadelphia County

Dear Mr. Baker:

Over the past few years, we have received documents from you that mention how Sunoco considers certain regulated storage tank release incidents to be covered by the 2003 Consent Order & Agreement (CO&A) between the Department and Sunoco, Inc. The purpose of this letter is to clarify for you which release incidents at the two above-mentioned facilities are covered under the 2003 CO&A. Paragraph 8 of the CO&A states that release incidents associated with a closure or change-in-service of an aboveground storage tank (AST) are covered by the CO&A. Thus, incidents not involving a tank closure or change-in-service are not covered.

All incidents occurring at these two facilities in the past few years (since we have been actively tracking regulated storage tank releases) are listed in the two tables below. There are multiple incidents that have occurred at these two facilities prior to our tracking of releases, which are not listed in the tables below and were not adequately addressed. Please be sure to address those releases incidents as well in accordance with either the CO&A or the corrective action process detailed in the storage tank regulations (25 Pa. Code Chapter 245 Subchapter D).

Please note that the CO&A does state that corrective actions required by Chapter 245 Sections 304, 305, 306, and 307 must still be completed for any AST closure and change-in-service.

Release incidents covered by 2003 CO&A

Facility	Sunoco Tank No.	PADEP Tank No.	Confirmed Release Date
Girard Point	1002	139A	4-7-06
Girard Point	1100	140A	5-31-06
Girard Point	277	039A	6-25-07
Girard Point	1208	025A	6-28-07
Point Breeze	119	024A	4-7-06
Point Breeze	182	048A	5-31-06
Point Breeze	181	047A	6-22-07
Point Breeze	848	116A	6-25-07
Point Breeze	252	055A	6-28-07

Release incidents NOT covered by 2003 CO&A

Facility	Sunoco Tank No.	PADEP Tank No.	Confirmed Release Date
Girard Point	250	030A	1-27-07
Girard Point	T-201	175A	12-10-07
Girard Point	1088	089A	12-31-07
Point Breeze	881	120A	9-3-05
Point Breeze	140	031A	9-15-05
Point Breeze	847	115A	9-3-06
Point Breeze	885	124A	10-15-06

The Department realizes that several corrective action reports have been submitted for some of the above-listed incidents which are not covered by the CO&A. We will issue a response for those reports. All incidents covered by the CO&A will be "administratively closed out" on our eFACTS database with a comment stating that the release will be addressed under the CO&A.

This letter is neither an order nor any other final action of the Department of Environmental Protection. It neither imposes nor waives any enforcement action available to the Department under any of its statutes. If the Department determines that an enforcement action is appropriate, you will be notified of the action.

Sincerely,

Heidi J. Kunsch
Water Quality Specialist
Environmental Cleanup

cc: Philadelphia Health Department
Mr. Higgins, Philadelphia L&I
Mr. Stan Sneath, PADEP
Mr. Steve O'Neil, PADEP
Mr. Ayman Ghobrial, PADEP
Re

GP-201

Soil Sampling Results

The analytical results for the soil samples collected are summarized on **Table 1**. Copies of the laboratory analytical results are included in **Appendix A.** The analytical results indicate that pH was detected ranging from 7.89 to 9.00 standard units. The PADEP has no cleanup criteria established for pH under Act 2.

Conclusions

Soil pH does not typically exceed 9.5 under normal conditions. The results indicate that the detected levels of pH was within the range typically found in soil, therefore, no further remedial activities are found to be necessary. The interim remedial activities completed have effectively removed imminent hazard to human health or the environment.

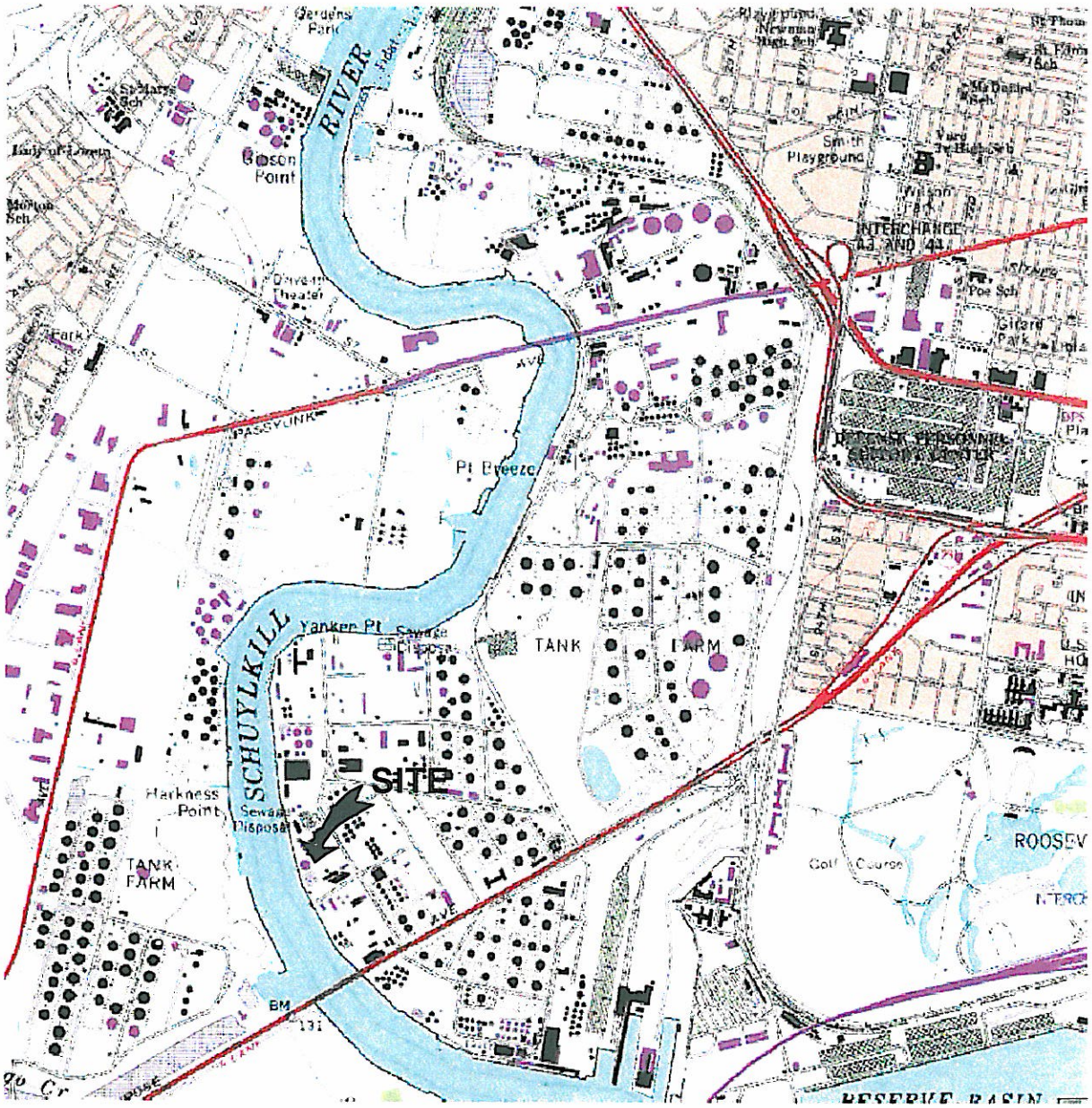
Should you have any questions or comments, please feel free to contact me at (484) 875-3075.

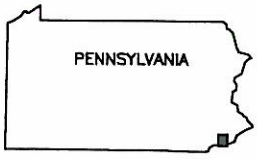
Sincerely,
SECOR International Incorporated

Casey Mundry
Project Manager

Cc: Dina Toto (Sunoco)
Frank Aceto (SECOR)
Project File

FIGURES





QUADRANGLE LOCATION

N

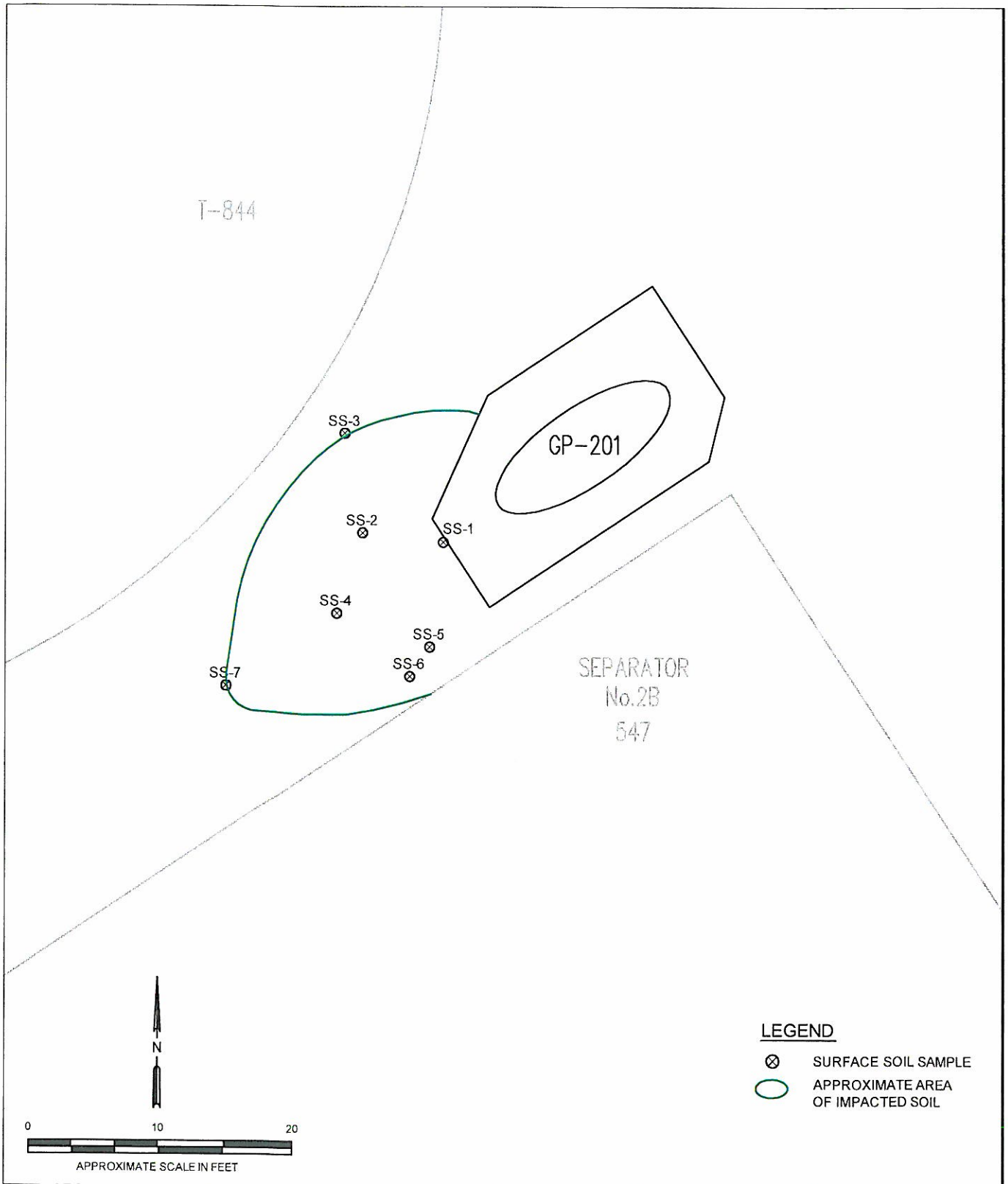
0 1/2 1

SCALE (MILES)

REFERENCE: USGS 7.5 MINUTE QUADRANGLE; PHILADELPHIA, PENNSYLVANIA–NEW JERSEY; 1995

SECOR
102 PICKERING WAY, SUITE 200
EXTON, PENNSYLVANIA
PHONE: (484) 875-3075/875-8286 (FAX)

FOR:		SITE LOCATION MAP TANK GP-201 AREA		FIGURE:
SUNOCO, INC. PHILADELPHIA REFINERY PHILADELPHIA, PENNSYLVANIA				1
JOB NUMBER:	DRAWN BY: TFB	CHECKED BY: CY	APPROVED BY:	DATE: 03/20/2008



SECOR
102 PICKERING WAY, SUITE 200
EXTON, PENNSYLVANIA
PHONE: (484) 875-3075 FAX.(484) 875-9286

FOR:			FIGURE:
SUNOCO, INC. PHILADELPHIA REFINERY PHILADELPHIA, PENNSYLVANIA		GP-201 AREA SOIL SAMPLE LOCATIONS	2
JOB NUMBER:	DRAWN BY: TFB	CHECKED BY:	APPROVED BY:	DATE: 05/28/2008

TABLE

Table 1
Summary of Soil Analytical Results
AST GP-201 Release Sampling
March 26, 2008

Sample Identification	GP-201-SS-1	GP-201-SS-2	GP-201-SS-3	GP-201-SS-4	GP-201-SS-5	GP-201-SS-6	GP-201-SS-7
Sample Collection Depth (FBG)	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5
pH (Standard Units)	8.88	9.00	8.53	8.55	8.88	7.89	7.99

Notes:
USEPA=United States Environmental Protection Agency
FBG = Feet Below Grade

APPENDIX A

Laboratory Analytical Report

Lancaster Laboratories

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

Analysis Report

ANALYTICAL RESULTS

Prepared for:

SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341

484-875-3075

Prepared by:

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

SAMPLE GROUP

The sample group for this submittal is 1083613. Samples arrived at the laboratory on Thursday, March 27, 2008.

Client Description	Lancaster Labs Number
GP-201-SS-1 Grab Soil Sample	5315620
GP-201-SS-2 Grab Soil Sample	5315621
GP-201-SS-3 Grab Soil Sample	5315622
GP-201-SS-4 Grab Soil Sample	5315623
GP-201-SS-5 Grab Soil Sample	5315624
GP-201-SS-6 Grab Soil Sample	5315625
GP-201-SS-7 Grab Soil Sample	5315626

1 COPY TO	SECOR International, Inc	Attn: Casey Mundry
ELECTRONIC COPY TO	LLI	Attn: EDD Group

Lancaster Laboratories

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

Analysis Report

Questions? Contact your Client Services Representative
Loran A Carter at (717) 656-2300

Respectfully Submitted,

Robert Heisey

Robert Heisey
Senior Specialist

Lancaster Laboratories

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

Analysis Report

Lancaster Laboratories Sample No. SW5315620 **Group No. 1083613**

GP-201-SS-1 Grab Soil Sample
GP-201

Collected:03/26/2008 13:35 by CM

Account Number: 11183

Submitted: 03/27/2008 16:45
Reported: 04/01/2008 at 15:10
Discard: 06/01/2008

SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341

201-1

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Method Detection Limit	Units	Dilution Factor
00394	pH in soil	n.a.	8.88	0.0100	Std. Units	1

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
00394	pH in soil	SW-846 9045C modified	1	03/28/2008 22:45	Luz M Groff	1

Lancaster Laboratories

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

Analysis Report

Lancaster Laboratories Sample No. SW5315621 **Group No. 1083613**

GP-201-SS-2 Grab Soil Sample
GP-201

Collected:03/26/2008 13:27 by CM

Account Number: 11183

Submitted: 03/27/2008 16:45
Reported: 04/01/2008 at 15:10
Discard: 06/01/2008

SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341

201-2

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Method Detection Limit	Units	Dilution Factor
00394	pH in soil	n.a.	9.00	0.0100	Std. Units	1

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
00394	pH in soil	SW-846 9045C modified	1	03/28/2008 22:45	Luz M Groff	1

Lancaster Laboratories

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

Analysis Report

Lancaster Laboratories Sample No. SW5315622 **Group No. 1083613**

GP-201-SS-3 Grab Soil Sample
GP-201

Collected:03/26/2008 13:30 by CM

Account Number: 11183

Submitted: 03/27/2008 16:45
Reported: 04/01/2008 at 15:10
Discard: 06/01/2008

SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341

201-3

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Method Detection Limit	Units	Dilution Factor
00394	pH in soil	n.a.	8.53	0.0100	Std. Units	1

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
00394	pH in soil	SW-846 9045C modified	1	03/28/2008 22:45	Luz M Groff	1

Lancaster Laboratories

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

Analysis Report

Lancaster Laboratories Sample No. SW5315623 **Group No. 1083613**

GP-201-SS-4 Grab Soil Sample
GP-201

Collected:03/26/2008 13:21 by CM

Account Number: 11183

Submitted: 03/27/2008 16:45
Reported: 04/01/2008 at 15:10
Discard: 06/01/2008

SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341

201-4

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Method Detection Limit	Units	Dilution Factor
00394	pH in soil	n.a.	8.55	0.0100	Std. Units	1

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
00394	pH in soil	SW-846 9045C modified	1	03/28/2008 22:45	Luz M Groff	1

Lancaster Laboratories

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

Analysis Report

Lancaster Laboratories Sample No. SW5315624 **Group No. 1083613**

GP-201-SS-5 Grab Soil Sample
GP-201

Collected:03/26/2008 13:24 by CM

Account Number: 11183

Submitted: 03/27/2008 16:45
Reported: 04/01/2008 at 15:10
Discard: 06/01/2008

SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341

201-5

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Method Detection Limit	Units	Dilution Factor
00394	pH in soil	n.a.	8.88	0.0100	Std. Units	1

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
00394	pH in soil	SW-846 9045C modified	1	03/28/2008 22:45	Luz M Groff	1

Lancaster Laboratories

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

Analysis Report

Lancaster Laboratories Sample No. SW5315625 **Group No. 1083613**

GP-201-SS-6 Grab Soil Sample
GP-201

Collected:03/26/2008 13:18 by CM

Account Number: 11183

Submitted: 03/27/2008 16:45
Reported: 04/01/2008 at 15:10
Discard: 06/01/2008

SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341

201-6

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Method Detection Limit	Units	Dilution Factor
00394	pH in soil	n.a.	7.89	0.0100	Std. Units	1

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
00394	pH in soil	SW-846 9045C modified	1	03/28/2008 22:45	Luz M Groff	1

Lancaster Laboratories

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

Analysis Report

Lancaster Laboratories Sample No. SW5315626 **Group No. 1083613**

GP-201-SS-7 Grab Soil Sample
GP-201

Collected:03/26/2008 13:20 by CM

Account Number: 11183

Submitted: 03/27/2008 16:45
Reported: 04/01/2008 at 15:10
Discard: 06/01/2008

SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341

201-7

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Method Detection Limit	Units	Dilution Factor
00394	pH in soil	n.a.	7.99	0.0100	Std. Units	1

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
00394	pH in soil	SW-846 9045C modified	1	03/28/2008 22:45	Luz M Groff	1

Lancaster Laboratories

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

Analysis Report

Quality Control Summary

Client Name: SECOR International, Inc
Reported: 04/01/08 at 03:10 PM

Group Number: 1083613

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

Analysis Name	Blank Result	Blank MDL	Report Units	LCS %REC	LCSD %REC	LCS/LCSD Limits	RPD	RPD Max
Batch number: 08088039402A	Sample number(s): 5315620-5315625							
pH in soil				100		99-101		
Batch number: 08088039402B	Sample number(s): 5315626							
pH in soil				100		99-101		

Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

Analysis Name	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD MAX	BKG Conc	DUP Conc	DUP RPD	Dup RPD Max
Batch number: 08088039402A	Sample number(s): 5315620-5315625					BKG: P315618			
pH in soil						10.1	10.1	0	1
Batch number: 08088039402B	Sample number(s): 5315626					BKG: 5315626			
pH in soil						7.99	7.98	0	1

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

Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only
Acct. # 11183 Group# 1093613 Sample # 5315620-26

COC # 177221

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

(1) Client: SECOR INTERNATIONAL Acct. #:
Project Name/#: GP-201 PWSID #:
Project Manager: Casey Mundry P.O.#:
Sampler: CM + SA Quote #:
Name of state where samples were collected: PA

(4) Preservation Codes

(5) Analyses Requested

For Lab Use Only
FSC:
SCR#: 57002

Preservation Codes
H=HCl T=Thiosulfate
N=HNO_3 B=NaOH
S=H_2SO_4 O=Other

(6) Remarks

(2) (3)

GP-201-SS-1	3-26-08	1335	X		X		1	X	
GP-201-SS-2	3-26-08	1327	X		X		1	X	
GP-201-SS-3	3-26-08	1330	X		X		1	X	
GP-201-SS-4	3-26-08	1321	X		X		1	X	
GP-201-SS-5	3-26-08	1324	X		X		1	X	
GP-201-SS-6	3-26-08	1318	X		X		1	X	
GP-201-SS-7	3-26-08	1320	X		X		1	X	

(7) **Turnaround Time Requested** (TAT) (please circle): (Normal) 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 #: 484.875.3075 Fax #: 484.875.9286
E-mail address: CMundry@secor.com

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg)
Type II (Tier II)
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)
TX TRRP-13
MA MCP CT RCP
SDG Complete? Yes No
Site-specific QC (MS/MSD/Dup)? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal COC Required? Yes / No

Relinquished by:	Date	Time	Received by:	Date	Time
Bonnie Storage					
Stephanie L. Andrews	3/27/08	8:47		3-27-08	8:47
	3/27/08	1645			
			Jeneen Dilon	3/27/08	1645

(9)

Lancaster Laboratories, Inc., 2425 New Holland Pike, Lancaster, PA 17601 (717) 656-2300 Fax: (717) 656-6766
Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

2102.03

SECOR

SECOR
INTERNATIONAL
INCORPORATED

www.secor.com
102 Pickering Way, Suite 200
Exton, PA 19341
484-875-3075 tel
484-875-9286 fax

June 3, 2008

Ron Rosendorn
Senior Environmental Engineer Specialist
SUNOCO (R&S)
3144 Passyunk Avenue
Philadelphia, Pennsylvania

RE: Tank GP-201 Soil Sampling
Philadelphia Refinery

Dear Mr. Rosendorn:

This letter summarizes the site assessment activities in response to a release of approximately 265 gallons of sulfuric acid, impacting approximately 25 cubic yards of surface soil surrounding tank GP-201. The release occurred on December 10, 2007

The project site is located within the Sunoco, Inc. (Sunoco) Philadelphia Refinery located in Philadelphia, Pennsylvania (**Figure 1**). As a result of the release, interim remedial activities were conducted by Sunoco, including treating the impacted area with sodium carbonate. Site assessment activities were conducted after the treatment of surface soil to determine whether additional interim remedial actions are necessary to abate an imminent hazard to human health or the environment.

The following information supplements the site characterization for area of interest (AOI) 6 conducted under the Consent Order & Agreement (CO&A), titled Site Characterization Report Area of Interest 6 submitted by Langan on September 29, 2006. GP-201 is located with in AOI 6.

Soil Sampling and Laboratory Analyses

The sampling activities were completed in accordance with Pennsylvania Department of Environmental Protection (PADEP) Pennsylvania Technical Guidance Document, Guidance for Attainment Demonstration. SECOR collected a total of 7 samples on March 26, 2008. The soil samples where collected with bias towards areas most likely impacted by the release. Soil sample locations are depicted on **Figure 2**. All soil samples were collected at a depth of approximately 0-0.5 feet below ground surface. Soil samples were analyzed for pH.

Lancaster Laboratories
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
Cal	(diet) calories	**lb.**	pound(s)
meq	milliequivalents	**kg**	kilogram(s)
g	gram(s)	**mg**	milligram(s)
ug	microgram(s)	**l**	liter(s)
ml	milliliter(s)	**ul**	microliter(s)
m3	cubic meter(s)	**fib >5 um/ml**	fibers greater than 5 microns in length per ml

< less than – The number following the sign is the limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

> greater than

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.

U.S. EPA data qualifiers:

Organic Qualifiers

A	TIC is a possible aldol-condensation product
B	Analyte was also detected in the blank
C	Pesticide result confirmed by GC/MS
D	Compound quatitated on a diluted sample
E	Concentration exceeds the calibration range of the instrument
J	Estimated value
N	Presumptive evidence of a compound (TICs only)
P	Concentration difference between primary and confirmation columns >25%
U	Compound was not detected
X,Y,Z	Defined in case narrative

Inorganic Qualifiers

B	Value is <CRDL, but ≥IDL
E	Estimated due to interference
M	Duplicate injection precision not met
N	Spike amount not within control limits
S	Method of standard additions (MSA) used for calculation
U	Compound was not detected
W	Post digestion spike out of control limits
*****	Duplicate analysis not within control limits
+	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.

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.

Pennsylvania Department of Environmental Protection

2 East Main Street
Norristown, PA 19401
July 30, 2008

Southeast Regional Office

Phone: 484-250-5960
Fax: 484-250-5961

Mr. Ron Rosendorn
Sunoco, Inc.
3144 Passyunk Avenue
Philadelphia, PA 19145-5299

Re: Storage Tank Program
310(b) Site Characterization Report Approval
Sunoco, Inc. Girard Point Process Area
Facility ID No. 51-36558
3144 Passyunk Avenue
City of Philadelphia
Philadelphia County

Dear Mr. Rosendorn:

Your Site Characterization Report (SCR) submitted by SECOR International, Inc., dated June 3, 2008, for the above-referenced facility meets the criteria of Chapter 245, Section 301(b).

The report summarizes the findings of the site assessment activities and the interim remedial actions taken in response to a release of sulfuric acid in the area of tank GP-201. The analytical results for soil sampling indicate that the detected levels of pH were within the range typically found in soil.

The report is hereby approved, as provided for in Chapter 245, Section 245.310(c)(1) of the Department of Environmental Protection's (Department) Corrective Action Regulations. This report fulfills your reporting requirements under the corrective action process for this incident.

This letter does not waive any rights of the Commonwealth of Pennsylvania to take enforcement action under applicable law for the conditions discussed in this letter.

Thank you for your cooperation in working with the Department toward the remediation of this site. If you need additional information or have any questions, please call me at 484-250-5781.

Sincerely,

Ayman L. Ghobrial

Ayman L. Ghobrial, P.G.
Licensed Professional Geologist
Environmental Cleanup

cc: Mr. Miceli - USTIF
Philadelphia Health Department
Ms. Mundry - SECOR
Mr. Canigiani
Ms. Warren
Ms. Kunsch (for Site-Specific Standard)
Re 30 (GJE08ECP)212

GP-250

SECOR

SECOR
INTERNATIONAL
INCORPORATED

www.secor.com
102 Pickering Way, Suite 200
Exton, PA 19341
484-875-3075 TEL
484-875-9286 FAX

July 19, 2007

Ron Rosendorn
Senior Environmental Engineer Specialist
SUNOCO (R&S)
3144 Passyunk Avenue
Philadelphia, Pennsylvania

RE: Tank GP 250 Soil Sampling
Philadelphia Refinery

Dear Mr. Rosendorn:

This letter summarizes the site assessment activities in response to a release of approximately 600 gallons of unfinished light fuel oil (also referred to as jet fuel stock) impacting approximately 40 cubic yards of surface soil within the dike area for tank GP 250.

The project site is located within the Sunoco, Inc. (Sunoco) Philadelphia Refinery located in Philadelphia, Pennsylvania (**Figure 1**). As a result of the release, interim remedial activities were conducted by Sunoco, including the removal of surface soils. Site assessment activities were conducted after the removal of surface soil to determine whether additional interim remedial actions are necessary to abate an imminent hazard to human health or the environment.

The following information supplements the AOI 6 Site Characterization Report submitted by Langan on September 29, 2006.

Soil Sampling and Laboratory Analyses

The sampling activities were completed in accordance with Pennsylvania Department of Environmental Protection (PADEP) Pennsylvania Technical Guidance Document, Guidance for Attainment Demonstration with Statistical Methods. SECOR collected a total of 8 samples on May 15, 2007 and the same sample locations re-sampled on July 3, 2007. The sample points were re-sampled due to the laboratory missing required parameters on the analysis requested and elevated detection limits. Soil sample locations are depicted on **Figure 2**. All soil samples were collected at a depth of approximately 0-0.5 feet below ground surface.

The soil samples were analyzed for PADEP Pennsylvania Land Recycling Program (Act 2) short list of parameters for jet fuel and kerosene. The list includes the analyses of benzene, toluene, ethylbenzene, total xylenes (BTEX), naphthalene, cumene, 1,2-dichloroethane, and 1,2-dibromomethane by EPA Method 8260B, fluorene by EPA Method 8270C, and lead by EPA Method 6010B. The samples were analyzed for the full list of parameters required under the PADEP short list for jet fuel and kerosene regardless of the fact that lead and EDB were not additives used in the released product. Lead and EDB were used as additives in a product called "aviation gasoline" but that product has not been produced at Sunoco in many years (per Sunoco).

Soil Sampling Results

The analytical results for the soil samples collected are summarized on **Table 1A** and **Table 1B**. Copies of the laboratory analytical results are included in **Appendix A.** The analytical results for the soil samples were compared to the cleanup criteria established by PADEP under Act 2. Under the regulations implementing Act 2, Medium Specific Concentrations (MSCs) for soils include two components: direct contact exposure scenarios and those which are designed to protect groundwater. Soil sample analytical results were compared to the Nonresidential Surface Soil and Subsurface Soil Direct Contact MSCs and Used Aquifer Nonresidential Soil-to-Groundwater MSCs. These MSCs are listed in Appendix A, Table 2, Tables 3A and 3B, and Tables 4A and 4B (revised November 24, 2001) of the Act 2 Rules and Regulations.

With the exception of lead, no soil samples exceeded the Nonresidential Surface Soil Direct Contact MSCs, Nonresidential Subsurface Soil Direct Contact, or the Used Aquifer Nonresidential Soil-to-Groundwater MSCs. Lead exceeded the Used Aquifer Nonresidential Soil-to-Groundwater MSC of 450 mg/kg in two locations, AST-250-SS-1 and AST-250-SS-6 at 940 mg/kg and1500 mg/kg, respectively. These two samples were analyzed by the Synthetic Precipitation Leaching Procedure (SPLP) to evaluate the potential for leaching metals into groundwater. These results are provided on **Table 1B**. As stated above, lead is not a constituent related to the product released. During the site characterization activities completed per the February 24, 2006 Site Characterization Work Plan (Langan), soil samples collected in and around the Tank 250 dike indicate that lead was detected at levels comparable to levels detected during this recent sampling event. Lead is a known historical contaminant which is being evaluated through site characterization efforts in accord with the 2003 Consent Order and Agreement between Sunoco, Inc. (R&M) and PADEP.

Conclusions

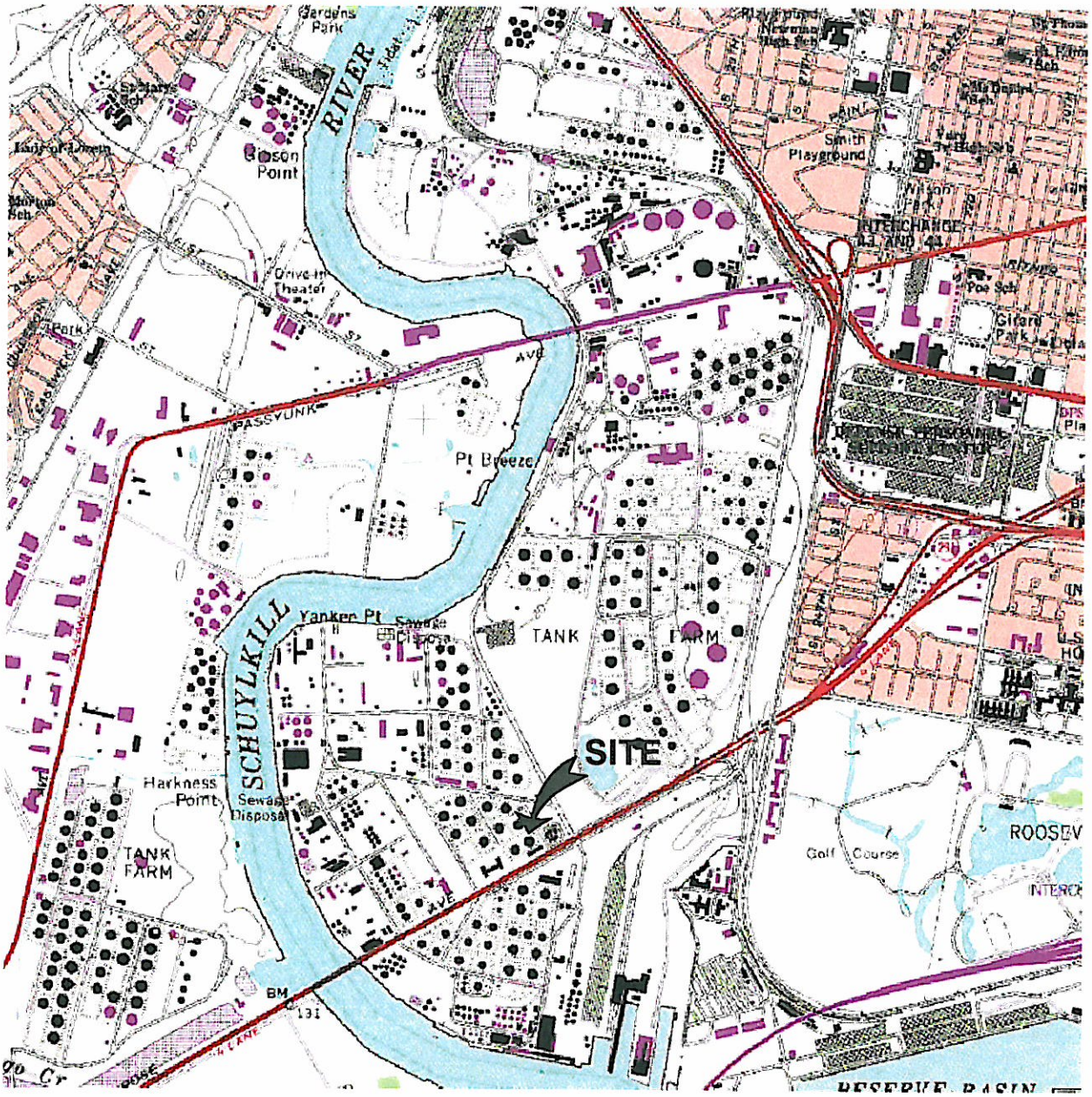
Soil attainment with respect to this release has been demonstrated, the analytical data indicate that no soil sample results exceed the Nonresidential Surface Soil and Subsurface Soil Direct Contact and Used Aquifer Nonresidential Soil-to-Groundwater MSCs for the released material. No further remedial activities are found to be necessary; the interim remedial activities completed have effectively removed imminent hazard to human health or the environment.

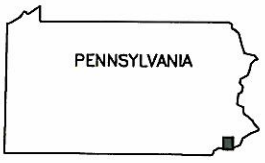
Should you have any questions or comments, please feel free to contact either of us at (484) 875-3075.

Sincerely,
SECOR International Incorporated

Casey Yetman
Project Manager

Cc: Jim Oppenheim (Sunoco)
Frank Aceto (SECOR)
Project File





QUADRANGLE LOCATION

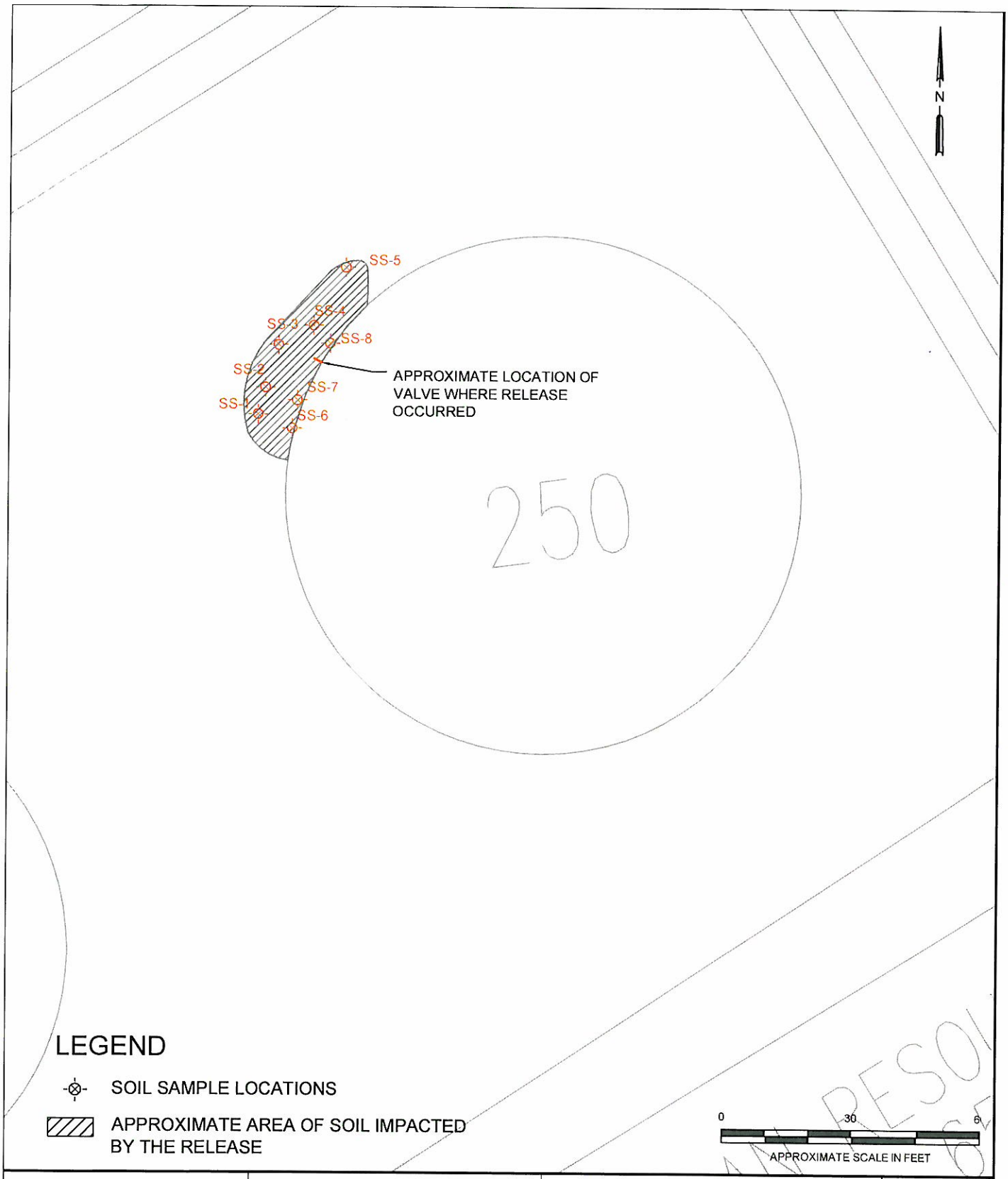
N

0 1/2 1

SCALE (MILES)

REFERENCE: USGS 7.5 MINUTE QUADRANGLE; PHILADELPHIA, PENNSYLVANIA–NEW JERSEY; 1995

SECOR 102 PICKERING WAY, SUITE 200 EXTON, PENNSYLVANIA PHONE: (484) 875-3075/875-8286 (FAX)	FOR: SUNOCO, INC. PHILADELPHIA REFINERY PHILADELPHIA, PENNSYLVANIA		**SITE LOCATION MAP TANK GP-250**		FIGURE: **1**
	JOB NUMBER: 62SU.01105.06/0001	DRAWN BY: TFB	CHECKED BY: CY	APPROVED BY:	DATE: 05/03/2006



SECOR
102 PICKERING WAY, SUITE 200
EXTON, PENNSYLVANIA
PHONE: (484) 875-3075 FAX: (484) 875-9286

FOR:				FIGURE:
SUNOCO, INC. PHILADELPHIA REFINERY PHILADELPHIA, PENNSYLVANIA		TANK 250 SOIL SAMPLES JULY 03, 2007		2
JOB NUMBER:	DRAWN BY: TFB	CHECKED BY:	APPROVED BY:	DATE: 07/03/2007

Table 1A
Summary of Soil Analytical Results
AST GP-250 Release Sampling
May 15, 2007 Sample Set

Sample Identification	MSCs			AST-250-SS-1	AST-250-SS-2	AST-250-SS-3	AST-250-SS-4	AST-250-SS-5	AST-250-SS-6	AST-250-SS-7	AST-250-SS-8
Sample Collection Depth (FBG)	Direct Contact, Non-residential, 0-2 feet[1]	Direct Contact, Non-residential, 2-15 feet[1]	Soil to Groundwater, Used Aquifer, Non residential[2]	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
VOCs											
Benzene	210,000	240,000	500	ND (81)	ND (97)	ND (88)	ND (100)	ND (110)	ND (69)	ND (78)	ND (92)
Cumene	10,000,000	10,000,000	1,600,000	ND (81)	ND (97)	ND (88)	120	ND (110)	ND (69)	ND (78)	ND (92)
1,2-Dibromoethane	930	8,600	5	ND (81)	ND (97)	ND (88)	ND (100)	ND (110)	ND (69)	ND (78)	ND (92)
1,2-Dichloroethane	63,000	73,000	500	ND (81)	ND (97)	ND (88)	ND (100)	ND (110)	ND (69)	ND (78)	ND (92)
Ethylbenzene	10,000,000	10,000,000	70,000	ND (81)	ND (97)	ND (88)	ND (100)	ND (110)	ND (69)	ND (78)	ND (92)
Naphthalene	56,000,000	190,000,000	25,000	ND (81)	ND (97)	310	4,200	ND (110)	ND (69)	ND (78)	ND (92)
Toluene	10,000,000	10,000,000	100,000	ND (81)	ND (97)	ND (88)	ND (100)	ND (110)	ND (69)	ND (78)	ND (92)
Total Xylenes	140,000	190,000	1,000,000	ND (81)	ND (97)	ND (88)	870	ND (110)	ND (69)	ND (78)	ND (92)
SVOC											
Fluorene	110,000,000	190,000,000	3,800,000	ND (350)	ND (350)	ND (350)	ND (350)	ND (350)	ND (350)	ND (350)	ND (350)

Notes:

FBG = Feet Below Grade

All concentrations are in ug/kg (micrograms per kilogram), with the exception of lead is reported in mg/kg

ND (30) = Not detected at or above the laboratory reporting limit

MSCs = Medium-Specific Concentrations

1. Pennsylvania Land Recycling Program (25 PA code Chapter 250), Appendix A, Table 3 A (Revised November 24, 2001)
2. Pennsylvania Land Recycling Program (25 PA code Chapter 250), Appendix A, Table 3 B (Revised November 24, 2001)

Table 1B
Summary of Soil Analytical Results
AST GP-250 Release Sampling
July 3, 2007 Sample Set

Sample Identification	MSCs			AST-250-SS-1	AST-250-SS-2	AST-250-SS-3	AST-250-SS-4	AST-250-SS-5	AST-250-SS-6	AST-250-SS-7	AST-250-SS-8
Sample Collection Depth (FBG)	Direct Contact, Non-residential, 0-2 feet[1]	Direct Contact, Non-residential, 2-15 feet[1]	Soil to Groundwater, Used Aquifer, Non-residential[2]	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
VOCs											
Benzene	210,000	240,000	500	ND (4.5)	ND (5.5)	ND (5.8)	ND (390)	ND (4.6)	ND (4.8)	ND (5.7)	ND (4.8)
Cumene	10,000,000	10,000,000	1,600,000	ND (4.5)	ND (5.5)	ND (5.8)	ND (390)	ND (4.6)	ND (4.8)	ND (5.7)	ND (4.8)
1,2-Dibromoethane (EDB)	930	8,600	5	ND (4.5)							
1,2-Dichloroethane	63,000	73,000	500	ND (4.5)	ND (5.5)	ND (5.8)	ND (390)	ND (4.6)	ND (4.8)	ND (5.7)	ND (4.8)
Ethylbenzene	10,000,000	10,000,000	70,000	ND (4.5)	ND (5.5)	ND (5.8)	ND (390)	ND (4.6)	ND (4.8)	ND (5.7)	ND (4.8)
Naphthalene	56,000,000	190,000,000	25,000	ND (4.5)	ND (5.5)	ND (5.8)	1,500	ND (4.6)	ND (4.8)	ND (5.7)	ND (4.8)
Toluene	10,000,000	10,000,000	100,000	ND (4.5)	ND (5.5)	6.1	ND (390)	ND (4.6)	ND (4.8)	ND (5.7)	ND (4.8)
Total Xylenes	140,000	190,000	1,000,000	ND (4.5)	ND (11)	ND (5.8)	1,200	ND (9.3)	ND (4.8)	ND (11)	ND (4.8)
SVOC											
Fluorene	110,000,000	190,000,000	3,800,000	ND (350)	ND (350)	ND (350)	620	ND (370)	ND (380)	ND (390)	ND (350)
Metal											
Lead (mg/kg)	1,000	190,000	450	**940**	30	100	2.8	190	**1,500**	140	13
Lead SPLP (mg/l)	0.005[3] (Residential Used Aquifer TDS ≤ 2500)			**0.15**	NA	NA	NA	NA	**ND (0.05)**	NA	NA

Notes:

FBG = Feet Below Grade

All concentrations are in ug/kg (micrograms per kilogram), with the exception of lead is reported in mg/kg

ND (30) = Not detected at or above the laboratory reporting limit

NA = Not Analyzed

MSCs = Medium-Specific Concentrations

1. Pennsylvania Land Recycling Program (25 PA code Chapter 250), Appendix A, Table 3 A (Revised November 24, 2001)
2. Pennsylvania Land Recycling Program (25 PA code Chapter 250), Appendix A, Table 3 B (Revised November 24, 2001)
3. Pennsylvania Land Recycling Program (25 PA code Chapter 250), Appendix A, Table 2 (Revised November 24, 2001)

Pace Analytical®
www.pacelabs.com

Pace Analytical Services, Inc.
5203 Triangle Lane
Export, PA 15632
Phone: 724.733.1161
Fax: 724.327.7793

May 29, 2007

Ms. Casey Yetman
Sunoco_SECOR International, Inc. - Exton
102 Pickering Way, Suite 200
Exton, PA 19341

Dear Ms. Yetman:

Enclosed are analytical results for samples submitted to Pace Analytical by Sunoco_SECOR International, Inc. - Exton. The samples were received on May 17, 2007. The results reported in this project meet the requirements as specified in Chapter 5 of the NELAC Standards. Any deviations or discrepancies from the NELAC standards are documented in the case narrative(s) of this report. Parameters printed in italics represent Non-NELAC accredited parameters. Please reference Pace project number 07-3770 when inquiring about this report.

Client Site: Tank 250
Client Ref.: UST

Pace Sample Identification	Client Sample Identification
0705-2798	AST-250-SS-1
0705-2799	AST-250-SS-2
0705-2800	AST-250-SS-3
0705-2801	AST-250-SS-5

Pace Sample Identification	Client Sample Identification
0705-2802	AST-250-SS-4
0705-2803	AST-250-SS-6
0705-2804	AST-250-SS-7
0705-2805	AST-250-SS-8

General Comments: Cooler temperature 5 ° C upon receipt. Ice was present. This report has been reissued on 7/19/07. Sample 0705-2801 was changed from AST-250-SS-4 to AST-250-SS-5 and sample 0705-2802 was changed from AST-250-SS-5 to AST-250-SS-4 as per client request. Please replace the original report with the revised report enclosed.

Please call me if you have any questions regarding the information contained within this report.

Sincerely,

Carin A. Ferris

Carin A. Ferris
Project Manager

CAM: jld

Enclosures

Page 1 of 10

REPORT OF LABORATORY ANALYSIS

Pace Analytical®
www.pacelabs.com

Pace Analytical Services, Inc.
5203 Triangle Lane
Export, PA 15632
Phone: 724.733.1161
Fax: 724.327.7793

Ms. Casey Yetman
Sunoco_SECOR International, Inc. - Exton
102 Pickering Way, Suite 200
Exton, PA 19341

Client Site: Tank 250
Client Ref.: UST

Lab Project ID: **07-3770**
Lab Sample ID: **0705-2798**
Client Sample ID: AST-250-SS-1
Sample Matrix: Solid

Date Sampled: 05/15/2007
Date Received: 05/17/2007

Inorganic Extraction

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Percent Solids	% Solids	96	N/A	%	DAB	05/18/2007	N/A	N/A

Semivolatiles

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Semivolatile Organic Compounds, GC/MS								
Fluorene	8270C[1]	<350	350	ug/kg	SPL	05/23/2007	0060950-1	<330

Volatiles

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Volatile Organic Compounds, MS								
Benzene	8260B[1]	<81	81	ug/kg	MAK	05/21/2007	0060990-1	<250
Cumene	8260B[1]	<81	81	ug/kg	MAK	05/21/2007	0060990-1	<250
1,2-Dibromoethane	8260B[1]	<81	81	ug/kg	MAK	05/21/2007	0060990-1	<250
1,2-Dichloroethane	8260B[1]	<81	81	ug/kg	MAK	05/21/2007	0060990-1	<250
Ethylbenzene	8260B[1]	<81	81	ug/kg	MAK	05/21/2007	0060990-1	<250
Naphthalene	8260B[1]	<81	81	ug/kg	MAK	05/21/2007	0060990-1	<250
Toluene	8260B[1]	<81	81	ug/kg	MAK	05/21/2007	0060990-1	<250
Xylenes (Total)	8260B[1]	<81	81	ug/kg	MAK	05/21/2007	0060990-1	<250

[1] U.S. Environmental Protection Agency, 1996, Test Methods for Evaluating Solid Waste, SW-846, 3rd ed., Office of Solid Waste and Emergency Response, Washington, DC.

Sample Comments: Results reported in dry weight equivalence.

REPORT OF LABORATORY ANALYSIS

Pace Analytical®
www.pacelabs.com

Pace Analytical Services, Inc.
5203 Triangle Lane
Export, PA 15632
Phone: 724.733.1161
Fax: 724.327.7793

Ms. Casey Yetman
Sunoco_SECOR International, Inc. - Exton
102 Pickering Way, Suite 200
Exton, PA 19341

Client Site: Tank 250
Client Ref.: UST

Lab Project ID: **07-3770**
Lab Sample ID: **0705-2799**
Client Sample ID: AST-250-SS-2
Sample Matrix: Solid

Date Sampled: 05/15/2007
Date Received: 05/17/2007

Inorganic Extraction

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Percent Solids	% Solids	96	N/A	%	DAB	05/18/2007	N/A	N/A

Semivolatiles

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Semivolatile Organic Compounds, GC/MS								
Fluorene	8270C(1)	<350	350	ug/kg	SPL	05/23/2007	0060950-1	<330

Volatiles

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Volatile Organic Compounds, MS								
Benzene	8260B(1)	<97	97	ug/kg	MAK	05/18/2007	0060931-1	<5.0
Cumene	8260B(1)	<97	97	ug/kg	MAK	05/18/2007	0060931-1	<5.0
1,2-Dibromoethane	8260B(1)	<97	97	ug/kg	MAK	05/18/2007	0060931-1	<5.0
1,2-Dichloroethane	8260B(1)	<97	97	ug/kg	MAK	05/18/2007	0060931-1	<5.0
Ethylbenzene	8260B(1)	<97	97	ug/kg	MAK	05/18/2007	0060931-1	<5.0
Naphthalene	8260B(1)	<97	97	ug/kg	MAK	05/18/2007	0060931-1	<5.0
Toluene	8260B(1)	<97	97	ug/kg	MAK	05/18/2007	0060931-1	<5.0
Xylenes (Total)	8260B(1)	<97	97	ug/kg	MAK	05/18/2007	0060931-1	<5.0

(1) U.S. Environmental Protection Agency, 1996, Test Methods for Evaluating Solid Waste, SW-846, 3rd ed., Office of Solid Waste and Emergency Response, Washington, DC.

Sample Comments: Results reported in dry weight equivalence.

REPORT OF LABORATORY ANALYSIS

Pace Analytical®
www.pacelabs.com

Pace Analytical Services, Inc.
5203 Triangle Lane
Export, PA 15632
Phone: 724.733.1161
Fax: 724.327.7793

Ms. Casey Yetman
Sunoco_SECOR International, Inc. - Exton
102 Pickering Way, Suite 200
Exton, PA 19341

Client Site: Tank 250
Client Ref.: UST

Lab Project ID: **07-3770**
Lab Sample ID: **0705-2800**
Client Sample ID: AST-250-SS-3
Sample Matrix: Solid

Date Sampled: 05/15/2007
Date Received: 05/17/2007

Inorganic Extraction

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Percent Solids	% Solids	89	N/A	%	DAB	05/18/2007	N/A	N/A

Semivolatiles

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Semivolatile Organic Compounds, GC/MS								
Fluorene	8270C(1)	<370	370	ug/kg	SPL	05/23/2007	0060950-1	<330

Volatiles

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Volatile Organic Compounds, MS								
Benzene	8260B(1)	<88	88	ug/kg	MAK	05/21/2007	0060990-1	<250
Cumene	8260B(1)	<88	88	ug/kg	MAK	05/21/2007	0060990-1	<250
1,2-Dibromoethane	8260B(1)	<88	88	ug/kg	MAK	05/21/2007	0060990-1	<250
1,2-Dichloroethane	8260B(1)	<88	88	ug/kg	MAK	05/21/2007	0060990-1	<250
Ethylbenzene	8260B(1)	<88	88	ug/kg	MAK	05/21/2007	0060990-1	<250
Naphthalene	8260B(1)	310	88	ug/kg	MAK	05/21/2007	0060990-1	<250
Toluene	8260B(1)	<88	88	ug/kg	MAK	05/21/2007	0060990-1	<250
Xylenes (Total)	8260B(1)	98	88	ug/kg	MAK	05/21/2007	0060990-1	<250

(1) U.S. Environmental Protection Agency, 1996, Test Methods for Evaluating Solid Waste, SW-846, 3rd ed., Office of Solid Waste and Emergency Response, Washington, DC.

Sample Comments: Results reported in dry weight equivalence. Surrogate recoveries were outside QC limits(high) due to matrix interferences.

REPORT OF LABORATORY ANALYSIS

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Ms. Casey Yetman
Sunoco_SECOR International, Inc. - Exton
102 Pickering Way, Suite 200
Exton, PA 19341

Client Site: Tank 250
Client Ref.: UST

Lab Project ID: **07-3770**
Lab Sample ID: **0705-2801**
Client Sample ID: AST-250-SS-5
Sample Matrix: Solid

Date Sampled: 05/15/2007
Date Received: 05/17/2007

Inorganic Extraction

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Percent Solids	% Solids	93	N/A	%	DAB	05/18/2007	N/A	N/A

Semivolatiles

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Semivolatile Organic Compounds, GC/MS								
Fluorene	8270C(1)	<360	360	ug/kg	SPL	05/23/2007	0060950-1	<330

Volatiles

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Volatile Organic Compounds, MS								
Benzene	8260B(1)	<110	110	ug/kg	MAK	05/18/2007	0060931-1	<5.0
Cumene	8260B(1)	<110	110	ug/kg	MAK	05/18/2007	0060931-1	<5.0
1,2-Dibromoethane	8260B(1)	<110	110	ug/kg	MAK	05/18/2007	0060931-1	<5.0
1,2-Dichloroethane	8260B(1)	<110	110	ug/kg	MAK	05/18/2007	0060931-1	<5.0
Ethylbenzene	8260B(1)	<110	110	ug/kg	MAK	05/18/2007	0060931-1	<5.0
Naphthalene	8260B(1)	<110	110	ug/kg	MAK	05/18/2007	0060931-1	<5.0
Toluene	8260B(1)	<110	110	ug/kg	MAK	05/18/2007	0060931-1	<5.0
Xylenes (Total)	8260B(1)	<110	110	ug/kg	MAK	05/18/2007	0060931-1	<5.0

(1) U.S. Environmental Protection Agency, 1996, Test Methods for Evaluating Solid Waste, SW-846, 3rd ed., Office of Solid Waste and Emergency Response, Washington, DC.

Sample Comments: Results reported in dry weight equivalence.

REPORT OF LABORATORY ANALYSIS

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Ms. Casey Yetman
Sunoco_SECOR International, Inc. - Exton
102 Pickering Way, Suite 200
Exton, PA 19341

Client Site: Tank 250
Client Ref.: UST

Lab Project ID: **07-3770**
Lab Sample ID: **0705-2802**
Client Sample ID: AST-250-SS-4
Sample Matrix: Solid

Date Sampled: 05/15/2007
Date Received: 05/17/2007

Inorganic Extraction

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Percent Solids	% Solids	96	N/A	%	DAB	05/18/2007	N/A	N/A

Semivolatiles

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Semivolatile Organic Compounds, GC/MS								
Fluorene	8270C[1]	<350	350	ug/kg	SPL	05/23/2007	0060950-1	<330

Volatiles

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Volatile Organic Compounds, MS								
Benzene	8260B[1]	<100	100	ug/kg	MAK	05/18/2007	0060931-1	<5.0
Cumene	8260B[1]	120	100	ug/kg	MAK	05/18/2007	0060931-1	<5.0
1,2-Dibromoethane	8260B[1]	<100	100	ug/kg	MAK	05/18/2007	0060931-1	<5.0
1,2-Dichloroethane	8260B[1]	<100	100	ug/kg	MAK	05/18/2007	0060931-1	<5.0
Ethylbenzene	8260B[1]	<100	100	ug/kg	MAK	05/18/2007	0060931-1	<5.0
Naphthalene	8260B[1]	4200	100	ug/kg	MAK	05/18/2007	0060931-1	<5.0
Toluene	8260B[1]	<100	100	ug/kg	MAK	05/18/2007	0060931-1	<5.0
Xylenes (Total)	8260B[1]	870	100	ug/kg	MAK	05/18/2007	0060931-1	<5.0

[1] U.S. Environmental Protection Agency, 1996, Test Methods for Evaluating Solid Waste, SW-846, 3rd ed., Office of Solid Waste and Emergency Response, Washington, DC.

Sample Comments: Results reported in dry weight equivalence. Surrogate recoveries were outside QC limits(high) due to matrix interferences.

REPORT OF LABORATORY ANALYSIS

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Ms. Casey Yetman
Sunoco_SECOR International, Inc. - Exton
102 Pickering Way, Suite 200
Exton, PA 19341

Client Site: Tank 250
Client Ref.: UST

Lab Project ID: **07-3770**
Lab Sample ID: **0705-2803**
Client Sample ID: AST-250-SS-6
Sample Matrix: Solid

Date Sampled: 05/15/2007
Date Received: 05/17/2007

Inorganic Extraction

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Percent Solids	% Solids	95	N/A	%	DAB	05/18/2007	N/A	N/A

Semivolatiles

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Semivolatile Organic Compounds, GC/MS								
Fluorene	8270C[1]	<350	350	ug/kg	SPL	05/23/2007	0060950-1	<330

Volatiles

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Volatile Organic Compounds, MS								
Benzene	8260B[1]	<69	69	ug/kg	MAK	05/18/2007	0060931-1	<5.0
Cumene	8260B[1]	<69	69	ug/kg	MAK	05/18/2007	0060931-1	<5.0
1,2-Dibromoethane	8260B[1]	<69	69	ug/kg	MAK	05/18/2007	0060931-1	<5.0
1,2-Dichloroethane	8260B[1]	<69	69	ug/kg	MAK	05/18/2007	0060931-1	<5.0
Ethylbenzene	8260B[1]	<69	69	ug/kg	MAK	05/18/2007	0060931-1	<5.0
Naphthalene	8260B[1]	<69	69	ug/kg	MAK	05/18/2007	0060931-1	<5.0
Toluene	8260B[1]	<69	69	ug/kg	MAK	05/18/2007	0060931-1	<5.0
Xylenes (Total)	8260B[1]	<69	69	ug/kg	MAK	05/18/2007	0060931-1	<5.0

[1] U.S. Environmental Protection Agency, 1996, Test Methods for Evaluating Solid Waste, SW-846, 3rd ed., Office of Solid Waste and Emergency Response, Washington, DC.

Sample Comments: Results reported in dry weight equivalence.

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Ms. Casey Yetman
Sunoco_SECOR International, Inc. - Exton
102 Pickering Way, Suite 200
Exton, PA 19341

Client Site: Tank 250
Client Ref.: UST

Lab Project ID: 07-3770
Lab Sample ID: 0705-2804
Client Sample ID: AST-250-SS-7
Sample Matrix: Solid

Date Sampled: 05/15/2007
Date Received: 05/17/2007

Inorganic Extraction

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Percent Solids	% Solids	95	N/A	%	DAB	05/18/2007	N/A	N/A

Semivolatiles

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Semivolatile Organic Compounds, GC/MS								
Fluorene	8270C(1)	<350	350	ug/kg	SPL	05/23/2007	0060950-1	<330

Volatiles

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Volatile Organic Compounds, MS								
Benzene	8260B(1)	<78	78	ug/kg	MAK	05/18/2007	0060931-1	<5.0
Cumene	8260B(1)	<78	78	ug/kg	MAK	05/18/2007	0060931-1	<5.0
1,2-Dibromoethane	8260B(1)	<78	78	ug/kg	MAK	05/18/2007	0060931-1	<5.0
1,2-Dichloroethane	8260B(1)	<78	78	ug/kg	MAK	05/18/2007	0060931-1	<5.0
Ethylbenzene	8260B(1)	<78	78	ug/kg	MAK	05/18/2007	0060931-1	<5.0
Naphthalene	8260B(1)	<78	78	ug/kg	MAK	05/18/2007	0060931-1	<5.0
Toluene	8260B(1)	<78	78	ug/kg	MAK	05/18/2007	0060931-1	<5.0
Xylenes (Total)	8260B(1)	<78	78	ug/kg	MAK	05/18/2007	0060931-1	<5.0

(1) U.S. Environmental Protection Agency, 1996, Test Methods for Evaluating Solid Waste, SW-846, 3rd ed., Office of Solid Waste and Emergency Response, Washington, DC.

Sample Comments: Results reported in dry weight equivalence.

REPORT OF LABORATORY ANALYSIS

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Ms. Casey Yetman
Sunoco_SECOR International, Inc. - Exton
102 Pickering Way, Suite 200
Exton, PA 19341

Client Site: Tank 250
Client Ref.: UST

Lab Project ID: **07-3770**
Lab Sample ID: **0705-2805**
Client Sample ID: AST-250-SS-8
Sample Matrix: Solid

Date Sampled: 05/15/2007
Date Received: 05/17/2007

Inorganic Extraction

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Percent Solids	% Solids	92	N/A	%	DAB	05/18/2007	N/A	N/A

Semivolatiles

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Semivolatile Organic Compounds, GC/MS								
Fluorene	8270C(1)	<360	360	ug/kg	SPL	05/23/2007	0060950-1	<330

Volatiles

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Volatile Organic Compounds, MS								
Benzene	8260B(1)	<92	92	ug/kg	MAK	05/18/2007	0060931-1	<5.0
Cumene	8260B(1)	<92	92	ug/kg	MAK	05/18/2007	0060931-1	<5.0
1,2-Dibromoethane	8260B(1)	<92	92	ug/kg	MAK	05/18/2007	0060931-1	<5.0
1,2-Dichloroethane	8260B(1)	<92	92	ug/kg	MAK	05/18/2007	0060931-1	<5.0
Ethylbenzene	8260B(1)	<92	92	ug/kg	MAK	05/18/2007	0060931-1	<5.0
Naphthalene	8260B(1)	<92	92	ug/kg	MAK	05/18/2007	0060931-1	<5.0
Toluene	8260B(1)	<92	92	ug/kg	MAK	05/18/2007	0060931-1	<5.0
Xylenes (Total)	8260B(1)	<92	92	ug/kg	MAK	05/18/2007	0060931-1	<5.0

(1) U.S. Environmental Protection Agency, 1996, Test Methods for Evaluating Solid Waste, SW-846, 3rd ed., Office of Solid Waste and Emergency Response, Washington, DC.

Sample Comments: Results reported in dry weight equivalence.

REPORT OF LABORATORY ANALYSIS

CHAIN OF CUSTODY

ACCUTEST Laboratories

2235 Route 130, Dayton NJ 08810
TEL. 732-329-0200 FAX: 732-329-3499/3480
www.accutest.com

FED-EX Tracking #: | Bottle Order Control #:
Accutest Quote #: | Accutest Job #:

Client / Reporting Information

Company Name: SECOR INTERNATIONAL
Address: 102 PICKERING WAY, STE 200
City: EXTON State: PA Zip: 19341
Project Contact: CASEY YETMAN E-mail: cyetman@secor.com
Phone #: 484.875.3075
Sampler's Name: JOHN BURCHETTE

Project Information

Project Name: TANK 250
Street:
City: PHILADELPHIA State: PA
Project #:
Fax #: 484.875.9286
Client Purchase Order #:

Requested Analysis

PADEP SHORTLIST FOR JET FUEL K-KEROSENE

Accutest Sample #	Field ID / Point of Collection	SUMMA # / MEOH Vial #	Collection Date	Collection Time	Sampled By	Matrix	# of bottles	Number of preserved Bottles	Requested Analysis
	AST-250-SS-1		5-15-07	1103	JB	S	5	2 2 1	07-03770
	AST-250-SS-2		5-15-07	1110	JB	S	5	2 2 1	05-2798
	AST-250-SS-3		5-15-07	1120	JB	S	5	2 2 1	↓ 99
	AST-250-SS-4		5-15-07	1130	JB	S	5	2 2 1	05-2800
	AST-250-SS-5		5-15-07	1135	JB	S	5	2 2 1	01
	AST-250-SS-6		5-15-07	1140	JB	S	5	2 2 1	02
	AST-250-SS-7		5-15-07	1145	JB	S	5	2 0 1	03
	AST-250-SS-8		5-15-07	1150	JB	S	5	2 2 1	04
									↓ 05

Matrix Codes

DW - Drinking Water
GW - Ground Water
WW - Water
SW - Surface Water
SO - Soil
SL - Sludge
OI - Oil
LIQ - Other Liquid
AIR - Air
SOL - Other Solid
WP - Wipe
LAB USE ONLY

Turnaround Time (Business Days)

- ☐ Std. 15 Business Days
- ☐ 10 Day *RUSH*
- ☐ 5 Day *RUSH*
- ☐ 3 Day *EMERGENCY*
- ☐ 2 Day *EMERGENCY*
- ☐ 1 Day *EMERGENCY*
- ☐ Other

Approved By: / Date:
STANDARD TURN AROUND TIME

Emergency & Rush T/A data available VIA LabLink

Data Deliverable Information

- ☐ Commercial "A"
- ☐ Commercial "B"
- ☐ NJ Reduced
- ☐ NJ Full
- ☐ Other _____
- ☐ FULL CLP
- ☐ NYASP Category A
- ☐ NYASP Category B
- ☐ State Forms
- ☐ EDD Format _____

Commercial "A" = Results Only

Comments / Remarks

ANALYZE PER PADEP SHORTLIST REQUIREMENTS

Sample Custody must be documented below each time samples change possession, including courier delivery.

Relinquished by Sampler:	Date Time:	Received by:	Relinquished by:	Date Time:	Received by:
1		1	2		2
Relinquished by: 3 USCargo	Date Time: 5/17/07 0920	Received by: 4	Relinquished by: 5 FedEx	Date Time:	Received by: 4
Relinquished by: 5	Date Time:	Received by: 5	Custody Seal #	Preserved where applicable ☐	On Ice ☐ Cooler Temp.

July 11, 2007

Ms. Casey Yetman
Sunoco_SECOR International, Inc. - Exton
102 Pickering Way, Suite 200
Exton, PA 19341

Dear Ms. Yetman:

Enclosed are analytical results for samples submitted to Pace Analytical by Sunoco_SECOR International, Inc. - Exton. The samples were received on July 6, 2007. The results reported in this project meet the requirements as specified in Chapter 5 of the NELAC Standards. Any deviations or discrepancies from the NELAC standards are documented in the case narrative(s) of this report. Parameters printed in italics represent Non-NELAC accredited parameters. Please reference Pace project number 07-5326 when inquiring about this report.

Client Site: Tank 250
Client Ref.: UST

Pace Sample Identification	Client Sample Identification
0707-0961	AST-250-SS-1
0707-0962	AST-250-SS-2
0707-0963	AST-250-SS-3
0707-0964	AST-250-SS-4

Pace Sample Identification	Client Sample Identification
0707-0965	AST-250-SS-5
0707-0966	AST-250-SS-6
0707-0967	AST-250-SS-7
0707-0968	AST-250-SS-8

General Comments: Cooler temperature 2 ° C upon receipt. Ice was present. The samples were subcontracted to Pace Analytical Services, Inc., 9800 Kincey Ave., Suite 100, Huntersville, NC 28078 for volatiles analysis. Results of the analysis are reported on the Pace Analytical, Charlotte data tables.

Please call me if you have any questions regarding the information contained within this report.

Sincerely,

Carin A. Ferris
Project Manager

CAM: cam

Enclosures

Page 1 of ____

Ms. Casey Yetman
Sunoco_SECOR International, Inc. - Exton
102 Pickering Way, Suite 200
Exton, PA 19341

Client Site: Tank 250
Client Ref.: UST

Lab Project ID: **07-5326**
Lab Sample ID: **0707-0961**
Client Sample ID: AST-250-SS-1
Sample Matrix: Solid

Date Sampled: 07/03/2007
Date Received: 07/06/2007

Inorganic Extraction

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Percent Solids	% Solids	93	N/A	%	DAB	07/06/2007	N/A	N/A

Metals

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Trace Metals, Total, ICP								
Lead	6010B[1]	940	0.54	mg/kg	CS0	07/11/2007	0062838-1	<0.50

Semivolatiles

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Semivolatile Organic Compounds, GC/MS								
Fluorene	8270C[1]	<350	350	ug/kg	JAS	07/11/2007	0062732-1	<330

Subcontracted Work

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Volatile Organic Compounds, MS								
Benzene	8260B[1]	Completed	5.4	ug/kg			N/A	N/A
Cumene	8260B[1]	Completed	5.4	ug/kg			N/A	N/A
1,2-Dibromoethane	8260B[1]	Completed	5.4	ug/kg			N/A	N/A
1,2-Dichloroethane	8260B[1]	Completed	5.4	ug/kg			N/A	N/A
Ethylbenzene	8260B[1]	Completed	5.4	ug/kg			N/A	N/A
Naphthalene	8260B[1]	Completed	5.4	ug/kg			N/A	N/A
Toluene	8260B[1]	Completed	5.4	ug/kg			N/A	N/A
Xylenes (Total)	8260B[1]	Completed	5.4	ug/kg			N/A	N/A

[1] U.S. Environmental Protection Agency, 1996, Test Methods for Evaluating Solid Waste, SW-846, 3rd ed., Office of Solid Waste and Emergency Response, Washington, DC.

Sample Comments: Results reported in dry weight equivalence.

Ms. Casey Yetman
Sunoco_SECOR International, Inc. - Exton
102 Pickering Way, Suite 200
Exton, PA 19341

Lab Project ID: **07-5326**
Lab Sample ID: **0707-0962**
Client Sample ID: AST-250-SS-2
Sample Matrix: Solid

Client Site: Tank 250
Client Ref.: UST

Date Sampled: 07/03/2007
Date Received: 07/06/2007

Inorganic Extraction

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Percent Solids	% Solids	94	N/A	%	DAB	07/06/2007	N/A	N/A

Metals

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Trace Metals, Total, ICP								
Lead	6010B[1]	30	0.53	mg/kg	CS0	07/11/2007	0062838-1	<0.50

Semivolatiles

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Semivolatile Organic Compounds, GC/MS								
Fluorene	8270C[1]	<350	350	ug/kg	JAS	07/11/2007	0062732-1	<330

Subcontracted Work

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Volatile Organic Compounds, MS								
Benzene	8260B[1]	Completed	5.3	ug/kg			N/A	N/A
Cumene	8260B[1]	Completed	5.3	ug/kg			N/A	N/A
1,2-Dibromoethane	8260B[1]	Completed	5.3	ug/kg			N/A	N/A
1,2-Dichloroethane	8260B[1]	Completed	5.3	ug/kg			N/A	N/A
Ethylbenzene	8260B[1]	Completed	5.3	ug/kg			N/A	N/A
Naphthalene	8260B[1]	Completed	5.3	ug/kg			N/A	N/A
Toluene	8260B[1]	Completed	5.3	ug/kg			N/A	N/A
Xylenes (Total)	8260B[1]	Completed	5.3	ug/kg			N/A	N/A

[1] U.S. Environmental Protection Agency, 1996, Test Methods for Evaluating Solid Waste, SW-846, 3rd ed., Office of Solid Waste and Emergency Response, Washington, DC.

Sample Comments: Results reported in dry weight equivalence.

Ms. Casey Yetman
Sunoco_SECOR International, Inc. - Exton
102 Pickering Way, Suite 200
Exton, PA 19341

Lab Project ID: **07-5326**
Lab Sample ID: **0707-0963**
Client Sample ID: AST-250-SS-3
Sample Matrix: Solid

Client Site: Tank 250
Client Ref.: UST

Date Sampled: 07/03/2007
Date Received: 07/06/2007

Inorganic Extraction

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Percent Solids	% Solids	93	N/A	%	DAB	07/06/2007	N/A	N/A

Metals

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Trace Metals, Total, ICP								
Lead	6010B[1]	100	0.54	mg/kg	CS0	07/11/2007	0062838-1	<0.50

Semivolatiles

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Semivolatile Organic Compounds, GC/MS								
Fluorene	8270C[1]	<350	350	ug/kg	JAS	07/11/2007	0062732-1	<330

Subcontracted Work

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Volatile Organic Compounds, MS								
Benzene	8260B[1]	Completed	5.4	ug/kg			N/A	N/A
Cumene	8260B[1]	Completed	5.4	ug/kg			N/A	N/A
1,2-Dibromoethane	8260B[1]	Completed	5.4	ug/kg			N/A	N/A
1,2-Dichloroethane	8260B[1]	Completed	5.4	ug/kg			N/A	N/A
Ethylbenzene	8260B[1]	Completed	5.4	ug/kg			N/A	N/A
Naphthalene	8260B[1]	Completed	5.4	ug/kg			N/A	N/A
Toluene	8260B[1]	Completed	5.4	ug/kg			N/A	N/A
Xylenes (Total)	8260B[1]	Completed	5.4	ug/kg			N/A	N/A

[1] U.S. Environmental Protection Agency, 1996, Test Methods for Evaluating Solid Waste, SW-846, 3rd ed., Office of Solid Waste and Emergency Response, Washington, DC.

Sample Comments: Results reported in dry weight equivalence.

Ms. Casey Yetman
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102 Pickering Way, Suite 200
Exton, PA 19341

Client Site: Tank 250
Client Ref.: UST

Lab Project ID: **07-5326**
Lab Sample ID: **0707-0964**
Client Sample ID: AST-250-SS-4
Sample Matrix: Solid

Date Sampled: 07/03/2007
Date Received: 07/06/2007

Inorganic Extraction

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Percent Solids	% Solids	93	N/A	%	DAB	07/06/2007	N/A	N/A

Metals

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Trace Metals, Total, ICP								
Lead	6010B[1]	2.8	0.54	mg/kg	CS0	07/11/2007	0062838-1	<0.50

Semivolatiles

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Semivolatile Organic Compounds, GC/MS								
Fluorene	8270C[1]	620	350	ug/kg	JAS	07/11/2007	0062732-1	<330

Subcontracted Work

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Volatile Organic Compounds, MS								
Benzene	8260B[1]	Completed	5.4	ug/kg			N/A	N/A
Cumene	8260B[1]	Completed	5.4	ug/kg			N/A	N/A
1,2-Dibromoethane	8260B[1]	Completed	5.4	ug/kg			N/A	N/A
1,2-Dichloroethane	8260B[1]	Completed	5.4	ug/kg			N/A	N/A
Ethylbenzene	8260B[1]	Completed	5.4	ug/kg			N/A	N/A
Naphthalene	8260B[1]	Completed	5.4	ug/kg			N/A	N/A
Toluene	8260B[1]	Completed	5.4	ug/kg			N/A	N/A
Xylenes (Total)	8260B[1]	Completed	5.4	ug/kg			N/A	N/A

[1] U.S. Environmental Protection Agency, 1996, Test Methods for Evaluating Solid Waste, SW-846, 3rd ed., Office of Solid Waste and Emergency Response, Washington, DC.

Sample Comments: Results reported in dry weight equivalence.

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Lab Project ID: **07-5326**
Lab Sample ID: **0707-0965**
Client Sample ID: AST-250-SS-5
Sample Matrix: Solid

Client Site: Tank 250
Client Ref.: UST

Date Sampled: 07/03/2007
Date Received: 07/06/2007

Inorganic Extraction

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Percent Solids	% Solids	89	N/A	%	DAB	07/06/2007	N/A	N/A

Metals

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Trace Metals, Total, ICP								
Lead	6010B[1]	190	0.56	mg/kg	CS0	07/11/2007	0062838-1	<0.50

Semivolatiles

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Semivolatile Organic Compounds, GC/MS								
Fluorene	8270C[1]	<370	370	ug/kg	JAS	07/11/2007	0062732-1	<330

Subcontracted Work

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Volatile Organic Compounds, MS								
Benzene	8260B[1]	Completed	5.6	ug/kg			N/A	N/A
Cumene	8260B[1]	Completed	5.6	ug/kg			N/A	N/A
1,2-Dibromoethane	8260B[1]	Completed	5.6	ug/kg			N/A	N/A
1,2-Dichloroethane	8260B[1]	Completed	5.6	ug/kg			N/A	N/A
Ethylbenzene	8260B[1]	Completed	5.6	ug/kg			N/A	N/A
Naphthalene	8260B[1]	Completed	5.6	ug/kg			N/A	N/A
Toluene	8260B[1]	Completed	5.6	ug/kg			N/A	N/A
Xylenes (Total)	8260B[1]	Completed	5.6	ug/kg			N/A	N/A

[1] U.S. Environmental Protection Agency, 1996, Test Methods for Evaluating Solid Waste, SW-846, 3rd ed., Office of Solid Waste and Emergency Response, Washington, DC.

Sample Comments: Results reported in dry weight equivalence.

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Lab Project ID: **07-5326**
Lab Sample ID: **0707-0966**
Client Sample ID: AST-250-SS-6
Sample Matrix: Solid

Client Site: Tank 250
Client Ref.: UST

Date Sampled: 07/03/2007
Date Received: 07/06/2007

Inorganic Extraction

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Percent Solids	% Solids	87	N/A	%	DAB	07/06/2007	N/A	N/A

Metals

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Trace Metals, Total, ICP								
Lead	6010B[1]	1500	0.58	mg/kg	CS0	07/11/2007	0062838-1	<0.50

Semivolatiles

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Semivolatile Organic Compounds, GC/MS								
Fluorene	8270C[1]	<380	380	ug/kg	JAS	07/11/2007	0062732-1	<330

Subcontracted Work

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Volatile Organic Compounds, MS								
Benzene	8260B[1]	Completed	5.8	ug/kg			N/A	N/A
Cumene	8260B[1]	Completed	5.8	ug/kg			N/A	N/A
1,2-Dibromoethane	8260B[1]	Completed	5.8	ug/kg			N/A	N/A
1,2-Dichloroethane	8260B[1]	Completed	5.8	ug/kg			N/A	N/A
Ethylbenzene	8260B[1]	Completed	5.8	ug/kg			N/A	N/A
Naphthalene	8260B[1]	Completed	5.8	ug/kg			N/A	N/A
Toluene	8260B[1]	Completed	5.8	ug/kg			N/A	N/A
Xylenes (Total)	8260B[1]	Completed	5.8	ug/kg			N/A	N/A

[1] U.S. Environmental Protection Agency, 1996, Test Methods for Evaluating Solid Waste, SW-846, 3rd ed., Office of Solid Waste and Emergency Response, Washington, DC.

Sample Comments: Results reported in dry weight equivalence.

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Client Site: Tank 250
Client Ref.: UST

Lab Project ID: **07-5326**
Lab Sample ID: **0707-0967**
Client Sample ID: AST-250-SS-7
Sample Matrix: Solid

Date Sampled: 07/03/2007
Date Received: 07/06/2007

Inorganic Extraction

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Percent Solids	% Solids	85	N/A	%	DAB	07/06/2007	N/A	N/A

Metals

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Trace Metals, Total, ICP								
Lead	6010B[1]	140	0.59	mg/kg	CS0	07/11/2007	0062838-1	<0.50

Semivolatiles

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Semivolatile Organic Compounds, GC/MS								
Fluorene	8270C[1]	<390	390	ug/kg	JAS	07/11/2007	0062732-1	<330

Subcontracted Work

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Volatile Organic Compounds, MS								
Benzene	8260B[1]	Completed	5.9	ug/kg			N/A	N/A
Cumene	8260B[1]	Completed	5.9	ug/kg			N/A	N/A
1,2-Dibromoethane	8260B[1]	Completed	5.9	ug/kg			N/A	N/A
1,2-Dichloroethane	8260B[1]	Completed	5.9	ug/kg			N/A	N/A
Ethylbenzene	8260B[1]	Completed	5.9	ug/kg			N/A	N/A
Naphthalene	8260B[1]	Completed	5.9	ug/kg			N/A	N/A
Toluene	8260B[1]	Completed	5.9	ug/kg			N/A	N/A
Xylenes (Total)	8260B[1]	Completed	5.9	ug/kg			N/A	N/A

[1] U.S. Environmental Protection Agency, 1996, Test Methods for Evaluating Solid Waste, SW-846, 3rd ed., Office of Solid Waste and Emergency Response, Washington, DC.

Sample Comments: Results reported in dry weight equivalence.

Ms. Casey Yetman
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Lab Project ID: **07-5326**
Lab Sample ID: **0707-0968**
Client Sample ID: AST-250-SS-8
Sample Matrix: Solid

Client Site: Tank 250
Client Ref.: UST

Date Sampled: 07/03/2007
Date Received: 07/06/2007

Inorganic Extraction

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Percent Solids	% Solids	93	N/A	%	DAB	07/06/2007	N/A	N/A

Metals

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Trace Metals, Total, ICP								
Lead	6010B[1]	13	0.54	mg/kg	CS0	07/11/2007	0062838-1	<0.50

Semivolatiles

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Semivolatile Organic Compounds, GC/MS								
Fluorene	8270C[1]	<350	350	ug/kg	JAS	07/11/2007	0062732-1	<330

Subcontracted Work

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Volatile Organic Compounds, MS								
Benzene	8260B[1]	Completed	5.4	ug/kg			N/A	N/A
Cumene	8260B[1]	Completed	5.4	ug/kg			N/A	N/A
1,2-Dibromoethane	8260B[1]	Completed	5.4	ug/kg			N/A	N/A
1,2-Dichloroethane	8260B[1]	Completed	5.4	ug/kg			N/A	N/A
Ethylbenzene	8260B[1]	Completed	5.4	ug/kg			N/A	N/A
Naphthalene	8260B[1]	Completed	5.4	ug/kg			N/A	N/A
Toluene	8260B[1]	Completed	5.4	ug/kg			N/A	N/A
Xylenes (Total)	8260B[1]	Completed	5.4	ug/kg			N/A	N/A

[1] U.S. Environmental Protection Agency, 1996, Test Methods for Evaluating Solid Waste, SW-846, 3rd ed., Office of Solid Waste and Emergency Response, Washington, DC.

Sample Comments: Results reported in dry weight equivalence.

Pace Analytical
www.pacelabs.com

Pace Analytical Services, Inc.
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Phone: 704.875.9092
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F

July 11, 2007

Client Services
Pace Analytical Services, Inc.
5203 Triangle Lane
Export, PA 15632

RE: Lab Project Number: 92148186
Client Project ID: Sunoco_Secor 07-5326

Dear Services:

Enclosed are the analytical results for sample(s) received by the laboratory on July 7, 2007. Results reported herein conform to the most current NELAC standards, where applicable, unless otherwise narrated in the body of the report.

Inorganic Wet Chemistry and Metals Analyses were performed at our Pace Asheville laboratory and Organic testing was performed at our Pace Charlotte laboratory unless otherwise footnoted.

The results relate only to samples in this report.

If you have any questions concerning this report please feel free to contact me.

Sincerely,

Kevin Herring
kevin.herring@pacelabs.com
Project Manager

Enclosures

Pace Analytical
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Lab Project Number: 92148186
Client Project ID: Sunoco Secor 07-5326

Solid results are reported on a dry weight basis

Lab Sample No: 928600147 Project Sample Number: 92148186-001 Date Collected: 07/03/07 18:00
Client Sample ID: 0707-0961 AST-250-SS-1 Matrix: Soil Date Received: 07/07/07 09:05

Parameters	Results	Units	Report Limit	Analyzed	By	CAS No.	Qual	RegLmt
Wet Chemistry								
Percent Moisture	Method: % Moisture							
Percent Moisture	6.6	%		07/09/07 15:16	MEJ			
GC/MS Volatiles								
GC/MS VOCs 5035/8260 low level	Method: EPA 8260							
Benzene	ND	ug/kg	4.5	07/09/07 18:50	DLK	71-43-2		
1,2-Dibromoethane (EDB)	ND	ug/kg	4.5	07/09/07 18:50	DLK	106-93-4		
1,2-Dichloroethane	ND	ug/kg	4.5	07/09/07 18:50	DLK	107-06-2		
Ethylbenzene	ND	ug/kg	4.5	07/09/07 18:50	DLK	100-41-4		
Isopropylbenzene (Cumene)	ND	ug/kg	4.5	07/09/07 18:50	DLK	98-82-8		
Naphthalene	ND	ug/kg	4.5	07/09/07 18:50	DLK	91-20-3		
Toluene	ND	ug/kg	4.5	07/09/07 18:50	DLK	108-88-3		
Xylene (Total)	ND	ug/kg	8.9	07/09/07 18:50	DLK	1330-20-7		
m&p-Xylene	ND	ug/kg	8.9	07/09/07 18:50	DLK			
o-Xylene	ND	ug/kg	4.5	07/09/07 18:50	DLK	95-47-6		
Toluene-d8 (S)	98	%		07/09/07 18:50	DLK	2037-26-5		
4-Bromofluorobenzene (S)	94	%		07/09/07 18:50	DLK	460-00-4		
Dibromofluoromethane (S)	101	%		07/09/07 18:50	DLK	1868-53-7		
1,2-Dichloroethane-d4 (S)	100	%		07/09/07 18:50	DLK	17060-07-0		

Date: 07/11/07

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Lab Project Number: 92148186
Client Project ID: Sunoco_Secor 07-5326

Lab Sample No: 928600154 Project Sample Number: 92148186-002 Date Collected: 07/03/07 18:10
Client Sample ID: 0707-0962 AST-250-SS-2 Matrix: Soil Date Received: 07/07/07 09:05

Parameters	Results	Units	Report Limit	Analyzed	By	CAS No.	Qual	RegLmt
Wet Chemistry								
Percent Moisture	Method: % Moisture							
Percent Moisture	4.0	%		07/09/07 15:17	MEJ			
GC/MS Volatiles								
GC/MS VOCs 5035/8260 low level	Method: EPA 8260							
Benzene	ND	ug/kg	5.5	07/09/07 19:08	DLK	71-43-2		
1,2-Dichloroethane	ND	ug/kg	5.5	07/09/07 19:08	DLK	107-06-2		
Ethylbenzene	ND	ug/kg	5.5	07/09/07 19:08	DLK	100-41-4		
Isopropylbenzene (Cumene)	ND	ug/kg	5.5	07/09/07 19:08	DLK	98-82-8		
Naphthalene	ND	ug/kg	5.5	07/09/07 19:08	DLK	91-20-3		
Toluene	ND	ug/kg	5.5	07/09/07 19:08	DLK	108-88-3		
Xylene (Total)	ND	ug/kg	11.	07/09/07 19:08	DLK	1330-20-7		
m&p-Xylene	ND	ug/kg	11.	07/09/07 19:08	DLK			
o-Xylene	ND	ug/kg	5.5	07/09/07 19:08	DLK	95-47-6		
Toluene-d8 (S)	104	%		07/09/07 19:08	DLK	2037-26-5		
4-Bromofluorobenzene (S)	100	%		07/09/07 19:08	DLK	460-00-4		
Dibromofluoromethane (S)	103	%		07/09/07 19:08	DLK	1868-53-7		
1,2-Dichloroethane-d4 (S)	96	%		07/09/07 19:08	DLK	17060-07-0		

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Lab Project Number: 92148186
Client Project ID: Sunoco_Secor 07-5326

Lab Sample No: 928600162 Project Sample Number: 92148186-003 Date Collected: 07/03/07 18:15
Client Sample ID: 0707-0963 AST-250-SS-3 Matrix: Soil Date Received: 07/07/07 09:05

Parameters	Results	Units	Report Limit	Analyzed	By	CAS No.	Qual	RegLmt
Wet Chemistry								
Percent Moisture	Method: % Moisture							
Percent Moisture	7.6	%		07/09/07 15:17	MEJ			
GC/MS Volatiles								
GC/MS VOCs 5035/8260 low level	Method: EPA 8260							
Benzene	ND	ug/kg	5.8	07/09/07 19:27	DLK	71-43-2		
1,2-Dichloroethane	ND	ug/kg	5.8	07/09/07 19:27	DLK	107-06-2		
Ethylbenzene	ND	ug/kg	5.8	07/09/07 19:27	DLK	100-41-4		
Isopropylbenzene (Cumene)	ND	ug/kg	5.8	07/09/07 19:27	DLK	98-82-8		
Naphthalene	ND	ug/kg	5.8	07/09/07 19:27	DLK	91-20-3		
Toluene	6.1	ug/kg	5.8	07/09/07 19:27	DLK	108-88-3		
Xylene (Total)	ND	ug/kg	12.	07/09/07 19:27	DLK	1330-20-7		
m&p-Xylene	ND	ug/kg	12.	07/09/07 19:27	DLK			
o-Xylene	ND	ug/kg	5.8	07/09/07 19:27	DLK	95-47-6		
Toluene-d8 (S)	96	%		07/09/07 19:27	DLK	2037-26-5		
4-Bromofluorobenzene (S)	90	%		07/09/07 19:27	DLK	460-00-4		
Dibromofluoromethane (S)	98	%		07/09/07 19:27	DLK	1868-53-7		
1,2-Dichloroethane-d4 (S)	93	%		07/09/07 19:27	DLK	17060-07-0		

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F

Lab Project Number: 92148186
Client Project ID: Sunoco Secor 07-5326

Lab Sample No: 928600170 Project Sample Number: 92148186-004 Date Collected: 07/03/07 18:25
Client Sample ID: 0707-0964 AST-250-SS-4 Matrix: Soil Date Received: 07/07/07 09:05

Parameters	Results	Units	Report Limit	Analyzed	By	CAS No.	Qual	RegLmt
Wet Chemistry								
Percent Moisture	Method: % Moisture							
Percent Moisture	7.5	%		07/09/07 15:18	MEJ			
GC/MS Volatiles								
GC/MS VOCs 5035/8260 low level	Method: EPA 8260							
Benzene	ND	ug/kg	390	07/09/07 22:49	DLK	71-43-2		
1,2-Dichloroethane	ND	ug/kg	390	07/09/07 22:49	DLK	107-06-2		
Ethylbenzene	ND	ug/kg	390	07/09/07 22:49	DLK	100-41-4		
Isopropylbenzene (Cumene)	ND	ug/kg	390	07/09/07 22:49	DLK	98-82-8		
Naphthalene	1500	ug/kg	390	07/09/07 22:49	DLK	91-20-3		
Toluene	ND	ug/kg	390	07/09/07 22:49	DLK	108-88-3		
Xylene (Total)	1200	ug/kg	780	07/09/07 22:49	DLK	1330-20-7		
m&p-Xylene	ND	ug/kg	780	07/09/07 22:49	DLK			
o-Xylene	960	ug/kg	390	07/09/07 22:49	DLK	95-47-6		
Toluene-d8 (S)	110	%		07/09/07 22:49	DLK	2037-26-5		
4-Bromofluorobenzene (S)	102	%		07/09/07 22:49	DLK	460-00-4		
Dibromofluoromethane (S)	106	%		07/09/07 22:49	DLK	1868-53-7		
1,2-Dichloroethane-d4 (S)	109	%		07/09/07 22:49	DLK	17060-07-0	1	

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Lab Project Number: 92148186
Client Project ID: Sunoco_Secor 07-5326

Lab Sample No: 928600188 Project Sample Number: 92148186-005 Date Collected: 07/03/07 18:35
Client Sample ID: 0707-0965 AST-250-SS-5 Matrix: Soil Date Received: 07/07/07 09:05

Parameters	Results	Units	Report Limit	Analyzed	By	CAS No.	Qual	RegLmt
Wet Chemistry								
Percent Moisture	Method: % Moisture							
Percent Moisture	11.2	%		07/09/07 15:18	MEJ			
GC/MS Volatiles								
GC/MS VOCs 5035/8260 low level	Method: EPA 8260							
Benzene	ND	ug/kg	4.6	07/09/07 19:45	DLK	71-43-2		
1,2-Dichloroethane	ND	ug/kg	4.6	07/09/07 19:45	DLK	107-06-2		
Ethylbenzene	ND	ug/kg	4.6	07/09/07 19:45	DLK	100-41-4		
Isopropylbenzene (Cumene)	ND	ug/kg	4.6	07/09/07 19:45	DLK	98-82-8		
Naphthalene	ND	ug/kg	4.6	07/09/07 19:45	DLK	91-20-3		
Toluene	ND	ug/kg	4.6	07/09/07 19:45	DLK	108-88-3		
Xylene (Total)	ND	ug/kg	9.3	07/09/07 19:45	DLK	1330-20-7		
m&p-Xylene	ND	ug/kg	9.3	07/09/07 19:45	DLK			
o-Xylene	ND	ug/kg	4.6	07/09/07 19:45	DLK	95-47-6		
Toluene-d8 (S)	95	%		07/09/07 19:45	DLK	2037-26-5		
4-Bromofluorobenzene (S)	88	%		07/09/07 19:45	DLK	460-00-4		
Dibromofluoromethane (S)	100	%		07/09/07 19:45	DLK	1868-53-7		
1,2-Dichloroethane-d4 (S)	96	%		07/09/07 19:45	DLK	17060-07-0		

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F

Lab Project Number: 92148186
Client Project ID: Sunoco_Secor 07-5326

Lab Sample No: 928600196 Project Sample Number: 92148186-006 Date Collected: 07/03/07 18:45
Client Sample ID: 0707-0966 AST-250-SS-6 Matrix: Soil Date Received: 07/07/07 09:05

Parameters	Results	Units	Report Limit	Analyzed	By	CAS No.	Qual	RegLmt
Wet Chemistry								
Percent Moisture	Method: % Moisture							
Percent Moisture	12.1	%		07/09/07 15:19	MEJ			
GC/MS Volatiles								
GC/MS VOCs 5035/8260 low level	Method: EPA 8260							
Benzene	ND	ug/kg	4.8	07/09/07 20:03	DLK	71-43-2		
1,2-Dichloroethane	ND	ug/kg	4.8	07/09/07 20:03	DLK	107-06-2		
Ethylbenzene	ND	ug/kg	4.8	07/09/07 20:03	DLK	100-41-4		
Isopropylbenzene (Cumene)	ND	ug/kg	4.8	07/09/07 20:03	DLK	98-82-8		
Naphthalene	ND	ug/kg	4.8	07/09/07 20:03	DLK	91-20-3		
Toluene	ND	ug/kg	4.8	07/09/07 20:03	DLK	108-88-3		
Xylene (Total)	ND	ug/kg	9.7	07/09/07 20:03	DLK	1330-20-7		
m&p-Xylene	ND	ug/kg	9.7	07/09/07 20:03	DLK			
o-Xylene	ND	ug/kg	4.8	07/09/07 20:03	DLK	95-47-6		
Toluene-d8 (S)	99	%		07/09/07 20:03	DLK	2037-26-5		
4-Bromofluorobenzene (S)	99	%		07/09/07 20:03	DLK	460-00-4		
Dibromofluoromethane (S)	97	%		07/09/07 20:03	DLK	1868-53-7		
1,2-Dichloroethane-d4 (S)	97	%		07/09/07 20:03	DLK	17060-07-0		

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Lab Project Number: 92148186
Client Project ID: Sunoco_Secor 07-5326

Lab Sample No: 928600204 Project Sample Number: 92148186-007 Date Collected: 07/03/07 19:00
Client Sample ID: 0707-0967 AST-250-SS-7 Matrix: Soil Date Received: 07/07/07 09:05

Parameters	Results	Units	Report Limit	Analyzed	By	CAS No.	Qual	RegLmt
Wet Chemistry								
Percent Moisture	Method: % Moisture							
Percent Moisture	4.4	%		07/09/07 15:19	MEJ			
GC/MS Volatiles								
GC/MS VOCs 5035/8260 low level	Method: EPA 8260							
Benzene	ND	ug/kg	5.7	07/09/07 20:22	DLK	71-43-2		
1,2-Dichloroethane	ND	ug/kg	5.7	07/09/07 20:22	DLK	107-06-2		
Ethylbenzene	ND	ug/kg	5.7	07/09/07 20:22	DLK	100-41-4		
Isopropylbenzene (Cumene)	ND	ug/kg	5.7	07/09/07 20:22	DLK	98-82-8		
Naphthalene	ND	ug/kg	5.7	07/09/07 20:22	DLK	91-20-3		
Toluene	ND	ug/kg	5.7	07/09/07 20:22	DLK	108-88-3		
Xylene (Total)	ND	ug/kg	11.	07/09/07 20:22	DLK	1330-20-7		
m&p-Xylene	ND	ug/kg	11.	07/09/07 20:22	DLK			
o-Xylene	ND	ug/kg	5.7	07/09/07 20:22	DLK	95-47-6		
Toluene-d8 (S)	99	%		07/09/07 20:22	DLK	2037-26-5		
4-Bromofluorobenzene (S)	92	%		07/09/07 20:22	DLK	460-00-4		
Dibromofluoromethane (S)	102	%		07/09/07 20:22	DLK	1868-53-7		
1,2-Dichloroethane-d4 (S)	97	%		07/09/07 20:22	DLK	17060-07-0		

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Lab Project Number: 92148186
Client Project ID: Sunoco_Secor 07-5326

Lab Sample No: 928600212 Project Sample Number: 92148186-008 Date Collected: 07/03/07 19:05
Client Sample ID: 0707-0968 AST-250-SS-8 Matrix: Soil Date Received: 07/07/07 09:05

Parameters	Results	Units	Report Limit	Analyzed	By	CAS No.	Qual	RegLmt
Wet Chemistry								
Percent Moisture	Method: % Moisture							
Percent Moisture	5.7	%		07/09/07 15:20	MEJ			
GC/MS Volatiles								
GC/MS VOCs 5035/8260 low level	Method: EPA 8260							
Benzene	ND	ug/kg	4.8	07/09/07 20:40	DLK	71-43-2		
1,2-Dichloroethane	ND	ug/kg	4.8	07/09/07 20:40	DLK	107-06-2		
Ethylbenzene	ND	ug/kg	4.8	07/09/07 20:40	DLK	100-41-4		
Isopropylbenzene (Cumene)	ND	ug/kg	4.8	07/09/07 20:40	DLK	98-82-8		
Naphthalene	ND	ug/kg	4.8	07/09/07 20:40	DLK	91-20-3		
Toluene	ND	ug/kg	4.8	07/09/07 20:40	DLK	108-88-3		
Xylene (Total)	ND	ug/kg	9.6	07/09/07 20:40	DLK	1330-20-7		
m&p-Xylene	ND	ug/kg	9.6	07/09/07 20:40	DLK			
o-Xylene	ND	ug/kg	4.8	07/09/07 20:40	DLK	95-47-6		
Toluene-d8 (S)	100	%		07/09/07 20:40	DLK	2037-26-5		
4-Bromofluorobenzene (S)	99	%		07/09/07 20:40	DLK	460-00-4		
Dibromofluoromethane (S)	97	%		07/09/07 20:40	DLK	1868-53-7		
1,2-Dichloroethane-d4 (S)	100	%		07/09/07 20:40	DLK	17060-07-0		

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Lab Project Number: 92148186
Client Project ID: Sunoco_Secor 07-5326

PARAMETER FOOTNOTES

Method 9071B modified to use ASE.

All pH, Free Chlorine, Total Chlorine and Ferrous Iron analyses conducted outside of EPA recommended immediate hold time.

Depending on the moisture content the PRLs can be elevated for all soil samples reported on a dry weight basis.

2-Chloroethyl vinyl ether has been shown to degrade in the presence of acid.

ND	Not detected at or above adjusted reporting limit
NC	Not Calculable
J	Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit
MDL	Adjusted Method Detection Limit
(S)	Surrogate
[1]	The sample was diluted due to the presence of high levels of non-target analytes resulting in elevated reporting limits.

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QUALITY CONTROL DATA

Lab Project Number: 92148186
Client Project ID: Sunoco_Secor 07-5326

QC Batch: 193594 — Analysis Method: EPA 8260
QC Batch Method: EPA 8260 — Analysis Description: GC/MS VOCs 5035/8260 low level
Associated Lab Samples: 928600147 928600154 928600162 928600170 928600188 928600196 928600204 928600212

METHOD BLANK: 928604008
Associated Lab Samples: 928600147 928600154 928600162 928600170 928600188 928600196 928600204 928600212

Parameter	Units	Blank Result	Reporting Limit	Footnotes
Benzene	ug/kg	ND	5.0	
1,2-Dibromoethane (EDB)	ug/kg	ND	5.0	
1,2-Dichloroethane	ug/kg	ND	5.0	
Ethylbenzene	ug/kg	ND	5.0	
Isopropylbenzene (Cumene)	ug/kg	ND	5.0	
Naphthalene	ug/kg	ND	5.0	
Toluene	ug/kg	ND	5.0	
Xylene (Total)	ug/kg	ND	10.	
m&p-Xylene	ug/kg	ND	10.	
o-Xylene	ug/kg	ND	5.0	
Toluene-d8 (S)	%	102		
4-Bromofluorobenzene (S)	%	98		
Dibromofluoromethane (S)	%	99		
1,2-Dichloroethane-d4 (S)	%	103		

LABORATORY CONTROL SAMPLE: 928604016

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	Footnotes
Benzene	ug/kg	50.00	51.96	104	
1,2-Dibromoethane (EDB)	ug/kg	50.00	52.50	105	
1,2-Dichloroethane	ug/kg	50.00	57.06	114	
Ethylbenzene	ug/kg	50.00	52.73	105	
Isopropylbenzene (Cumene)	ug/kg	50.00	58.85	118	
Naphthalene	ug/kg	50.00	61.17	122	
Toluene	ug/kg	50.00	52.17	104	
m&p-Xylene	ug/kg	100.00	111.3	111	
o-Xylene	ug/kg	50.00	55.14	110	
Toluene-d8 (S)				98	
4-Bromofluorobenzene (S)				95	
Dibromofluoromethane (S)				102	
1,2-Dichloroethane-d4 (S)				103	

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QUALITY CONTROL DATA

Lab Project Number: 92148186
Client Project ID: Sunoco_Secor 07-5326

QC Batch: 193599 — Analysis Method: % Moisture
QC Batch Method: — Analysis Description: Percent Moisture
Associated Lab Samples: 928600147 928600154 928600162 928600170 928600188 928600196 928600204 928600212

SAMPLE DUPLICATE: 928604081

Parameter	Units	928600147 Result	DUP Result	RPD	Footnotes
Percent Moisture	%	6.600	6.300	6	

Date: 07/11/07

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Lab Project Number: 92148186
Client Project ID: Sunoco_Secor 07-5326

QUALITY CONTROL DATA PARAMETER FOOTNOTES

Consistent with EPA guidelines, unrounded concentrations are displayed and have been used to calculate % Rec and RPD values.

LCS(D)	Laboratory Control Sample (Duplicate)
MS(D)	Matrix Spike (Duplicate)
DUP	Sample Duplicate
ND	Not detected at or above adjusted reporting limit
NC	Not Calculable
J	Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit
MDL	Adjusted Method Detection Limit
RPD	Relative Percent Difference
(S)	Surrogate

July 18, 2007

Ms. Casey Yetman
Sunoco_SECOR International, Inc. - Exton
102 Pickering Way, Suite 200
Exton, PA 19341

Dear Ms. Yetman:

Enclosed are analytical results for samples submitted to Pace Analytical by Sunoco_SECOR International, Inc. - Exton. The samples were received on July 6, 2007. The results reported in this project meet the requirements as specified in Chapter 5 of the NELAC Standards. Any deviations or discrepancies from the NELAC standards are documented in the case narrative(s) of this report. Parameters printed in italics represent Non-NELAC accredited parameters. Please reference Pace project number 07-5326A when inquiring about this report.

Client Site: Tank 250
Client Ref.: UST

Pace Sample Identification	Client Sample Identification
0707-0961R	AST-250-SS-1
0707-0966R	AST-250-SS-6

General Comments: Cooler temperature 2 ° C upon receipt. Ice was present.

Please call me if you have any questions regarding the information contained within this report.

Sincerely,

Carin A. Ferris
Project Manager

CAM: cam

Enclosures

Page 1 of ____

Ms. Casey Yetman
Sunoco_SECOR International, Inc. - Exton
102 Pickering Way, Suite 200
Exton, PA 19341

Client Site: Tank 250
Client Ref.: UST

Lab Project ID: **07-5326A**
Lab Sample ID: **0707-0961R**
Client Sample ID: AST-250-SS-1
Sample Matrix: Solid

Date Sampled: 07/03/2007
Date Received: 07/06/2007

Metals

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Trace Metals, SPLP, ICP								
Lead	6010B[1]	0.15	0.050	mg/l	PMM	07/17/2007	0062994-1	<0.050

[1] U.S. Environmental Protection Agency, 1996, Test Methods for Evaluating Solid Waste, SW-846, 3rd ed., Office of Solid Waste and Emergency Response, Washington, DC.

Sample Comments: Results reported on an as received basis.

Ms. Casey Yetman
Sunoco_SECOR International, Inc. - Exton
102 Pickering Way, Suite 200
Exton, PA 19341

Client Site: Tank 250
Client Ref.: UST

Lab Project ID: **07-5326A**
Lab Sample ID: **0707-0966R**
Client Sample ID: AST-250-SS-6
Sample Matrix: Solid

Date Sampled: 07/03/2007
Date Received: 07/06/2007

Metals

Test	Method	Result	Reporting Limit	Units	Analyst	Analysis Date	Method Blank ID	Blank Result
Trace Metals, SPLP, ICP								
Lead	6010B[1]	<0.050	0.050	mg/l	PMM	07/17/2007	0062994-1	<0.050

[1] U.S. Environmental Protection Agency, 1996, Test Methods for Evaluating Solid Waste, SW-846, 3rd ed., Office of Solid Waste and Emergency Response, Washington, DC.

Sample Comments: Results reported on an as received basis.

Appendix B
Performance Monitoring and Gauging Data
Monthly Gauging
Landfill Area
Sunoco, Inc. Eagle Point Refinery
Westville, New Jersey

Well Gauging	Month	Jan-07	Feb-07	Mar-07	Apr-07	May-07	Jun-07
	Date			3/28/2007			
WTZ-1-1	DTP	NG	NG	NP	NG	NG	NG
	DTW	NG	NG	5.58	NG	NG	NG
	LNAPL Thickness	NA	NA	0.00	NA	NA	NA
	DTB	15.10	15.10	15.10	15.10	15.10	15.10
WTZ-1-2	DTP	NG	NG	NP	NG	NG	NG
	DTW	NG	NG	6.73	NG	NG	NG
	LNAPL Thickness	NA	NA	0.00	NA	NA	NA
	DTB	15.41	15.41	15.41	15.41	15.41	15.41
WTZ-1-3	DTP	NG	NG	3.72	NG	NG	NG
	DTW	NG	NG	4.96	NG	NG	NG
	LNAPL Thickness	NA	NA	1.24	NA	NA	NA
	DTB	14.15	14.15	13.56	14.15	14.15	14.15
WTZ-1-4	DTP	NG	NG	6.28	NG	NG	NG
	DTW	NG	NG	10.58	NG	NG	NG
	LNAPL Thickness	NA	NA	4.30	NA	NA	NA
	DTB	15.23	15.23	15.23	15.23	15.23	15.23
WTZ-1-5	DTP	NG	NG	NP	NG	NG	NG
	DTW	NG	NG	5.18	NG	NG	NG
	LNAPL Thickness	NA	NA	0.00	NA	NA	NA
	DTB	13.56	13.56	13.56	13.56	13.56	13.56
WTZ-1-8	DTP	NG	NG	NP	NG	NG	NG
	DTW	NG	NG	11.02	NG	NG	NG
	LNAPL Thickness	NA	NA	0.00	NA	NA	NA
	DTB	16.80	16.80	16.80	16.80	16.80	16.80
WTZ-1-9	DTP	NG	NG	NP	NG	NG	NG
	DTW	NG	NG	11.09	NG	NG	NG
	LNAPL Thickness	NA	NA	0.00	NA	NA	NA
	DTB	16.68	16.68	16.68	16.68	16.68	16.68

Notes:
1. Np= No Light Non-Aqueous Phase Liquids (LNAPLs) present
2. DTP = Depth to LNAPL
3. DTW= Depth to Water
4. NG= Not gauged.
5. N/A = Not applicable
6. DTB = Depth to bottom

Pennsylvania Department of Environmental Protection

2 East Main Street
Norristown, PA 19401

August 15, 2007

RECEIVED AUG 17 2007

Southeast Regional Office

Phone: 484-250-5960
Fax: 484-250-5961

Ms. Pam Blackwell
Sunoco, Inc. R&M
3144 Passyunk Avenue
Philadelphia, PA 19145

Re: Storage Tank Program
Sunoco Girard Point Processing Area (GP-250)
Facility ID No. 51-36558
3144 Passyunk avenue
City of Philadelphia
Philadelphia County

Dear Ms. Blackwell:

On July 31, 2007 we received your report entitled "Site Characterization/Assessment Report", dated July 25, 2007, for the storage tank facility referenced above. We consider this submittal to be the Remedial Action Completion Report required by the Corrective Action Process regulations, 25 Pa. Code Section 245.313.

You have identified your selected cleanup standard as either the Department's Statewide Health Standard or Background Standard. As such, the Department will attempt to review this report within 60 days of its receipt and send a review letter to the facility owner.

If you have any questions concerning the requirements of the Corrective Action Process regulations, please contact me at 484-250-5703.

Sincerely,

Thomas D. Canigiani, Jr.
Water Quality Specialist Supervisor
Environmental Cleanup

cc: Philadelphia County Health Department
City of Philadelphia
Mr. Miceli, USTIF
Mr. Yetman (SECOR Intl Inc.)
Mr. Payne
Re 30 (RW07ECP) 227-4

GP-U 677

Stantec Consulting Corporation
1060 Andrew Drive, Suite 140
West Chester, PA 19380
Tel: (610) 840-2500
Fax: (610) 840-2501

August 22, 2011

Paula Murphy
Sunoco (R&S)
Philadelphia Refinery
3144 Passyunk Avenue
Philadelphia, Pennsylvania 19145

RE: Tank Closure Assessment Report for AST GP U 677 in Girard Point Processing Area
Sunoco Philadelphia Refinery, Philadelphia, Pennsylvania
PADEP Facility ID #: 51-36558, PADEP Tank #131A

Dear Paula Murphy:

INTRODUCTION

Stantec Consulting Corporation (Stantec) has prepared this Tank Closure Assessment Report for aboveground storage tank (AST) GP U 677 located within the Sunoco Philadelphia Refinery in Philadelphia, Pennsylvania. The tank number is referenced by the PADEP as tank number 131A in the Girard Point Processing Area (GP). This AST is located within Area of Interest (AOI) 6 in the west quadrant of the Girard Point Processing Area. **Figure 1** is a site location map showing the facility location with respect to the surrounding area and **Figure 2** is a site plan which identifies AOI 6 and the referenced AST location.

GP U 677 (PADEP Tank # 131A) is an AST 30 feet in diameter with a design capacity of 158,340 gallons. The AST was historically used to store No. 6 fuel oil and has been temporarily out of service (TOOU) since June 1, 2005. GP U 677 was formally closed-in-place with Closure Notification forms submitted to PADEP by Sunoco on February 24, 2011 (see **Appendix A** for notification documents).

Stantec performed the soil boring installation and sampling activities in accordance with the PADEP technical document “Closure Requirements for Aboveground Storage Tank Systems” (257-4200-001) to the extent practical, however, number and locations of samples were collected as identified in the work plan to Sunoco dated April 13, 2011. The closure sampling plan for GP U 677 consists of four shallow perimeter soil samples as well as one shallow soil sample beneath the product delivery line as well as groundwater sampling of a previously existing downgradient monitoring well.

The constituents of concern (COCs) are the parameters for PADEP leaded gasoline and No. 2, 4, 5, and 6 fuel oils.

SOIL INVESTIGATION

On June 8, 2011, Stantec collected a total of five (5) discrete soil samples from the perimeter area of AST GP U 677 (**Figure 3**). Four (4) soil borings were installed around the northeast, southeast, southwest, and northwest quadrants of the tank perimeter and to the extent possible were aligned adjacent to tank vents and/or associated piping. An additional sample was collected beneath a pipe elbow of the aboveground product delivery line. Boreholes were completed using a properly decontaminated stainless steel hand auger and shovel. Soils were logged and field screened using a photoionization detector (PID) prior to collecting the sample (**Appendix B**).

Grab soil samples were collected from the zero to 6-inch interval above the water table. Groundwater was not encountered in U677-1 or U677-3, however, groundwater in the proximal well was 2 feet below ground surface (bgs) and therefore, soil samples were collected in the 1.5 to 2 feet bgs interval.

Each soil sample was collected using a dedicated, airtight sampling device and placed into laboratory-provided glassware with preservatives if required. In addition, all samples were preserved at a temperature of 4℃ ± 2℃ (Celsius) prior to shipment to the analytical laboratory by application of ice. This temperature was maintained during shipment by placing ice in zip-top bags above, around, and below the sample containers.

In order to characterize subsurface soil conditions, soil samples were analyzed for benzene, toluene, ethylbenzene, xylenes, cumene (isopropylbenzene), naphthalene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, 1,2-dichloroethane (EDC), methyl-tertiary-butyl-ether (MTBE), 1,2-dibromoethane [ethylene dibromide] (EDB), fluorene, anthracene, pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, benzo(g,h,i)perylene, phenanthrene, chrysene, and lead. Soil samples were submitted to Pennsylvania-certified Lancaster Laboratories (LL) in New Holland, Pennsylvania for analysis of volatile organic compounds (VOCs) by EPA SW-846 Method 8260B, semi-volatile organic compounds (SVOCs) by EPA SW-846 Method 8310, and lead by SW-846 Method 6010B.

SOIL SAMPLING RESULTS

For purposes of evaluating the analytical data obtained through the characterization activities for GP U 677, the used aquifer, medium-specific concentrations (MSCs) for non-residential properties developed by PADEP to implement the Statewide Health Standard under Act 2 have been used as a basis for comparison. Given both the current use of the site and the anticipated use of the site in the future, the MSCs for non-residential property provide appropriate grounds for evaluation. In addition, while groundwater at the site is not currently used nor planned to be used for drinking water or agricultural purposes, the MSCs applicable to non-residential properties overlying used aquifers (with total dissolved solids less than 2,500 milligrams per liter) have been chosen as a conservative basis for comparison.

The highest value between 100 times the groundwater MSC and the generic value MSC was selected to represent the soil to groundwater numeric value. The used aquifer, non-residential soil to groundwater numeric value was then compared with the non-residential direct contact value for surface soil (0 to 2 feet bgs). The more stringent of the soil to groundwater value and the direct contact value was selected as the applicable soil MSC, otherwise referred to as the Statewide Health Standard (SHS).

The soil analytical data are summarized on **Table 1** and a copy of the laboratory analytical data report for the soil samples is included in **Appendix C**. The soil sampling results were compared to the MSCs under Act 2 for non-residential properties overlying used aquifers. All COCs in soil samples collected from the AST assessment were below MSCs except for EDB and lead.

EDB was detected in U677-1(1.5-2.0) at an estimated concentration of 0.13 milligrams per kilogram (mg/kg) which was above the non-residential soil MSC of 0.005 mg/kg and below the direct contact MSC of 3.7 mg/kg. Lead detected in soil at concentrations above the non-residential soil MSC of 450 mg/kg included the following:

- GP U677-1(1.5-2.0) 453 mg/kg; and
- GP U677-3(1.5-2.0) 451 mg/kg.

In accordance with Section IV of the PADEP's Technical Guidance Manual, a site-specific standard for the lead was calculated using PADEP default intake parameters for an onsite worker. As presented in Appendix H of the *Site Characterization/Remedial Investigation Report* for AOI 10 at the Philadelphia Refinery which was submitted to PADEP on June 29, 2011, the derived site-specific standard for lead in soil is 1,708 mg/kg for a refinery worker. None of the reported results for lead were detected above the site-specific standards.

GROUNDWATER CHARACTERIZATION

A previously unidentified monitoring well was located in proximity to GP U 677. This well is located approximately 25 feet west-southwest of GP U 677 and has been subsequently named B-95.

On June 8, 2011, Stantec performed groundwater sampling for B-95 for characterizing groundwater conditions in the vicinity of GP U 677. Light non-aqueous phase liquid (LNAPL) was not observed in the monitoring well during sampling.

Following well purging activities, groundwater samples were collected by lowering a disposable bailer slowly into the monitoring well to minimize agitation of the groundwater. 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. In order to characterize groundwater conditions, groundwater samples were analyzed for benzene, toluene, ethylbenzene, xylenes, cumene, MTBE, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, EDC, EDB, naphthalene, pyrene, phenanthrene, chrysene, and dissolved lead. Groundwater samples were submitted to LL for analysis of VOCs by EPA SW-846 Method 8260B, SVOCs by EPA SW-846 Method 8270C, EDB by EPA SW-846 Method 8011, and dissolved lead by SW-846 Method 6020. Dissolved lead samples were filtered prior to analysis by LL.

GROUNDWATER CHARACTERIZATION RESULTS

For the purpose of evaluating analytical data obtained during the AOI 6 characterization activities, groundwater results from B-95 was screened against the PADEP residential used aquifer (TDS≤ 2,500) ground-water MSCs. While groundwater at the site is not currently used nor planned to be used for drinking water or agricultural purposes, the MSCs applicable to residential properties overlying used aquifers (with total dissolved solids less than 2,500 milligrams per liter) have been chosen as a conservative basis for comparison.

All of the groundwater results for COCs in B-95 were below their respective PADEP residential groundwater MSCs. In addition, groundwater results for EDB in B-95 were non-detect (ND). Therefore, the EDB exceedance in soil at U677-1 does not appear to have an impact on groundwater quality beneath or in the vicinity of GP U 677.

The groundwater analytical results for B-95 are presented in **Table 2**. The laboratory analytical report for the groundwater sample is included in **Appendix C**.

GROUNDWATER FLOW, POTENTIAL MIGRATION PATHWAYS, AND SITE RECEPTORS

The nearest surface water body to GP U 677 is the Schuylkill River which represents the western boundary of AOI 6. Previous investigations verified that no groundwater wells located within 1.5 miles of the Refinery are used for drinking water or agricultural use.

Groundwater flow direction for the shallow/intermediate aquifer is illustrated on the site-wide groundwater elevation map (**Figure 4**). Groundwater flow in the shallow/intermediate zone in the vicinity of GP U 677 appears to be toward the east. However, groundwater in this area may be influenced by the tidal Schuylkill River. Groundwater flow in the deep aquifer is towards the south-southwest.

This site is an active refinery on industrial property. Access in AOI 6 is restricted by the Schuylkill River, fencing, and by security measures. Access to subsurface soils is denied by on-site procedures and PPE requirements that protect onsite workers from exposure. There were no COCs identified in groundwater above MSCs. Therefore, there are no complete exposure pathways from groundwater into indoor air at the on-site receptors.

RECOMMENDATIONS AND CONCLUSIONS

Based on the current and future intended non-residential site use and the results of the tank closure assessment activities, conclusions and recommendations follow:

- Concentrations of lead detected in surface soil samples GP U677-1(1.5-2.0) and GP U677-3(1.5-2.0) were above the applicable non-residential soil MSC but did not exceed the site-specific standard for lead.
- Groundwater results for EDB in B-95 were ND. Therefore, the EDB exceedance in soil at U677-1 demonstrates no impact on groundwater quality in the vicinity of GP U 677.
- All other surface soil samples were below applicable non-residential soil MSCs.
- All of the groundwater results for COCs in B-95 were below their respective PADEP residential groundwater MSCs.
- No further action is warranted at this location.

Should you have any questions or require additional information regarding this closure site assessment report for AST GP U677, please contact Jennifer Menges at (610) 840-2540 or by email at jennifer.menges@stantec.com.

Sincerely,

STANTEC CONSULTING CORPORATION

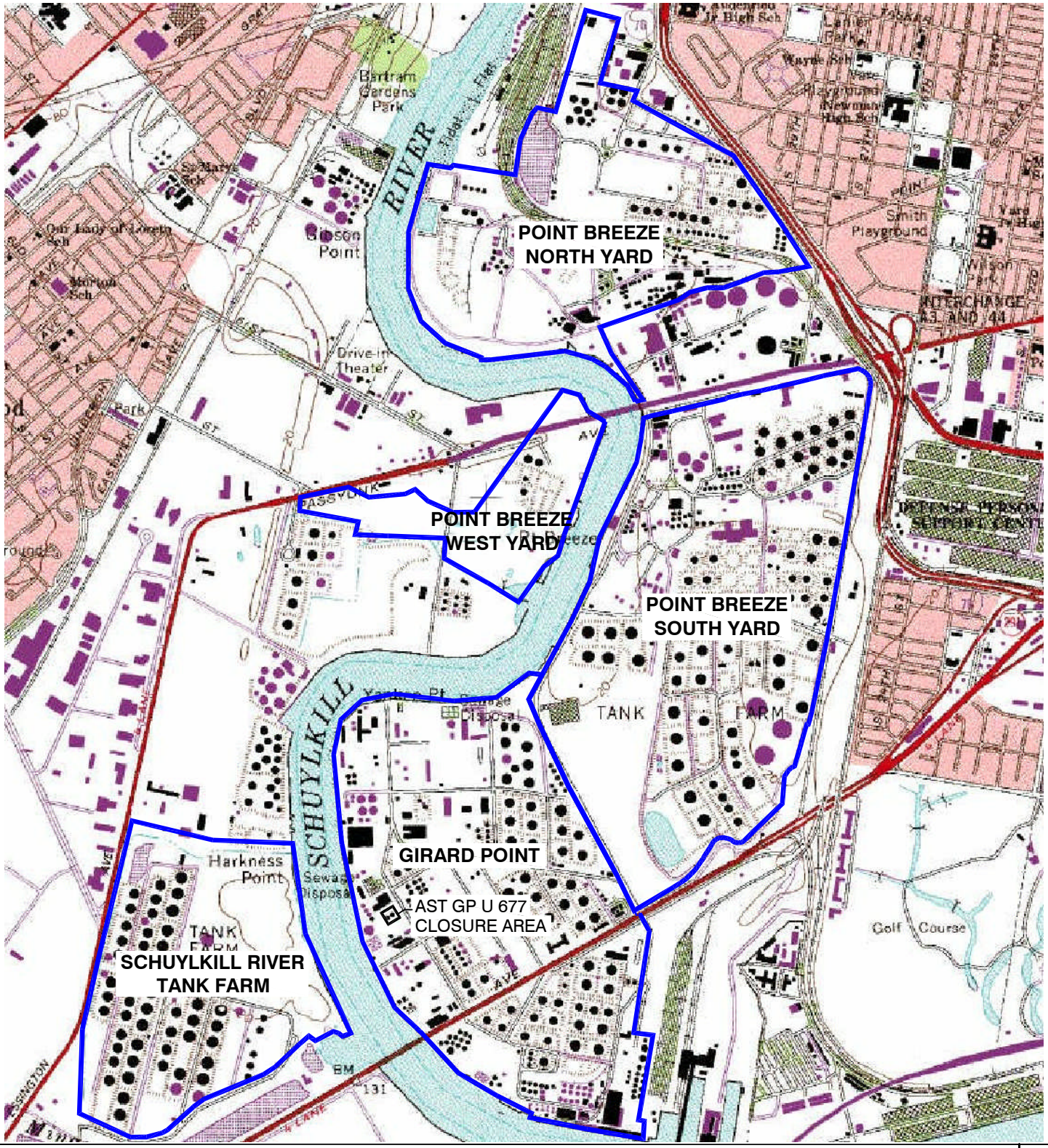
Jennifer Menges
Project Manager

Frank Aceto, PG
Principal Hydrogeologist

Attachments:
Figure 1 – Site Location Map
Figure 2 – Site Plan
Figure 3 – GP U 677 Soil Boring and Monitoring Well Locations Map
Figure 4 – Site-Wide Groundwater Elevation Map for Shallow and Intermediate Monitoring Wells
Table 1 – Soil Analytical Results Summary
Table 2 – Groundwater Analytical Result Summary
Appendix A – PADEP Closure Notification Forms
Appendix B – Soil Boring Logs
Appendix C – Laboratory Analytical Data Report (Soil and Groundwater)

cc: Jim Oppenheim – Sunoco, Inc.
Frank Aceto – Stantec
Dennis Webster – Langan
Stantec Project File

FIGURES



PENNSYLVANIA

QUADRANGLE LOCATION

0 1/2 1

SCALE (MILES)

N

REFERENCE: USGS 7.5 MINUTE QUADRANGLE; PHILADELPHIA, PENNSYLVANIA–NEW JERSEY; 1995

Stantec Consulting Services, Inc.
1060 ANDREW DRIVE, SUITE 140
WEST CHESTER, PENNSYLVANIA
19380
Tel. 610.840.2500
Fax. 610.840.2501
www.stantec.com

FOR:

SUNOCO, INC.
PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

SITE LOCATION MAP
PHILADELPHIA REFINERY
AST GP U 677 CLOSURE AREA

FIGURE: **1**

JOB NUMBER:	DRAWN BY:	CHECKED BY:	APPROVED BY:	DATE:
	TFB/KEF	JLM	JLM	07/27/2011

AOI-1

AOI-2

AOI-3

AOI-4

AOI-5

AOI-6

AOI-7

AOI-8

AOI-9

AOI-10

PASSAYUNK AVENUE

26TH STREET NORTH

26TH STREET SOUTH

SOURCE: BASEMAP PROVIDED BY LANGAN ENGINEERING AND ENVIRONMENTAL SERVICES

N

LEGEND

- SHALLOW / INTERMEDIATE / DEEP MONITORING WELL
- SHALLOW / INTERMEDIATE MONITORING WELL
- POLLOCK STREET SEWER
- POLLOCK STREET HORIZONTAL WELL
- SHALLOW / INTERMEDIATE O_2 MONITORING WELL
- DEEP MONITORING WELL
- INTERMEDIATE MONITORING WELL
- SHALLOW MONITORING WELL
- OTHER MONITORING WELL
- PIEZOMETER
- DEEP RECOVERY WELL
- INTERMEDIATE RECOVERY WELL
- SHALLOW RECOVERY WELL
- OTHER RECOVERY WELL
- SHALLOW/INTERMEDIATE RECOVERY WELL
- OR DAMAGED WELL
- STAFF GAUGE
- AREA OF INTEREST

SITE PLAN
FIGURE 2

FOR:

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

0 250 500 FEET

SCALE: 1"=500'
DATE: 4/22/11
DRN: TFB
CHD: JLM

SOURCE: BASEMAP PROVIDED BY LANGAN ENGINEERING AND ENVIRONMENTAL SERVICES

LEGEND

SHALLOW MONITORING WELL

SOIL BORING LOCATION

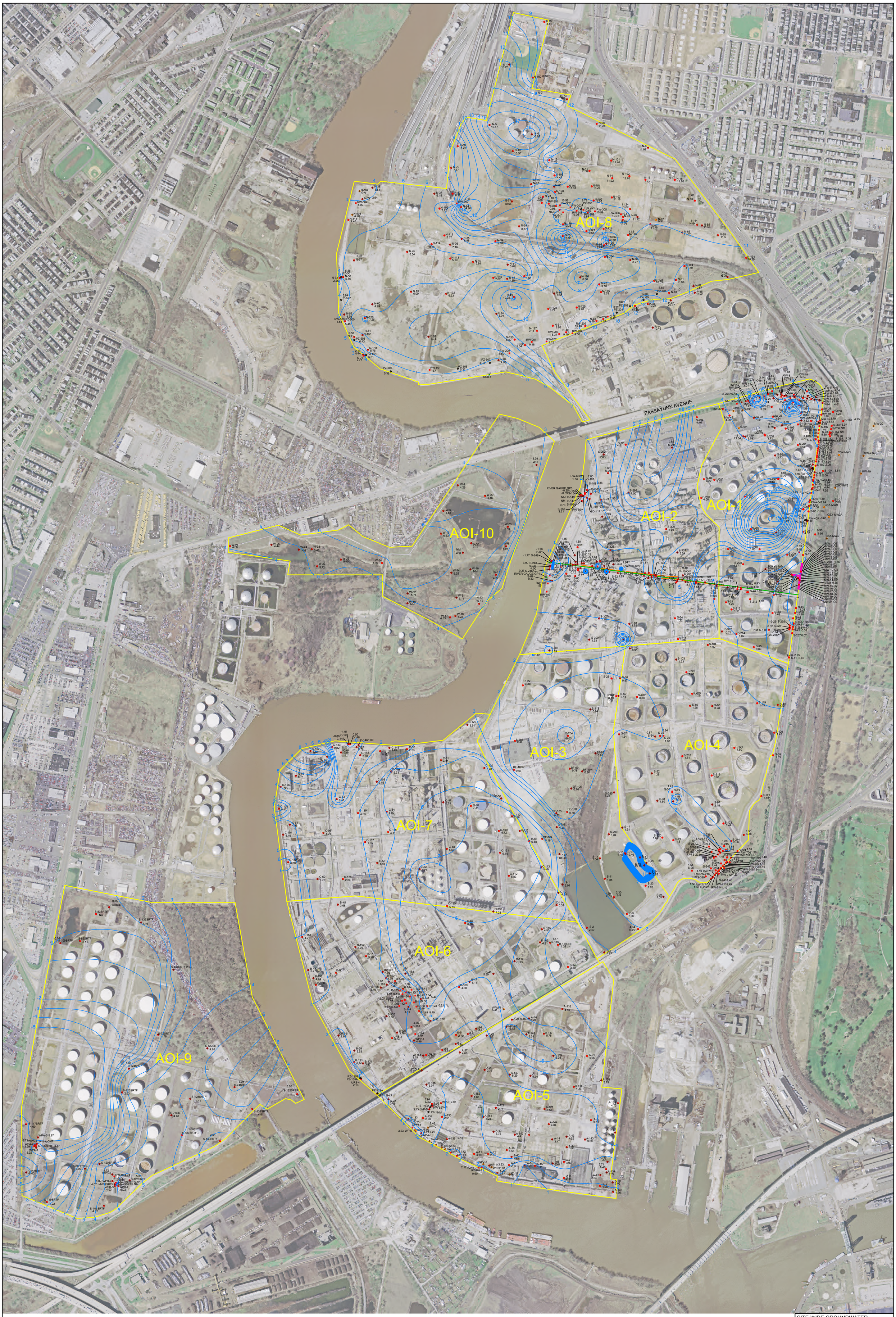
FIGURE 3
GP U 677 SOIL BORING AND MONITORING WELL LOCATIONS MAP

FOR:

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

1" = 60'

SCALE: 1"=60'
DATE: 08/02/2011
DRN: TFB
CHD: PM



SOURCE: BASEMAP PROVIDED BY LANGAN ENGINEERING AND ENVIRONMENTAL SERVICES

N

LEGEND

- SHALLOW / INTERMEDIATE / DEEP MONITORING WELL
- SHALLOW / INTERMEDIATE MONITORING WELL
- POLLOCK STREET SEWER
- POLLOCK STREET HORIZONTAL WELL
- SHALLOW / INTERMEDIATE O_2 MONITORING WELL
- INTERMEDIATE MONITORING WELL
- SHALLOW MONITORING WELL
- OTHER MONITORING WELL
- PIEZOMETER
- INTERMEDIATE RECOVERY WELL
- SHALLOW RECOVERY WELL
- OTHER RECOVERY WELL
- SHALLOW/INTERMEDIATE RECOVERY WELL
- OR DAMAGED WELL
- STAFF GAUGE
- AREA OF INTEREST

SITE-WIDE GROUNDWATER ELEVATION MAP FOR SHALLOW AND INTERMEDIATE MONITORING WELLS SECOND QUARTER 2011

FIGURE 4

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

0 250 500 FEET

SCALE: 1"=500'
DATE: 4/22/11
DRN: TFB
CHD: JLM

TABLES

Table 1
Soil Analytical Results Summary
Sunoco - Philadelphia Refinery
Girard Point AST GP U 677

	Sample Location				U677-1(1.5-2.0)	U677-2(0.8-1.3)	U677-3(1.5-2.0)	U677-4(0.3-0.8)	U677-5(0.8-1.3)
	Depth (ft)				1.5-2.0	0.8-1.3	1.5-2.0	0.3-0.8	0.8-1.3
	Date				6/8/2011	6/8/2011	6/8/2011	6/8/2011	6/8/2011
Volatile Compounds	**Non-Residential Direct Contact MSC (0-2 ft)**	**Non-Residential Soil to Groundwater 100x GW MSC**	**Non-Residential Soil to Groundwater Generic Value**	**Site-Specific Standard**					
Benzene	290	0.5	0.13	NA	0.06 J	ND (0.0006)	ND (0.0005)	ND (0.0005)	ND (0.0005)
Ethylbenzene	10,000	70	46	NA	0.11 J	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)
Isopropylbenzene (Cumene)	10,000	350	2,500	NA	0.70	ND (0.002)	ND (0.001)	ND (0.001)	ND (0.001)
Naphthalene	56,000	10	25	NA	0.29 J	ND (0.001)	ND (0.001)	ND (0.001)	0.16
Toluene	10,000	100	44	NA	0.12 J	ND (0.001)	ND (0.001)	ND (0.001)	0.001 J
1,2,4-Trimethylbenzene	560	6.2	35	NA	0.097 J	ND (0.001)	ND (0.001)	ND (0.001)	0.056
1,3,5-Trimethylbenzene	480	5.3	9.3	NA	ND (0.07)	ND (0.001)	ND (0.001)	ND (0.001)	0.046
Xylenes (Total)	8,000	1,000	990	NA	0.42	ND (0.001)	ND (0.001)	ND (0.001)	0.005
Methyl Tertiary Butyl Ether	3,200	2	0.28	NA	ND (0.035)	ND (0.0006)	ND (0.0005)	ND (0.0005)	ND (0.0005)
1,2-Dibromoethane (EDB)	3.7	0.005	0.0012	NA	**0.13 J**	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)
1,2-Dichloroethane (EDC)	86	0.5	0.1	NA	ND (0.07)	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)
Semi-Volatile Compounds									
Anthracene	190,000	6.6	350	NA	0.78	0.037 J	0.50	ND (0.028)	0.99
Benzo(a)anthracene	110	0.36	320	NA	1.0	0.11	1.2	0.031	ND (0.59)
Benzo(a)pyrene	11	0.02	46	NA	1.2	0.12	1.2	0.05	0.62
Benzo(b)fluoranthene	110	0.12	170	NA	0.8	0.091	0.85	0.053	0.81
Benzo(g,h,i)perylene	170,000	0.026	180	NA	1.7	0.19 J	1.5	0.13 J	1.4
Chrysene	11,000	0.19	230	NA	2.0	0.16	1.6	0.25	4.3
Fluorene	110,000	190	3,800	NA	1.3	ND (0.085)	0.39	ND (0.071)	2.5
Phenanthrene	190,000	110	10,000	NA	2.2	0.09 J	1.6	0.095 J	5.2
Pyrene	84,000	13	2,200	NA	1.5	0.24 J	2.3	ND (0.37)	ND (17)
Metals									
Lead	1,000	0.5	450	1,708	453	67.0	451	47.8	18.5

Notes:
All results are presented in mg/kg unless noted otherwise.
Non-Residential Used Aquifer Medium-Specific Concentrations (MSCs) with TDS<= 2,500 mg/L were chosen for comparison for soil results.
0.5 Indicates the applicable Non-Residential Statewide Health Standard for the unsaturated soil samples collected.
45 Indicates an exceedence of the applicable Non-Residential Statewide Health Standard.
J - Indicates an estimated value below the laboratory reporting limit.
bgs - below ground surface
NA - not applicable
ND (0.029) - Not detected above the laboratory method detection limit (in parenthesis).

Table 2
Groundwater Analytical Result Summary
Sunoco - Philadelphia Refinery Girard Point AST GP U 677

CONSTITUENTS OF CONCERN	PADEP Residential Used Aquifer with TDS ≤ 2,500 mg/L Groundwater MSCs	Groundwater Monitoring Well Sample Location: B-95
		Sample ID: U677-MW
		Date: 06/08/2011
Volatile Organic Compounds	**MSCs in ug/l**	**Groundwater Result (ug/l)**
Benzene	5	ND (0.5)
Ethylbenzene	700	ND (0.5)
Isopropylbenzene (Cumene)	840	ND (0.5)
Toluene	1,000	ND (0.5)
1,2,4-Trimethylbenzene	15	ND (0.5)
1,3,5-Trimethylbenzene	13	ND (0.5)
Xylenes (Total)	10,000	0.5 J
Methyl Tertiary Butyl Ether	20	ND (0.5)
1,2-Dibromoethane (EDB)	0.05	ND (0.0099)
1,2-Dichloroethane (EDC)	5	ND (0.5)
Semi-Volatile Organic Compounds		
Chrysene	1.9	0.18 J
Naphthalene	100	ND (1)
Phenanthrene	1,100	0.18 J
Pyrene	130	1.2
Metals		
Lead	5	ND (0.052)

Notes:
mg/L = milligrams per liter
ug/l = micrograms per liter
PADEP = Pennsylvania Department of Environmental Protection
MSCs = Medium-Specific Concentrations for Groundwater
ND (0.5) Indicates groundwater result was not detected above laboratory limit of quantitation (in parenthesis).

APPENDIX A
PADEP CLOSURE NOTIFICATION FORMS
GP U 677 CLOSURE ASSESSMENT REPORT
GIRARD POINT PROCESSING AREA
SUNOCO, INC. – PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

Certified Mail Number: 7002 0460 0003 1936 3785

Sunoco Inc.
3144 Passyunk Avenue
Philadelphia PA 19145-5299
215 339 2000

February 24, 2011

Kathy Nagle
PADEP Southeast Regional Office
Division of Storage Tanks
2 East Main Street
Norristown, PA 19401

RE: 30-day Notification of Intent to Close Aboveground Storage Tank

Dear Ms. Nagle:

This is to provide 30-day notification that Sunoco, Inc. (R&M) intends to permanently close in place the following aboveground storage tank:

Facility ID #51-36558 Girard Point Process Area
Tank # 136A (Sunoco tank # GP U 677)

Attached is the completed Aboveground Storage Tank System Closure Notification Form for this tank. Should you have any questions or comments in reference to this matter please contact me at 215-339-2074.

Very truly yours,

Charles D. Barksdale Jr, PE
Environmental Manager

CDB/pm

Attachments: Aboveground Storage Tank System Closure Notification Form

CC: J. Grawe – MH MOB

File: Tank AST Registration Amendments – CLOSURES 2011

2570-FM-BWM0513 6/2002

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF WASTE MANAGEMENT

DATE RECEIVED: _____

ABOVEGROUND STORAGE TANK SYSTEM CLOSURE NOTIFICATION FORM

NOTE: Notification of permanent closure must be received by the appropriate regional office of the Department at least 30 days prior to initiation of the closure activities.

I.	**Owner of Tank System**			
	Owner Name Sunoco, Inc. (R & M)			
	Street Address 3144 Passyunk Avenue		Phone Number ( )	
	City Philadelphia	State PA	Zip Code 19145-5299	
II.	**Location of Tank System**			
	Facility Name Girard Point Processing Area		Facility Identification Number 51-36558	
	Street Address 3144 Passyunk Avenue	City Philadelphia	State PA	Zip Code 19145
	Municipality Philadelphia	County Philadelphia		
	Contact Person Barksdale, Charles D.		Phone Number (215) 339-2074	
III.	**Month/Day/Year of Proposed Closure** 04 / 01 / 2011			
IV.	**Certified Installer/Company Performing Tank Handling Activities**			
	Certified Installer Name Chris Lieggi		Installer Certification Number 5263	
	Street Address 1000 Union Landing Road		Phone Number (856) 764-1210	
	City Riverton	State NJ	Zip Code 08077	
	Certified Company Name W&K Welding & Tank Erectors, Inc		Company Certification Number 385	
V.	**Contractor/Individual Performing Site Assessment Activities**			
	Name of Contractor or Individual TBD - currently out for bid.			
	Street Address		Phone Number ( )	
	City	State	Zip Code	
VI.	**Description of Aboveground Storage Tank Systems** (See reverse side of form)			
VII.	**Will this closure involve replacement of at least one old tank with a new tank?** Yes ☐ No ☒			
VIII.	**Signature of Tank System Owner** Michael C Barhorst		**Date** 2/24/2011	

VI.	**Description of Aboveground Storage Tank System** (Complete for each tank undergoing closure)				
	Tank Registration Number	136A			
	Estimated Total Capacity (Gallons)	38000			
	Substance(s) Stored Throughout Operating Life of Tank (Check All That Apply) **a. Petroleum**				
	Unleaded Gasoline	☐	☐	☐	☐
	Leaded Gasoline	☐	☐	☐	☐
	Aviation Gasoline	☐	☐	☐	☐
	Kerosene	☐	☐	☐	☐
	Jet Fuel	☐	☐	☐	☐
	Diesel Fuel	☐	☐	☐	☐
	Fuel Oil No. 1	☐	☐	☐	☐
	Fuel Oil No. 2	☐	☐	☐	☐
	Fuel Oil No. 4	☐	☐	☐	☐
	Fuel Oil No. 5	☐	☐	☐	☐
	Fuel Oil No. 6	☒	☐	☐	☐
	New Motor Oil	☐	☐	☐	☐
	Used Motor Oil	☐	☐	☐	☐
	Other, Please Specify				
	b. Hazardous Substance	☐	☐	☐	☐
	Name of Principal CERCLA Substance				
	AND				
	Chemical Abstract Service (CAS) No.				
	c. Unknown	☐	☐	☐	☐
	Proposed Closure Method (Check Only One) **a. Removal**	☐	☐	☐	☐
	b. Closure-in-Place	☒	☐	☐	☐
	c. Change-In-Service	☐	☐	☐	☐
	Partial System Closure (Yes or No)	No			
	Tank Registration Number				
	Estimated Total Capacity (Gallons)				
	Substance(s) Stored Throughout Operating Life of Tank (Check All That Apply) **a. Petroleum**				
	Unleaded Gasoline	☐	☐	☐	☐
	Leaded Gasoline	☐	☐	☐	☐
	Aviation Gasoline	☐	☐	☐	☐
	Kerosene	☐	☐	☐	☐
	Jet Fuel	☐	☐	☐	☐
	Diesel Fuel	☐	☐	☐	☐
	Fuel Oil No. 1	☐	☐	☐	☐
	Fuel Oil No. 2	☐	☐	☐	☐
	Fuel Oil No. 4	☐	☐	☐	☐
	Fuel Oil No. 5	☐	☐	☐	☐
	Fuel Oil No. 6	☐	☐	☐	☐
	New Motor Oil	☐	☐	☐	☐
	Used Motor Oil	☐	☐	☐	☐
	Other, Please Specify				
	b. Hazardous Substance	☐	☐	☐	☐
	Name of Principal CERCLA Substance				
	AND				
	Chemical Abstract Service (CAS) No.				
	c. Unknown	☐	☐	☐	☐
	Proposed Closure Method (Check Only One) **a. Removal**	☐	☐	☐	☐
	b. Closure-in-Place	☐	☐	☐	☐
	c. Change-In-Service	☐	☐	☐	☐
	Partial System Closure (Yes or No)				

VIA EMAIL

Sunoco Inc.
3144 Passyunk Avenue
Philadelphia PA 19145-5299
215 339 2000

March 1, 2011

Kathy Nagle
PADEP Southeast Regional Office
Division of Storage Tanks
2 East Main Street
Norristown, PA 19401

RE: Amended 30-day Notification of Intent to Close Aboveground Storage Tank

Dear Ms. Nagle:

On February 24, 2011, Sunoco, Inc. (R&M) submitted a 30-day notification of our intent to permanently close in place an aboveground storage tank in Facility ID #51-36558 (Girard Point Process Area). This PADEP tank number was incorrectly reported as Tank # 136A, the correct PADEP tank number that we wish to close is # 131A (Sunoco tank # GP U 677). Tank 136A will remain in Temporarily Out-of-Service Status.

We sincerely apologize for any inconvenience this may have caused you. Attached is the corrected Aboveground Storage Tank System Closure Notification Form for this tank. Should you have any questions or comments in reference to this matter please contact me at 215-339-2074.

Very truly yours,

Charles D. Barksdale Jr, PE
Environmental Manager

CDB/pm

Attachments: Aboveground Storage Tank System Closure Notification Form

CC: J. Grawe – MH MOB

File: Tank AST Registration Amendments – CLOSURES 2011

2570-FM-BWM0513 6/2002

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF WASTE MANAGEMENT

DATE RECEIVED: _____

ABOVEGROUND STORAGE TANK SYSTEM CLOSURE NOTIFICATION FORM

NOTE: Notification of permanent closure must be received by the appropriate regional office of the Department at least 30 days prior to initiation of the closure activities.

I.	**Owner of Tank System**			
	Owner Name Sunoco, Inc. (R & M)			
	Street Address 3144 Passyunk Avenue		Phone Number ( )	
	City Philadelphia	State PA	Zip Code 19145-5299	
II.	**Location of Tank System**			
	Facility Name Girard Point Processing Area	Facility Identification Number 51-36558		
	Street Address 3144 Passyunk Avenue	City Philadelphia	State PA	Zip Code 19145
	Municipality Philadelphia	County Philadelphia		
	Contact Person Barksdale, Charles D.	Phone Number (215) 339-2074		
III.	**Month/Day/Year of Proposed Closure** 04 / 05 / 2011			
IV.	**Certified Installer/Company Performing Tank Handling Activities**			
	Certified Installer Name Chris Lieggi	Installer Certification Number 5263		
	Street Address 1000 Union Landing Road	Phone Number (856) 764-1210		
	City Riverton	State NJ	Zip Code 08077	
	Certified Company Name W&K Welding & Tank Erectors, Inc	Company Certification Number 385		
V.	**Contractor/Individual Performing Site Assessment Activities**			
	Name of Contractor or Individual TBD - currently out for bid.			
	Street Address	Phone Number ( )		
	City	State	Zip Code	
VI.	**Description of Aboveground Storage Tank Systems** (See reverse side of form)			
VII.	**Will this closure involve replacement of at least one old tank with a new tank?** Yes ☐ No ☒			
VIII.	**Signature of Tank System Owner**	**Date** 3/3/2011		

VI.	**Description of Aboveground Storage Tank System** (Complete for each tank undergoing closure)					
	Tank Registration Number		131A			
	Estimated Total Capacity (Gallons)		158340			
	Substance(s) Stored Throughout Operating Life of Tank (Check All That Apply)	**a. Petroleum**				
		Unleaded Gasoline	☐	☐	☐	☐
		Leaded Gasoline	☐	☐	☐	☐
		Aviation Gasoline	☐	☐	☐	☐
		Kerosene	☐	☐	☐	☐
		Jet Fuel	☐	☐	☐	☐
		Diesel Fuel	☐	☐	☐	☐
		Fuel Oil No. 1	☐	☐	☐	☐
		Fuel Oil No. 2	☐	☐	☐	☐
		Fuel Oil No. 4	☐	☐	☐	☐
		Fuel Oil No. 5	☐	☐	☐	☐
		Fuel Oil No. 6	☒	☐	☐	☐
		New Motor Oil	☐	☐	☐	☐
		Used Motor Oil	☐	☐	☐	☐
		Other, Please Specify				
		b. Hazardous Substance	☐	☐	☐	☐
		Name of Principal CERCLA Substance				
		AND				
		Chemical Abstract Service (CAS) No.				
		c. Unknown	☐	☐	☐	☐
	Proposed Closure Method (Check Only One)	**a. Removal**	☐	☐	☐	☐
		b. Closure-in-Place	☒	☐	☐	☐
		c. Change-In-Service	☐	☐	☐	☐
	Partial System Closure (Yes or No)		No			
	Tank Registration Number					
	Estimated Total Capacity (Gallons)					
	Substance(s) Stored Throughout Operating Life of Tank (Check All That Apply)	**a. Petroleum**				
		Unleaded Gasoline	☐	☐	☐	☐
		Leaded Gasoline	☐	☐	☐	☐
		Aviation Gasoline	☐	☐	☐	☐
		Kerosene	☐	☐	☐	☐
		Jet Fuel	☐	☐	☐	☐
		Diesel Fuel	☐	☐	☐	☐
		Fuel Oil No. 1	☐	☐	☐	☐
		Fuel Oil No. 2	☐	☐	☐	☐
		Fuel Oil No. 4	☐	☐	☐	☐
		Fuel Oil No. 5	☐	☐	☐	☐
		Fuel Oil No. 6	☐	☐	☐	☐
		New Motor Oil	☐	☐	☐	☐
		Used Motor Oil	☐	☐	☐	☐
		Other, Please Specify				
		b. Hazardous Substance	☐	☐	☐	☐
		Name of Principal CERCLA Substance				
		AND				
		Chemical Abstract Service (CAS) No.				
		c. Unknown	☐	☐	☐	☐
	Proposed Closure Method (Check Only One)	**a. Removal**	☐	☐	☐	☐
		b. Closure-in-Place	☐	☐	☐	☐
		c. Change-In-Service	☐	☐	☐	☐
	Partial System Closure (Yes or No)					

Stantec

APPENDIX B
SOIL BORING LOGS
GP U 677 CLOSURE ASSESSMENT REPORT
GIRARD POINT PROCESSING AREA
SUNOCO, INC. – PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

PROJECT: **Sunoco - Philadelphia Refinery**
LOCATION: **AOI 6 AST GP U 677**
PROJECT NUMBER: **213401245**

WELL / PROBEHOLE / BOREHOLE NO: **U677-1** PAGE 1 OF 1

DRILLING / INSTALLATION:
STARTED **6/8/11** COMPLETED: **6/8/11**
DRILLING COMPANY: **Stantec**
DRILLING EQUIPMENT:
DRILLING METHOD: **Hand Auger**
SAMPLING EQUIPMENT: **Dedicated Airtight Sampler**

NORTHING (ft):
EASTING (ft):
LAT:
LONG:
GROUND ELEV (ft):
TOC ELEV (ft):
INITIAL DTW (ft): **Not Encountered**
WELL DEPTH (ft): **---**
STATIC DTW (ft): **NA**
BOREHOLE DEPTH (ft): **2.0**
WELL CASING DIA. (in): **---**
BOREHOLE DIA. (in):
LOGGED BY: **Paul Miller**
CHECKED BY: **J. Menges**

Time & Depth (feet)	Graphic Log	USCS	Description	Sample	Time Sample ID	Measured Recov. (feet)	Blow Count	Headspace PID (units)	Depth (feet)
			0-0.5' - STONE		--			3.5	
					--				
			0.5-0.9' - Brown and tan SAND with clay		--			50.8	
					--				
			0.9-2.0' - Moist, dark brown, clayey SAND						
					0920 U677-1 (1.5-2.0)			NM	
			Borehole terminated at 2 feet.						

PROJECT: **Sunoco - Philadelphia Refinery**
LOCATION: **AOI 6 AST GP U 677**
PROJECT NUMBER: **213401245**

WELL / PROBEHOLE / BOREHOLE NO: **U677-2** PAGE 1 OF 1

DRILLING / INSTALLATION:
STARTED **6/8/11** COMPLETED: **6/8/11**
DRILLING COMPANY: **Stantec**
DRILLING EQUIPMENT:
DRILLING METHOD: **Hand Auger**
SAMPLING EQUIPMENT: **Dedicated Airtight Sampler**

NORTHING (ft):
EASTING (ft):
LAT:
LONG:
GROUND ELEV (ft):
TOC ELEV (ft):
INITIAL DTW (ft): **1.4**
WELL DEPTH (ft): **---**
STATIC DTW (ft): **NA**
BOREHOLE DEPTH (ft): **1.4**
WELL CASING DIA. (in): **---**
BOREHOLE DIA. (in):
LOGGED BY: **Paul Miller**
CHECKED BY: **J. Menges**

Time & Depth (feet)	Graphic Log	USCS	Description	Sample	Time Sample ID	Measured Recov. (feet)	Blow Count	Headspace PID (units)	Depth (feet)
			0-0.5' - STONE (saturated from leaking steam line)		--			30.2	
					--				
			0.5-1.4' - Brown, tan, and gray, clayey SAND with rock fragments		0940 U677-2 (0.8-1.3)			17.1	
			Borehole terminated at 1.4 feet.						

PROJECT: **Sunoco - Philadelphia Refinery**
LOCATION: **AOI 6 AST GP U 677**
PROJECT NUMBER: **213401245**

WELL / PROBEHOLE / BOREHOLE NO: **U677-3** PAGE 1 OF 1

DRILLING / INSTALLATION:
STARTED **6/8/11** COMPLETED: **6/8/11**
DRILLING COMPANY: **Stantec**
DRILLING EQUIPMENT:
DRILLING METHOD: **Hand Auger**
SAMPLING EQUIPMENT: **Dedicated Airtight Sampler**

NORTHING (ft):
EASTING (ft):
LAT:
LONG:
GROUND ELEV (ft):
TOC ELEV (ft):
INITIAL DTW (ft): **Not Encountered**
WELL DEPTH (ft): **---**
STATIC DTW (ft): **NA**
BOREHOLE DEPTH (ft): **2.0**
WELL CASING DIA. (in): **---**
BOREHOLE DIA. (in):
LOGGED BY: **Paul Miller**
CHECKED BY: **J. Menges**

Time & Depth (feet)	Graphic Log	USCS	Description	Sample	Time Sample ID	Measured Recov. (feet)	Blow Count	Headspace PID (units)	Depth (feet)
			0-0.5' - STONE		--			0.0	
					--				
			0.5-1.3' - Brown SAND with silt and rock fragments		--			0.0	
					--				
			1.3-2.0' - Black, silty SAND						
					1000 U677-3 (1.5-2.0)			0.0	
			Borehole terminated at 2 feet.						

PROJECT: **Sunoco - Philadelphia Refinery**
LOCATION: **AOI 6 AST GP U 677**
PROJECT NUMBER: **213401245**

WELL / PROBEHOLE / BOREHOLE NO: **U677-4** PAGE 1 OF 1

DRILLING / INSTALLATION:
STARTED **6/8/11** COMPLETED: **6/8/11**
DRILLING COMPANY: **Stantec**
DRILLING EQUIPMENT:
DRILLING METHOD: **Hand Auger**
SAMPLING EQUIPMENT: **Dedicated Airtight Sampler**

NORTHING (ft):
EASTING (ft):
LAT:
LONG:
GROUND ELEV (ft):
TOC ELEV (ft):
INITIAL DTW (ft): **0.8**
WELL DEPTH (ft): **---**
STATIC DTW (ft): **NA**
BOREHOLE DEPTH (ft): **1.5**
WELL CASING DIA. (in): **---**
BOREHOLE DIA. (in):
LOGGED BY: **Paul Miller**
CHECKED BY: **J. Menges**

Time & Depth (feet)	Graphic Log	USCS	Description	Sample	Time Sample ID	Measured Recov. (feet)	Blow Count	Headspace PID (units)	Depth (feet)
			0-0.3' - STONE						
			0.3-0.8' - Tan SAND with stone		1020 U677-4 (0.3-0.8)			8.1	
			0.8-1.5' - SAND and STONE with sticky black tar-like substance; wet						▽
			Borehole terminated at 1.5 feet.						

PROJECT: **Sunoco - Philadelphia Refinery**
LOCATION: **AOI 6 AST GP U 677**
PROJECT NUMBER: **213401245**

WELL / PROBEHOLE / BOREHOLE NO: **U677-5** PAGE 1 OF 1

DRILLING / INSTALLATION:
STARTED **6/8/11** COMPLETED: **6/8/11**
DRILLING COMPANY: **Stantec**
DRILLING EQUIPMENT:
DRILLING METHOD: **Shovel**
SAMPLING EQUIPMENT: **Dedicated Airtight Sampler**

NORTHING (ft):
LAT:
GROUND ELEV (ft):
INITIAL DTW (ft): **1.3**
STATIC DTW (ft): **NA**
WELL CASING DIA. (in): **---**
LOGGED BY: **Paul Miller**

EASTING (ft):
LONG:
TOC ELEV (ft):
WELL DEPTH (ft): **---**
BOREHOLE DEPTH (ft): **1.3**
BOREHOLE DIA. (in):
CHECKED BY: **J. Menges**

Time & Depth (feet)	Graphic Log	USCS	Description	Sample	Time Sample ID	Measured Recov. (feet)	Blow Count	Headspace PID (units)	Depth (feet)
			0-0.3' - STONE						
			0.3-0.8' - Brown and black SAND and ROCK						
			0.8-1.3' - Brown and black SAND and ROCK with sticky, black tar-like substance		1035 U677-5 (0.8-1.3)			3.7	
			Borehole terminated at 1.3 feet.						▽

APPENDIX C
LABORATORY ANALYTICAL DATA REPORT (SOIL AND GROUNDWATER)
GP U 677 CLOSURE ASSESSMENT REPORT
GIRARD POINT PROCESSING AREA
SUNOCO, INC. – PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

Lancaster Laboratories

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Analysis Report

REVISED

ANALYTICAL RESULTS

Prepared by:

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

Prepared for:

Sunoco c/o Stantec
1060 Andrew Drive
Suite 140
West Chester PA 19380

June 24, 2011

Project: Sunoco

Submittal Date: 06/09/2011
Group Number: 1250778
PO Number: 213401245
State of Sample Origin: PA

Client Sample Description	Lancaster Labs (LLI) #
SR-31-1(1.3-1.8) Grab Soil Sample	6311678
SR-31-2(0.9-1.4) Grab Soil Sample	6311679
SR-31-3(0.8-1.3) Grab Soil Sample	6311680
SR-31-4(0.9-1.4) Grab Soil Sample	6311681
SR-31-5(0.8-1.3) Grab Soil Sample	6311682
SR-31-6(1.0-1.5) Grab Soil Sample	6311683
SR-31-7(1.1-1.6) Grab Soil Sample	6311684
SR-31-8(0.5-1.0) Grab Soil Sample	6311685
SR-31-9(1.2-1.7) Grab Soil Sample	6311686
GP U 677-1(1.5-2.0) Grab Soil Sample	6311687
GP U 677-2(0.8-1.3) Grab Soil Sample	6311688
GP U 677-3(1.5-2.0) Grab Soil Sample	6311689
GP U 677-4(0.3-0.8) Grab Soil Sample	6311690
GP U 677-5(0.8-1.3) Grab Soil Sample	6311691
B-95 GP U 677-MW Grab Water Sample	6311692
GP U 677-MW-TB Water Sample	6311693

The specific methodologies used in obtaining the enclosed analytical results are indicated on the Laboratory Sample Analysis Record.

ELECTRONIC COPY TO Sunoco c/o Stantec Attn: Jennifer Menges

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Analysis Report

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Questions? Contact your Client Services Representative
Loran A Carter at (717) 656-2300 Ext. 1375

Respectfully Submitted,

Lawrence M. Taylor
Senior Specialist

Lancaster Laboratories

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Analysis Report

REVISED

Sample Description: SR-31-1(1.3-1.8) Grab Soil Sample
Sunoco

LLI Sample # SW 6311678
LLI Group # 1250778
Account # 11183

Project Name: Sunoco

Collected: 06/07/2011 09:50 by PM

Submitted: 06/09/2011 16:15
Reported: 06/24/2011 13:41

Sunoco c/o Stantec
1060 Andrew Drive
Suite 140
West Chester PA 19380

SR311

CAT No.	Analysis Name	CAS Number	Dry Result		Dry Method Detection Limit	Dilution Factor
GC/MS Volatiles	**SW-846 8260B**		**ug/kg**		**ug/kg**	
10950	Benzene	71-43-2	44		1	1.97
10950	1,2-Dibromoethane	106-93-4	N.D.		3	1.97
10950	1,2-Dichloroethane	107-06-2	N.D.		3	1.97
10950	Ethylbenzene	100-41-4	15		3	1.97
10950	Isopropylbenzene	98-82-8	6	J	3	1.97
10950	Methyl Tertiary Butyl Ether	1634-04-4	N.D.		1	1.97
10950	Naphthalene	91-20-3	8	J	3	1.97
10950	Toluene	108-88-3	41		3	1.97
10950	1,2,4-Trimethylbenzene	95-63-6	38		3	1.97
10950	1,3,5-Trimethylbenzene	108-67-8	150		3	1.97
10950	Xylene (Total)	1330-20-7	110		3	1.97

The GC/MS volatile internal standard peak areas were outside the QC limits. A re-analysis was performed, and the matrix effect was confirmed.

GC/MS Semivolatiles	**SW-846 8310**		**ug/kg**		**ug/kg**	
00941	Anthracene	120-12-7	89		19	20
00941	Benzo(a)anthracene	56-55-3	540		9.7	20
00941	Benzo(a)pyrene	50-32-8	640		9.7	20
00941	Benzo(b)fluoranthene	205-99-2	570		7.7	20
00941	Benzo(g,h,i)perylene	191-24-2	830		58	20
00941	Chrysene	218-01-9	890		87	20
00941	Fluorene	86-73-7	160	J	97	20
00941	Phenanthrene	85-01-8	490		58	20
00941	Pyrene	129-00-0	1,200		97	20

The surrogate data is outside the QC limits due to unresolvable matrix problems evident in the sample chromatogram.

Reporting limits were raised due to interference from the sample matrix.

Metals	**SW-846 6010B**		**mg/kg**		**mg/kg**	
06955	Lead	7439-92-1	1,120		0.307	1

Wet Chemistry	**SM20 2540 G**		**%**		**%**	
00111	Moisture	n.a.	31.1		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.

General Sample Comments

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/12

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

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Analysis Report

REVISED

Sample Description: SR-31-1(1.3-1.8) Grab Soil Sample
Sunoco

LLI Sample # SW 6311678
LLI Group # 1250778
Account # 11183

Project Name: Sunoco

Collected: 06/07/2011 09:50 by PM

Submitted: 06/09/2011 16:15
Reported: 06/24/2011 13:41

Sunoco c/o Stantec
1060 Andrew Drive
Suite 140
West Chester PA 19380

SR311

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
10950	BTEX/MTBE/Nap/Cum/EDB/EDC/TMBs	SW-846 8260B	1	X111612AA	06/10/2011 23:32	Kristen D Pelliccia	1.97
07579	GC/MS-5g Field Preserv.MeOH-NC	SW-846 5035	1	201116024628	06/07/2011 09:50	Client Supplied	1
02392	L/H Field Preserved Bisulfate	SW-846 5035	1	201116024628	06/07/2011 09:50	Client Supplied	1
02392	L/H Field Preserved Bisulfate	SW-846 5035	2	201116024628	06/07/2011 09:50	Client Supplied	1
00941	PAH's in Solids by HPLC	SW-846 8310	1	11161SLA026	06/11/2011 16:48	Mark A Clark	20
03338	PAH Solid Extraction	SW-846 3550B	1	11161SLA026	06/10/2011 17:35	Sally L Appleyard	1
06955	Lead	SW-846 6010B	1	111655708004	06/15/2011 15:42	Eric L Eby	1
05708	SW SW846 ICP Digest	SW-846 3050B	1	111615708002	06/12/2011 19:47	Annamaria Stipkovits	1
05708	SW SW846 ICP Digest	SW-846 3050B	2	111655708004	06/14/2011 20:09	Annamaria Stipkovits	1
00111	Moisture	SM20 2540 G	1	11161820004B	06/10/2011 20:42	Scott W Freisher	1

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Analysis Report

REVISED

Sample Description: SR-31-2(0.9-1.4) Grab Soil Sample
Sunoco

LLI Sample # SW 6311679
LLI Group # 1250778
Account # 11183

Project Name: Sunoco

Collected: 06/07/2011 10:15 by PM

Submitted: 06/09/2011 16:15
Reported: 06/24/2011 13:41

Sunoco c/o Stantec
1060 Andrew Drive
Suite 140
West Chester PA 19380

SR312

CAT No.	Analysis Name	CAS Number	Dry Result		Dry Method Detection Limit	Dilution Factor
GC/MS Volatiles	**SW-846 8260B**		**ug/kg**		**ug/kg**	
10950	Benzene	71-43-2	2	J	0.9	1.13
10950	1,2-Dibromoethane	106-93-4	N.D.		2	1.13
10950	1,2-Dichloroethane	107-06-2	N.D.		2	1.13
10950	Ethylbenzene	100-41-4	N.D.		2	1.13
10950	Isopropylbenzene	98-82-8	N.D.		2	1.13
10950	Methyl Tertiary Butyl Ether	1634-04-4	N.D.		0.9	1.13
10950	Naphthalene	91-20-3	6	J	2	1.13
10950	Toluene	108-88-3	2	J	2	1.13
10950	1,2,4-Trimethylbenzene	95-63-6	N.D.		2	1.13
10950	1,3,5-Trimethylbenzene	108-67-8	N.D.		2	1.13
10950	Xylene (Total)	1330-20-7	2	J	2	1.13

The GC/MS volatile internal standard peak areas were outside the QC limits. A re-analysis was performed, and the matrix effect was confirmed.

GC/MS Semivolatiles	**SW-846 8310**		**ug/kg**		**ug/kg**	
00941	Anthracene	120-12-7	380		21	20
00941	Benzo(a)anthracene	56-55-3	2,900		11	20
00941	Benzo(a)pyrene	50-32-8	2,800		11	20
00941	Benzo(b)fluoranthene	205-99-2	2,600		8.5	20
00941	Benzo(g,h,i)perylene	191-24-2	3,300		64	20
00941	Chrysene	218-01-9	4,000		96	20
00941	Fluorene	86-73-7	370	J	110	20
00941	Phenanthrene	85-01-8	1,400		64	20
00941	Pyrene	129-00-0	5,000		110	20

Reporting limits were raised due to interference from the sample matrix.

Metals	**SW-846 6010B**		**mg/kg**		**mg/kg**	
06955	Lead	7439-92-1	898		0.345	1

Wet Chemistry	**SM20 2540 G**		**%**		**%**	
00111	Moisture	n.a.	37.4		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.

General Sample Comments

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/12

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
10950	BTEX/MTBE/Nap/Cum/EDB/EDC/TMBs	SW-846 8260B	1	X111612AA	06/10/2011 22:00	Kristen D Pelliccia	1.13

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Analysis Report

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Sample Description: SR-31-2(0.9-1.4) Grab Soil Sample
Sunoco

LLI Sample # SW 6311679
LLI Group # 1250778
Account # 11183

Project Name: Sunoco

Collected: 06/07/2011 10:15 by PM

Submitted: 06/09/2011 16:15
Reported: 06/24/2011 13:41

Sunoco c/o Stantec
1060 Andrew Drive
Suite 140
West Chester PA 19380

SR312

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
07579	GC/MS-5g Field Preserv.MeOH-NC	SW-846 5035	1	201116024628	06/07/2011 10:15	Client Supplied	1
02392	L/H Field Preserved Bisulfate	SW-846 5035	1	201116024628	06/07/2011 10:15	Client Supplied	1
02392	L/H Field Preserved Bisulfate	SW-846 5035	2	201116024628	06/07/2011 10:15	Client Supplied	1
00941	PAH's in Solids by HPLC	SW-846 8310	1	11161SLA026	06/11/2011 17:34	Mark A Clark	20
03338	PAH Solid Extraction	SW-846 3550B	1	11161SLA026	06/10/2011 17:35	Sally L Appleyard	1
06955	Lead	SW-846 6010B	1	111655708004	06/15/2011 15:45	Eric L Eby	1
05708	SW SW846 ICP Digest	SW-846 3050B	1	111615708002	06/12/2011 19:47	Annamaria Stipkovits	1
05708	SW SW846 ICP Digest	SW-846 3050B	2	111655708004	06/14/2011 20:09	Annamaria Stipkovits	1
00111	Moisture	SM20 2540 G	1	11161820004B	06/10/2011 20:42	Scott W Freisher	1

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Analysis Report

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Sample Description: SR-31-3(0.8-1.3) Grab Soil Sample
Sunoco

LLI Sample # SW 6311680
LLI Group # 1250778
Account # 11183

Project Name: Sunoco

Collected: 06/07/2011 10:45 by PM

Submitted: 06/09/2011 16:15
Reported: 06/24/2011 13:41

Sunoco c/o Stantec
1060 Andrew Drive
Suite 140
West Chester PA 19380

SR313

CAT No.	Analysis Name	CAS Number	Dry Result		Dry Method Detection Limit	Dilution Factor
GC/MS Volatiles	**SW-846 8260B**		**ug/kg**		**ug/kg**	
10950	Benzene	71-43-2	3	J	0.8	1.1
10950	1,2-Dibromoethane	106-93-4	N.D.		2	1.1
10950	1,2-Dichloroethane	107-06-2	N.D.		2	1.1
10950	Ethylbenzene	100-41-4	N.D.		2	1.1
10950	Isopropylbenzene	98-82-8	N.D.		2	1.1
10950	Methyl Tertiary Butyl Ether	1634-04-4	N.D.		0.8	1.1
10950	Naphthalene	91-20-3	N.D.		2	1.1
10950	Toluene	108-88-3	2	J	2	1.1
10950	1,2,4-Trimethylbenzene	95-63-6	2	J	2	1.1
10950	1,3,5-Trimethylbenzene	108-67-8	N.D.		2	1.1
10950	Xylene (Total)	1330-20-7	N.D.		2	1.1

The GC/MS volatile internal standard peak areas were outside the QC limits. A re-analysis was performed, and the matrix effect was confirmed.

GC/MS Semivolatiles	**SW-846 8310**		**ug/kg**		**ug/kg**	
00941	Anthracene	120-12-7	180		20	20
00941	Benzo(a)anthracene	56-55-3	730		10	20
00941	Benzo(a)pyrene	50-32-8	810		10	20
00941	Benzo(b)fluoranthene	205-99-2	620		8.0	20
00941	Benzo(g,h,i)perylene	191-24-2	950		60	20
00941	Chrysene	218-01-9	1,200		90	20
00941	Fluorene	86-73-7	N.D.		190	20
00941	Phenanthrene	85-01-8	660		60	20
00941	Pyrene	129-00-0	1,500		100	20

Reporting limits were raised due to interference from the sample matrix.

Due to the presence of an interferent near its retention time, the normal reporting limit was not attained for fluorene. The reporting limit for this compound was raised accordingly.

Metals	**SW-846 6010B**		**mg/kg**		**mg/kg**	
06955	Lead	7439-92-1	774		0.320	1

Wet Chemistry	**SM20 2540 G**		**%**		**%**	
00111	Moisture	n.a.	33.3		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.

General Sample Comments

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/12

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

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Analysis Report

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Sample Description: SR-31-3(0.8-1.3) Grab Soil Sample
Sunoco

LLI Sample # SW 6311680
LLI Group # 1250778
Account # 11183

Project Name: Sunoco

Collected: 06/07/2011 10:45 by PM

Submitted: 06/09/2011 16:15
Reported: 06/24/2011 13:41

Sunoco c/o Stantec
1060 Andrew Drive
Suite 140
West Chester PA 19380

SR313

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
10950	BTEX/MTBE/Nap/Cum/EDB/EDC/TMBs	SW-846 8260B	1	X111612AA	06/11/2011 01:04	Kristen D Pelliccia	1.1
07579	GC/MS-5g Field Preserv.MeOH-NC	SW-846 5035	1	201116024628	06/07/2011 10:45	Client Supplied	1
02392	L/H Field Preserved Bisulfate	SW-846 5035	1	201116024628	06/07/2011 10:45	Client Supplied	1
02392	L/H Field Preserved Bisulfate	SW-846 5035	2	201116024628	06/07/2011 10:45	Client Supplied	1
00941	PAH's in Solids by HPLC	SW-846 8310	1	11161SLA026	06/11/2011 18:20	Mark A Clark	20
03338	PAH Solid Extraction	SW-846 3550B	1	11161SLA026	06/10/2011 17:35	Sally L Appleyard	1
06955	Lead	SW-846 6010B	1	111655708004	06/15/2011 15:56	Eric L Eby	1
05708	SW SW846 ICP Digest	SW-846 3050B	1	111615708002	06/12/2011 19:47	Annamaria Stipkovits	1
05708	SW SW846 ICP Digest	SW-846 3050B	2	111655708004	06/14/2011 20:09	Annamaria Stipkovits	1
00111	Moisture	SM20 2540 G	1	11161820004B	06/10/2011 20:42	Scott W Freisher	1

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Analysis Report

REVISED

Sample Description: SR-31-4(0.9-1.4) Grab Soil Sample
Sunoco

LLI Sample # SW 6311681
LLI Group # 1250778
Account # 11183

Project Name: Sunoco

Collected: 06/07/2011 11:15 by PM

Submitted: 06/09/2011 16:15
Reported: 06/24/2011 13:41

Sunoco c/o Stantec
1060 Andrew Drive
Suite 140
West Chester PA 19380

SR314

CAT No.	Analysis Name	CAS Number	Dry Result		Dry Method Detection Limit	Dilution Factor
GC/MS Volatiles	**SW-846 8260B**		**ug/kg**		**ug/kg**	
10950	Benzene	71-43-2	1	J	0.8	0.96
10950	1,2-Dibromoethane	106-93-4	N.D.		2	0.96
10950	1,2-Dichloroethane	107-06-2	N.D.		2	0.96
10950	Ethylbenzene	100-41-4	N.D.		2	0.96
10950	Isopropylbenzene	98-82-8	N.D.		2	0.96
10950	Methyl Tertiary Butyl Ether	1634-04-4	N.D.		0.8	0.96
10950	Naphthalene	91-20-3	N.D.		2	0.96
10950	Toluene	108-88-3	N.D.		2	0.96
10950	1,2,4-Trimethylbenzene	95-63-6	N.D.		2	0.96
10950	1,3,5-Trimethylbenzene	108-67-8	N.D.		2	0.96
10950	Xylene (Total)	1330-20-7	N.D.		2	0.96
GC/MS Semivolatiles	**SW-846 8310**		**ug/kg**		**ug/kg**	
00941	Anthracene	120-12-7	34	J	21	20
00941	Benzo(a)anthracene	56-55-3	190		10	20
00941	Benzo(a)pyrene	50-32-8	220		10	20
00941	Benzo(b)fluoranthene	205-99-2	190		8.3	20
00941	Benzo(g,h,i)perylene	191-24-2	330		63	20
00941	Chrysene	218-01-9	360		94	20
00941	Fluorene	86-73-7	N.D.		100	20
00941	Phenanthrene	85-01-8	130	J	63	20
00941	Pyrene	129-00-0	460		100	20
	Reporting limits were raised due to interference from the sample matrix.					
Metals	**SW-846 6010B**		**mg/kg**		**mg/kg**	
06955	Lead	7439-92-1	2,210		1.66	5
Wet Chemistry	**SM20 2540 G**		**%**		**%**	
00111	Moisture	n.a.	36.1		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.					

General Sample Comments

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/12

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
10950	BTEX/MTBE/Nap/Cum/EDB/EDC/TMBs	SW-846 8260B	1	X111612AA	06/10/2011 22:23	Kristen D Pelliccia	0.96
07579	GC/MS-5g Field Preserv.MeOH-NC	SW-846 5035	1	201116024628	06/07/2011 11:15	Client Supplied	1

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Analysis Report

REVISED

Sample Description: SR-31-4(0.9-1.4) Grab Soil Sample
Sunoco

LLI Sample # SW 6311681
LLI Group # 1250778
Account # 11183

Project Name: Sunoco

Collected: 06/07/2011 11:15 by PM

Submitted: 06/09/2011 16:15
Reported: 06/24/2011 13:41

Sunoco c/o Stantec
1060 Andrew Drive
Suite 140
West Chester PA 19380

SR314

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
02392	L/H Field Preserved Bisulfate	SW-846 5035	1	201116024628	06/07/2011 11:15	Client Supplied	1
02392	L/H Field Preserved Bisulfate	SW-846 5035	2	201116024628	06/07/2011 11:15	Client Supplied	1
00941	PAH's in Solids by HPLC	SW-846 8310	1	11161SLA026	06/11/2011 19:44	Mark A Clark	20
03338	PAH Solid Extraction	SW-846 3550B	1	11161SLA026	06/10/2011 17:35	Sally L Appleyard	1
06955	Lead	SW-846 6010B	1	111655708004	06/15/2011 16:49	Eric L Eby	5
05708	SW SW846 ICP Digest	SW-846 3050B	1	111615708002	06/12/2011 19:47	Annamaria Stipkovits	1
05708	SW SW846 ICP Digest	SW-846 3050B	2	111655708004	06/14/2011 20:09	Annamaria Stipkovits	1
00111	Moisture	SM20 2540 G	1	11161820004B	06/10/2011 20:42	Scott W Freisher	1

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Analysis Report

REVISED

Sample Description: SR-31-5(0.8-1.3) Grab Soil Sample
Sunoco

LLI Sample # SW 6311682
LLI Group # 1250778
Account # 11183

Project Name: Sunoco

Collected: 06/07/2011 12:00 by PM

Submitted: 06/09/2011 16:15
Reported: 06/24/2011 13:41

Sunoco c/o Stantec
1060 Andrew Drive
Suite 140
West Chester PA 19380

SR315

CAT No.	Analysis Name	CAS Number	Dry Result		Dry Method Detection Limit	Dilution Factor
GC/MS Volatiles	**SW-846 8260B**		**ug/kg**		**ug/kg**	
10950	Benzene	71-43-2	N.D.		65	69.81
10950	1,2-Dibromoethane	106-93-4	N.D.		130	69.81
10950	1,2-Dichloroethane	107-06-2	N.D.		130	69.81
10950	Ethylbenzene	100-41-4	N.D.		130	69.81
10950	Isopropylbenzene	98-82-8	N.D.		130	69.81
10950	Methyl Tertiary Butyl Ether	1634-04-4	N.D.		65	69.81
10950	Naphthalene	91-20-3	200	J	130	69.81
10950	Toluene	108-88-3	N.D.		130	69.81
10950	1,2,4-Trimethylbenzene	95-63-6	N.D.		130	69.81
10950	1,3,5-Trimethylbenzene	108-67-8	N.D.		130	69.81
10950	Xylene (Total)	1330-20-7	N.D.		130	69.81
	Reporting limits were raised due to interference from the sample matrix.					
GC/MS Semivolatiles	**SW-846 8310**		**ug/kg**		**ug/kg**	
00941	Anthracene	120-12-7	110		25	20
00941	Benzo(a)anthracene	56-55-3	340		12	20
00941	Benzo(a)pyrene	50-32-8	420		12	20
00941	Benzo(b)fluoranthene	205-99-2	350		10	20
00941	Benzo(g,h,i)perylene	191-24-2	610		75	20
00941	Chrysene	218-01-9	680		110	20
00941	Fluorene	86-73-7	N.D.		120	20
00941	Phenanthrene	85-01-8	250		75	20
00941	Pyrene	129-00-0	730		120	20
	Reporting limits were raised due to interference from the sample matrix.					
Metals	**SW-846 6010B**		**mg/kg**		**mg/kg**	
06955	Lead	7439-92-1	1,890		2.04	5
Wet Chemistry	**SM20 2540 G**		**%**		**%**	
00111	Moisture	n.a.	46.5		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.					

General Sample Comments

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/12

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
10950	BTEX/MTBE/Nap/Cum/EDB/EDC/TMBs	SW-846 8260B	1	Q111641AA	06/14/2011 00:55	Kristen D Pelliccia	69.81
07579	GC/MS-5g Field Preserv.MeOH-NC	SW-846 5035	1	201116024628	06/07/2011 12:00	Client Supplied	1

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Analysis Report

REVISED

Sample Description: SR-31-5(0.8-1.3) Grab Soil Sample
Sunoco

LLI Sample # SW 6311682
LLI Group # 1250778
Account # 11183

Project Name: Sunoco

Collected: 06/07/2011 12:00 by PM

Submitted: 06/09/2011 16:15
Reported: 06/24/2011 13:41

Sunoco c/o Stantec
1060 Andrew Drive
Suite 140
West Chester PA 19380

SR315

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
02392	L/H Field Preserved Bisulfate	SW-846 5035	1	201116024628	06/07/2011 12:00	Client Supplied	1
02392	L/H Field Preserved Bisulfate	SW-846 5035	2	201116024628	06/07/2011 12:00	Client Supplied	1
00941	PAH's in Solids by HPLC	SW-846 8310	1	11161SLA026	06/11/2011 20:30	Mark A Clark	20
03338	PAH Solid Extraction	SW-846 3550B	1	11161SLA026	06/10/2011 17:35	Sally L Appleyard	1
06955	Lead	SW-846 6010B	1	111655708004	06/15/2011 16:52	Eric L Eby	5
05708	SW SW846 ICP Digest	SW-846 3050B	1	111615708002	06/12/2011 19:47	Annamaria Stipkovits	1
05708	SW SW846 ICP Digest	SW-846 3050B	2	111655708004	06/14/2011 20:09	Annamaria Stipkovits	1
00111	Moisture	SM20 2540 G	1	11161820004B	06/10/2011 20:42	Scott W Freisher	1

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Analysis Report

REVISED

Sample Description: SR-31-6(1.0-1.5) Grab Soil Sample
Sunoco

LLI Sample # SW 6311683
LLI Group # 1250778
Account # 11183

Project Name: Sunoco

Collected: 06/07/2011 12:20 by PM

Submitted: 06/09/2011 16:15
Reported: 06/24/2011 13:41

Sunoco c/o Stantec
1060 Andrew Drive
Suite 140
West Chester PA 19380

SR316

CAT No.	Analysis Name	CAS Number	Dry Result		Dry Method Detection Limit	Dilution Factor
GC/MS Volatiles	**SW-846 8260B**		**ug/kg**		**ug/kg**	
10950	Benzene	71-43-2	N.D.		45	64.13
10950	1,2-Dibromoethane	106-93-4	N.D.		89	64.13
10950	1,2-Dichloroethane	107-06-2	N.D.		89	64.13
10950	Ethylbenzene	100-41-4	N.D.		89	64.13
10950	Isopropylbenzene	98-82-8	N.D.		89	64.13
10950	Methyl Tertiary Butyl Ether	1634-04-4	N.D.		45	64.13
10950	Naphthalene	91-20-3	N.D.		89	64.13
10950	Toluene	108-88-3	N.D.		89	64.13
10950	1,2,4-Trimethylbenzene	95-63-6	N.D.		89	64.13
10950	1,3,5-Trimethylbenzene	108-67-8	N.D.		89	64.13
10950	Xylene (Total)	1330-20-7	N.D.		89	64.13
	Reporting limits were raised due to interference from the sample matrix.					
GC/MS Semivolatiles	**SW-846 8310**		**ug/kg**		**ug/kg**	
00941	Anthracene	120-12-7	260		19	20
00941	Benzo(a)anthracene	56-55-3	2,000		9.3	20
00941	Benzo(a)pyrene	50-32-8	1,800		9.3	20
00941	Benzo(b)fluoranthene	205-99-2	1,600		7.4	20
00941	Benzo(g,h,i)perylene	191-24-2	2,200		56	20
00941	Chrysene	218-01-9	2,500		83	20
00941	Fluorene	86-73-7	180	J	93	20
00941	Phenanthrene	85-01-8	1,000		56	20
00941	Pyrene	129-00-0	3,600		93	20
	Reporting limits were raised due to interference from the sample matrix.					
Metals	**SW-846 6010B**		**mg/kg**		**mg/kg**	
06955	Lead	7439-92-1	780		0.300	1
Wet Chemistry	**SM20 2540 G**		**%**		**%**	
00111	Moisture	n.a.	28.1		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.					

General Sample Comments

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/12

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
10950	BTEX/MTBE/Nap/Cum/EDB/EDC/TMBs	SW-846 8260B	1	Q111641AA	06/14/2011 01:19	Kristen D Pelliccia	64.13
07579	GC/MS-5g Field Preserv.MeOH-NC	SW-846 5035	1	201116024628	06/07/2011 12:20	Client Supplied	1

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Analysis Report

REVISED

Sample Description: SR-31-6(1.0-1.5) Grab Soil Sample
Sunoco

LLI Sample # SW 6311683
LLI Group # 1250778
Account # 11183

Project Name: Sunoco

Collected: 06/07/2011 12:20 by PM

Submitted: 06/09/2011 16:15
Reported: 06/24/2011 13:41

Sunoco c/o Stantec
1060 Andrew Drive
Suite 140
West Chester PA 19380

SR316

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
02392	L/H Field Preserved Bisulfate	SW-846 5035	1	201116024628	06/07/2011 12:20	Client Supplied	1
00941	PAH's in Solids by HPLC	SW-846 8310	1	11161SLA026	06/11/2011 21:16	Mark A Clark	20
03338	PAH Solid Extraction	SW-846 3550B	1	11161SLA026	06/10/2011 17:35	Sally L Appleyard	1
06955	Lead	SW-846 6010B	1	111655708004	06/15/2011 16:07	Eric L Eby	1
05708	SW SW846 ICP Digest	SW-846 3050B	1	111615708002	06/12/2011 19:47	Annamaria Stipkovits	1
05708	SW SW846 ICP Digest	SW-846 3050B	2	111655708004	06/14/2011 20:09	Annamaria Stipkovits	1
00111	Moisture	SM20 2540 G	1	11161820004B	06/10/2011 20:42	Scott W Freisher	1

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Analysis Report

REVISED

Sample Description: SR-31-7(1.1-1.6) Grab Soil Sample
Sunoco

LLI Sample # SW 6311684
LLI Group # 1250778
Account # 11183

Project Name: Sunoco

Collected: 06/07/2011 12:45 by PM

Submitted: 06/09/2011 16:15
Reported: 06/24/2011 13:41

Sunoco c/o Stantec
1060 Andrew Drive
Suite 140
West Chester PA 19380

SR317

CAT No.	Analysis Name	CAS Number	Dry Result		Dry Method Detection Limit	Dilution Factor
GC/MS Volatiles	**SW-846 8260B**		**ug/kg**		**ug/kg**	
10950	Benzene	71-43-2	1	J	0.9	1.15
10950	1,2-Dibromoethane	106-93-4	N.D.		2	1.15
10950	1,2-Dichloroethane	107-06-2	N.D.		2	1.15
10950	Ethylbenzene	100-41-4	N.D.		2	1.15
10950	Isopropylbenzene	98-82-8	N.D.		2	1.15
10950	Methyl Tertiary Butyl Ether	1634-04-4	N.D.		0.9	1.15
10950	Naphthalene	91-20-3	N.D.		2	1.15
10950	Toluene	108-88-3	N.D.		2	1.15
10950	1,2,4-Trimethylbenzene	95-63-6	N.D.		2	1.15
10950	1,3,5-Trimethylbenzene	108-67-8	N.D.		2	1.15
10950	Xylene (Total)	1330-20-7	N.D.		2	1.15

The GC/MS volatile internal standard peak areas were outside the QC limits. A re-analysis was performed, and the matrix effect was confirmed.

GC/MS Semivolatiles	**SW-846 8310**		**ug/kg**		**ug/kg**	
00941	Anthracene	120-12-7	100		21	20
00941	Benzo(a)anthracene	56-55-3	380		11	20
00941	Benzo(a)pyrene	50-32-8	440		11	20
00941	Benzo(b)fluoranthene	205-99-2	360		8.4	20
00941	Benzo(g,h,i)perylene	191-24-2	590		63	20
00941	Chrysene	218-01-9	570		95	20
00941	Fluorene	86-73-7	N.D.		110	20
00941	Phenanthrene	85-01-8	420		63	20
00941	Pyrene	129-00-0	690		110	20

Reporting limits were raised due to interference from the sample matrix.

Metals	**SW-846 6010B**		**mg/kg**		**mg/kg**	
06955	Lead	7439-92-1	1,370		0.335	1

Wet Chemistry	**SM20 2540 G**		**%**		**%**	
00111	Moisture	n.a.	36.8		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.

General Sample Comments

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/12

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
10950	BTEX/MTBE/Nap/Cum/EDB/EDC/TMBs	SW-846 8260B	1	X111612AA	06/10/2011 23:55	Kristen D Pelliccia	1.15

Sample Description: SR-31-7(1.1-1.6) Grab Soil Sample
Sunoco

LLI Sample # SW 6311684
LLI Group # 1250778
Account # 11183

Project Name: Sunoco

Collected: 06/07/2011 12:45 by PM

Submitted: 06/09/2011 16:15
Reported: 06/24/2011 13:41

Sunoco c/o Stantec
1060 Andrew Drive
Suite 140
West Chester PA 19380

SR317

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
07579	GC/MS-5g Field Preserv.MeOH-NC	SW-846 5035	1	201116024628	06/07/2011 12:45	Client Supplied	1
02392	L/H Field Preserved Bisulfate	SW-846 5035	1	201116024628	06/07/2011 12:45	Client Supplied	1
02392	L/H Field Preserved Bisulfate	SW-846 5035	2	201116024628	06/07/2011 12:45	Client Supplied	1
00941	PAH's in Solids by HPLC	SW-846 8310	1	11161SLA026	06/11/2011 23:27	Mark A Clark	20
03338	PAH Solid Extraction	SW-846 3550B	1	11161SLA026	06/10/2011 17:35	Sally L Appleyard	1
06955	Lead	SW-846 6010B	1	111655708004	06/15/2011 16:11	Eric L Eby	1
05708	SW SW846 ICP Digest	SW-846 3050B	1	111615708002	06/12/2011 19:47	Annamaria Stipkovits	1
05708	SW SW846 ICP Digest	SW-846 3050B	2	111655708004	06/14/2011 20:09	Annamaria Stipkovits	1
00111	Moisture	SM20 2540 G	1	11161820004B	06/10/2011 20:42	Scott W Freisher	1

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Analysis Report

REVISED

Sample Description: SR-31-8(0.5-1.0) Grab Soil Sample
Sunoco

LLI Sample # SW 6311685
LLI Group # 1250778
Account # 11183

Project Name: Sunoco

Collected: 06/07/2011 13:05 by PM

Submitted: 06/09/2011 16:15
Reported: 06/24/2011 13:41

Sunoco c/o Stantec
1060 Andrew Drive
Suite 140
West Chester PA 19380

SR318

CAT No.	Analysis Name	CAS Number	Dry Result		Dry Method Detection Limit	Dilution Factor
GC/MS Volatiles	**SW-846 8260B**		**ug/kg**		**ug/kg**	
10950	Benzene	71-43-2	5	J	0.7	1.04
10950	1,2-Dibromoethane	106-93-4	N.D.		1	1.04
10950	1,2-Dichloroethane	107-06-2	N.D.		1	1.04
10950	Ethylbenzene	100-41-4	N.D.		1	1.04
10950	Isopropylbenzene	98-82-8	N.D.		1	1.04
10950	Methyl Tertiary Butyl Ether	1634-04-4	N.D.		0.7	1.04
10950	Naphthalene	91-20-3	N.D.		1	1.04
10950	Toluene	108-88-3	2	J	1	1.04
10950	1,2,4-Trimethylbenzene	95-63-6	N.D.		1	1.04
10950	1,3,5-Trimethylbenzene	108-67-8	N.D.		1	1.04
10950	Xylene (Total)	1330-20-7	N.D.		1	1.04

A GC/MS volatile internal standard peak area and a surrogate recovery were outside the QC limits. A re-analysis was performed using the remaining sample vial, but could not be reported due to a power outage.

GC/MS Semivolatiles	**SW-846 8310**		**ug/kg**		**ug/kg**	
00941	Anthracene	120-12-7	50	J	19	20
00941	Benzo(a)anthracene	56-55-3	370		9.3	20
00941	Benzo(a)pyrene	50-32-8	470		9.3	20
00941	Benzo(b)fluoranthene	205-99-2	380		7.4	20
00941	Benzo(g,h,i)perylene	191-24-2	620		56	20
00941	Chrysene	218-01-9	590		84	20
00941	Fluorene	86-73-7	N.D.		93	20
00941	Phenanthrene	85-01-8	200		56	20
00941	Pyrene	129-00-0	660		93	20

Reporting limits were raised due to interference from the sample matrix.

Metals	**SW-846 6010B**		**mg/kg**		**mg/kg**	
06955	Lead	7439-92-1	1,560		1.48	5

Wet Chemistry	**SM20 2540 G**		**%**		**%**	
00111	Moisture	n.a.	28.3		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.

General Sample Comments

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/12

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
10950	BTEX/MTBE/Nap/Cum/EDB/EDC/TMBs	SW-846 8260B	1	X111612AA	06/11/2011 00:18	Kristen D Pelliccia	1.04

Sample Description: SR-31-8(0.5-1.0) Grab Soil Sample
Sunoco

LLI Sample # SW 6311685
LLI Group # 1250778
Account # 11183

Project Name: Sunoco

Collected: 06/07/2011 13:05 by PM

Submitted: 06/09/2011 16:15
Reported: 06/24/2011 13:41

Sunoco c/o Stantec
1060 Andrew Drive
Suite 140
West Chester PA 19380

SR318

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
07579	GC/MS-5g Field Preserv.MeOH-NC	SW-846 5035	1	201116024628	06/07/2011 13:05	Client Supplied	1
02392	L/H Field Preserved Bisulfate	SW-846 5035	1	201116024628	06/07/2011 13:05	Client Supplied	1
02392	L/H Field Preserved Bisulfate	SW-846 5035	2	201116024628	06/07/2011 13:05	Client Supplied	1
00941	PAH's in Solids by HPLC	SW-846 8310	1	11161SLA026	06/12/2011 00:13	Mark A Clark	20
03338	PAH Solid Extraction	SW-846 3550B	1	11161SLA026	06/10/2011 17:35	Sally L Appleyard	1
06955	Lead	SW-846 6010B	1	111655708004	06/15/2011 16:56	Eric L Eby	5
05708	SW SW846 ICP Digest	SW-846 3050B	1	111615708002	06/12/2011 19:47	Annamaria Stipkovits	1
05708	SW SW846 ICP Digest	SW-846 3050B	2	111655708004	06/14/2011 20:09	Annamaria Stipkovits	1
00111	Moisture	SM20 2540 G	1	11161820004B	06/10/2011 20:42	Scott W Freisher	1

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Analysis Report

REVISED

Sample Description: SR-31-9(1.2-1.7) Grab Soil Sample
Sunoco

LLI Sample # SW 6311686
LLI Group # 1250778
Account # 11183

Project Name: Sunoco

Collected: 06/07/2011 13:30 by PM

Submitted: 06/09/2011 16:15
Reported: 06/24/2011 13:41

Sunoco c/o Stantec
1060 Andrew Drive
Suite 140
West Chester PA 19380

SR319

CAT No.	Analysis Name	CAS Number	Dry Result		Dry Method Detection Limit	Dilution Factor
GC/MS Volatiles	**SW-846 8260B**		**ug/kg**		**ug/kg**	
10950	Benzene	71-43-2	N.D.		0.6	0.95
10950	1,2-Dibromoethane	106-93-4	N.D.		1	0.95
10950	1,2-Dichloroethane	107-06-2	N.D.		1	0.95
10950	Ethylbenzene	100-41-4	N.D.		1	0.95
10950	Isopropylbenzene	98-82-8	N.D.		1	0.95
10950	Methyl Tertiary Butyl Ether	1634-04-4	N.D.		0.6	0.95
10950	Naphthalene	91-20-3	N.D.		1	0.95
10950	Toluene	108-88-3	N.D.		1	0.95
10950	1,2,4-Trimethylbenzene	95-63-6	N.D.		1	0.95
10950	1,3,5-Trimethylbenzene	108-67-8	N.D.		1	0.95
10950	Xylene (Total)	1330-20-7	N.D.		1	0.95
GC/MS Semivolatiles	**SW-846 8310**		**ug/kg**		**ug/kg**	
00941	Anthracene	120-12-7	140		18	20
00941	Benzo(a)anthracene	56-55-3	580		8.9	20
00941	Benzo(a)pyrene	50-32-8	770		8.9	20
00941	Benzo(b)fluoranthene	205-99-2	680		7.1	20
00941	Benzo(g,h,i)perylene	191-24-2	1,000		54	20
00941	Chrysene	218-01-9	1,000		80	20
00941	Fluorene	86-73-7	120	J	89	20
00941	Phenanthrene	85-01-8	480		54	20
00941	Pyrene	129-00-0	1,200		89	20
	Reporting limits were raised due to interference from the sample matrix.					
Metals	**SW-846 6010B**		**mg/kg**		**mg/kg**	
06955	Lead	7439-92-1	830		0.289	1
Wet Chemistry	**SM20 2540 G**		**%**		**%**	
00111	Moisture	n.a.	25.4		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.					

General Sample Comments

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/12

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
10950	BTEX/MTBE/Nap/Cum/EDB/EDC/TMBs	SW-846 8260B	1	B111662AA	06/15/2011 16:20	Chelsea B Eastep	0.95
07579	GC/MS-5g Field Preserv.MeOH-NC	SW-846 5035	1	201116024628	06/07/2011 13:30	Client Supplied	1

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Analysis Report

REVISED

Sample Description: SR-31-9(1.2-1.7) Grab Soil Sample
Sunoco

LLI Sample # SW 6311686
LLI Group # 1250778
Account # 11183

Project Name: Sunoco

Collected: 06/07/2011 13:30 by PM

Submitted: 06/09/2011 16:15
Reported: 06/24/2011 13:41

Sunoco c/o Stantec
1060 Andrew Drive
Suite 140
West Chester PA 19380

SR319

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
00374	GC/MS - Low Level Bulk Prep	SW-846 5035A Modified	1	201116124640	06/10/2011 21:15	Lois E Hiltz	n.a.
00374	GC/MS - Low Level Bulk Prep	SW-846 5035A Modified	2	201116124640	06/10/2011 21:16	Lois E Hiltz	n.a.
00941	PAH's in Solids by HPLC	SW-846 8310	1	11161SLA026	06/12/2011 00:58	Mark A Clark	20
03338	PAH Solid Extraction	SW-846 3550B	1	11161SLA026	06/10/2011 17:35	Sally L Appleyard	1
06955	Lead	SW-846 6010B	1	111655708004	06/15/2011 16:19	Eric L Eby	1
05708	SW SW846 ICP Digest	SW-846 3050B	1	111615708002	06/12/2011 19:47	Annamaria Stipkovits	1
05708	SW SW846 ICP Digest	SW-846 3050B	2	111655708004	06/14/2011 20:09	Annamaria Stipkovits	1
00111	Moisture	SM20 2540 G	1	11164820005B	06/13/2011 19:30	Scott W Freisher	1

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Analysis Report

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Sample Description: GP U 677-1(1.5-2.0) Grab Soil Sample
Sunoco

LLI Sample # SW 6311687
LLI Group # 1250778
Account # 11183

Project Name: Sunoco

Collected: 06/08/2011 09:20 by PM

Submitted: 06/09/2011 16:15
Reported: 06/24/2011 13:41

Sunoco c/o Stantec
1060 Andrew Drive
Suite 140
West Chester PA 19380

677-1

CAT No.	Analysis Name	CAS Number	Dry Result		Dry Method Detection Limit	Dilution Factor
GC/MS Volatiles	**SW-846 8260B**		**ug/kg**		**ug/kg**	
10950	Benzene	71-43-2	60	J	35	55.27
10950	1,2-Dibromoethane	106-93-4	130	J	70	55.27
10950	1,2-Dichloroethane	107-06-2	N.D.		70	55.27
10950	Ethylbenzene	100-41-4	110	J	70	55.27
10950	Isopropylbenzene	98-82-8	700		70	55.27
10950	Methyl Tertiary Butyl Ether	1634-04-4	N.D.		35	55.27
10950	Naphthalene	91-20-3	290	J	70	55.27
10950	Toluene	108-88-3	120	J	70	55.27
10950	1,2,4-Trimethylbenzene	95-63-6	97	J	70	55.27
10950	1,3,5-Trimethylbenzene	108-67-8	N.D.		70	55.27
10950	Xylene (Total)	1330-20-7	420		70	55.27

Reporting limits were raised due to interference from the sample matrix.

GC/MS Semivolatiles	**SW-846 8310**		**ug/kg**		**ug/kg**	
00941	Anthracene	120-12-7	780		17	20
00941	Benzo(a)anthracene	56-55-3	1,000		8.4	20
00941	Benzo(a)pyrene	50-32-8	1,200		8.4	20
00941	Benzo(b)fluoranthene	205-99-2	800		6.7	20
00941	Benzo(g,h,i)perylene	191-24-2	1,700		51	20
00941	Chrysene	218-01-9	2,000		76	20
00941	Fluorene	86-73-7	1,300		84	20
00941	Phenanthrene	85-01-8	2,200		51	20
00941	Pyrene	129-00-0	1,500		84	20

Reporting limits were raised due to interference from the sample matrix.

Metals	**SW-846 6010B**		**mg/kg**		**mg/kg**	
06955	Lead	7439-92-1	453		0.268	1

Wet Chemistry	**SM20 2540 G**		**%**		**%**	
00111	Moisture	n.a.	21.1		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.

General Sample Comments

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/12

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
10950	BTEX/MTBE/Nap/Cum/EDB/EDC/TMBs	SW-846 8260B	1	Q111641AA	06/14/2011 01:42	Kristen D Pelliccia	55.27
07579	GC/MS-5g Field Preserv.MeOH-NC	SW-846 5035	1	201116024628	06/08/2011 09:20	Client Supplied	1

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Analysis Report

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Sample Description: GP U 677-1(1.5-2.0) Grab Soil Sample
Sunoco

LLI Sample # SW 6311687
LLI Group # 1250778
Account # 11183

Project Name: Sunoco

Collected: 06/08/2011 09:20 by PM

Submitted: 06/09/2011 16:15
Reported: 06/24/2011 13:41

Sunoco c/o Stantec
1060 Andrew Drive
Suite 140
West Chester PA 19380

677-1

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
02392	L/H Field Preserved Bisulfate	SW-846 5035	1	201116024628	06/08/2011 09:20	Client Supplied	1
02392	L/H Field Preserved Bisulfate	SW-846 5035	2	201116024628	06/08/2011 09:20	Client Supplied	1
00941	PAH's in Solids by HPLC	SW-846 8310	1	11161SLA026	06/12/2011 02:23	Mark A Clark	20
03338	PAH Solid Extraction	SW-846 3550B	1	11161SLA026	06/10/2011 17:35	Sally L Appleyard	1
06955	Lead	SW-846 6010B	1	111655708004	06/15/2011 16:23	Eric L Eby	1
05708	SW SW846 ICP Digest	SW-846 3050B	1	111615708002	06/12/2011 19:47	Annamaria Stipkovits	1
05708	SW SW846 ICP Digest	SW-846 3050B	2	111655708004	06/14/2011 20:09	Annamaria Stipkovits	1
00111	Moisture	SM20 2540 G	1	11161820004B	06/10/2011 20:42	Scott W Freisher	1

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Analysis Report

REVISED

Sample Description: GP U 677-2(0.8-1.3) Grab Soil Sample
Sunoco

LLI Sample # SW 6311688
LLI Group # 1250778
Account # 11183

Project Name: Sunoco

Collected: 06/08/2011 09:40 by PM

Submitted: 06/09/2011 16:15
Reported: 06/24/2011 13:41

Sunoco c/o Stantec
1060 Andrew Drive
Suite 140
West Chester PA 19380

677-2

CAT No.	Analysis Name	CAS Number	Dry Result		Dry Method Detection Limit	Dilution Factor
GC/MS Volatiles	**SW-846 8260B**		**ug/kg**		**ug/kg**	
10950	Benzene	71-43-2	N.D.		0.6	0.9
10950	1,2-Dibromoethane	106-93-4	N.D.		1	0.9
10950	1,2-Dichloroethane	107-06-2	N.D.		1	0.9
10950	Ethylbenzene	100-41-4	N.D.		1	0.9
10950	Isopropylbenzene	98-82-8	N.D.		1	0.9
10950	Methyl Tertiary Butyl Ether	1634-04-4	N.D.		0.6	0.9
10950	Naphthalene	91-20-3	N.D.		1	0.9
10950	Toluene	108-88-3	N.D.		1	0.9
10950	1,2,4-Trimethylbenzene	95-63-6	N.D.		1	0.9
10950	1,3,5-Trimethylbenzene	108-67-8	N.D.		1	0.9
10950	Xylene (Total)	1330-20-7	N.D.		1	0.9
GC/MS Semivolatiles	**SW-846 8310**		**ug/kg**		**ug/kg**	
00941	Anthracene	120-12-7	37	J	17	20
00941	Benzo(a)anthracene	56-55-3	110		8.5	20
00941	Benzo(a)pyrene	50-32-8	120		8.5	20
00941	Benzo(b)fluoranthene	205-99-2	91		6.8	20
00941	Benzo(g,h,i)perylene	191-24-2	190	J	51	20
00941	Chrysene	218-01-9	160		76	20
00941	Fluorene	86-73-7	N.D.		85	20
00941	Phenanthrene	85-01-8	90	J	51	20
00941	Pyrene	129-00-0	240	J	85	20
	Reporting limits were raised due to interference from the sample matrix.					
Metals	**SW-846 6010B**		**mg/kg**		**mg/kg**	
06955	Lead	7439-92-1	67.0		0.276	1
Wet Chemistry	**SM20 2540 G**		**%**		**%**	
00111	Moisture	n.a.	21.2		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.					

General Sample Comments

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/12

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
10950	BTEX/MTBE/Nap/Cum/EDB/EDC/TMBs	SW-846 8260B	1	X111612AA	06/10/2011 22:46	Kristen D Pelliccia	0.9
07579	GC/MS-5g Field Preserv.MeOH-NC	SW-846 5035	1	201116024628	06/08/2011 09:40	Client Supplied	1

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Analysis Report

REVISED

Sample Description: GP U 677-2(0.8-1.3) Grab Soil Sample
Sunoco

LLI Sample # SW 6311688
LLI Group # 1250778
Account # 11183

Project Name: Sunoco

Collected: 06/08/2011 09:40 by PM

Submitted: 06/09/2011 16:15
Reported: 06/24/2011 13:41

Sunoco c/o Stantec
1060 Andrew Drive
Suite 140
West Chester PA 19380

677-2

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
02392	L/H Field Preserved Bisulfate	SW-846 5035	1	201116024628	06/08/2011 09:40	Client Supplied	1
02392	L/H Field Preserved Bisulfate	SW-846 5035	2	201116024628	06/08/2011 09:40	Client Supplied	1
00941	PAH's in Solids by HPLC	SW-846 8310	1	11161SLA026	06/12/2011 03:09	Mark A Clark	20
03338	PAH Solid Extraction	SW-846 3550B	1	11161SLA026	06/10/2011 17:35	Sally L Appleyard	1
06955	Lead	SW-846 6010B	1	111655708004	06/15/2011 16:26	Eric L Eby	1
05708	SW SW846 ICP Digest	SW-846 3050B	1	111615708002	06/12/2011 19:47	Annamaria Stipkovits	1
05708	SW SW846 ICP Digest	SW-846 3050B	2	111655708004	06/14/2011 20:09	Annamaria Stipkovits	1
00111	Moisture	SM20 2540 G	1	11161820004B	06/10/2011 20:42	Scott W Freisher	1

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Analysis Report

REVISED

Sample Description: GP U 677-3(1.5-2.0) Grab Soil Sample
Sunoco

LLI Sample # SW 6311689
LLI Group # 1250778
Account # 11183

Project Name: Sunoco

Collected: 06/08/2011 10:00 by PM

Submitted: 06/09/2011 16:15
Reported: 06/24/2011 13:41

Sunoco c/o Stantec
1060 Andrew Drive
Suite 140
West Chester PA 19380

677-3

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Method Detection Limit	Dilution Factor
GC/MS Volatiles	**SW-846 8260B**		**ug/kg**	**ug/kg**	
10950	Benzene	71-43-2	N.D.	0.5	0.82
10950	1,2-Dibromoethane	106-93-4	N.D.	1	0.82
10950	1,2-Dichloroethane	107-06-2	N.D.	1	0.82
10950	Ethylbenzene	100-41-4	N.D.	1	0.82
10950	Isopropylbenzene	98-82-8	N.D.	1	0.82
10950	Methyl Tertiary Butyl Ether	1634-04-4	N.D.	0.5	0.82
10950	Naphthalene	91-20-3	N.D.	1	0.82
10950	Toluene	108-88-3	N.D.	1	0.82
10950	1,2,4-Trimethylbenzene	95-63-6	N.D.	1	0.82
10950	1,3,5-Trimethylbenzene	108-67-8	N.D.	1	0.82
10950	Xylene (Total)	1330-20-7	N.D.	1	0.82
GC/MS Semivolatiles	**SW-846 8310**		**ug/kg**	**ug/kg**	
00941	Anthracene	120-12-7	500	17	20
00941	Benzo(a)anthracene	56-55-3	1,200	8.6	20
00941	Benzo(a)pyrene	50-32-8	1,200	8.6	20
00941	Benzo(b)fluoranthene	205-99-2	850	6.9	20
00941	Benzo(g,h,i)perylene	191-24-2	1,500	51	20
00941	Chrysene	218-01-9	1,600	77	20
00941	Fluorene	86-73-7	390	86	20
00941	Phenanthrene	85-01-8	1,600	51	20
00941	Pyrene	129-00-0	2,300	86	20
	Reporting limits were raised due to interference from the sample matrix.				
Metals	**SW-846 6010B**		**mg/kg**	**mg/kg**	
06955	Lead	7439-92-1	451	0.272	1
Wet Chemistry	**SM20 2540 G**		**%**	**%**	
00111	Moisture	n.a.	22.2	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.				

General Sample Comments

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/12

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
10950	BTEX/MTBE/Nap/Cum/EDB/EDC/TMBs	SW-846 8260B	1	X111641AA	06/13/2011 10:43	Holly Berry	0.82
07579	GC/MS-5g Field Preserv.MeOH-NC	SW-846 5035	1	201116024628	06/08/2011 10:00	Client Supplied	1

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Analysis Report

REVISED

Sample Description: GP U 677-3(1.5-2.0) Grab Soil Sample
Sunoco

LLI Sample # SW 6311689
LLI Group # 1250778
Account # 11183

Project Name: Sunoco

Collected: 06/08/2011 10:00 by PM

Submitted: 06/09/2011 16:15
Reported: 06/24/2011 13:41

Sunoco c/o Stantec
1060 Andrew Drive
Suite 140
West Chester PA 19380

677-3

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
02392	L/H Field Preserved Bisulfate	SW-846 5035	1	201116024628	06/08/2011 10:00	Client Supplied	1
02392	L/H Field Preserved Bisulfate	SW-846 5035	2	201116024628	06/08/2011 10:00	Client Supplied	1
00941	PAH's in Solids by HPLC	SW-846 8310	1	11161SLA026	06/12/2011 03:55	Mark A Clark	20
03338	PAH Solid Extraction	SW-846 3550B	1	11161SLA026	06/10/2011 17:35	Sally L Appleyard	1
06955	Lead	SW-846 6010B	1	111655708004	06/15/2011 16:30	Eric L Eby	1
05708	SW SW846 ICP Digest	SW-846 3050B	1	111615708002	06/12/2011 19:47	Annamaria Stipkovits	1
05708	SW SW846 ICP Digest	SW-846 3050B	2	111655708004	06/14/2011 20:09	Annamaria Stipkovits	1
00111	Moisture	SM20 2540 G	1	11161820004B	06/10/2011 20:42	Scott W Freisher	1

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Analysis Report

REVISED

Sample Description: GP U 677-4(0.3-0.8) Grab Soil Sample
Sunoco

LLI Sample # SW 6311690
LLI Group # 1250778
Account # 11183

Project Name: Sunoco

Collected: 06/08/2011 10:20 by PM

Submitted: 06/09/2011 16:15
Reported: 06/24/2011 13:41

Sunoco c/o Stantec
1060 Andrew Drive
Suite 140
West Chester PA 19380

677-4

CAT No.	Analysis Name	CAS Number	Dry Result		Dry Method Detection Limit	Dilution Factor
GC/MS Volatiles	**SW-846 8260B**		**ug/kg**		**ug/kg**	
10950	Benzene	71-43-2	N.D.		0.5	0.98
10950	1,2-Dibromoethane	106-93-4	N.D.		1	0.98
10950	1,2-Dichloroethane	107-06-2	N.D.		1	0.98
10950	Ethylbenzene	100-41-4	N.D.		1	0.98
10950	Isopropylbenzene	98-82-8	N.D.		1	0.98
10950	Methyl Tertiary Butyl Ether	1634-04-4	N.D.		0.5	0.98
10950	Naphthalene	91-20-3	N.D.		1	0.98
10950	Toluene	108-88-3	N.D.		1	0.98
10950	1,2,4-Trimethylbenzene	95-63-6	N.D.		1	0.98
10950	1,3,5-Trimethylbenzene	108-67-8	N.D.		1	0.98
10950	Xylene (Total)	1330-20-7	N.D.		1	0.98
GC/MS Semivolatiles	**SW-846 8310**		**ug/kg**		**ug/kg**	
00941	Anthracene	120-12-7	N.D.		28	20
00941	Benzo(a)anthracene	56-55-3	31		7.1	20
00941	Benzo(a)pyrene	50-32-8	50		7.1	20
00941	Benzo(b)fluoranthene	205-99-2	53		5.7	20
00941	Benzo(g,h,i)perylene	191-24-2	130	J	43	20
00941	Chrysene	218-01-9	250		64	20
00941	Fluorene	86-73-7	N.D.		71	20
00941	Phenanthrene	85-01-8	95	J	43	20
00941	Pyrene	129-00-0	N.D.		370	20

Reporting limits were raised due to interference from the sample matrix.

Due to the presence of interferents near their retention times, normal reporting limits were not attained for several target compounds. The reporting limits for these compounds were raised accordingly.

Metals	**SW-846 6010B**		**mg/kg**		**mg/kg**	
06955	Lead	7439-92-1	47.8		0.232	1
Wet Chemistry	**SM20 2540 G**		**%**		**%**	
00111	Moisture	n.a.	6.1		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.

General Sample Comments

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/12

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Sample Analysis Record

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

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Analysis Report

REVISED

Sample Description: GP U 677-4(0.3-0.8) Grab Soil Sample
Sunoco

LLI Sample # SW 6311690
LLI Group # 1250778
Account # 11183

Project Name: Sunoco

Collected: 06/08/2011 10:20 by PM

Submitted: 06/09/2011 16:15
Reported: 06/24/2011 13:41

Sunoco c/o Stantec
1060 Andrew Drive
Suite 140
West Chester PA 19380

677-4

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
10950	BTEX/MTBE/Nap/Cum/EDB/EDC/TMBs	SW-846 8260B	1	X111612AA	06/10/2011 23:09	Kristen D Pelliccia	0.98
07579	GC/MS-5g Field Preserv.MeOH-NC	SW-846 5035	1	201116024628	06/08/2011 10:20	Client Supplied	1
02392	L/H Field Preserved Bisulfate	SW-846 5035	1	201116024628	06/08/2011 10:20	Client Supplied	1
02392	L/H Field Preserved Bisulfate	SW-846 5035	2	201116024628	06/08/2011 10:20	Client Supplied	1
00941	PAH's in Solids by HPLC	SW-846 8310	1	11161SLA026	06/12/2011 05:59	Mark A Clark	20
03338	PAH Solid Extraction	SW-846 3550B	1	11161SLA026	06/10/2011 17:35	Sally L Appleyard	1
06955	Lead	SW-846 6010B	1	111655708004	06/15/2011 16:41	Eric L Eby	1
05708	SW SW846 ICP Digest	SW-846 3050B	1	111615708002	06/12/2011 19:47	Annamaria Stipkovits	1
05708	SW SW846 ICP Digest	SW-846 3050B	2	111655708004	06/14/2011 20:09	Annamaria Stipkovits	1
00111	Moisture	SM20 2540 G	1	11161820004B	06/10/2011 20:42	Scott W Freisher	1

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Analysis Report

REVISED

Sample Description: GP U 677-5(0.8-1.3) Grab Soil Sample
Sunoco

LLI Sample # SW 6311691
LLI Group # 1250778
Account # 11183

Project Name: Sunoco

Collected: 06/08/2011 10:35 by PM

Submitted: 06/09/2011 16:15
Reported: 06/24/2011 13:41

Sunoco c/o Stantec
1060 Andrew Drive
Suite 140
West Chester PA 19380

677-5

CAT No.	Analysis Name	CAS Number	Dry Result		Dry Method Detection Limit	Dilution Factor
GC/MS Volatiles	**SW-846 8260B**		**ug/kg**		**ug/kg**	
10950	Benzene	71-43-2	N.D.		0.5	1
10950	1,2-Dibromoethane	106-93-4	N.D.		1	1
10950	1,2-Dichloroethane	107-06-2	N.D.		1	1
10950	Ethylbenzene	100-41-4	N.D.		1	1
10950	Isopropylbenzene	98-82-8	N.D.		1	1
10950	Methyl Tertiary Butyl Ether	1634-04-4	N.D.		0.5	1
10950	Naphthalene	91-20-3	160		1	1
10950	Toluene	108-88-3	1	J	1	1
10950	1,2,4-Trimethylbenzene	95-63-6	56		1	1
10950	1,3,5-Trimethylbenzene	108-67-8	46		1	1
10950	Xylene (Total)	1330-20-7	5		1	1

The GC/MS volatile internal standard peak areas were outside the QC limits. A re-analysis was performed, and the matrix effect was confirmed.

GC/MS Semivolatiles	**SW-846 8310**		**ug/kg**		**ug/kg**	
00941	Anthracene	120-12-7	990		36	50
00941	Benzo(a)anthracene	56-55-3	N.D.		590	50
00941	Benzo(a)pyrene	50-32-8	620		18	50
00941	Benzo(b)fluoranthene	205-99-2	810		14	50
00941	Benzo(g,h,i)perylene	191-24-2	1,400		110	50
00941	Chrysene	218-01-9	4,300		160	50
00941	Fluorene	86-73-7	2,500		180	50
00941	Phenanthrene	85-01-8	5,200		110	50
00941	Pyrene	129-00-0	N.D.		17,000	50

The surrogate data is outside the QC limits due to unresolvable matrix problems evident in the sample chromatogram.

Reporting limits were raised due to interference from the sample matrix.

Due to the presence of interferents near their retention times, normal reporting limits were not attained for several target compounds. The reporting limits for these compounds were raised accordingly.

Metals	**SW-846 6010B**		**mg/kg**		**mg/kg**	
06955	Lead	7439-92-1	18.5		0.232	1

Wet Chemistry	**SM20 2540 G**		**%**		**%**	
00111	Moisture	n.a.	6.9		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.

General Sample Comments

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/12

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

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Analysis Report

REVISED

Sample Description: GP U 677-5(0.8-1.3) Grab Soil Sample
Sunoco

LLI Sample # SW 6311691
LLI Group # 1250778
Account # 11183

Project Name: Sunoco

Collected: 06/08/2011 10:35 by PM

Submitted: 06/09/2011 16:15
Reported: 06/24/2011 13:41

Sunoco c/o Stantec
1060 Andrew Drive
Suite 140
West Chester PA 19380

677-5

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
10950	BTEX/MTBE/Nap/Cum/EDB/EDC/TMBs	SW-846 8260B	1	X111612AA	06/11/2011 01:26	Kristen D Pelliccia	1
07579	GC/MS-5g Field Preserv.MeOH-NC	SW-846 5035	1	201116024628	06/08/2011 10:35	Client Supplied	1
02392	L/H Field Preserved Bisulfate	SW-846 5035	1	201116024628	06/08/2011 10:35	Client Supplied	1
02392	L/H Field Preserved Bisulfate	SW-846 5035	2	201116024628	06/08/2011 10:35	Client Supplied	1
00941	PAH's in Solids by HPLC	SW-846 8310	1	11161SLA026	06/12/2011 06:44	Mark A Clark	50
03338	PAH Solid Extraction	SW-846 3550B	1	11161SLA026	06/10/2011 17:35	Sally L Appleyard	1
06955	Lead	SW-846 6010B	1	111655708004	06/15/2011 16:45	Eric L Eby	1
05708	SW SW846 ICP Digest	SW-846 3050B	1	111615708002	06/12/2011 19:47	Annamaria Stipkovits	1
05708	SW SW846 ICP Digest	SW-846 3050B	2	111655708004	06/14/2011 20:09	Annamaria Stipkovits	1
00111	Moisture	SM20 2540 G	1	11161820004B	06/10/2011 20:42	Scott W Freisher	1

Lancaster Laboratories

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Analysis Report

REVISED

Sample Description: B-95 GP U 677-MW Grab Water Sample
Sunoco

LLI Sample # WW 6311692
LLI Group # 1250778
Account # 11183

Project Name: Sunoco

Collected: 06/08/2011 11:30 by PM

Submitted: 06/09/2011 16:15
Reported: 06/24/2011 13:41

Sunoco c/o Stantec
1060 Andrew Drive
Suite 140
West Chester PA 19380

677MW

CAT No.	Analysis Name	CAS Number	As Received Result		As Received Method Detection Limit	Dilution Factor
GC/MS Volatiles	**SW-846 8260B**		**ug/l**		**ug/l**	
10943	Benzene	71-43-2	N.D.		0.5	1
10943	1,2-Dichloroethane	107-06-2	N.D.		0.5	1
10943	Ethylbenzene	100-41-4	N.D.		0.5	1
10943	Isopropylbenzene	98-82-8	N.D.		0.5	1
10943	Methyl Tertiary Butyl Ether	1634-04-4	N.D.		0.5	1
10943	Naphthalene	91-20-3	N.D.		1	1
10943	Toluene	108-88-3	N.D.		0.5	1
10943	1,2,4-Trimethylbenzene	95-63-6	N.D.		0.5	1
10943	1,3,5-Trimethylbenzene	108-67-8	N.D.		0.5	1
10943	Xylene (Total)	1330-20-7	0.5	J	0.5	1
GC/MS Semivolatiles	**SW-846 8310**		**ug/l**		**ug/l**	
00774	Chrysene	218-01-9	0.18	J	0.079	1
00774	Phenanthrene	85-01-8	0.18	J	0.079	1
00774	Pyrene	129-00-0	1.2		0.099	1
GC Miscellaneous	**SW-846 8011**		**ug/l**		**ug/l**	
07879	Ethylene dibromide	106-93-4	N.D.		0.0099	1
Metals Dissolved	**SW-846 6020**		**mg/l**		**mg/l**	
06035	Lead	7439-92-1	N.D.		0.000052	1

General Sample Comments

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/12
This sample was field filtered for dissolved metals.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
10943	UST PA leaded/unleaded + TMBs	SW-846 8260B	1	D111612AA	06/10/2011 13:56	Daniel H Heller	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	D111612AA	06/10/2011 13:56	Daniel H Heller	1
00774	PAH's in Water by HPLC	SW-846 8310	1	11162WAJ026	06/15/2011 00:35	Mark A Clark	1
03337	PAH Water Extraction	SW-846 3510C	1	11162WAJ026	06/13/2011 08:50	Olivia Arosemena	1
07879	EDB in Wastewater	SW-846 8011	1	111640001A	06/14/2011 08:27	Michele D Hamilton	1
07786	EDB Extraction	SW-846 8011	1	111640001A	06/13/2011 13:15	Kelli M Barto	1
06035	Lead	SW-846 6020	1	111616050002A	06/14/2011 15:11	Choon Y Tian	1
06050	ICP/MS SW-846 Water Digest	SW-846 3010A modified	1	111616050002	06/13/2011 13:21	James L Mertz	1

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Analysis Report

REVISED

Sample Description: GP U 677-MW-TB Water Sample
Sunoco

LLI Sample # WW 6311693
LLI Group # 1250778
Account # 11183

Project Name: Sunoco

Collected: 06/07/2011

Submitted: 06/09/2011 16:15
Reported: 06/24/2011 13:41

Sunoco c/o Stantec
1060 Andrew Drive
Suite 140
West Chester PA 19380

677TB

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Method Detection Limit	Dilution Factor
GC/MS Volatiles	**SW-846 8260B**		**ug/l**	**ug/l**	
10943	Benzene	71-43-2	N.D.	0.5	1
10943	1,2-Dichloroethane	107-06-2	N.D.	0.5	1
10943	Ethylbenzene	100-41-4	N.D.	0.5	1
10943	Isopropylbenzene	98-82-8	N.D.	0.5	1
10943	Methyl Tertiary Butyl Ether	1634-04-4	N.D.	0.5	1
10943	Naphthalene	91-20-3	N.D.	1	1
10943	Toluene	108-88-3	N.D.	0.5	1
10943	1,2,4-Trimethylbenzene	95-63-6	N.D.	0.5	1
10943	1,3,5-Trimethylbenzene	108-67-8	N.D.	0.5	1
10943	Xylene (Total)	1330-20-7	N.D.	0.5	1
GC Miscellaneous	**SW-846 8011**		**ug/l**	**ug/l**	
07879	Ethylene dibromide	106-93-4	N.D.	0.010	1

General Sample Comments

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/12

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
10943	UST PA leaded/unleaded + TMBs	SW-846 8260B	1	D111612AA	06/10/2011 14:19	Daniel H Heller	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	D111612AA	06/10/2011 14:19	Daniel H Heller	1
07879	EDB in Wastewater	SW-846 8011	1	111640001A	06/14/2011 10:27	Michele D Hamilton	1
07786	EDB Extraction	SW-846 8011	1	111640001A	06/13/2011 13:15	Kelli M Barto	1

Quality Control Summary

Client Name: Sunoco c/o Stantec
Group Number: 1250778
Reported: 06/24/11 at 01:41 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

Analysis Name	Blank Result	Blank MDL	Report Units	LCS %REC	LCSD %REC	LCS/LCSD Limits	RPD	RPD Max
Batch number: B111662AA	Sample number(s): 6311686							
Benzene	N.D.	0.5	ug/kg	87		80-120		
1,2-Dibromoethane	N.D.	1.	ug/kg	80		80-120		
1,2-Dichloroethane	N.D.	1.	ug/kg	91		71-129		
Ethylbenzene	N.D.	1.	ug/kg	87		80-120		
Isopropylbenzene	N.D.	1.	ug/kg	88		76-120		
Methyl Tertiary Butyl Ether	N.D.	0.5	ug/kg	81		74-121		
Naphthalene	N.D.	1.	ug/kg	69		59-123		
Toluene	N.D.	1.	ug/kg	89		80-120		
1,2,4-Trimethylbenzene	N.D.	1.	ug/kg	85		79-120		
1,3,5-Trimethylbenzene	N.D.	1.	ug/kg	87		78-120		
Xylene (Total)	N.D.	1.	ug/kg	89		80-120		
Batch number: D111612AA	Sample number(s): 6311692-6311693							
Benzene	N.D.	0.5	ug/l	100	92	79-120	8	30
1,2-Dichloroethane	N.D.	0.5	ug/l	104	97	70-130	6	30
Ethylbenzene	N.D.	0.5	ug/l	102	98	79-120	4	30
Isopropylbenzene	N.D.	0.5	ug/l	99	97	77-120	2	30
Methyl Tertiary Butyl Ether	N.D.	0.5	ug/l	93	85	76-120	9	30
Naphthalene	N.D.	1.	ug/l	84	82	62-120	3	30
Toluene	N.D.	0.5	ug/l	101	98	79-120	4	30
1,2,4-Trimethylbenzene	N.D.	0.5	ug/l	97	93	74-120	5	30
1,3,5-Trimethylbenzene	N.D.	0.5	ug/l	100	94	75-120	5	30
Xylene (Total)	N.D.	0.5	ug/l	100	95	80-120	5	30
Batch number: Q111641AA	Sample number(s): 6311682-6311683,6311687							
Benzene	N.D.	25.	ug/kg	108		80-120		
1,2-Dibromoethane	N.D.	50.	ug/kg	107		80-120		
1,2-Dichloroethane	N.D.	50.	ug/kg	109		71-129		
Ethylbenzene	N.D.	50.	ug/kg	107		80-120		
Isopropylbenzene	N.D.	50.	ug/kg	108		76-120		
Methyl Tertiary Butyl Ether	N.D.	25.	ug/kg	102		74-121		
Naphthalene	N.D.	50.	ug/kg	77		59-123		
Toluene	N.D.	50.	ug/kg	107		80-120		
1,2,4-Trimethylbenzene	N.D.	50.	ug/kg	101		79-120		
1,3,5-Trimethylbenzene	N.D.	50.	ug/kg	104		78-120		
Xylene (Total)	N.D.	50.	ug/kg	108		80-120		
Batch number: X111612AA	Sample number(s): 6311678-6311681,6311684-6311685,6311688,6311690-6311691							
Benzene	N.D.	0.5	ug/kg	99	96	80-120	3	30
1,2-Dibromoethane	N.D.	1.	ug/kg	100	99	80-120	1	30
1,2-Dichloroethane	N.D.	1.	ug/kg	97	96	71-129	1	30
Ethylbenzene	N.D.	1.	ug/kg	100	97	80-120	3	30
Isopropylbenzene	N.D.	1.	ug/kg	102	99	76-120	3	30
Methyl Tertiary Butyl Ether	N.D.	0.5	ug/kg	97	97	74-121	0	30
Naphthalene	N.D.	1.	ug/kg	104	104	59-123	0	30
Toluene	N.D.	1.	ug/kg	98	95	80-120	3	30

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

Quality Control Summary

Client Name: Sunoco c/o Stantec Group Number: 1250778
Reported: 06/24/11 at 01:41 PM

Analysis Name	Blank Result	Blank MDL	Report Units	LCS %REC	LCSD %REC	LCS/LCSD Limits	RPD	RPD Max
1,2,4-Trimethylbenzene	N.D.	1.	ug/kg	100	98	79-120	1	30
1,3,5-Trimethylbenzene	N.D.	1.	ug/kg	101	101	78-120	0	30
Xylene (Total)	N.D.	1.	ug/kg	101	99	80-120	2	30
Batch number: X111641AA	Sample number(s): 6311689							
Benzene	N.D.	0.5	ug/kg	102		80-120		
1,2-Dibromoethane	N.D.	1.	ug/kg	101		80-120		
1,2-Dichloroethane	N.D.	1.	ug/kg	98		71-129		
Ethylbenzene	N.D.	1.	ug/kg	106		80-120		
Isopropylbenzene	N.D.	1.	ug/kg	110		76-120		
Methyl Tertiary Butyl Ether	N.D.	0.5	ug/kg	93		74-121		
Naphthalene	N.D.	1.	ug/kg	99		59-123		
Toluene	N.D.	1.	ug/kg	104		80-120		
1,2,4-Trimethylbenzene	N.D.	1.	ug/kg	103		79-120		
1,3,5-Trimethylbenzene	N.D.	1.	ug/kg	105		78-120		
Xylene (Total)	N.D.	1.	ug/kg	108		80-120		
Batch number: 11161SLA026	Sample number(s): 6311678-6311691							
Anthracene	N.D.	0.67	ug/kg	77		71-105		
Benzo(a)anthracene	N.D.	0.33	ug/kg	81		74-111		
Benzo(a)pyrene	N.D.	0.33	ug/kg	78		65-106		
Benzo(b)fluoranthene	N.D.	0.27	ug/kg	79		75-113		
Benzo(g,h,i)perylene	N.D.	2.0	ug/kg	87		75-112		
Chrysene	N.D.	3.0	ug/kg	86		74-112		
Fluorene	N.D.	3.3	ug/kg	83		75-111		
Phenanthrene	N.D.	2.0	ug/kg	85		77-111		
Pyrene	N.D.	3.3	ug/kg	90		71-109		
Batch number: 11162WAJ026	Sample number(s): 6311692							
Chrysene	N.D.	0.080	ug/l	95	96	74-111	1	30
Phenanthrene	N.D.	0.080	ug/l	94	93	71-108	1	30
Pyrene	N.D.	0.10	ug/l	97	97	70-108	0	30
Batch number: 111640001A	Sample number(s): 6311692-6311693							
Ethylene dibromide	N.D.	0.010	ug/l	96	92	60-140	4	20
Batch number: 111616050002A	Sample number(s): 6311692							
Lead	N.D.	0.00005 2	mg/l	99		90-115		
Batch number: 111655708004	Sample number(s): 6311678-6311691							
Lead	N.D.	0.220	mg/kg	100		80-120		
Batch number: 11161820004B	Sample number(s): 6311678-6311685,6311687-6311691							
Moisture				100		99-101		
Batch number: 11164820005B	Sample number(s): 6311686							
Moisture				100		99-101		

Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

MS	MSD	MS/MSD	RPD	BKG	DUP	DUP	Dup RPD

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

Quality Control Summary

Client Name: Sunoco c/o Stantec Group Number: 1250778
Reported: 06/24/11 at 01:41 PM

Analysis Name	%REC	%REC	Limits	RPD	MAX	Conc	Conc	RPD	Max
Batch number: B111662AA	Sample number(s): 6311686 UNSPK: P313738								
Benzene	66	68	55-143	3	30				
1,2-Dibromoethane	21*	26*	54-129	18	30				
1,2-Dichloroethane	42*	47*	68-131	10	30				
Ethylbenzene	43*	47	44-141	9	30				
Isopropylbenzene	47	52	38-144	10	30				
Methyl Tertiary Butyl Ether	97	101	55-129	4	30				
Naphthalene	10	14	10-138	34*	30				
Toluene	59	61	50-146	3	30				
1,2,4-Trimethylbenzene	46	53	37-149	14	30				
1,3,5-Trimethylbenzene	56	64	38-150	14	30				
Xylene (Total)	44	47	44-136	7	30				
Batch number: Q111641AA	Sample number(s): 6311682-6311683,6311687 UNSPK: P307116								
Benzene	89	90	55-143	14	30				
1,2-Dibromoethane	88	91	54-129	16	30				
1,2-Dichloroethane	90	91	68-131	14	30				
Ethylbenzene	88	89	44-141	15	30				
Isopropylbenzene	89	95	38-144	18	30				
Methyl Tertiary Butyl Ether	90	88	55-129	11	30				
Naphthalene	68	75	10-138	23	30				
Toluene	88	89	50-146	14	30				
1,2,4-Trimethylbenzene	55	69	37-149	24	30				
1,3,5-Trimethylbenzene	82	85	38-150	16	30				
Xylene (Total)	90	93	44-136	17	30				
Batch number: X111641AA	Sample number(s): 6311689 UNSPK: P308556								
Benzene	84	89	55-143	9	30				
1,2-Dibromoethane	66	73	54-129	5	30				
1,2-Dichloroethane	70	77	68-131	5	30				
Ethylbenzene	76	73	44-141	19	30				
Isopropylbenzene	79	73	38-144	23	30				
Methyl Tertiary Butyl Ether	68	75	55-129	5	30				
Naphthalene	28	22	10-138	35*	30				
Toluene	83	85	50-146	12	30				
1,2,4-Trimethylbenzene	69	63	37-149	23	30				
1,3,5-Trimethylbenzene	76	70	38-150	22	30				
Xylene (Total)	76	72	44-136	19	30				
Batch number: 11161SLA026	Sample number(s): 6311678-6311691 UNSPK: 6311678								
Anthracene	64*	85	71-98	16	50				
Benzo(a)anthracene	-154*	-104*	10-76	20	50				
Benzo(a)pyrene	-328 (2)	-166 (2)	39-132	26	50				
Benzo(b)fluoranthene	-380 (2)	-197 (2)	43-143	27	50				
Benzo(g,h,i)perylene	12*	46*	81-111	20	50				
Chrysene	-53*	-4*	81-110	18	50				
Fluorene	69*	80	71-117	12	50				
Phenanthrene	25*	67*	80-116	20	50				
Pyrene	18*	30*	67-119	8	50				
Batch number: 111640001A	Sample number(s): 6311692-6311693 UNSPK: 6311692 BKG: 6311693								
Ethylene dibromide	74		65-135			N.D.	N.D.	0 (1)	30
Batch number: 111616050002A	Sample number(s): 6311692 UNSPK: P311040 BKG: P311040								
Lead	100	98	83-120	2	20	N.D.	N.D.	0 (1)	20

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

Quality Control Summary

Client Name: Sunoco c/o Stantec Group Number: 1250778
Reported: 06/24/11 at 01:41 PM

Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

Analysis Name	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD MAX	BKG Conc	DUP Conc	DUP RPD	Dup RPD Max
Batch number: 111655708004	Sample number(s): 6311678-6311691 UNSPK: P306620 BKG: P306620								
Lead	90 (2)	82 (2)	75-125	1	20	68.4	78.2	13	20
Batch number: 11161820004B	Sample number(s): 6311678-6311685,6311687-6311691 BKG: 6311687								
Moisture						21.1	21.6	2	15
Batch number: 11164820005B	Sample number(s): 6311686 BKG: P309011								
Moisture						95.8	96.1	0	15

Surrogate Quality Control

Surrogate recoveries which are outside of the QC window are confirmed unless attributed to dilution or otherwise noted on the Analysis Report.

Analysis Name: TCL(4.3)by 8260(soil)
Batch number: B111662AA

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
6311686	105	105	105	94
Blank	104	103	103	96
LCS	102	101	106	104
MS	104	101	121	91
MSD	104	101	122	90
Limits:	71-114	70-109	70-123	70-111

Analysis Name: UST BTEX, MTBE in Water
Batch number: D111612AA

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
6311692	96	97	101	105
6311693	95	96	101	97
Blank	96	99	103	96
LCS	93	96	100	101
LCSD	95	102	102	102
Limits:	80-116	77-113	80-113	78-113

Analysis Name: TCL(4.3)by 8260(soil)
Batch number: Q111641AA

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
6311682	49*	54*	38*	28*
6311683	71	73	68*	65*
6311687	42*	41*	62*	74
Blank	95	100	100	102
LCS	96	94	97	97
MS	57*	58*	56*	53*
MSD	61*	61*	60*	58*

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

Quality Control Summary

Client Name: Sunoco c/o Stantec Group Number: 1250778
Reported: 06/24/11 at 01:41 PM

Surrogate Quality Control

Limits:	71-114	70-109	70-123	70-111

Analysis Name: TCL(4.3)by 8260(soil)
Batch number: X111612AA

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
6311678	102	102	102	67*
6311679	101	106	105	71
6311680	98	101	96	69*
6311681	102	107	96	85
6311684	104	105	111	59*
6311685	101	101	107	64*
6311688	101	105	94	84
6311690	100	106	93	96
6311691	115*	123*	114	55*
Blank	101	103	93	92
LCS	100	106	101	94
LCSD	100	104	99	96
Limits:	71-114	70-109	70-123	70-111

Analysis Name: TCL(4.3)by 8260(soil)
Batch number: X111641AA

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
6311689	101	102	99	88
Blank	102	106	90	94
LCS	99	94	103	95
MS	100	108	106	92
MSD	101	107	106	89
Limits:	71-114	70-109	70-123	70-111

Analysis Name: PAH's in Solids by HPLC
Batch number: 11161SLA026

	Nitrobenzene	Triphenylene
6311678	74	42*
6311679	77	100
6311680	66	55
6311681	80	96
6311682	80	69
6311683	89	87
6311684	81	83
6311685	79	65
6311686	85	83
6311687	84	82
6311688	82	98
6311689	82	48
6311690	80	105
6311691	70	246*
Blank	88	103
LCS	80	90
MS	82	68
MSD	89	66
Limits:	48-130	47-155

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

Quality Control Summary

Client Name: Sunoco c/o Stantec Group Number: 1250778
Reported: 06/24/11 at 01:41 PM

Surrogate Quality Control

Analysis Name: PAH's in Water by HPLC
Batch number: 11162WAJ026

	Nitrobenzene	Triphenylene
6311692	92	95
Blank	103	100
LCS	100	100
LCSD	100	100
Limits:	67-111	77-122

Analysis Name: EDB in Wastewater
Batch number: 111640001A

	1,1,2,2-Tetrachloroethane
6311692	83
6311693	84
Blank	99
DUP	80
LCS	103
LCSD	97
MS	73
Limits:	46-136

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

Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 11183 Group# 1250778 Sample # 6311678-93

COC # 263605

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

(1) Client: Stantec/Sunoco Acct. #:

Project Name/#: Sunoco PWSID #:

Project Manager: Jen Hunger P.O.#: 2134012455

Sampler: Paul Miller Quote #:

Name of state where samples were collected: PA

For Lab Use Only
FSC:
SCR#: 1060599

Preservation Codes
H=HCl T=Thiosulfate
N=HNO_3 B=NaOH
S=H_2SO_4 O=Other

(2) Sample Identification	Date Collected	Time Collected	(3) Grab	Composite	Matrix: Soil	Water	Other (Potable / NPDES — Check if Applicable)	(4) Total # of Containers	(5) Analyses Requested — Preservation Codes: PADEP Act 2 Short List of parameters for leaked gasoline & No. 2, 4, 5, and 6 fuel oils *	EPA Method SW-846: 8260B *	8310 *	(6) Temperature of samples upon receipt (if requested)	Remarks
SR-31-1(1.3-1.8)	6-2-11	0950	X		X			4		X	X	X	*PADEP Act 2 Short List of parameters for leaked gasoline & No. 2, 4, 5, and 6 fuel oils
SR-31-2(0.9-1.4)		1015	X		X			4		X	X	X	
SR-31-3(0.8-1.3)		1045	X		X			4		X	X	X	
SR-31-4(0.9-1.4)		1115	X		X			4		X	X	X	
SR-31-5(0.8-1.3)		1200	X		X			4		X	X	X	
SR-31-6(1.0-1.5)		1220	X		X			4		X	X	X	temp 1.0-2.2°C
SR-31-7(1.1-1.6)		1245	X		X			4		X	X	X	
SR-31-8(0.5-1.0)		1305	X		X			4		X	X	X	
SR-31-9(1.2-1.7)		1330	X		X			4		X	X	X	

(7) **Turnaround Time Requested** (TAT) (please circle): Normal (Rush)
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed: 6-15-11
Rush results requested by (please circle): Phone Fax (E-mail)
Phone #: Fax #:
E-mail address: paul.miller@stantec.com

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg)
Type II (Tier II)
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)
TX TRRP-13
MA MCP CT RCP
SDG Complete? Yes No
Site-specific QC (MS/MSD/Dup)? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal COC Required? Yes / No

(9)

Relinquished by:	Date	Time	Received by:	Date	Time
Paul Miller			Lydia	6/3/11	8:45
Lydia	6/3/11	1310		6-3-11	1310
	6/9/11	0930	Lydia	6/9/11	930
Lydia	6/9/11	1615			
				6/9/11	1615

Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 11183 Group# 1250778 Sample # 631678-93

COC # 263603

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

(1) Client: Stantec/Sunoco Acct. #:

Project Name/#: Sunoco PWSID #:

Project Manager: Jen Menges P.O.#: 2134012457

Sampler: Paul Miller Quote #:

Name of state where samples were collected:

(2) Sample Identification	Date Collected	Time Collected	(3) Grab	Composite	Matrix: Soil	Water	Other	(4) Total # of Containers	(5) Analyses Requested / Preservation Codes: EPA Method Sub 8260	8260	8310
U677-1(1.5-2.0)	6-8-11	0920	X		X			4	X	X	X
U677-2(0.8-1.3)		0940	X		X			4	X	X	X
U677-3(1.5-2.0)		1000	X		X			4	X	X	X
U677-4(0.3-0.8)		1020	X		X			4	X	X	X
U677-5(0.8-1.3)		1035	X		X			4	X	X	X
U677-MW		1130	X			X		7	X	X	X
U677-MW-TB						X		7	X	X	

Check if Potable / NPDES Applicable

For Lab Use Only

FSC:

SCR#:

Preservation Codes

H=HCl T=Thiosulfate

N=HNO_3 B=NaOH

S=H_2SO_4 O=Other

(6) Temperature of samples upon receipt (if requested)

Remarks

*DEP Act 2 Short List of parameters for Leaded gasoline & No 2, 4, 5, and 6 fuel oils

*Sample U677-MW was field filtered for lead sample

temp 1.0-2.2°C

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

(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)

Date results are needed: 6-15-11

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

Phone #: Fax #:

E-mail address: paul.miller@stantec.com

(8) **Data Package Options** (please circle if required)

Type I (validation/NJ Reg) TX TRRP-13

Type II (Tier II) MA MCP CT RCP

Type III (Reduced NJ)

Type IV (CLP SOW)

Type VI (Raw Data Only)

SDG Complete? Yes No

Site-specific QC (MS/MSD/Dup)? Yes No

(If yes, indicate QC sample and submit triplicate volume.)

Internal COC Required? Yes / No

Relinquished by:	Date	Time	Received by:	Date	Time
	6-9-11	0930		6/9/11	0930
Relinquished by:	Date	Time	Received by:	Date	Time
	6/9/11	1615			
Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	6/9/11	1615

(9)

Lancaster Laboratories, Inc., 2425 New Holland Pike, Lancaster, PA 17601 (717) 656-2300 Fax: (717) 656-6766

Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

Issued by Dept. 6042 Management

2102.05

June 24, 2011

Ms. Jennifer Menges
Sunoco c/o Stantec
1060 Andrew Drive Suite 140
West Chester, PA 19380

Dear Ms. Menges:

I am writing to inform you of revised analytical reports that are being issued for the following:

Project No. Sunoco

Group No. 1250778

LLI Sample No.	Client Sample Identification	Collection Date
6311692	B-95 GP U 677-MW Grab Water Sample	06/08/2011
6311693	GP U 677-MW-TB Water Sample	06/07/2011

The correction to the data affects the 8260 volatiles analysis only.

In response to an inquiry regarding the data, it was determined that MTBE was omitted from the water sample results in error. MTBE has been added to the samples listed above.

The revised analytical report reflects this correction and is enclosed.

You are a valued client and we apologize for any inconvenience that this incident may have caused. If you have any questions or require further assistance, please call me at 717-656-2300, Ext. 1881. We appreciate your business and look forward to continuing to serve your laboratory needs.

Sincerely,

Natalie R. Luciano

Natalie R. Luciano
Specialist
Environmental Client Services

NRL/mcs
Enclosures

cc: Amek Carter
Paul Miller (e-mail)

Explanation of Symbols and Abbreviations

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

RL	Reporting Limit	**BMQL**	Below Minimum Quantitation Level
N.D.	none detected	**MPN**	Most Probable Number
TNTC	Too Numerous To Count	**CP Units**	cobalt-chloroplatinate units
IU	International Units	**NTU**	nephelometric turbidity units
umhos/cm	micromhos/cm	**ng**	nanogram(s)
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 limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

> greater than

J estimated value – The result is ≥ 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

A	TIC is a possible aldol-condensation product
B	Analyte was also detected in the blank
C	Pesticide result confirmed by GC/MS
D	Compound quantitated on a diluted sample
E	Concentration exceeds the calibration range of the instrument
N	Presumptive evidence of a compound (TICs only)
P	Concentration difference between primary and confirmation columns >25%
U	Compound was not detected
X,Y,Z	Defined in case narrative

Inorganic Qualifiers

B	Value is <CRDL, but ≥IDL
E	Estimated due to interference
M	Duplicate injection precision not met
N	Spike sample not within control limits
S	Method of standard additions (MSA) used for calculation
U	Compound was not detected
W	Post digestion spike out of control limits
*****	Duplicate analysis not within control limits
+	Correlation coefficient for MSA <0.995

Analytical test results 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.

GP-797

SECOR
International Incorporated

July 10, 2002

Mr. Jim Tucker
Sunoco, Inc.
Philadelphia Refinery
3144 Passyunk Avenue
Philadelphia, PA 19145-5299

Subject: **Aboveground Storage Tank #797 Closure Report**
Sunoco Philadelphia Refinery, Philadelphia, Pennsylvania

Dear Mr. Tucker:

This letter summarizes the aboveground storage tank (AST) soil characterization activities that were conducted in support of the closure requirements for Pennsylvania Code Title 25 § 245.561 under the Administration of Storage Tank and Spill Prevention Program. The project site is within the Sunoco, Inc. (Sunoco) Philadelphia Refinery located in Philadelphia, Pennsylvania (**Figure 1**). Soil characterization activities using direct observation and soil sampling and laboratory analyses were conducted surrounding AST #797 in order to evaluate potential impacts associated with product storage. AST #797 is situated on a concrete pad within a diked area and has been reported by Sunoco to have formerly contained process water that contained light-end hydrocarbons such as benzene and cumene.

Soil Boring Installation and Soil Sampling

Work in this area of the refinery is required to be performed using non-sparking equipment. As a result, borings in this area were installed using a stainless steel hand auger. Since the AST is situated on a concrete pad approximately two feet above grade, surface soil samples would detect potential historic releases from the AST.

It was intended that two samples (one sample at a depth of 0 to 2 feet below ground surface (bgs) and one at a depth greater than 2 feet) be collected from each of 4 soil borings advanced to the groundwater table or auger refusal. However, as a result of localized shallow water conditions and hand auger refusal, a total of five samples were collected from 4 borings. The soil borings are designated HA-1 to HA-4. Soil boring locations are depicted on **Figure 2**.

Observations recorded during soil boring installation are recorded on soil boring logs presented in **Appendix A.** The soil boring logs include lithologic descriptions of material encountered and relative soil volatile organic vapor content based on photoionization detector (PID) readings. As indicated on the boring logs, the materials encountered were largely sand with some silt and trace gravel.

Auger refusal was encountered in HA-1, HA-2, and HA-4 at depths ranging from 3.5 feet to 4.5 feet bgs. However, water was encountered at a depth of approximately 1.5 feet bgs. As a result, samples were collected from these locations at a depth of 1.0 to 1.5 feet bgs. Auger refusal was encountered in HA-3 at a depth of 2 feet bgs. Samples were collected from this location at a depth of 1.0 to 1.5 feet bgs and 2.0 feet bgs.

After collection, the soil samples were placed in appropriate laboratory containers, labeled, placed in an ice-chilled cooler and logged on a chain-of-custody form. The soil samples were delivered to Washington Group Environmental Services Laboratory of Boothwyn, Pennsylvania for analysis.

Laboratory Analyses of Soil Samples

The laboratory analyses selected for each soil sample were based on the former contents of the AST. As mentioned above, AST #797 was reported to have stored process water that contained light-end hydrocarbons such as benzene and cumene. As a result, each soil sample was analyzed for Pennsylvania Department of Environmental Protection (PADEP) Pennsylvania Land Recycling Program (Act 2) short list of parameters for unleaded gasoline in soil. This includes the analyses of benzene, toluene, ethyl benzene, xylenes, cumene, MTBE, and naphthalene by EPA Method 5035/8260B.

For quality assurance/quality control (QA/QC) purposes, a trip blank accompanied each sample shipment and submitted for laboratory analyses.

Soil Sampling Results

The soil analytical data is summarized on **Table 1.** The analytical results for the soil samples were compared to the cleanup criteria established by for PADEP under Act 2. Under the regulations implementing Act 2, Medium Specific Concentrations (MSCs) for soils include two components. PADEP has developed MSCs for soils are based on direct contact exposure scenarios and PADEP has developed procedures for selecting MSCs for soils that are designed to protect groundwater from the potential impacts that could be caused by the migration of regulated substances from soils into the groundwater. Soil sample results were compared to Nonresidential Surface Soil and Subsurface Soil Direct Contact MSCs and Used Aquifer Nonresidential Soil-to-Groundwater MSCs. These MSCs are

listed in Appendix A, Tables 3A and 3B (revised November 24, 2001) of the Act 2 Rules and Regulations.

Figure 3 depicts sample results that were reported above an MSC. Benzene in HA-1 (1-1.5) and HA-3 (1-1.5) was reported in concentrations of 920 mg/Kg and 310 mg/Kg, respectively, exceeding the Nonresidential Surface Soil Direct Contact MSC of 210 mg/Kg.

Used Aquifer Nonresidential Soil-to-Groundwater MSCs were exceeded for benzene (0.5 mg/kg) in all five samples (at concentrations ranging from 28 mg/Kg to 310 mg/Kg); ethyl benzene (70 mg/kg) in one sample (HA-1/1-1.5 reported 80 mg/Kg ethyl benzene); and toluene (100 mg/Kg) in four samples (at concentrations ranging from 300 mg/Kg to 1,800 mg/Kg). Copies of the laboratory analytical data are presented in **Appendix B**.

Since MSCs were exceeded in all soil samples, additional site characterization is warranted in accordance with the Pennsylvania Storage Tank and Spill Prevention Program. Further recommendations for site characterization will be provided under separate cover.

Should you have any questions or comments, please feel free to contact me at (484) 875-3075.

Sincerely,
SECOR International Incorporated

Steve Baggett

Steve Baggett, P.G.
Principal Hydrogeologist

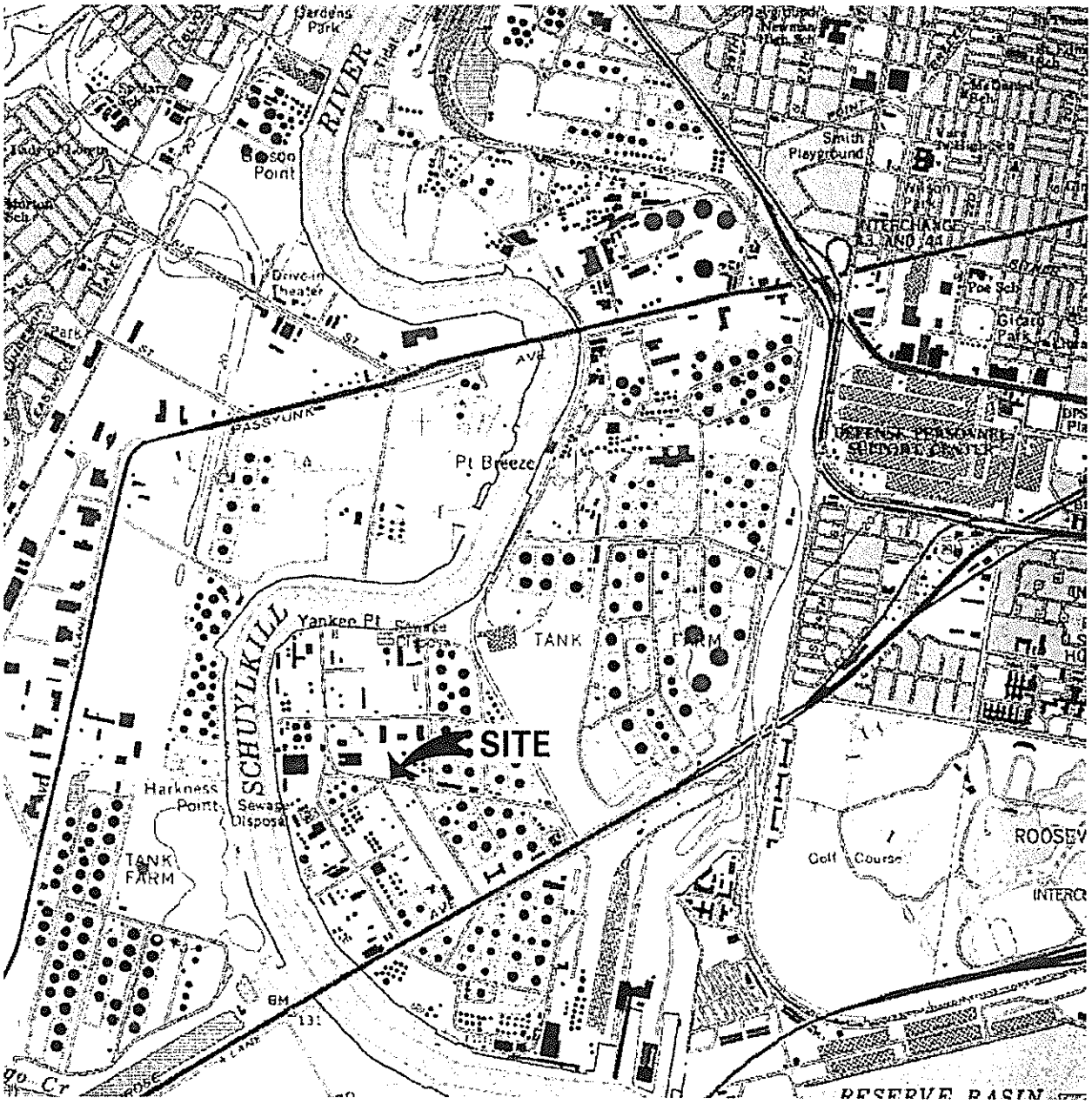
cc: James Oppenheim (Sunoco)
Al Hornung (Sunoco)
Project File

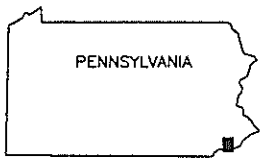
TABLE 1
Summary of Soil Analytical Results (ug/Kg)

AST 797
Sunoco Philadelphia Refinery

Sample	0-2 feet	2-15 feet	Soil to Groundwater	HA-1 (1-1.5)		HA-2 (1-1.5)		HA-3 (1-1.5)		HA-3 (2)		HA-4 (1-1.5)	
Date	Non-Residential	Non-Residential	Non-Residential	8/29		05/24/02		05/24/02		05/24/02		05/24/02	
Constituent	Direct Contact (1)	Direct Contact (1)	Used Aquifer (2)	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL
Benzene	210,000	240,000	500	**920,000 D**	240	**28,000 D**	260	**310,000 D**	270	**170,000 D**	250	**190,000 D**	250
Ethylbenzene	10,000,000	10,000,000	70,000	**80,000 JD**	240	850	260	37,000 JD	270	8,500	250	55,000 D	250
Isopropyl Benzene (Cumene)	10,000,000	10,000,000	1,600,000	1,600,000 D	240	17,000 D	260	1,000,000 D	270	230,000 D	250	950,000 D	250
Methyl-t-butyl Ether (MTBE)	3,200,000	3,700,000	2,000	ND	240	ND	260	ND	270	ND	250	ND	250
Naphthalene	56,000,000	190,000,000	25,000	650	240	ND	260	410	270	300	250	290	250
Toluene	10,000,000	10,000,000	100,000	**1,800,000 D**	240	11,000 D	260	**920,000 D**	270	**300,000 D**	250	**660,000 D**	250
Xylenes-Meta&Para (3)	190,000,000	190,000,000	4,700,000	310,000 D	240	4,500	260	140,000 D	270	29,000 D	250	210,000 D	250
Xylenes-Ortho (3)	110,000	190,000,000	320,000	71,000 D	240	1,400	260	29,000 JD	270	7,700	250	50,000 JD	250

Bold = Exceeds Soil-to-Groundwater standard
J = Estimated Value (concentration is below laboratory reporting limit)
D = Result obtained from different dilution than other samples
(1)= Pennsylvania Land Recycling Program (25 PA code Chapter 250), Appendix A, Table 3 A (Revised November 24, 2001)
(2)= Pennsylvania Land Recycling Program (25 PA code Chapter 250), Appendix A, Table 3 B (Revised November 24, 2001)
(3)= MSCs are based on Total Xylenes





QUADRANGLE LOCATION

N

0 1/2 1

SCALE (MILES)

REFERENCE: USGS 7.5 MINUTE QUADRANGLE; PHILADELPHIA, PENNSYLVANIA–NEW JERSEY; 1995

SECOR
International Incorporated
102 PICKERING WAY, SUITE 200
EXTON, PENNSYLVANIA 19341
(484) 876-3075/876-9286 (FAX)

SITE LOCATION MAP

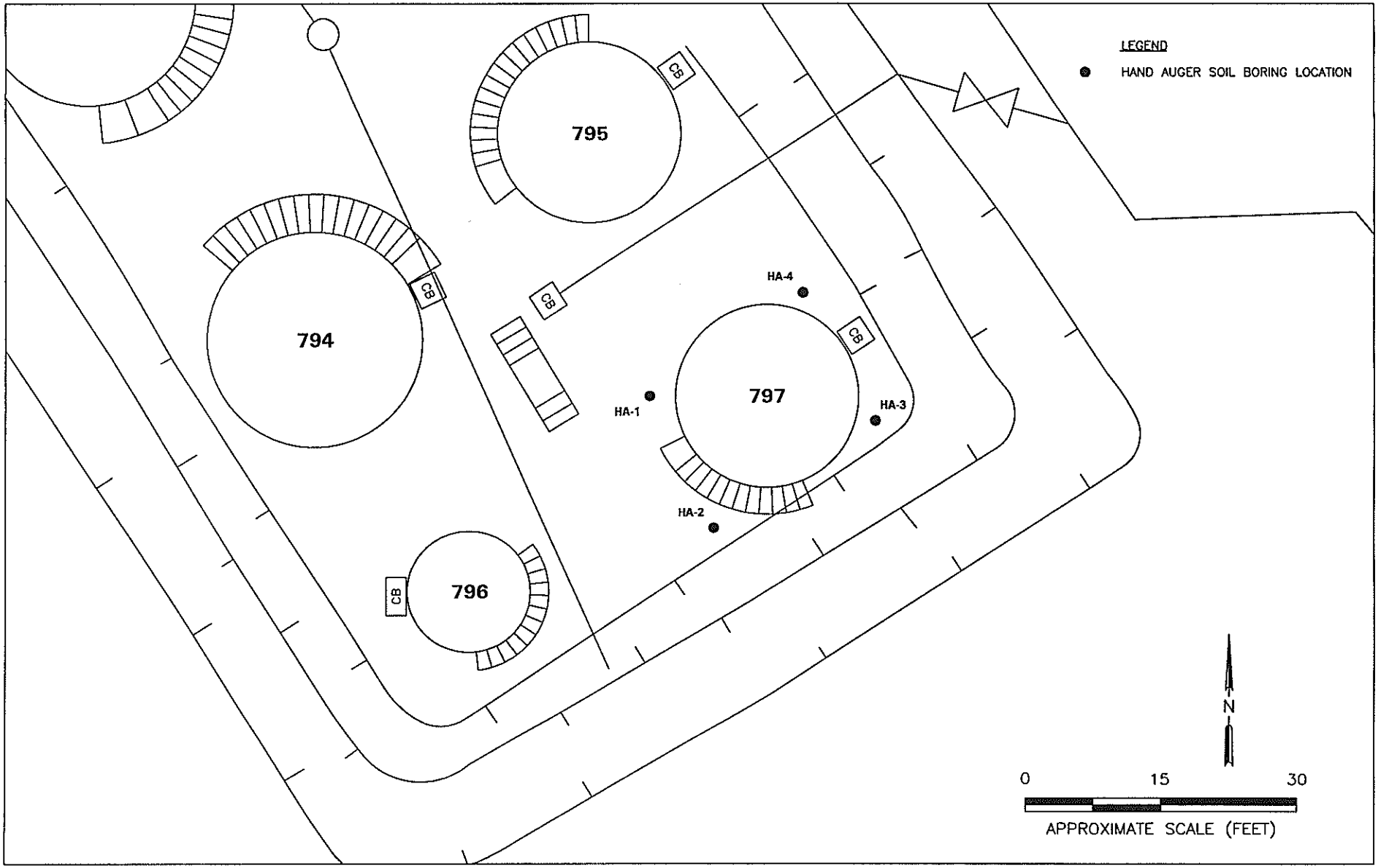
SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

FIGURE: **1**

JOB#: 62SU.01006.02 APPR: DWN: KPM DATE: 06/28/02

N:/OFFICE-062

DWG: 62SU-1006-231(1)



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International Incorporated
102 PICKERING WAY, STE 200
EXTON, PA 19341
(484) 875-3075/875-9286 (FAX)

AST 797 HAND AUGER SOIL BORING LOCATIONS

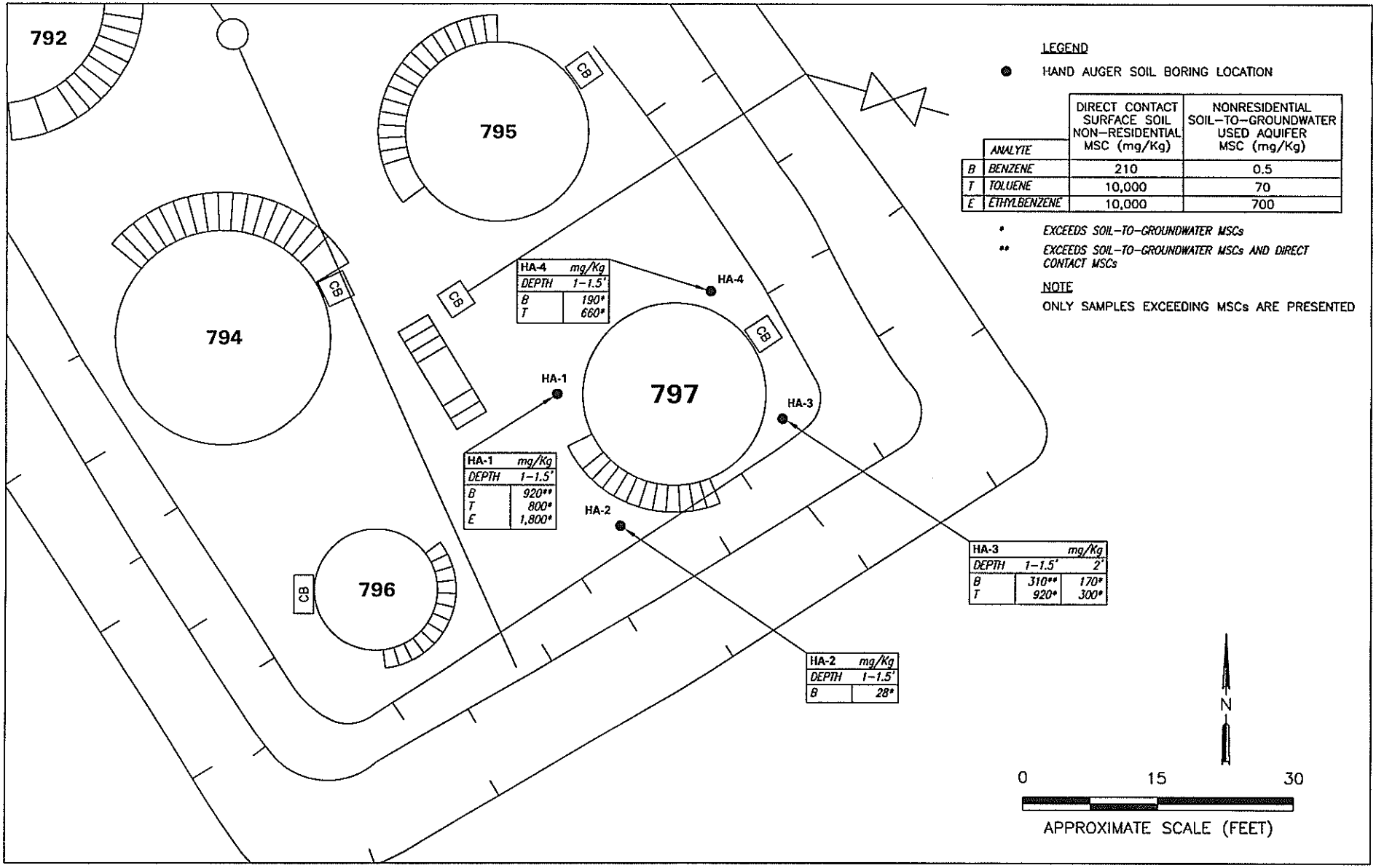
SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

FIGURE: **2**

JOB#: 62SU.01006.02 APPR: DWN: KPM DATE: 06/28/02

N:/SECOR-062

DWG: 62SU-1006-32SP(797)



SECOR
International Incorporated
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EXTON, PA 19341
(484) 875-3075/875-9286 (FAX)

AST 797 HAND AUGER SOIL BORING ANALYTICAL RESULTS MAP (MAY 24, 2002)

SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

FIGURE: **3**

JOB#: 62SU.01006.02 APPR: DWN: KPM DATE: 06/28/02

N:/SECOR-052

DWG: 62SU-1006-33A(797)

APPENDIX A

Soil Boring Logs

SECOR International Incorporated
102 PICKERING WAY, SUITE 200
EXTON, PENNSYLVANIA 19341
(484) 875-3075/875-9286 (FAX)

FACILITY **SUNOCO PHILADELPHIA REFINERY** JOB# **62SU.01006.02.0003** BORING/WELL **HA-1**
LOCATION **PHILADELPHIA, PENNSYLVANIA** SURFACE ELEVATION **NA**
START (TIME/DATE) **05/24/02** FINISH **05/24/02** CASING TOP ELEVATION **NA**
LOGGED BY **S. MORESCALCHI** MONITORING DEVICE **HAND AUGER**
SUBCONTRACTOR AND EQUIPMENT
COMMENTS

SAMPLE ID (DEPTH)	Sample Depth Interval (feet)	PID Reading (ppm)	Sheen	Depth Below Surface (feet)	Lithologic Description	Unified Soil Classification System SYM	Unified Soil Classification System PAT	Depth Below Surface (feet)	Well Construction Schematic
				5				5	
		0.0		0	SAND, fine to medium; some coarse SAND, trace silt; trace fine gravel; brown; dry	SW		0	
		0.0			SAND, fine to medium; some coarse SAND, some fine gravel; brown; dry				
HA-1 (1.0-1.5')*		2586		1	SAND, fine to medium; some coarse SAND, some fine gravel; brown; dry			1	
		1986			SAND, fine to medium; some coarse SAND, some fine gravel; brown; wet				
		9999+		2	SAND, fine to coarse; some fine gravel; brown; wet			2	
				3				3	
		9999+			SAND, fine to coarse; some fine gravel; brown; wet				
		9999+			SAND, fine to coarse; some fine gravel; brown; wet				
		9999+		4	SILT, some fine SAND, black; moist	ML		4	
		1875			SAND, fine to coarse; some fine gravel; brown; wet	SW			
					Boring terminated at 4.5 feet.				
				5				5	

Field Screen/Lithologic Description Sample
Preserved Sample
No Recovery
* Sample Submitted for Laboratory Analysis
Groundwater Level at Time of Drilling
Static Groundwater Level
SD Sheen Detected
NS No Sheen Detected
NT Not Tested
(2.5Y 4/2) Munsell (1990) Soil Color Charts
Gradational Contact
Contact Located Approximately
Contact
Concrete
Bentonite
10/20 Colorado Silica Sand
2" PVC Blank Casing
2" PVC Screen Casing (0.010 slots)
End Cap

N:/SECOR-062

DWG:

SECOR International Incorporated
102 PICKERING WAY, SUITE 200
EXTON, PENNSYLVANIA 19341
(484) 875-3075/875-9286 (FAX)

FACILITY **SUNOCO PHILADELPHIA REFINERY** JOB# **62SU.01006.02.0003** BORING/WELL **HA-2**
LOCATION **PHILADELPHIA, PENNSYLVANIA** SURFACE ELEVATION **NA**
START (TIME/DATE) **05/24/02** FINISH **05/24/02** CASING TOP ELEVATION **NA**
LOGGED BY **S. MORESCALCHI** MONITORING DEVICE **HAND AUGER**
SUBCONTRACTOR AND EQUIPMENT
COMMENTS

SAMPLE ID (DEPTH)	Sample Depth Interval (feet)	PID Reading (ppm)	Sheen	Depth Below Surface (feet)	Lithologic Description	Unified Soil Classification System SYM	Unified Soil Classification System PAT	Depth Below Surface (feet)	Well Construction Schematic
				5				5	
		0.0		0	SAND, fine to medium; little coarse sand; little silt; trace fine gravel; light brown; dry			0	
		0.0			SAND, fine to medium; little coarse sand; little silt; trace fine gravel; brown; dry				
		493		1	SAND, fine to medium; little coarse sand; little silt; trace fine gravel; brown; dry			1	
HA-2 (1.0-1.5')*						SW			
		1482			SAND, fine to medium; little coarse sand; little silt; trace fine gravel; brown; moist/wet				
		1679		2	SAND, fine to coarse; some fine gravel; trace silt; brown; wet			2	
		1243			SAND, fine to coarse; some fine gravel; trace silt; brown; wet				
		1989		3	SAND, fine to coarse; some fine gravel; trace silt; brown; wet			3	
					Boring terminated at 3.5 feet.				
				4				4	
				5				5	

Field Screen/Lithologic Description Sample
Preserved Sample
No Recovery
* Sample Submitted for Laboratory Analysis
Groundwater Level at Time of Drilling
Static Groundwater Level
SD Sheen Detected
NS No Sheen Detected
NT Not Tested
(2.5Y 4/2) Munsell (1990) Soil Color Charts
Gradational Contact
Contact Located Approximately
Contact
Concrete
Bentonite
10/20 Colorado Silica Sand
2" PVC Blank Casing
2" PVC Screen Casing (0.010 slots)
End Cap

N:/SECOR-062
DWG:

SECOR International Incorporated
102 PICKERING WAY, SUITE 200
EXTON, PENNSYLVANIA 19341
(484) 875-3075/875-9286 (FAX)

FACILITY **SUNOCO PHILADELPHIA REFINERY** JOB# **62SU.01006.02.0003** BORING/WELL **HA-3**
LOCATION **PHILADELPHIA, PENNSYLVANIA** SURFACE ELEVATION **NA**
START (TIME/DATE) **05/24/02** FINISH **05/24/02** CASING TOP ELEVATION **NA**
LOGGED BY **S. MORESCALCHI** MONITORING DEVICE **HAND AUGER**
SUBCONTRACTOR AND EQUIPMENT
COMMENTS

SAMPLE ID (DEPTH)	Sample Depth Interval (feet)	PID Reading (ppm)	Sheen	Depth Below Surface (feet)	Lithologic Description	Unified Soil Classification System SYM	Unified Soil Classification System PAT	Depth Below Surface (feet)	Well Construction Schematic
				5				5	
		0.0		0	SAND, fine to medium; little coarse sand; little silt; brown; dry	SW		0	
		102			SAND, fine to medium; little coarse sand; little silt; brown; dry				
		813		1	SAND, fine to medium; little coarse sand; little silt; little fine gravel; brown; dry			1	
HA-3 (1.0-1.5')*									
		9999+			SAND, fine to medium; little coarse sand; trace silt; little fine; brown; moist				
HA-3 (2.0')*		9999+		2	Refusal at 2 feet			2	
					Boring terminated at 2.0 feet.				
				3				3	
				4				4	
				5				5	

Field Screen/Lithologic Description Sample
Preserved Sample
No Recovery
* Sample Submitted for Laboratory Analysis

Groundwater Level at Time of Drilling
Static Groundwater Level
SD Sheen Detected
NS No Sheen Detected
NT Not Tested
(2.5Y 4/2) Munsell (1990) Soil Color Charts

Gradational Contact
Contact Located Approximately
Contact

Concrete
Bentonite
10/20 Colorado Silica Sand

2" PVC Blank Casing
2" PVC Screen Casing (0.010 slots)
End Cap

N:/SECOR-062

DWG:

SECOR International Incorporated
102 PICKERING WAY, SUITE 200
EXTON, PENNSYLVANIA 19341
(484) 875-3075/875-9286 (FAX)

FACILITY **SUNOCO PHILADELPHIA REFINERY** JOB# **62SU.01006.02.0003** BORING/WELL **HA-4**
LOCATION **PHILADELPHIA, PENNSYLVANIA** SURFACE ELEVATION **NA**
START (TIME/DATE) **05/24/02** FINISH **05/24/02** CASING TOP ELEVATION **NA**
LOGGED BY **S. MORESCALCHI** MONITORING DEVICE **HAND AUGER**
SUBCONTRACTOR AND EQUIPMENT
COMMENTS

SAMPLE ID (DEPTH)	Sample Depth Interval (feet)	PID Reading (ppm)	Sheen	Depth Below Surface (feet)	Lithologic Description	Unified Soil Classification System SYM	Unified Soil Classification System PAT	Depth Below Surface (feet)	Well Construction Schematic
				5				5	
		0.0		0	SAND, fine to medium; little coarse sand; little silt; trace fine gravel; light brown; dry			0	
		3237			SAND, fine to medium; little coarse sand; little silt; trace fine gravel; brown; dry	SW			
		1609		1	SAND, fine to medium; little coarse sand; little silt; trace fine gravel; brown; dry			1	
HA-4 (1.0-1.5')*		681			SAND, fine to medium; little coarse sand; trace silt; trace fine gravel; brown; moist/wet				
		389		2	SAND, fine to coarse; little fine gravel; brown; wet			2	
		9999+			SAND, fine to coarse; little fine gravel; brown; wet				
		779		3	SAND, fine to coarse; some fine gravel; brown; wet			3	
		587			SAND, fine to coarse; some fine gravel; brown; wet				
		9999+			SILT; some fine to medium SAND; black; wet Refusal at 4 feet	ML			
				4	Boring terminated at 4 feet.			4	
				5				5	

Field Screen/Lithologic Description Sample
Preserved Sample
No Recovery
* Sample Submitted for Laboratory Analysis
Groundwater Level at Time of Drilling
Static Groundwater Level
SD Sheen Detected
NS No Sheen Detected
NT Not Tested
(2.5Y 4/2) Munsell (1990) Soil Color Charts
Gradational Contact
Contact Located Approximately
Contact
Concrete
Bentonite
10/20 Colorado Silica Sand
2" PVC Blank Casing
2" PVC Screen Casing (0.010 slots)
End Cap

N:/SECOR-062
DWG:

APPENDIX B

Laboratory Analytical Reports

THE WASHINGTON GROUP
ENVIRONMENTAL SERVICES LABORATORY

301 Chelsea Parkway
Boothwyn, Pa. 19061
(610) 497-8000

Report For:

Secor Int., Inc. (Sun Philly Refin)
Mr. Steve Baggett
102 Pickering Way, Suite 200
Exton PA 19341

Job Number

75702702

Summary Number

68562

June 05, 2002

Reviewed by Mary E. Pierce
Project Manager Mary Pierce

NJ ID# PA343	EPA ID# PA00078	PA ID# 23-272
CA ID# 02105CA	RI ID# 238	CT ID# PH0687
NY ID# 11345	MD ID# 286	MA ID# M-PA078

Total Pages = 7

The Washington Group International
Environmental Services Laboratory Data Summary
Summary # 68562 Printed - 06/05/02 06:58:39

Log	Description	Code	Parameter	Result	Limit	Units	Sampled	Started	Complete	Analyst
284206A	HA-1 (1-1.5)	G01PA	Benzene	920000 D	240	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284206A	HA-1 (1-1.5)	G01PA	Ethylbenzene	80000 JD	240	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284206A	HA-1 (1-1.5)	G01PA	Isopropyl Benzene	1600000 D	240	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284206A	HA-1 (1-1.5)	G01PA	Methyl-t-butyl Ether	ND	240	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284206A	HA-1 (1-1.5)	G01PA	Naphthalene	650	240	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284206A	HA-1 (1-1.5)	G01PA	Toluene	1800000 D	240	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284206A	HA-1 (1-1.5)	G01PA	Xylenes-Meta&Para	310000 D	240	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284206A	HA-1 (1-1.5)	G01PA	Xylenes-Ortho	71000 JD	240	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284206B	HA-1 (1-1.5)	S06	WATER BY EVAP	7.6		% as received	05/24/2002	05/28/2002	05/28/2002	MCH
284207A	HA-2 (1-1.5)	G01PA	Benzene	28000 D	260	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284207A	HA-2 (1-1.5)	G01PA	Ethylbenzene	850	260	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284207A	HA-2 (1-1.5)	G01PA	Isopropyl Benzene	17000 D	260	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284207A	HA-2 (1-1.5)	G01PA	Methyl-t-butyl Ether	ND	260	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284207A	HA-2 (1-1.5)	G01PA	Naphthalene	ND	260	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284207A	HA-2 (1-1.5)	G01PA	Toluene	11000 D	260	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284207A	HA-2 (1-1.5)	G01PA	Xylenes-Meta&Para	4500	260	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284207A	HA-2 (1-1.5)	G01PA	Xylenes-Ortho	1400	260	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284207B	HA-2 (1-1.5)	S06	WATER BY EVAP	10.0		% as received	05/24/2002	05/28/2002	05/28/2002	MCH
284208A	HA-3 (1-1.5)	G01PA	Benzene	310000 D	270	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284208A	HA-3 (1-1.5)	G01PA	Ethylbenzene	37000 JD	270	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284208A	HA-3 (1-1.5)	G01PA	Isopropyl Benzene	1000000 D	270	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284208A	HA-3 (1-1.5)	G01PA	Methyl-t-butyl Ether	ND	270	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284208A	HA-3 (1-1.5)	G01PA	Naphthalene	410	270	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284208A	HA-3 (1-1.5)	G01PA	Toluene	920000 D	270	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284208A	HA-3 (1-1.5)	G01PA	Xylenes-Meta&Para	140000 D	270	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284208A	HA-3 (1-1.5)	G01PA	Xylenes-Ortho	29000 JD	270	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284208B	HA-3 (1-1.5)	S06	WATER BY EVAP	9.6		% as received	05/24/2002	05/28/2002	05/28/2002	MCH

The Washington Group International
Environmental Services Laboratory Data Summary
Summary # 68562 Printed - 06/05/02 06:58:39

Log	Description	Code	Parameter	Result	Limit	Units	Sampled	Started	Complete	Analyst
284209A	HA-3 (2)	G01PA	Benzene	170000 D	250	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284209A	HA-3 (2)	G01PA	Ethylbenzene	8500	250	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284209A	HA-3 (2)	G01PA	Isopropyl Benzene	230000 D	250	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284209A	HA-3 (2)	G01PA	Methyl-t-butyl Ether	ND	250	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284209A	HA-3 (2)	G01PA	Naphthalene	300	250	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284209A	HA-3 (2)	G01PA	Toluene	300000 D	250	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284209A	HA-3 (2)	G01PA	Xylenes-Meta&Para	29000 D	250	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284209A	HA-3 (2)	G01PA	Xylenes-Ortho	7700	250	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284209B	HA-3 (2)	S06	WATER BY EVAP	8.8		% as received	05/24/2002	05/28/2002	05/28/2002	MCH
284210A	HA-4 (1-1.5)	G01PA	Benzene	190000 D	250	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284210A	HA-4 (1-1.5)	G01PA	Ethylbenzene	55000 D	250	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284210A	HA-4 (1-1.5)	G01PA	Isopropyl Benzene	950000 D	250	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284210A	HA-4 (1-1.5)	G01PA	Methyl-t-butyl Ether	ND	250	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284210A	HA-4 (1-1.5)	G01PA	Naphthalene	290	250	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284210A	HA-4 (1-1.5)	G01PA	Toluene	660000 D	250	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284210A	HA-4 (1-1.5)	G01PA	Xylenes-Meta&Para	210000 D	250	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284210A	HA-4 (1-1.5)	G01PA	Xylenes-Ortho	50000 JD	250	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284210B	HA-4 (1-1.5)	S06	WATER BY EVAP	11.5		% as received	05/24/2002	05/28/2002	05/28/2002	MCH
284211	Trip Blank	G01PA	Benzene	ND	250	ug/kg as rcvd	05/24/2002	05/29/2002	05/29/2002	PSS
284211	Trip Blank	G01PA	Ethylbenzene	ND	250	ug/kg as rcvd	05/24/2002	05/29/2002	05/29/2002	PSS
284211	Trip Blank	G01PA	Isopropyl Benzene	ND	250	ug/kg as rcvd	05/24/2002	05/29/2002	05/29/2002	PSS
284211	Trip Blank	G01PA	Methyl-t-butyl Ether	ND	250	ug/kg as rcvd	05/24/2002	05/29/2002	05/29/2002	PSS
284211	Trip Blank	G01PA	Naphthalene	ND	250	ug/kg as rcvd	05/24/2002	05/29/2002	05/29/2002	PSS
284211	Trip Blank	G01PA	Toluene	ND	250	ug/kg as rcvd	05/24/2002	05/29/2002	05/29/2002	PSS
284211	Trip Blank	G01PA	Xylenes-Meta&Para	ND	250	ug/kg as rcvd	05/24/2002	05/29/2002	05/29/2002	PSS
284211	Trip Blank	G01PA	Xylenes-Ortho	ND	250	ug/kg as rcvd	05/24/2002	05/29/2002	05/29/2002	PSS

Approved by: _____

Report Prep: K. Kester

THE WASHINGTON GROUP
ENVIRONMENTAL LABORATORY

Methods Used for Summary# 68562:

Code	Description
G01PA	SW-846 5035/8260B/PA UST VOCs - BTEX;Cumene;Naph.;EDB;EDC
S06	Water by evaporation/ EPA-600 Mtd 160.3

The Washington Group
Environmental Laboratory

DATA QUALIFIERS

The following list shows data qualifiers that may appear in this report, and the meaning of each.

Qualifier	Meaning
B	Compound was detected in the associated blank.
D	Result was obtained from a different dilution than other analytes.
E	Result is estimated. Usually, this qualifier indeicates that the result is above the calibrated range of the instrument
J	Result is estimated. Usually this qualifier indicates the reported concentration is below the laboratory's reporting limit.
N	Indicates a Tentatively Identified Compound.
ND	Analyte was not detected.
U	Analyte was not detected (U and ND qualifiers are interchangable).

ABBREVIATIONS

The following list shows abbreviations that commonly occur in analytical reports.

Abbreviation	Meaning
DL	Dilution
LCS	Laboratory Control Sample
LCSS	Laboratory Control Sample (soil)
LCSW	Laboratory Control Sample (water)
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NR	No Recovery
PB	Preparation Blank
PS	Post-Digestion Spike
RE	Reanalysis
RPD	Relative Percent Difference
SR	Serial Dilution

Washington — Laboratory Chain Of Custody

Quote No:

Ship To:

Lab Job No: 75702702

Washington Group Laboratory
301 Chelsea Parkway
Boothwyn, PA 19061
Phone: 610-497-8000
Fax: 610-497-8005

Client/Office: SECOR INT. INC. Phone: 484 875 3025

Address: 102 PICKERING WAY, SUITE 200 EXTON PA 19341

Send report to: STEVE BAGGETT Fax: 484 875 9286

Project Description: SUN PHILADELPHIA REFINERY

Send invoice to: SAME

Address:

P.O. No: 1012

TAT (for data): Identify number of working days below);...or Date-->:

☐ Rush 1 2 3 4 5 days ☐ Firm(6-12) ____ ☒ Std.(~12) ____ ☐ Other ____

Lab Staffer confirming Rush/Firm: Hardcopy TAT Date?:

Report Type: ☒ Results only ☐ Data +QC ☐ Reduced Deliv. ☐ Other:
☐ Regulatory Format (CLP like) ☐ Electronic/diskette->(Format?)

Regulatory Samples? ☒ YES ☐ NO — If YES?: ☒ Act II ☐ UST ☐ RCRA ☐ NPDES ☐ Phase I/II ☐ ISRA ☐ Other:

Analytical Protocol: ☐ SW846 ☐ EPA600 ☐ Drinking H2O ☐ ASTM ☐ Other:

Analysis Required: STARS LIST (PADEP UNLEADED GAS PARAMETERS - 5035/BASED CHTEX, CUMENE, MTBE, NAPHTHALENE)

Lab Use Only
Rec'd @ 0°C
Due Date:
Cooler Temp:
Custody Seal: Yes ☐ No ☐ N/A ☐
Summary No: 68562
Lab Log No:

Sample Data (NJ HAZITE disk deliverable limits sample ID to 7 Characters)						Container Data			
ID (NJ limit=7 characters)	date	time	matrix	grab	comp	type	no.	preservative	pH
HA+1 (1-1.5)	5/24/02	0940	SOIL	✓			2	METH	
HA-2 (1-1.5)	5/24/02	1050		✓			2		
HA+3 (1-1.5)	5/24/02	1130		✓			2		
HA+3 (2)	5/24/02	1140		✓			2		
HA-4 (1-1.5)	5/24/02	1210		✓			2		
TRIP BLANK			METH				1		

A+B

Comments/Special Handling/Storage/Disposal-->: A= Blue, 40g, MeOH (1) B= All other, 40g (4)

Sampled by: SERGIO MORESCALCHI

Phone no: 484 875 3075

Relinquished By:			Received By:			Method of Shipment
Name:	Date: 5/24/02		Name:	Date: 5/24/02		
Organization: SECOR	Time: 1400		Organization: TW SAINT	Time: 1400		Airbill No.
Name:	Date:		Name:	Date:		
Organization:	Time:		Organization:	Time:		
Name:	Date:		Name:	Date:		
Organization:	Time:		Organization:	Time:		

Washington
Environmental Laboratory

SAMPLE RECEIVING CHECKLIST

Client/Site: Secor

Assigned Summary # 68562

Section 1. Laboratory Courier (omit if samples received directly from client or 3rd party)

1.1 Samples taken by lab personnel?	☐ Yes	☐ No	
Preserved in field?	☐ Yes	☐ No	☐ Not Req.
Stored on ice?	☐ Yes	☐ No	☐ Not Req.
Date/time last sample placed in cooler: _____			
1.2 Samples taken by customer or 3rd party?	☐ Yes	☐ No	
Received under refrigeration?	☐ Yes (cooler)	☐ Yes (refrig.)	☐ No
If yes, in Cooler sealed?	☐ Yes	☐ No	
If no, ice present?	☐ Yes	☐ No	
Ice added?	☐ Yes	☐ No	
If refrig. placed in cooler/iced	☐ Yes	☐ No	

Section 2. Laboratory

2.1 Delivered by	☒ Client	☐ Lab Pers	☐ Parcel Svc
2.2 Packaging	☒ Cooler	☐ Other/none	
Custody Seals	☐ Present	☒ Absent	☐ Broken
Ice	☒ Present	☐ Absent	☐ Melted
Temperature	6 °C		
2.3 Documentation			
Airbill Present	☐ Yes, # N/A		☐ No
COC	☒ Rec'd		☐ Prpd by Lab
2.4 Sample Containers			
Appropriate for specified analyses?	☒ Yes	☐ No*	
Intact?	☒ Yes	☐ No*	
Labeled, and labels legible?	☒ Yes	☐ No*	
Labels agree with COC?	☒ Yes	☐ No*	

2.5 Preservation (water samples only)				
Metals	pH<2	☐ Yes	☐ No*	☒ NA
Cyanides	pH >12	☐ Yes	☐ No*	☒ NA
Sulfides	pH >9	☐ Yes	☐ No*	☒ NA
BNA, Pest, PCB, CN, Phenols, NO_3	Cl_2 absent	☐ Yes	☐ No*	☒ NA
TOC, COD, Oil/Grease, Phenols, TPH	pH<2	☐ Yes	☐ No*	☒ NA
TOX, TKN, NH3, Tot. P.	pH<2	☐ Yes	☐ No*	☒ NA
Were preservatives added at lab?		☐ Yes*	☐ No	☒ N/A

Comments (note: any response marked "*" requires detailed explanation identify specific samples, what was wrong, and what was done)

Initials: DAG Date: 5/24/02

admin3/QA/lList/SR Checlist rev10/01

Pennsylvania Department of Environmental Protection

Lee Park, Suite 6010
555 North Lane
Conshohocken, PA 19428

July 29, 2002

Southeast Regional Office

610-832-5950
Fax 610-832-6143

NOTICE OF VIOLATION

RECEIVED 7/31/02

Mr. James Tucker
Sunoco, Inc.
3144 Passyunk Avenue
Philadelphia, PA 19145

797 TANK

Re: Storage Tank Program
Facility ID No. 51-36558
Sunoco Inc., Girard Point Processing Area
City of Philadelphia
Philadelphia County

Dear Mr. Tucker:

On June 10, 2002, a reportable release of gasoline or another regulated substance was confirmed at your above-named facility. This release constitutes a violation of Section 1310 of the Pennsylvania Storage Tank and Spill Prevention Act and the provisions of the Pennsylvania Clean Streams Law.

Our purpose in sending you this written notice is to both advise you of your responsibility and to provide guidance and details to help you address this problem quickly and effectively under the Department's corrective action regulations. This notice is sent to all owners of regulated storage tanks whenever a release of gasoline or another regulated substance is confirmed. You are required to conduct appropriate corrective actions and to document those actions by submitting various written reports to the Department.

In the following sections you will find details regarding a number of important requirements. Please read them carefully and be sure any contractor or consultant you hire is familiar with them.

In order to ensure this release is addressed in a prompt and appropriate manner, you are requested to provide monthly progress reports to the Department until this release is resolved. These progress reports should describe actions taken and include all sampling data gathered. The progress reports are to provide documentation that the corrective actions and site characterization/cleanup activities specified below are being implemented. The first such report is due the tenth of September, 2002. Thereafter, reports are due by the 10th day of each subsequent month. A sample report format, that includes required information, is enclosed for your use.

1. INTERIM CORRECTIVE ACTIONS (CHAPTER 245, SECTION 306 OF THE REGULATIONS)

The actions taken to promptly contain and remove contamination after first discovering a release are vital. Effective interim actions can, in some cases, fully resolve a problem or at least limit the severity of a problem, thus making site cleanup easier and less expensive. We have listed below examples of interim actions. Appropriate interim actions must begin immediately after a release is confirmed.

a. Conduct a survey to determine whether any private or public water supplies exist in the vicinity of the facility and sample such supplies for the designated indicator parameters associated with the regulated substance released. In the case of a gasoline release, MTBE must be included as one of the indicator parameters.

b. If your release does impact a private or public water supply, you must, within 48 hours, provide a temporary water supply for affected users. The temporary measure usually recommended by the Department for private water supplies is the installation of dual phase activated carbon filtration systems. Within 90 days a permanent water supply must be in place. We recognize that in certain cases, activated carbon filtration may also be considered a permanent water supply.

c. Remove regulated substances from all leaking storage tank systems.

d. Remove all free product discovered and address hazards posed by vapors or free product.

e. Excavate contaminated soil unless the extent of contamination is so extensive that on-site treatment is considered more appropriate. Properly stored contaminated soil can only remain on site for a maximum of 90 days before treatment begins or disposal occurs.

f. Notify all impacted municipalities and residents and establish an open dialogue to insure they remain informed of remedial activities.

2. SITE CHARACTERIZATION (CHAPTER 245, SECTIONS 309 AND 310 OF THE REGULATIONS).

You must submit a written site characterization report to our office. There are two types of characterization reports. You need to determine, based on the circumstances at your site, which one of the two reports is appropriate for your release. The following paragraphs briefly describe both reports and the compliance dates for submission.

a. Interim Remedial Action Report [See Section 310(b)] – When interim remedial actions have effectively reduced soil contamination to within an established Commonwealth cleanup standard, a report detailing the actions taken and data confirming achievement of a cleanup standard must be submitted. When contamination involved closure or partial closure of an underground storage tank system and any soil contamination was localized, the Department's closure report form may be submitted as your interim remedial action report. This Interim Remedial Action Report must be submitted as soon as possible, but not later than August 10, 2002.

b. Detailed Site Characterization Report [See Section 310(a)] – When contamination is extensive and/or involves impact to surface or groundwater, more sophisticated site analyses will be needed. The Department defines "extensive" contamination as any occurrence where contamination has spread more than three feet beyond the storage tank system or has impacted surface water or groundwater. Section 309(b) describes the types of site activities that may be necessary. It is this type of site characterization, which will often involve extensive sub-surface studies of soil and groundwater, that requires the help of a specialized consultant. A detailed Site Characterization Report characterizing the full horizontal and vertical extent of soil and groundwater contamination must be submitted as soon as possible, but no later than December 10, 2002.

3. REMEDIAL ACTION (CHAPTER 245, SECTION 311 OF THE REGULATIONS)

A Remedial Action Plan must be submitted only when extensive site contamination exists. The content of this plan is described in Section 311 of the regulations. This plan must be submitted within 45 days of the date of the detailed site characterization report submission. It is to your benefit to combine your remedial action plan information with your detailed Site Characterization Report, since this will eliminate the need for two documents to be prepared and submitted and will speed the cleanup of your site.

4. CONSULTATIVE ASSISTANCE NEEDED

The completion of a detailed Site Characterization Report and a Remedial Action Plan will necessitate special consultative assistance. Submission of these more sophisticated corrective action documents may involve the services of a registered professional geologist and/or a registered professional engineer. Your contractor, product distributor, or other business contacts may be able to advise you on the selection of a consultant. Thereafter, make monthly contacts with your consultant and our office to be sure compliance dates are met.

5. SELECTION OF A CLEANUP STANDARD

The cleanup of contaminated soil and groundwater must meet one of three Commonwealth standards. You may choose any of the three standards described in this section. The Statewide Health Standard identifies maximum allowable contaminant levels in both soil and groundwater for various regulated substances. The Department's Land Recycling Program Technical Guidance Manual contains a comprehensive listing of all regulated substances should your release involve something other than gasoline or another petroleum compound. If you select to meet the Statewide Health Standard, use this information to guide your cleanup.

There are two other cleanup standards possible – the Background Standard and the Site-Specific Standard. Upon selection of your cleanup standard, please clearly identify in your Site Characterization Report and/or your Remedial Action Plan which standard you will be pursuing. The selection of a Background Standard may include the submission of an area-wide study which should be included in your Site Characterization report. The selection of a Site-Specific Standard may require a risk assessment and fate and transport modeling which should be included in your Site Characterization Report.

6. DOCUMENTS

Many of the documents mentioned in this letter can be found on the Department's Website (www.dep.state.pa.us) or by contacting our Regional Office at 610-832-5950.

7. FINANCIAL ASSISTANCE

Immediately upon confirmation of your release, you should contact the Underground Storage Tank Indemnification Fund (USTIF) at 717-787-0763. This is your insurance fund administered by the Pennsylvania Department of Insurance. Financial coverage for cleanups and third party claims is available to tank owners or operators with eligible underground storage tank systems.

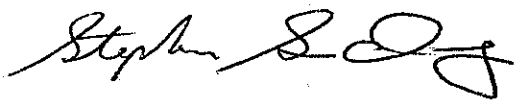
A Small Business First Fund is administered by the Pennsylvania Department of Community and Economic Development. Loans are available for qualifying small businesses. For further information, call the Business Loans Division at 717-783-5046.

We realize there is much information to be understood in this letter. You need to know that a cleanup can proceed voluntarily through cooperative efforts or involuntarily through enforcement action. Whether enforcement action is taken depends in part on the circumstances that led to your release and, most importantly, on the actions of your contractor, consultant and yourself in meeting the requirements explained in this letter. We would much prefer to work closely and cooperatively with you.

This Notice of Violation is neither an order nor any other final action of the Department of Environmental Protection. It neither imposes nor waives any enforcement action available to the Department under any of its statutes. If the Department determines that an enforcement action is appropriate, you will be notified of the action.

Remember it is your responsibility to ensure the requirements explained in this letter are met. All reports referenced in this letter are to be submitted to Mr. Stephan Sinding, Storage Tanks Section Chief, in the Department's Southeast Regional Office. Questions can be directed to me at 610-832-5968.

Sincerely,



Stephan B. Sinding
Chief, Storage Tank Section
Environmental Cleanup

Enclosure

cc: Philadelphia County Health Department
Ms. Fields, Philadelphia L & I
Storage Tanks Compliance and Monitoring – Ms. Wnukowski
Ms. Fries (5)
Mr. Ghobrial
Mr. Brown
Re 30

****PLEASE DO NOT FAX THIS REPORT****

MONTHLY PROGRESS REPORT

Facility ID Number: **Report Period:**

Facility Name:

Facility Address:

Facility Contact Name:

Municipality: **County:**

Release Date:

Date Municipality Notified: (if a written communication, please enclose a copy)

Describe activities (accomplished and planned) specifically intended to address off-site exposures (e.g. private water supplies, vapor pathways):

Describe activities (accomplished and planned) specifically intended to address the site characterization and remediation requirements:

Submitted by: **Date Submitted:**

Company Name:

Address:

Phone Number:

SECOR International Incorporated
Philadelphia Office
102 Pickering Way, Suite 200
Exton, Pennsylvania 19341
Phone: (484) 875-3075
FAX: (484) 875-9286

LETTER OF TRANSMITTAL

Attn: Jim Tucker
Jim Oppenheim

Date: 12/2/02

Company: Sunoco, Inc.

Job No: AST 797

RE: Draft Site Characterization Report

ENCLOSED:
( ) Proposal
( ) Contract
(X) Report
( ) Letter Report
( ) Other:

FOR:
( ) As Requested
(X) Review
( ) Your Information
( ) Approval
( ) Signature
( ) Return
( ) Other:

Comments:
Attached is the Draft Site Characterization Report. Please review, there are a few things to discuss. The report indicates that although delineation has not been performed to Statewide Standards, this area does not pose a risk and will be addressed under other programs. OPP - the Girard Point annual perimeter well sampling results may help (I don't have the last report).

Signature: Steve Baggett

cc:

SUNOCO, INC. (R&M)

AST 797 AREA
GIRARD POINT PROCESSING AREA
PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

SITE CHARACTERIZATION REPORT

December 6, 2002

Prepared for:

Sunoco, Inc. (R&M)
3144 Passyunk Avenue
Philadelphia, PA 19145-5299

Completed by:

SECOR International Incorporated
102 Pickering Way, Suite 200
Exton, PA 19341

Steve Baggett

Steve Baggett, P.G. (PG000790G)
Principal Hydrogeologist

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1.0 INTRODUCTION

This Site Characterization Report (SCR) was prepared on behalf of Sunoco, Inc. (R&M) (Sunoco) for investigative activities associated with aboveground storage tank (AST) closure within the Girard Point Processing Area of the Philadelphia Refinery located in Philadelphia, Pennsylvania (**Figure 1-1**). The investigation was conducted in support of the site characterization requirements of Pennsylvania Code Title 25 § 245.310 under the Administration of Storage Tank and Spill Prevention Program.

1.1 Background

Sunoco, Inc. completed the in-place closure of AST 797 on April 30, 2002. AST 797 is a 42,000 gallon tank, approximately 20 feet in diameter, and is situated on a concrete pad within a diked area with other active ASTs (refer to **Figures 1-2** and **1-3**). Sunoco has indicated that the AST formerly contained process water. Components of the process water included light-end hydrocarbons such as benzene and cumene.

In accordance with the requirements of the Administration of Storage Tank and Spill Prevention Program, Sunoco retained SECOR International, Inc. (SECOR), to perform soil characterization activities following the in-place closure of the AST. During that investigation, soil samples were collected from four soil borings around the perimeter of the AST. Soil samples were analyzed for for Pennsylvania Department of Environmental Protection (PADEP) Pennsylvania Land Recycling Program (Act 2) short-list of parameters for unleaded gasoline in soil. This list of analytes includes benzene, toluene, ethyl benzene, xylenes, cumene, methy tert – butyl ether (MTBE), and naphthalene. The analytical results for the soil samples were compared to Medium Specific Concentrations (MSCs) established by PADEP under Act 2 to guide site remediation. The results of the investigation indicated that soil Used Aquifer Nonresidential Soil-to-Groundwater MSCs were exceeded for benzene, ethyl benzene, and toluene. Benzene was also reported in concentrations exceeding the Nonresidential Surface Soil Direct Contact MSC. The AST 797 closure report prepared by SECOR dated July 10, 2002 is included as **Appendix A.**

Upon receipt of laboratory data from the soil sampling activities, Sunoco notified the PADEP on June 10, 2002 of the confirmation of a reportable release from AST 797. In response to this notification, PADEP issued a Notice of Violation to Sunoco in a letter dated July 29, 2002.

Included in PADEP's letter was a request to characterize the extent of soil and impact and submit a Site Characterization Report.

1.2 Objectives

The objectives of Sunoco are to perform a characterization of soil and groundwater impact in the vicinity of AST 797 as requested by PADEP. In order to address PADEP's request, site characterization activities were initiated during September 2002. Activities performed and documented in this SCR include:

- Soil sampling and laboratory analyses,
- Monitoring well installation,
- Liquid level gauging,
- Groundwater sampling and laboratory analyses,
- Slug testing and
- Fate and transport modeling.

1.3 Report Organization

This Site Characterization Report has been developed in accordance with PADEP guidelines. The report sections are described as follows:

Section 1.0 - Provides a general introduction to the site, project background, and the objectives of the site investigation.

Section 2.0 - Summarizes the setting, including site location and description, geology and hydrogeology, and a brief summary of the previous site investigations.

Section 3.0 - Provides a description of investigation methods implemented in order to characterize the site.

Section 4.0 - Provides a discussion of the results of the site investigation including hydrogeology, soil analytical results, and groundwater analytical results.

Section 5.0 - Presents a discussion of the site conceptual model and groundwater fate transport modeling.

Section 6.0 - Presents the preliminary ecological screening.

Section 7.0 - Presents conclusions of the investigations and recommendations.

2.0 SITE SETTING

2.1 Site Location and Description

AST 797 is located within the Girard Point Processing Area of the Philadelphia Refinery (refer to **Figure 1-1**). The Girard Point Processing Area is generally bounded to the north, west and south by the Schuylkill River and to the east by the Point Breeze Processing Area of the refinery and other industrial properties of south Philadelphia. AST 797 is located in the central portion of the Girard Point Processing Area and is approximately 1,000 feet east of the Schuylkill River (refer to **Figure 1-2**). AST 797 is situated in the southwest corner of a containment bermed area. In the vicinity of AST 797 is an extensive network of above ground and underground utilities.

Surface water runoff within the refinery is controlled by a storm water management system. Storm water is routed to the Girard Point Waste Water Treatment Plant and discharges through a NPDES permitted outfall to the Schuylkill River.

2.2 Hydrogeology

The Girard Point Processing Area is located within the Coastal Plain Physiographic Province. The area is generally flat and ranges in elevation from just above sea level to approximately 20 feet in elevation (above mean sea level). As mentioned above, the Girard Point Processing Area is bounded to the north, west, and south by the Schuylkill River which is tidal in this reach.

Previous investigations in the area indicate that the surficial geology consists of localized fill, Quaternary Alluvium and the Pliestocene-age Trenton Gravel. The Quaternary Alluvium in the area is reported to consist predominantly of sandy silt and sandy micaceous clay. This unit generally ranges in thickness from 0 to 20 feet. The Trenton Gravel underlies the Quaternary Alluvium.

The Trenton Gravel is described as gray or pale-reddish-brown, very gravelly sand interstratified with semi consolidated limonite cemented sand and clay-silt beds; and includes areas of alluvium and swamp deposits. The sediments are poorly sorted (Balmer and Davis, 1996). The thickness of the Trenton Gravel is generally less than 20 feet and may approach 50 feet locally. The Trenton Gravel is underlain by a sequence of Upper Cretaceous Age sand and clay units which overlie the crystalline bedrock of the Wissahichon Formation. The Wissahickon Formation is

described as dark- to light-gray, well foliated schist and gneiss, having some quartz- and/or feldspar-rich layers; quartz, feldspar, biotite, and muscovite are the primary minerals (Berg and Dodge, 1981).

2.3 Previous Investigations

Several previous environmental investigations have been performed at the Girard Point Processing Area under various PADEP and United States Environmental Protection Agency (USEPA) programs. Recently (during 2001), Sunoco submitted appropriate documentation for the Girard Point Processing Area in accordance with the USEPA Environmental Indicators (EI) Program being used by the Resource Conservation and Recovery Act (RCRA) Corrective Action program. The documentation submitted to USEPA by Sunoco under this program indicated that the migration of "contaminated groundwater" from the facility is under control and "current human exposures" are under control. Sunoco also performs liquid level monitoring of a network of groundwater monitoring wells, operation of remedial systems, and annual groundwater sampling of six perimeter wells within the Girard Point Processing Area. This data is provided to PADEP in quarterly and annual status reports.

In addition to the facility-wide investigations, soil samples were previously collected in the vicinity of AST 797. During June 2002, four hand auger soil borings (the soil borings were designated HA-1 to HA-4) were installed using a stainless steel hand auger within the bermed area of AST 797. The use of truck-mounted drilling equipment was prohibited because of the requirement that nonsparking equipment be used inside of the AST containment berms due to safety considerations. However, since the AST is situated on a concrete pad approximately two feet above grade, surface soil samples would detect potential historic releases from the AST.

It was intended that two samples (one sample at a depth of 0 to 2 feet below ground surface (bgs) and one at greater than 2 feet in depth) be collected from each of 4 soil borings. However, as a result of shallow water table conditions and hand auger refusal, a total of five samples were collected from 4 borings. As has been described, soil samples were analyzed for the PADEP Act 2 short-list of parameters for unleaded gasoline in soil. The results of the investigation indicated Used Aquifer Nonresidential Soil-to-Groundwater MSCs were exceeded for benzene, ethyl benzene, and toluene. Benzene was also reported in concentrations exceeding the Nonresidential

Surface Soil Direct Contact MSC. Soil boring locations and analytical results are presented the AST 797 closure report which is included as **Appendix A**.

3.0 SITE CHARACTERIZATION METHODS

This section describes the methods of the site characterization activities. Site characterization activities included soil sampling and laboratory analyses, monitoring well installation, liquid level gauging, groundwater sampling and laboratory analyses, and slug testing. All field activities were performed under a site-specific Health and Safety Plan which included site-specific health and safety training requirements of Sunoco. Due to restrictions with use of truck- mounted drilling equipment within the bermed area, this investigation was performed outside of the AST berm.

3.1 Soils Investigation

Three soil borings were advanced to characterize soil conditions downgradient and lateral to AST 797. Assuming that the overall groundwater flow is in the direction of the Schuylkill River, MW-2 and MW-3 were positioned as downgradient locations. MW-1 was positioned downgradient and lateral to AST 797. Soil borings could not be installed to the north of AST 797 because of other active ASTs, or to the south and east of AST 797 because of extensive underground and aboveground utilities.

Soil boring installation was initiated on September 16, 2002 by Parrot-Wolfe, Inc. under the supervision of a SECOR professional geologist registered in Pennsylvania. Soil borings were advanced using continuous flight hollow-stem auger drilling techniques. During drilling, soil samples were collected for lithologic description continuously to the target depth with a split-barrel sampling device. The organic vapors in headspace of soil samples were also monitored with a photoionization detector (PID). Soil borings were advanced to a depth of 11 feet below ground surface. The subsurface lithology and PID measurements were recorded by the supervising geologist on a lithologic log (refer to **Appendix B**).

Soil samples were collected from each boring for laboratory analyses. It was originally intended that two soil samples be collected from each boring (at 0 to 2 feet bgs for comparison with Direct Contact Soil MSCs and from 2 feet to the water table surface or auger refusal for comparison with Direct Contact Subsurface and/or Soil-to-Groundwater MSCs). However, only one sample was collected from each soil boring at depth of 1 to 1.5 feet bgs due the shallow depth to ground water (the water table was encountered at 2 to 3 feet bgs in each boring). Soil boring/monitoring well locations are presented on **Figure 1-3**.

After collection, the soil samples were placed in appropriate laboratory containers, labeled, placed in an ice-chilled cooler and logged on a chain-of-custody form. The soil samples were delivered to Lancaster Laboratories of Lancaster, Pennsylvania for analyses.

The laboratory analyses selected for each soil sample were based on the former contents of the AST. As mentioned, AST 797 was reported to have stored process water that contained light-end hydrocarbons such as benzene and cumene. As a result, each soil sample was analyzed for PADEP (Act 2) short-list of parameters for unleaded gasoline in soil. This includes the analyses of benzene, toluene, ethyl benzene, xylenes, cumene, MTBE, and naphthalene by EPA Method 5035/8260B. For quality assurance/quality control (QA/QC) purposes, a trip blank accompanied each sample shipment and submitted for laboratory analyses.

As will be described in Section 4.2, Nonresidential Used Aquifer Soil-to-Groundwater MSCs were exceeded at each location for at least one analyte. As a result, soil samples were collected on October 17, 2002 in the vicinity (within 4 feet based on access) of each soil boring location, at a depth of 1.0 to 1.5 feet using a hand driven stainless steel auger. Each sample was then appropriately containerized and shipped to Lancaster Laboratories for Sythetic Precipitation Leaching Procedure (SPLP) analyses of each analyte that exceeded a Soil-to-Groundwater MSC.

3.2 Monitoring Well Installation

Three monitoring wells were installed during site characterization activities (designated MW-1, MW-2 and MW-3) (refer to **Figure 1-3**). Once the termination depth of each soil boring was reached (refer to Section 3.1), the well casing and screen was inserted into the boring through the center of the hollow stem augers. The monitoring wells were constructed of 4-inch diameter schedule 40 polyvinyl chloride (PVC) well screen and blank PVC riser. Lengths of pipe were joined using threaded flush joint couplings. The well screen was pre-constructed, commercially slotted, with a slot size of 0.020 inches. The bottom of each screen was provided with a threaded flush joint cap. A well sorted silica filter sand (#2 grade) was poured in through the augers from the bottom of the boring to a level above the top of the screened interval to fill the annular space. The remaining annular space above the sand pack was filled with a bentonite grout to the surface. The augers were then withdrawn from the boring and protective steel casing with a

locking cap was installed. Soil cuttings were placed in the vicinity of the well heads for management by the facility.

Monitoring wells were developed to provide efficient hydraulic communication between the well and the surrounding aquifer using a surge block and vacuum truck. No water was added to the wells during development. All well development water was routed to the refinery's NPDES permitted waste water treatment facility.

Monitoring well construction specifications are summarized on **Table 3-1**. Monitoring well completion logs are included in **Appendix B**. Following completion, each well was located and surveyed for vertical control relative to the established site-specific datum (refer to **Table 3-1**).

3.3 Groundwater Sample Collection and Analyses

Groundwater samples were collected from MW-1, MW-2, and MW-3 during sampling performed on October 17, 2002 and November 19, 2002. Prior to well purging or collecting any samples, the water level was measured in each monitoring well. The depth-to-groundwater and the depth-to-light nonaqueous phase liquids (LNAPL) (if present) were measured using an electronic oil/water interface probe attached to a graduated tape. This instrument is capable of measuring the depth-to-liquids to an accuracy of 0.01 foot.

After recording the static depth to water, three well volumes were removed from each well using a submersible pump. Purge water was routed through granular activated carbon and discharged to the ground surface. Groundwater samples were then collected using a disposable bailer and placed into the sample containers provided by the laboratory. Measurements of conductance, pH, and temperature were recorded in the field.

After sample collection, the groundwater samples were placed in appropriate laboratory containers, labeled, placed in an ice-chilled cooler and logged on a chain-of-custody form and were delivered to Lancaster Laboratories of Lancaster, Pennsylvania for analysis. For quality assurance/quality control (QA/QC) purposes, a trip blank accompanied each sample shipment and submitted for laboratory analyses. All samples were analyzed for the Act 2 short-list of unleaded gasoline parameters in water which include benzene, toluene, ethyl benzene, xylenes, cumene, MTBE and naphthalene.

3.4 Aquifer Characterization

On October 17, 2002, slug tests were performed in each well to estimate the hydraulic conductivity of the saturated unconsolidated material in the vicinity of the well. A slug test is a single well test that consists of rapidly changing the water level in the well and recording the response of the aquifer. The slug test involves placing a cylindrical object (a "slug") in the well. When water levels have stabilized following the insertion, the object is removed resulting in an increasing water level (rising head) in the well. Care was taken to ensure that adequate water was displaced so that the test is measuring the aquifer properties rather than the properties of the sand pack. Following removal of the slug, the change in water level was monitored using a pressure transducer and data logger. The data logger was set to record at intervals of seconds or fractions of seconds to obtain the necessary data.

Slug test data were reduced and analyzed using the Bouwer and Rice (1976) method for determining the hydraulic conductivity of unconfined water-bearing zones. Results of the aquifer testing program are discussed in Section 4.0.

4.0 SITE CHARACTERIZATION RESULTS

This section of the Site Characterization Report presents the results of the characterization activities described in Section 3.0. These activities were performed in order to characterize soil and groundwater conditions in the vicinity of AST 797.

4.1 Hydrogeology

Site-specific data collected to characterize hydrogeologic conditions included monitoring well installations, depth to liquids measurements, and slug tests performed in recently installed monitoring wells. As described previously, depth to liquids measurements were recorded from each monitoring well during two events and the maximum depth of exploration was 11 feet bgs.

Overburden materials encountered consisted primarily of fine to medium grained sand and silt (refer to **Appendix B** for well logs). Water was encountered at a depth of 2 to 3 feet in each soil boring. Bedrock was not encountered in any soil boring.

Groundwater elevations from liquid level measurements recorded on October 17, 2002 and November 19, 2002 are summarized on **Table 4-1**. Depth to water ranged from approximately 1.5 feet bgs to 3 feet bgs (approximately 3.5 to 5 feet below top of casing). LNAPL was not detected in any monitoring well.

Liquid level and survey data were used to prepare groundwater elevation contour maps. Groundwater elevation maps for the October 17, 2002 and November 19, 2002 events are presented as **Figures 4-1** and **4-2**, respectively. Based on the proximity of the monitoring wells to the Schuylkill River, it was assumed that groundwater flow in the vicinity of AST 797 would be to the west/southwest. However, **Figure 4-1** and **4-2** indicate a northwesterly direction of groundwater flow. This is likely a result of the density of underground utilities in the project site vicinity, specifically subsurface pipe conduits in the vicinity of MW-1 and possibly the operation of a total fluids (LNAPL and water) recovery system in the area of Pump House 27 which is located immediately south of the AST 797 Area.

Figure 4-3 is a groundwater elevation map prepared by Handex for the Girard Point Processing Area from measurements recorded on November 8, 2001 during the annual sampling event (the map was included in the 2001 progress report for the Girard Point Processing Area submitted to

PADEP by Sunoco). As indicated on **Figure 4-3**, the water table surface in the vicinity of AST 797 is generally flat although groundwater flow immediately east of the AST 797 area is to the southwest. Groundwater elevations in the vicinity of Pump House 27 range from approximately elevation 4.2 feet to elevation 6.4 feet and may also be locally influenced by underground utilities, well construction, and remedial system operation. Groundwater flow from this area is in a general southwesterly direction towards the Schuylkill River.

Slug tests were performed to estimate the hydraulic conductivity of saturated materials in the vicinity of each monitoring well tested. Slug test data were analyzed using the Bouwer and Rice (1976) method for unconfined water-bearing zones. Slug test results are summarized on **Table 4-2** and data graphs generated during slug test data analyses are presented in **Appendix C**. Estimated hydraulic conductivity values were 1.66 feet/day (MW-1) to 12.10 feet/day (MW-3). The geometric mean of the hydraulic conductivity value from all tests is 4.64 feet/day.

4.2 Soil Analytical Results

Soil samples were collected from soil borings MW-1, MW-2, and MW-3 at depths of 1.0 to 1.5 feet bgs. Each sample was analyzed for unleaded gasoline parameters. The soil analytical data is summarized on **Table 4-3** (laboratory data sheets are provided in **Appendix D**).

The analytical results for the soil samples were compared to the cleanup criteria established by for PADEP under Act 2. Under the regulations implementing Act 2, Medium Specific Concentrations (MSCs) for soils include two components. PADEP has developed MSCs for soils are based on direct contact exposure scenarios and PADEP has developed procedures for selecting MSCs for soils that are designed to protect groundwater from the potential impacts that could be caused by the migration of regulated substances from soils into the groundwater. Soil sample results were compared to Nonresidential Surface Soil and Subsurface Soil Direct Contact MSCs and Used Aquifer Nonresidential Soil-to-Groundwater MSCs.

Figure 4-4 depicts sample results that were reported above an MSC. As indicated, benzene was reported above the Soil-to-Groundwater MSC of 500 ug/kg in each sample. Benzene concentrations were 2,600 ug/kg in MW-1 (1-1.5 feet), 6,500 ug/kg in MW-2 (1-1.5 feet), and 610,000 ug/kg in MW-3 (1-1.5 feet). Benzene was also measured above the Nonresidential Surface Soil Direct Contact MSC (210,000 ug/kg) in MW-3 (1-1.5 feet) that reported a

concentration of 610,000 ug/kg. Toluene was reported above the Soil-to-Groundwater MSC (100,000 ug/kg) in MW-3 that reported a concentration of 300,000 ug/kg.

Soil samples were also submitted for the SPLP analyses of parameters exceeding Soil-to-Groundwater MSCs. SPLP results are summarized on **Table 4-4** which compares SPLP results to Nonresidential Used Aquifer Groundwater MSCs. As indicated, each sample reported concentrations above the respective groundwater MSC.

4.3 Groundwater

As described in Section 4.3, groundwater samples were collected from MW-1, MW-2, and MW-3 during sampling events performed on October 17, 2002 and November 19, 2002. Each groundwater sample was analyzed for unleaded gasoline parameters in groundwater. Groundwater analytical results for the October 17, 2002 and November 19, 2002 sampling events are summarized on **Tables 4-5** and **4-6**, respectively (laboratory data sheets are included in **Appendix E**).

The groundwater analytical data exceeding Used Aquifer Nonresidential Groundwater (TDS <2,500 ug/L) MSCs for the October 17, 2002 and November 19, 2002 gauging events are summarized on **Figures 4-5** and **4-6**, respectively. During each sampling event, benzene was reported above the Used Aquifer Nonresidential Groundwater MSC of 5 ug/L. Benzene concentrations reported from the October 17, 2002 sampling event were 32 ug/L (MW-1), 28,000 ug/L (MW-2), and 610,000 ug/L (MW-3). Benzene concentrations from the November 19, 2002 sampling event were 61 ug/L (MW-1), 52,000 ug/L (MW-2), and 500,000 ug/L (MW-3). Toluene was also reported above the Used Aquifer Nonresidential MSC (1,000 ug/L) in MW-3 during both sampling events at 59,000 ug/L and 62,000 ug/L respectively. During each sampling event, the highest benzene concentrations were reported to the west of AST 797 in MW-3.

5.0 FATE AND TRANSPORT ANALYSES

This section of the Site Characterization Report provides an evaluation of the fate and transport of chemical constituents at the site. Also provided below is a conceptual model of the site which describes the occurrence, migration pathways, and exposure routes for substances of interest. The evaluation was performed in accordance with the general guidelines presented in the Act 2 Technical Guidance Manual (TGM).

5.1 Site Conceptual Model

This site conceptual model is presented to briefly characterize subsurface conditions, identify potential exposure and migration pathways, and describe the migration of constituents dissolved in groundwater. Data compiled during the site characterization was used to develop this conceptual model.

AST 797 is located within the Girard Point Processing Area of the Philadelphia Refinery. It is situated within a AST containment berm with seven other ASTs and was formerly used to store process water which contained light-end hydrocarbons such as benzene and cumene. The vicinity of the Philadelphia Refinery is serviced with public water by the City of Philadelphia Water Department.

The water table occurs within overburden material at a depth of 1.5 feet to 3 feet bgs. Overall groundwater flow in the area is to the west and southwest towards the Schuylkill River, although the local water table configuration appears to be influenced by subsurface utilities and possibly operation of remedial systems.

Subsurface conditions were characterized through the installation and sampling of soil borings and monitoring wells. The results of these and previous investigations have been described in Section 5.0 and 2.3, respectively. As has been described, benzene and toluene have been detected in soil and groundwater outside of the AST berms above PADEP MSCs (refer to Section 4.0). Benzene, ethylbenzene, and toluene were also reported above MSCs in soil samples collected from hand auger soil borings installed around the perimeter of AST 797 and within the AST berm (refer to Section 2.3 and 5.0). The release mechanism or precise release location which resulted in the observed concentrations is not known based on the investigations performed. However,

current and future site conditions eliminate exposure pathways or provide personal protection for site workers as is described below.

Access to the Philadelphia Refinery is through guarded gates only and is restricted to Sunoco employees and Sunoco-approved visitors and contractors. Therefore, there is no potential exposure pathway for trespassers. Site workers are required to wear appropriate personal protection equipment (PPE) in accordance with refinery operational protocols. In addition, each individual operational unit has its own work permits and PPE requirements. There are no enclosed occupied structures within the immediate downgradient vicinity of AST 797 and Sunoco has performed indoor air monitoring in areas of the refinery to verify that exposure to indoor area is within Occupational Safety and Health Administration (OSHA) standards. As mentioned, the area is serviced with public water. Therefore groundwater ingestion is not a completed pathway.

As has been described, benzene and toluene have been detected in groundwater above PADEP MSCs during site characterization activities. The concentration and composition of organic constituents in groundwater may be altered by natural fate and transport processes. The degree to which these processes occur is influenced by both the site subsurface conditions and the properties of the individual hydrocarbons. Fate and transport processes that may alter dissolved hydrocarbon concentrations in groundwater include biodegradation, sorption, and dispersion. A brief description of these processes and a discussion of these processes are provided below.

Biodegradation of organic constituents in groundwater may occur under both aerobic and anaerobic conditions. The biologic degradation of these compounds involves the oxidation of the hydrocarbon and the reduction by an electron acceptor. Under aerobic conditions oxygen is commonly the major electron acceptor.

As groundwater passes through the aquifer matrix, a portion of the dissolved hydrocarbons adhere to the soil particles. This process is known as sorption and is controlled by both site conditions (i.e. organic carbon content of the aquifer matrix) and chemical-specific characteristics (partitioning coefficients (KOC)). The partitioning between the liquid and solid phases occurs until an equilibrium is reached. As a result, the rate of movement of dissolved hydrocarbons is less than that of non-impacted groundwater (this process is also known as retardation).

Dispersion is the spreading and attenuation of the dissolved hydrocarbon due to molecular diffusion and groundwater velocity stratification. This process occurs in three directions (longitudinal, transverse and vertically) as the dissolved hydrocarbons move in a downgradient direction through the aquifer matrix.

As described below, predictive groundwater fate and transport modeling has been performed to evaluate the potential maximum hydrocarbon concentrations at the property boundary relative to Nonresidential Used Aquifer Groundwater MSCs under Act 2. The fate and transport processes described above are considered in the simulations that were completed. Overall, fate and transport modeling demonstrated that no MSC is predicted to be exceeded at the property boundary for 1, 10, and 30 year timeframes.

5.2 Fate and Transport Modeling Approach

Groundwater fate and transport modeling has been performed to predict the maximum concentrations likely to occur at downgradient compliance points. For the purposes of this modeling exercise, the downgradient compliance point is considered to be the property boundary (adjacent to the Schuylkill River). Data compiled during the site characterization as well as available literature regarding the physical and chemical characteristics, and fate and transport processes of site-related constituents were used in the modeling.

The substances which were evaluated as part of the fate and transport modeling were selected by comparing data collected during all sampling events to groundwater MSCs implementing the Statewide Health Standard under Act 2. **Table 5-1** summarizes the substances detected in groundwater at concentrations above MSCs along with the maximum concentrations detected (and the location of the maximum concentration).

5.2.1 Computer Code Selection

The fate and transport modeling was performed using the Domenico (1987) solution which is described in the TGM. As described in the TGM, the model allows for three dimensional dispersion, first order decay (biodegradation) and retardation. The program can be used to calculate constituent concentrations under various time scenarios. As with other similar models, several overall simplifying assumptions were made to characterize actual field conditions which include:

- a constant concentration at the source
- the average groundwater velocity is constant along the flow path
- the aquifer is uniformly porous, homogeneous, isotropic and of constant thickness

5.2.2 Input Parameters

Model parameters used to estimate maximum concentrations were derived from actual data collected during the site characterization process as well as literature values. Some input parameters were constant for all scenarios while others were constituent-specific.

Table 5-2 summarizes the scenarios performed and the constituent-specific input parameters. These parameters include:

- Source Concentration: the highest concentration detected in either sampling event.

- Biodegradation coefficient (Attenuation Lambda): this parameter is a chemical-specific parameter applied to account for the natural degradation of the constituent. Values were obtained from the Act 2 regulations (25 PA Code Ch, 250, Appendix A, Table 5).

- Organic Carbon Partitioning Coefficient (KOC): this parameter is also a chemical-specific parameter applied to account for sorption (retardation). Values were obtained from the Act 2 regulations (25 PA Code Ch, 250, Appendix A, Table 5).

Parameters used for all simulations are summarized in **Table 5-3** along with the source of the values used. These parameters include:

- Source location: the location where the highest concentration of the dissolved constituent was detected (MW-3).

- Distance to property downgradient boundary: as a conservative estimate, the closest distance from MW-3 to the property boundary.

- Hydraulic gradient: this normally is the hydraulic gradient between the source location and the downgradient property boundary based on site groundwater elevation data.

However, as has been described, and indicated on **Figure 4-3**, on an area-wide basis the water table surface in the vicinity of AST 797 is relatively flat and influenced by underground utilities and remedial system operation. However, the overall direction of groundwater flow is assumed to be to the west/southwest toward the Schuylkill River. The hydraulic gradient near the river may also be tidally influenced. Therefore, as a conservative estimate of the overall hydraulic gradient, the hydraulic gradient immediately east of AST 797 was used (0.003) based on the November 2001 area-wide data (refer to **Figure 4-3**).

- Longitudinal dispersion (Ax): the dispersion in the direction of groundwater flow was assumed to be one-tenth of the distance to the property boundary (TGM).

- Transverse dispersion (Ay): the dispersion perpendicular to the direction of groundwater flow was assumed to be Ax/3 (TGM).

- Vertical dispersion (Az): assumed to be Ax/20 (TGM)

- Effective Porosity: a value (0.15) was estimated for materials between the grain-size of silt and fine sand, the value was derived from Pettijohn (1982).

- Source Area Width: estimated, for simulation proposes it was assumed to be 200 feet. The assumed width is perpendicular to groundwater flow.

- Source Thickness: estimated to be 20 feet based on the nature of the chemicals of interest (specific gravity less than water).

- Hydraulic Conductivity: 4.64 ft/day, the geometric mean of the hydraulic conductivity values determined from all site slug tests was used (refer to Section 4.1).

- Soil Bulk Density: default value of 1.8 g/cm3 (TGM).

- Fraction Organic Carbon: 0.005, default value of 0.005 (TGM).

5.2.3 Predictive Simulations

The fate and transport of each substance was simulated from the assumed source area to the downgradient property boundary well containing the highest concentration of each constituent. Each scenario was performed for one-year, 10-year and 30-year periods in order to evaluate potential maximum concentrations over time at the downgradient property boundary. Simulations were performed as summarized on **Table 5-4**. As previously discussed, the model assumed a constant source concentration although source concentrations will decrease over time due to natural degradation processes.

5.2.4 Model Predictions

The results of model simulations are presented in **Table 5-4**. Spreadsheets for each simulation are included in **Appendix F**. For each scenario, the concentrations of the substance being evaluated at the property boundary after 1-year, 10 year and 30 year periods were compared to the MSCs for groundwater implementing the Statewide Health Standard under Act 2. As indicated even with the conservative assumptions built into the modeling, no MSC is predicted to be exceeded at the property boundary.

6.0 ECOLOGICAL SCREENING

A preliminary ecological screening was performed in order to assess whether surface soils and groundwater at the site have the potential to pose significant ecological concerns and if further ecological evaluation is required. The ecological screening is based on site observations and the investigative results presented in this Site Characterization Report and other site investigations.

As has been described, AST 797 was reported to have contained process water that contained light-end hydrocarbons such as benzene and cumene. Under the Statewide Health Standard ecological screening process, no further ecological action is required if the constituents detected on-site are associated with light petroleum products. However, as described benzene and toluene have not been delineated to below Statewide Health MSCs in soil and groundwater.

Specific site features associated with the current and future land use and the storm water management system at the site preclude the occurrence of habitats of concern and eliminate significant ecological exposure pathways to off-site receptors. The Girard Point Processing Area is an active refinery and will continue to be used for that purpose. The immediate vicinity of AST 797 includes other ASTs, processing areas, above-ground utilities racks, and equipment/material storage areas.

The occurrence and distribution of site-related constituents have been described in Sections 4.0. The potential transport of site-related constituents in surface soils through storm water runoff from each area is controlled by the site storm water management system.

As described in Section 5.0, fate and transport analyses were performed to evaluate potential maximum concentrations of organic compounds of interest at the property boundary. The fate and transport simulations indicate that compounds of interest would not be detected at the property boundary.

As indicated by the discussion presented above, current and future land use precludes the occurrence of habitats of concern within the area of interest, and surface soils and groundwater do not pose significant ecological concerns to off-site receptors. Therefore, no further ecological evaluation is required.

7.0 SUMMARY AND RECOMMENDATIONS

This Site Characterization Report was prepared on behalf of Sunoco, Inc. (R&M) (Sunoco) for investigative activities associated with aboveground storage tank (AST) closure within the Girard Point Processing Area of the Philadelphia Refinery located in Philadelphia, Pennsylvania. The investigation was conducted in support of the site characterization requirements for Pennsylvania Code Title 25 § 245.310 under the Administration of Storage Tank and Spill Prevention Program.

AST 797 is located approximately 1,000 feet east of the Schuylkill River. AST 797 is situated in the southwest corner of a containment bermed area with seven other ASTs including some active ASTs. The vicinity of AST 797 contains an extensive network of above ground and underground utilities. Sunoco has indicated that the AST formerly contained process water. Components of the process water included light-end hydrocarbons such as benzene and cumene.

Previous soil sampling activities performed following the in-place closure of AST 797 reported constituent concentrations above Medium Specific Concentrations (MSCs) established by PADEP under Act 2 to guide site remediation. Upon receipt of laboratory data, Sunoco notified the PADEP on June 2002 of the confirmation of a reportable release from AST 797. In response to this notification, PADEP issued a Notice of Violation to Sunoco in a letter dated July 29, 2002. Included in PADEP's letter was a request to characterize the extent of soil impact and submit a Site Characterization Report for the AST 797 area.

This investigation was performed to characterize the extent of soil and groundwater impact in the vicinity of AST 797 as requested by PADEP. In order to address PADEP's request, site characterization activities were initiated during September 2002. Activities performed and documented in this report include:

- Soil sampling and analysis from three soil borings outside the containment berm,
- Soil sampling and analysis from four soil borings within the containment berm (during the previous investigation, refer to **Appendix A**),
- Installation of three monitoring wells,
- Liquid level gauging (two events),
- Groundwater sampling and laboratory analyses (two events), and

- Fate and transport modeling.

7.1 Conclusions

The findings of this investigation are summarized below:

- Groundwater was encountered at a depth of 1.5 to 3.0 feet below ground surface (bgs) within unconsolidated materials (silt and sand). The overall direction of groundwater flow is to the west/southwest in the direction of the Schuylkill River although localized water table surface is relatively flat and appears to be influenced by subsurface utilities and the operation of remedial systems.

- Soil samples were collected (at a depth of 1.0 to 1.5 feet bgs) from three borings installed downgradient/lateral to AST 797. Benzene was reported above the Nonresidential Used Aquifer Soil-to-Groundwater MSC of 500 ug/kg in each sample. Benzene was also measured above the Nonresidential Surface Soil Direct Contact MSC in MW-3 (1-1.5 feet). Toluene was reported above the Soil-to-Groundwater MSC in MW-3.

- Soil samples were also collected for the SPLP analyses of parameters exceeding Soil-to-Groundwater MSCs. Each sample reported concentrations above Nonresidential Used Aquifer Groundwater MSCs.

- Groundwater samples were collected from three monitoring wells (MW-1, MW-2, and MW-3) during sampling events performed on October 17, 2002 and November 19, 2002. Each groundwater sample was analyzed for unleaded gasoline parameters in groundwater. During each sampling event benzene was reported above the Used Aquifer Nonresidential Groundwater MSC of 5 ug/L in each well. Toluene was also reported above the Used Aquifer Nonresidential MSC of 1,000 ug/l in MW-3 during both sampling events. During each sampling event, the highest benzene concentrations were reported to the west of the AST 797.

- Groundwater fate and transport modeling was performed to evaluate concentrations of benzene and toluene at the property boundary using the well with the highest concentrations

as the source location. The results of the fate and transport modeling indicate groundwater MSCs would not be exceeded at the property boundary for 1, 10, and 30-year time frames.

- A preliminary ecological screening was performed in order to assess whether surface soils and groundwater at the site have the potential to pose significant ecological concerns. The constituents of interest reported above MSCs were light-end hydrocarbons. Current and future land use precludes the occurrence of habitats of concern. Surface soils and groundwater do not pose significant ecological concerns to off-site receptors. Therefore, no further ecological evaluation is required.

7.2 Recommendations

In September 2001, Sunoco submitted appropriate documentation for the Girard Point Processing Area in accordance with the USEPA Environmental Indicators (EI) Program being used by the RCRA Corrective Action program. The documentation submitted to USEPA by Sunoco under this program indicated that the migration of "contaminated groundwater" from the facility is under control and "current human exposures" are under control. This documentation will be forwarded to PADEP's Water Quality Management Section before the end of 2002. Sunoco also performs semi-annual liquid level monitoring of the network of groundwater monitoring wells, routine operation of remedial systems, and annual groundwater sampling of six perimeter wells in the Girard Point Processing Area. This data is provided to PADEP in quarterly and annual status reports.

Although soil Direct Contact MSC's were exceeded, the contaminants involved with potential exposures (i.e. direct contact) are all constituents associated with the primary facility activity of petroleum refining. OSHA workplace standards and exposure controls are in place/applicable in all areas of the facility. Since OSHA workplace standards and controls apply to ensure acceptable exposure levels are not exceeded for hydrocarbons and their associated hazards, these standards effectively control exposure to media contaminated by these materials. Examples of types of exposure controls include training, personal protective equipment, and work area monitoring.

Although groundwater protection MSCs were exceeded for soil and groundwater and delineation to MSCs has not been achieved as part of this investigation, conservative groundwater fate and transport modeling using the well with the highest benzene and toluene concentrations as the

source area, indicate MSCs will not be exceeded at the downgradient property boundary. Therefore, since Sunoco is not seeking a release of liability, Sunoco has indicated that subsurface impacts in the vicinity of AST 797 will be managed through other facility-wide programs.

8.0 REFERENCES

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Paulachok, G.N., 1991. "Geohydrology and Ground-Water Resources of Philadelphia, Pennsylvania. " United States Geological Survey Water-Supply Paper 2346. Prepared in cooperation with the City of Philadelphia Water Department.

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TABLE 3-1

Monitoring Well Construction Summary

AST 797 Area
Sunoco Philadelphia Refinery

Well No.	Well Completion Date	Ground Elevation (see Note 1)	Top of Casing Elevation (see Note 1)	Well Screen Diamater (in)	Depth of Screen Interval (feet bgs)
MW-1	9/17/02	7.78	9.90	4	1 - 11
MW-2	9/17/02	8.53	10.44	4	1 - 11
MW-3	9/16/02	8.26	10.43	4	1 - 11

Notes:

Note 1: Survey is releative to existing monitoring well network

bgs = below ground surface

TABLE 4-1

LIQUID LEVEL MEASUREMENTS

AST 797AREA
PHILADELPHIA REFINERY

Well	TOC Elevation (Feet)	Depth To		Groundwater Elevation (FAMSL)
		NAPL (Feet)	Water (Feet)	
October 17, 2002				
MW-1	9.90	ND	5.29	4.61
MW-2	10.44	ND	4.01	6.43
MW-3	10.43	ND	4.20	6.23
November 19, 2002				
MW-1	9.90	ND	5.13	4.77
MW-2	10.44	ND	3.67	6.77
MW-3	10.43	ND	3.56	6.87

NOTES:

TOC = Top of casing

LNAPL = Light Nonaqueous phase liquid

ND = No NAPL detected

S:\Clients\Sunoco\AST Investigations\AST 797\report\[Well gauging data 2002.xls]data

TABLE 4-2

Summary of Hydraulic Conductivity Values from Rising Head Slug Tests October 2002

AST 797 Area Philadelphia Refinery

Well No.	Hydraulic Conductivity (K)	
	ft/day	cm/sec
MW-1	1.66	5.86E-04
MW-2	4.98	1.76E-03
MW-3	12.10	4.27E-03
Geometric Mean	**4.64**	**1.64E-03**

Note: Bouwer and Rice (1976) method used for slug test analysis .

TABLE 4-3

Summary of Soil Analytical Results (ug/Kg)
September 16 and 17, 2002

AST 797 AREA
Philadelphia Refinery

Sample	0-2 feet	2-15 feet	Soil to Groundwater	MW-1 (1-1.5)		MW-2 (1-1.5)		MW-3 (1-1.5)	
Date	Non-Residential	Non-Residential	Non-Residential	9/17/2002		9/17/2002		9/16/2002	
Constituent	Direct Contact (1)	Direct Contact (1)	Used Aquifer (2)	Result	DL	Result	DL	Result	DL
Benzene	210,000	240,000	500	**2,600***	310	**6,500***	330	**610,000****	11,000
Ethylbenzene	10,000,000	10,000,000	70,000	3,700	310	520	330	14,000	1,100
Isopropyl Benzene (Cumene)	10,000,000	10,000,000	1,600,000	60,000	1,600	190,000	3,300	270,000	11,000
Methyl-t-butyl Ether (MTBE)	3,200,000	3,700,000	2,000	ND	310	ND	330	ND	1,100
Naphthalene	56,000,000	190,000,000	25,000	1,800	310	1,900	330	4,800	1,100
Toluene	10,000,000	10,000,000	100,000	1,600	310	ND	330	**300,000***	11,000
Xylenes (Total)	190,000,000	190,000,000	4,700,000	3,500	310	860	330	67,000	1,100

* = Exceeds Soil-to-Groundwater standard

** = Exceeds Soil-to-Groundwater standard and Surface Soil Direct Contact Standard

(1)= Pennsylvania Land Recycling Program (25 PA code Chapter 250), Appendix A, Table 3 A (Revised November 24, 2001)

(2)= Pennsylvania Land Recycling Program (25 PA code Chapter 250), Appendix A, Table 3 B (Revised November 24, 2001)

TABLE 4-4

Summary of Soil SPLP Analytical Results (ug/L)
October 17, 2002

AST 797 Area
Philadelphia Refinery

Sample	Groundwater SHS Non-Residential Used Aquifer TDS<2500 (1)	MW-1 (1-1.5)		MW-2 (1-1.5)		MW-3 (1-1.5)	
Date		10/17/02		10/17/02		10/17/02	
		Result	LOQ	Result	DL	Result	DL
Benzene	5	**23**	5	**860**	25	**20,000**	500
Toluene	1000	NA		NA		**7,200**	500

BOLD denotes exceedance of the Statewide Health Standard (SHS)
(1)= Pennsylvania Land Recycling Program (25 PA Code Chapter 250), Appendix A, Table 1 (Revised November 24, 2001)
NA= Not Analyzed

TABLE 4-5

Groundwater Analytical Results (ug/L)
October 17, 2002

AST 797 Area
Philadelphia Refinery

Sample		MW-1		MW-2		MW-3		Trip Blank	
Date	Non-residential, Used Aquifer, MSC (1)	10/17/02		10/17/02		10/17/02		10/17/02	
	ug/L	Result	LOQ	Result	LOQ	Result	LOQ	Result	LOQ
Benzene	5	**32**	5	**28,000**	1,000	**610,000**	25,000	ND	5
Toluene	1,000	5	5	<250	250	**59,000**	5,000	ND	5
Ethylbenzene	700	<5	5	<250	250	ND	5,000	ND	5
Xylenes (total)	10,000	<5	5	ND	250	<5,000	5,000	ND	5
Methyl-t-butyl Ether	20	ND	5	ND	250	ND	5,000	ND	5
Isopropylbenzene (cumene)	2,300	16	5	2,000	250	<5,000	5,000	ND	5
Naphthalene	100	<5	5	<250	250	ND	5,000	ND	5

BOLD = denotes exceedance of a Statewide Health Standard

(1)= Pennsylvania Land Recycling Program (25 PA code Chapter 250), Appendix A, Table 1 (Revised November 24, 2001)

ND = Not Detected

<5 = Concentration below Limit of Quantitation

LOQ = Limit of Quantitation

Note: The reporting limits for samples MW-2 and MW-3 were raised because sample dilution was necessary to bring target compounds into calibration range.

S:\Clients\Sunoco\AST Investigations\AST 797\report\[groundwater anal data.xls]Oct

TABLE 4-6

Groundwater Analytical Results
November 19, 2002

AST 797 Area
Philadelphia Refinery

Sample		MW-1		MW-2		MW-3		Trip Blank	
Date	Non-residential, Used Aquifer, MSC (1)	11/19/02		11/19/02		11/19/02		11/19/02	
	ug/L	Result	LOQ	Result	LOQ	Result	LOQ	Result	LOQ
Benzene	5	**61**	5	**52,000**	5,000	**500,000**	25,000	ND	5
Toluene	1,000	<5	5	<1000	1,000	**62,000**	5,000	ND	5
Ethylbenzene	700	7	5	ND	1,000	ND	5,000	ND	5
Xylenes (total)	10,000	7	5	<1000	1,000	<5,000	5,000	ND	5
Methyl-t-butyl Ether	20	ND	5	ND	1,000	ND	5,000	ND	5
Isopropylbenzene (cumene)	2,300	12	5	1,800	1,000	<5,000	5,000	ND	5
Naphthalene	100	<5	5	ND	1,000	ND	5,000	ND	5

BOLD = denotes exceedance of a Statewide Health Standard

(1)= Pennsylvania Land Recycling Program (25 PA code Chapter 250), Appendix A, Table 1 (Revised November 24, 2001)

ND = Not Detected

<5 = Concentration below Limit of Quantitation

LOQ = Limit of Quantitation

Note: The reporting limits for samples MW-2 and MW-3 were raised because sample dilution was necessary to bring target compounds into calibration range.

S:\Clients\Sunoco\AST Investigations\AST 797\report\[groundwater anal data.xls]Oct

TABLE 5-1

Comparison of Groundwater Analytical Results to Groundwater MSCs
AST 797 Area
Philadelphia Refinery

Parameter Exceeding a Groundwater MSC	Maximum Concentration Detected (ug/l)	Sample Location	Sample Collection Date	Medium Specific Concentrations (1) Non-Residential Used Aquifers (ug/l)
Benzene	610,000	MW-3	10/17/02	5
Toluene	62,000	MW-3	10/17/02	1,000

NOTES:

(1) Pennsylvania Land Recycling Program (25 Pa Code Ch. 250), Appendix A, Table 1

S:\Clients\Sunoco\AST Investigations\AST 797\Fate and Transport\[F&T summary tables.xls]5-1

TABLE 5-2

Summary of Simulations and Constituent-Specific Input Parameters
AST 797 Area
Philadelphia Refinery

Parameter	Assumed Source Location (1)	Source (Maximum) Conc. (Co) ug/l	Degradation Coefficient (days-1) (1)	KOC (2)	Simulation Duration (years)
Benzene	MW-3	610,000	0.00096	58	1, 10, 30
Toluene	MW-3	62,000	0.025	130	1, 10, 30

NOTES:

(1) Pennsylvania Land Recycling Program (25 Pa Code Ch. 250), Appendix A, Table 5; values converted to days-1 by dividing by 365

(2) Organic carbon partitiioning coefficient; Pennsylvania Land Recycling Program (25 Pa Code Ch. 250), Appendix A, Table 5

TABLE 5-3

Input Parameters Used in All Simulations
AST 797 Area
Philadelphia Refinery

Parameter	Value	Source
Distance to Downgradient Property Boundary (x)	1,000 feet	Closest distance from property boundary to MW-3 (conservative estimate)
Hydraulic Gradient (I)	0.003	For area immediately upgradient of the AST 797 area based on November 2001 facility-wide data (conservative estimate - refer to text)
Hydraulic Conductivity (K)	4.64 ft/day	Geometric mean of site-specfic slug test data
Longitudinal Dispersivity (Ax)	x/10	Act 2 TGM
Transverse Dispersivity (Ay)	Ax/3	Act 2 TGM
Vertical Dispersivity (Az)	Ax/20	Act 2 TGM
Effective Porosity	0.15	Value for materials between silt and fine sand (Pettijohn, 1982)
Source Area Width	200 ft	Estimate
Source Area Thickness	20ft	Estimate
Soil Bulk Density	1.8 g/cm3	Default value (Act 2 TGM)
Fraction Organ Carbon (Foc)	0.005	Act 2 TGM

TABLE 5-4

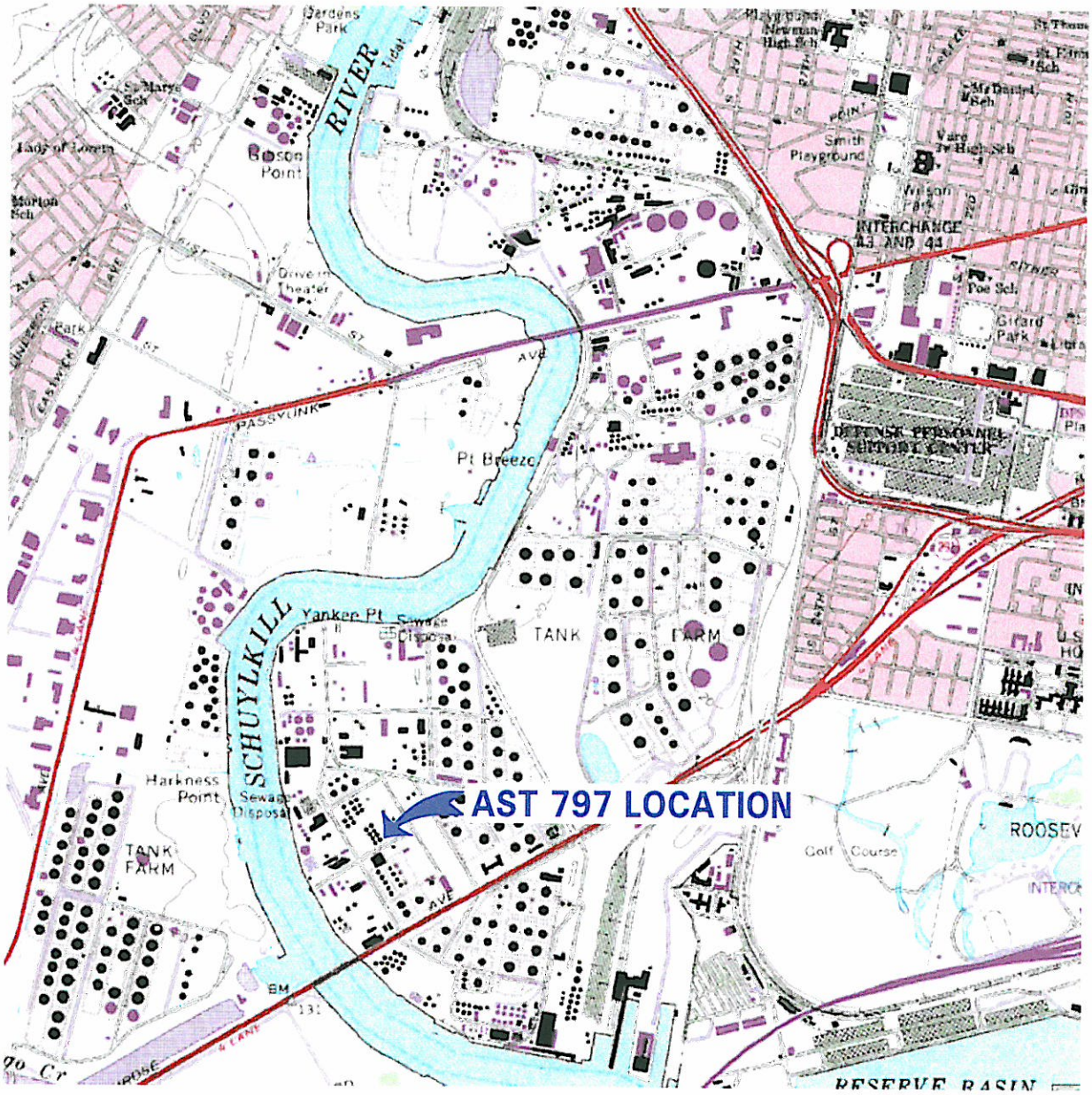
Summary of Predictive Modeling Results
AST 797 Area
Philadelphia Refinery

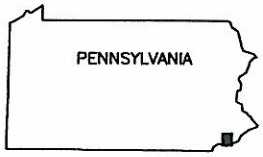
Parameter	Assumed Source Location	Source (Maximum) Conc. (Co) ug/l	Distance to Downgradient Prop. Boundary (feet)	Hydraulic Gradient	Predicted Concentrations at Downgradient Boundary (ug/l)			Medium Specific Concentrations (1) Non-Residential Used Aquifers
					After 1 Year	After 10 Years	After 30 Years	
Benzene	MW-3	610,000	1000	0.003	<1	<1	<1	5
Toluene	MW-3	62,000	1000	0.003	<1	<1	<1	1000

NOTES:

(1) Pennsylvania Land Recycling Program (25 Pa Code Ch. 250), Appendix A, Table 1

S:\Clients\Sunoco\AST Investigations\AST 797\Fate and Transport\[F&T summary tables.xls]5-4





QUADRANGLE LOCATION

N

0 1/2 1

SCALE (MILES)

REFERENCE: USGS 7.5 MINUTE QUADRANGLE; PHILADELPHIA, PENNSYLVANIA–NEW JERSEY; 1995

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International Incorporated
102 PICKERING WAY, SUITE 200
EXTON, PENNSYLVANIA 19341
(484) 875-3075/875-9286 (FAX)

SITE LOCATION MAP
AST 797 AREA

SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

FIGURE: **1-1**

JOB#: 62SU.01006.02 APPR: DWN: KPM DATE: 11/25/02/02

N:/OFFICE-062

DWG: 62SU-1006-231(1-1)

LEGEND

- PROPERTY BOUNDARY
- A137 — VI MONITORING WELL LOCATION
- A120 — RFI MONITORING WELL LOCATION
- BF90D — EXISTING MONITORING WELL LOCATION
- WP-1 — RFI WELL POINT LOCATION
- RW-9 — RECOVERY WELL LOCATION
- GEOPROBE BORING LOCATION
- ABANDONED VI MONITORING WELL
- ABANDONED MONITORING WELL
- SUMP

NOTES

1. 200 FOOT GRID BASED ON PENNSYLVANIA STATE RECTANGULAR COORDINATE SYSTEM, SOUTH ZONE 1927 N.A. DATUM
2. THIS MAP REPRESENTS DATA FOR THE "A", "B", "BF", AND "C" WELLS ONLY. DATA FOR DEEP WELLS A13D, A19D, A21D, B48D, BF90D, C50D, AND C65D IS NOT INCLUDED

N

0 500 1000

APPROXIMATE SCALE (FEET)

REFERENCE: HANDEX; TITLE: CONTOURED GROUNDWATER ELEVATION MAP, NOVEMBER 8, 2001; JOB NO.: 110535-01; DATE: 12/07/01

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International Incorporated
102 PICKERING WAY, STE 200
EXTON, PA 19341
(484) 876-3076/876-9286 (FAX)

SITE PLAN

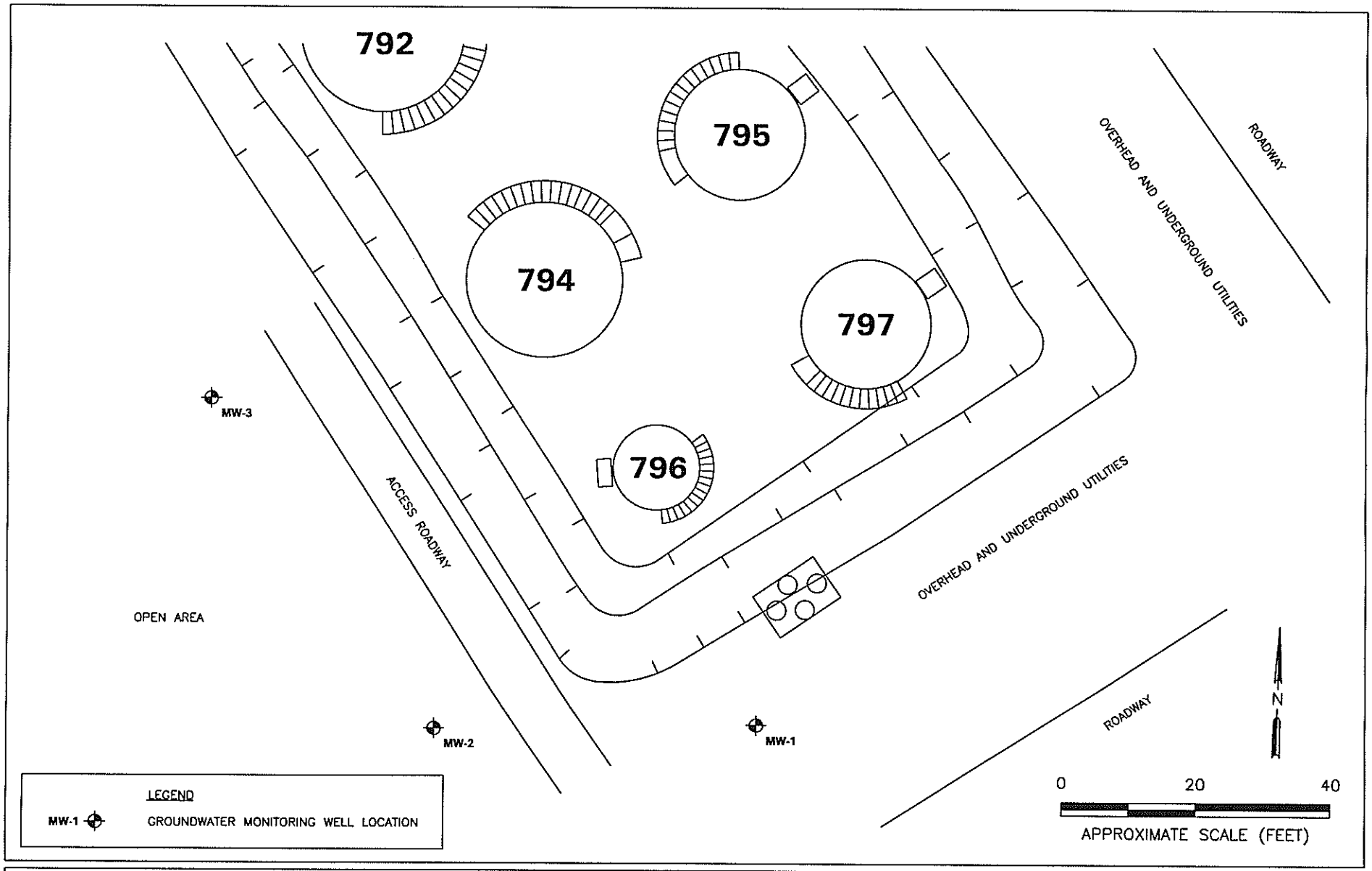
GIRARD POINT PROCESSING AREA
PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

FIGURE: **1-2**

JOB#: 62SU.01017.02.0006 APPR: DWN: KPM DATE: 12/02/02

N:/SECOR-062

DWG: 62SU-1017-2-6(1-2)



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SITE PLAN
AST 797 AREA

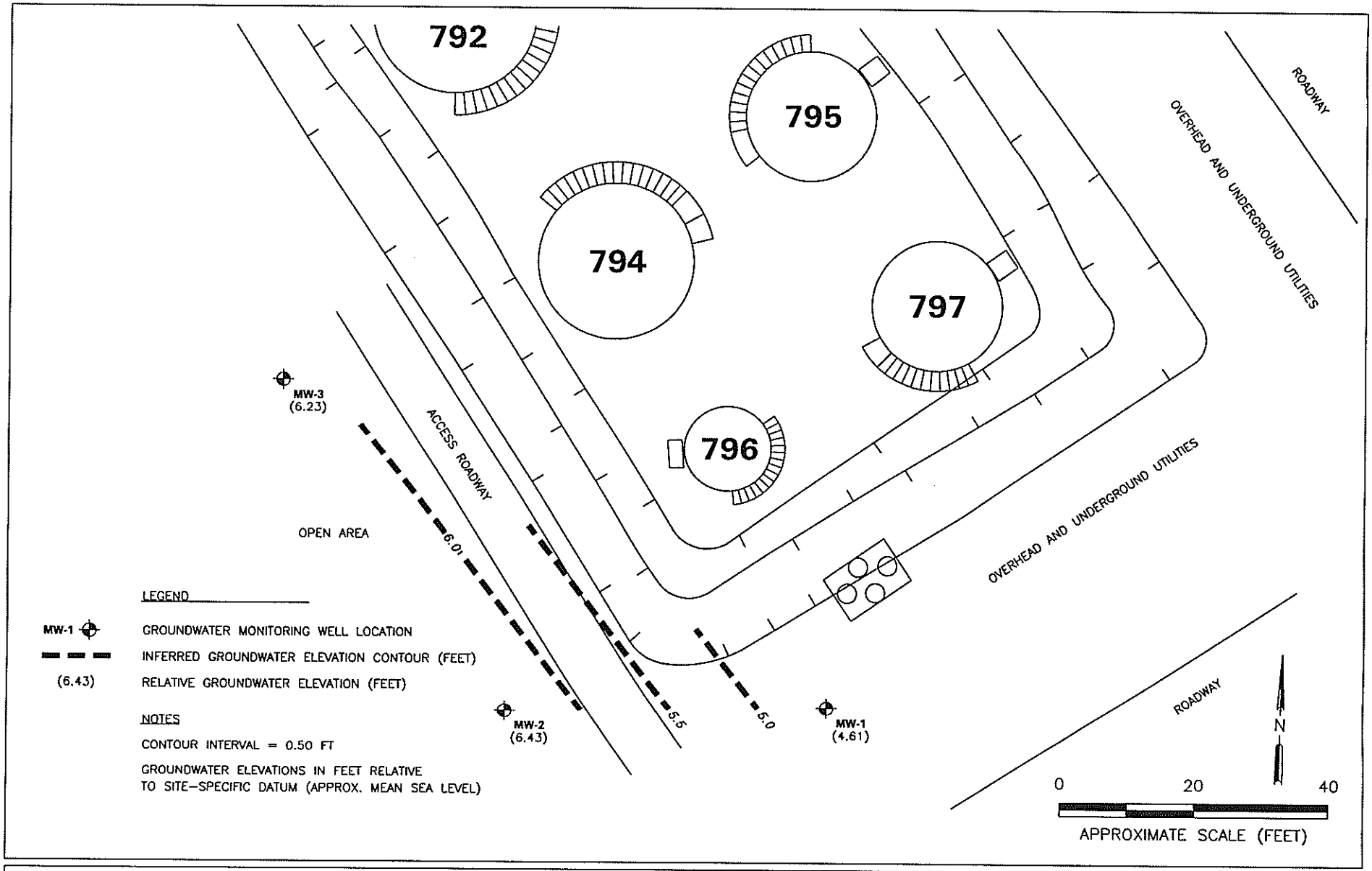
SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

FIGURE: **1-3**

JOB#: 62SU.01017.02.0006 APPR: DWN: KPM DATE: 12/02/02

N:/SECOR-062

DWG: 62SU-1017-2-6(1-3)



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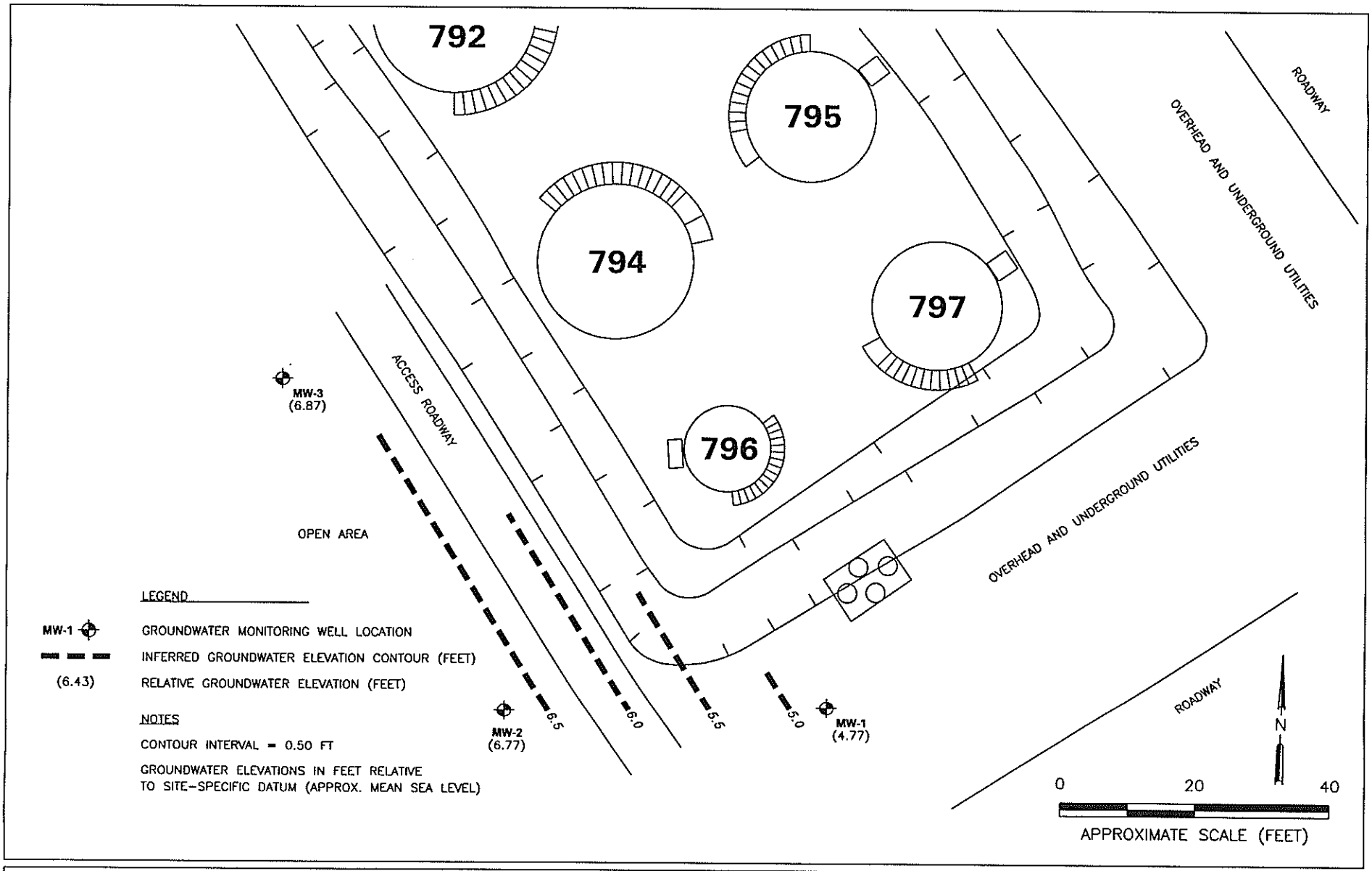
GROUNDWATER ELEVATION CONTOUR
(OCTOBER 17, 2002)
AST 797 AREA
SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

FIGURE: **4-1**

JOB#: 62SU.01017.02.0006 APPR: DWN: KPM DATE: 11/25/02

N:/SECOR-062

DWG: 62SU-1017-2-6(4-1)



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GROUNDWATER ELEVATION CONTOUR
(NOVEMBER 19, 2002)
AST 797 AREA
SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

FIGURE:
4-2

JOB#: **62SU.01017.02.0006** APPR: DWN: **KPM** DATE: **11/25/02**

N:/SECOR-062

DWG: 62SU-1017-2-6(4-2)

LEGEND

- PROPERTY BOUNDARY
- A137 — VI MONITORING WELL LOCATION
- A120 — RFI MONITORING WELL LOCATION
- BF90D — EXISTING MONITORING WELL LOCATION
- WP-1 — RFI WELL POINT LOCATION
- RW-9 — RECOVERY WELL LOCATION
- GEOPROBE BORING LOCATION
- ABANDONED VI MONITORING WELL
- ABANDONED MONITORING WELL
- SUMP
- GROUND WATER CONTOUR LINE (dashed when inferred)
- 1.54 — GROUND WATER ELEVATION (feet)
- NA — CASING ELEVATION NOT AVAILABLE

NOTES:

1. CONTOUR INTERVAL = 1.0 ft.
2. 200 FOOT GRID BASED ON PENNSYLVANIA STATE RECTANGULAR COORDINATE SYSTEM, SOUTH ZONE 1927 N.A. DATUM
3. THIS MAP REPRESENTS DATA FOR THE "A", "B", "BF", AND "C" WELLS ONLY. DATA FOR DEEP WELLS A13D, A19D, A21D, B48D, BF90D, C50D, AND C65D IS NOT INCLUDED

N

0 500 1000

APPROXIMATE SCALE (FEET)

REFERENCE: HANDEX; TITLE: CONTOURED GROUNDWATER ELEVATION MAP, NOVEMBER 8, 2001; JOB NO.: 110535-01; DATE: 12/07/01

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102 PICKERING WAY, STE 200
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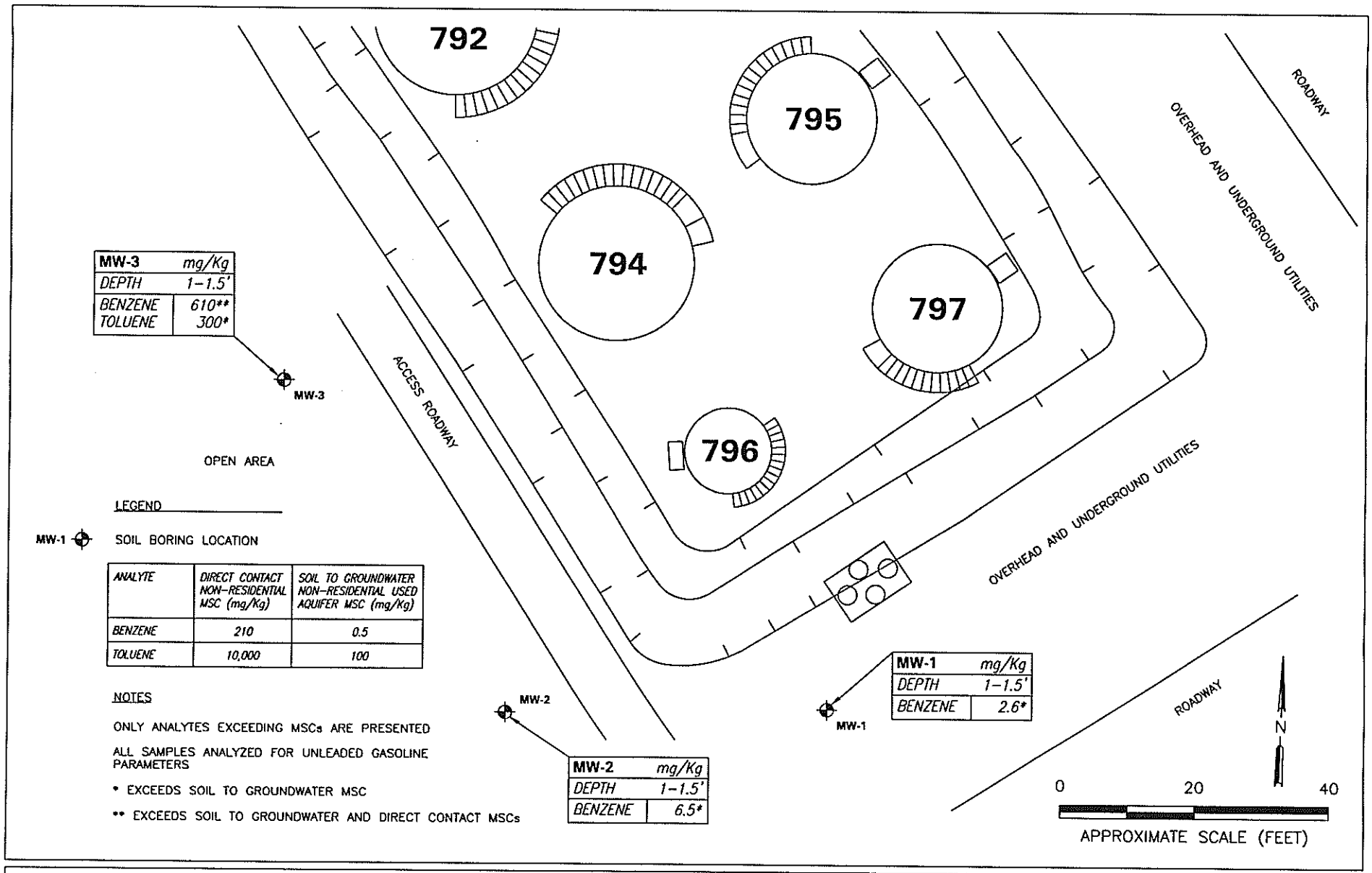
CONTOURED GROUND WATER ELEVATION MAP
NOVEMBER 8, 2001
GIRARD POINT PROCESSING AREA
PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

FIGURE: **4-3**

JOB#: 62SU.01017.02.0006 APPR: DWN: KPM DATE: 12/02/02

N:/SECOR-062

DWG: 62SU-1017-2-6(4-3)



MW-3	mg/Kg
DEPTH	1-1.5'
BENZENE	610**
TOLUENE	300*

MW-1	mg/Kg
DEPTH	1-1.5'
BENZENE	2.6*

MW-2	mg/Kg
DEPTH	1-1.5'
BENZENE	6.5*

LEGEND

MW-1 SOIL BORING LOCATION

ANALYTE	DIRECT CONTACT NON-RESIDENTIAL MSC (mg/Kg)	SOIL TO GROUNDWATER NON-RESIDENTIAL USED AQUIFER MSC (mg/Kg)
BENZENE	210	0.5
TOLUENE	10,000	100

NOTES

ONLY ANALYTES EXCEEDING MSCs ARE PRESENTED

ALL SAMPLES ANALYZED FOR UNLEADED GASOLINE PARAMETERS

* EXCEEDS SOIL TO GROUNDWATER MSC

** EXCEEDS SOIL TO GROUNDWATER AND DIRECT CONTACT MSCs

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SOIL ANALYTICAL RESULTS (mg/Kg)
(SEPTEMBER 16 AND 17, 2002)
AST 797 AREA
SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

FIGURE: **4-4**

JOB#: 62SU.01017.02.0006 APPR: DWN: KPM DATE: 12/02/02

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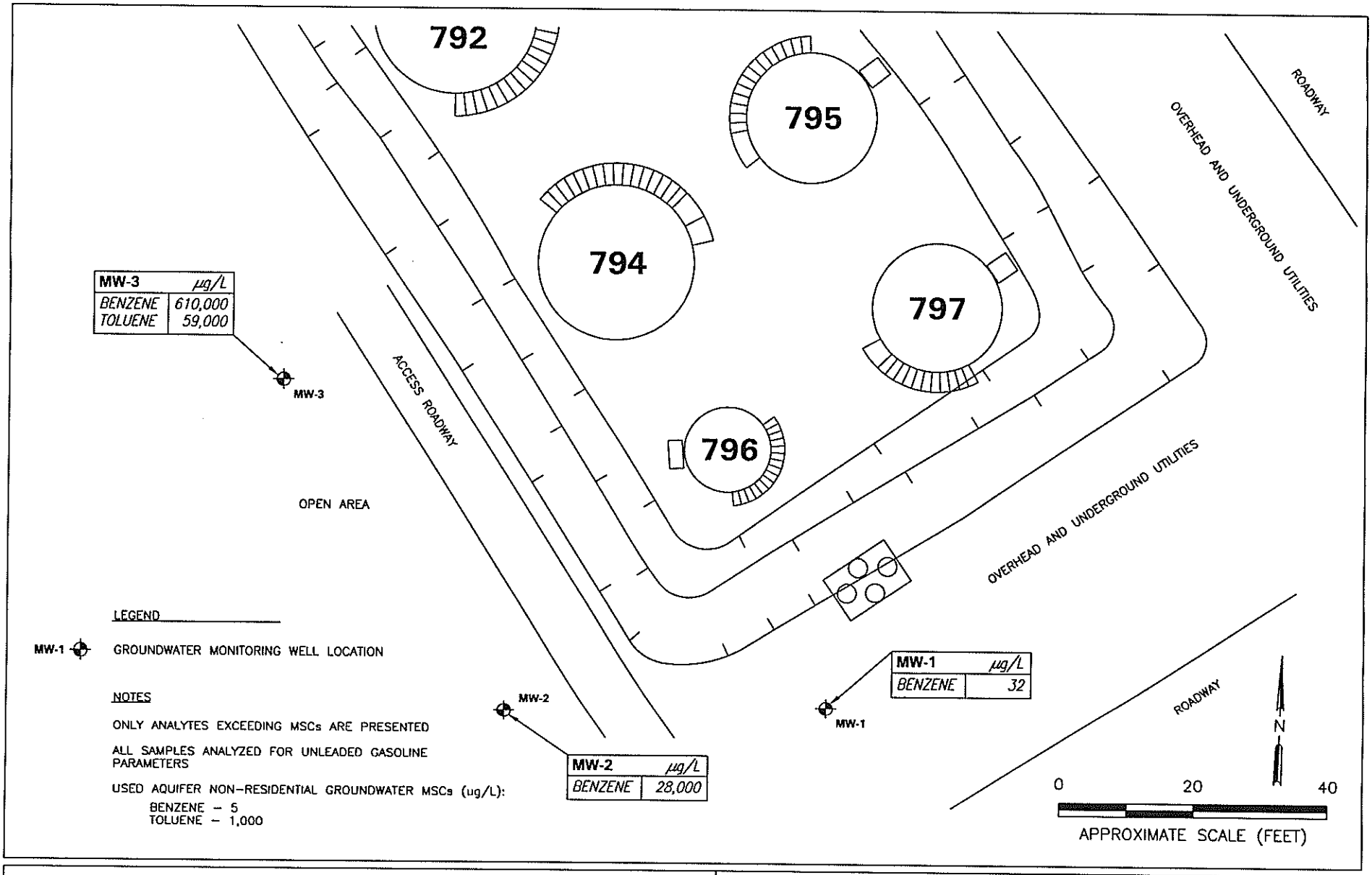
DWG: 62SU-1017-2-6(4-4)



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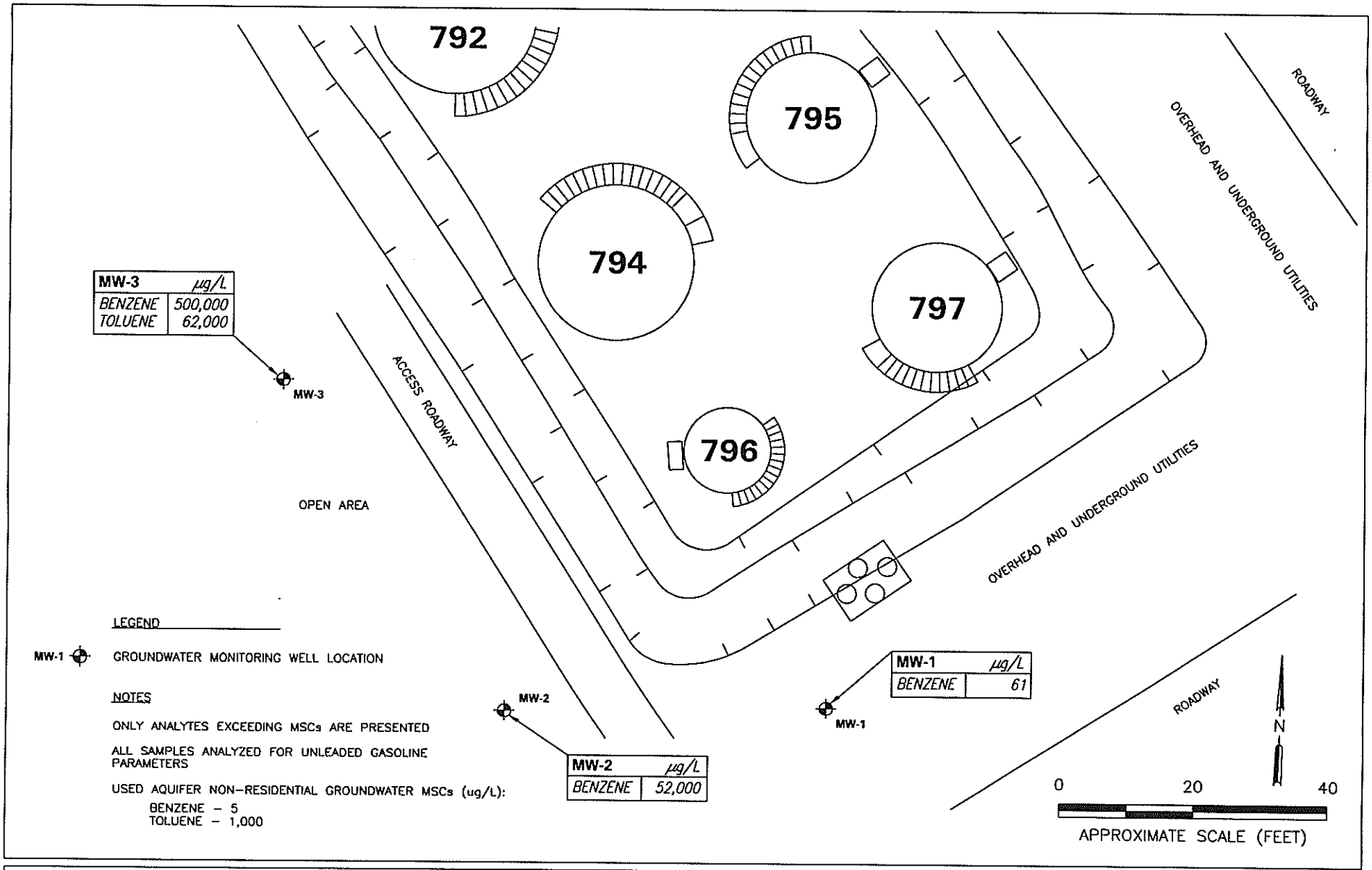
GROUNDWATER ANALYTICAL RESULTS
(OCTOBER 17, 2002)
AST 797 AREA
SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

FIGURE: **4-5**

JOB#: 62SU.01017.02.0006 APPR: DWN: KPM DATE: 12/02/02

N:/SECOR-062

DWG: 62SU-1017-2-6(4-5)



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(484) 875-3075/875-9286 (FAX)

GROUNDWATER ANALYTICAL RESULTS
(NOVEMBER 19, 2002)
AST 797 AREA
SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

FIGURE: **4-6**

JOB#: 62SU.01017.02.0006 APPR: DWN: KPM DATE: 12/02/02

N:/SECOR-062

DWG: 62SU-1017-2-6(4-6)

APPENDIX A

AST 797 CLOSURE REPORT

SECOR
International Incorporated

July 10, 2002

Mr. Jim Tucker
Sunoco, Inc.
Philadelphia Refinery
3144 Passyunk Avenue
Philadelphia, PA 19145-5299

Subject: **Aboveground Storage Tank #797 Closure Report**
Sunoco Philadelphia Refinery, Philadelphia, Pennsylvania

Dear Mr. Tucker:

This letter summarizes the aboveground storage tank (AST) soil characterization activities that were conducted in support of the closure requirements for Pennsylvania Code Title 25 § 245.561 under the Administration of Storage Tank and Spill Prevention Program. The project site is within the Sunoco, Inc. (Sunoco) Philadelphia Refinery located in Philadelphia, Pennsylvania (**Figure** 1). Soil characterization activities using direct observation and soil sampling and laboratory analyses were conducted surrounding AST #797 in order to evaluate potential impacts associated with product storage. AST #797 is situated on a concrete pad within a diked area and has been reported by Sunoco to have formerly contained process water that contained light-end hydrocarbons such as benzene and cumene.

Soil Boring Installation and Soil Sampling

Work in this area of the refinery is required to be performed using non-sparking equipment. As a result, borings in this area were installed using a stainless steel hand auger. Since the AST is situated on a concrete pad approximately two feet above grade, surface soil samples would detect potential historic releases from the AST.

It was intended that two samples (one sample at a depth of 0 to 2 feet below ground surface (bgs) and one at a depth greater than 2 feet) be collected from each of 4 soil borings advanced to the groundwater table or auger refusal. However, as a result of localized shallow water conditions and hand auger refusal, a total of five samples were collected from 4 borings. The soil borings are designated HA-1 to HA-4. Soil boring locations are depicted on **Figure 2**.

Observations recorded during soil boring installation are recorded on soil boring logs presented in **Appendix A.** The soil boring logs include lithologic descriptions of material encountered and relative soil volatile organic vapor content based on photoionization detector (PID) readings. As indicated on the boring logs, the materials encountered were largely sand with some silt and trace gravel.

Auger refusal was encountered in HA-1, HA-2, and HA-4 at depths ranging from 3.5 feet to 4.5 feet bgs. However, water was encountered at a depth of approximately 1.5 feet bgs. As a result, samples were collected from these locations at a depth of 1.0 to 1.5 feet bgs. Auger refusal was encountered in HA-3 at a depth of 2 feet bgs. Samples were collected from this location at a depth of 1.0 to 1.5 feet bgs and 2.0 feet bgs.

After collection, the soil samples were placed in appropriate laboratory containers, labeled, placed in an ice-chilled cooler and logged on a chain-of-custody form. The soil samples were delivered to Washington Group Environmental Services Laboratory of Boothwyn, Pennsylvania for analysis.

Laboratory Analyses of Soil Samples

The laboratory analyses selected for each soil sample were based on the former contents of the AST. As mentioned above, AST #797 was reported to have stored process water that contained light-end hydrocarbons such as benzene and cumene. As a result, each soil sample was analyzed for Pennsylvania Department of Environmental Protection (PADEP) Pennsylvania Land Recycling Program (Act 2) short list of parameters for unleaded gasoline in soil. This includes the analyses of benzene, toluene, ethyl benzene, xylenes, cumene, MTBE, and naphthalene by EPA Method 5035/8260B.

For quality assurance/quality control (QA/QC) purposes, a trip blank accompanied each sample shipment and submitted for laboratory analyses.

Soil Sampling Results

The soil analytical data is summarized on **Table 1.** The analytical results for the soil samples were compared to the cleanup criteria established by for PADEP under Act 2. Under the regulations implementing Act 2, Medium Specific Concentrations (MSCs) for soils include two components. PADEP has developed MSCs for soils are based on direct contact exposure scenarios and PADEP has developed procedures for selecting MSCs for soils that are designed to protect groundwater from the potential impacts that could be caused by the migration of regulated substances from soils into the groundwater. Soil sample results were compared to Nonresidential Surface Soil and Subsurface Soil Direct Contact MSCs and Used Aquifer Nonresidential Soil-to-Groundwater MSCs. These MSCs are

listed in Appendix A, Tables 3A and 3B (revised November 24, 2001) of the Act 2 Rules and Regulations.

Figure 3 depicts sample results that were reported above an MSC. Benzene in HA-1 (1-1.5) and HA-3 (1-1.5) was reported in concentrations of 920 mg/Kg and 310 mg/Kg, respectively, exceeding the Nonresidential Surface Soil Direct Contact MSC of 210 mg/Kg.

Used Aquifer Nonresidential Soil-to-Groundwater MSCs were exceeded for benzene (0.5 mg/kg) in all five samples (at concentrations ranging from 28 mg/Kg to 310 mg/Kg); ethyl benzene (70 mg/kg) in one sample (HA-1/1-1.5 reported 80 mg/Kg ethyl benzene); and toluene (100 mg/Kg) in four samples (at concentrations ranging from 300 mg/Kg to 1,800 mg/Kg). Copies of the laboratory analytical data are presented in **Appendix B**.

Since MSCs were exceeded in all soil samples, additional site characterization is warranted in accordance with the Pennsylvania Storage Tank and Spill Prevention Program. Further recommendations for site characterization will be provided under separate cover.

Should you have any questions or comments, please feel free to contact me at (484) 875-3075.

Sincerely,
SECOR International Incorporated

Steve Baggett

Steve Baggett, P.G.
Principal Hydrogeologist

cc: James Oppenheim (Sunoco)
Al Hornung (Sunoco)
Project File

TABLE 1
Summary of Soil Analytical Results (ug/Kg)

AST 797
Sunoco Philadelphia Refinery

Sample	0-2 feet	2-15 feet	Soil to Groundwater	HA-1 (1-1.5)		HA-2 (1-1.5)		HA-3 (1-1.5)		HA-3 (2)		HA-4 (1-1.5)	
Date	Non-Residential	Non-Residential	Non-Residential	8/29		05/24/02		05/24/02		05/24/02		05/24/02	
Constituent	Direct Contact (1)	Direct Contact (1)	Used Aquifer (2)	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL
Benzene	210,000	240,000	500	**920,000 D**	240	**28,000 D**	260	**310,000 D**	270	**170,000 D**	250	**190,000 D**	250
Ethylbenzene	10,000,000	10,000,000	70,000	**80,000 JD**	240	850	260	37,000 JD	270	8,500	250	55,000 D	250
Isopropyl Benzene (Cumene)	10,000,000	10,000,000	1,600,000	1,600,000 D	240	17,000 D	260	1,000,000 D	270	230,000 D	250	950,000 D	250
Methyl-t-butyl Ether (MTBE)	3,200,000	3,700,000	2,000	ND	240	ND	260	ND	270	ND	250	ND	250
Naphthalene	56,000,000	190,000,000	25,000	650	240	ND	260	410	270	300	250	290	250
Toluene	10,000,000	10,000,000	100,000	**1,800,000 D**	240	11,000 D	260	**920,000 D**	270	**300,000 D**	250	**660,000 D**	250
Xylenes-Meta&Para (3)	190,000,000	190,000,000	4,700,000	310,000 D	240	4,500	260	140,000 D	270	29,000 D	250	210,000 D	250
Xylenes-Ortho (3)	110,000	190,000,000	320,000	71,000 D	240	1,400	260	29,000 JD	270	7,700	250	50,000 JD	250

Bold = Exceeds Soil-to-Groundwaler standard

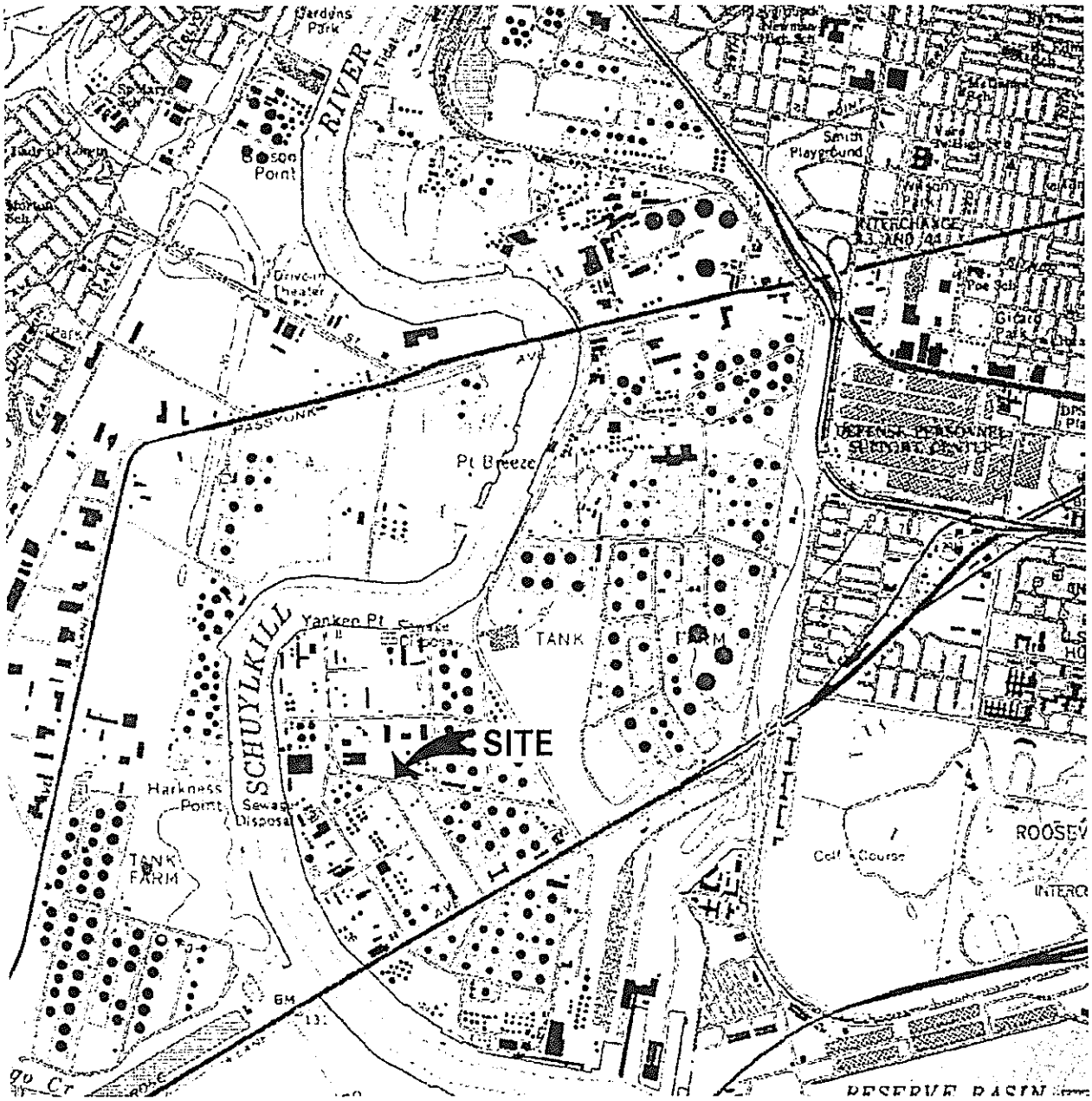
J = Estimated Value (concentration is below laboratory reporting limit)

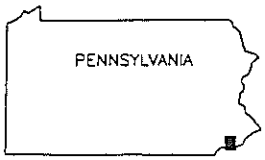
D = Result obtained from different dilution than other samples

(1)= Pennsylvania Land Recycling Program (25 PA code Chapter 250), Appendix A, Table 3 A (Revised November 24, 2001)

(2)= Pennsylvania Land Recycling Program (25 PA code Chapter 250), Appendix A, Table 3 B (Revised November 24, 2001)

(3)= MSCs are based on Total Xylenes





QUADRANGLE LOCATION

N

0 1/2 1

SCALE (MILES)

REFERENCE: USGS 7.5 MINUTE QUADRANGLE; PHILADELPHIA, PENNSYLVANIA–NEW JERSEY; 1995

SECOR
International Incorporated
102 PICKERING WAY, SUITE 200
EXTON, PENNSYLVANIA 19341
(484) 875-3075/875-9286 (FAX)

SITE LOCATION MAP

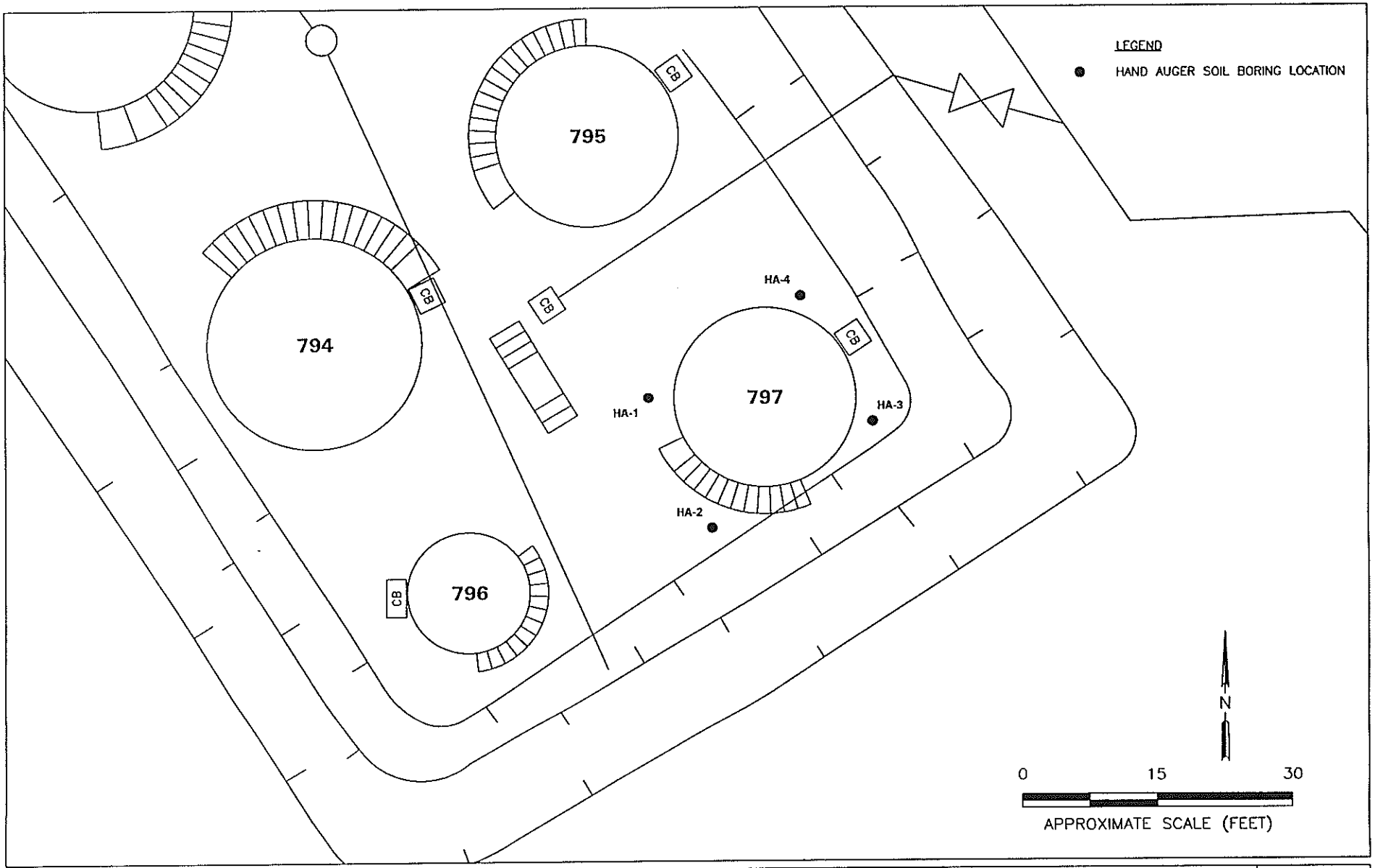
SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

FIGURE: 1

JOB#: 62SU.01006.02 APPR: DWN: KPM DATE: 06/28/02

N:/OFFICE-062

DWG: 62SU-1006-231(1)



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AST 797 HAND AUGER SOIL BORING LOCATIONS

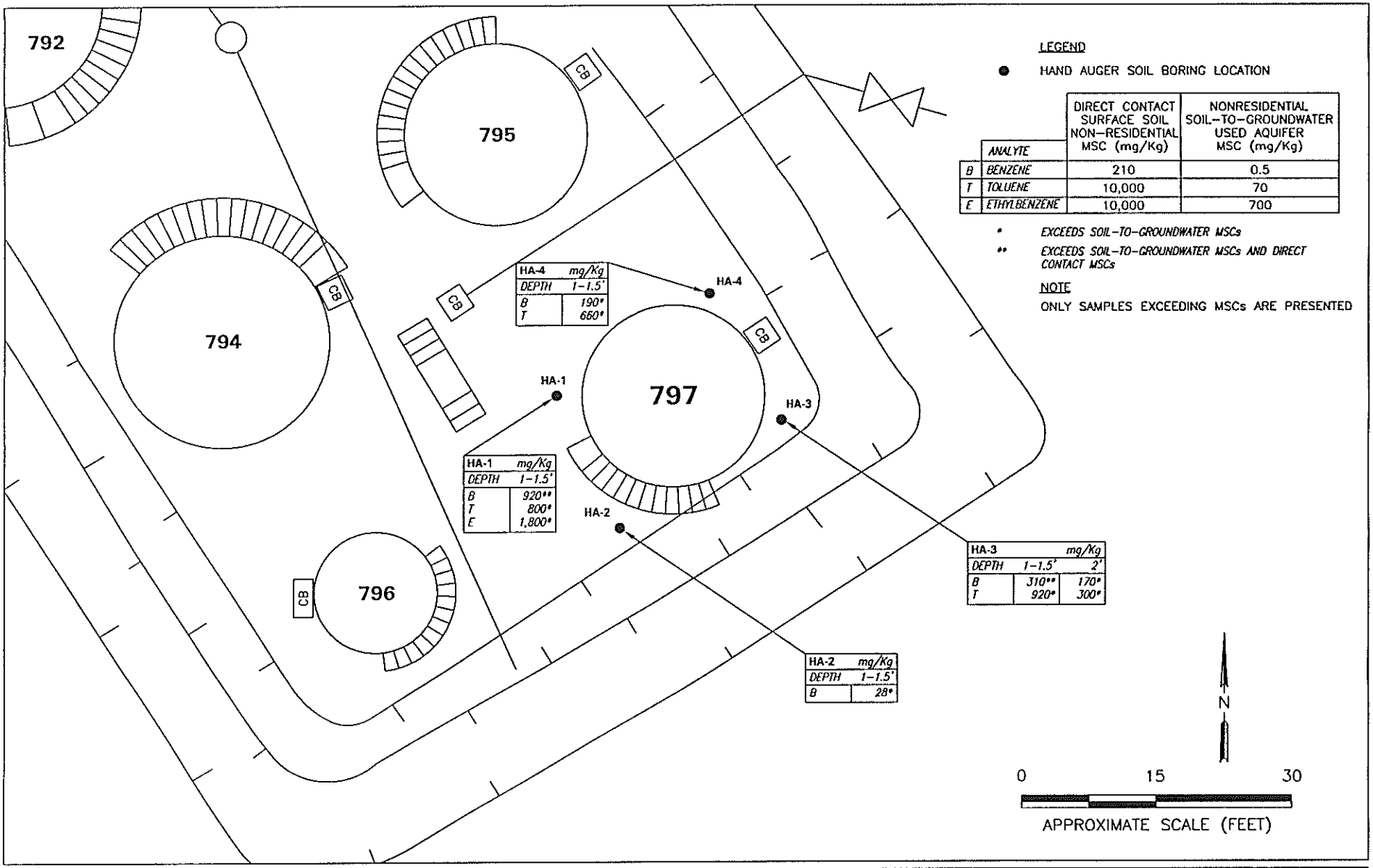
SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

FIGURE: **2**

JOB#: 62SU.01006.02 APPR: DWN: KPM DATE: 06/28/02

DWG: 62SU-1006-32SP(797)

N:/SECOR-062



SECOR
International Incorporated
102 PICKERING WAY, STE 200
EXTON, PA 19341
(484) 875-3075/875-9286 (FAX)

AST 797 HAND AUGER SOIL BORING ANALYTICAL RESULTS MAP (MAY 24, 2002)

SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

FIGURE: **3**

JOB#: 62SU.01006.02 APPR: DWN: KPM DATE: 06/28/02

N:/SECOR-062

DWG: 62SU-1006-33A(797)

APPENDIX A

Soil Boring Logs

SECOR International Incorporated
102 PICKERING WAY, SUITE 200
EXTON, PENNSYLVANIA 19341
(484) 875-3075/875-9286 (FAX)

FACILITY **SUNOCO PHILADELPHIA REFINERY** JOB# **62SU.01006.02.0003** BORING/WELL **HA-1**
LOCATION **PHILADELPHIA, PENNSYLVANIA** SURFACE ELEVATION **NA**
START (TIME/DATE) **05/24/02** FINISH **05/24/02** CASING TOP ELEVATION **NA**
LOGGED BY **S. MORESCALCHI** MONITORING DEVICE **HAND AUGER**
SUBCONTRACTOR AND EQUIPMENT
COMMENTS

SAMPLE ID (DEPTH)	Sample Depth Interval (feet)	PID Reading (ppm)	Sheen	Depth Below Surface (feet)	Lithologic Description	Unified Soil Classification System SYM	PAT	Depth Below Surface (feet)	Well Construction Schematic
				5				5	
		0.0		0	SAND, fine to medium; some coarse SAND, trace silt; trace fine gravel; brown; dry			0	
		0.0			SAND, fine to medium; some coarse SAND, some fine gravel; brown; dry	SW			
HA-1 (1.0-1.5')*		2586		1	SAND, fine to medium; some coarse SAND, some fine gravel; brown; dry			1	
		1986			SAND, fine to medium; some coarse SAND, some fine gravel; brown; wet				
		9999+		2	SAND, fine to coarse; some fine gravel; brown; wet			2	
				3				3	
		9999+			SAND, fine to coarse; some fine gravel; brown; wet				
		9999+			SAND, fine to coarse; some fine gravel; brown; wet				
		9999+		4	SILT, some fine SAND, black; moist	ML		4	
		1875			SAND, fine to coarse; some fine gravel; brown; wet	SW			
					Boring terminated at 4.5 feet.				
				5				5	

Field Screen/Lithologic Description Sample
Preserved Sample
No Recovery
* Sample Submitted for Laboratory Analysis

Groundwater Level at Time of Drilling
Static Groundwater Level
SD Sheen Detected
NS No Sheen Detected
NT Not Tested
(2.5Y 4/2) Munsell (1990) Soil Color Charts

Gradational Contact
Contact Located Approximately
Contact

Concrete
Bentonite
10/20 Colorado Silica Sand

2" PVC Blank Casing
2" PVC Screen Casing (0.010 slots)
End Cap

N:/SECOR-062

DWG:

SECOR International Incorporated
102 PICKERING WAY, SUITE 200
EXTON, PENNSYLVANIA 19341
(484) 875-3075/875-9286 (FAX)

FACILITY **SUNOCO PHILADELPHIA REFINERY** JOB# **62SU.01006.02.0003** BORING/WELL **HA-2**
LOCATION **PHILADELPHIA, PENNSYLVANIA** SURFACE ELEVATION **NA**
START (TIME/DATE) **05/24/02** FINISH **05/24/02** CASING TOP ELEVATION **NA**
LOGGED BY **S. MORESCALCHI** MONITORING DEVICE **HAND AUGER**
SUBCONTRACTOR AND EQUIPMENT
COMMENTS

SAMPLE ID (DEPTH)	Sample Depth Interval (feet)	PID Reading (ppm)	Sheen	Depth Below Surface (feet)	Lithologic Description	Unified Soil Classification System SYM	Unified Soil Classification System PAT	Depth Below Surface (feet)	Well Construction Schematic
				5				5	
		0.0		0	SAND, fine to medium; little coarse sand; little silt; trace fine gravel; light brown; dry			0	
		0.0			SAND, fine to medium; little coarse sand; little silt; trace fine gravel; brown; dry				
		493		1	SAND, fine to medium; little coarse sand; little silt; trace fine gravel; brown; dry			1	
HA-2 (1.0-1.5')*						SW			
		1482			SAND, fine to medium; little coarse sand; little silt; trace fine gravel; brown; moist/wet				
		1679		2	SAND, fine to coarse; some fine gravel; trace silt; brown; wet			2	
		1243			SAND, fine to coarse; some fine gravel; trace silt; brown; wet				
		1989		3	SAND, fine to coarse; some fine gravel; trace silt; brown; wet			3	
					Boring terminated at 3.5 feet.				
				4				4	
				5				5	

Field Screen/Lithologic Description Sample
Preserved Sample
No Recovery
* Sample Submitted for Laboratory Analysis
Groundwater Level at Time of Drilling
Static Groundwater Level
SD Sheen Detected
NS No Sheen Detected
NT Not Tested
(2.5Y 4/2) Munsell (1990) Soil Color Charts
Gradational Contact
Contact Located Approximately
Contact
Concrete
Bentonite
10/20 Colorado Silica Sand
2" PVC Blank Casing
2" PVC Screen Casing (0.010 slots)
End Cap

N:/SECOR-062 DWG:

SECOR International Incorporated
102 PICKERING WAY, SUITE 200
EXTON, PENNSYLVANIA 19341
(484) 875-3075/875-9286 (FAX)

FACILITY **SUNOCO PHILADELPHIA REFINERY** JOB# **62SU.01006.02.0003** BORING/WELL **HA-3**
LOCATION **PHILADELPHIA, PENNSYLVANIA** SURFACE ELEVATION **NA**
START (TIME/DATE) **05/24/02** FINISH **05/24/02** CASING TOP ELEVATION **NA**
LOGGED BY **S. MORESCALCHI** MONITORING DEVICE **HAND AUGER**
SUBCONTRACTOR AND EQUIPMENT
COMMENTS

SAMPLE ID (DEPTH)	Sample Depth Interval (feet)	PID Reading (ppm)	Sheen	Depth Below Surface (feet)	Lithologic Description	Unified Soil Classification System SYM	Unified Soil Classification System PAT	Depth Below Surface (feet)	Well Construction Schematic
				5				5	
		0.0		0	SAND, fine to medium; little coarse sand; little silt; brown; dry	SW		0	
		102			SAND, fine to medium; little coarse sand; little silt; brown; dry				
HA-3 (1.0-1.5')*		813		1	SAND, fine to medium; little coarse sand; little silt; little fine gravel; brown; dry			1	
		9999+			SAND, fine to medium; little coarse sand; trace silt; little fine; brown; moist				
HA-3 (2.0')*		9999+		2	Refusal at 2 feet Boring terminated at 2.0 feet.			2	
				3				3	
				4				4	
				5				5	

Field Screen/Lithologic Description Sample
Preserved Sample
No Recovery
* Sample Submitted for Laboratory Analysis

Groundwater Level at Time of Drilling
Static Groundwater Level
SD Sheen Detected
NS No Sheen Detected
NT Not Tested
(2.5Y 4/2) Munsell (1990) Soil Color Charts

Gradational Contact
Contact Located Approximately
Contact

Concrete
Bentonite
10/20 Colorado Silica Sand

2" PVC Blank Casing
2" PVC Screen Casing (0.010 slots)
End Cap

N:/SECOR-062

DWG:

SECOR International Incorporated
102 PICKERING WAY, SUITE 200
EXTON, PENNSYLVANIA 19341
(484) 875-3075/875-9286 (FAX)

FACILITY **SUNOCO PHILADELPHIA REFINERY** JOB# **62SU.01006.02.0003** BORING/WELL **HA-4**
LOCATION **PHILADELPHIA, PENNSYLVANIA** SURFACE ELEVATION **NA**
START (TIME/DATE) **05/24/02** FINISH **05/24/02** CASING TOP ELEVATION **NA**
LOGGED BY **S. MORESCALCHI** MONITORING DEVICE **HAND AUGER**
SUBCONTRACTOR AND EQUIPMENT
COMMENTS

SAMPLE ID (DEPTH)	Sample Depth Interval (feet)	PID Reading (ppm)	Sheen	Depth Below Surface (feet)	Lithologic Description	Unified Soil Classification System SYM	PAT	Depth Below Surface (feet)	Well Construction Schematic
				5				5	
		0.0		0	SAND, fine to medium; little coarse sand; little silt; trace fine gravel; light brown; dry	SW		0	
		3237			SAND, fine to medium; little coarse sand; little silt; trace fine gravel; brown; dry				
		1609		1	SAND, fine to medium; little coarse sand; little silt; trace fine gravel; brown; dry			1	
HA-4 (1.0-1.5')*		681			SAND, fine to medium; little coarse sand; trace silt; trace fine gravel; brown; moist/wet				
		389		2	SAND, fine to coarse; little fine gravel; brown; wet			2	
		9999+			SAND, fine to coarse; little fine gravel; brown; wet				
		779		3	SAND, fine to coarse; some fine gravel; brown; wet			3	
		587			SAND, fine to coarse; some fine gravel; brown; wet				
		9999+		4	SILT; some fine to medium SAND; black; wet Refusal at 4 feet	ML		4	
					Boring terminated at 4 feet.				
				5				5	

Field Screen/Lithologic Description Sample
Preserved Sample
No Recovery
* Sample Submitted for Laboratory Analysis
Groundwater Level at Time of Drilling
Static Groundwater Level
SD Sheen Detected
NS No Sheen Detected
NT Not Tested
(2.5Y 4/2) Munsell (1990) Soil Color Charts
Gradational Contact
Contact Located Approximately
Contact
Concrete
Bentonite
10/20 Colorado Silica Sand
2" PVC Blank Casing
2" PVC Screen Casing (0.010 slots)
End Cap

APPENDIX B

Laboratory Analytical Reports

THE WASHINGTON GROUP
ENVIRONMENTAL SERVICES LABORATORY

301 Chelsea Parkway
Boothwyn, Pa. 19061
(610) 497-8000

Report For:

Secor Int., Inc. (Sun Philly Refin)
Mr. Steve Baggett
102 Pickering Way, Suite 200
Exton PA 19341

Job Number

75702702

Summary Number

68562

June 05, 2002

Reviewed by Mary E. Pierce
Project Manager Mary Pierce

NJ ID# PA343	EPA ID# PA00078	PA ID# 23-272
CA ID# 02105CA	RI ID# 238	CT ID# PH0687
NY ID# 11345	MD ID# 286	MA ID# M-PA078

Total Pages = 7

The Washington Group International
Environmental Services Laboratory Data Summary
Summary # 68562 Printed - 06/05/02 06:58:39

Log	Description	Code	Parameter	Result	Limit	Units	Sampled	Started	Complete	Analyst
284206A	HA-1 (1-1.5)	G01PA	Benzene	920000 D	240	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284206A	HA-1 (1-1.5)	G01PA	Ethylbenzene	80000 JD	240	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284206A	HA-1 (1-1.5)	G01PA	Isopropyl Benzene	1600000 D	240	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284206A	HA-1 (1-1.5)	G01PA	Methyl-t-butyl Ether	ND	240	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284206A	HA-1 (1-1.5)	G01PA	Naphthalene	650	240	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284206A	HA-1 (1-1.5)	G01PA	Toluene	1800000 D	240	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284206A	HA-1 (1-1.5)	G01PA	Xylenes-Meta&Para	310000 D	240	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284206A	HA-1 (1-1.5)	G01PA	Xylenes-Ortho	71000 JD	240	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284206B	HA-1 (1-1.5)	S06	WATER BY EVAP	7.6		% as received	05/24/2002	05/28/2002	05/28/2002	MCH
284207A	HA-2 (1-1.5)	G01PA	Benzene	28000 D	260	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284207A	HA-2 (1-1.5)	G01PA	Ethylbenzene	850	260	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284207A	HA-2 (1-1.5)	G01PA	Isopropyl Benzene	17000 D	260	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284207A	HA-2 (1-1.5)	G01PA	Methyl-t-butyl Ether	ND	260	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284207A	HA-2 (1-1.5)	G01PA	Naphthalene	ND	260	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284207A	HA-2 (1-1.5)	G01PA	Toluene	11000 D	260	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284207A	HA-2 (1-1.5)	G01PA	Xylenes-Meta&Para	4500	260	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284207A	HA-2 (1-1.5)	G01PA	Xylenes-Ortho	1400	260	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284207B	HA-2 (1-1.5)	S06	WATER BY EVAP	10.0		% as received	05/24/2002	05/28/2002	05/28/2002	MCH
284208A	HA-3 (1-1.5)	G01PA	Benzene	310000 D	270	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284208A	HA-3 (1-1.5)	G01PA	Ethylbenzene	37000 JD	270	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284208A	HA-3 (1-1.5)	G01PA	Isopropyl Benzene	1000000 D	270	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284208A	HA-3 (1-1.5)	G01PA	Methyl-t-butyl Ether	ND	270	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284208A	HA-3 (1-1.5)	G01PA	Naphthalene	410	270	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284208A	HA-3 (1-1.5)	G01PA	Toluene	920000 D	270	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284208A	HA-3 (1-1.5)	G01PA	Xylenes-Meta&Para	140000 D	270	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284208A	HA-3 (1-1.5)	G01PA	Xylenes-Ortho	29000 JD	270	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284208B	HA-3 (1-1.5)	S06	WATER BY EVAP	9.6		% as received	05/24/2002	05/28/2002	05/28/2002	MCH

The Washington Group International
Environmental Services Laboratory Data Summary
Summary # 68562 Printed - 06/05/02 06:58:39

Log	Description	Code	Parameter	Result	Limit	Units	Sampled	Started	Complete	Analyst
284209A	HA-3 (2)	G01PA	Benzene	170000 D	250	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284209A	HA-3 (2)	G01PA	Ethylbenzene	8500	250	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284209A	HA-3 (2)	G01PA	Isopropyl Benzene	230000 D	250	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284209A	HA-3 (2)	G01PA	Methyl-t-butyl Ether	ND	250	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284209A	HA-3 (2)	G01PA	Naphthalene	300	250	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284209A	HA-3 (2)	G01PA	Toluene	300000 D	250	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284209A	HA-3 (2)	G01PA	Xylenes-Meta&Para	29000 D	250	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284209A	HA-3 (2)	G01PA	Xylenes-Ortho	7700	250	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284209B	HA-3 (2)	S06	WATER BY EVAP	8.8		% as received	05/24/2002	05/28/2002	05/28/2002	MCH
284210A	HA-4 (1-1.5)	G01PA	Benzene	190000 D	250	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284210A	HA-4 (1-1.5)	G01PA	Ethylbenzene	55000 D	250	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284210A	HA-4 (1-1.5)	G01PA	Isopropyl Benzene	950000 D	250	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284210A	HA-4 (1-1.5)	G01PA	Methyl-t-butyl Ether	ND	250	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284210A	HA-4 (1-1.5)	G01PA	Naphthalene	290	250	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284210A	HA-4 (1-1.5)	G01PA	Toluene	660000 D	250	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284210A	HA-4 (1-1.5)	G01PA	Xylenes-Meta&Para	210000 D	250	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284210A	HA-4 (1-1.5)	G01PA	Xylenes-Ortho	50000 JD	250	ug/kg-dry	05/24/2002	05/29/2002	05/29/2002	PSS
284210B	HA-4 (1-1.5)	S06	WATER BY EVAP	11.5		% as received	05/24/2002	05/28/2002	05/28/2002	MCH
284211	Trip Blank	G01PA	Benzene	ND	250	ug/kg as rcvd	05/24/2002	05/29/2002	05/29/2002	PSS
284211	Trip Blank	G01PA	Ethylbenzene	ND	250	ug/kg as rcvd	05/24/2002	05/29/2002	05/29/2002	PSS
284211	Trip Blank	G01PA	Isopropyl Benzene	ND	250	ug/kg as rcvd	05/24/2002	05/29/2002	05/29/2002	PSS
284211	Trip Blank	G01PA	Methyl-t-butyl Ether	ND	250	ug/kg as rcvd	05/24/2002	05/29/2002	05/29/2002	PSS
284211	Trip Blank	G01PA	Naphthalene	ND	250	ug/kg as rcvd	05/24/2002	05/29/2002	05/29/2002	PSS
284211	Trip Blank	G01PA	Toluene	ND	250	ug/kg as rcvd	05/24/2002	05/29/2002	05/29/2002	PSS
284211	Trip Blank	G01PA	Xylenes-Meta&Para	ND	250	ug/kg as rcvd	05/24/2002	05/29/2002	05/29/2002	PSS
284211	Trip Blank	G01PA	Xylenes-Ortho	ND	250	ug/kg as rcvd	05/24/2002	05/29/2002	05/29/2002	PSS

Approved by: _____

Report Prep: K. Kester

THE WASHINGTON GROUP
ENVIRONMENTAL LABORATORY

Methods Used for Summary# 68562:

Code	Description
G01PA	SW-846 5035/8260B/PA UST VOCs - BTEX;Cumene;Naph.;EDB;EDC
S06	Water by evaporation/ EPA-600 Mtd 160.3

DATA QUALIFIERS

The following list shows data qualifiers that may appear in this report, and the meaning of each.

Qualifier	Meaning
B	Compound was detected in the associated blank.
D	Result was obtained from a different dilution than other analytes.
E	Result is estimated. Usually, this qualifier indeicates that the result is above the calibrated range of the instrument
J	Result is estimated. Usually this qualifier indicates the reported concentration is below the laboratory's reporting limit.
N	Indicates a Tentatively Identified Compound.
ND	Analyte was not detected.
U	Analyte was not detected (U and ND qualifiers are interchangable).

ABBREVIATIONS

The following list shows abbreviations that commonly occur in analytical reports.

Abbreviation	Meaning
DL	Dilution
LCS	Laboratory Control Sample
LCSS	Laboratory Control Sample (soil)
LCSW	Laboratory Control Sample (water)
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NR	No Recovery
PB	Preparation Blank
PS	Post-Digestion Spike
RE	Reanalysis
RPD	Relative Percent Difference
SR	Serial Dilution

Washington — Laboratory Chain Of Custody

Quote No:

Ship To:

Lab Job No: 75702702

Washington Group Laboratory
301 Chelsea Parkway
Boothwyn, PA 19061
Phone: 610-497-8000
Fax: 610-497-8005

Client/Office: SECOR INT. INC. Phone: 484 875 3025

Address: 102 PICKERING WAY, SUITE 200 EXTON PA 19341

Send report to: STEVE BAGGETT Fax: 484 875 9286

Send invoice to: SAME

Address:

P.O. No: 1012

Project Description: SUN PHILADELPHIA REFINERY

TAT (for data): Identify number of working days below); ...or Date-->:

☐ Rush 1 2 3 4 5 days ☐ Firm(6-12) ____ ☒ Std.(~12) ____ ☐ Other ____

Lab Staffer confirming Rush/Firm: ____ Hardcopy TAT Date?: ____

Report Type: ☒ Results only ☐ Data +QC ☐ Reduced Deliv. ☐ Other: ____
☐ Regulatory Format (CLP like) ☐ Electronic/disk->(Format?)

Regulatory Samples? ☒ YES ☐ NO

If YES?: ☒ Act II ☐ UST ☐ RCRA ☐ NPDES ☐ Phase I/II ☐ ISRA ☐ Other: ____

Analytical Protocol: ☐ SW846 ☐ EPA600 ☐ Drinking H2O ☐ ASTM ☐ Other: ____

Analysis Required: PADEP UNLEADED GAS (BTEX, CUMENE, MTBE, NAPHTHALENE); PARAMETERS - 5035/8260B; SHORT LIST

Lab Use Only
rec. 10/12/99
Due Date:
Receipt Temp: 4 deg C
Custody seal yes ___ no: ___ No
Summary No: 68562
Lab Log No:

Sample Data (NJ HAZITE disk deliverable limits sample ID to 7 Characters)							Container Data			
ID (NJ limit=7 characters)	date	time	matrix	grab	comp	type	no.	preservative	pH	
HA-1 (1-1.5)	5/24/02	0940	SOIL	✓			2	METH		A+B
HA-2 (1-1.5)	5/24/02	1050		✓			2			
HA-3 (1-1.5)	5/24/02	1130		✓			2			
HA-3 (2)	5/24/02	1140		✓			2			
HA-4 (1-1.5)	5/24/02	1210	↓	✓			2	↓		
TRIP BLANK			METH				1			

Comments/Special Handling/Storage/Disposal-->: A= Blue, 40g, meoH (1) B= All other, 40zg (4)

Sampled by: SERGIO MORESCALCHI

Phone no: 484 875 3075

Relinquished By:		Received By:		Method of Shipment
Name:	Date: 5/24/02	Name:	Date: 5/24/02	Airbill No.
Organization: SECOR	Time: 1400	Organization: TWG LAB	Time: 1405	
Name:	Date:	Name:	Date:	
Organization:	Time:	Organization:	Time:	
Name:	Date:	Name:	Date:	
Organization:	Time:	Organization:	Time:	

Washington
Environmental Laboratory

SAMPLE RECEIVING CHECKLIST

Client/Site: Secor

Assigned Summary # 68562

Section 1. Laboratory Courier (omit if samples received directly from client or 3rd party)

1.1 Samples taken by lab personnel?	☐ Yes	☐ No	
Preserved in field?	☐ Yes	☐ No	☐ Not Req.
Stored on ice?	☐ Yes	☐ No	☐ Not Req.
Date/time last sample placed in cooler: _____			
1.2 Samples taken by customer or 3rd party?	☐ Yes	☐ No	
Received under refrigeration?	☐ Yes (cooler)	☐ Yes (refrig.)	☐ No
If yes, in Cooler sealed?	☐ Yes	☐ No	
If no, ice present?	☐ Yes	☐ No	
Ice added?	☐ Yes	☐ No	
If refrig. placed in cooler/iced	☐ Yes	☐ No	

Section 2. Laboratory

2.1 Delivered by	☒ Client	☐ Lab Pers	☐ Parcel Svc
2.2 Packaging	☒ Cooler	☐ Other/none	
Custody Seals	☐ Present	☒ Absent	☐ Broken
Ice	☒ Present	☐ Absent	☐ Melted
Temperature	6 °C		
2.3 Documentation			
Airbill Present	☐ Yes, # N/A		☐ No
COC	☒ Rec'd		☐ Prpd by Lab

2.4 Sample Containers				
Appropriate for specified analyses?		☒ Yes	☐ No*	
Intact?		☒ Yes	☐ No*	
Labeled, and labels legible?		☒ Yes	☐ No*	
Labels agree with COC?		☒ Yes	☐ No*	
2.5 Preservation (water samples only)				
Metals	pH<2	☐ Yes	☐ No*	☒ NA
Cyanides	pH >12	☐ Yes	☐ No*	☒ NA
Sulfides	pH >9	☐ Yes	☐ No*	☒ NA
BNA, Pest, PCB, CN, Phenols, NO_3	Cl_2 absent	☐ Yes	☐ No*	☒ NA
TOC, COD, Oil/Grease, Phenols, TPH	pH<2	☐ Yes	☐ No*	☒ NA
TOX, TKN, NH3, Tot. P.	pH<2	☐ Yes	☐ No*	☒ NA
Were preservatives added at lab?		☐ Yes*	☐ No	☒ N/A

Comments (note: any response marked "*" requires detailed explanation identify specific samples, what was wrong, and what was done)

Initials: DAG Date: 5/24/02

APPENDIX B

MONITORING WELL LOGS

SECOR
International Incorporated

Logged By:	Date Drilled:	Drilling Contractor	Project Name:	Method/Equipment:	Well Number:
SM	**09/17/02**	**Parratt-Wolff, Inc.**	**Sunoco, Inc. Philadelphia Refinery - AST 797**	**Hollow Stem Auger Split Spoon**	**MW-1**

See "Legend to Logs" for sampling method, classifications and laboratory testing methods	Boring Diam.(in.):	Surface Elev.(ft.):	Groundwater Depth (ft.): ▽ **2**	Total Depth (ft.): **11.0**	Drive wt.(lbs.):	Drop Dist.(in.):

Well Construction	Depth, (ft.)	Sample Type	Description	Recovery (Feet)	PID Reading (ppm)
	0		GRAVEL, fine; gray, dry.		
			SAND, fine; some silt, some medium to coarse sand, little fine gravel, black, dry to 2 feet, moist/wet at 2 feet.		549
				.9	
	5		SILT; some fine to medium sand, trace coarse sand, trace organic material, black, wet.		424
			SAND, fine to medium; little coarse sand, trace fine gravel, black, wet.	1.0	1050
					564
			SILT; little fine to medium sand, dark gray, wet.	1.5	13.7
			SAND, fine and SILT; little medium to coarse sand, trace fine gravel, black, wet.		86
	10			1.4	
			SAND, fine to medium; little coarse sand, trace fine gravel, trace silt, black, wet.		380
			SILT; some fine sand, dark gray, wet.		41
	15				
	20				

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

Project No. **62SU.01011.02** Date **September, 2002**

Log of Well

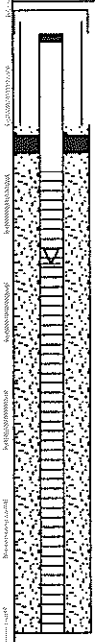
AST 797 WELLS.GPJ
LOG OF BOREHOLE

Figure

SECOR
International Incorporated

Logged By:	Date Drilled:	Drilling Contractor	Project Name:	Method/Equipment:	Well Number:
SM	**09/17/02**	**Parratt-Wolff, Inc.**	**Sunoco, Inc. Philadelphia Refinery - AST 797**	**Hollow Stem Auger Split Spoon**	**MW-2**

See "Legend to Logs" for sampling method, classifications and laboratory testing methods	Boring Diam.(in.):	Surface Elev.(ft.):	Groundwater Depth (ft.): ▽ 3	Total Depth (ft.): 11.0	Drive wt.(lbs.):	Drop Dist.(in.):



Depth, (ft.)	Sample Type	Description	Recovery (Feet)	PID Reading (ppm)
0		GRAVEL, fine; gray, dry.		
		SAND, fine; some silt, some medium to coars sand, some fine gravel, black, dry to 3 feet, moist/wet at 3 feet.	.4	476
5		SAND, fine to medium; some fine gravel, some coarse sand, trace silt, black,wet.	.4	179
		SAND, fine to medium; little silt, little coarse sand, little fine gravel, black, wet.	.7	47 89
10		SILT; little fine to medium sand, trace clay, trace organic material, dark brown, wet.	.6	67
		SILT: some fine to medium sand, trace clay, trace coarse sand, black, wet.		
15				
20				

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

Project No. **62SU.01011.02** Date **September, 2002**

Log of Well

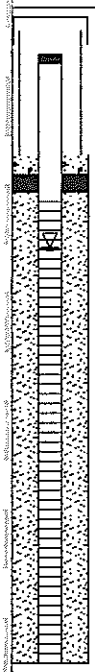
AST 797 WELLS.GPJ
LOG OF BOREHOLE

Figure

SECOR
International Incorporated

Logged By:	Date Drilled:	Drilling Contractor	Project Name:	Method/Equipment:	Well Number:
SM	**09/16/02**	**Parratt-Wolff, Inc.**	**Sunoco, Inc. Philadelphia Refinery - AST 797**	**Hollow Stem Auger Split Spoon**	**MW-3**

See "Legend to Logs" for sampling method, classifications and laboratory testing methods	Boring Diam.(in.):	Surface Elev.(ft.):	Groundwater Depth (ft.): ▽ **2**	Total Depth (ft.): **11.0**	Drive wt.(lbs.):	Drop Dist.(in.):



Depth, (ft.)	Sample Type	Description	Recovery (Feet)	PID Reading (ppm)
0		SAND, fine to coarse; some silt, some fine gravel, pieces of brick, black, dry to 2 feet, wet at 2 feet.		9999
5		SAND, fine to coarse; trace silt, black, wet.	.4	
			0.1	827 2.7
		Piece of brick, little silt clump, three coarse pieces of sand, black, wet. SAND, fine; some medium to coarse sand, trace fine gravel, black, wet.	0.3	
10			1	424
		SAND, fine to medium; black, wet.		820
		GRAVEL, fine; little fine to coarse sand, black, wet.		527
		SAND, fine to medium; some silt, trace coarse sand, black, wet.		801
15				
20				

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

Project No. **62SU.01011.02** Date **September, 2002**

Log of Well

AST 797 WELLS.GPJ
LOG OF BOREHOLE

Figure

APPENDIX C

SLUG TEST GRAPHS

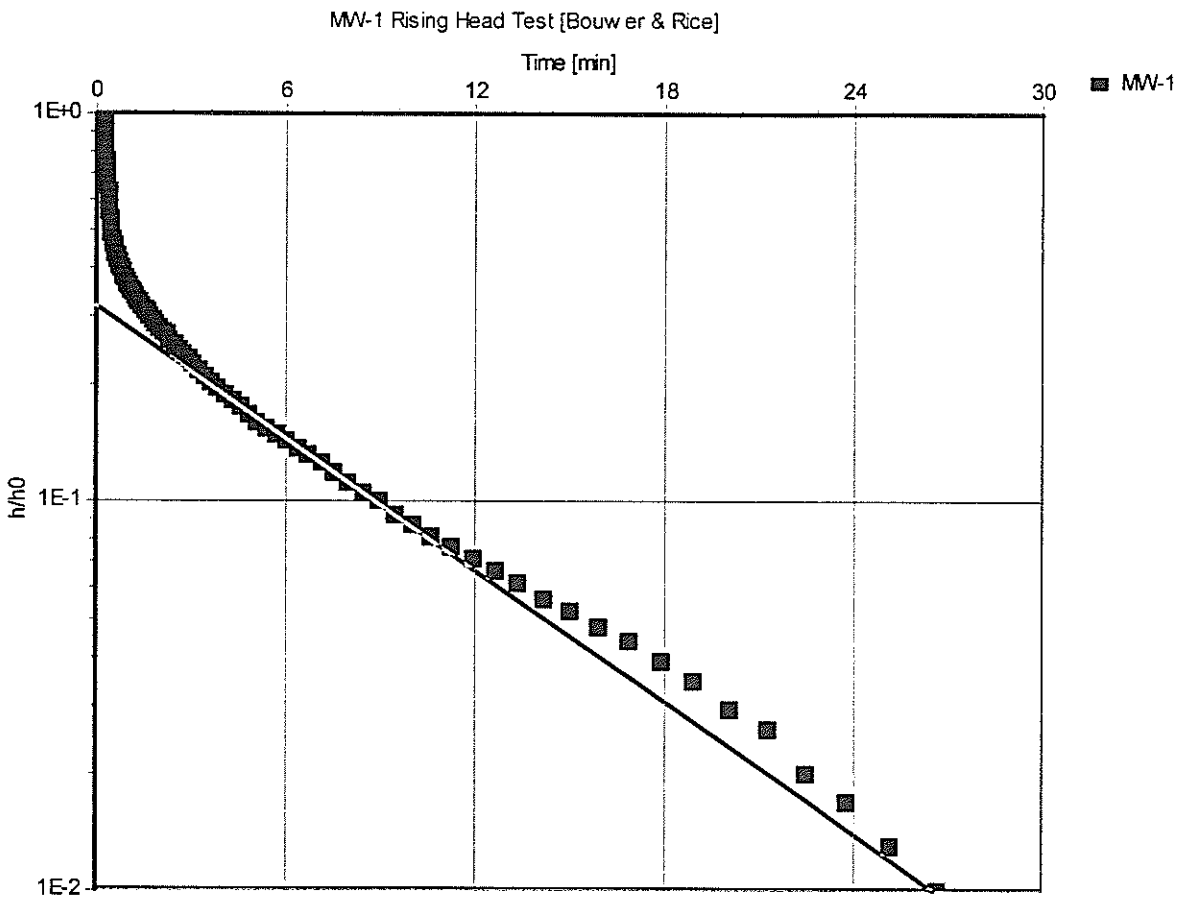
SECOR International, Inc.
102 Pickering Way - Suite 200
Exton, PA
Phone: (484) 875-3075

Slug Test Analysis Report

Project: AST 797

Number:

Client: Sunoco



Slug Test: **MW-1 Rising Head Test**

Analysis Method: **Bouwer & Rice**

Analysis Results:

Conductivity: 1.66E+0 [ft/d]

Test parameters:				
	Test Well:	MW-1	Aquifer Thickness:	9.54 [ft]
	Casing radius:	0.167 [ft]	Gravel Pack Porosity (%)	25
	Screen length:	9.54 [ft]		
	Boring radius:	0.458 [ft]		
	r(eff):	0.271 [ft]		

Comments:

Evaluated by:

Evaluation Date: 11/6/02

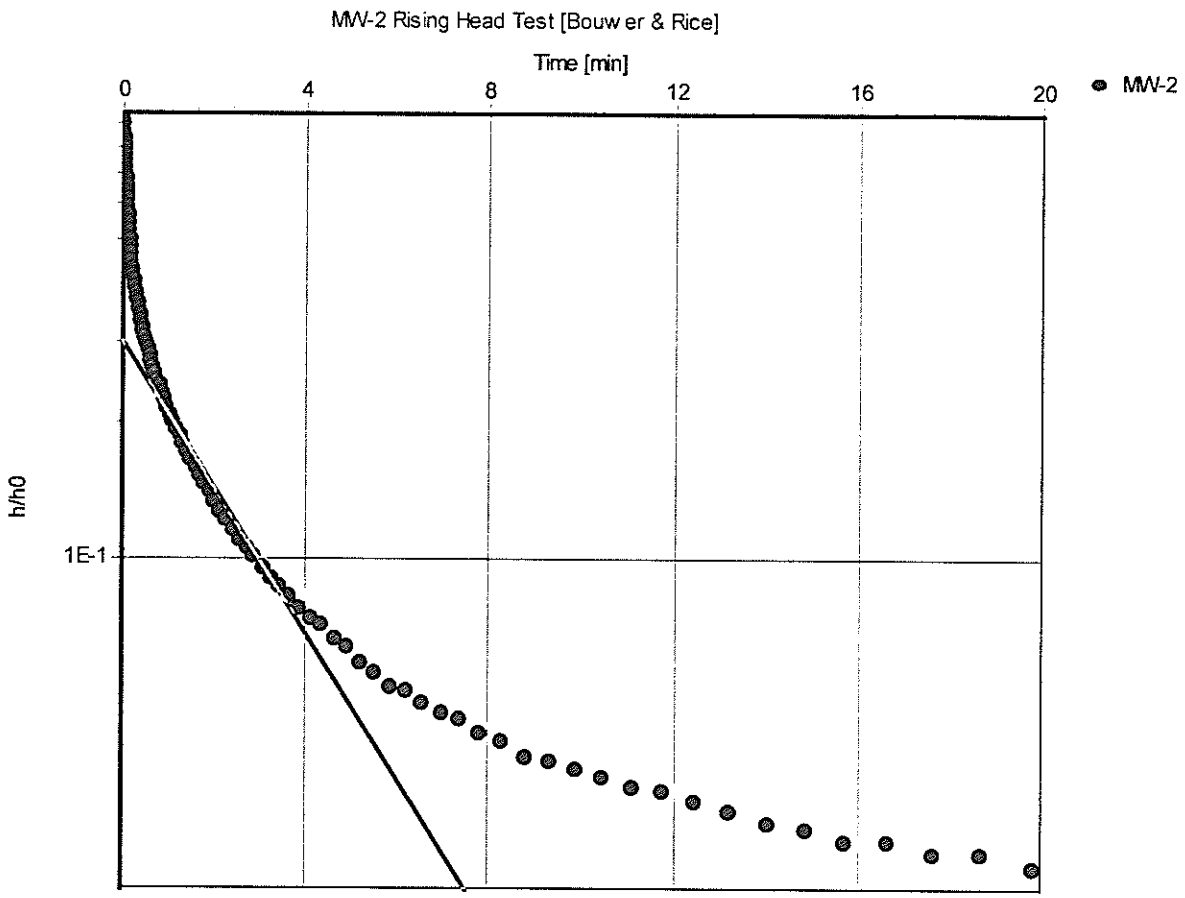
SECOR International, Inc.
102 Pickering Way - Suite 200
Exton, PA
Phone: (484) 875-3075

Slug Test Analysis Report

Project: AST 797

Number:

Client: Sunoco



Slug Test: **MW-2 Rising Head Test**

Analysis Method: **Bouwer & Rice**

Analysis Results:

Conductivity: 4.98E+0 [ft/d]

Test parameters:

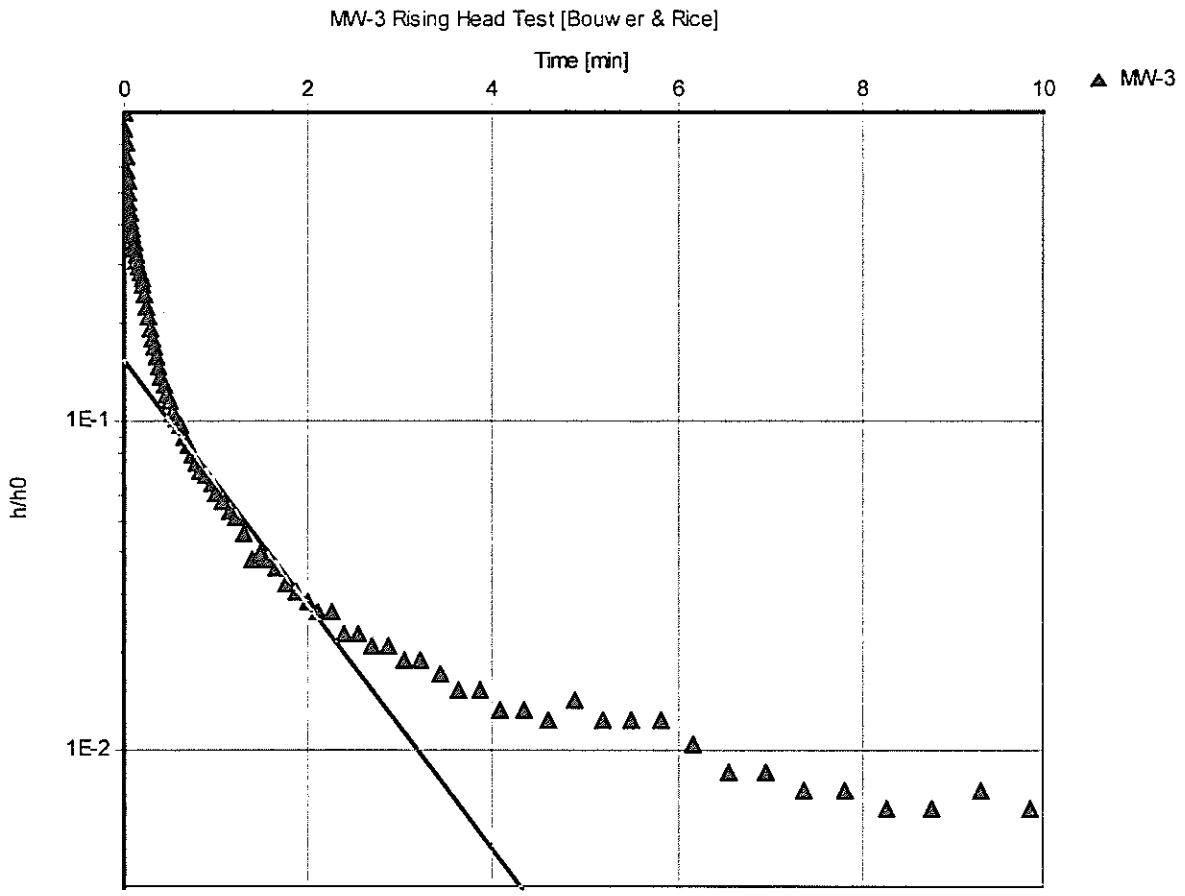
Test Well:	MW-2	Aquifer Thickness:	8.71 [ft]
Casing radius:	0.167 [ft]	Gravel Pack Porosity (%)	25
Screen length:	8.71 [ft]		
Boring radius:	0.458 [ft]		
r(eff):	0.271 [ft]		

Comments:

Evaluated by:

Evaluation Date: 11/6/02

SECOR International, Inc.	Slug Test Analysis Report
102 Pickering Way - Suite 200	Project: AST 797
Exton, PA	Number:
Phone: (484) 875-3075	Client: Sunoco



Slug Test: **MW-3 Rising Head Test**

Analysis Method: **Bouwer & Rice**

Analysis Results:

Conductivity: 1.21E+1 [ft/d]

Test parameters:

Test Well:	MW-3	Aquifer Thickness:	8.07 [ft]
Casing radius:	0.167 [ft]	Gravel Pack Porosity (%)	25
Screen length:	8.07 [ft]		
Boring radius:	0.458 [ft]		
r(eff):	0.271 [ft]		

Comments:

Evaluated by:

Evaluation Date: 11/6/02

APPENDIX D

SOIL SAMPLE ANALYTICAL DATA

Lancaster Laboratories
Where quality is a science.

RECEIVED 11-1-02

ANALYTICAL RESULTS

Prepared for:

Sun: SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341
484-875-9075

Prepared by:

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

SAMPLE GROUP

The sample group for this submittal is 823334. Samples arrived at the laboratory on Wednesday, September 18, 2002. The PO# for this group is 1037.

Client Description	Lancaster Labs Number
MW-1(1-1.5) Grab Soil Sample	3901264
MW-2(1-1.5) Grab Soil Sample	3901265
MW-3(1-1.5) Grab Soil Sample	3901266
Trip Blank Methanol Sample	3901267

1 COPY TO Sun: SECOR International, Inc Attn: Mr. Steve Bagett

Questions? Contact your Client Services Representative
Sandra L Patton at (717) 656-2300.

Respectfully Submitted,

Robert E. Mellinger
Sr Chemist/Coordinator

Lancaster Laboratories
Where quality is a science.

Lancaster Laboratories Sample No. SW 3901264

Collected:09/17/2002 10:40 by SM

Account Number: 11183

Submitted: 09/18/2002 15:30
Reported: 09/25/2002 at 12:28
Discard: 10/03/2002
MW-1(1-1.5) Grab Soil Sample
SUNOCO: AST 797

Sun: SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341

1115-

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Limit of Quantitation	Units	Dilution Factor
00111	Moisture	n.a.	22.7	0.50	% by wt.	1

"Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The result reported above is on an as-received basis.

02304 UST-Unleaded Soils by 8260B

02016	Methyl t-butyl ether	1634-04-4	< 310.	310.	ug/kg	48.26
05460	Benzene	71-43-2	2,600.	310.	ug/kg	48.26
05466	Toluene	108-88-3	1,600.	310.	ug/kg	48.26
05474	Ethylbenzene	100-41-4	3,700.	310.	ug/kg	48.26
05479	Isopropylbenzene	98-82-8	60,000.	1,600.	ug/kg	241.31
05498	Naphthalene	91-20-3	1,800.	310.	ug/kg	48.26
06301	Xylene (Total)	1330-20-7	3,500.	310.	ug/kg	48.26

The analysis for volatiles was performed on a sample which was preserved in methanol. The reporting limits were adjusted appropriately.

Poor surrogate recoveries were observed for the GC/MS volatile fraction. The analysis was repeated and poor surrogate recoveries were again observed indicating a significant matrix effect.

00405 Field Preserved Methanol
The sample submitted for volatile organic analysis was preserved with methanol in the field.

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Analysis Trial#	Date and Time	Analyst	Dilution Factor
00111	Moisture	EPA 160.3 modified	1	09/19/2002 08:32	Helen L Schaeffer	1
02304	UST-Unleaded Soils by 8260B	SW-846 8260B	1	09/23/2002 17:32	Bryan J Polick	48.26
02304	UST-Unleaded Soils by 8260B	SW-846 8260B	1	09/23/2002 19:55	Bryan J Polick	241.31

MEMBER ACIL
Lancaster Laboratories, Inc.
2425 New Holland Pike
PO Box 12425
Lancaster, PA 17605-2425
717-656-2300 Fax: 717-656-2681

Lancaster Laboratories
Where quality is a science.

Lancaster Laboratories Sample No. SW 3901265

Collected:09/17/2002 08:00 by SM

Account Number: 11183

Submitted: 09/18/2002 15:30
Reported: 09/25/2002 at 12:28
Discard: 10/03/2002
MW-2(1-1.5) Grab Soil Sample
SUNOCO: AST 797

Sun: SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341

2115-

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Limit of Quantitation	Units	Dilution Factor
00111	Moisture	n.a.	27.4	0.50	% by wt.	1

"Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The result reported above is on an as-received basis.

02304 UST-Unleaded Soils by 8260B

02016	Methyl t-butyl ether	1634-04-4	< 330.	330.	ug/kg	47.53
05460	Benzene	71-43-2	6,500.	330.	ug/kg	47.53
05466	Toluene	108-88-3	< 330.	330.	ug/kg	47.53
05474	Ethylbenzene	100-41-4	520.	330.	ug/kg	47.53
05479	Isopropylbenzene	98-82-8	190,000.	3,300.	ug/kg	475.29
05498	Naphthalene	91-20-3	1,900.	330.	ug/kg	47.53
06301	Xylene (Total)	1330-20-7	860.	330.	ug/kg	47.53

The analysis for volatiles was performed on a sample which was preserved in methanol. The reporting limits were adjusted appropriately.

Poor surrogate recoveries were observed for the GC/MS volatile fraction. The analysis was repeated and poor surrogate recoveries were again observed indicating a significant matrix effect.

00405 Field Preserved Methanol
The sample submitted for volatile organic analysis was preserved with methanol in the field.

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
00111	Moisture	EPA 160.3 modified	1	09/19/2002 08:32	Helen L Schaeffer	1
02304	UST-Unleaded Soils by 8260B	SW-846 8260B	1	09/23/2002 18:08	Bryan J Polick	47.53
02304	UST-Unleaded Soils by 8260B	SW-846 8260B	1	09/23/2002 20:30	Bryan J Polick	475.29

MEMBER ACIL
Lancaster Laboratories, Inc.
2425 New Holland Pike
PO Box 12425
Lancaster, PA 17605-2425
717-656-2300 Fax: 717-656-2681

Lancaster Laboratories
Where quality is a science.

Lancaster Laboratories Sample No. SW 3901266

Collected:09/16/2002 14:45 by SM

Account Number: 11183

Submitted: 09/18/2002 15:30
Reported: 09/25/2002 at 12:28
Discard: 10/03/2002
MW-3(1-1.5) Grab Soil Sample
SUNOCO: AST 797

Sun: SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341

31115

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Limit of Quantitation	Units	Dilution Factor
00111	Moisture	n.a.	14.2	0.50	% by wt.	1

"Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The result reported above is on an as-received basis.

02304 UST-Unleaded Soils by 8260B

02016	Methyl t-butyl ether	1634-04-4	< 1,100.	1,100.	ug/kg	187.97
05460	Benzene	71-43-2	610,000.	11,000.	ug/kg	1879.7
05466	Toluene	108-88-3	300,000.	11,000.	ug/kg	1879.7
05474	Ethylbenzene	100-41-4	14,000.	1,100.	ug/kg	187.97
05479	Isopropylbenzene	98-82-8	270,000.	11,000.	ug/kg	1879.7
05498	Naphthalene	91-20-3	4,800.	1,100.	ug/kg	187.97
06301	Xylene (Total)	1330-20-7	67,000.	1,100.	ug/kg	187.97

The analysis for volatiles was performed on a sample which was preserved in methanol. The reporting limits were adjusted appropriately.

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

Poor surrogate recoveries were observed for the GC/MS volatile fraction due to the dilution needed to perform the analysis.

00405 Field Preserved Methanol

The sample submitted for volatile organic analysis was preserved with methanol in the field.

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
00111	Moisture	EPA 160.3 modified	1	09/19/2002 08:32	Helen L Schaeffer	1
02304	UST-Unleaded Soils by 8260B	SW-846 8260B	1	09/23/2002 16:57	Bryan J Polick	1879.7
02304	UST-Unleaded Soils by 8260B	SW-846 8260B	1	09/23/2002 18:43	Bryan J Polick	187.97

MEMBER ACIL
Lancaster Laboratories, Inc.
2425 New Holland Pike
PO Box 12425
Lancaster, PA 17605-2425
717-656-2300 Fax: 717-656-2681

Lancaster Laboratories
Where quality is a science.

Lancaster Laboratories Sample No. SW 3901266

Collected:09/16/2002 14:45 by SM

Submitted: 09/18/2002 15:30
Reported: 09/25/2002 at 12:28
Discard: 10/03/2002
MW-3(1-1.5) Grab Soil Sample
SUNOCO: AST 797

Account Number: 11183

Sun: SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341

31115

MEMBER ACIL
Lancaster Laboratories, Inc.
2425 New Holland Pike
PO Box 12425
Lancaster, PA 17605-2425
717-656-2300 Fax: 717-656-2681

Lancaster Laboratories
Where quality is a science.

Lancaster Laboratories Sample No. SW 3901267

Collected: n.a.

Account Number: 11183

Submitted: 09/18/2002 15:30
Reported: 09/25/2002 at 12:28
Discard: 10/03/2002
Trip Blank Methanol Sample
SUNOCO: AST 797

Sun: SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341

METTB

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation	Units	Dilution Factor
02304	UST-Unleaded Soils by 8260B					
02016	Methyl t-butyl ether	1634-04-4	< 250.	250.	ug/kg	50
05460	Benzene	71-43-2	< 250.	250.	ug/kg	50
05466	Toluene	108-88-3	< 250.	250.	ug/kg	50
05474	Ethylbenzene	100-41-4	< 250.	250.	ug/kg	50
05479	Isopropylbenzene	98-82-8	< 250.	250.	ug/kg	50
05498	Naphthalene	91-20-3	< 250.	250.	ug/kg	50
06301	Xylene (Total)	1330-20-7	< 250.	250.	ug/kg	50

The analysis for volatiles was performed on a sample which was preserved in methanol. The reporting limits were adjusted appropriately.

00405 Field Preserved Methanol
The sample submitted for volatile organic analysis was preserved with methanol in the field.

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Analysis Trial#	Analysis Date and Time	Analyst	Dilution Factor
02304	UST-Unleaded Soils by 8260B	SW-846 8260B	1	09/20/2002 22:52	Bryan J Polick	50

MEMBER ACIL
Lancaster Laboratories, Inc.
2425 New Holland Pike
PO Box 12425
Lancaster, PA 17605-2425
717-656-2300 Fax: 717-656-2681

Analysis Request / Environmental Services Chain of Custody

Lancaster Laboratories
Where quality is a science.

For Lancaster Laboratories use only
Acct. # 11183 Group# 823334 Sample # 3901264-67

COC # 0003488

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

(1)
Client: SUNOCO / SECOR Acct. #:
Project Name/#: AST 797 PWSID #:
Project Manager: STEVE BAGGETT P.O.#:
Sampler: SERGIO MORESCALCHI Quote #:
Name of state where samples were collected: PA

(2) Sample Identification	Date Collected	Time Collected	(3) Grab	Composite	(4) Matrix: Soil	Water (Potable / NPDES)	Other	Total # of Containers	(5) Analyses Requested: BTEX, Cumene & 8260B, MTBE, Naphthalene	Remarks
MW-1 (1-1.5)	9/17/02	1040	✓		✓			2	✓ ✓	
MW-2 (1-1.5)	9/17/02	0800	✓		✓			2	✓ ✓	cooler temp 3°C @ 9/19/02
MW-3 (1-1.5)	9/16/02	1445	✓		✓			2	✓ ✓	
TRIP BLANK							✓	1	✓ ✓	

(6) For Lab Use Only
FSC:
SCR #: 116834

Temperature of samples upon receipt (if requested)

(7) **Turnaround Time Requested** (TAT) (please circle): ~~Normal~~ 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 I (Tier I), Type II (Tier II), Type III (NJ Red. Del.), Type IV (CLP), Type VI (Raw Data), GLP, Other
SDG Complete? Yes No
State-specific QC required? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal Chain of Custody required? Yes No

(9)

Relinquished by:	Date	Time	Received by:	Date	Time
K. Hunt	9-12-02	1500			
Karen R. Middleton	9/18/02	950		9/19/02	1429
	9/19-02	1535			

Lancaster Laboratories, Inc., 2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 (717) 656-2300
Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

2102 Rev. 7/1/02

Lancaster Laboratories
Where quality is a science.

ANALYTICAL RESULTS

Prepared for:

Sun: SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341
484-875-9075

Prepared by:

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

SAMPLE GROUP

The sample group for this submittal is 827419. Samples arrived at the laboratory on Friday, October 18, 2002.

Client Description	Lancaster Labs Number
MW-1(1-1.5) Grab Soil Sample	3922341
MW-2(1-1.5) Grab Soil Sample	3922342
MW-3(1-1.5) Grab Soil Sample	3922343

1 COPY TO Sun: SECOR International, Inc Attn: Mr. Steve Baggett

Questions? Contact your Client Services Representative
Sandra L Patton at (717) 656-2300.

Respectfully Submitted,

Robert E. Mellinger
Sr Chemist/Coordinator

Lancaster Laboratories
Where quality is a science.

Lancaster Laboratories Sample No. TL 3922341

Collected:10/17/2002 14:45 by SM

Account Number: 11183

Submitted: 10/18/2002 15:30
Reported: 10/31/2002 at 01:38
Discard: 11/15/2002
MW-1(1-1.5) Grab Soil Sample
SPLP ZERO HEADSPACE EXTRACTION
SUNOCO: AST 797

Sun: SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341

MW001

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation	Units	Dilution Factor
02300	UST-Unleaded Waters by 8260B					
05401	Benzene	71-43-2	23.	5.	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
02300	UST-Unleaded Waters by 8260B	SW-846 8260B	1	10/29/2002 15:45	Susan McMahon-Luu	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	10/29/2002 15:45	Susan McMahon-Luu	n.a.
08792	SPLP Volatile Extraction	SW-846 1312	1	10/21/2002 14:30	David G Splain Jr	n.a.

Lancaster Laboratories
Where quality is a science.

Lancaster Laboratories Sample No. TL 3922342

Collected:10/17/2002 14:30 by SM

Account Number: 11183

Submitted: 10/18/2002 15:30
Reported: 10/31/2002 at 01:38
Discard: 11/15/2002
MW-2(1-1.5) Grab Soil Sample
SPLP ZERO HEADSPACE EXTRACTION
SUNOCO: AST 797

Sun: SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341

MW002

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation	Units	Dilution Factor
02300	UST-Unleaded Waters by 8260B					
05401	Benzene	71-43-2	860.	25.	ug/l	5

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
02300	UST-Unleaded Waters by 8260B	SW-846 8260B	1	10/29/2002 19:49	Parker D Lindstrom	5
01163	GC/MS VOA Water Prep	SW-846 5030B	1	10/29/2002 19:49	Parker D Lindstrom	n.a.
08792	SPLP Volatile Extraction	SW-846 1312	1	10/21/2002 14:30	David G Splain Jr	n.a.

Lancaster Laboratories
Where quality is a science.

Lancaster Laboratories Sample No. TL 3922343

Collected:10/17/2002 13:15 by SM

Account Number: 11183

Submitted: 10/18/2002 15:30
Reported: 10/31/2002 at 01:38
Discard: 11/15/2002
MW-3(1-1.5) Grab Soil Sample
SPLP ZERO HEADSPACE EXTRACTION
SUNOCO: AST 797

Sun: SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341

MW003

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation	Units	Dilution Factor
02300	UST-Unleaded Waters by 8260B					
05401	Benzene	71-43-2	20,000.	500.	ug/l	100
05407	Toluene	108-88-3	7,200.	500.	ug/l	100

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
02300	UST-Unleaded Waters by 8260B	SW-846 8260B	1	10/29/2002 21:06	Parker D Lindstrom	100
01163	GC/MS VOA Water Prep	SW-846 5030B	1	10/29/2002 21:06	Parker D Lindstrom	n.a.
08792	SPLP Volatile Extraction	SW-846 1312	1	10/21/2002 14:30	David G Splain Jr	n.a.

Lancaster Laboratories
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Quality Control Summary

Client Name: Sun: SECOR International, Inc
Reported: 10/31/02 at 01:38 AM

Group Number: 827419

Laboratory Compliance Quality Control

Analysis Name	Blank Result	Blank LOQ	Report Units	LCS %REC	LCSD %REC	LCS/LCSD Limits	RPD	RPD Max
Batch number: R023022AB	Sample number(s): 3922341-3922343							
Benzene	N.D.	5.	ug/l	98		85-117		
Toluene	N.D.	5.	ug/l	100		85-115		

Sample Matrix Quality Control

Analysis Name	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD MAX	BKG Conc	DUP Conc	DUP RPD	Dup RPD Max
Batch number: R023022AB	Sample number(s): 3922341-3922343								
Benzene	(2)	(2)	78-134	1	30				
Toluene	101	105	83-127	4	30				

Surrogate Quality Control

Analysis Name: UST-Unleaded Waters by 8260B
Batch number: R023022AB

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
3922341	93	87	97	97
3922342	94	89	94	95
3922343	92	86	93	96
Blank	96	89	94	93
LCS	95	90	96	99
MS	92	86	94	97
MSD	94	88	94	96
Limits:	86-118	80-120	88-110	86-115

*- Outside of specification
(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.

MEMBER ACIL
Lancaster Laboratories, Inc.
2425 New Holland Pike
PO Box 12425
Lancaster, PA 17605-2425
717-656-2300 Fax: 717-656-2681

Analysis Request / Environmental Services Chain of Custody

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For Lancaster Laboratories use only
Acct. # 11188 Group# 827419 Sample # 3922341-46

COC # NOV 06 2002
COC # 0006291

RECEIVED
By

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

(1)
Clie.. ECOR Acct. #:
Project Name/#: SUNOCO - AST 797 PWSID #:
Project Manager: STEVE BAGGETT P.O.#:
Sampler: SERGIO MORESCALCHI Quote #:
Name of state where samples were collected: PA

For Lab Use Only
FSC:
SCR #: 1170765

(2) Sample Identification	Date Collected	Time Collected	(3) Grab	Composite	(4) Matrix: Soil	Water	Other	Total # of Containers	(5) Analyses Requested: SPLP Benzene	SPLP Toluene	Remarks	(6) Temperature of samples upon receipt (if requested)
MW-1(1-1.5)	10/17/02	1445	✓		✓			2	✓		temp 3.0 C	
MW-2(1-1.5)	10/17/02	1430	✓		✓			2	✓		DB 10/18/02	
MW-3(1-1.5)	10/17/02	1315	✓		✓			2	✓	✓		

Matrix: ☐ Potable ☐ NPDES (Check if Applicable)

(7) **Turnaround Time Requested** (TAT) (please circle): (Normal) 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)	SDG Complete? Yes No
Type I (Tier I)	GLP	State-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)

Relinquished by:	Date	Time	Received by:	Date	Time
K. Hunt	10-14-02	1010		10/15/02	0730
	10/15/02	1035			
S. Baggett	10/16	9:30		10/17/02	0930
	10/17/02	1330			
				10/18/02	1150

APPENDIX E

GROUNDWATER ANALYTICAL DATA

Lancaster Laboratories
Where quality is a science.

ANALYTICAL RESULTS

Prepared for:

Sun: SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341
484-875-9075

Prepared by:

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

SAMPLE GROUP

The sample group for this submittal is 827401. Samples arrived at the laboratory on Friday, October 18, 2002. The PO# for this group is 1037.

Client Description	Lancaster Labs Number
MW-3 Grab Water Sample	3922244
MW-2 Grab Water Sample	3922245
MW-1 Grab Water Sample	3922246
Trip Blank Water Sample	3922247

1 COPY TO Sun: SECOR International, Inc Attn: Mr. Steve Baggett

Questions? Contact your Client Services Representative
Sandra L Patton at (717) 656-2300.

Respectfully Submitted,

Robert E. Mellinger
Sr Chemist/Coordinator

MEMBER ACIL
Lancaster Laboratories, Inc.
2425 New Holland Pike
PO Box 12425
Lancaster, PA 17605-2425
717-656-2300 Fax: 717-656-2681

Lancaster Laboratories
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Lancaster Laboratories Sample No. WW 3922244

Collected:10/17/2002 08:40 by DS

Account Number: 11183

Submitted: 10/18/2002 15:30
Reported: 10/27/2002 at 13:45
Discard: 11/04/2002
MW-3 Grab Water Sample
SUNOCO: AST 797

Sun: SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341

797-3

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation	Units	Dilution Factor
02300	UST-Unleaded Waters by 8260B					
02010	Methyl t-butyl ether	1634-04-4	N.D.	5,000.	ug/l	1000
05401	Benzene	71-43-2	610,000.	25,000.	ug/l	5000
05407	Toluene	108-88-3	59,000.	5,000.	ug/l	1000
05415	Ethylbenzene	100-41-4	N.D.	5,000.	ug/l	1000
05420	Isopropylbenzene	98-82-8	< 5,000.	5,000.	ug/l	1000
05439	Naphthalene	91-20-3	N.D.	5,000.	ug/l	1000
06310	Xylene (Total)	1330-20-7	< 5,000.	5,000.	ug/l	1000

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

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
02300	UST-Unleaded Waters by 8260B	SW-846 8260B	1	10/24/2002 13:48	Trent S Sprenkle	5000
02300	UST-Unleaded Waters by 8260B	SW-846 8260B	1	10/24/2002 16:19	Trent S Sprenkle	1000
01163	GC/MS VOA Water Prep	SW-846 5030B	1	10/24/2002 13:48	Trent S Sprenkle	n.a.

Lancaster Laboratories
Where quality is a science.

Lancaster Laboratories Sample No. WW 3922245

Collected:10/17/2002 09:05 by DS

Account Number: 11183

Submitted: 10/18/2002 15:30
Reported: 10/27/2002 at 13:45
Discard: 11/04/2002
MW-2 Grab Water Sample
SUNOCO: AST 797

Sun: SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341

797-2

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation	Units	Dilution Factor
02300	UST-Unleaded Waters by 8260B					
02010	Methyl t-butyl ether	1634-04-4	N.D.	250.	ug/l	50
05401	Benzene	71-43-2	28,000.	1,000.	ug/l	200
05407	Toluene	108-88-3	< 250.	250.	ug/l	50
05415	Ethylbenzene	100-41-4	< 250.	250.	ug/l	50
05420	Isopropylbenzene	98-82-8	2,000.	250.	ug/l	50
05439	Naphthalene	91-20-3	< 250.	250.	ug/l	50
06310	Xylene (Total)	1330-20-7	N.D.	250.	ug/l	50

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

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
02300	UST-Unleaded Waters by 8260B	SW-846 8260B	1	10/24/2002 16:49	Trent S Sprenkle	50
02300	UST-Unleaded Waters by 8260B	SW-846 8260B	1	10/24/2002 17:18	Trent S Sprenkle	200
01163	GC/MS VOA Water Prep	SW-846 5030B	1	10/24/2002 16:49	Trent S Sprenkle	n.a.

Lancaster Laboratories
Where quality is a science.

Lancaster Laboratories Sample No. WW 3922246

Collected:10/17/2002 09:30 by DS

Account Number: 11183

Submitted: 10/18/2002 15:30
Reported: 10/27/2002 at 13:45
Discard: 11/04/2002
MW-1 Grab Water Sample
SUNOCO: AST 797

Sun: SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341

797-1

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation	Units	Dilution Factor
02300	UST-Unleaded Waters by 8260B					
02010	Methyl t-butyl ether	1634-04-4	N.D.	5.	ug/l	1
05401	Benzene	71-43-2	32.	5.	ug/l	1
05407	Toluene	108-88-3	5.	5.	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	ug/l	1
05420	Isopropylbenzene	98-82-8	16.	5.	ug/l	1
05439	Naphthalene	91-20-3	< 5.	5.	ug/l	1
06310	Xylene (Total)	1330-20-7	< 5.	5.	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
02300	UST-Unleaded Waters by 8260B	SW-846 8260B	1	10/22/2002 20:43	Trent S Sprenkle	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	10/22/2002 20:43	Trent S Sprenkle	n.a.

Lancaster Laboratories
Where quality is a science.

Lancaster Laboratories Sample No. WW 3922247

Collected: n.a.

Account Number: 11183

Submitted: 10/18/2002 15:30
Reported: 10/27/2002 at 13:45
Discard: 11/04/2002
Trip Blank Water Sample
SUNOCO: AST 797

Sun: SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341

797TB

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation	Units	Dilution Factor
02300	UST-Unleaded Waters by 8260B					
02010	Methyl t-butyl ether	1634-04-4	N.D.	5.	ug/l	1
05401	Benzene	71-43-2	N.D.	5.	ug/l	1
05407	Toluene	108-88-3	N.D.	5.	ug/l	1
05415	Ethylbenzene	100-41-4	N.D.	5.	ug/l	1
05420	Isopropylbenzene	98-82-8	N.D.	5.	ug/l	1
05439	Naphthalene	91-20-3	N.D.	5.	ug/l	1
06310	Xylene (Total)	1330-20-7	N.D.	5.	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
02300	UST-Unleaded Waters by 8260B	SW-846 8260B	1	10/22/2002 21:13	Trent S Sprenkle	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	10/22/2002 21:13	Trent S Sprenkle	n.a.

MEMBER ACIL
Lancaster Laboratories, Inc.
2425 New Holland Pike
PO Box 12425
Lancaster, PA 17605-2425
717-656-2300 Fax: 717-656-2681

Analysis Request / Environmental Services Chain of Custody

Lancaster Laboratories
Where quality is a science.

For Lancaster Laboratories use only
Acct. # 11183 Group# 827401 Sample # 3922244-47

COC # 0006021

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

(1)
Client: Secor Acct. #:
Project Name/#: Sunoco AST 797 PWSID #:
Project Manager: Steve Baggett P.O.#:
Sampler: Dave Seaman Quote #:
Name of state where samples were collected: PA

For Lab Use Only
FSC:
SCR #: 11079

(2) Sample Identification	Date Collected	Time Collected	(3) Grab	Composite	Matrix: Soil	Water (Potable / NPDES)	Other	(4) Total # of Containers	(5) Analyses Requested: 2300 UST-UN	Remarks
MW-3	10-17	8:40	X			X		3	X	
MW-2	10-17	9:05	X			X		3	X	
MW-1	10-17	9:30	X			X		3	X	cooler temp 4°C SP 10/21/02

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(6) Temperature of samples upon receipt (if requested)

(7) **Turnaround Time Requested** (TAT) (please circle): Normal 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 #: 484 875-3075 Fax #: 484 875-9286
E-mail address:

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

Relinquished by:	Date	Time	Received by:	Date	Time
	10/17/02	8:25			
Dave Seaman	10/17/02	3:30			
	10/18/02	1530		10/18/02	0950
				10/18/02	1530

(9)

Lancaster Laboratories, Inc., 2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 (717) 656-2300
Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

2102 Rev. 7/1/02

Lancaster Laboratories
Where quality is a science.

ANALYTICAL RESULTS

Prepared for:

Sun: SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341
484-875-9075

Prepared by:

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

SAMPLE GROUP

The sample group for this submittal is 831613. Samples arrived at the laboratory on Wednesday, November 20, 2002. The PO# for this group is 1037.

Client Description	Lancaster Labs Number
MW-1 Grab Water Sample	3944152
MW-2 Grab Water Sample	3944153
MW-3 Grab Water Sample	3944154
Trip Blank Water Sample	3944155

1 COPY TO Sun: SECOR International, Inc Attn: Mr. Steve Baggett

Questions? Contact your Client Services Representative
Sandra L Patton at (717) 656-2300.

Respectfully Submitted,

Robert E. Mellinger
Sr. Chemist/Coordinator

Lancaster Laboratories
Where quality is a science.

Lancaster Laboratories Sample No. WW 3944152

Collected:11/19/2002 12:20 by SM

Account Number: 11183

Submitted: 11/20/2002 17:30
Reported: 11/22/2002 at 18:03
Discard: 11/30/2002
MW-1 Grab Water Sample
SUNOCO: AST 797

Sun: SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341

MW001

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation	Units	Dilution Factor
02300	UST-Unleaded Waters by 8260B					
02010	Methyl t-butyl ether	1634-04-4	N.D.	5.	ug/l	1
05401	Benzene	71-43-2	61.	5.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	ug/l	1
05415	Ethylbenzene	100-41-4	7.	5.	ug/l	1
05420	Isopropylbenzene	98-82-8	12.	5.	ug/l	1
05439	Naphthalene	91-20-3	< 5.	5.	ug/l	1
06310	Xylene (Total)	1330-20-7	7.	5.	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
02300	UST-Unleaded Waters by 8260B	SW-846 8260B	1	11/21/2002 22:37	Marc S Neal	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	11/21/2002 22:37	Marc S Neal	n.a.

Lancaster Laboratories
Where quality is a science.

Lancaster Laboratories Sample No. WW 3944153

Collected:11/19/2002 11:55 by SM

Account Number: 11183

Submitted: 11/20/2002 17:30
Reported: 11/22/2002 at 18:03
Discard: 11/30/2002
MW-2 Grab Water Sample
SUNOCO: AST 797

Sun: SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341

MW002

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation	Units	Dilution Factor
02300	UST-Unleaded Waters by 8260B					
02010	Methyl t-butyl ether	1634-04-4	N.D.	1,000.	ug/l	200
05401	Benzene	71-43-2	52,000.	5,000.	ug/l	1000
05407	Toluene	108-88-3	< 1,000.	1,000.	ug/l	200
05415	Ethylbenzene	100-41-4	N.D.	1,000.	ug/l	200
05420	Isopropylbenzene	98-82-8	1,800.	1,000.	ug/l	200
05439	Naphthalene	91-20-3	N.D.	1,000.	ug/l	200
06310	Xylene (Total)	1330-20-7	< 1,000.	1,000.	ug/l	200

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

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
02300	UST-Unleaded Waters by 8260B	SW-846 8260B	1	11/22/2002 15:14	John B Kiser	200
02300	UST-Unleaded Waters by 8260B	SW-846 8260B	1	11/22/2002 15:43	John B Kiser	1000
01163	GC/MS VOA Water Prep	SW-846 5030B	1	11/22/2002 15:14	John B Kiser	n.a.

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Lancaster Laboratories, Inc.
2425 New Holland Pike
PO Box 12425
Lancaster, PA 17605-2425
717-656-2300 Fax: 717-656-2681

Lancaster Laboratories
Where quality is a science.

Lancaster Laboratories Sample No. WW 3944154

Collected:11/19/2002 11:20 by SM

Account Number: 11183

Submitted: 11/20/2002 17:30
Reported: 11/22/2002 at 18:03
Discard: 11/30/2002
MW-3 Grab Water Sample
SUNOCO: AST 797

Sun: SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341

MW003

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation	Units	Dilution Factor
02300	UST-Unleaded Waters by 8260B					
02010	Methyl t-butyl ether	1634-04-4	N.D.	5,000.	ug/l	1000
05401	Benzene	71-43-2	500,000.	25,000.	ug/l	5000
05407	Toluene	108-88-3	62,000.	5,000.	ug/l	1000
05415	Ethylbenzene	100-41-4	N.D.	5,000.	ug/l	1000
05420	Isopropylbenzene	98-82-8	< 5,000.	5,000.	ug/l	1000
05439	Naphthalene	91-20-3	N.D.	5,000.	ug/l	1000
06310	Xylene (Total)	1330-20-7	< 5,000.	5,000.	ug/l	1000

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

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
02300	UST-Unleaded Waters by 8260B	SW-846 8260B	1	11/22/2002 14:59	John B Kiser	1000
02300	UST-Unleaded Waters by 8260B	SW-846 8260B	1	11/22/2002 15:28	John B Kiser	5000
01163	GC/MS VOA Water Prep	SW-846 5030B	1	11/22/2002 14:59	John B Kiser	n.a.

Lancaster Laboratories
Where quality is a science.

Lancaster Laboratories Sample No. WW 3944155

Collected: n.a.

Account Number: 11183

Submitted: 11/20/2002 17:30
Reported: 11/22/2002 at 18:03
Discard: 11/30/2002
Trip Blank Water Sample
SUNOCO: AST 797

Sun: SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341

TBXX-

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation	Units	Dilution Factor
02300	UST-Unleaded Waters by 8260B					
02010	Methyl t-butyl ether	1634-04-4	N.D.	5.	ug/l	1
05401	Benzene	71-43-2	N.D.	5.	ug/l	1
05407	Toluene	108-88-3	N.D.	5.	ug/l	1
05415	Ethylbenzene	100-41-4	N.D.	5.	ug/l	1
05420	Isopropylbenzene	98-82-8	N.D.	5.	ug/l	1
05439	Naphthalene	91-20-3	N.D.	5.	ug/l	1
06310	Xylene (Total)	1330-20-7	N.D.	5.	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
02300	UST-Unleaded Waters by 8260B	SW-846 8260B	1	11/21/2002 15:02	Marc S Neal	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	11/21/2002 15:02	Marc S Neal	n.a.

MEMBER ACIL
Lancaster Laboratories, Inc.
2425 New Holland Pike
PO Box 12425
Lancaster, PA 17605-2425
717-656-2300 Fax: 717-656-2681

Analysis Request / Environmental Services Chain of Custody

Lancaster Laboratories
Where quality is a science.

For Lancaster Laboratories use only
Acct. # 11188 Group# 831613 Sample # 394152-55

COC # 0008659

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

(1) Client: SECOR Acct. #:
Project Name/#: SUNOCO - AST 797 PWSID #:
Project Manager: STEVE BAGGETT P.O.#: 1037
Sampler: SERGIO MORESCALCHI Quote #:
Name of state where samples were collected: PA

For Lab Use Only
FSC:
SCR #: 1172082

(2) Sample Identification	Date Collected	Time Collected	(3) Grab	Composite	(4) Matrix: Soil	Potable / NPDES (Check if Applicable)	Water	Other	Total # of Containers	(5) Analyses Requested: PA UST UNLEADED GAS PARAMETERS	Remarks	(6) Temperature of samples upon receipt (if requested)
MW-1	11/19/02	1220	✓				✓		3	✓	temp 2°C TIB 11/20/02	
MW-2	11/19/02	1155	✓				✓		3	✓		
MW-3	11/19/02	1120	✓				✓		3	✓		
TRIP BLANK							✓		4	✓		

(7) **Turnaround Time Requested** (TAT) (please circle): Normal (Rush)
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed: 11/22/02
Rush results requested by (please circle): Phone (Fax) E-mail
Phone #: Fax #: 484-875-9286
E-mail address:

(8) **Data Package Options** (please circle if required)
QC Summary Type VI (Raw Data)
Type I (Tier I) GLP
Type II (Tier II) Other
Type III (NJ Red. Del.)
Type IV (CLP)

SDG Complete? Yes No
State-specific QC required? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal Chain of Custody required? Yes No

Relinquished by:	Date	Time	Received by:	Date	Time
	11/20/02	1410		11/20/02	0730
	11/20/02	0730			
	11/20/02	1615		11/20/02	1615
	11/20/02	1731			
				11/21/02	1730

(9)

Lancaster Laboratories, Inc., 2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 (717) 656-2300
Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

2102 Rev. 7/1/02

APPENDIX F

FATE AND TRANSPORT MODELING RESULTS

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION AND 1ST ORDER DECAY and RETARDATION

Project: AST 797 Girard Point Processing Area

Date: 12/2/02 Prepared by: SECOR International, Inc.

Contaminant: Benzene (1 year)

X

PA DEPARTMENT
OF ENVIRONMENTAL PROTECTION
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

SOURCE CONC (MG/L)	DISTANCE TO LOCATION OF CONCERN (ft)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)
610	1000	100	33	5	0.00096	200	20

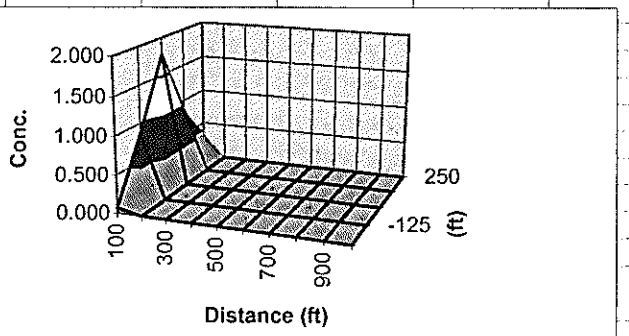
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
4.64E+00	0.003	0.15	1.8	58	5.00E-03	4.48	0.02071429

	y(ft)	z(ft)	Time (days)
1000	0	0	365

Projected Conc. at 1000 0 0

at 365 days

0.000 mg/l



AREAL MODEL CALCULATION DOMAIN

Length (ft) 1000

Width (ft) 250

	100	200	300	400	500	600	700	800	900	1000
250	0.073	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
125	0.853	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	1.771	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-125	0.853	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-250	0.073	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION AND 1ST ORDER DECAY and RETARDATION

Project:	AST 797 Girard Point Processing Area		
Date:	12/2/02	Prepared by:	SECOR International, Inc.
		Contaminant:	Benzene (10 years)

PA DEPARTMENT
OF ENVIRONMENTAL PROTECTION
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

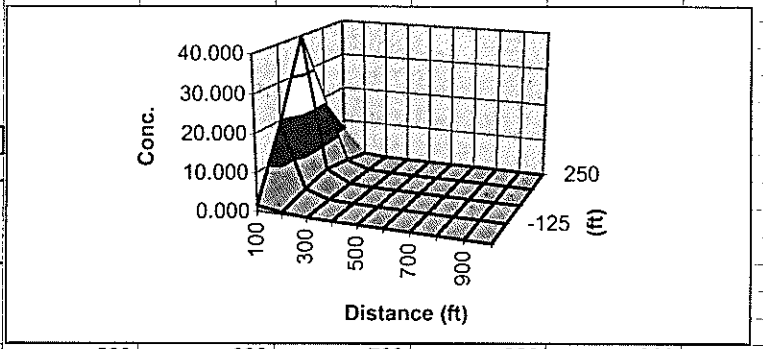
	X						
SOURCE CONC (MG/L)	DISTANCE TO LOCATION OF CONCERN (ft)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)
610	1000	100	33	5	0.00096	200	20

Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retardation (R)	V (=K*i/n*R) (ft/day)
4.64E+00	0.003	0.15	1.8	58	5.00E-03	4.48	0.02071429

	y(ft)	z(ft)	Time (days)
	1000	0	0	3650

Projected Conc. at	1000	0	0
at	3650	days	

0.000 mg/l



AREAL MODEL CALCULATION DOMAIN
Length (ft) 1000
Width (ft) 250

	100	200	300	400	500	600	700	800	900	1000
250	1.643	0.563	0.086	0.008	0.000	0.000	0.000	0.000	0.000	0.000
125	19.076	2.310	0.235	0.017	0.001	0.000	0.000	0.000	0.000	0.000
0	39.620	3.659	0.328	0.022	0.001	0.000	0.000	0.000	0.000	0.000
-125	19.076	2.310	0.235	0.017	0.001	0.000	0.000	0.000	0.000	0.000
-250	1.643	0.563	0.086	0.008	0.000	0.000	0.000	0.000	0.000	0.000

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION AND 1ST ORDER DECAY and RETARDATION

Project:	AST 797 Girard Point Processing Area		
Date:	12/2/02	Prepared by:	SECOR International, Inc.
		Contaminant:	Benzene (30 years)

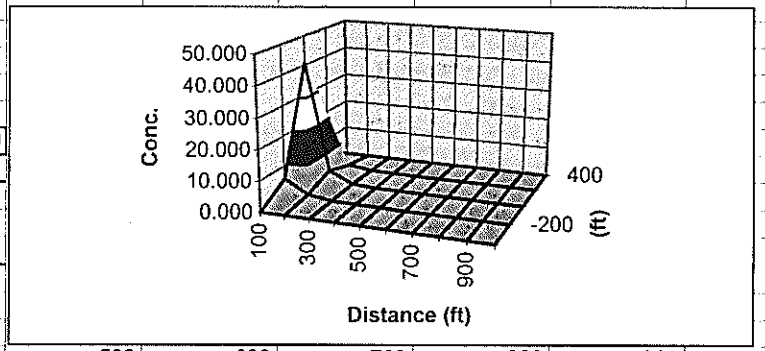
PA DEPARTMENT
OF ENVIRONMENTAL PROTECTION
QUICK_DOMENICO.XLS
SPREADSHEET APPLICATION OF
"AN ANALYTICAL MODEL FOR
MULTIDIMENSIONAL TRANSPORT OF A
DECAYING CONTAMINANT SPECIES"
P.A. Domenico (1987)
Modified to Include Retardation

	X						
SOURCE CONC (MG/L)	DISTANCE TO LOCATION OF CONCERN (ft)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)
610	1000	100	33	5	0.00096	200	20

Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
4.64E+00	0.003	0.15	1.8	58	5.00E-03	4.48	0.02071429

	y(ft)	z(ft)	Time (days)
	1000	0	0	10950

Projected Conc. at	1000	0	0
at	10950	days	
0.000	mg/l		



AREAL MODEL CALCULATION DOMAIN
Length (ft) 1000
Width (ft) 400

	100	200	300	400	500	600	700	800	900	1000
400	0.006	0.031	0.017	0.005	0.001	0.000	0.000	0.000	0.000	0.000
200	5.690	1.292	0.228	0.038	0.006	0.001	0.000	0.000	0.000	0.000
0	40.779	4.242	0.537	0.075	0.011	0.002	0.000	0.000	0.000	0.000
-200	5.690	1.292	0.228	0.038	0.006	0.001	0.000	0.000	0.000	0.000
-400	0.006	0.031	0.017	0.005	0.001	0.000	0.000	0.000	0.000	0.000

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION AND 1ST ORDER DECAY and RETARDATION

Project: AST 797 Girard Point Processing Area

Date: 12/2/02 Prepared by: SECOR International, Inc.

Contaminant: Toluene (10 years)

X

SOURCE CONC (MG/L)	DISTANCE TO LOCATION OF CONCERN (ft)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)
62	1000	100	33	5	0.025	200	20

Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retardation (R)	V (=K*i/n*R) (ft/day)
4.64E+00	0.003	0.15	1.8	130	5.00E-03	8.8	0.01054545

y(ft)	z(ft)	Time (days)
1000	0	3650

Projected Conc. at 1000 0 0

at 3650 days

0.000 mg/l

PA DEPARTMENT
OF ENVIRONMENTAL PROTECTION
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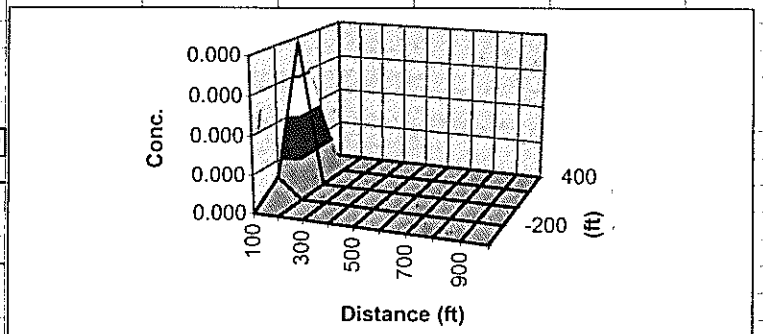
P.A. Domenico (1987)
Modified to Include Retardation



AREAL MODEL CALCULATION DOMAIN

Length (ft) 1000

Width (ft) 400

	100	200	300	400	500	600	700	800	900	1000
400	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-400	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION AND 1ST ORDER DECAY and RETARDATION

Project: AST 797 Girard Point Processing Area
Date: 12/2/02 Prepared by: SECOR International, Inc.
Contaminant: Toluene (30 years)

PA DEPARTMENT
OF ENVIRONMENTAL PROTECTION
QUICK_DOMENICO.XLS
SPREADSHEET APPLICATION OF
"AN ANALYTICAL MODEL FOR
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DECAYING CONTAMINANT SPECIES"
P.A. Domenico (1987)
Modified to Include Retardation

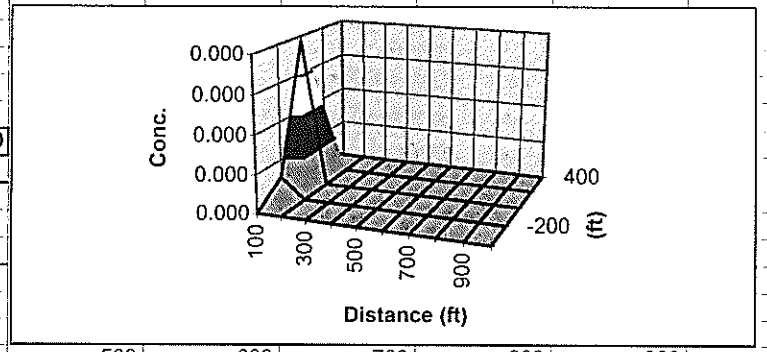
	X						
SOURCE CONC (MG/L)	DISTANCE TO LOCATION OF CONCERN (ft)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)
62	1000	100	33	5	0.025	200	20

Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm³)	KOC	Frac. Org. Carb.	Retardation (R)	V (=K*i/n*R) (ft/day)
4.64E+00	0.003	0.15	1.8	130	5.00E-03	8.8	0.01054545

y(ft)	z(ft)	Time (days)
1000	0	10950

Projected Conc. at	1000	0	0
at	10950	days	

0.000 mg/l



AREAL MODEL CALCULATION DOMAIN
Length (ft) 1000
Width (ft) 400

	100	200	300	400	500	600	700	800	900	1000
400	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-400	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION AND 1ST ORDER DECAY and RETARDATION

Project:	AST 797 Girard Point Processing Area		
Date:	12/2/02	Prepared by:	SECOR International, Inc.
		Contaminant:	Toluene (1 years)
	X		

PA DEPARTMENT
OF ENVIRONMENTAL PROTECTION
QUICK_DOMENICO.XLS
SPREADSHEET APPLICATION OF
"AN ANALYTICAL MODEL FOR
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P.A. Domenico (1987)
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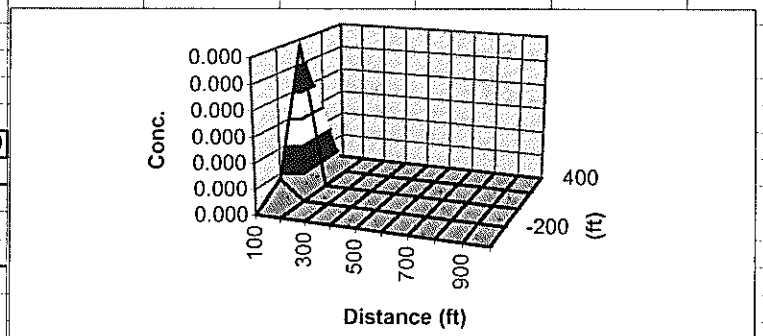
62	1000	100	33	5	0.025	200	20

Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retardation (R)	V (=K*i/n*R) (ft/day)
4.64E+00	0.003	0.15	1.8	130	5.00E-03	8.8	0.01054545

y(ft)	z(ft)	Time (days)
1000	0	0	365

Projected Conc. at	1000	0	0
at 365 days			
0.000 mg/l			



AREAL MODEL CALCULATION DOMAIN

Length (ft) 1000
Width (ft) 400

	100	200	300	400	500	600	700	800	900	1000
400	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-400	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

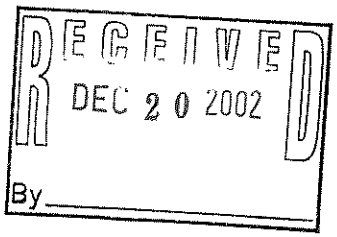
Pennsylvania Department of Environmental Protection

Lee Park, Suite 6010
555 North Lane
Conshohocken, PA 19428

December 18, 2002

Southeast Regional Office

Phone: 610-832-5950
Fax: 610-832-6143



Mr. Jim Tucker
Sunoco, Inc.
3144 Pennsylvania Ave
Philadelphia, PA 19145-5299

Re: Storage Tank Program
Girard Point Processing Area Tank #979
Facility ID No. 51-36558
City of Philadelphia
Philadelphia County

Dear Mr. Tucker:

On December 12, 2002 we received your report entitled "Site Characterization Report", dated December 6, 2002, for the storage tank facility referenced above. We consider this submittal to be the Remedial Action Completion Report required by the Corrective Action Process regulations, 25 Pa. Code Section 245.313.

You have identified your selected cleanup standard as the Department's Site Specific Standard. As such, the Department will attempt to review this report within 90 days of its receipt and send a review letter to the facility owner.

If you have any questions concerning the requirements of the Corrective Action Process regulations, please contact me at 610-832-5968.

Sincerely,

Stephan B. Sinding
Chief, Storage Tank Section
Environmental Cleanup

cc: Philadelphia County Health Department
City of Philadelphia
Mr. Baggett, SECOR
Mr. Brown
Mr. Payne
Re 30 (RW02ECP) 353.2

Pennsylvania Department of Environmental Protection

Lee Park, Suite 6010
555 North Lane
Conshohocken, PA 19428
March 5, 2003

Southeast Regional Office

610-832-5949
Fax 610-832-6143

Mr. Jim Tucker
Senior Staff
Sunoco Inc.
3144 Passyunk Avenue
Philadelphia, PA 19145-5299

Re: ECP - Tanks Program
Sunoco Point Breeze Refinery
AST #797 Site Characterization
Facility ID # 51-36558
e-FACTS Site # 456930
3144 Passyunk Avenue
City of Philadelphia

Dear Mr. Tucker:

The Pennsylvania Department of Environmental Protection (DEP), has received and reviewed the Site Characterization Report, dated December 6, 2002, for the site referenced above. SECOR International Corporation (SECOR), environmental consultant for Sun Oil Company, submitted this Site Characterization Report to the DEP on December 12, 2002. Investigations at this site were initiated in conjunction with the closure of Tank #797 on April 30, 2002. The Above Ground Storage Tank (AST) was approximately 20 feet in diameter and was capable of containing 42,000 gallons. The tank was used to store process water contaminated with "light end hydrocarbons" primarily including Benzene and Isopropyl Benzene (a.k.a. Cumene).

SECOR investigated soil conditions surrounding the AST by sampling at four locations in the immediate vicinity of the AST on May 25, 2002. Analytical results for these surficial soil samples, collected at a 0-2 foot depth, exceed the Act 2 soil to groundwater pathway standard for non-residential used aquifers in boring HA-1, HA-2, HA-3, and HA-4. Act 2 non-residential direct contact standards for benzene were exceeded in borings HA-1 and HA-3. A closure report, dated July 10, 2002 and prepared by SECOR was provided to the DEP. This Site Characterization Report provides no record of DEP's review of this closure report. Sunoco submitted a notification of release on June 10, 2002 and received a Notice of Violation on July 29, 2002 requesting further characterization of soil and groundwater.

Subsequent site characterization activities were initiated in September of 2002 that involved installing three groundwater monitoring wells outside of the tank 797 dike. Soil samples collected at these locations exceeded the Act 2 Nonresidential Soil to Groundwater Pathway Standard for Benzene in

MW-1 (2.6 ppm), MW-2 (6.5 ppm), and Benzene and Toluene in MW-3 (610 ppm and 300 ppm). Act 2 Nonresidential Direct Contact Standards for Benzene in soils were exceeded in MW-3 (610 ppm 0-2' below grade). Groundwater analyticals from the one round of samples collected from the three monitoring wells exceeds the Act 2 Nonresidential Used Aquifer standard for Benzene in all three wells (MW-1-32 ppb, MW-2-28,000 ppb, and MW-3-610,000 ppb) and Toluene in MW-3 (59,000 ppb). Dissolved concentrations in MW-2 and MW-3 exceed the Act 2 Used and Non-Use Aquifer Standards for Benzene. Contaminant concentrations of these magnitudes likely represent saturated conditions and should materialize as free product in soils and on groundwater.

Conditions at this site are alarming due to the significant concentrations of petroleum contaminants present in both soils and groundwater. DEP offers the following comments :

1) A minimum of two groundwater sampling events should be conducted separated by a sufficient time period to render them independent. This will verify that the concentrations in groundwater are reproducible and reliable.

2) The lateral extent of the impacted soil and groundwater has not been delineated as described in §245.309 & §245.310 of the Department's regulations.

3) Please provide a map showing the location and description of currently operating recovery systems that would intercept and/or recover any plume from this area.

4) Please provide a risk assessment demonstrating that potentially open exposure pathways associated with soil and groundwater conditions at this site are in compliance with our Act 2 Acceptable Risk Ranges. Interim Remedial Actions should be implemented if conditions are outside acceptable risk ranges.

5) Please provide any additional data that may be pertinent to the distribution of contaminants in groundwater associated with this site from other sources in the vicinity of tank 797. What engineering performance standards for soil were considered in the construction of this tank dike ?

6) Data presented in the Site Characterization Report is insufficient to construct a reasonable and/or defensible fate and transport model.

7) Please consider, and share with SECOR, the additional data collected throughout the entire refinery as reported in the Comprehensive Remedial Plan reflecting known groundwater patterns of flow.

At this time, the Site Characterization Report is determined to be incomplete due to the limited groundwater data available and the need to further evaluate groundwater and soils at this site.

The closure of this regulated AST should follow the Corrective Action Procedures as specified in the Department's regulations. A final demonstration of attainment must comply with our Act 2 Regulations (see §250). References to the USEPA Environmental Indicators Program do not supersede the requirements of the Pennsylvania Statutes referenced above.

DEP looks forward to receiving and reviewing a complete site characterization report that considers the comments offered in this letter. Please provide a schedule of events planned for this site that will move the Site Characterization closer to completion. Please prepare and submit Act 2 Demonstration of Attainment Reports for soil and groundwater at this site considering the comments offered above.

If you have any questions or need further information regarding this matter, please contact the Environmental Cleanup Program.

Sincerely,

Walter J. Payne, P.G.
Licensed Geological Professional
Environmental Cleanup Program

cc: Mr. Beitler
Mr. O'Neil
Mr. Day-Lewis
Mr. Sinding
Mr. Burke
Mr. S. Brown
Mr. Mountain
Mr. Swokal
Mr. Sneath, Esq.
Mr. Gotthold
Mr. Opppenheim
Mr. Zipin
Regional File

GP-U 1088

SECOR

SECOR
INTERNATIONAL
INCORPORATED

www.secor.com
102 Pickering Way, Suite 200
Exton, PA 19341
484-875-3075 TEL
484-875-9286 FAX

June 24, 2008

Ron Rosendorn
Senior Environmental Engineer Specialist
SUNOCO (R&S)
3144 Passyunk Avenue
Philadelphia, Pennsylvania

RE: Tank GP-U-1088 Soil Sampling
Philadelphia Refinery

Dear Mr. Rosendorn:

This letter summarizes the site assessment activities in response to a release of approximately 61 gallons of sodium hydroxide impacting approximately 10 cubic yards of surface soil within the containment dike for GP-U-1088. The release occurred on December 31, 2007

The project site is located within the Sunoco, Inc. (Sunoco) Philadelphia Refinery located in Philadelphia, Pennsylvania (**Figure 1**). As a result of the release, interim remedial activities were conducted by Sunoco that included flushing/rinsing the impacted area with water. The rinse water was directed to a local sewer that drains to the refinery Wastewater Treatment Plant. Site assessment activities were conducted after interim remedial activities to determine whether additional interim remedial actions were necessary to abate an imminent hazard to human health or the environment.

The following information supplements the site characterization for area of interest (AOI) 6 conducted under the Consent Order & Agreement (CO&A), titled Site Characterization Report Area of Interest 6 submitted by Langan on September 29, 2006. GP-U-1088 is located with-in AOI 6.

Soil Sampling and Laboratory Analyses

The sampling activities were completed in accordance with Pennsylvania Department of Environmental Protection (PADEP) Pennsylvania Technical Guidance Document, Guidance for Attainment Demonstration with Statistical Methods. SECOR collected a total of 8 samples on March 26, 2008. Soil sample locations are depicted on **Figure 2**. All soil samples were collected at a depth of approximately 0-

0.5 feet below ground surface. Soil samples were analyzed for pH.

Soil Sampling Results

The analytical results for the soil samples collected are summarized on **Table 1**. Copies of the laboratory analytical results are included in **Appendix A.** The analytical results indicate that pH was detected ranging from 10.1 to 11.6 standard units with six of the eight samples at 10.7 standard units or lower. This is equivalent to a typical sodium hydroxide concentration of approximately 30 mg/kg. This amount of alkalinity is well within the normal alkalinity concentrations commonly associated with soils. The PADEP has no cleanup criteria established for pH under Act 2.

Conclusions

In situ soil treatment regimens at many remedial activity sites or construction sites can often involve addition of lime or other alkaline chemical agents. Alkaline treatment chemicals are typically used to tighten loose soils or to stabilize/immobilize harmful metals. Soils treated with alkaline chemicals can have a residual pH as high as 12.4. Therefore, this suggests that soils having a residual pH less than 12.4 do not pose an imminent hazard to human health or the environment. The analytical results indicate that soil pH values ranged from 10.1 to 11.6 standard units which are all below 12.4. These results demonstrate that the interim remedial activities completed have effectively removed the more concentrated sodium hydroxide that may have posed an imminent hazard to human health or the environment. Therefore no additional remedial activities are necessary.

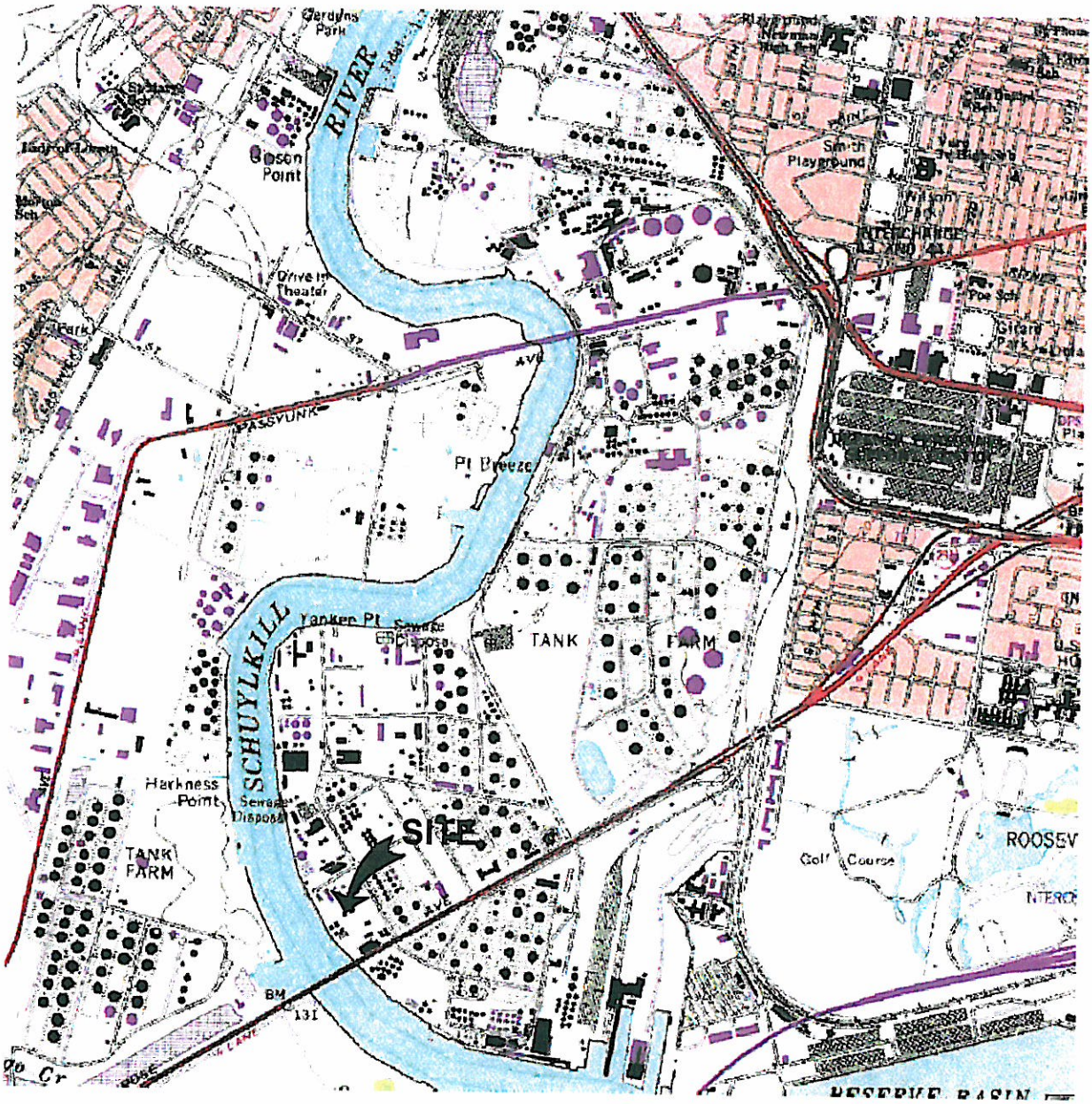
Should you have any questions or comments, please feel free to contact me at (484) 875-3075.

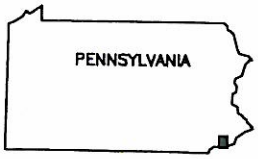
Sincerely,
SECOR International Incorporated

Casey Mundry
Project Manager

Cc: Dina Toto (Sunoco)
Frank Aceto (SECOR)
Project File

FIGURES





QUADRANGLE LOCATION

N

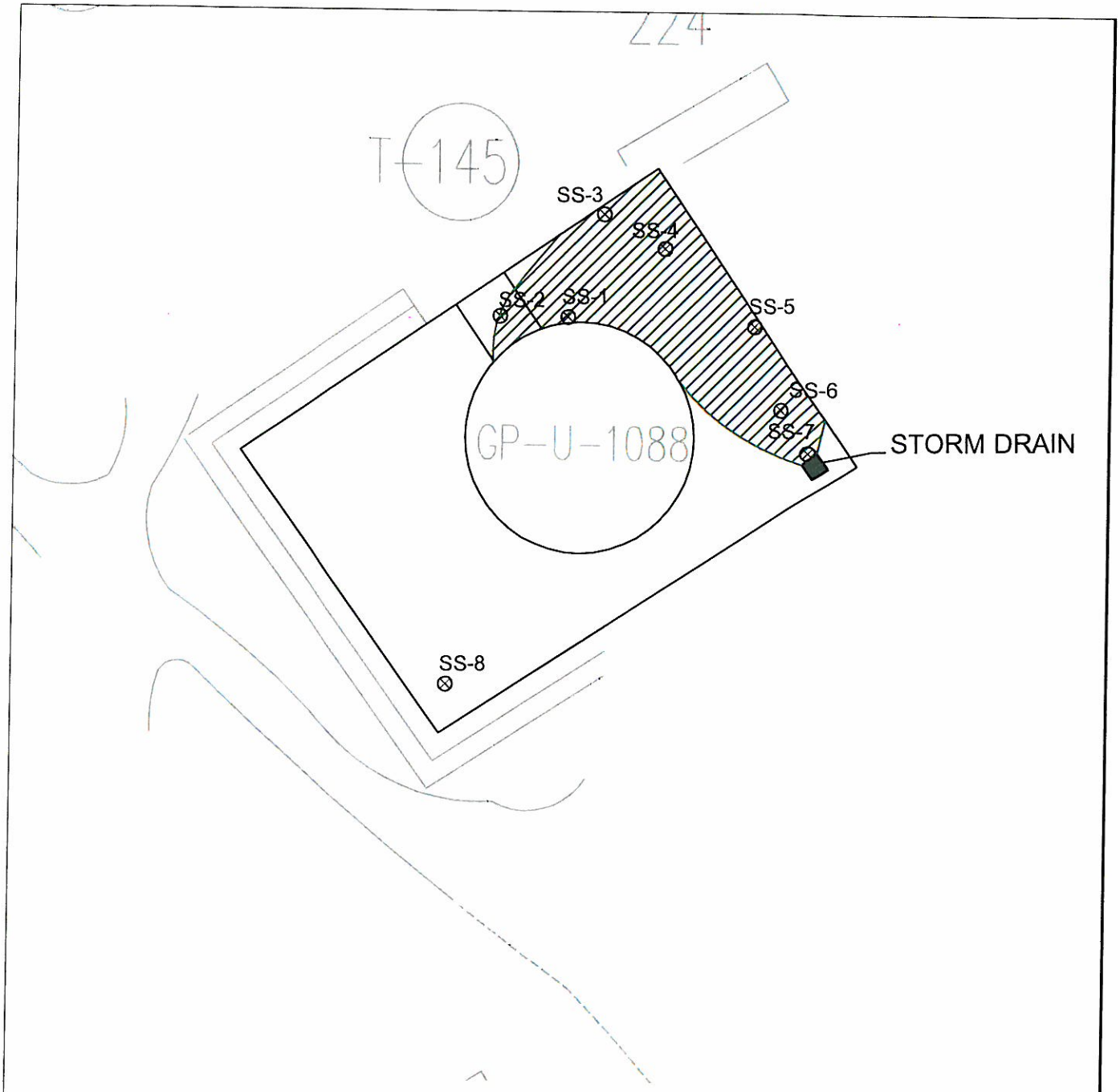
0 1/2 1

SCALE (MILES)

REFERENCE: USGS 7.5 MINUTE QUADRANGLE; PHILADELPHIA, PENNSYLVANIA–NEW JERSEY; 1995

SECOR
102 PICKERING WAY, SUITE 200
EXTON, PENNSYLVANIA
PHONE: (484) 875-3075/875-8286 (FAX)

FOR:		SITE LOCATION MAP TANK GP-U-1088 AREA		FIGURE:
SUNOCO, INC. PHILADELPHIA REFINERY PHILADELPHIA, PENNSYLVANIA				1
JOB NUMBER:	DRAWN BY: TFB	CHECKED BY: CY	APPROVED BY:	DATE: 03/20/2008



NOTE: SAMPLE DEPTH PROVIDED NEXT TO SAMPLE LOCATION POINT

SECOR
102 PICKERING WAY, SUITE 200
EXTON, PENNSYLVANIA
PHONE: (484) 875-3075 FAX: (484) 875-9286

FOR:		GP-U-1088 AREA SOIL SAMPLE LOCATIONS		FIGURE:
SUNOCO, INC. PHILADELPHIA REFINERY PHILADELPHIA, PENNSYLVANIA				2
JOB NUMBER:	DRAWN BY: TFB	CHECKED BY:	APPROVED BY:	DATE: 05/28/2008

TABLE

Table 1
Summary of Soil Analytical Results
AST GP-U-1088 Release Sampling
March 26, 2008

Sample Identification	GP-1088-SS-1	GP-1088-SS-2	GP-1088-SS-3	GP-1088-SS-4	GP-1088-SS-5	GP-1088-SS-6	GP-1088-SS-7	GP-1088-SS-8
Sample Collection Depth (FBG)	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface
pH	11.2	10.4	10.1	10.3	10.7	11.6	10.1	10.5

Notes:
USEPA=United States Environmental Protection Agency
FBG = Feet Below Grade

APPENDIX A

Laboratory Analytical Report

Lancaster Laboratories

ANALYTICAL RESULTS

Prepared for:

SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341

484-875-3075

Prepared by:

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

SAMPLE GROUP

The sample group for this submittal is 1083612. Samples arrived at the laboratory on Thursday, March 27, 2008.

Client Description	Lancaster Labs Number
GP-1088-SS-1 Grab Soil Sample	5315612
GP-1088-SS-2 Grab Soil Sample	5315613
GP-1088-SS-3 Grab Soil Sample	5315614
GP-1088-SS-4 Grab Soil Sample	5315615
GP-1088-SS-5 Grab Soil Sample	5315616
GP-1088-SS-6 Grab Soil Sample	5315617
GP-1088-SS-7 Grab Soil Sample	5315618
GP-1088-SS-8 Grab Soil Sample	5315619

1 COPY TO	SECOR International, Inc	Attn: Casey Mundry
ELECTRONIC COPY TO	LLI	Attn: EDD Group

Lancaster Laboratories

Questions? Contact your Client Services Representative
Loran A Carter at (717) 656-2300

Respectfully Submitted,

Robert Heisey

Robert Heisey
Senior Specialist

Lancaster Laboratories, Inc.
2425 New Holland Pike
PO Box 12425
Lancaster, PA 17605-2425
717-656-2300 Fax: 717-656-2681

Lancaster Laboratories

Lancaster Laboratories Sample No. SW5315612 Group No. 1083612

GP-1088-SS-1 Grab Soil Sample
GP-1088

Collected:03/26/2008 11:17 by CM

Account Number: 11183

Submitted: 03/27/2008 16:45
Reported: 04/01/2008 at 15:09
Discard: 06/01/2008

SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341

10881

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Method Detection Limit	Units	Dilution Factor
00394	pH in soil	n.a.	11.2	0.0100	Std. Units	1

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
00394	pH in soil	SW-846 9045C modified	1	03/28/2008 21:00	Luz M Groff	1

Lancaster Laboratories, Inc.
2425 New Holland Pike
PO Box 12425
Lancaster, PA 17605-2425
717-656-2300 Fax: 717-656-2681

Lancaster Laboratories

Lancaster Laboratories Sample No. SW5315613 **Group No. 1083612**

GP-1088-SS-2 Grab Soil Sample
GP-1088

Collected:03/26/2008 11:18 by CM

Account Number: 11183

Submitted: 03/27/2008 16:45
Reported: 04/01/2008 at 15:09
Discard: 06/01/2008

10882

SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Method Detection Limit	Units	Dilution Factor
00394	pH in soil	n.a.	10.4	0.0100	Std. Units	1

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
00394	pH in soil	SW-846 9045C modified	1	03/28/2008 21:00	Luz M Groff	1

Lancaster Laboratories, Inc.
2425 New Holland Pike
PO Box 12425
Lancaster, PA 17605-2425
717-656-2300 Fax: 717-656-2681

Lancaster Laboratories

Lancaster Laboratories Sample No. SW5315614 **Group No. 1083612**

GP-1088-SS-3 Grab Soil Sample
GP-1088

Collected:03/26/2008 11:12 by CM

Account Number: 11183

Submitted: 03/27/2008 16:45
Reported: 04/01/2008 at 15:09
Discard: 06/01/2008

10883

SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Method Detection Limit	Units	Dilution Factor
00394	pH in soil	n.a.	10.1	0.0100	Std. Units	1

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
00394	pH in soil	SW-846 9045C modified	1	03/28/2008 21:00	Luz M Groff	1

Lancaster Laboratories, Inc.
2425 New Holland Pike
PO Box 12425
Lancaster, PA 17605-2425
717-656-2300 Fax: 717-656-2681

Lancaster Laboratories

Lancaster Laboratories Sample No. SW5315615 **Group No. 1083612**

GP-1088-SS-4 Grab Soil Sample
GP-1088

Collected:03/26/2008 11:15 by CM

Account Number: 11183

Submitted: 03/27/2008 16:45
Reported: 04/01/2008 at 15:09
Discard: 06/01/2008

SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341

10884

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Method Detection Limit	Units	Dilution Factor
00394	pH in soil	n.a.	10.3	0.0100	Std. Units	1

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
00394	pH in soil	SW-846 9045C modified	1	03/28/2008 21:00	Luz M Groff	1

Lancaster Laboratories, Inc.
2425 New Holland Pike
PO Box 12425
Lancaster, PA 17605-2425
717-656-2300 Fax: 717-656-2681

Lancaster Laboratories

Lancaster Laboratories Sample No. SW5315616 **Group No. 1083612**

GP-1088-SS-5 Grab Soil Sample
GP-1088

Collected:03/26/2008 11:14 by CM

Account Number: 11183

Submitted: 03/27/2008 16:45
Reported: 04/01/2008 at 15:09
Discard: 06/01/2008

10885

SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Method Detection Limit	Units	Dilution Factor
00394	pH in soil	n.a.	10.7	0.0100	Std. Units	1

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
00394	pH in soil	SW-846 9045C modified	1	03/28/2008 21:00	Luz M Groff	1

Lancaster Laboratories, Inc.
2425 New Holland Pike
PO Box 12425
Lancaster, PA 17605-2425
717-656-2300 Fax: 717-656-2681

Lancaster Laboratories

Lancaster Laboratories Sample No. SW5315617 **Group No. 1083612**

GP-1088-SS-6 Grab Soil Sample
GP-1088

Collected:03/26/2008 11:12 by CM

Account Number: 11183

Submitted: 03/27/2008 16:45
Reported: 04/01/2008 at 15:09
Discard: 06/01/2008

10886

SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Method Detection Limit	Units	Dilution Factor
00394	pH in soil	n.a.	11.6	0.0100	Std. Units	1

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
00394	pH in soil	SW-846 9045C modified	1	03/28/2008 22:45	Luz M Groff	1

Lancaster Laboratories, Inc.
2425 New Holland Pike
PO Box 12425
Lancaster, PA 17605-2425
717-656-2300 Fax: 717-656-2681

Lancaster Laboratories

Lancaster Laboratories Sample No. SW5315618 **Group No. 1083612**

GP-1088-SS-7 Grab Soil Sample
GP-1088

Collected:03/26/2008 11:10 by CM

Account Number: 11183

Submitted: 03/27/2008 16:45
Reported: 04/01/2008 at 15:09
Discard: 06/01/2008

10887

SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Method Detection Limit	Units	Dilution Factor
00394	pH in soil	n.a.	10.1	0.0100	Std. Units	1

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
00394	pH in soil	SW-846 9045C modified	1	03/28/2008 22:45	Luz M Groff	1

Lancaster Laboratories, Inc.
2425 New Holland Pike
PO Box 12425
Lancaster, PA 17605-2425
717-656-2300 Fax: 717-656-2681

Lancaster Laboratories

Lancaster Laboratories Sample No. SW5315619 Group No. 1083612

GP-1088-SS-8 Grab Soil Sample
GP-1088

Collected:03/26/2008 11:23 by CM

Account Number: 11183

Submitted: 03/27/2008 16:45
Reported: 04/01/2008 at 15:09
Discard: 06/01/2008

SECOR International, Inc
Suite 200
102 Pickering Way
Exton PA 19341

10888

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Method Detection Limit	Units	Dilution Factor
00394	pH in soil	n.a.	10.5	0.0100	Std. Units	1

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
00394	pH in soil	SW-846 9045C modified	1	03/28/2008 22:45	Luz M Groff	1

Lancaster Laboratories, Inc.
2425 New Holland Pike
PO Box 12425
Lancaster, PA 17605-2425
717-656-2300 Fax: 717-656-2681

Lancaster Laboratories

Quality Control Summary

Client Name: SECOR International, Inc
Reported: 04/01/08 at 03:09 PM

Group Number: 1083612

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

Analysis Name	Blank Result	Blank MDL	Report Units	LCS %REC	LCSD %REC	LCS/LCSD Limits	RPD	RPD Max
Batch number: 08088039401B	Sample number(s): 5315612-5315616							
pH in soil				100		99-101		
Batch number: 08088039402A	Sample number(s): 5315617-5315619							
pH in soil				100		99-101		

Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

Analysis Name	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD MAX	BKG Conc	DUP Conc	DUP RPD	Dup RPD Max
Batch number: 08088039401B	Sample number(s): 5315612-5315616					BKG: P315566			
pH in soil						7.08	7.02	1	1
Batch number: 08088039402A	Sample number(s): 5315617-5315619					BKG: 5315618			
pH in soil						10.1	10.1	0	1

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

Lancaster Laboratories, Inc.
2425 New Holland Pike
PO Box 12425
Lancaster, PA 17605-2425
717-656-2300 Fax: 717-656-2681

Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 11183 Group# 1083612 Sample # 5315612-19

COC # 177222

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

(1)
Client: SECOR INTERNATIONAL Acct. #:
Project Name/#: GP-1088 PWSID #:
Project Manager: Casey Mundry P.O.#:
Sampler: CM+SA Quote #:
Name of state where samples were collected: PA

For Lab Use Only
FSC:
SCR#: 57002

Preservation Codes
H=HCl T=Thiosulfate
N=HNO_3 B=NaOH
S=H_2SO_4 O=Other

(5) Analyses Requested — Preservation Codes

(2)			(3)		(4)		(5) HC	Remarks
GP-1088-SS-1	3.26.08	1117	X	X		1	X	
GP-1088-SS-2	3.26.08	1118	X	X		1	X	
GP-1088-SS-3	3.26.08	1112	X	X		1	X	
GP-1088-SS-4	3.26.08	1115	X	X		1	X	
GP-1088-SS-5	3.26.08	1114	X	X		1	X	
GP-1088-SS-6	3.26.08	1112	X	X		1	X	
GP-1088-SS-7	3.26.08	1110	X	X		1	X	
GP-1088-SS-8	3.26.08	1123	X	X		1	X	

(7) **Turnaround Time Requested** (TAT) (please circle): Normal (circled) 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 #: 484.875.3075 Fax #: 484.875.9286
E-mail address: cmundry@secor.com

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg) TX TRRP-13
Type II (Tier II) MA MCP CT RCP
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)

SDG Complete? Yes No
Site-specific QC (MS/MSD/Dup)? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal COC Required? Yes / No

(9)

Relinquished by:	Date	Time	Received by:	Date	Time
Bottle Storage	3/27/08	530	[signature]	3/27/08	530
[signature]	3/27/08	1014			
Stephanie Adams	3/27/08	8:47	[signature]	3/27/08	847
[signature]	3/27/08	1014			
			Jenese Dillow	3/27/08	1045

Lancaster Laboratories, Inc., 2425 New Holland Pike, Lancaster, PA 17601 (717) 656-2300 Fax: (717) 656-6766
Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

2102.03

Pennsylvania Department of Environmental Protection

2 East Main Street
Norristown, PA 19401
July 21, 2008

Southeast Regional Office

Phone: 484-250-5960
Fax: 484-250-5961

RECEIVED JUL 23 2008

Mr. Ron Rosendorn
Sunoco, Inc. (R&M)
3144 Passyunk Avenue
Philadelphia, PA 19145-5299

Re: Storage Tank Program
Sunoco, Inc. Girard Point Process Area
Facility ID No. 51-36558
Incident No(s). 38644
3144 Passyunk Avenue
City of Philadelphia
Philadelphia County

Dear Mr. Rosendorn:

On July 2, 2008 we received your report entitled "Site Characterization Report", dated June 26, 2008, for the storage tank facility referenced above. We consider this submittal to be the Site Characterization Report required by the Corrective Action Process regulations, 25 Pa. Code Section 245.310(b). As such, the Department will attempt to review this report within 60 days of its receipt and send a review letter to the facility owner.

If you have any questions concerning the requirements of the Corrective Action Process Regulations, please contact me at 484-250-5703.

Sincerely,

Thomas D. Canigiani, Jr.
Water Quality Specialist Supervisor
Environmental Cleanup

cc: Philadelphia County Health Department
City of Philadelphia
Mr. Miceli, USTIF
Ms. Mundry (SERCOR Intl Inc.)
Mr. Ghobrial
Re 30 (RW08ECP) 203

Pennsylvania Department of Environmental Protection

2 East Main Street
Norristown, PA 19401

July 30, 2008

Southeast Regional Office

Phone: 484-250-5960
Fax: 484-250-5961

Mr. Ron Rosendorn
Sunoco, Inc. (R&M)
3144 Passyunk Avenue
Philadelphia, PA 19145

Re: Storage Tank Program
310(b) Site Characterization Report Approval
Sunoco, Inc. Girard Point Process Area
Facility ID No. 51-36558
Incident No. 38644
3144 Passyunk Avenue
City of Philadelphia
Philadelphia County

Dear Mr. Rosendorn:

Your Site Characterization Report (SCR) submitted by SECOR International, Inc., dated June 24, 2008, for the above-referenced facility meets the criteria of Chapter 245, Section 301(b).

The report summarizes the findings of the site assessment activities and the interim remedial actions taken in response to a release of sodium hydroxide within the containment dike for the GP-U-1088 tank area. The analytical results for soil sampling demonstrate that the interim remedial activities have effectively removed the more concentrated sodium hydroxide from the impacted soil.

The report is hereby approved, as provided for in Chapter 245, Section 245.310(c)(1) of the Department's Corrective Action Regulations. This report fulfills your reporting requirements under the corrective action process for this incident.

This letter does not waive any rights of the Commonwealth of Pennsylvania to take enforcement action under applicable law for the conditions discussed in this letter.

Thank you for your cooperation in working with the Department toward the remediation of this site. If you need additional information or have any questions, please call me at 484-250-5781.

Sincerely,

Ayman L. Ghobrial

Ayman L. Ghobrial
Licensed Professional Geologist
Environmental Cleanup

cc: Mr. Miceli - USTIF
Philadelphia Health Department
Ms. Mundry - SECOR
Mr. Canigiani
Ms. Warren
Ms. Kunsch (for Site-Specific Standard)
Re 30 (GJE08ECP)212-1

APPENDIX F

Fate and Transport Analysis

APPENDIX F

FATE AND TRANSPORT MODELING PROCEDURES

AOI 6: PES FACILITY

PHILADELPHIA, PENNSYLVNIA

F.1 INTRODUCTION

Fate and transport calculations were completed for groundwater in Area of Interest (AOI) 6 to evaluate the potential migration pathway of impacted groundwater to the Schuylkill River. Since AOI-6 is bordered by AOI-7 to the north, AOI-3 to the east and AOI-5 to the south, the Schuylkill River is the only potential off-site receptor. Fate and transport modeling was completed for a subset of impacted wells based on criteria described in Section F.4 below.

Eleven compounds of concern (COCs) were detected in groundwater during the January 2013 groundwater sampling event at concentrations above their respective MSCs (Figure F.1). These COCs are benzene, toluene, benzo(a)pyrene, benzo(a)anthracene, benzo(g,h,i)perylene, benzo(b)fluoranthene, pyrene, chrysene, 1,2,4 trimethylbenzene (1,2,4-TMB), 1,3,5 trimethylbenzene (1,3,5-TMB) and lead. To address the potential future migration of these COCs, a fate and transport analysis was performed using three models developed by PADEP. The Quick Domenico Version 2 (QD) model and the SWLOAD model were used for fate and transport in groundwater. PENTOXSD was used when assessing potential impacts of groundwater on surface water. For assessing the potential impact of metals in surface water, the equation for calculating the allowable groundwater concentration (discharge equation), presented in the PA Act 2 Technical Guidance page IV-20 was used. Site-specific data was used to complete the fate and transport calculations, when available.

F.2 QUICK DOMENICO AND SWLOAD MODEL OVERVIEW

The QD and SWLOAD models are Microsoft Excel spreadsheet applications 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 SWLOAD model calculates groundwater contaminant concentrations just before discharge to surface water. Both models incorporate the processes of advection, first order decay, retardation, and dispersion to describe fate and transport of compounds.

F.3 MODEL LIMITATIONS

Limitations of the QD and SWLOAD models 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 SCREENING AND APPROACH TO FATE AND TRANSPORT ANALYSIS

For the purpose of fate and transport modeling, groundwater concentrations at AOI 6 are assumed to be at or near steady-state. If a well exists with COC detections below the respective groundwater MSC downgradient of a location with a MSC exceedance, the COC exceeding the MSC was determined to not have potential to impact the Schuylkill River or off site. Assuming steady state, the well with the COC concentrations not exceeding the MSC indicates the COC from the well in exceedance has attenuated below the respective groundwater MSC before reaching off site receptors.

Wells with organic compounds above the groundwater MSCs that were not delineated by down gradient wells were modeled using QD. At each well where a QD simulation was run, COC's were also evaluated with SWLOAD. SWLOAD simulations incorporated the appropriate COC edge criterion found in Table IV-1, IV-2 and IV 3 in the AP Act 2 Technical Guidance Manual pages IV-23 to IV-29 and distance to the point of concern (POC). SWLOAD output indicates if PENTOXSD is needed. When PENTOXSD was needed, a site-specific groundwater screening concentration for the protection of surface water (wasteload allocation) was calculated.

Groundwater with metal exceedences were conservatively assumed to not under go any attenuation in the aquifer and were compared directly to the wasteload allocation calculated using the discharge equation.

There are two main hydraulic features that could affect the migration of impacted groundwater in AOI 6 towards the Schuylkill River. The first hydraulic feature is the sheet pile wall which runs along the entire river boundary of AOI 6. For assessment purposes it was assumed that groundwater flow through sediments near the sheet pile wall are affected more by the lower sheet pile permeability relative to the higher hydraulic conductivity of the sediments. Interpreted groundwater flow paths from two wells, B-154 and B-155, have the potential to move from the center of the site to potentially discharge through the sheet pile wall. Additional modeling was performed to account for the transition in hydraulic conductivity using a two-step approach for both QD and SWLOAD models. The two-step modeling approach used at B-154 and B-155 is discussed in more detail in section F.6.

Another significant hydraulic feature in AOI 6, based on December 2012 groundwater gauging, is a groundwater depression located just west of the center of AOI 6, near B-136, which contains up to 0.15 feet of light non-aqueous liquid (LNAPL). As a conservative measure, impacted groundwater within and surrounding the groundwater depression is assumed to flow towards the Schuylkill River and has been modeled as such.

QD simulations were constructed for wells B-39, B-125, B-126, B-135, B-144, B-145, B-151, B-152, B-154, B-155, B-156, B-163, B-164, B-169, URS-2, URS-4, U-4 and WPM-11. B-167 was not modeled based on groundwater flow in the area of this well. SWLOAD simulations were constructed for all locations except URS-2, U-4 and WPM-11 due to their distance from the Schuylkill River (over 1,000 feet) and the local groundwater flow pattern towards AOI 5.

F.5 MODEL INPUT PARAMETERS

Input values for the QD and SWLOAD models were compiled from available site-specific data. When no site-specific data was available, estimated input values from the PADEP spreadsheet "Number Please!2011," which is based on PA Code, Chapter 250, Appendix A, Table 5; or other acceptable literature sources, were utilized. The input parameters are discussed in detail in the following sections. An Excel spreadsheet interface developed by Langan was used to construct the QD simulations. This interface allowed the simulation of multiple compounds simultaneously and models to be saved in a single electronic file. Results of the QD and SWLOAD modeling can be found in Table F.1 in this appendix.

F.5.1 Source Concentration

Analytical results from the most recent AOI 6 site wide groundwater sampling (January 2013) were used as the starting concentrations for QD and SWLOAD simulations. A summary of groundwater exceedences can be found in Figure F.1

F.5.2 Distance to Point of Concern (x)

For SWLOAD the distance to the location of concern is the shortest distance between the subject well and the Schuylkill River. Measurements were made using the GIS developed for the site.

F.5.3 Dispersivity

Dispersivity is the tendency of a dissolved plume to "spread out" as it moves down-gradient.

- Longitudinal dispersivity (A_X) occurs in the direction parallel to groundwater flow;
- Transverse dispersivity (A_Y) occurs in the same plane as longitudinal dispersivity but perpendicular to the direction of groundwater flow; and
- Vertical dispersivity (A_Z) 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 small number (0.001) unless vertical monitoring can reliably justify a larger number. Additionally, a value of 0.0001 is suggested for un-calibrated or conceptual applications).

As stated above the value for A_Y was estimated to be 10 percent of A_X. A value of 0.0001 was used as a value for A_Z. Based on the scale of impacts at AOI 6 the longitudinal dispersivity was estimated at 200 feet and the lateral as 20 feet.

F.5.4 Lambda

Lambda is the first order decay constant. It is determined by dividing 0.693 by the half-life of the compound. The value can typically be estimated for shrinking

plumes by evaluating at concentrations versus time or distance. Lambda can also sometimes be estimated for stable plumes by evaluating concentration versus time using the methodology outlined in Buscheck and Alcantar (1995). Important considerations to estimating Lambda from site data include:

1. Are the measured concentrations along the centerline of the plume?
2. Are the measured concentrations the result of the single source area?
3. Are there no remedial systems and/or activities that effected the migration of the plume during the time interval of evaluation?

If the answer is yes to these questions, the methodologies outlined in Buscheck and Alcantar may be utilized to estimate a site-specific lambda from site data.

Based on review of the available site data, the criteria necessary to calculate a site-specific lambda could not be met; therefore, a default value for lambda (when appropriate and available) was obtained from the PADEP spreadsheet "Number Please!2011" which is based on PA Code, Chapter 250, Appendix A, Table 5. There is no lambda value reported for 1,3,5-TMB in the above referenced table. For the purposes of the fate and transport analysis, 1,3,5-TMB was assumed to have the same lambda value as 1,2,4-TMB.

F.5.5 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 soils below the water table that contribute contamination to groundwater.

In the absence of a well-defined source, a width of 100 feet was used. The source thickness was estimated as 39 feet, which is the maximum thickness of the alluvium/fill in AOI 6.

F.5.6 Hydraulic Conductivity (K)

The hydraulic conductivity of a geologic material is a measure of its ability to transmit water. For the wells located in the center of AOI 6, a hydraulic conductivity of 23.98 ft/d was used. This value is the maximum reported hydraulic conductivity from a constant rate aquifer test performed in AOI 6 by URS, 2002.

Along the sheet pile wall, the migration of groundwater and contaminants through the alluvium/fill towards the Schuylkill River is limited by the hydraulic conductivity of the sheet pile wall. For an unsealed sheet pile wall, a typical hydraulic conductivity is 0.283 ft/d or $1x10^{-5}$ cm/sec, (Waterloo Barrier, Inc.). Based on the previous December 2012 gauging the lower hydraulic conductivity of the sheet pile wall has caused cause groundwater to mound up behind it. To account for the presence of the sheet pile wall in the QD and SWLOAD models for AOI 6, a hydraulic conductivity of 0.283 ft/d was used for locations nearest the Schuylkill River (B-169, B-39, B-164, and URS-1).

For the two-step modeling approach an initial hydraulic conductivity of 23.98 ft/d was used for transport modeling within the center of the site. For the second step a hydraulic conductivity of 0.283 ft/d was used to represent the influence of the sheet pile wall.

F.5.7 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. Site specific hydraulic gradients were derived from December 2012 groundwater elevations at all modeled locations. WPM-11 was assigned a low hydraulic gradient of 0.001 because it is located on a broad ridge between two equal contour lines. The hydraulic gradients all other wells were estimated based on surrounding wells.

F.5.8 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 6 were based on historical geotechnical analysis of fill and alluvium materials found in the shallow aquifer zone of AOI 6.

F.5.9 Soil Bulk Density (ρ_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

$$\rho_b = 2.65 * (1- n).$$

The soil bulk density values used in the fate and transport modeling is 1.7 grams per cubic centimeter as calculated using the above equation and porosity estimate of 0.35 from historical geotechnical analysis.

F.5.10 Organic Carbon Partition Coefficient (K_{OC})

The organic carbon partition coefficient is chemical specific and is provided in the PADEP EP spreadsheet "Number Please!2011" which is based on PA Code, Chapter 250, Appendix A, Table 5. These values were used in the fate and transport modeling.

F.5.11 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

model-recommended default concentration of 0.005, which is a conservative value based on the description of site soils.

F.5.12 Time (t)

'Time zero' is the point at which contamination was introduced into the aquifer. Time since 'time zero' is measured in days. The final simulation time of 1×10^{99} days was used to ensure that a steady-state plume was simulated.

F.6 QD and SWLOAD Modeling Results

Initial QD and SWLOAD groundwater fate and transport results indicate benzene concentrations at B-154 (238,000 ug/l) and B-155 (77,800 ug/l) and URS-4 (46.8 ug/l) have the potential to reach the bank of the Schuylkill River at concentrations above the DEP groundwater MSC (Table F.1). All other COCs evaluated using the QD and SWLOAD models were predicted to attenuate before reaching the nearest receptor (Table F.1). QD models can be found in Figures F.2 through F.19. SWLOAD model can be found in Figure F.20 through F.48.

Despite the initial QD and SWLOAD modeling results for benzene at B-154 and B-155 which indicate some potential for off-site impacts, one factor suggests that it is unlikely that these impacts could reach nearby surface water receptors. That factor suggests benzene will not impact nearby receptor is that benzene concentrations in surrounding wells B-156 at 301 ug/l, B-151 at 15.2 ug/l, B-163 at 373 ug/l, and non- detect at B-135 are several orders of magnitude less than those at B-154 and B-155.

However, to further address potential benzene impacts originating from B-154 and B-155 a two-step modeling approach approved by Pennsylvania Department of Environmental Protection (PADEP) was undertaken using QD and SWLOAD. The first step QD and SWLOAD simulations were run to predict the benzene concentrations and plume widths for each well at a point 150 feet from the Schuylkill River. The distance of 150 feet represents a transition point where groundwater flow begins to be controlled

by the sheet pile rather than the alluvium/fill. The first step simulations were run with the same input parameters as the initial, single step QD and SWLOAD model runs.

The second step QD and SWLOAD simulations use concentrations (QD results) and plume widths (SWLOAD results) from the first step as input. The starting concentrations in step two (i.e., the ending concentrations in step one) are applied over the entire source areas, to be conservative. All other parameters stay the same in the second simulation step except for hydraulic conductivity which decreases from 23.98 ft/d (alluvium/fill) to 0.283 ft/d (unsealed sheet pile).

Using this two-step model approach, QD and SWLOAD simulations for B-154 indicate the benzene impacted groundwater has a potential to discharge to the Schuylkill River at a concentration of 31.15 ug/l. Therefore a PENTOXSD analysis was run for benzene from B-154 using a groundwater flux calculated by SWLOAD in the second step of the two step simulation. Using the two step approach the QD and SWLOAD simulations predict the benzene impacts from B-155 will attenuate below the PADEP groundwater MSC before reaching the Schuylkill River. The two step QD and SWLOAD simulations can be found in Figures F.49 through F.56

QD and SWLOAD results for URS-4 indicated that benzene could reach the Schuylkill River at a concentration of 31.74 ug/l which exceeds SWLOAD edge criterion of 5 ug/l. Therefore a PENTOXSD model was run for benzene at URS-4.

The QD and SWLOAD models are not used for the fate and transport of lead. Therefore the lead groundwater MSC exceedence at B-39 was assessed using the mixing equation.

F.7 Potential Impacts to Surface Water Results

As directed by PADEP the Schuylkill River $Q_{7\text{-}10}$ flow was entered into PENTOXSD as 10% of the actual $Q_{7\text{-}10}$ flow of 101 cubic feet per second (CFS); the harmonic mean flow for the Schuylkill River was entered in PENTOXSD as 10% of the actual harmonic mean

flow of 807 CFS. Input parameters for the PENTOXSD simulations can be found in Table F.2. PENTOXSD output can be found in Table F.3. PENTOXSD input and output data can be found in Figures F.57 through F.68

PENTOXSD results, using groundwater flux from the initial single step QD/SWLOAD simulations, indicate that the benzene groundwater concentration at B-154 (238,000 ug/l) would exceed its wasteload allocations (WLAs) for acute fish criterion (AFC), chronic fisher criterion (CFC) and cancer risk level (CRL). PENTOXSD results indicate that the benzene groundwater concentration at B-155 (77,800 ug/l) exceeds its WLAs for AFC, CFC and CRL.

QD/SWLOAD results using the two-step model approach indicate benzene concentrations at B-155 attenuate before reaching the Schuylkill River. Benzene concentrations at B-154 do not attenuate below the groundwater MSC by the time they reach the river. However, the SWLOAD predicted benzene groundwater concentration for B-155 at the Schuylkill River (31.2 ug/l) does not exceed any of the PENTOXSD calculated WLAs.

For URS-4 the groundwater benzene concentration was 46.8 ug/l. The calculated benzene concentration, using SWLOAD, at the receptor is 31.7 ug/l. Neither of these concentrations exceed any of the PENTOXSD calculated WLAs.

For assessing the potential impact of dissolved metals in groundwater to surface water, the equation for calculating the allowable groundwater concentration (discharge equation), as presented in the PA Act 2 Technical Guidance page IV-20, was used.

The wasteload allocation calculations were performed using the equation;

$$C_{gw} = C_x + \frac{Y_c \times Q_{sw} \times (C_x - C_{bsw})}{Q_{gw}}$$

Where:

- C_{gw} = the allowable groundwater concentration (ug/l)

- C_x = the water quality objective from PA Code Chapter 93 (ug/l)
- Q_{sw} = the quantity of stream flow above the nonpoint source discharge into surface water (cubic ft per second)
- C_{bsw} = the background concentration in surface water of a contaminant of concern above the nonpoint source discharge (ug/l)
- Q_{gw} = the quantity of flow in the groundwater plume discharging to the surface water (cubic ft per second)
- Y_c = partial mixing factor is the fractional portion of the stream that mixes with the discharge

Surface water impact calculations for lead at B-39 can be found in Table F.4. The calculated AFC for lead is 1,298.7 ug/l and the CFC for lead is 33,766.33 ug/l. The observed lead concentration at B-39 is 5.7 ug/l, which is below both wasteload allocations.

F.8 Fate and Transport Modeling Summary

All COCs (benzene, toluene, benzo(a)pyrene, benzo(a)anthracene, benzo(g,h,i)perylene, benzo(b)fluoranthene, pyrene, chrysene, 1,2,4-TMB, 1,3,5-TMB and lead) evaluated using the QD and SWLOAD models were predicted to attenuate before reaching the nearest receptor, except for benzene at B-154, B-155 and URS-4.

Using the two-step model approach which accounts for changing hydraulic conditions (i.e., presence of a less permeable sheet pile wall along the river), QD and SWLOAD simulations indicate the benzene concentration in B-155 will attenuate below the groundwater MSC before discharging to the Schuylkill River. Using the same two-step modeling approach, SWLOAD predicts that benzene groundwater concentrations from B-154 decrease to 31.2 ug/l, which is several orders of magnitude less than the WLAs calculated by PENTOSXD.

Calculations using the mixing equation for lead at B-39 indicate that the groundwater lead impact of 5.7 ug/l, is several orders of magnitude lower than the AFC and CFC wasteload allocations.

Table F.1
Quick Domenico and SWLOAD Modeling Results
AOI 6
PES Facility
Philadlephia, Pennsylvania

Well ID	Contaminant of Concern	QD/SWLOAD Starting Concentration	Groundwater MSC[1]	Distance to Point of Compliance[4]	QD Predicted Distance to Meet Non-Residential MSC	SWLOAD Edge Criterion[2]	SWLOAD Highest Modeled Concentration	PENTOX Needed?
		ug/l	ug/l	ft	ft	ug/l	ug/l	
B-152	Benzene	38.8	5	633	363.85	5	1.95	NO
B-151	Benzene	15.2	5	727	150.73	5	0.56	NO
B-154	Benzene	238000	5	881	3,400.73	5	5465.67	YES
	Toluene	1100	1000	881	3.58	330	0.38	NO
B-155	Benzene	77800	5	879	2,505.60	5	1146.42	YES
B-156	Benzene	301	5	775	770.31	5	4.91	NO
B-163	Benzene	373	5	1,130	824.07	5	1.52	NO
B-135	Benzo(a)pyrene	4.02	0.2	968	5.03	0.07	<.1	NO
	Benzo(a)anthracene	7.94	3.6	968	2.41	0.041	<.1	NO
	Benzo(g,h,i)perylene	1.46	0.26	968	1.85	0.26	<.1	NO
	Benzo(b)fluoranthene	4.35	1.2	968	2.98	0.057	<.1	NO
	Chrysene	4.87	1.9	968	2.93	0.477	0.48	NO
B-144	Benzene	77.5	5	963	404.85	5	0.39	NO
	1,2,4-Trimethylbenzene[3]	212	62	963	12.41	33[3]	<.1	NO
	1,3,5-Trimethylbenzene[3]	64.4	53	963	3.66	71[3]	12.95	NO
B-145	Benzene	18	5	1,060	156.93	5	<.1	NO
B-126	Benzene	189	5	681	589.95	5	3.29	NO
B-125	Benzene	173	5	705	503.31	5	1.72	NO
	Benzo(a)pyrene	0.262	0.2	705	0.52	0.07	<.1	NO
B-169	Benzene	6.4	5	31	14.54	5	3.47	NO
	Benzo(a)pyrene	0.223	0.2	31	0.08	0.07	<.1	NO
B-39	Benzene	44	5	150	49.78	5	<.1	NO
	Benzo(a)pyrene	6.03	0.2	150	1.07	0.07	<.1	NO
	Benzo(a)anthracene	8.27	3.6	150	0.47	0.041	<.1	NO
	Benzo(g,h,i)perylene	2.89	0.26	150	0.49	0.26	<.1	NO
	Benzo(b)fluoranthene	6	1.2	150	0.70	0.057	<.1	NO
	Chrysene	6.78	1.9	150	0.74	0.477	<.1	NO
B-164	Benzene	99.1	5	89	68.47	5	2.09	NO
URS-4	Benzene	46.8	5	10	51.18	5	31.74	YES
URS-2	Benzo(a)pyrene	0.407	0.2	113	1.95	0.07	N/A	NO
	Benzo(g,h,i)perylene	0.314	0.26	113	0.33	0.26	N/A	NO
U-4	Benzo(a)pyrene	0.686	0.2	81	5.89	0.07	N/A	NO
	Benzo(g,h,i)perylene	0.344	0.26	81	0.85	0.26	N/A	NO
WPM-11	Benzene	20.5	5	110	84.95	5	N/A	NO
	Benzo(a)pyrene	115	0.2	110	6.14	0.07	N/A	NO
	Benzo(a)anthracene	66	3.6	110	5.10	0.041	N/A	NO
	Benzo(g,h,i)perylene	118	0.26	110	3.79	0.26	N/A	NO
	Benzo(b)fluoranthene	161	1.2	110	6.52	0.057	N/A	NO
	Chrysene	149	1.9	110	7.81	0.477	N/A	NO
	Pyrene	265	130	110	4.73	130	N/A	NO
B-154 and B-155 Two-Step Modeling Results for Benzene								
B-154 Step1	Benzene	238000	5	731	NA	5	8725.44	NA
B-154 Step 2	Benzene	8725.44	5	150	198.70	5	31.15	YES
B-155 Step 1	Benzene	77800	5	729	NA	5	1976.62	NA
B-155 Step 2	Benzene	1976.62	5	150	130.35	5	3.17	NO

NOTES:
(1) ACT 2 TGM, Appendix A, Table 1 Medium Specific Concentration for a Non-Residential Used Aquifer with TDS less than or equal to 2,500 ug/l
QD = Quick Domenico
(2) Edge criterion developed per PADEP Act Guidance Section IV subsection d (pg IV-22).
(3) Values from USEPA Region 3 BTAG Freshwater Screening Benchmarks.
(4) Distance of Compliance is the distance to the start of the second simulation and distance to the Schuylkill River for the Step 1 and Step 2 of the Two-Step Modeling Approach, resepe
100 = Distance for COC to attanueate to screening concentrtion exceeds distance to receptor

Table F.2
Input Parameters for PENTOXSD Simulation
AOI 6
PES Facility
Philadelphia, Pennsylvania

Parameter	Unit	Value	Source
River Mile Index (**at discharge point**)	mile	1.6	From confluence with Delaware River to potenital point of discharge at AOI 6
River Stage Elevation (**at discharge point**)	ft	0.5	Estimated from USGS Water Resources Investigations Report 01-4218
Drainage Area	mi^2	1,910.00	Penrose Avenue USGS gauge
Q_{7-10} Stream Flow	ft^3/s	10.1	Penrose Avenue USGS gauge
Q_{7-10} Reach Width	ft	calculated	Calculated by PENTOXSD
Q_{7-10} Reach Depth	ft	calculated	Calculated by PENTOXSD
Q_h Stream Flow	ft^3/s	81.10	Penrose Avenue USGS gauge
Q_h Reach Width	ft	calculated	Calculated by PENTOXSD
Q_h Reach Depth	ft	calculated	Calculated by PENTOXSD
River Mile Index (**at confluence**)	mile	0.001	Confluence of Schuylkill River with Delaware River
River Stage Elevation (**at confluence**)	ft	0.00	Estimated from USGS Water Resources Investigations Report 01-4218
Drainage Area	mi^2	1,912.00	PA Gazetteer of Streams
Q_{7-10} Stream Flow	ft^3/s	calculated	Calculated by PENTOXSD
Q_{7-10} Reach Width	ft	calculated	Calculated by PENTOXSD
Q_{7-10} Reach Depth	ft	calculated	Calculated by PENTOXSD
Q_h Stream Flow	ft^3/s	calculated	Calculated by PENTOXSD
Q_h Reach Width	ft	calculated	Calculated by PENTOXSD
Q_h Reach Depth	ft	calculated	Calculated by PENTOXSD
Diffuse Groundwater Flow			
B-154 benzene	million gallons per day	8.93E-02	SWLOAD Simulation
B-154 Two-Step Approach benzene		1.11E-03	
B-155 benzene		6.11E-02	
URS-4 benzene		1.00E-04	

Table F.3
PENTOXSD Protection of Surface Water Groundwater Screening Values and Results for Benzene
AOI-6
PES Facility
Philadelphia, Pennsylvania

Well ID	Grounwater Benzene Concentrations (January 2013)	SWLOAD Predicted Groundwater Benzene Concentration at Receptor	PENTOXSD-Calculated Wasteload Allocations			
			AFC	CFC	THH	CRL
	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
B-154	238,000.0	5,465.7	5,163.7	6,496.1	NA	706.0
B-154 Two Step Approa	238,000.0	31.2	360,993.9	507,252.9	NA	56,675.9
B-155	77,800.0	1,146.4	7,227.7	9,400.8	NA	1,030.6
URS-4	46.8	31.7	4,000,000.0	5,620,000.0	NA	629,089.8

Notes:
AFC = Acute Fish Criterion
CFC = Chronic Fish Criterion
THH = Target Human Health
CRL = Cancer Risk Level
NA = Target Human Health surface water quality criteria for benzene not developed for PA Code 93.8c Table 5.

Table F.4
Calculated Mass Balance Wasteload Allocation
B-39 - Lead
PES Facility
Philadelphia, Pennsylvania

Lead AFC				
Parameter	**Unit**	**Value**	**Parameter Description**	**Data Source**
Cgw[(1)]	ug/l	**1,298.70**	WLA	Calculated
Cx	ug/l	2.50	WQC	PA Chapter 16
Cbsw	ug/l	0.00	Background Concentration	Assumed to be zero
Yc	unitless	1.00	Partial Mixing Factor	Not used, therefore set to a value of 1
Qsw	cfs	10.10	Surface Water Flow	10% of **Q7-10 flow** per PADEP
Qgw	cfs	1.948E-02	Groundwater Flow	See notes
Lead CFC				
Cgw[(1)]	ug/l	**33,766.23**	WLA	Calculated
Cx	ug/l	65.00	WQC	PA Chapter 16
Cbsw	ug/l	0.00	Background Concentration	Assumed to be zero
Yc	unitless	1.00	Partial Mixing Factor	Not used, therefore set to a value of 1
Qsw	cfs	10.10	Surface Water Flow	10% of **Q7-10 flow** per PADEP
Qgw	cfs	1.948E-02	Groundwater Flow	See notes

NOTES:

(1) Wasteload allocation calculated from equation found in ACT 2 Guidance, Section IV, page 20.

(2) Qgw = hydraulic conductivity x hydraulic gradient x area.

Hydraulic conductivity = 23.98 ft/d, the highest value derived from AOI 6 constant rate test by URS, 2002.

Hydraulic gradient = 0.009 estimated from July 2012 gauging data.

Area: 7,800 ft^2 (200 ft width x 39 ft aquifer thickness).

N
W E
S

Legend

- Shallow Monitoring Well and Groundwater Elevation (ft.)
- Shallow Recovery Well and Groundwater Elevation (ft.)
- Deep Monitoring Wells
- Shallow Piezometer
- Monitoring Well Abandoned/Damaged/Unable to Locate
- Shallow Monitoring Well with No Exceedance of PADEP Non-Res GW MSCs
- Shallow Monitoring Well Location with No Exceedance of PADEP Non-Res GW MSCs (see Note 2)
- Shallow Monitoring Well Location with Exceedance of PADEP Non-Res GW MSCs
- Groundwater Elevation Contour (ft.)
- Sheet Pile Wall
- Removed Tank
- Tank In Service
- Tank Closed in Place
- Tank With Release Assessment
- Solid Waste Management Unit (SWMU)
- AOIs

Notes:
1. Bing Maps aerial imagery provided by © 2010 Microsoft Corporation and its data suppliers and obtained under the licensing agreement with ESRI.
2. Groundwater sample usable for qualitative assessment but cannot be used for site characterization, delineation or to show attainment of an Act 2 standard.
3. Monitoring wells sampled January 2013.

Figure F1 Summary of Groundwater Sample Exceedances - January 2013
AOI-6 Site Characterization/
Remedial Investigation Report
PES Facility
Philadelphia, Pennsylvania

SUNOCO
PHILADELPHIA ENERGY SOLUTIONS

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

0 150 300 Feet

SCALE: 1" = 150'
DATE: July 8, 2013
DRN. BY: MH
CKD. BY: PT
JOB#: 3574601

Path: \\langan.com\data\DT\data6\2574601\ArcGIS\MapDocuments\AOI 6 Repackaged SCRFigure X - Summary of Groundwater Exceedances_7-8-13.mxd

Figure F.2
Quick Domenico
Fate and Transport Model Input and Output
B-152
AOI 6 PES Facility
Philadelphia, Pennsylvania

Project	AOI 6 PES Facility
Prepared by	TS
Date Prepared	8/28/2013

Generic Input Parameters				Data Source
Source Identification (or Well ID)			B-152	
Sample Date			Jan-13	
Source Width		ft	100	100' default if no plume present
Source Thickness		ft	39	Maximum thickness of alluvium/fill
Longitudinal Dispersivity	A_x	ft	200	From CCR QD Simulations
Transverse Dispersivity	A_y	ft	20.0	Quick Domenico User's Guide
Vertical Dispersivity	A_z	ft	0.0001	Quick Domenico User's Guide
Hydraulic Conductivty	k	ft/day	23.98	Highest K URS 2002 Aquifer testing
Hydraulic Gradient		ft/ft	0.009	December 2012 Groundwater Gauging
Porosity		decimal fraction	0.35	Site soil analysis
Soil Bulk Density	p_b	g/cm3	1.7225	Quick Domenico User's Guide
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005	Quick Domenico User's Guide
Time		days	1.00E+99	Steady-state conditions

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.038800
Lambda (per day)		day^{-1}	0.000958904
KOC			58

Output

Contaminant	Starting Concentration (mg/l)	Screening Criteria (mg/l)	Predicted Concentration (mg/l)	Distance to Meet Screening Criteria (ft)
Sim 1 - Benzene	0.038800	0.005000	0.005000	363.856122

Figure F.2
SIM 1

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzene

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

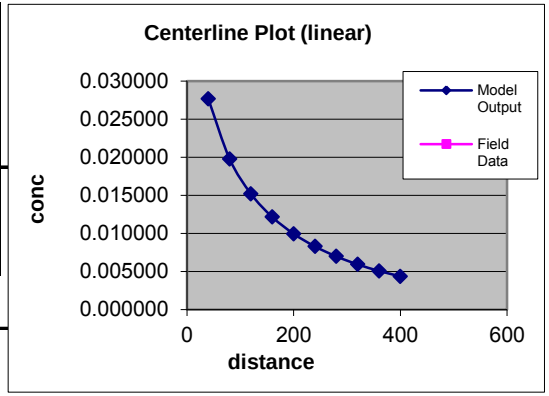
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.038800	2.00E+02	2.00E+01	1.00E-04	9.589E-04	100	39	1E+99

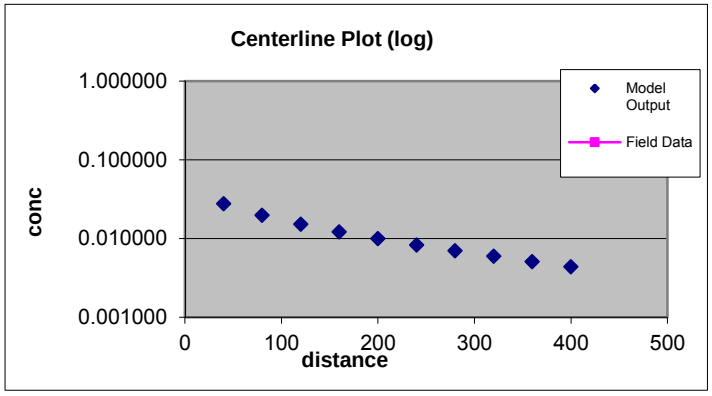
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.009	0.35	1.72	58.00	5.00E-03	2.427214286	0.25404785

Point Concentration

x(ft)	y(ft)	z(ft)
363.856122	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	363.856122	0	0
at	1E+99	days =	0.005000 mg/l





AREAL MODEL CALCULATION DOMAIN

Length (ft) 400
Width (ft) 100

	40	80	120	160	200	240	280	320	360	400
100	0.003704	0.005851	0.006316	0.006115	0.005665	0.005139	0.004611	0.004113	0.003656	0.003245
50	0.017327	0.014644	0.012214	0.010236	0.008644	0.007352	0.006291	0.005412	0.004675	0.004054
0	0.027676	0.019779	0.015198	0.012149	0.009950	0.008284	0.006978	0.005930	0.005074	0.004366
-50	0.017327	0.014644	0.012214	0.010236	0.008644	0.007352	0.006291	0.005412	0.004675	0.004054
-100	0.003704	0.005851	0.006316	0.006115	0.005665	0.005139	0.004611	0.004113	0.003656	0.003245
Field Data:	**Centerline C Concentration**									
	Distance from Source									

Figure F.3
Quick Domenico
Fate and Transport Model Input and Output
B-151
AOI 6 PES Facility
Philadelphia, Pennsylvania

Project	AOI 6 PES Facility
Prepared by	TS
Date Prepared	8/28/2013

Generic Input Parameters				Data Source
Source Identification (or Well ID)			B-151	
Sample Date			Jan-13	
Source Width		ft	100	100' default if no plume present
Source Thickness		ft	39	Maximum thickness of alluvium/fill
Longitudinal Dispersivity	A_x	ft	200	From CCR QD Simulations
Transverse Dispersivity	A_y	ft	20.0	Quick Domenico User's Guide
Vertical Dispersivity	A_z	ft	0.0001	Quick Domenico User's Guide
Hydraulic Conductivty	k	ft/day	23.98	Highest K URS 2002 Aquifer testing
Hydraulic Gradient		ft/ft	0.009	December 2012 Groundwater Gauging
Porosity		decimal fraction	0.35	Site soil analysis
Soil Bulk Density	p_b	g/cm3	1.7225	Quick Domenico User's Guide
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005	Quick Domenico User's Guide
Time		days	1.00E+99	Steady-state conditions

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.015200
Lambda (per day)		day^{-1}	0.000958904
KOC			58

Output

Contaminant	Starting Concentration (mg/l)	Screening Criteria (mg/l)	Predicted Concentration (mg/l)	Distance to Meet Screening Criteria (ft)
Sim 1 - Benzene	0.015200	0.005000	0.005000	150.732085

Figure F.3
SIM 1

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzene

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

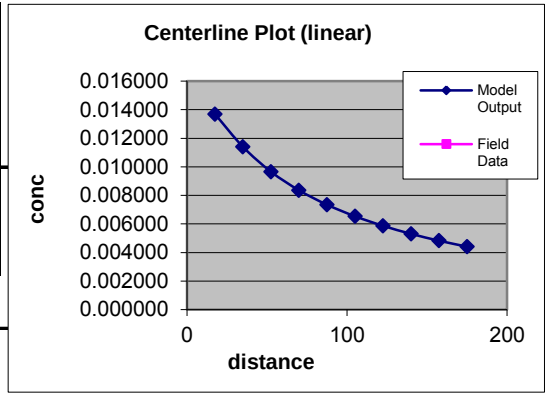
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.015200	2.00E+02	2.00E+01	1.00E-04	9.589E-04	100	39	1E+99

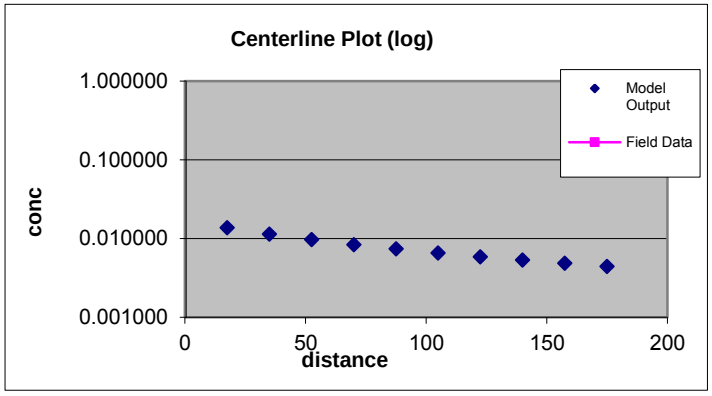
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.009	0.35	1.72	58.00	5.00E-03	2.427214286	0.25404785

Point Concentration

x(ft)	y(ft)	z(ft)
150.732085	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	150.7320852	0	0
at	1E+99	days =	0.005000 mg/l





AREAL MODEL CALCULATION DOMAIN
Length (ft) 175
Width (ft) 100

	17.5	35	52.5	70	87.5	105	122.5	140	157.5	175
100	0.000428	0.001263	0.001826	0.002168	0.002360	0.002451	0.002475	0.002454	0.002405	0.002336
50	0.007272	0.006908	0.006467	0.006000	0.005545	0.005121	0.004731	0.004376	0.004054	0.003760
0	0.013691	0.011395	0.009655	0.008354	0.007344	0.006534	0.005866	0.005303	0.004822	0.004406
-50	0.007272	0.006908	0.006467	0.006000	0.005545	0.005121	0.004731	0.004376	0.004054	0.003760
-100	0.000428	0.001263	0.001826	0.002168	0.002360	0.002451	0.002475	0.002454	0.002405	0.002336
Field Data:	**Centerline C Concentration**									
	Distance from Source									

Figure F.4
Quick Domenico
Fate and Transport Model Input and Output
B-154
AOI 6 PES
Philadelphia, Pennsylvania

Project	AOI 6 PES
Prepared by	TS
Date Prepared	8/28/2013

Generic Input Parameters				Data Source
Source Identification (or Well ID)			B-154	
Sample Date			Jan-13	
Source Width		ft	100	100' default if no plume present
Source Thickness		ft	39	Maximum thickness of alluvium/fill
Longitudinal Dispersivity	A_x	ft	200	From CCR QD Simulations
Transverse Dispersivity	A_y	ft	20.0	Quick Domenico User's Guide
Vertical Dispersivity	A_z	ft	0.0001	Quick Domenico User's Guide
Hydraulic Conductivty	k	ft/day	23.98	Highest K URS 2002 Aquifer testing
Hydraulic Gradient		ft/ft	0.009	December 2012 Groundwater Gauging
Porosity		decimal fraction	0.35	Site soil analysis
Soil Bulk Density	p_b	g/cm3	1.7225	Quick Domenico User's Guide
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005	Quick Domenico User's Guide
Time		days	1.00E+99	Steady-state conditions

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	238.000000
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			Toluene
Source Concentration (mg/l)		mg/l	1.100000
Lambda (per day)		day^{-1}	0.0247
KOC			130

Output

Contaminant	Starting Concentration (mg/l)	Screening Criteria (mg/l)	Predicted Concentration (mg/l)	Distance to Meet Screening Criteria (ft)
Sim 1 - Benzene	238.000000	0.005000	0.005000	3,400.734351
Sim 2 - Toluene	1.100000	1.000000	1.000000	3.581033775

Figure F.4
SIM 1

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzene

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

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
238.000000	2.00E+02	2.00E+01	1.00E-04	9.589E-04	100	39	1E+99

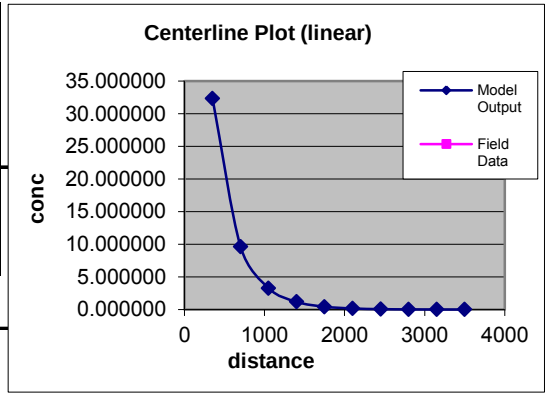
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.009	0.35	1.72	58.00	5.00E-03	2.427214286	0.25404785

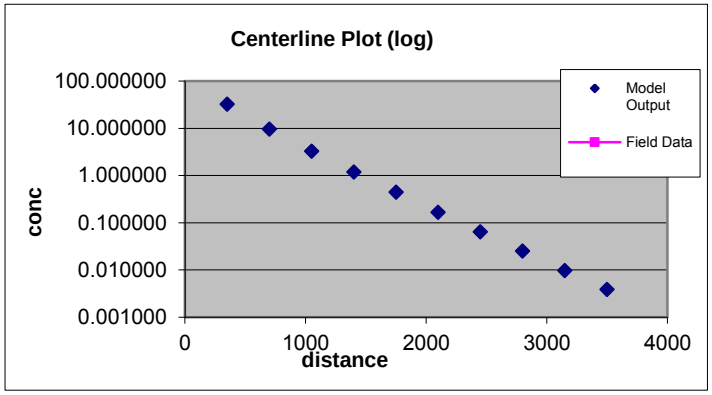
Point Concentration

x(ft)	y(ft)	z(ft)
3,400.734351	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	3400.734351	0	0
at	1E+99	days =	

0.005000 mg/l





AREAL MODEL CALCULATION DOMAIN
Length (ft) 3500
Width (ft) 100

	350	700	1050	1400	1750	2100	2450	2800	3150	3500
100	23.102340	8.099800	2.919334	1.082675	0.409607	0.157180	0.060952	0.023828	0.009374	0.003707
50	29.734322	9.224235	3.186377	1.156512	0.431875	0.164283	0.063309	0.024633	0.009656	0.003807
0	32.343200	9.632710	3.280713	1.182227	0.439563	0.166722	0.064115	0.024907	0.009751	0.003841
-50	29.734322	9.224235	3.186377	1.156512	0.431875	0.164283	0.063309	0.024633	0.009656	0.003807
-100	23.102340	8.099800	2.919334	1.082675	0.409607	0.157180	0.060952	0.023828	0.009374	0.003707

Field Data:	Centerline C Concentration								
	Distance from Source								

Figure F.4
SIM 2

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES
Date: 8/28/2013 Prepared by: TS
Contaminant: Toluene

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

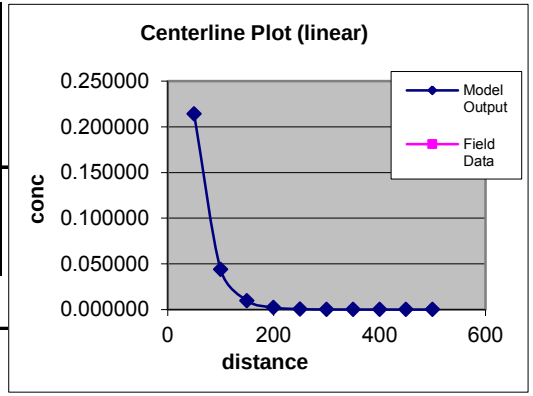
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
1.100000	2.00E+02	2.00E+01	1.00E-04	2.470E-02	100	39	1E+99

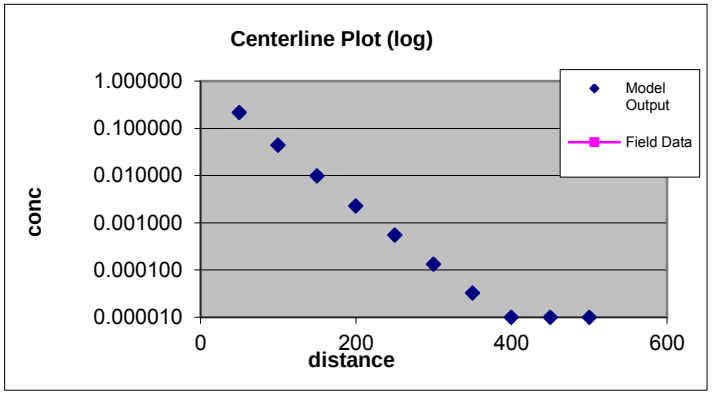
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.009	0.35	1.72	130.00	5.00E-03	4.198928571	0.146853789

Point Concentration

x(ft)	y(ft)	z(ft)
3.581034	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	3.581033775	0	0
at	1E+99	days =	1.000000
			mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	500
Width (ft)	100

	50	100	150	200	250	300	350	400	450	500
100	0.038208	0.015819	0.004734	0.001297	0.000343	0.000090	0.000023	0.000006	0.000002	0.000000
50	0.141725	0.034068	0.008165	0.001979	0.000485	0.000120	0.000030	0.000007	0.000002	0.000000
0	0.214175	0.043888	0.009786	0.002278	0.000544	0.000132	0.000033	0.000010	0.000010	0.000010
-50	0.141725	0.034068	0.008165	0.001979	0.000485	0.000120	0.000030	0.000007	0.000002	0.000000
-100	0.038208	0.015819	0.004734	0.001297	0.000343	0.000090	0.000023	0.000006	0.000002	0.000000

Field Data:	Centerline C Concentration								
	Distance from Source								

Figure F.5
Quick Domenico
Fate and Transport Model Input and Output
B-155
AOI 6 PES Facility
Philadelphia, Pennsylvania

Project	AOI 6 PES Facility
Prepared by	TS
Date Prepared	8/28/2013

Generic Input Parameters				Data Source
Source Identification (or Well ID)			B-155	
Sample Date			Jan-13	
Source Width		ft	100	100' default if no plume present
Source Thickness		ft	39	Maximum thickness of alluvium/fill
Longitudinal Dispersivity	A_x	ft	200	From CCR QD Simulations
Transverse Dispersivity	A_y	ft	20.0	Quick Domenico User's Guide
Vertical Dispersivity	A_z	ft	0.0001	Quick Domenico User's Guide
Hydraulic Conductivty	k	ft/day	23.98	Highest K URS 2002 Aquifer testing
Hydraulic Gradient		ft/ft	0.007	December 2012 Groundwater Gauging
Porosity		decimal fraction	0.35	Site soil analysis
Soil Bulk Density	p_b	g/cm3	1.7225	Quick Domenico User's Guide
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005	Quick Domenico User's Guide
Time		days	1.00E+99	Steady-state conditions

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	77.800000
Lambda (per day)		day^{-1}	0.000958904
KOC			58

Output

Contaminant	Starting Concentration (mg/l)	Screening Criteria (mg/l)	Predicted Concentration (mg/l)	Distance to Meet Screening Criteria (ft)
Sim 1 - Benzene	77.800000	0.005000	0.005000	2,505.603209

Figure F.5
SIM 1

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzene

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

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
77.800000	2.00E+02	2.00E+01	1.00E-04	9.589E-04	100	39	1E+99

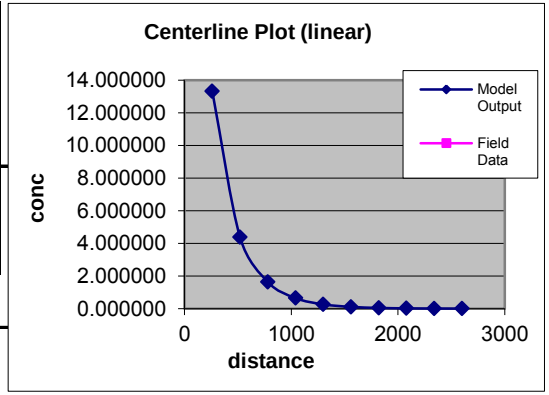
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^{3})	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.007	0.35	1.72	58.00	5.00E-03	2.427214286	0.197592772

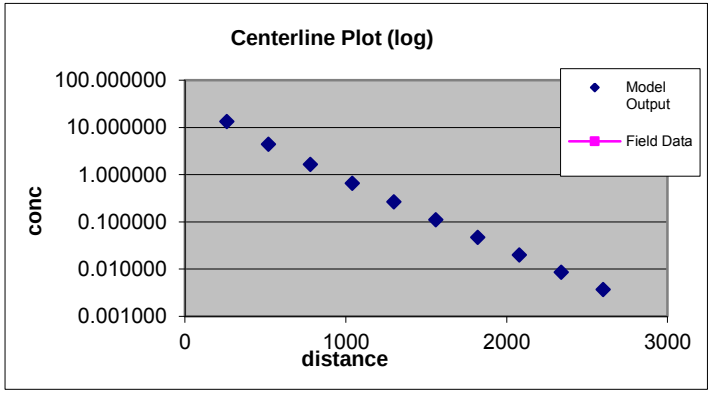
Point Concentration

x(ft)	y(ft)	z(ft)
2,505.603209	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	2505.603209	0	0
at	1E+99	days =	

0.005000 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	2600
Width (ft)	100

	260	520	780	1040	1300	1560	1820	2080	2340	2600
100	8.552215	3.475499	1.402494	0.576775	0.241003	0.101931	0.043514	0.018713	0.008094	0.003518
50	11.929809	4.132717	1.576602	0.630054	0.258728	0.108158	0.045788	0.019567	0.008422	0.003646
0	13.328754	4.378311	1.639313	0.648886	0.264921	0.110317	0.046572	0.019860	0.008534	0.003690
-50	11.929809	4.132717	1.576602	0.630054	0.258728	0.108158	0.045788	0.019567	0.008422	0.003646
-100	8.552215	3.475499	1.402494	0.576775	0.241003	0.101931	0.043514	0.018713	0.008094	0.003518
Field Data:	**Centerline C Concentration**									
	Distance from Source									

Figure F.6
Quick Domenico
Fate and Transport Model Input and Output
B-156
AOI 6 PES Facility
Philadelphia, Pennsylvania

Project	AOI 6 PES Facility
Prepared by	TS
Date Prepared	8/28/2013

Generic Input Parameters				Data Source
Source Identification (or Well ID)			B-156	
Sample Date			Jan-13	
Source Width		ft	100	100' default if no plume present
Source Thickness		ft	39	Maximum thickness of alluvium/fill
Longitudinal Dispersivity	A_x	ft	200	From CCR QD Simulations
Transverse Dispersivity	A_y	ft	20.0	Quick Domenico User's Guide
Vertical Dispersivity	A_z	ft	0.0001	Quick Domenico User's Guide
Hydraulic Conductivty	k	ft/day	23.98	Highest K URS 2002 Aquifer testing
Hydraulic Gradient		ft/ft	0.006	December 2012 Groundwater Gauging
Porosity		decimal fraction	0.35	Site soil analysis
Soil Bulk Density	p_b	g/cm3	1.7225	Quick Domenico User's Guide
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005	Quick Domenico User's Guide
Time		days	1.00E+99	Steady-state conditions

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.301000
Lambda (per day)		day^{-1}	0.000958904
KOC			58

Output

Contaminant	Starting Concentration (mg/l)	Screening Criteria (mg/l)	Predicted Concentration (mg/l)	Distance to Meet Screening Criteria (ft)
Sim 1 - Benzene	0.301000	0.005000	0.005000	770.314552

Figure F.6
SIM 1

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzene

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

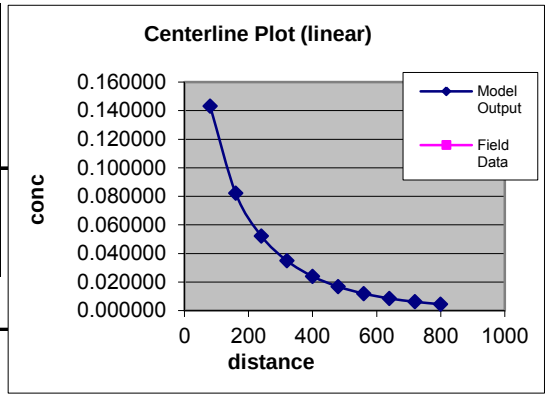
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.301000	2.00E+02	2.00E+01	1.00E-04	9.589E-04	100	39	1E+99

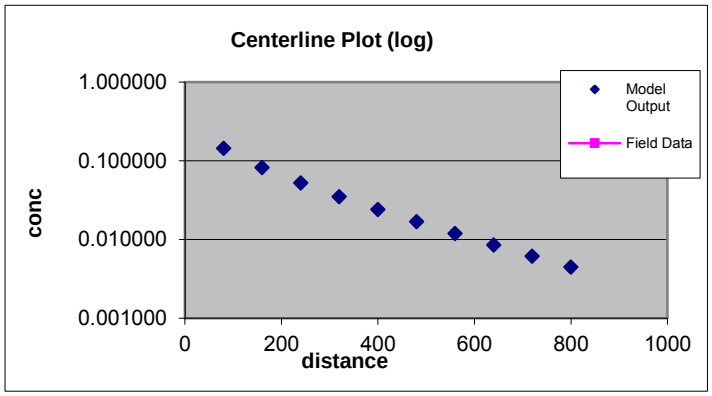
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.006	0.35	1.72	58.00	5.00E-03	2.427214286	0.169365234

Point Concentration

x(ft)	y(ft)	z(ft)
770.314552	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	770.3145522	0	0
at	1E+99	days =	**0.005000** mg/l





AREAL MODEL CALCULATION DOMAIN
Length (ft) 800
Width (ft) 100

	80	160	240	320	400	480	560	640	720	800
100	0.042353	0.041300	0.032379	0.024179	0.017802	0.013058	0.009577	0.007033	0.005174	0.003813
50	0.106000	0.069131	0.046327	0.031816	0.022238	0.015743	0.011253	0.008104	0.005871	0.004274
0	0.143165	0.082047	0.052198	0.034863	0.023949	0.016756	0.011875	0.008496	0.006124	0.004440
-50	0.106000	0.069131	0.046327	0.031816	0.022238	0.015743	0.011253	0.008104	0.005871	0.004274
-100	0.042353	0.041300	0.032379	0.024179	0.017802	0.013058	0.009577	0.007033	0.005174	0.003813
Field Data:	**Centerline C Concentration**									
	Distance from Source									

Figure F.7
Quick Domenico
Fate and Transport Model Input and Output
B-163
AOI 6 PES Facility
Philadelphia, Pennsylvania

Project	AOI 6 PES Facility
Prepared by	TS
Date Prepared	8/28/2013

Generic Input Parameters				Data Source
Source Identification (or Well ID)			B-163	
Sample Date			Jan-13	
Source Width		ft	100	100' default if no plume present
Source Thickness		ft	39	Maximum thickness of alluvium/fill
Longitudinal Dispersivity	A_x	ft	200	From CCR QD Simulations
Transverse Dispersivity	A_y	ft	20.0	Quick Domenico User's Guide
Vertical Dispersivity	A_z	ft	0.0001	Quick Domenico User's Guide
Hydraulic Conductivty	k	ft/day	23.98	Highest K URS 2002 Aquifer testing
Hydraulic Gradient		ft/ft	0.006	December 2012 Groundwater Gauging
Porosity		decimal fraction	0.35	Site soil analysis
Soil Bulk Density	p_b	g/cm3	1.7225	Quick Domenico User's Guide
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005	Quick Domenico User's Guide
Time		days	1.00E+99	Steady-state conditions

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.373000
Lambda (per day)		day^{-1}	0.000958904
KOC			58

Output

Contaminant	Starting Concentration (mg/l)	Screening Criteria (mg/l)	Predicted Concentration (mg/l)	Distance to Meet Screening Criteria (ft)
Sim 1 - Benzene	0.373000	0.005000	0.005000	824.067063

Figure F.7
SIM 1

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzene

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

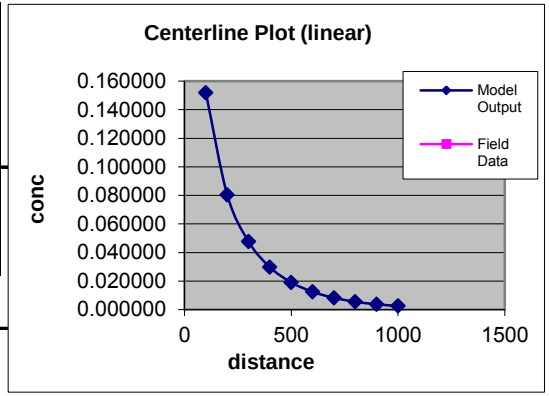
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.373000	2.00E+02	2.00E+01	1.00E-04	9.589E-04	100	39	1E+99

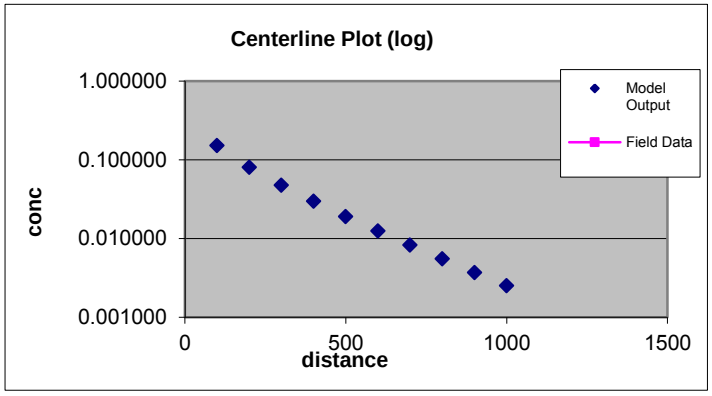
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.006	0.35	1.72	58.00	5.00E-03	2.427214286	0.169365234

Point Concentration

x(ft)	y(ft)	z(ft)
824.067063	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	824.0670628	0	0
at	1E+99	days =	0.005000 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	1000
Width (ft)	100

	100	200	300	400	500	600	700	800	900	1000
100	0.054740	0.045795	0.032296	0.022060	0.014974	0.010168	0.006922	0.004725	0.003235	0.002221
50	0.117884	0.069880	0.043228	0.027557	0.017924	0.011824	0.007882	0.005297	0.003582	0.002435
0	0.151867	0.080437	0.047638	0.029678	0.019031	0.012434	0.008232	0.005502	0.003706	0.002510
-50	0.117884	0.069880	0.043228	0.027557	0.017924	0.011824	0.007882	0.005297	0.003582	0.002435
-100	0.054740	0.045795	0.032296	0.022060	0.014974	0.010168	0.006922	0.004725	0.003235	0.002221

Field Data:	Centerline C Concentration								
	Distance from Source								

Figure F.8
Quick Domenico
Fate and Transport Model Input and Output
B-135
AOI 6 PES Facility
Philadelphia, Pennsylvania

Project	AOI 6 PES Facility
Prepared by	TS
Date Prepared	8/28/2013

Generic Input Parameters				Data Source
Source Identification (or Well ID)			B-135	
Sample Date			Jan-13	
Source Width		ft	100	100' default if no plume present
Source Thickness		ft	39	Maximum thickness of alluvium/fill
Longitudinal Dispersivity	A_x	ft	200	From CCR QD Simulations
Transverse Dispersivity	A_y	ft	20.0	Quick Domenico User's Guide
Vertical Dispersivity	A_z	ft	0.0001	Quick Domenico User's Guide
Hydraulic Conductivty	k	ft/day	23.98	Highest K URS 2002 Aquifer testing
Hydraulic Gradient		ft/ft	0.003	December 2012 Groundwater Gauging
Porosity		decimal fraction	0.35	Site soil analysis
Soil Bulk Density	ρ_b	g/cm3	1.7225	Quick Domenico User's Guide
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005	Quick Domenico User's Guide
Time		days	1.00E+99	Steady-state conditions

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzo(a)pyrene
Source Concentration (mg/l)		mg/l	0.004020
Lambda (per day)		day^{-1}	0.000658
KOC			910000
Sim 2			
Contaminant			Benzo(a)anthracene
Source Concentration (mg/l)		mg/l	0.007940
Lambda (per day)		day^{-1}	0.000521
KOC			350000
Sim 3			
Contaminant			Benzo(g,h,i)perylene
Source Concentration (mg/l)		mg/l	0.001460
Lambda (per day)		day^{-1}	0.000521
KOC			2800000
Sim 4			
Contaminant			Benzo(b)fluoranthene
Source Concentration (mg/l)		mg/l	0.004350
Lambda (per day)		day^{-1}	0.000575
KOC			550000
Sim 5			
Contaminant			Chrysene
Source Concentration (mg/l)		mg/l	0.004870
Lambda (per day)		day^{-1}	0.000356164
KOC			490000

Output				
Contaminant	**Starting Concentration (mg/l)**	**Screening Criteria (mg/l)**	**Predicted Concentration (mg/l)**	**Distance to Meet Screening Criteria (ft)**
Sim 1 - Benzo(a)pyrene	0.004020	0.000200	0.000200	5.032357
Sim 2 - Benzo(a)anthracene	0.007940	0.003600	0.003600	2.412176
Sim 3 - Benzo(g,h,i)perylene	0.001460	0.000260	0.000260	1.851873
Sim 4 - Benzo(b)fluoranthene	0.004350	0.001200	0.001200	2.976911
Sim 5 - Chrysene	0.004870	0.001900	0.001900	2.934626

Figure F.8
SIM 1

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzo(a)pyrene

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

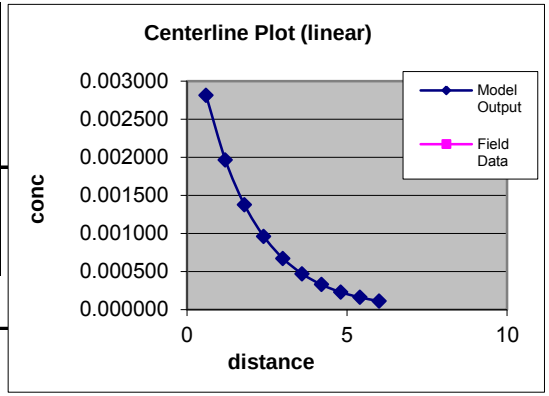
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.004020	2.00E+02	2.00E+01	1.00E-04	6.580E-04	100	39	1E+99

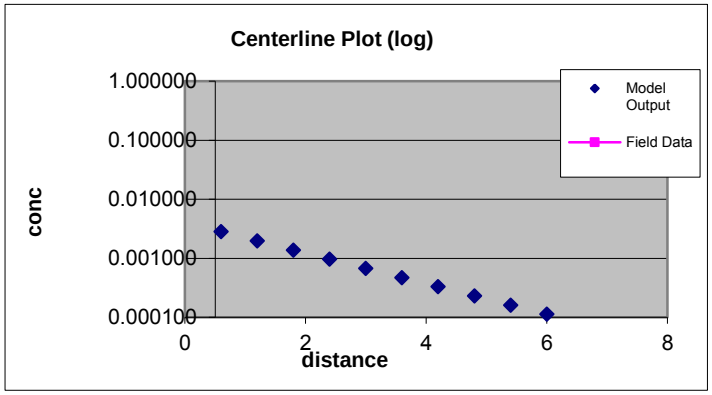
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.003	0.35	1.72	910,000.00	5.00E-03	22393.5	9.17868E-06

Point Concentration

x(ft)	y(ft)	z(ft)
5.032357	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	5.032356794	0	0
at	1E+99	days =	**0.000200** mg/l





AREAL MODEL CALCULATION DOMAIN
Length (ft) 6
Width (ft) 100

	0.6	1.2	1.8	2.4	3	3.6	4.2	4.8	5.4	6
100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	0.001406	0.000983	0.000687	0.000481	0.000336	0.000235	0.000164	0.000115	0.000080	0.000056
0	0.002811	0.001966	0.001375	0.000961	0.000672	0.000470	0.000329	0.000230	0.000161	0.000112
-50	0.001406	0.000983	0.000687	0.000481	0.000336	0.000235	0.000164	0.000115	0.000080	0.000056
-100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Field Data:	**Centerline C Concentration**									
	Distance from Source									

Figure F.8
SIM 2

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzo(a)anthracene

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

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.007940	2.00E+02	2.00E+01	1.00E-04	5.210E-04	100	39	1E+99

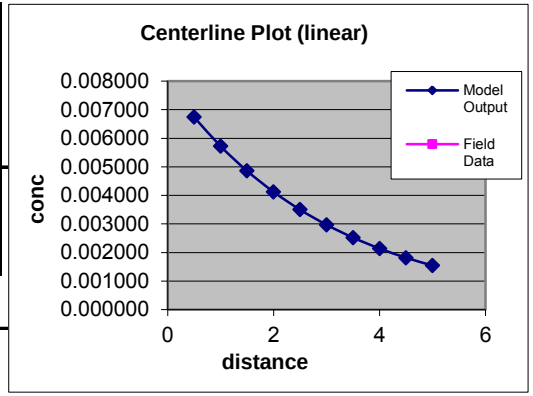
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.003	0.35	1.72	350,000.00	5.00E-03	8613.5	2.38629E-05

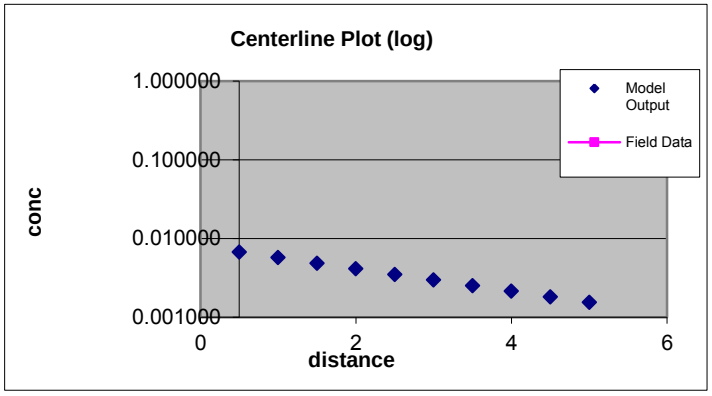
Point Concentration

x(ft)	y(ft)	z(ft)
2.412176	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	2.412176469	0	0
at	1E+99	days =	

0.003600 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	5
Width (ft)	100

	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	0.003370	0.002860	0.002428	0.002060	0.001749	0.001484	0.001260	0.001069	0.000908	0.000770
0	0.006739	0.005720	0.004855	0.004121	0.003498	0.002969	0.002520	0.002139	0.001815	0.001540
-50	0.003370	0.002860	0.002428	0.002060	0.001749	0.001484	0.001260	0.001069	0.000908	0.000770
-100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Field Data:	**Centerline C Concentration**									
	Distance from Source									

Figure F.8
SIM 3

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzo(g,h,i)perylene

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

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.001460	2.00E+02	2.00E+01	1.00E-04	5.210E-04	100	39	1E+99

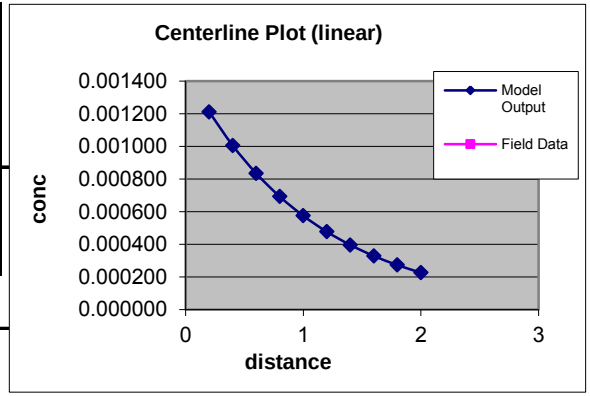
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.003	0.35	1.72	2,800,000.00	5.00E-03	68901	2.98316E-06

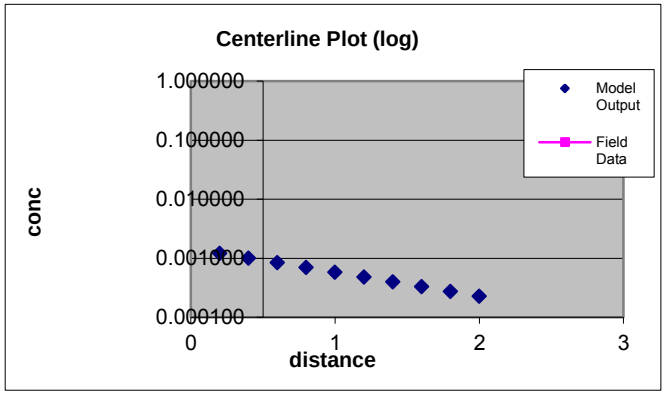
Point Concentration

x(ft)	y(ft)	z(ft)
1.851873	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	1.85187317	0	0
at	1E+99	days =	

0.000260 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	2
Width (ft)	100

	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2
100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	0.000606	0.000503	0.000417	0.000346	0.000287	0.000239	0.000198	0.000164	0.000136	0.000113
0	0.001212	0.001006	0.000835	0.000693	0.000575	0.000477	0.000396	0.000329	0.000273	0.000226
-50	0.000606	0.000503	0.000417	0.000346	0.000287	0.000239	0.000198	0.000164	0.000136	0.000113
-100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

Field Data:	Centerline C Concentration									
	Distance from Source									

Figure F.8
SIM 4

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzo(b)fluoranthene

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

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.004350	2.00E+02	2.00E+01	1.00E-04	5.750E-04	100	39	1E+99

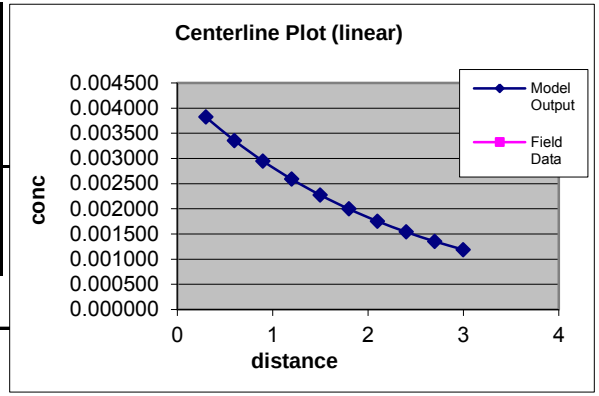
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.003	0.35	1.72	550,000.00	5.00E-03	13534.92857	1.51861E-05

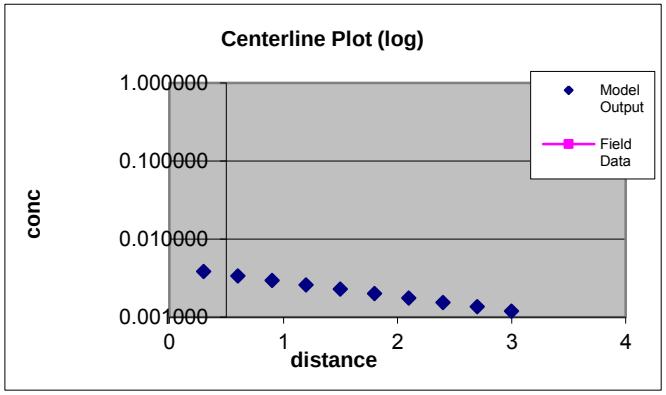
Point Concentration

x(ft)	y(ft)	z(ft)
2.976911	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	2.976911191	0	0
at	1E+99	days =	

0.001200 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	3
Width (ft)	100

	0.3	0.6	0.9	1.2	1.5	1.8	2.1	2.4	2.7	3
100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	0.001910	0.001678	0.001474	0.001294	0.001137	0.000998	0.000877	0.000770	0.000676	0.000594
0	0.003821	0.003356	0.002947	0.002588	0.002273	0.001997	0.001754	0.001540	0.001353	0.001188
-50	0.001910	0.001678	0.001474	0.001294	0.001137	0.000998	0.000877	0.000770	0.000676	0.000594
-100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Field Data:	**Centerline C Concentration**									
	Distance from Source									

Figure F.8
SIM 5

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Chrysene

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

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.004870	2.00E+02	2.00E+01	1.00E-04	3.562E-04	100	39	1E+99

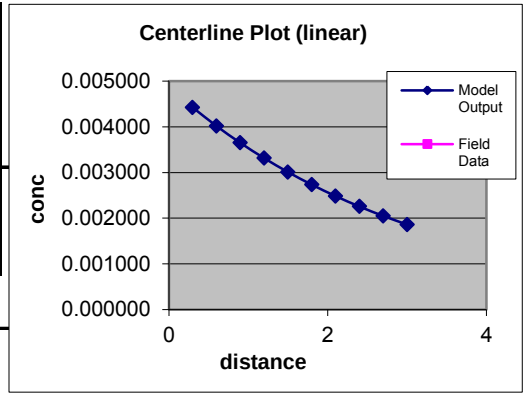
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.003	0.35	1.72	490,000.00	5.00E-03	12058.5	1.70455E-05

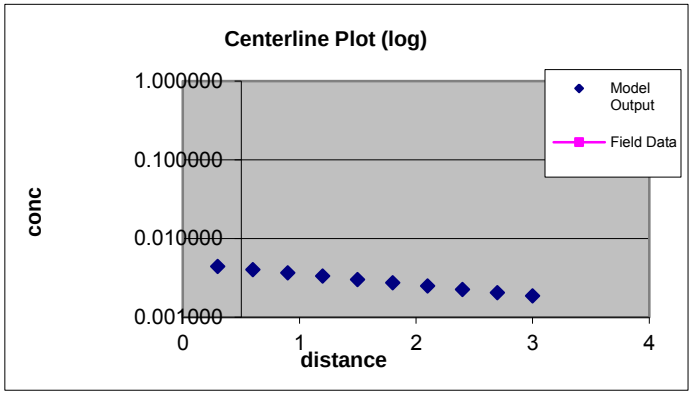
Point Concentration

x(ft)	y(ft)	z(ft)
2.934626	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	2.934625858	0	0
at	1E+99	days =	

0.001900 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	3
Width (ft)	100

	0.3	0.6	0.9	1.2	1.5	1.8	2.1	2.4	2.7	3
100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	0.002212	0.002009	0.001824	0.001657	0.001505	0.001367	0.001242	0.001128	0.001024	0.000930
0	0.004423	0.004017	0.003649	0.003314	0.003010	0.002734	0.002483	0.002255	0.002048	0.001861
-50	0.002212	0.002009	0.001824	0.001657	0.001505	0.001367	0.001242	0.001128	0.001024	0.000930
-100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

Field Data:	Centerline C Concentration									
	Distance from Source									

Figure F.9
Quick Domenico
Fate and Transport Model Input and Output
B-144
AOI 6 PES Facility
Philadelphia, Pennsylvania

Project	AOI 6 PES Facility
Prepared by	TS
Date Prepared	8/28/2013

Generic Input Parameters				Data Source
Source Identification (or Well ID)			B-144	
Sample Date			Jan-13	
Source Width		ft	100	100' default if no plume present
Source Thickness		ft	39	Maximum thickness of alluvium/fill
Longitudinal Dispersivity	A_x	ft	200	From CCR QD Simulations
Transverse Dispersivity	A_y	ft	20.0	Quick Domenico User's Guide
Vertical Dispersivity	A_z	ft	0.0001	Quick Domenico User's Guide
Hydraulic Conductivty	k	ft/day	23.98	Highest K URS 2002 Aquifer testing
Hydraulic Gradient		ft/ft	0.005	December 2012 Groundwater Gauging
Porosity		decimal fraction	0.35	Site soil analysis
Soil Bulk Density	p_b	g/cm3	1.7225	Quick Domenico User's Guide
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005	Quick Domenico User's Guide
Time		days	1.00E+99	Steady-state conditions

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.077500
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			1,2,4-Trimethylbenzene
Source Concentration (mg/l)		mg/l	0.212000
Lambda (per day)		day^{-1}	0.0123
KOC			2200
Sim 3			
Contaminant			1,3,5-Trimethylbenzene
Source Concentration (mg/l)		mg/l	0.064400
Lambda (per day)		day^{-1}	0.0123
KOC			660

Output				
Contaminant	**Starting Concentration (mg/l)**	**Screening Criteria (mg/l)**	**Predicted Concentration (mg/l)**	**Distance to Meet Screening Criteria (ft)**
Sim 1 - Benzene	0.077500	0.005000	0.005000	404.850591
Sim 2 - 1,2,4-Trimethylbenzene	0.212000	0.062000	0.062000	12.412782
Sim 3 - 1,3,5-Trimethylbenzene	0.064400	0.053000	0.053000	3.662074

Figure F.9
SIM 1

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzene

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

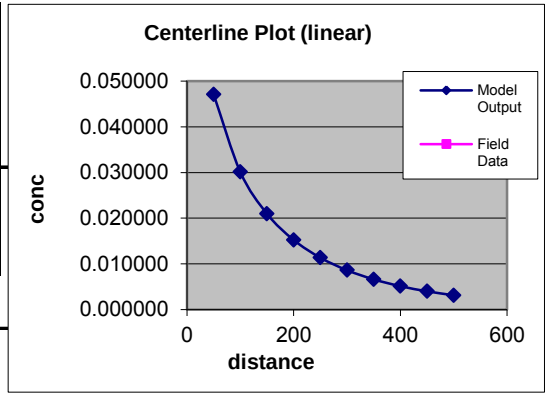
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.077500	2.00E+02	2.00E+01	1.00E-04	9.589E-04	100	39	1E+99

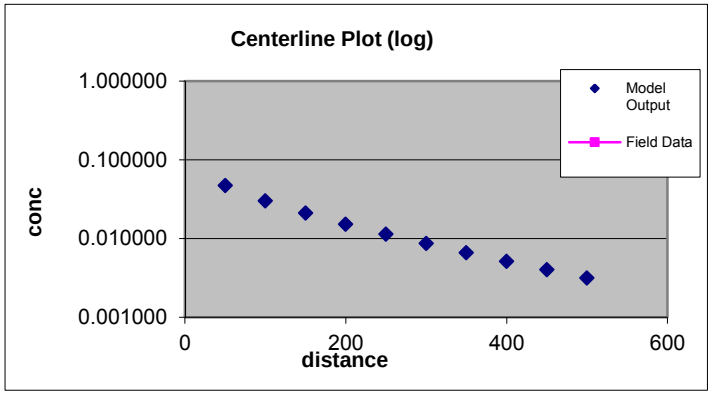
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.005	0.35	1.72	58.00	5.00E-03	2.427214286	0.141137695

Point Concentration

x(ft)	y(ft)	z(ft)
404.850591	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	404.8505909	0	0
at	1E+99	days =	0.005000
			mg/l





AREAL MODEL CALCULATION DOMAIN
Length (ft) 500
Width (ft) 100

	50	100	150	200	250	300	350	400	450	500
100	0.008402	0.010859	0.010143	0.008673	0.007170	0.005840	0.004723	0.003808	0.003066	0.002468
50	0.031167	0.023384	0.017493	0.013234	0.010124	0.007816	0.006079	0.004757	0.003741	0.002954
0	0.047100	0.030126	0.020966	0.015234	0.011357	0.008614	0.006613	0.005123	0.003997	0.003137
-50	0.031167	0.023384	0.017493	0.013234	0.010124	0.007816	0.006079	0.004757	0.003741	0.002954
-100	0.008402	0.010859	0.010143	0.008673	0.007170	0.005840	0.004723	0.003808	0.003066	0.002468

Field Data:	Centerline C Concentration								
	Distance from Source								

Figure F.9
SIM 2

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: 1,2,4-Trimethylbenzene

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

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.212000	2.00E+02	2.00E+01	1.00E-04	1.230E-02	100	39	1E+99

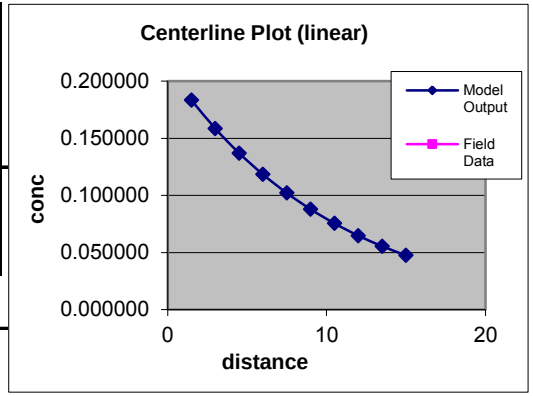
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.005	0.35	1.72	2,200.00	5.00E-03	55.13571429	0.00621324

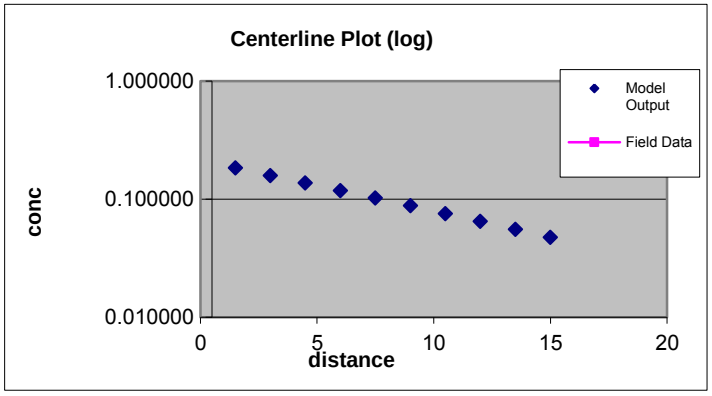
Point Concentration

x(ft)	y(ft)	z(ft)
12.412782	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	12.41278234	0	0
at	1E+99	days =	

0.062000 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	15
Width (ft)	100

	1.5	3	4.5	6	7.5	9	10.5	12	13.5	15
100	0.000000	0.000000	0.000013	0.000074	0.000199	0.000372	0.000562	0.000744	0.000899	0.001020
50	0.091644	0.079232	0.068501	0.059223	0.051202	0.044267	0.038272	0.033088	0.028607	0.024731
0	0.183287	0.158462	0.136975	0.118298	0.102006	0.087790	0.075419	0.064689	0.055416	0.047426
-50	0.091644	0.079232	0.068501	0.059223	0.051202	0.044267	0.038272	0.033088	0.028607	0.024731
-100	0.000000	0.000000	0.000013	0.000074	0.000199	0.000372	0.000562	0.000744	0.000899	0.001020

Field Data:	Centerline C Concentration								
	Distance from Source								

Figure F.9
SIM 3

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: 1,3,5-Trimethylbenzene

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

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.064400	2.00E+02	2.00E+01	1.00E-04	1.230E-02	100	39	1E+99

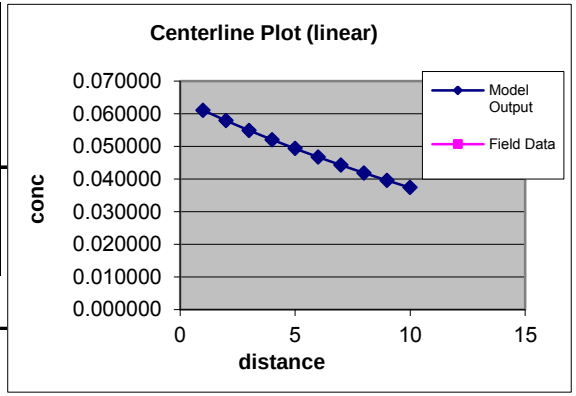
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.005	0.35	1.72	660.00	5.00E-03	17.24071429	0.019869909

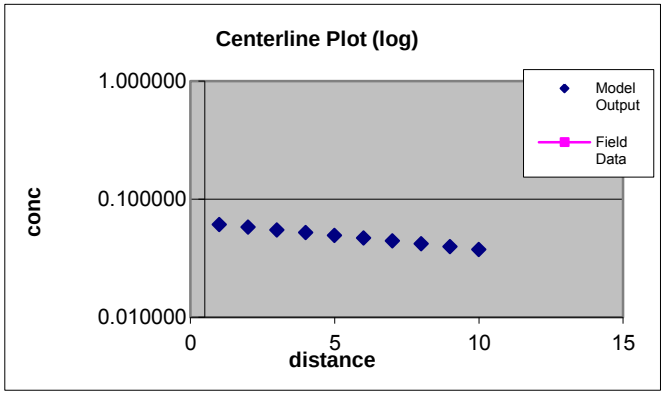
Point Concentration

x(ft)	y(ft)	z(ft)
3.662074	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	3.662073596	0	0
at	1E+99	days =	

0.053000 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	10
Width (ft)	100

	1	2	3	4	5	6	7	8	9	10
100	0.000000	0.000000	0.000000	0.000002	0.000010	0.000029	0.000062	0.000109	0.000168	0.000235
50	0.030532	0.028950	0.027451	0.026029	0.024681	0.023402	0.022190	0.021040	0.019951	0.018917
0	0.061064	0.057901	0.054901	0.052054	0.049341	0.046746	0.044255	0.041863	0.039566	0.037364
-50	0.030532	0.028950	0.027451	0.026029	0.024681	0.023402	0.022190	0.021040	0.019951	0.018917
-100	0.000000	0.000000	0.000000	0.000002	0.000010	0.000029	0.000062	0.000109	0.000168	0.000235

Field Data:	Centerline C	Concentration							
	Distance from Source								

Figure F.10
Quick Domenico
Fate and Transport Model Input and Output
B-145
AOI 6 PES Facility
Philadelphia, Pennsylvania

Project	AOI 6 PES Facility
Prepared by	TS
Date Prepared	8/28/2013

Generic Input Parameters				Data Source
Source Identification (or Well ID)			B-145	
Sample Date			Jan-13	
Source Width		ft	100	100' default if no plume present
Source Thickness		ft	39	Maximum thickness of alluvium/fill
Longitudinal Dispersivity	A_x	ft	200	From CCR QD Simulations
Transverse Dispersivity	A_y	ft	20.0	Quick Domenico User's Guide
Vertical Dispersivity	A_z	ft	0.0001	Quick Domenico User's Guide
Hydraulic Conductivty	k	ft/day	23.98	Highest K URS 2002 Aquifer testing
Hydraulic Gradient		ft/ft	0.006	December 2012 Groundwater Gauging
Porosity		decimal fraction	0.35	Site soil analysis
Soil Bulk Density	p_b	g/cm3	1.7225	Quick Domenico User's Guide
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005	Quick Domenico User's Guide
Time		days	1.00E+99	Steady-state conditions

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.018000
Lambda (per day)		day^{-1}	0.000958904
KOC			58

Output

Contaminant	Starting Concentration (mg/l)	Screening Criteria (mg/l)	Predicted Concentration (mg/l)	Distance to Meet Screening Criteria (ft)
Sim 1 - Benzene	0.018000	0.005000	0.005000	156.925663

Figure F.10
SIM 1

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzene

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

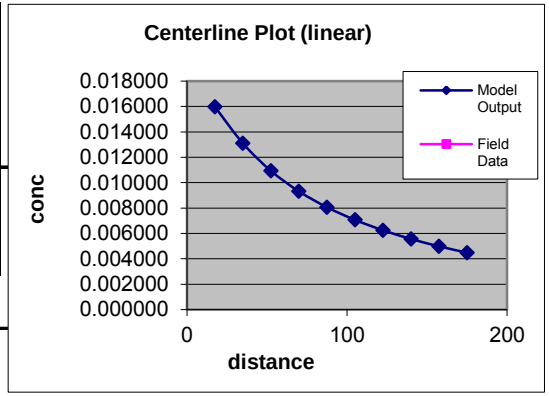
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.018000	2.00E+02	2.00E+01	1.00E-04	9.589E-04	100	39	1E+99

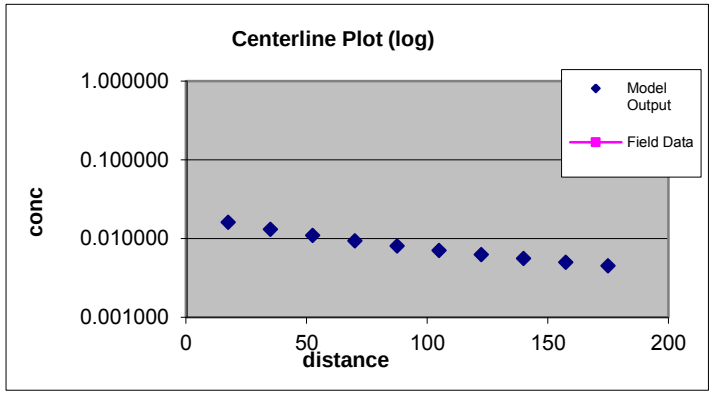
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.006	0.35	1.72	58.00	5.00E-03	2.427214286	0.169365234

Point Concentration

x(ft)	y(ft)	z(ft)
156.925663	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	156.9256631	0	0
at	1E+99	days =	0.005000 mg/l





AREAL MODEL CALCULATION DOMAIN
Length (ft) 175
Width (ft) 100

	17.5	35	52.5	70	87.5	105	122.5	140	157.5	175
100	0.000499	0.001450	0.002066	0.002416	0.002590	0.002650	0.002635	0.002574	0.002484	0.002377
50	0.008482	0.007936	0.007318	0.006687	0.006087	0.005537	0.005039	0.004591	0.004188	0.003827
0	0.015969	0.013091	0.010925	0.009311	0.008062	0.007064	0.006247	0.005563	0.004982	0.004483
-50	0.008482	0.007936	0.007318	0.006687	0.006087	0.005537	0.005039	0.004591	0.004188	0.003827
-100	0.000499	0.001450	0.002066	0.002416	0.002590	0.002650	0.002635	0.002574	0.002484	0.002377
Field Data:	**Centerline C Concentration**									
	Distance from Source									

Figure F.11
Quick Domenico
Fate and Transport Model Input and Output
B-169
AOI 6 PES Facility
Philadelphia, Pennsylvania

Project	AOI 6 PES Facility
Prepared by	TS
Date Prepared	8/28/2013

Generic Input Parameters				Data Source
Source Identification (or Well ID)			B-169	
Sample Date			Jan-13	
Source Width		ft	100	100' default if no plume present
Source Thickness		ft	39	Maximum thickness of alluvium/fill
Longitudinal Dispersivity	A_x	ft	200	From CCR QD Simulations
Transverse Dispersivity	A_y	ft	20.0	Quick Domenico User's Guide
Vertical Dispersivity	A_z	ft	0.0001	Quick Domenico User's Guide
Hydraulic Conductivty	k	ft/day	0.238	Permeable bulkhead estimate
Hydraulic Gradient		ft/ft	0.062	December 2012 Groundwater Gauging
Porosity		decimal fraction	0.35	Site soil analysis
Soil Bulk Density	p_b	g/cm3	1.7225	Quick Domenico User's Guide
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005	Quick Domenico User's Guide
Time		days	1.00E+99	Steady-state conditions

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.006400
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			Benzo(a)pyrene
Source Concentration (mg/l)		mg/l	0.000223
Lambda (per day)		day^{-1}	0.000658
KOC			910000

Output

Contaminant	Starting Concentration (mg/l)	Screening Criteria (mg/l)	Predicted Concentration (mg/l)	Distance to Meet Screening Criteria (ft)
Sim 1 - Benzene	0.006400	0.005000	0.005000	14.541332
Sim 2 - Benzo(a)pyrene	0.000223	0.000200	0.000200	0.082501

Figure F.11
SIM 1

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzene

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

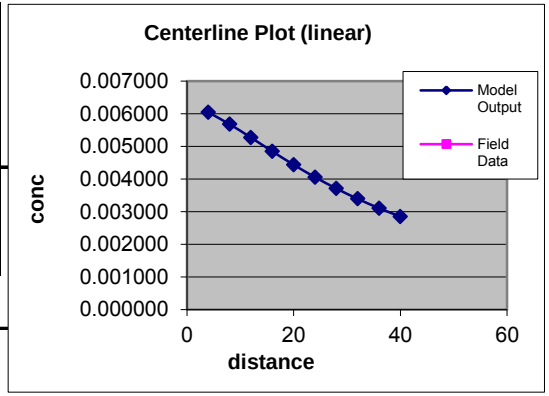
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.006400	2.00E+02	2.00E+01	1.00E-04	9.589E-04	100	39	1E+99

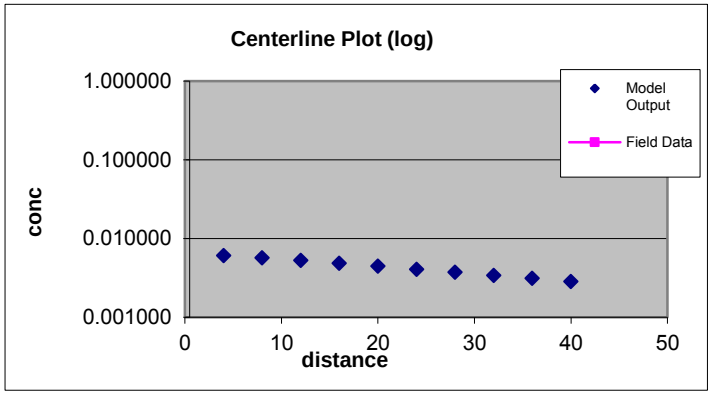
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.38E-01	0.062	0.35	1.72	58.00	5.00E-03	2.427214286	0.017369707

Point Concentration

x(ft)	y(ft)	z(ft)
14.541332	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	14.54133208	0	0
at	1E+99	days =	0.005000 mg/l





AREAL MODEL CALCULATION DOMAIN

Length (ft)	40
Width (ft)	100

	4	8	12	16	20	24	28	32	36	40
100	0.000000	0.000015	0.000061	0.000122	0.000185	0.000242	0.000290	0.000328	0.000359	0.000381
50	0.003022	0.002854	0.002695	0.002545	0.002403	0.002267	0.002138	0.002014	0.001896	0.001784
0	0.006044	0.005678	0.005270	0.004846	0.004437	0.004057	0.003709	0.003393	0.003107	0.002849
-50	0.003022	0.002854	0.002695	0.002545	0.002403	0.002267	0.002138	0.002014	0.001896	0.001784
-100	0.000000	0.000015	0.000061	0.000122	0.000185	0.000242	0.000290	0.000328	0.000359	0.000381
Field Data:	**Centerline C Concentration**									
	Distance from Source									

Figure F.11
SIM 2

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzo(a)pyrene

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

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.000223	2.00E+02	2.00E+01	1.00E-04	6.580E-04	100	39	1E+99

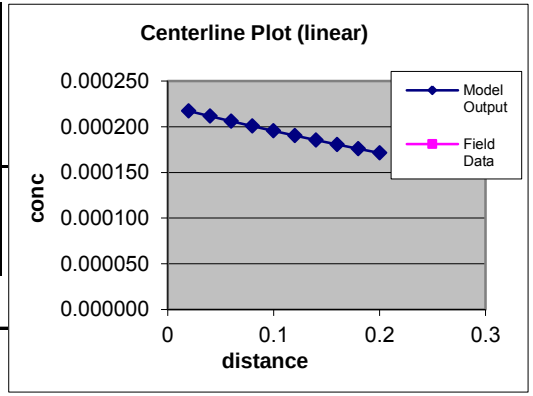
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.38E-01	0.062	0.35	1.72	910,000.00	5.00E-03	22393.5	1.88269E-06

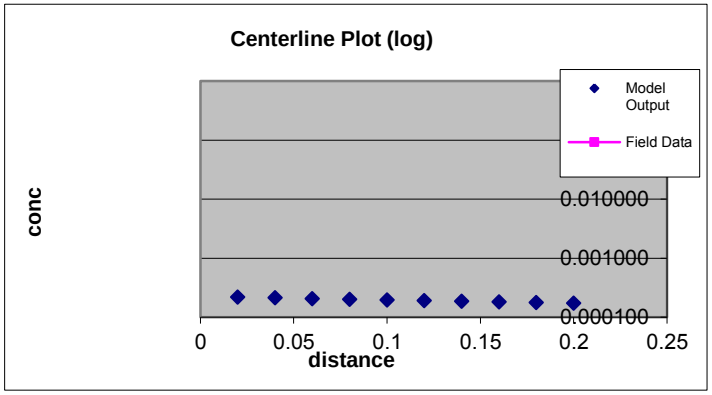
Point Concentration

x(ft)	y(ft)	z(ft)
0.082501	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	0.082501043	0	0
at	1E+99	days =	

0.000200
mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	0.2
Width (ft)	100

	0.02	0.04	0.06	0.08	0.1	0.12	0.14	0.16	0.18	0.2
100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	0.000109	0.000106	0.000103	0.000100	0.000098	0.000095	0.000093	0.000090	0.000088	0.000086
0	0.000217	0.000212	0.000206	0.000201	0.000195	0.000190	0.000185	0.000181	0.000176	0.000171
-50	0.000109	0.000106	0.000103	0.000100	0.000098	0.000095	0.000093	0.000090	0.000088	0.000086
-100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Field Data:	**Centerline C Concentration**									
	Distance from Source									

Figure F.12
Quick Domenico
Fate and Transport Model Input and Output
B-126
AOI 6 PES Facility
Philadelphia, Pennsylvania

Project	AOI 6 PES Facility
Prepared by	TS
Date Prepared	8/28/2013

Generic Input Parameters				Data Source
Source Identification (or Well ID)			B-126	
Sample Date			Jan-13	
Source Width		ft	100	100' default if no plume present
Source Thickness		ft	39	Maximum thickness of alluvium/fill
Longitudinal Dispersivity	A_x	ft	200	From CCR QD Simulations
Transverse Dispersivity	A_y	ft	20.0	Quick Domenico User's Guide
Vertical Dispersivity	A_z	ft	0.0001	Quick Domenico User's Guide
Hydraulic Conductivty	k	ft/day	23.98	Highest K URS 2002 Aquifer testing
Hydraulic Gradient		ft/ft	0.005	December 2012 Groundwater Gauging
Porosity		decimal fraction	0.35	Site soil analysis
Soil Bulk Density	p_b	g/cm3	1.7225	Quick Domenico User's Guide
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005	Quick Domenico User's Guide
Time		days	1.00E+99	Steady-state conditions

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.189000
Lambda (per day)		day^{-1}	0.000958904
KOC			58

Output

Contaminant	Starting Concentration (mg/l)	Screening Criteria (mg/l)	Predicted Concentration (mg/l)	Distance to Meet Screening Criteria (ft)
Sim 1 - Benzene	0.189000	0.005000	0.005000	589.948971

FIgure F.12
SIM 1

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzene

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

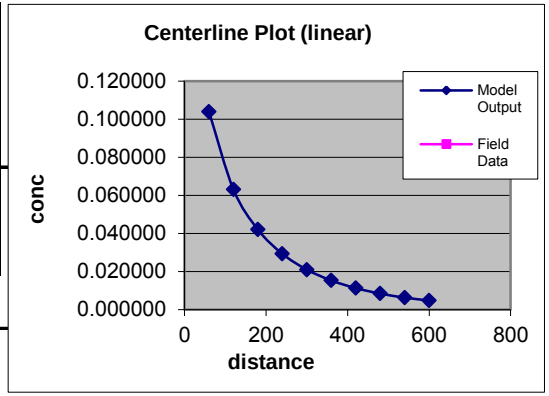
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.189000	2.00E+02	2.00E+01	1.00E-04	9.589E-04	100	39	1E+99

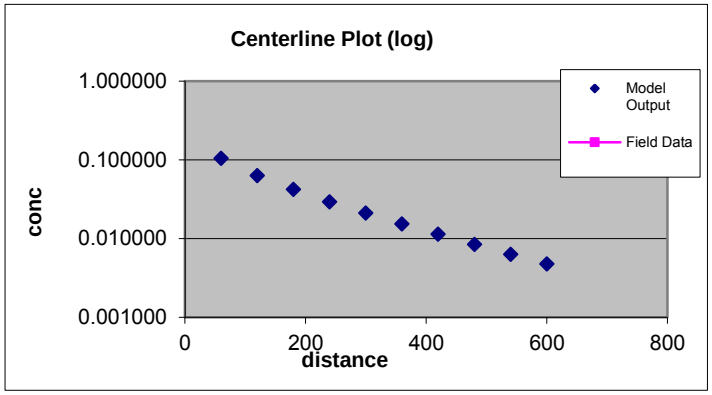
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.005	0.35	1.72	58.00	5.00E-03	2.427214286	0.141137695

Point Concentration

x(ft)	y(ft)	z(ft)
589.948971	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	589.9489713	0	0
at	1E+99	days =	0.005000 mg/l





AREAL MODEL CALCULATION DOMAIN
Length (ft) 600
Width (ft) 100

	60	120	180	240	300	360	420	480	540	600
100	0.022906	0.026228	0.022649	0.018192	0.014241	0.011035	0.008517	0.006564	0.005059	0.003902
50	0.071951	0.050720	0.036034	0.026028	0.019062	0.014110	0.010532	0.007914	0.005979	0.004537
0	0.103947	0.063112	0.042054	0.029327	0.021006	0.015314	0.011305	0.008423	0.006321	0.004771
-50	0.071951	0.050720	0.036034	0.026028	0.019062	0.014110	0.010532	0.007914	0.005979	0.004537
-100	0.022906	0.026228	0.022649	0.018192	0.014241	0.011035	0.008517	0.006564	0.005059	0.003902
Field Data:	**Centerline C Concentration**									
	Distance from Source									

Figure F.13
Quick Domenico
Fate and Transport Model Input and Output
B-125
AOI 6 PES Facility
Philadelphia, Pennsylvania

Project	AOI 6 PES Facility
Prepared by	TS
Date Prepared	8/28/2013

Generic Input Parameters				Data Source
Source Identification (or Well ID)			B-125	
Sample Date			Jan-13	
Source Width		ft	100	100' default if no plume present
Source Thickness		ft	39	Maximum thickness of alluvium/fill
Longitudinal Dispersivity	A_x	ft	200	From CCR QD Simulations
Transverse Dispersivity	A_y	ft	20.0	Quick Domenico User's Guide
Vertical Dispersivity	A_z	ft	0.0001	Quick Domenico User's Guide
Hydraulic Conductivty	k	ft/day	23.98	Highest K URS 2002 Aquifer testing
Hydraulic Gradient		ft/ft	0.004	December 2012 Groundwater Gauging
Porosity		decimal fraction	0.35	Site soil analysis
Soil Bulk Density	p_b	g/cm3	1.7225	Quick Domenico User's Guide
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005	Quick Domenico User's Guide
Time		days	1.00E+99	Steady-state conditions

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.173000
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			Benzo(a)pyrene
Source Concentration (mg/l)		mg/l	0.000262
Lambda (per day)		day^{-1}	0.000658
KOC			910000

Output				
Contaminant	**Starting Concentration (mg/l)**	**Screening Criteria (mg/l)**	**Predicted Concentration (mg/l)**	**Distance to Meet Screening Criteria (ft)**
Sim 1 - Benzene	0.173000	0.005000	0.005000	503.306310
Sim 2 - Benzo(a)pyrene	0.000262	0.000200	0.000200	0.523314

Figure F.13
SIM 1

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzene

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

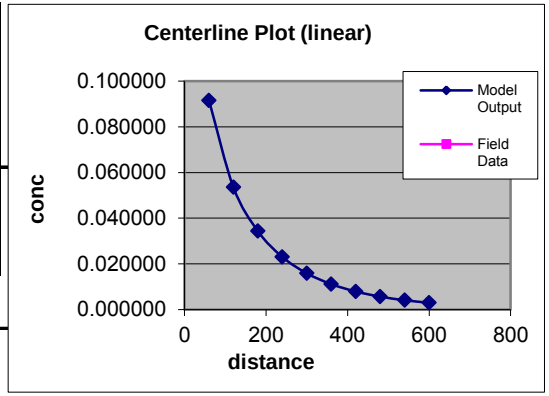
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.173000	2.00E+02	2.00E+01	1.00E-04	9.589E-04	100	39	1E+99

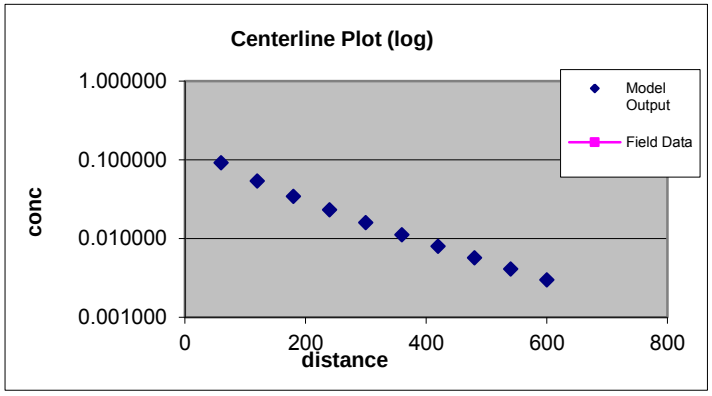
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.004	0.35	1.72	58.00	5.00E-03	2.427214286	0.112910156

Point Concentration

x(ft)	y(ft)	z(ft)
503.306310	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	503.3063105	0	0
at	1E+99	days =	0.005000 mg/l





AREAL MODEL CALCULATION DOMAIN
Length (ft) 600
Width (ft) 100

	60	120	180	240	300	360	420	480	540	600
100	0.020180	0.022239	0.018484	0.014289	0.010766	0.008030	0.005965	0.004425	0.003282	0.002436
50	0.063388	0.043007	0.029408	0.020445	0.014411	0.010267	0.007376	0.005335	0.003879	0.002833
0	0.091576	0.053515	0.034321	0.023035	0.015881	0.011143	0.007917	0.005678	0.004101	0.002979
-50	0.063388	0.043007	0.029408	0.020445	0.014411	0.010267	0.007376	0.005335	0.003879	0.002833
-100	0.020180	0.022239	0.018484	0.014289	0.010766	0.008030	0.005965	0.004425	0.003282	0.002436

Field Data:	Centerline C Concentration								
	Distance from Source								

FIgure F.13
SIM 2

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzo(a)pyrene

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

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.000262	2.00E+02	2.00E+01	1.00E-04	6.580E-04	100	39	1E+99

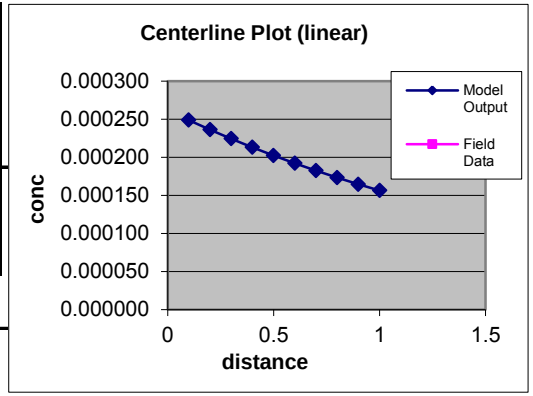
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.004	0.35	1.72	910,000.00	5.00E-03	22393.5	1.22382E-05

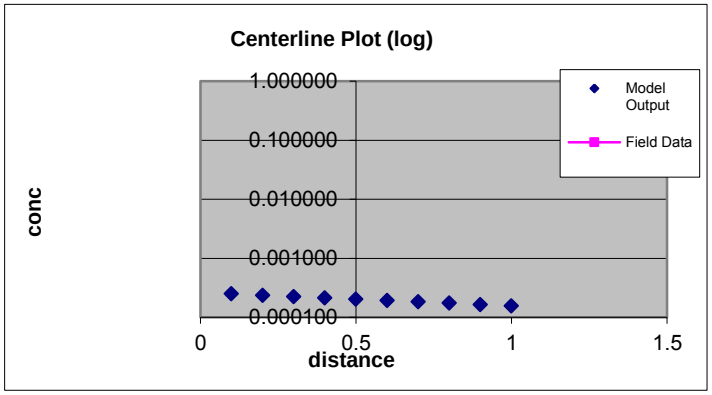
Point Concentration

x(ft)	y(ft)	z(ft)
0.523314	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	0.523314053	0	0
at	1E+99	days =	

0.000200 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	1
Width (ft)	100

	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	0.000124	0.000118	0.000112	0.000107	0.000101	0.000096	0.000091	0.000087	0.000082	0.000078
0	0.000249	0.000236	0.000224	0.000213	0.000202	0.000192	0.000183	0.000173	0.000165	0.000156
-50	0.000124	0.000118	0.000112	0.000107	0.000101	0.000096	0.000091	0.000087	0.000082	0.000078
-100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Field Data:	**Centerline C Concentration**									
	Distance from Source									

Figure F.14
Quick Domenico
Fate and Transport Model Input and Output
B-39
AOI 6 PES Facility
Philadelphia, Pennsylvania

Project	AOI 6 PES Facility
Prepared by	TS
Date Prepared	8/28/2013

Generic Input Parameters				Data Source
Source Identification (or Well ID)			B-39	
Sample Date			Jan-13	
Source Width		ft	100	100' default if no plume present
Source Thickness		ft	39	Maximum thickness of alluvium/fill
Longitudinal Dispersivity	A_x	ft	200	From CCR QD Simulations
Transverse Dispersivity	A_y	ft	20.0	Quick Domenico User's Guide
Vertical Dispersivity	A_z	ft	0.0001	Quick Domenico User's Guide
Hydraulic Conductivty	k	ft/day	0.283	Permeable bulkhead estimate
Hydraulic Gradient		ft/ft	0.009	December 2012 Groundwater Gauging
Porosity		decimal fraction	0.35	Site soil analysis
Soil Bulk Density	p_b	g/cm3	1.7225	Quick Domenico User's Guide
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005	Quick Domenico User's Guide
Time		days	1.00E+99	Steady-state conditions

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.044000
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			Benzo(a)pyrene
Source Concentration (mg/l)		mg/l	0.006030
Lambda (per day)		day^{-1}	0.000658
KOC			910000
Sim 3			
Contaminant			Benzo(a)anthracene
Source Concentration (mg/l)		mg/l	0.008270
Lambda (per day)		day^{-1}	0.000521
KOC			350000
Sim 4			
Contaminant			Benzo(g,h,i)perylene
Source Concentration (mg/l)		mg/l	0.002890
Lambda (per day)		day^{-1}	0.000521
KOC			2800000
Sim 5			
Contaminant			Benzo(b)fluoranthene
Source Concentration (mg/l)		mg/l	0.006000
Lambda (per day)		day^{-1}	0.000575
KOC			550000
Sim 6			
Contaminant			Chrysene
Source Concentration (mg/l)		mg/l	0.006780
Lambda (per day)		day^{-1}	0.000356164
KOC			490000

Output

Contaminant	Starting Concentration (mg/l)	Screening Criteria (mg/l)	Predicted Concentration (mg/l)	Distance to Meet Screening Criteria (ft)
Sim 1 - Benzene	0.044000	0.005000	0.005000	49.783468
Sim 2 - Benzo(a)pyrene	0.006030	0.000200	0.000200	1.071510
Sim 3 - Benzo(a)anthracene	0.008270	0.003600	0.003600	0.474322
Sim 4 - Benzo(g,h,i)perylene	0.002890	0.000260	0.000260	0.485183
Sim 5 - Benzo(b)fluoranthene	0.006000	0.001200	0.001200	0.696752
Sim 6 - Chrysene	0.006780	0.001900	0.001900	0.741626706

Figure F.14
SIM 1

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzene

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

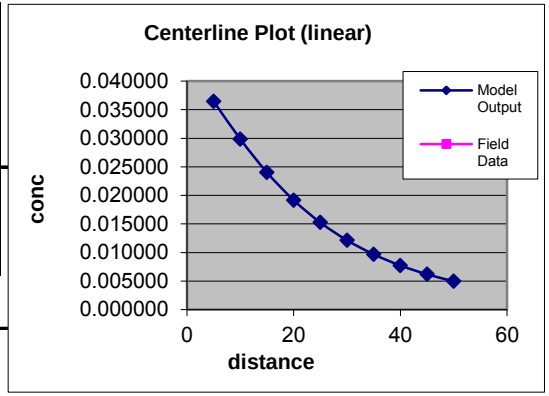
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.044000	2.00E+02	2.00E+01	1.00E-04	9.589E-04	100	39	1E+99

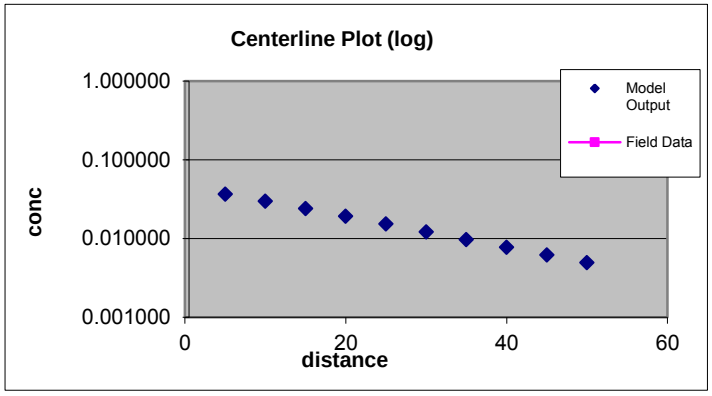
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.83E-01	0.009	0.35	1.72	58.00	5.00E-03	2.427214286	0.002998146

Point Concentration

x(ft)	y(ft)	z(ft)
49.783468	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	49.78346763	0	0
at	1E+99	days =	0.005000 mg/l





AREAL MODEL CALCULATION DOMAIN
Length (ft) 50
Width (ft) 100

	5	10	15	20	25	30	35	40	45	50
100	0.000007	0.000188	0.000516	0.000800	0.000979	0.001061	0.001072	0.001034	0.000966	0.000883
50	0.018232	0.015110	0.012522	0.010374	0.008587	0.007100	0.005863	0.004835	0.003982	0.003277
0	0.036450	0.029845	0.024013	0.019156	0.015243	0.012133	0.009671	0.007722	0.006178	0.004953
-50	0.018232	0.015110	0.012522	0.010374	0.008587	0.007100	0.005863	0.004835	0.003982	0.003277
-100	0.000007	0.000188	0.000516	0.000800	0.000979	0.001061	0.001072	0.001034	0.000966	0.000883
Field Data:	**Centerline C Concentration**									
	Distance from Source									

Figure F.14
SIM 2

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzo(a)pyrene

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

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.006030	2.00E+02	2.00E+01	1.00E-04	6.580E-04	100	39	1E+99

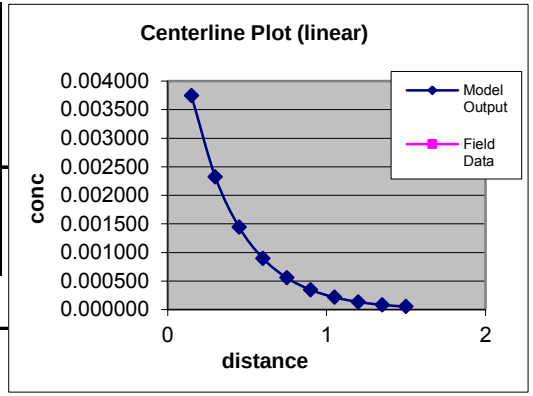
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.83E-01	0.009	0.35	1.72	910,000.00	5.00E-03	22393.5	3.24967E-07

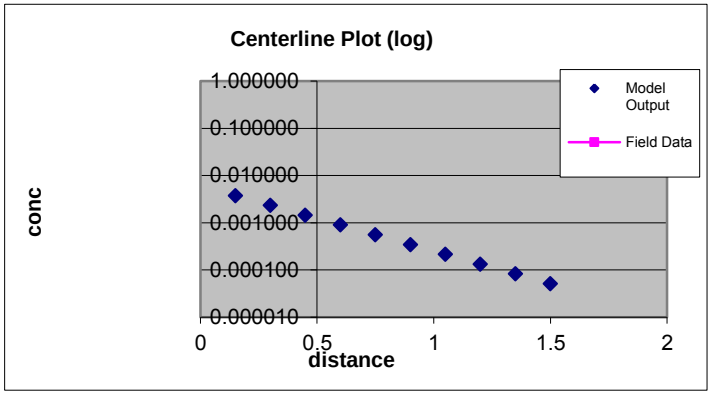
Point Concentration

x(ft)	y(ft)	z(ft)
1.071510	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	1.07151002	0	0
at	1E+99	days =	

0.000200 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	1.5
Width (ft)	100

	0.15	0.3	0.45	0.6	0.75	0.9	1.05	1.2	1.35	1.5
100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	0.001871	0.001162	0.000721	0.000448	0.000278	0.000172	0.000107	0.000066	0.000041	0.000026
0	0.003743	0.002323	0.001442	0.000895	0.000556	0.000345	0.000214	0.000133	0.000082	0.000051
-50	0.001871	0.001162	0.000721	0.000448	0.000278	0.000172	0.000107	0.000066	0.000041	0.000026
-100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Field Data:	**Centerline C Concentration**									
	Distance from Source									

Figure F.14
SIM 3

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzo(a)anthracene

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

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.008270	2.00E+02	2.00E+01	1.00E-04	5.210E-04	100	39	1E+99

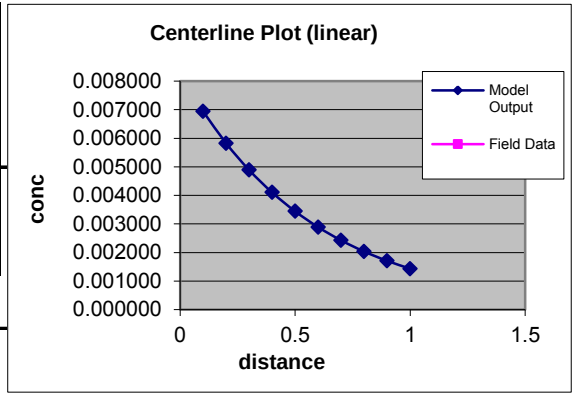
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^{3})	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.83E-01	0.009	0.35	1.72	350,000.00	5.00E-03	8613.5	8.44853E-07

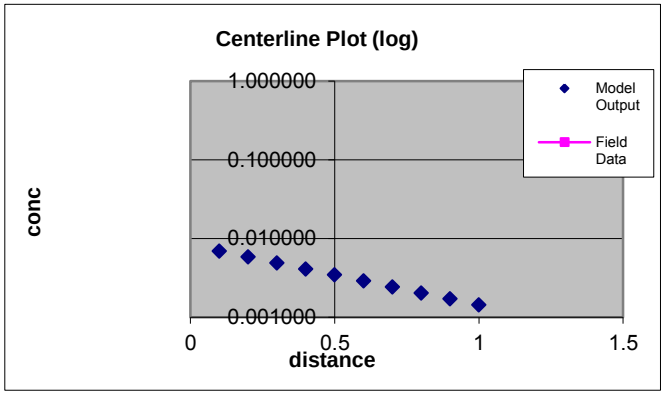
Point Concentration

x(ft)	y(ft)	z(ft)
0.474322	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	0.474321753	0	0
at	1E+99	days =	

0.003600 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	1
	Width (ft)	100

	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	0.003470	0.002912	0.002444	0.002051	0.001721	0.001444	0.001212	0.001017	0.000853	0.000716
0	0.006940	0.005824	0.004887	0.004101	0.003441	0.002888	0.002424	0.002034	0.001707	0.001432
-50	0.003470	0.002912	0.002444	0.002051	0.001721	0.001444	0.001212	0.001017	0.000853	0.000716
-100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

Field Data:	Centerline C	Concentration							
	Distance from Source								

Figure F.14
SIM 4

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzo(g,h,i)perylene

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

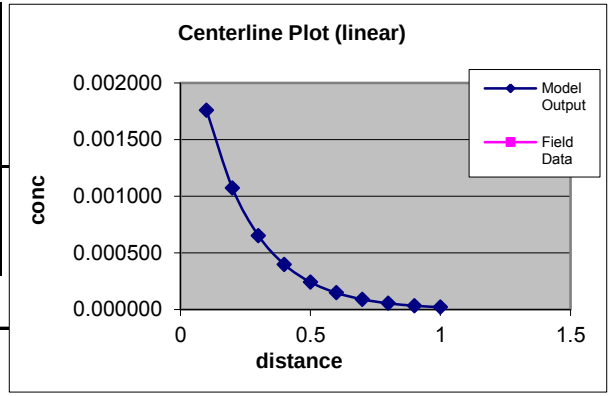
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.002890	2.00E+02	2.00E+01	1.00E-04	5.210E-04	100	39	1E+99

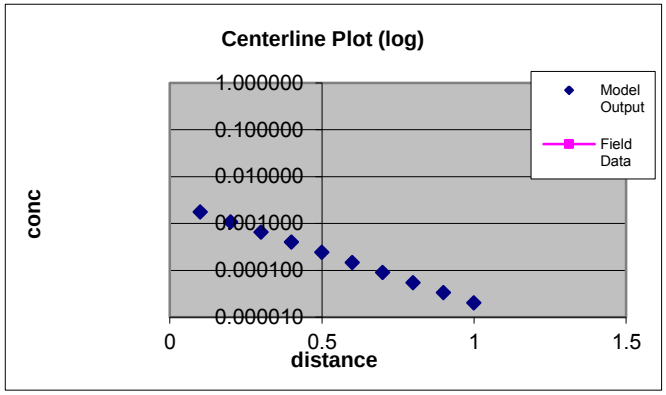
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.83E-01	0.009	0.35	1.72	2,800,000.00	5.00E-03	68901	1.05617E-07

Point Concentration

x(ft)	y(ft)	z(ft)
0.485183	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	0.485182886	0	0
at	1E+99	days =	0.000260 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	1
Width (ft)	100

	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	0.000880	0.000535	0.000326	0.000198	0.000121	0.000074	0.000045	0.000027	0.000017	0.000010
0	0.001759	0.001071	0.000652	0.000397	0.000242	0.000147	0.000090	0.000054	0.000033	0.000020
-50	0.000880	0.000535	0.000326	0.000198	0.000121	0.000074	0.000045	0.000027	0.000017	0.000010
-100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

Field Data:	Centerline C Concentration									
	Distance from Source									

Figure F.14
SIM 5

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzo(b)fluoranthene

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

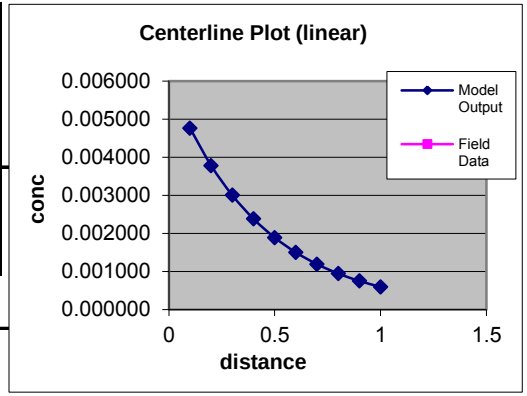
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.006000	2.00E+02	2.00E+01	1.00E-04	5.750E-04	100	39	1E+99

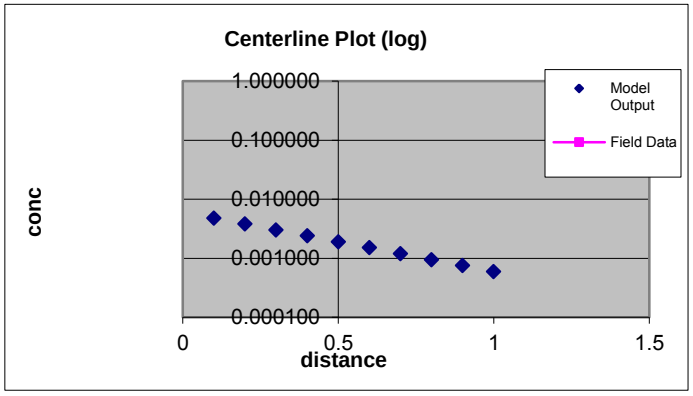
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.83E-01	0.009	0.35	1.72	550,000.00	5.00E-03	13534.92857	5.37657E-07

Point Concentration

x(ft)	y(ft)	z(ft)
0.696752	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	0.696751501	0	0
at	1E+99	days =	
			0.001200
			mg/l





AREAL MODEL CALCULATION DOMAIN

Length (ft) 1
Width (ft) 100

	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	0.002381	0.001890	0.001500	0.001191	0.000945	0.000750	0.000596	0.000473	0.000375	0.000298
0	0.004762	0.003780	0.003001	0.002382	0.001890	0.001501	0.001191	0.000945	0.000750	0.000596
-50	0.002381	0.001890	0.001500	0.001191	0.000945	0.000750	0.000596	0.000473	0.000375	0.000298
-100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

Field Data:	Centerline C Concentration									
	Distance from Source									

Figure F.14
SIM 6

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Chrysene

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

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.006780	2.00E+02	2.00E+01	1.00E-04	3.562E-04	100	39	1E+99

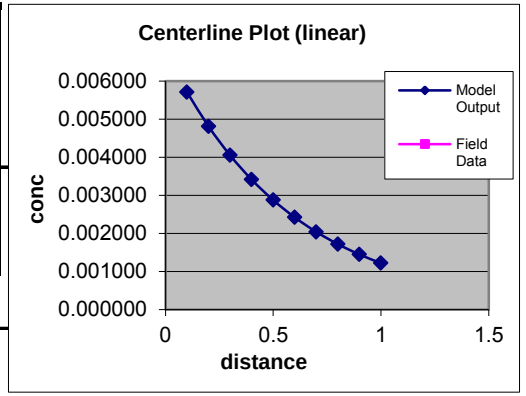
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.83E-01	0.009	0.35	1.72	490,000.00	5.00E-03	12058.5	6.03487E-07

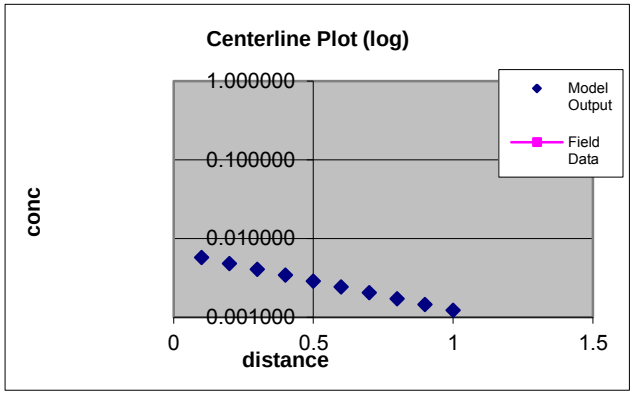
Point Concentration

x(ft)	y(ft)	z(ft)
0.741627	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	0.741626706	0	0
at	1E+99	days =	

0.001900 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	1
Width (ft)	100

	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	0.002856	0.002406	0.002026	0.001707	0.001438	0.001211	0.001020	0.000859	0.000724	0.000610
0	0.005711	0.004811	0.004053	0.003414	0.002876	0.002422	0.002041	0.001719	0.001448	0.001220
-50	0.002856	0.002406	0.002026	0.001707	0.001438	0.001211	0.001020	0.000859	0.000724	0.000610
-100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

Field Data:	Centerline C	Concentration							
	Distance from Source								

Figure F.15
Quick Domenico
Fate and Transport Model Input and Output
B-164
AOI 6 PES Facility
Philadelphia, Pennsylvania

Project	AOI 6 PES Facility
Prepared by	TS
Date Prepared	8/28/2013

Generic Input Parameters				Data Source
Source Identification (or Well ID)			B-164	
Sample Date			Jan-13	
Source Width		ft	100	100' default if no plume present
Source Thickness		ft	39	Maximum thickness of alluvium/fill
Longitudinal Dispersivity	A_x	ft	200	From CCR QD Simulations
Transverse Dispersivity	A_y	ft	20.0	Quick Domenico User's Guide
Vertical Dispersivity	A_z	ft	0.0001	Quick Domenico User's Guide
Hydraulic Conductivty	k	ft/day	0.283	Permeable bulkhead estimate
Hydraulic Gradient		ft/ft	0.009	December 2012 Groundwater Gauging
Porosity		decimal fraction	0.35	Site soil analysis
Soil Bulk Density	p_b	g/cm3	1.7225	Quick Domenico User's Guide
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005	Quick Domenico User's Guide
Time		days	1.00E+99	Steady-state conditions

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.099100
Lambda (per day)		day^{-1}	0.000958904
KOC			58

Output

Contaminant	Starting Concentration (mg/l)	Screening Criteria (mg/l)	Predicted Concentration (mg/l)	Distance to Meet Screening Criteria (ft)
Sim 1 - Benzene	0.099100	0.005000	0.005000	68.467131

Figure F.15
SIM 1

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzene

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

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.099100	2.00E+02	2.00E+01	1.00E-04	9.589E-04	100	39	1E+99

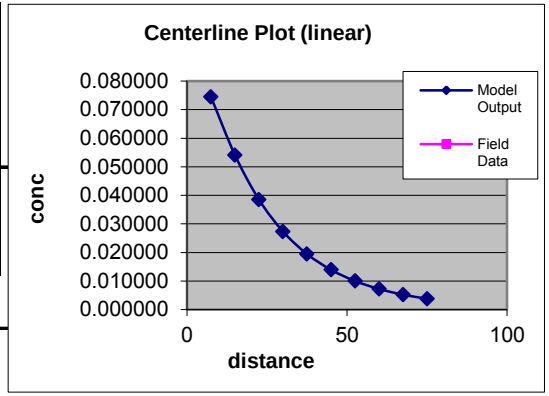
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.83E-01	0.009	0.35	1.72	58.00	5.00E-03	2.427214286	0.002998146

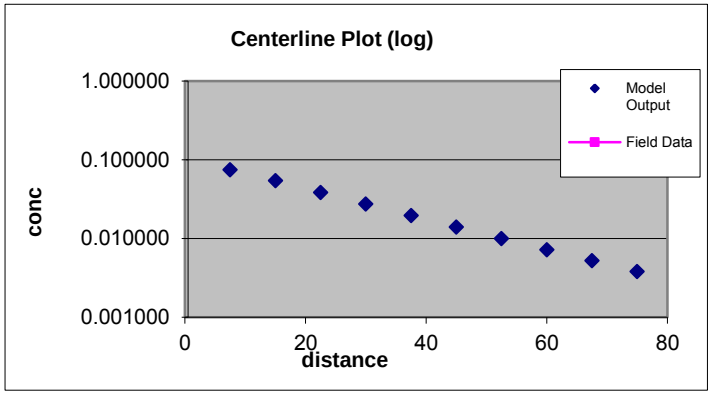
Point Concentration

x(ft)	y(ft)	z(ft)
68.467131	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	68.46713055	0	0
at	1E+99	days =	

0.005000 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	75
Width (ft)	100

	7.5	15	22.5	30	37.5	45	52.5	60	67.5	75
100	0.000146	0.001163	0.002034	0.002390	0.002381	0.002177	0.001890	0.001588	0.001303	0.001051
50	0.037383	0.028203	0.021261	0.015991	0.011993	0.008970	0.006694	0.004987	0.003711	0.002760
0	0.074476	0.054083	0.038490	0.027327	0.019459	0.013915	0.009993	0.007205	0.005212	0.003782
-50	0.037383	0.028203	0.021261	0.015991	0.011993	0.008970	0.006694	0.004987	0.003711	0.002760
-100	0.000146	0.001163	0.002034	0.002390	0.002381	0.002177	0.001890	0.001588	0.001303	0.001051
Field Data:	**Centerline C Concentration**									
	Distance from Source									

Figure F.16
Quick Domenico
Fate and Transport Model Input and Output
URS-4
AOI 6 PES Facility
Philadelphia, Pennsylvania

Project	AOI 6 PES Facility
Prepared by	TS
Date Prepared	8/28/2013

Generic Input Parameters				Data Source
Source Identification (or Well ID)			URS-4	
Sample Date			Jan-13	
Source Width		ft	100	100' default if no plume present
Source Thickness		ft	39	Maximum thickness of alluvium/fill
Longitudinal Dispersivity	A_x	ft	200	From CCR QD Simulations
Transverse Dispersivity	A_y	ft	20.0	Quick Domenico User's Guide
Vertical Dispersivity	A_z	ft	0.0001	Quick Domenico User's Guide
Hydraulic Conductivty	k	ft/day	0.283	Permeable bulkhead estimate
Hydraulic Gradient		ft/ft	0.009	December 2012 Groundwater Gauging
Porosity		decimal fraction	0.35	Site soil analysis
Soil Bulk Density	p_b	g/cm3	1.7225	Quick Domenico User's Guide
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005	Quick Domenico User's Guide
Time		days	1.00E+99	Steady-state conditions

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.046800
Lambda (per day)		day^{-1}	0.000958904
KOC			58

Output

Contaminant	Starting Concentration (mg/l)	Screening Criteria (mg/l)	Predicted Concentration (mg/l)	Distance to Meet Screening Criteria (ft)
Sim 1 - Benzene	0.046800	0.005000	0.005000	51.184949

Figure F.16
SIM 1

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzene

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

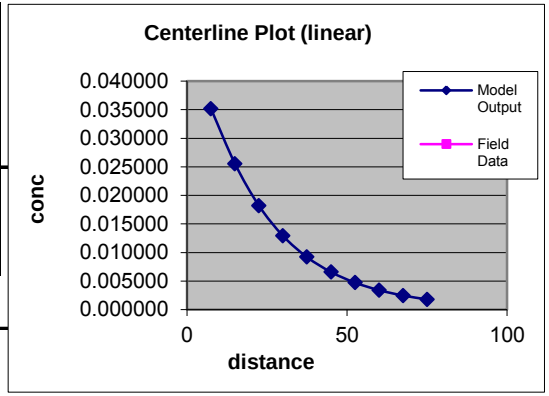
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.046800	2.00E+02	2.00E+01	1.00E-04	9.589E-04	100	39	1E+99

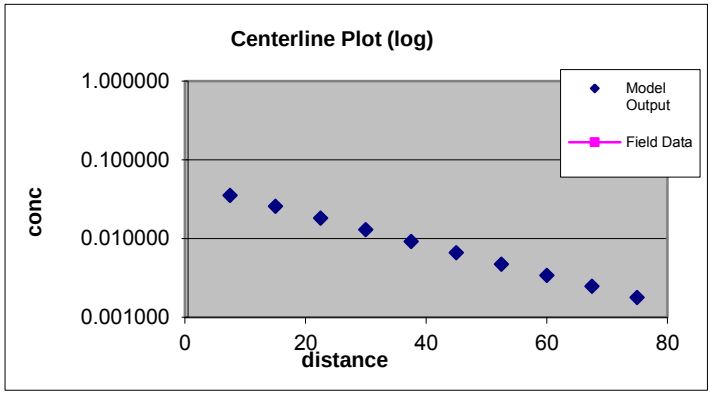
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.83E-01	0.009	0.35	1.72	58.00	5.00E-03	2.427214286	0.002998146

Point Concentration

x(ft)	y(ft)	z(ft)
51.184949	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	51.18494875	0	0
at	1E+99	days =	0.005000 mg/l





AREAL MODEL CALCULATION DOMAIN
Length (ft) 75
Width (ft) 100

	7.5	15	22.5	30	37.5	45	52.5	60	67.5	75
100	0.000069	0.000549	0.000960	0.001129	0.001125	0.001028	0.000893	0.000750	0.000615	0.000497
50	0.017654	0.013319	0.010040	0.007552	0.005664	0.004236	0.003161	0.002355	0.001753	0.001303
0	0.035171	0.025541	0.018177	0.012905	0.009190	0.006572	0.004719	0.003402	0.002461	0.001786
-50	0.017654	0.013319	0.010040	0.007552	0.005664	0.004236	0.003161	0.002355	0.001753	0.001303
-100	0.000069	0.000549	0.000960	0.001129	0.001125	0.001028	0.000893	0.000750	0.000615	0.000497
Field Data:	**Centerline C Concentration**									
	Distance from Source									

Figure F.17
Quick Domenico
Fate and Transport Model Input and Output
URS-2
AOI 6 PES Facility
Philadelphia, Pennsylvania

Project	AOI 6 PES Facility
Prepared by	TS
Date Prepared	8/28/2013

Generic Input Parameters				Data Source
Source Identification (or Well ID)			URS-2	
Sample Date			Jan-13	
Source Width		ft	100	100' default if no plume present
Source Thickness		ft	39	Maximum thickness of alluvium/fill
Longitudinal Dispersivity	A_x	ft	200	From CCR QD Simulations
Transverse Dispersivity	A_y	ft	20.0	Quick Domenico User's Guide
Vertical Dispersivity	A_z	ft	0.0001	Quick Domenico User's Guide
Hydraulic Conductivty	k	ft/day	23.98	Highest K URS 2002 Aquifer testing
Hydraulic Gradient		ft/ft	0.008	December 2012 Groundwater Gauging
Porosity		decimal fraction	0.35	Site soil analysis
Soil Bulk Density	p_b	g/cm3	1.7225	Quick Domenico User's Guide
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005	Quick Domenico User's Guide
Time		days	1.00E+99	Steady-state conditions

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzo(a)pyrene
Source Concentration (mg/l)		mg/l	0.000407
Lambda (per day)		day^{-1}	0.000658
KOC			910000
Sim 2			
Contaminant			Benzo(g,h,i)perylene
Source Concentration (mg/l)		mg/l	0.000314
Lambda (per day)		day^{-1}	0.000521
KOC			2800000

Output				
Contaminant	**Starting Concentration (mg/l)**	**Screening Criteria (mg/l)**	**Predicted Concentration (mg/l)**	**Distance to Meet Screening Criteria (ft)**
Sim 1 - Benzo(a)pyrene	0.000407	0.000200	0.000200	1.951188
Sim 2 - Benzo(g,h,i)perylene	0.000314	0.000260	0.000260	0.331286

Figure F.17
SIM 1

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzo(a)pyrene

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

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.000407	2.00E+02	2.00E+01	1.00E-04	6.580E-04	100	39	1E+99

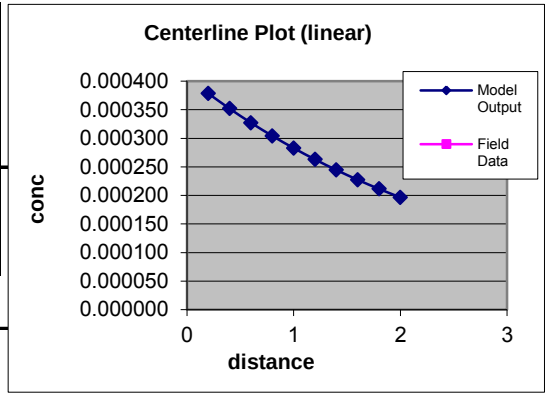
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.008	0.35	1.72	910,000.00	5.00E-03	22393.5	2.44765E-05

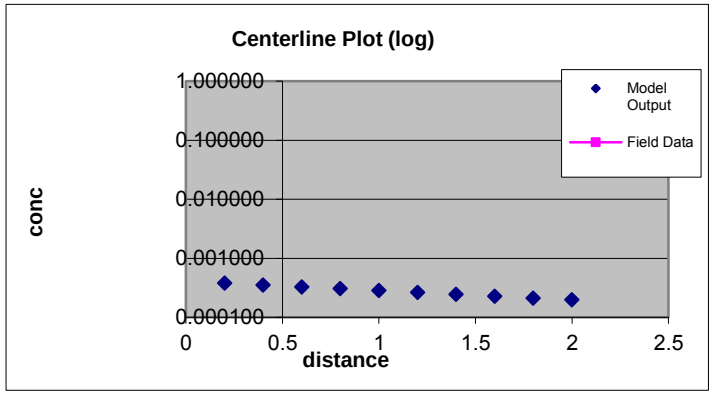
Point Concentration

x(ft)	y(ft)	z(ft)
1.951188	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	1.951188409	0	0
at	1E+99	days =	

0.000200 mg/l





AREAL MODEL CALCULATION DOMAIN

Length (ft) 2
Width (ft) 100

	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2
100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	0.000189	0.000176	0.000164	0.000152	0.000141	0.000131	0.000122	0.000114	0.000106	0.000098
0	0.000378	0.000352	0.000327	0.000304	0.000283	0.000263	0.000244	0.000227	0.000211	0.000196
-50	0.000189	0.000176	0.000164	0.000152	0.000141	0.000131	0.000122	0.000114	0.000106	0.000098
-100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Field Data:	**Centerline C Concentration**									
	Distance from Source									

Figure F.17
SIM 2

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzo(g,h,i)perylene

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

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.000314	2.00E+02	2.00E+01	1.00E-04	5.210E-04	100	39	1E+99

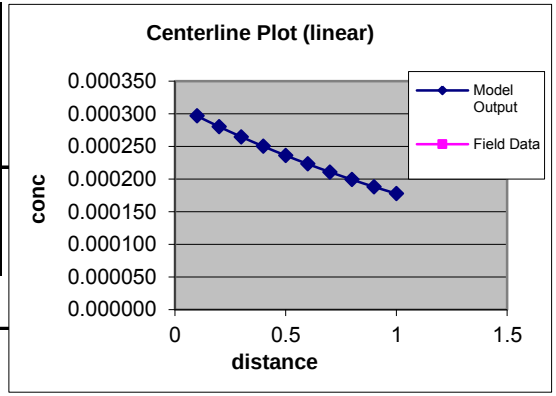
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.008	0.35	1.72	2,800,000.00	5.00E-03	68901	7.9551E-06

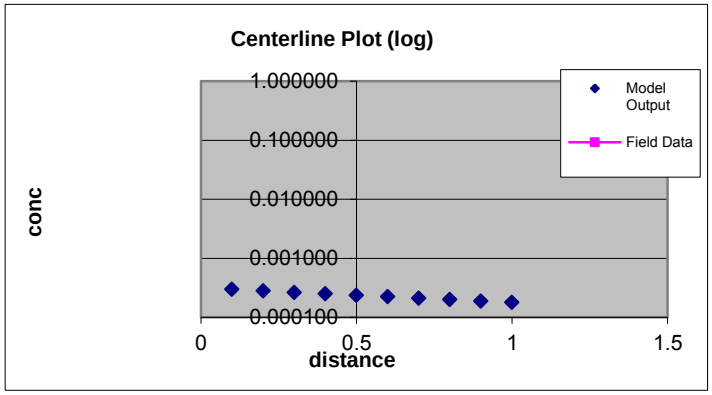
Point Concentration

x(ft)	y(ft)	z(ft)
0.331286	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	0.331286195	0	0
at	1E+99	days =	

0.000260 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	1
Width (ft)	100

	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	0.000148	0.000140	0.000132	0.000125	0.000118	0.000112	0.000105	0.000100	0.000094	0.000089
0	0.000297	0.000280	0.000265	0.000250	0.000236	0.000223	0.000211	0.000199	0.000188	0.000178
-50	0.000148	0.000140	0.000132	0.000125	0.000118	0.000112	0.000105	0.000100	0.000094	0.000089
-100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

Field Data:	Centerline C Concentration									
	Distance from Source									

Figure F.18
Quick Domenico
Fate and Transport Model Input and Output
U-4
AOI 6 PES Facility
Philadelphia, Pennsylvania

Project	AOI 6 PES Facility
Prepared by	TS
Date Prepared	8/28/2013

Generic Input Parameters				Data Source
Source Identification (or Well ID)			U-4	
Sample Date			Jan-13	
Source Width		ft	100	100' default if no plume present
Source Thickness		ft	39	Maximum thickness of alluvium/fill
Longitudinal Dispersivity	A_x	ft	200	From CCR QD Simulations
Transverse Dispersivity	A_y	ft	20.0	Quick Domenico User's Guide
Vertical Dispersivity	A_z	ft	0.0001	Quick Domenico User's Guide
Hydraulic Conductivty	k	ft/day	23.98	Highest K URS 2002 Aquifer testing
Hydraulic Gradient		ft/ft	0.024	December 2012 Groundwater Gauging
Porosity		decimal fraction	0.35	Site soil analysis
Soil Bulk Density	p_b	g/cm3	1.7225	Quick Domenico User's Guide
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005	Quick Domenico User's Guide
Time		days	1.00E+99	Steady-state conditions

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzo(a)pyrene
Source Concentration (mg/l)		mg/l	0.000686
Lambda (per day)		day^{-1}	0.000658
KOC			910000
Sim 2			
Contaminant			Benzo(g,h,i)perylene
Source Concentration (mg/l)		mg/l	0.000344
Lambda (per day)		day^{-1}	0.000521
KOC			2800000

Output				
Contaminant	**Starting Concentration (mg/l)**	**Screening Criteria (mg/l)**	**Predicted Concentration (mg/l)**	**Distance to Meet Screening Criteria (ft)**
Sim 1 - Benzo(a)pyrene	0.000686	0.000200	0.000200	5.886804
Sim 2 - Benzo(g,h,i)perylene	0.000344	0.000260	0.000260	0.853930

Figure F.18
SIM 1

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzo(a)pyrene

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

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.000686	2.00E+02	2.00E+01	1.00E-04	6.580E-04	100	39	1E+99

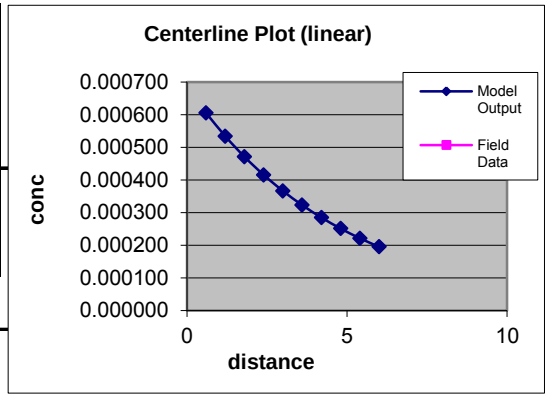
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.024	0.35	1.72	910,000.00	5.00E-03	22393.5	7.34295E-05

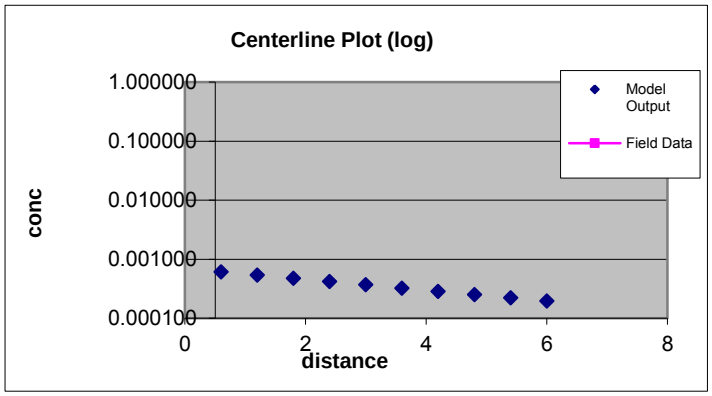
Point Concentration

x(ft)	y(ft)	z(ft)
5.886804	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	5.886803792	0	0
at	1E+99	days =	

0.000200 mg/l





AREAL MODEL CALCULATION DOMAIN
Length (ft) 6
Width (ft) 100

	0.6	1.2	1.8	2.4	3	3.6	4.2	4.8	5.4	6
100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	0.000303	0.000267	0.000235	0.000208	0.000183	0.000162	0.000142	0.000126	0.000111	0.000098
0	0.000605	0.000534	0.000471	0.000415	0.000366	0.000323	0.000285	0.000251	0.000222	0.000195
-50	0.000303	0.000267	0.000235	0.000208	0.000183	0.000162	0.000142	0.000126	0.000111	0.000098
-100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Field Data:	**Centerline C Concentration**									
	Distance from Source									

Figure F.18
SIM 2

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzo(g,h,i)perylene

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

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.000344	2.00E+02	2.00E+01	1.00E-04	5.210E-04	100	39	1E+99

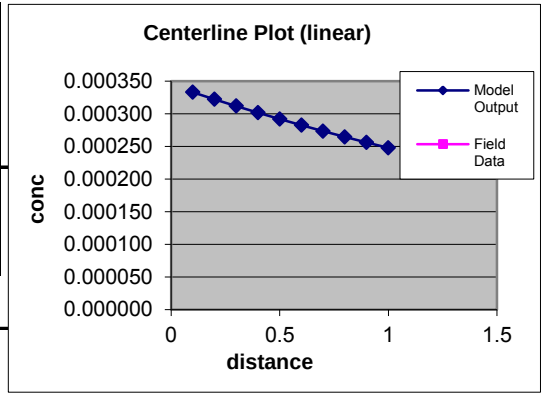
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.024	0.35	1.72	2,800,000.00	5.00E-03	68901	2.38653E-05

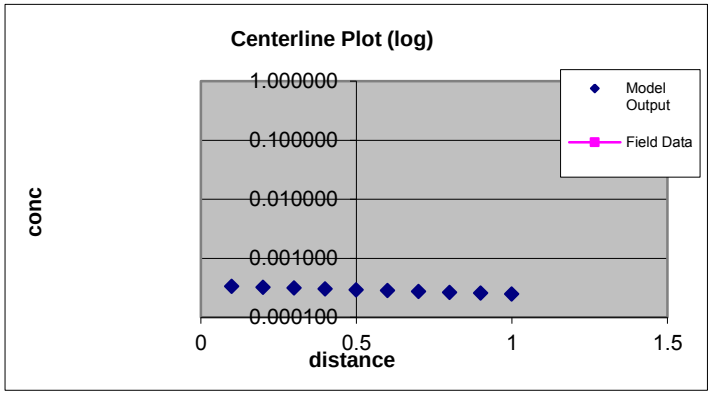
Point Concentration

x(ft)	y(ft)	z(ft)
0.853930	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	0.853929715	0	0
at	1E+99	days =	

0.000260 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	1
Width (ft)	100

	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	0.000166	0.000161	0.000156	0.000151	0.000146	0.000141	0.000137	0.000132	0.000128	0.000124
0	0.000333	0.000322	0.000312	0.000302	0.000292	0.000283	0.000273	0.000265	0.000256	0.000248
-50	0.000166	0.000161	0.000156	0.000151	0.000146	0.000141	0.000137	0.000132	0.000128	0.000124
-100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

Field Data:	Centerline C Concentration									
	Distance from Source									

Figure F.19
Quick Domenico
Fate and Transport Model Input and Output
WPM-11
AOI 6 PES Facility
Philadelphia, Pennsylvania

Project	AOI 6 PES Facility
Prepared by	TS
Date Prepared	8/28/2013

Generic Input Parameters				Data Source
Source Identification (or Well ID)			WPM-11	
Sample Date			Jan-13	
Source Width		ft	100	100' default if no plume present
Source Thickness		ft	39	Maximum thickness of alluvium/fill
Longitudinal Dispersivity	A_x	ft	200	From CCR QD Simulations
Transverse Dispersivity	A_y	ft	20.0	Quick Domenico User's Guide
Vertical Dispersivity	A_z	ft	0.0001	Quick Domenico User's Guide
Hydraulic Conductivty	k	ft/day	23.98	Highest K URS 2002 Aquifer testing
Hydraulic Gradient		ft/ft	0.001	December 2012 Groundwater Gauging
Porosity		decimal fraction	0.35	Site soil analysis
Soil Bulk Density	p_b	g/cm3	1.7225	Quick Domenico User's Guide
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005	Quick Domenico User's Guide
Time		days	1.00E+99	Steady-state conditions

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.020500
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			Benzo(a)pyrene
Source Concentration (mg/l)		mg/l	0.115000
Lambda (per day)		day^{-1}	0.000658
KOC			910000
Sim 3			
Contaminant			Benzo(a)anthracene
Source Concentration (mg/l)		mg/l	0.066000
Lambda (per day)		day^{-1}	0.000521
KOC			350000
Sim 4			
Contaminant			Benzo(g,h,i)perylene
Source Concentration (mg/l)		mg/l	0.118000
Lambda (per day)		day^{-1}	0.000521
KOC			2800000
Sim 5			
Contaminant			Benzo(b)fluoranthene
Source Concentration (mg/l)		mg/l	0.161000
Lambda (per day)		day^{-1}	0.000575
KOC			550000
Sim 6			
Contaminant			Chrysene
Source Concentration (mg/l)		mg/l	0.149000
Lambda (per day)		day^{-1}	0.000356164
KOC			490000
Sim 7			
Contaminant			Pyrene
Source Concentration (mg/l)		mg/l	0.265000
Lambda (per day)		day^{-1}	0.000191781
KOC			68000

Output				
Contaminant	**Starting Concentration (mg/l)**	**Screening Criteria (mg/l)**	**Predicted Concentration (mg/l)**	**Distance to Meet Screening Criteria (ft)**
Sim 1 - Benzene	0.020500	0.005000	0.005000	84.953639
Sim 2 - Benzo(a)pyrene	0.115000	0.000200	0.000200	6.141432
Sim 3 - Benzo(a)anthracene	0.066000	0.003600	0.003600	5.104215
Sim 4 - Benzo(g,h,i)perylene	0.118000	0.000260	0.000260	3.785615
Sim 5 - Benzo(b)fluoranthene	0.161000	0.001200	0.001200	6.519773
Sim 6 - Chrysene	0.149000	0.001900	0.001900	7.818088757
Sim 7 - Pyrene	0.265000	0.130000	0.130000	4.727276366

Figure F.19
SIM 1

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzene

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

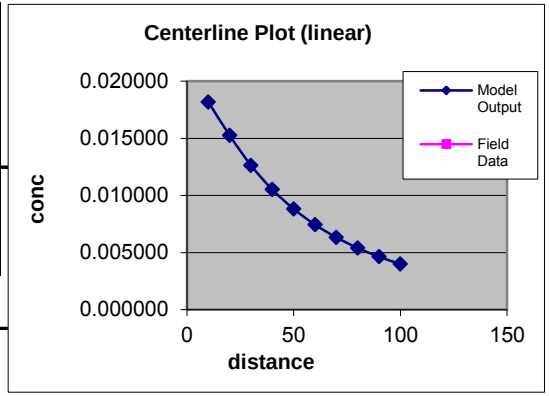
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.020500	2.00E+02	2.00E+01	1.00E-04	9.589E-04	100	39	1E+99

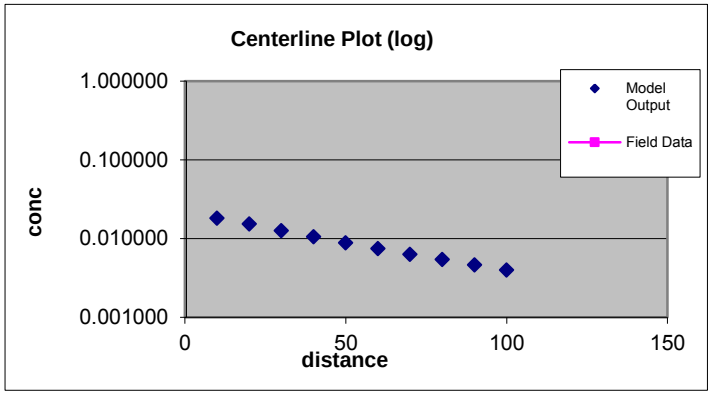
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.001	0.35	1.72	58.00	5.00E-03	2.427214286	0.028227539

Point Concentration

x(ft)	y(ft)	z(ft)
84.953639	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	84.95363853	0	0
at	1E+99	days =	**0.005000** mg/l





AREAL MODEL CALCULATION DOMAIN
Length (ft) 100
Width (ft) 100

	10	20	30	40	50	60	70	80	90	100
100	0.000114	0.000637	0.001105	0.001407	0.001572	0.001639	0.001640	0.001597	0.001525	0.001437
50	0.009203	0.008260	0.007391	0.006580	0.005830	0.005150	0.004539	0.003996	0.003517	0.003094
0	0.018178	0.015253	0.012630	0.010509	0.008811	0.007440	0.006321	0.005398	0.004630	0.003986
-50	0.009203	0.008260	0.007391	0.006580	0.005830	0.005150	0.004539	0.003996	0.003517	0.003094
-100	0.000114	0.000637	0.001105	0.001407	0.001572	0.001639	0.001640	0.001597	0.001525	0.001437
Field Data:	**Centerline C Concentration**									
	Distance from Source									

Figure F.19
SIM 2

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzo(a)pyrene

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

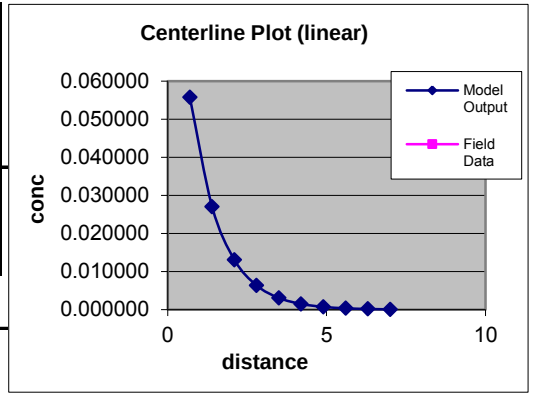
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.115000	2.00E+02	2.00E+01	1.00E-04	6.580E-04	100	39	1E+99

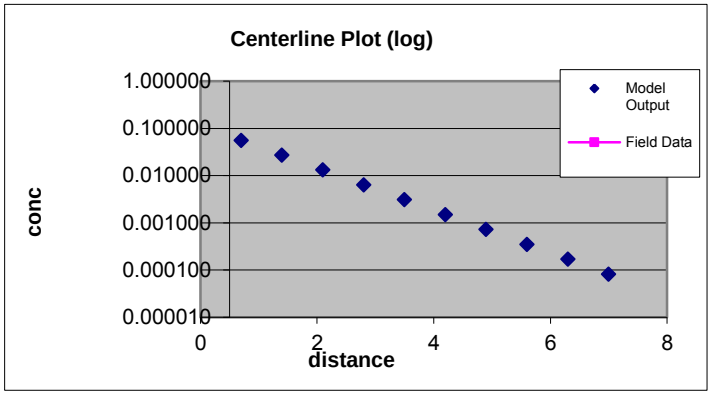
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.001	0.35	1.72	910,000.00	5.00E-03	22393.5	3.05956E-06

Point Concentration

x(ft)	y(ft)	z(ft)
6.141432	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	6.141432244	0	0
at	1E+99	days =	0.000200 mg/l





AREAL MODEL CALCULATION DOMAIN
Length (ft) 7
Width (ft) 100

	0.7	1.4	2.1	2.8	3.5	4.2	4.9	5.6	6.3	7
100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	0.027873	0.013511	0.006549	0.003175	0.001539	0.000746	0.000362	0.000175	0.000085	0.000041
0	0.055746	0.027022	0.013099	0.006350	0.003078	0.001492	0.000723	0.000350	0.000170	0.000082
-50	0.027873	0.013511	0.006549	0.003175	0.001539	0.000746	0.000362	0.000175	0.000085	0.000041
-100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Field Data:	**Centerline C Concentration**									
	Distance from Source									

Figure F.19
SIM 3

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzo(a)anthracene

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

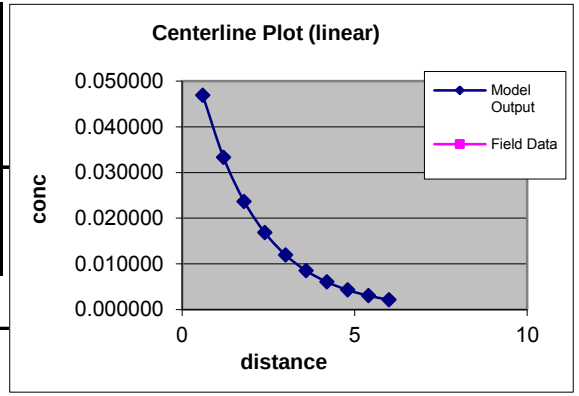
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.066000	2.00E+02	2.00E+01	1.00E-04	5.210E-04	100	39	1E+99

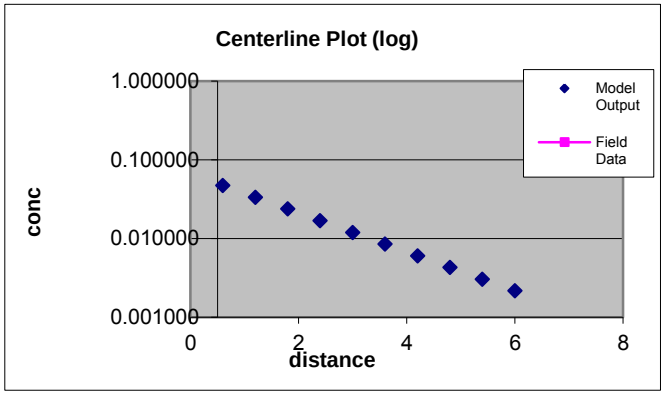
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm³)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.001	0.35	1.72	350,000.00	5.00E-03	8613.5	7.95429E-06

Point Concentration

x(ft)	y(ft)	z(ft)
5.104215	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	5.104215403	0	0
at	1E+99	days =	0.003600
			mg/l





AREAL MODEL CALCULATION DOMAIN
Length (ft) 6
Width (ft) 100

	0.6	1.2	1.8	2.4	3	3.6	4.2	4.8	5.4	6
100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000001	0.000001	0.000001
50	0.023445	0.016656	0.011833	0.008407	0.005973	0.004243	0.003015	0.002142	0.001522	0.001081
0	0.046889	0.033312	0.023666	0.016814	0.011945	0.008486	0.006028	0.004282	0.003041	0.002159
-50	0.023445	0.016656	0.011833	0.008407	0.005973	0.004243	0.003015	0.002142	0.001522	0.001081
-100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000001	0.000001	0.000001
Field Data:	Centerline C	Concentration								
	Distance from Source									

Figure F.19
SIM 4

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzo(g,h,i)perylene

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

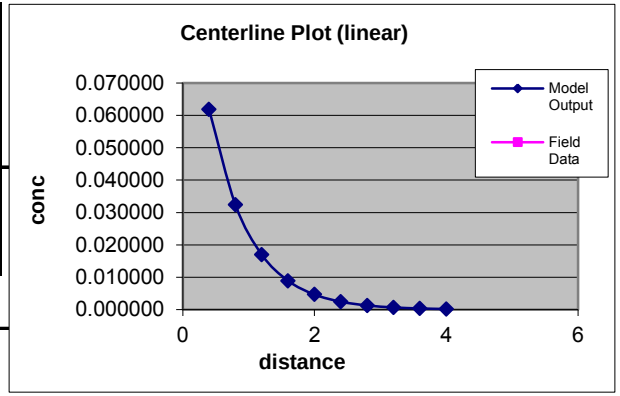
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.118000	2.00E+02	2.00E+01	1.00E-04	5.210E-04	100	39	1E+99

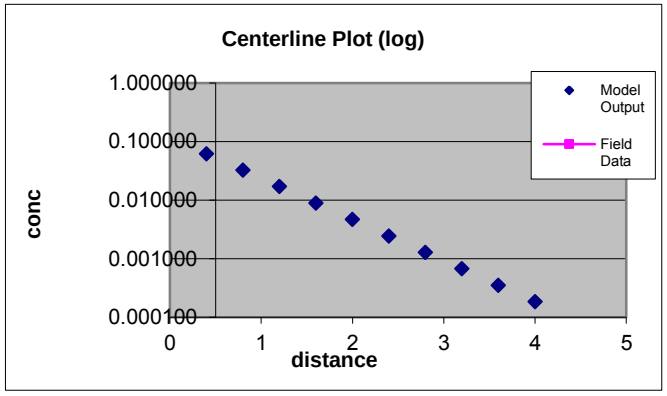
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.001	0.35	1.72	2,800,000.00	5.00E-03	68901	9.94387E-07

Point Concentration

x(ft)	y(ft)	z(ft)
3.785615	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	3.785614537	0	0
at	1E+99	days =	0.000260 mg/l





AREAL MODEL CALCULATION DOMAIN
Length (ft) 4
Width (ft) 100

	0.4	0.8	1.2	1.6	2	2.4	2.8	3.2	3.6	4
100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	0.030911	0.016195	0.008485	0.004445	0.002329	0.001220	0.000639	0.000335	0.000175	0.000092
0	0.061822	0.032390	0.016970	0.008891	0.004658	0.002440	0.001279	0.000670	0.000351	0.000184
-50	0.030911	0.016195	0.008485	0.004445	0.002329	0.001220	0.000639	0.000335	0.000175	0.000092
-100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Field Data:	**Centerline C Concentration**									
	Distance from Source									

Figure F.19
SIM 5

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzo(b)fluoranthene

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

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.161000	2.00E+02	2.00E+01	1.00E-04	5.750E-04	100	39	1E+99

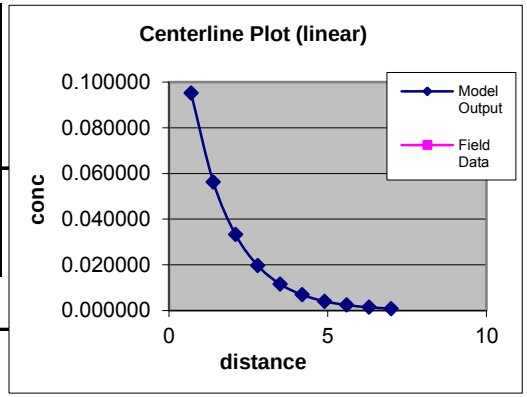
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.001	0.35	1.72	550,000.00	5.00E-03	13534.92857	5.06204E-06

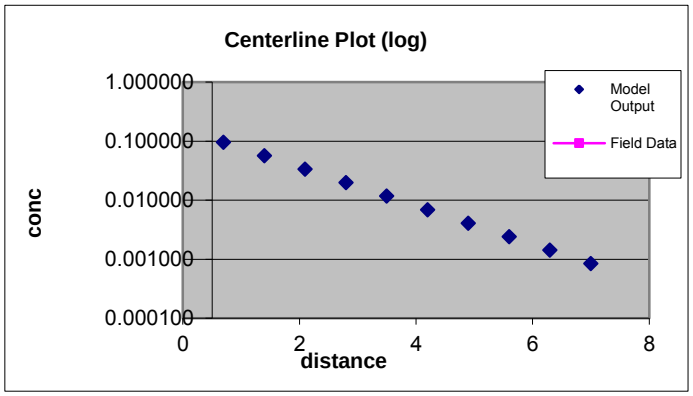
Point Concentration

x(ft)	y(ft)	z(ft)
6.519773	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	6.519773406	0	0
at	1E+99	days =	

0.001200 mg/l





AREAL MODEL **CALCULATION DOMAIN**

Length (ft)	7
Width (ft)	100

	0.7	1.4	2.1	2.8	3.5	4.2	4.9	5.6	6.3	7
100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000001	0.000001	0.000001	0.000001
50	0.047583	0.028125	0.016625	0.009827	0.005808	0.003433	0.002029	0.001200	0.000709	0.000419
0	0.095165	0.056251	0.033249	0.019653	0.011616	0.006866	0.004057	0.002397	0.001416	0.000836
-50	0.047583	0.028125	0.016625	0.009827	0.005808	0.003433	0.002029	0.001200	0.000709	0.000419
-100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000001	0.000001	0.000001	0.000001
Field Data:	**Centerline C Concentration**									
	Distance from Source									

Figure F.19
SIM 6

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Chrysene

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

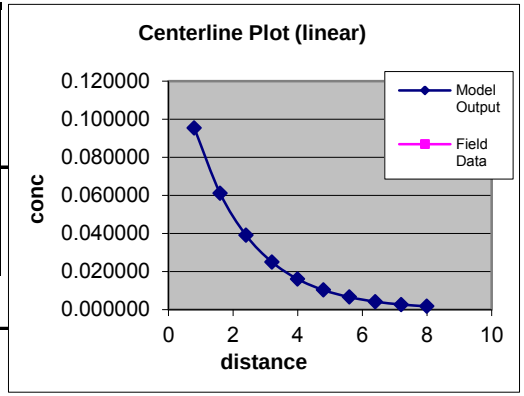
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.149000	2.00E+02	2.00E+01	1.00E-04	3.562E-04	100	39	1E+99

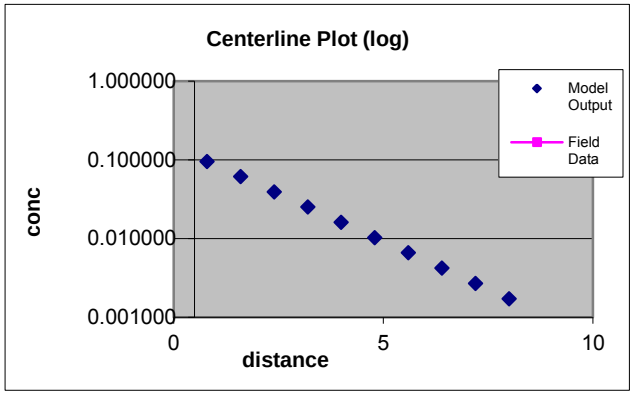
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.001	0.35	1.72	490,000.00	5.00E-03	12058.5	5.68182E-06

Point Concentration

x(ft)	y(ft)	z(ft)
7.818089	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	7.818088757	0	0
at	1E+99	days =	**0.001900**
			mg/l





AREAL MODEL CALCULATION DOMAIN
Length (ft) 8
Width (ft) 100

	0.8	1.6	2.4	3.2	4	4.8	5.6	6.4	7.2	8
100	0.000000	0.000000	0.000000	0.000000	0.000001	0.000002	0.000003	0.000004	0.000004	0.000004
50	0.047699	0.030540	0.019554	0.012519	0.008016	0.005132	0.003286	0.002104	0.001347	0.000862
0	0.095399	0.061080	0.039107	0.025039	0.016030	0.010261	0.006566	0.004200	0.002685	0.001716
-50	0.047699	0.030540	0.019554	0.012519	0.008016	0.005132	0.003286	0.002104	0.001347	0.000862
-100	0.000000	0.000000	0.000000	0.000000	0.000001	0.000002	0.000003	0.000004	0.000004	0.000004

Field Data: Centerline C Concentration
Distance from Source

Figure F.19
SIM 7

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Pyrene

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

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.265000	2.00E+02	2.00E+01	1.00E-04	1.918E-04	100	39	1E+99

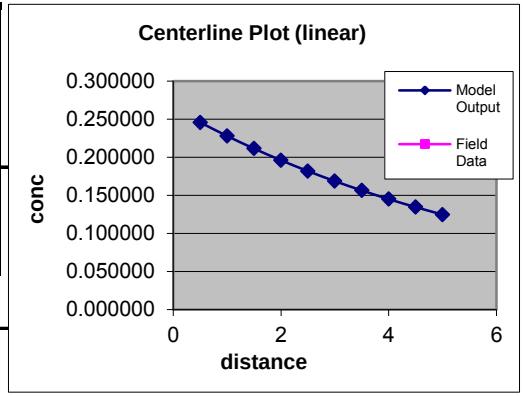
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.001	0.35	1.72	68,000.00	5.00E-03	1674.285714	4.09215E-05

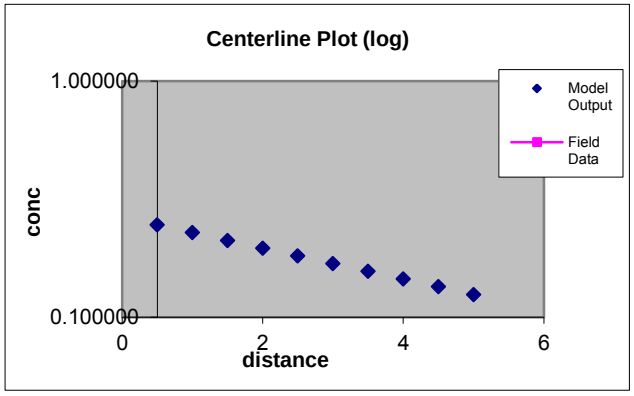
Point Concentration

x(ft)	y(ft)	z(ft)
4.727276	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	4.727276366	0	0
at	1E+99	days =	

0.130000 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	5
Width (ft)	100

	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000002	0.000006	0.000013	0.000025
50	0.122889	0.113976	0.105709	0.098041	0.090930	0.084334	0.078217	0.072544	0.067282	0.062402
0	0.245779	0.227951	0.211417	0.196082	0.181860	0.168668	0.156431	0.145076	0.134538	0.124753
-50	0.122889	0.113976	0.105709	0.098041	0.090930	0.084334	0.078217	0.072544	0.067282	0.062402
-100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000002	0.000006	0.000013	0.000025

Field Data:	Centerline C	Concentration							
	Distance from Source								

Figure F.20
AOI 6
Appendix F
Benzene at B-152

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER

Project: AOI 6 PES Facility
Date: 8/28/2013
Contaminant: Benzene at B-152
Prepared by: TS

PA DEPARTMENT
OF ENVIRONMENTAL PROTECTION
SWLOAD5B.XLS
A METHOD FOR ESTIMATING
COMTAMINANT LOADING TO SURFACE
WATER
based on
P.A. Domenico (1987)
Modified to Include Retardation

SOURCE CONC (units)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days)
mg/l	>.0001	>.0001	>=.0001	day-1			
0.0388	200	20	1.00E-04	9.59E-04	100	39	1.00E+99

Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^{3})	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.009	0.35	1.7225	58	5.00E-03	2.427214	0.2540479

Edge Criterion (mg/l) 0.005
Higest modeled conc. 0.00195

SURFACE WATER LOADING GRID
Distance to Stream (ft) 633
Plume View Width (ft) 100
Plume View Depth (ft) 39

PENTOX NOT NEEDED

	-50	-40	-30	-20	-10	0	10	20	30	40	50
0	0.00186	0.0018923	0.001918	0.0019362	0.0019474	0.0019511	0.0019474	0.0019362	0.0019178	0.001892	0.00186
-3.9	0.00186	0.0018923	0.001918	0.0019362	0.0019474	0.0019511	0.0019474	0.0019362	0.0019178	0.001892	0.00186
-7.8	0.00186	0.0018923	0.001918	0.0019362	0.0019474	0.0019511	0.0019474	0.0019362	0.0019178	0.001892	0.00186
-11.7	0.00186	0.0018923	0.001918	0.0019362	0.0019474	0.0019511	0.0019474	0.0019362	0.0019178	0.001892	0.00186
-15.6	0.00186	0.0018923	0.001918	0.0019362	0.0019474	0.0019511	0.0019474	0.0019362	0.0019178	0.001892	0.00186
-19.5	0.00186	0.0018923	0.001918	0.0019362	0.0019474	0.0019511	0.0019474	0.0019362	0.0019178	0.001892	0.00186
-23.4	0.00186	0.0018923	0.001918	0.0019362	0.0019474	0.0019511	0.0019474	0.0019362	0.0019178	0.001892	0.00186
-27.3	0.00186	0.0018923	0.001918	0.0019362	0.0019474	0.0019511	0.0019474	0.0019362	0.0019178	0.001892	0.00186
-31.2	0.00186	0.0018923	0.001918	0.0019362	0.0019474	0.0019511	0.0019474	0.0019362	0.0019178	0.001892	0.00186
-35.1	0.00186	0.0018923	0.001918	0.0019362	0.0019474	0.0019511	0.0019474	0.0019362	0.0019178	0.001892	0.00186
-39	0.00093	0.0009462	0.000959	0.0009681	0.0009737	0.0009755	0.0009737	0.0009681	0.0009589	0.000946	0.00093

Average Groundwater Concentration 0.00183 mg/l

Plume Flow 0.00973 cfs 0.00629 MGD

Mass Loading to Stream 43.56 mg/day

Figure F.21
AOI 6
Appendix F
Benzene at B-151

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER

Project: AOI 6 PES Facility
Date: 8/28/2013
Contaminant: Benzene at B-151
Prepared by: ED

PA DEPARTMENT
OF ENVIRONMENTAL PROTECTION
SWLOAD5B.XLS
A METHOD FOR ESTIMATING
COMTAMINANT LOADING TO SURFACE
WATER
based on
P.A. Domenico (1987)
Modified to Include Retardation

SOURCE CONC (units)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days)
mg/l	>.0001	>.0001	>=.0001	day-1			
0.0152	200	20	1.00E-04	9.59E-04	100	39	1.00E+99

Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^{3})	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.009	0.35	1.7225	58	5.00E-03	2.427214	0.2540479

Edge Criterion (mg/l) 0.005
Higest modeled conc. 0.00056

SURFACE WATER LOADING GRID
Distance to Stream (ft) 727
Plume View Width (ft) 20
Plume View Depth (ft) 39

PENTOX NOT NEEDED

	-10	-8	-6	-4	-2	0	2	4	6	8	10
0	0.000563	0.0005638	0.000564	0.0005642	0.0005643	0.0005644	0.0005643	0.0005642	0.000564	0.000564	0.000563
-3.9	0.000563	0.0005638	0.000564	0.0005642	0.0005643	0.0005644	0.0005643	0.0005642	0.000564	0.000564	0.000563
-7.8	0.000563	0.0005638	0.000564	0.0005642	0.0005643	0.0005644	0.0005643	0.0005642	0.000564	0.000564	0.000563
-11.7	0.000563	0.0005638	0.000564	0.0005642	0.0005643	0.0005644	0.0005643	0.0005642	0.000564	0.000564	0.000563
-15.6	0.000563	0.0005638	0.000564	0.0005642	0.0005643	0.0005644	0.0005643	0.0005642	0.000564	0.000564	0.000563
-19.5	0.000563	0.0005638	0.000564	0.0005642	0.0005643	0.0005644	0.0005643	0.0005642	0.000564	0.000564	0.000563
-23.4	0.000563	0.0005638	0.000564	0.0005642	0.0005643	0.0005644	0.0005643	0.0005642	0.000564	0.000564	0.000563
-27.3	0.000563	0.0005638	0.000564	0.0005642	0.0005643	0.0005644	0.0005643	0.0005642	0.000564	0.000564	0.000563
-31.2	0.000563	0.0005638	0.000564	0.0005642	0.0005643	0.0005644	0.0005643	0.0005642	0.000564	0.000564	0.000563
-35.1	0.000563	0.0005638	0.000564	0.0005642	0.0005643	0.0005644	0.0005643	0.0005642	0.000564	0.000564	0.000563
-39	0.000282	0.0002819	0.000282	0.0002821	0.0002822	0.0002822	0.0002822	0.0002821	0.000282	0.000282	0.000282

Average Groundwater Concentration #DIV/0! mg/l

Plume Flow 0.00000 cfs 0 MGD

Mass Loading to Stream #DIV/0! mg/day

Figure F.22
AOI 6
Appendix F
Benzene at B-154

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER															
Project:	AOI 6 PES Facility										PA DEPARTMENT OF ENVIRONMENTAL PROTECTION SWLOAD5B.XLS A METHOD FOR ESTIMATING COMTAMINANT LOADING TO SURFACE WATER based on P.A. Domenico (1987) Modified to Include Retardation					
Date:	8/28/2013														
Contaminant:	Benzene at B-154			Prepared by:		TS									
SOURCE CONC (units)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days)								
mg/l	>.0001	>.0001	>=.0001												
238	200	20	1.00E-04	9.59E-04	100	39	1.00E+99								
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^{3})	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)								
2.40E+01	0.009	0.35	1.7225	58	5.00E-03	2.427214	0.2540479								
				-710	-568	-426	-284	-142	0	142	284	426	568	710	
Edge Criterion (mg/l)		0.005	0	0.005034	0.0624115	0.44186	1.7874142	4.1333299	5.4656659	4.1333299	1.7874142	0.4418596	0.062411	0.005034	
Higest modeled conc.		5.46567	-3.9	0.005034	0.0624115	0.44186	1.7874142	4.1333299	5.4656659	4.1333299	1.7874142	0.4418596	0.062411	0.005034	
			-7.8	0.005034	0.0624115	0.44186	1.7874142	4.1333299	5.4656659	4.1333299	1.7874142	0.4418596	0.062411	0.005034	
SURFACE WATER LOADING GRID			-11.7	0.005034	0.0624115	0.44186	1.7874142	4.1333299	5.4656659	4.1333299	1.7874142	0.4418596	0.062411	0.005034	
Distance to Stream (ft)		881	-15.6	0.005034	0.0624115	0.44186	1.7874142	4.1333299	5.4656659	4.1333299	1.7874142	0.4418596	0.062411	0.005034	
Plume View Width (ft)		1420	-19.5	0.005034	0.0624115	0.44186	1.7874142	4.1333299	5.4656659	4.1333299	1.7874142	0.4418596	0.062411	0.005034	
Plume View Depth (ft)		39	-23.4	0.005034	0.0624115	0.44186	1.7874142	4.1333299	5.4656659	4.1333299	1.7874142	0.4418596	0.062411	0.005034	
			-27.3	0.005034	0.0624115	0.44186	1.7874142	4.1333299	5.4656659	4.1333299	1.7874142	0.4418596	0.062411	0.005034	
			-31.2	0.005034	0.0624115	0.44186	1.7874142	4.1333299	5.4656659	4.1333299	1.7874142	0.4418596	0.062411	0.005034	
PENTOX NEEDED			-35.1	0.005034	0.0624115	0.44186	1.7874142	4.1333299	5.4656659	4.1333299	1.7874142	0.4418596	0.062411	0.005034	
			-39	0.002517	0.0312057	0.22093	0.8937071	2.066665	2.732833	2.066665	0.8937071	0.2209298	0.031206	0.002517	
				Average Groundwater Concentration				1.59025	mg/l						
				Plume Flow				0.13810	cfs	0.08926	MGD				
				Mass Loading to Stream			538274.62	mg/day							

Figure F.23
AOI 6
Appendix F
Toluene at B-154

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER															
Project:	AOI 6 PES Facility														
Date:	8/28/2013														
Contaminant:	Toluene at B-154			Prepared by:		TS									
SOURCE															
CONC	Ax	Ay	Az	LAMBDA	SOURCE	SOURCE									
(units)	(ft)	(ft)	(ft)		WIDTH	THICKNESS	Time								
mg/l	>.0001	>.0001	>=.0001	day-1	(ft)	(ft)	(days)								
1.1	200	20	1.00E-04	2.47E-02	100	39	1.00E+99								
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	0.009	0.35	1.7225	130	5.00E-03	4.198929	0.1468538								
				-50	-40	-30	-20	-10	0	10	20	30	40	50	
Edge Criterion (mg/l)		0.33	0	0.000338	0.0003514	0.000362	0.0003704	0.0003753	0.000377	0.0003753	0.0003704	0.0003624	0.000351	0.000338	
Higest modeled conc.		0.00038	-3.9	0.000338	0.0003514	0.000362	0.0003704	0.0003753	0.000377	0.0003753	0.0003704	0.0003624	0.000351	0.000338	
			-7.8	0.000338	0.0003514	0.000362	0.0003704	0.0003753	0.000377	0.0003753	0.0003704	0.0003624	0.000351	0.000338	
SURFACE WATER LOADING GRID			-11.7	0.000338	0.0003514	0.000362	0.0003704	0.0003753	0.000377	0.0003753	0.0003704	0.0003624	0.000351	0.000338	
Distance to Stream (ft)		263	-15.6	0.000338	0.0003514	0.000362	0.0003704	0.0003753	0.000377	0.0003753	0.0003704	0.0003624	0.000351	0.000338	
Plume View Width (ft)		100	-19.5	0.000338	0.0003514	0.000362	0.0003704	0.0003753	0.000377	0.0003753	0.0003704	0.0003624	0.000351	0.000338	
Plume View Depth (ft)		39	-23.4	0.000338	0.0003514	0.000362	0.0003704	0.0003753	0.000377	0.0003753	0.0003704	0.0003624	0.000351	0.000338	
			-27.3	0.000338	0.0003514	0.000362	0.0003704	0.0003753	0.000377	0.0003753	0.0003704	0.0003624	0.000351	0.000338	
			-31.2	0.000338	0.0003514	0.000362	0.0003704	0.0003753	0.000377	0.0003753	0.0003704	0.0003624	0.000351	0.000338	
PENTOX NOT NEEDED			-35.1	0.000338	0.0003514	0.000362	0.0003704	0.0003753	0.000377	0.0003753	0.0003704	0.0003624	0.000351	0.000338	
			-39	0.000169	0.0001757	0.000181	0.0001852	0.0001877	0.0001885	0.0001877	0.0001852	0.0001812	0.000176	0.000169	
				Average Groundwater Concentration				#DIV/0!	mg/l						
				Plume Flow				0.00000	cfs	0 MGD					
				Mass Loading to Stream			#DIV/0!		mg/day						

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SWLOAD5B.XLS
A METHOD FOR ESTIMATING
COMTAMINANT LOADING TO SURFACE WATER
based on
P.A. Domenico (1987)
Modified to Include Retardation

Table J.24
AOI 6
Appendix F
Benzene at B-155

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER															
Project:	AOI 6 PES Facility														
Date:	8/28/2013														
Contaminant:	Benzene at B-155			Prepared by:		TS									
SOURCE															
CONC	Ax	Ay	Az	LAMBDA	SOURCE	SOURCE									
(units)	(ft)	(ft)	(ft)		WIDTH	THICKNESS	Time								
mg/l	>.0001	>.0001	>=.0001	day-1	(ft)	(ft)	(days)								
77.8	200	20	1.00E-04	9.59E-04	100	39	1.00E+99								
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	0.007	0.35	1.7225	58	5.00E-03	2.427214	0.1975928								
				-625	-500	-375	-250	-125	0	125	250	375	500	625	
Edge Criterion (mg/l)		0.005	0	0.005036	0.0355645	0.162574	0.4812496	0.9227995	1.14642	0.9227995	0.4812496	0.1625739	0.035565	0.005036	
Higest modeled conc.		1.14642	-3.9	0.005036	0.0355645	0.162574	0.4812496	0.9227995	1.14642	0.9227995	0.4812496	0.1625739	0.035565	0.005036	
			-7.8	0.005036	0.0355645	0.162574	0.4812496	0.9227995	1.14642	0.9227995	0.4812496	0.1625739	0.035565	0.005036	
SURFACE WATER LOADING GRID			-11.7	0.005036	0.0355645	0.162574	0.4812496	0.9227995	1.14642	0.9227995	0.4812496	0.1625739	0.035565	0.005036	
Distance to Stream (ft)		879	-15.6	0.005036	0.0355645	0.162574	0.4812496	0.9227995	1.14642	0.9227995	0.4812496	0.1625739	0.035565	0.005036	
Plume View Width (ft)		1250	-19.5	0.005036	0.0355645	0.162574	0.4812496	0.9227995	1.14642	0.9227995	0.4812496	0.1625739	0.035565	0.005036	
Plume View Depth (ft)		39	-23.4	0.005036	0.0355645	0.162574	0.4812496	0.9227995	1.14642	0.9227995	0.4812496	0.1625739	0.035565	0.005036	
			-27.3	0.005036	0.0355645	0.162574	0.4812496	0.9227995	1.14642	0.9227995	0.4812496	0.1625739	0.035565	0.005036	
			-31.2	0.005036	0.0355645	0.162574	0.4812496	0.9227995	1.14642	0.9227995	0.4812496	0.1625739	0.035565	0.005036	
PENTOX NEEDED			-35.1	0.005036	0.0355645	0.162574	0.4812496	0.9227995	1.14642	0.9227995	0.4812496	0.1625739	0.035565	0.005036	
			-39	0.002518	0.0177823	0.081287	0.2406248	0.4613998	0.57321	0.4613998	0.2406248	0.0812869	0.017782	0.002518	
				Average Groundwater Concentration				0.37842	mg/l						
				Plume Flow				0.09455	cfs	0.06111	MGD				
				Mass Loading to Stream			87698.44	mg/day							

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SWLOAD5B.XLS
A METHOD FOR ESTIMATING
COMTAMINANT LOADING TO SURFACE
WATER
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P.A. Domenico (1987)
Modified to Include Retardation

Figure F.25
AOI 6
Appendix F
Benzene at B-156

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER

Project: AOI 6 PES Facility
Date: 8/28/2013
Contaminant: Benzene at B-156
Prepared by: TS

PA DEPARTMENT
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SWLOAD5B.XLS
A METHOD FOR ESTIMATING
COMTAMINANT LOADING TO SURFACE
WATER
based on
P.A. Domenico (1987)
Modified to Include Retardation

SOURCE CONC (units)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days)
mg/l	>.0001	>.0001	>=.0001	day-1			
0.301	200	20	1.00E-04	9.59E-04	100	39	1.00E+99

Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^{3})	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.006	0.35	1.7225	58	5.00E-03	2.427214	0.1693652

Edge Criterion (mg/l) 0.005
Higest modeled conc. 0.00491

SURFACE WATER LOADING GRID
Distance to Stream (ft) 775
Plume View Width (ft) 100
Plume View Depth (ft) 39

PENTOX NOT NEEDED

	-50	-40	-30	-20	-10	0	10	20	30	40	50
0	0.004718	0.0047851	0.004838	0.0048761	0.0048992	0.0049069	0.0048992	0.0048761	0.004838	0.004785	0.004718
-3.9	0.004718	0.0047851	0.004838	0.0048761	0.0048992	0.0049069	0.0048992	0.0048761	0.004838	0.004785	0.004718
-7.8	0.004718	0.0047851	0.004838	0.0048761	0.0048992	0.0049069	0.0048992	0.0048761	0.004838	0.004785	0.004718
-11.7	0.004718	0.0047851	0.004838	0.0048761	0.0048992	0.0049069	0.0048992	0.0048761	0.004838	0.004785	0.004718
-15.6	0.004718	0.0047851	0.004838	0.0048761	0.0048992	0.0049069	0.0048992	0.0048761	0.004838	0.004785	0.004718
-19.5	0.004718	0.0047851	0.004838	0.0048761	0.0048992	0.0049069	0.0048992	0.0048761	0.004838	0.004785	0.004718
-23.4	0.004718	0.0047851	0.004838	0.0048761	0.0048992	0.0049069	0.0048992	0.0048761	0.004838	0.004785	0.004718
-27.3	0.004718	0.0047851	0.004838	0.0048761	0.0048992	0.0049069	0.0048992	0.0048761	0.004838	0.004785	0.004718
-31.2	0.004718	0.0047851	0.004838	0.0048761	0.0048992	0.0049069	0.0048992	0.0048761	0.004838	0.004785	0.004718
-35.1	0.004718	0.0047851	0.004838	0.0048761	0.0048992	0.0049069	0.0048992	0.0048761	0.004838	0.004785	0.004718
-39	0.002359	0.0023926	0.002419	0.0024381	0.0024496	0.0024534	0.0024496	0.0024381	0.002419	0.002393	0.002359

Average Groundwater Concentration 0.00461 mg/l

Plume Flow 0.00648 cfs 0.00419 MGD

Mass Loading to Stream 73.28 mg/day

Figure F.26
AOI 6
Appendix F
Benzene at B-163

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER

Project: AOI 6 PES Facility
Date: 8/28/2013
Contaminant: Benzene at B-163
Prepared by: TS

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SWLOAD5B.XLS
A METHOD FOR ESTIMATING
COMTAMINANT LOADING TO SURFACE
WATER
based on
P.A. Domenico (1987)
Modified to Include Retardation

SOURCE CONC (units)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days)
mg/l	>.0001	>.0001	>=.0001	day-1			
0.373	200	20	1.00E-04	9.59E-04	100	39	1.00E+99

Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^{3})	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.006	0.35	1.7225	58	5.00E-03	2.427214	0.1693652

Edge Criterion (mg/l) 0.005
Higest modeled conc. 0.00152

SURFACE WATER LOADING GRID
Distance to Stream (ft) 1130
Plume View Width (ft) 100
Plume View Depth (ft) 39

PENTOX NOT NEEDED

	-50	-40	-30	-20	-10	0	10	20	30	40	50
0	0.001483	0.0014977	0.001509	0.0015173	0.0015223	0.0015239	0.0015223	0.0015173	0.0015091	0.001498	0.001483
-3.9	0.001483	0.0014977	0.001509	0.0015173	0.0015223	0.0015239	0.0015223	0.0015173	0.0015091	0.001498	0.001483
-7.8	0.001483	0.0014977	0.001509	0.0015173	0.0015223	0.0015239	0.0015223	0.0015173	0.0015091	0.001498	0.001483
-11.7	0.001483	0.0014977	0.001509	0.0015173	0.0015223	0.0015239	0.0015223	0.0015173	0.0015091	0.001498	0.001483
-15.6	0.001483	0.0014977	0.001509	0.0015173	0.0015223	0.0015239	0.0015223	0.0015173	0.0015091	0.001498	0.001483
-19.5	0.001483	0.0014977	0.001509	0.0015173	0.0015223	0.0015239	0.0015223	0.0015173	0.0015091	0.001498	0.001483
-23.4	0.001483	0.0014977	0.001509	0.0015173	0.0015223	0.0015239	0.0015223	0.0015173	0.0015091	0.001498	0.001483
-27.3	0.001483	0.0014977	0.001509	0.0015173	0.0015223	0.0015239	0.0015223	0.0015173	0.0015091	0.001498	0.001483
-31.2	0.001483	0.0014977	0.001509	0.0015173	0.0015223	0.0015239	0.0015223	0.0015173	0.0015091	0.001498	0.001483
-35.1	0.001483	0.0014977	0.001509	0.0015173	0.0015223	0.0015239	0.0015223	0.0015173	0.0015091	0.001498	0.001483
-39	0.000742	0.0007488	0.000755	0.0007587	0.0007611	0.000762	0.0007611	0.0007587	0.0007546	0.000749	0.000742

Average Groundwater Concentration 0.00151 mg/l

Plume Flow 0.00584 cfs 0.00377 MGD

Mass Loading to Stream 21.56 mg/day

Figure F.27
AOI 6
Appendix F
Benzo(a)pyrene at B-135

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER															
Project:	AOI 6 PES Facility														
Date:	8/28/2013														
Contaminant:	Benzo(a)pyrene at B-135			Prepared by:		TS									
SOURCE															
CONC	Ax	Ay	Az	LAMBDA	SOURCE	SOURCE									
(units)	(ft)	(ft)	(ft)		WIDTH	THICKNESS	Time								
mg/l	>.0001	>.0001	>=.0001	day-1	(ft)	(ft)	(days)								
0.00402	200	20	1.00E-04	6.58E-04	100	39	1.00E+99								
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	0.003	0.35	1.7225	910000	5.00E-03	22393.5	9.179E-06								
				-50	-40	-30	-20	-10	0	10	20	30	40	50	
Edge Criterion (mg/l)		0.00007	0	2.2E-254	2.21E-254	2.2E-254	2.25E-254	2.25E-254	2.26E-254	2.25E-254	2.25E-254	2.23E-254	2.2E-254	2.2E-254	
Higest modeled conc.		2E-254	-3.9	2.2E-254	2.21E-254	2.2E-254	2.25E-254	2.25E-254	2.26E-254	2.25E-254	2.25E-254	2.23E-254	2.2E-254	2.2E-254	
			-7.8	2.2E-254	2.21E-254	2.2E-254	2.25E-254	2.25E-254	2.26E-254	2.25E-254	2.25E-254	2.23E-254	2.2E-254	2.2E-254	
SURFACE WATER LOADING GRID			-11.7	2.2E-254	2.21E-254	2.2E-254	2.25E-254	2.25E-254	2.26E-254	2.25E-254	2.25E-254	2.23E-254	2.2E-254	2.2E-254	
Distance to Stream (ft)		968	-15.6	2.2E-254	2.21E-254	2.2E-254	2.25E-254	2.25E-254	2.26E-254	2.25E-254	2.25E-254	2.23E-254	2.2E-254	2.2E-254	
Plume View Width (ft)		100	-19.5	2.2E-254	2.21E-254	2.2E-254	2.25E-254	2.25E-254	2.26E-254	2.25E-254	2.25E-254	2.23E-254	2.2E-254	2.2E-254	
Plume View Depth (ft)		39	-23.4	2.2E-254	2.21E-254	2.2E-254	2.25E-254	2.25E-254	2.26E-254	2.25E-254	2.25E-254	2.23E-254	2.2E-254	2.2E-254	
			-27.3	2.2E-254	2.21E-254	2.2E-254	2.25E-254	2.25E-254	2.26E-254	2.25E-254	2.25E-254	2.23E-254	2.2E-254	2.2E-254	
			-31.2	2.2E-254	2.21E-254	2.2E-254	2.25E-254	2.25E-254	2.26E-254	2.25E-254	2.25E-254	2.23E-254	2.2E-254	2.2E-254	
PENTOX NOT NEEDED			-35.1	2.2E-254	2.21E-254	2.2E-254	2.25E-254	2.25E-254	2.26E-254	2.25E-254	2.25E-254	2.23E-254	2.2E-254	2.2E-254	
			-39	1.1E-254	1.11E-254	1.1E-254	1.12E-254	1.13E-254	1.13E-254	1.13E-254	1.12E-254	1.12E-254	1.1E-254	1.1E-254	
				Average Groundwater Concentration				#DIV/0!	mg/l						
				Plume Flow				0.00000	cfs	0 MGD					
				Mass Loading to Stream			#DIV/0!		mg/day						

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Figure F.28
AOI 6
Appendix F
Benzo(a)anthracene at B-135

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER															
Project:	AOI 6 PES Facility														
Date:	6/3/2013														
Contaminant:	Benzo(a)anthracene at B-135			Prepared by:		TS									
SOURCE CONC (units)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days)								
mg/l	>.0001	>.0001	>=.0001												
0.00794	200	20	1.00E-04	5.21E-04	100	39	1.00E+99								
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^{3})	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)								
2.40E+01	0.003	0.35	1.7225	350000	5.00E-03	8613.5	2.386E-05								
				-50	-40	-30	-20	-10	0	10	20	30	40	50	
Edge Criterion (mg/l)		4.1E-05	0	2.5E-141	2.52E-141	2.5E-141	2.55E-141	2.56E-141	2.57E-141	2.56E-141	2.55E-141	2.54E-141	2.5E-141	2.5E-141	
Higest modeled conc.		3E-141	-3.9	2.5E-141	2.52E-141	2.5E-141	2.55E-141	2.56E-141	2.57E-141	2.56E-141	2.55E-141	2.54E-141	2.5E-141	2.5E-141	
			-7.8	2.5E-141	2.52E-141	2.5E-141	2.55E-141	2.56E-141	2.57E-141	2.56E-141	2.55E-141	2.54E-141	2.5E-141	2.5E-141	
SURFACE WATER LOADING GRID			-11.7	2.5E-141	2.52E-141	2.5E-141	2.55E-141	2.56E-141	2.57E-141	2.56E-141	2.55E-141	2.54E-141	2.5E-141	2.5E-141	
Distance to Stream (ft)		968	-15.6	2.5E-141	2.52E-141	2.5E-141	2.55E-141	2.56E-141	2.57E-141	2.56E-141	2.55E-141	2.54E-141	2.5E-141	2.5E-141	
Plume View Width (ft)		100	-19.5	2.5E-141	2.52E-141	2.5E-141	2.55E-141	2.56E-141	2.57E-141	2.56E-141	2.55E-141	2.54E-141	2.5E-141	2.5E-141	
Plume View Depth (ft)		39	-23.4	2.5E-141	2.52E-141	2.5E-141	2.55E-141	2.56E-141	2.57E-141	2.56E-141	2.55E-141	2.54E-141	2.5E-141	2.5E-141	
			-27.3	2.5E-141	2.52E-141	2.5E-141	2.55E-141	2.56E-141	2.57E-141	2.56E-141	2.55E-141	2.54E-141	2.5E-141	2.5E-141	
			-31.2	2.5E-141	2.52E-141	2.5E-141	2.55E-141	2.56E-141	2.57E-141	2.56E-141	2.55E-141	2.54E-141	2.5E-141	2.5E-141	
PENTOX NOT NEEDED			-35.1	2.5E-141	2.52E-141	2.5E-141	2.55E-141	2.56E-141	2.57E-141	2.56E-141	2.55E-141	2.54E-141	2.5E-141	2.5E-141	
			-39	1.2E-141	1.26E-141	1.3E-141	1.28E-141	1.28E-141	1.28E-141	1.28E-141	1.28E-141	1.27E-141	1.3E-141	1.2E-141	
Average Groundwater Concentration								#DIV/0!	mg/l						
Plume Flow								0.00000	cfs	0	MGD				
Mass Loading to Stream							#DIV/0!	mg/day							

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Figure F.29
AOI 6
Appendix F
Benzo(g,h,i)perylene at B-135

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER															
Project:	AOI 6 PES Facility														
Date:	8/28/2013														
Contaminant:	Benzo(g,h,i)perylene at B-135			Prepared by:		TS									
SOURCE															
CONC	Ax	Ay	Az	LAMBDA	SOURCE	SOURCE									
(units)	(ft)	(ft)	(ft)		WIDTH	THICKNESS	Time								
mg/l	>.0001	>.0001	>=.0001	day-1	(ft)	(ft)	(days)								
0.00146	200	20	1.00E-04	5.21E-04	100	39	1.00E+99								
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	0.003	0.35	1.7225	2800000	5.00E-03	68901	2.986E-06								
				-50	-40	-30	-20	-10	0	10	20	30	40	50	
Edge Criterion (mg/l)		0.00026	0	0	0	0	0	0	0	0	0	0	0	0	
Higest modeled conc.		0	-3.9	0	0	0	0	0	0	0	0	0	0	0	
			-7.8	0	0	0	0	0	0	0	0	0	0	0	
SURFACE WATER LOADING GRID			-11.7	0	0	0	0	0	0	0	0	0	0	0	
Distance to Stream (ft)		968	-15.6	0	0	0	0	0	0	0	0	0	0	0	
Plume View Width (ft)		100	-19.5	0	0	0	0	0	0	0	0	0	0	0	
Plume View Depth (ft)		39	-23.4	0	0	0	0	0	0	0	0	0	0	0	
			-27.3	0	0	0	0	0	0	0	0	0	0	0	
			-31.2	0	0	0	0	0	0	0	0	0	0	0	
PENTOX NOT NEEDED			-35.1	0	0	0	0	0	0	0	0	0	0	0	
			-39	0	0	0	0	0	0	0	0	0	0	0	
				Average Groundwater Concentration				#DIV/0!	mg/l						
				Plume Flow				0.00000	cfs	0	MGD				
				Mass Loading to Stream			#DIV/0!		mg/day						

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Figure F.30
AOI 6
Appendix F
Benzo(b)fluoranthene at B-135

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER															
Project:	AOI 6 PES Facility														
Date:	8/28/2013														
Contaminant:	Benzo(b)fluoranthene at B-135			Prepared by:		TS									
SOURCE															
CONC	Ax	Ay	Az	LAMBDA	SOURCE	SOURCE									
(units)	(ft)	(ft)	(ft)		WIDTH	THICKNESS	Time								
mg/l	>.0001	>.0001	>=.0001	day-1	(ft)	(ft)	(days)								
0.00435	200	20	1.00E-04	5.75E-04	100	39	1.00E+99								
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	0.003	0.35	1.7225	550000	5.00E-03	13534.93	1.52E-05								
				-50	-40	-30	-20	-10	0	10	20	30	40	50	
Edge Criterion (mg/l)		5.7E-05	0	1.2E-185	1.21E-185	1.2E-185	1.23E-185	1.24E-185	1.24E-185	1.24E-185	1.23E-185	1.22E-185	1.2E-185	1.2E-185	
Higest modeled conc.		1E-185	-3.9	1.2E-185	1.21E-185	1.2E-185	1.23E-185	1.24E-185	1.24E-185	1.24E-185	1.23E-185	1.22E-185	1.2E-185	1.2E-185	
			-7.8	1.2E-185	1.21E-185	1.2E-185	1.23E-185	1.24E-185	1.24E-185	1.24E-185	1.23E-185	1.22E-185	1.2E-185	1.2E-185	
SURFACE WATER LOADING GRID			-11.7	1.2E-185	1.21E-185	1.2E-185	1.23E-185	1.24E-185	1.24E-185	1.24E-185	1.23E-185	1.22E-185	1.2E-185	1.2E-185	
Distance to Stream (ft)		968	-15.6	1.2E-185	1.21E-185	1.2E-185	1.23E-185	1.24E-185	1.24E-185	1.24E-185	1.23E-185	1.22E-185	1.2E-185	1.2E-185	
Plume View Width (ft)		100	-19.5	1.2E-185	1.21E-185	1.2E-185	1.23E-185	1.24E-185	1.24E-185	1.24E-185	1.23E-185	1.22E-185	1.2E-185	1.2E-185	
Plume View Depth (ft)		39	-23.4	1.2E-185	1.21E-185	1.2E-185	1.23E-185	1.24E-185	1.24E-185	1.24E-185	1.23E-185	1.22E-185	1.2E-185	1.2E-185	
			-27.3	1.2E-185	1.21E-185	1.2E-185	1.23E-185	1.24E-185	1.24E-185	1.24E-185	1.23E-185	1.22E-185	1.2E-185	1.2E-185	
			-31.2	1.2E-185	1.21E-185	1.2E-185	1.23E-185	1.24E-185	1.24E-185	1.24E-185	1.23E-185	1.22E-185	1.2E-185	1.2E-185	
PENTOX NOT NEEDED			-35.1	1.2E-185	1.21E-185	1.2E-185	1.23E-185	1.24E-185	1.24E-185	1.24E-185	1.23E-185	1.22E-185	1.2E-185	1.2E-185	
			-39	6E-186	6.07E-186	6.1E-186	6.16E-186	6.19E-186	6.19E-186	6.19E-186	6.16E-186	6.12E-186	6.1E-186	6E-186	
				Average Groundwater Concentration				#DIV/0!	mg/l						
				Plume Flow				0.00000	cfs	0 MGD					
				Mass Loading to Stream			#DIV/0!		mg/day						

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Figure F.31
AOI 6
Appendix F
Chrysene at B-135

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER															
Project:	AOI 6 PES Facility														
Date:	8/28/2013														
Contaminant:	Chrysene at B-135			Prepared by:		TS									
SOURCE															
CONC	Ax	Ay	Az	LAMBDA	SOURCE	SOURCE									
(units)	(ft)	(ft)	(ft)		WIDTH	THICKNESS	Time								
mg/l	>.0001	>.0001	>=.0001	day-1	(ft)	(ft)	(days)								
0.00487	200	20	1.00E-04	3.56E-04	100	39	1.00E+99								
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	0.003	0.35	1.7225	490000	5.00E-03	12058.5	1.705E-05								
				-50	-40	-30	-20	-10	0	10	20	30	40	50	
Edge Criterion (mg/l)		0.00048	0	1.4E-138	1.4E-138	1.4E-138	1.42E-138	1.42E-138	1.42E-138	1.42E-138	1.42E-138	1.41E-138	1.4E-138	1.4E-138	
Higest modeled conc.		1E-138	-3.9	1.4E-138	1.4E-138	1.4E-138	1.42E-138	1.42E-138	1.42E-138	1.42E-138	1.42E-138	1.41E-138	1.4E-138	1.4E-138	
			-7.8	1.4E-138	1.4E-138	1.4E-138	1.42E-138	1.42E-138	1.42E-138	1.42E-138	1.42E-138	1.41E-138	1.4E-138	1.4E-138	
SURFACE WATER LOADING GRID			-11.7	1.4E-138	1.4E-138	1.4E-138	1.42E-138	1.42E-138	1.42E-138	1.42E-138	1.42E-138	1.41E-138	1.4E-138	1.4E-138	
Distance to Stream (ft)		968	-15.6	1.4E-138	1.4E-138	1.4E-138	1.42E-138	1.42E-138	1.42E-138	1.42E-138	1.42E-138	1.41E-138	1.4E-138	1.4E-138	
Plume View Width (ft)		100	-19.5	1.4E-138	1.4E-138	1.4E-138	1.42E-138	1.42E-138	1.42E-138	1.42E-138	1.42E-138	1.41E-138	1.4E-138	1.4E-138	
Plume View Depth (ft)		39	-23.4	1.4E-138	1.4E-138	1.4E-138	1.42E-138	1.42E-138	1.42E-138	1.42E-138	1.42E-138	1.41E-138	1.4E-138	1.4E-138	
			-27.3	1.4E-138	1.4E-138	1.4E-138	1.42E-138	1.42E-138	1.42E-138	1.42E-138	1.42E-138	1.41E-138	1.4E-138	1.4E-138	
			-31.2	1.4E-138	1.4E-138	1.4E-138	1.42E-138	1.42E-138	1.42E-138	1.42E-138	1.42E-138	1.41E-138	1.4E-138	1.4E-138	
PENTOX NOT NEEDED			-35.1	1.4E-138	1.4E-138	1.4E-138	1.42E-138	1.42E-138	1.42E-138	1.42E-138	1.42E-138	1.41E-138	1.4E-138	1.4E-138	
			-39	6.9E-139	6.98E-139	7E-139	7.09E-139	7.11E-139	7.12E-139	7.11E-139	7.09E-139	7.04E-139	7E-139	6.9E-139	
				Average Groundwater Concentration				#DIV/0!	mg/l						
				Plume Flow				0.00000	cfs	0 MGD					
				Mass Loading to Stream			#DIV/0!		mg/day						

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Figure F.32
AOI 6
Appendix F
Benzene at B-144

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER															
Project:	AOI 6 PES Facility														
Date:	8/28/2013														
Contaminant:	Benzene at B-144			Prepared by:		TS									
SOURCE															
CONC	Ax	Ay	Az	LAMBDA	SOURCE	SOURCE									
(units)	(ft)	(ft)	(ft)		WIDTH	THICKNESS	Time								
mg/l	>.0001	>.0001	>=.0001	day-1	(ft)	(ft)	(days)								
0.0775	200	20	1.00E-04	9.59E-04	100	39	1.00E+99								
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	0.005	0.35	1.7225	58	5.00E-03	2.427214	0.1411377								
				-179	-143.2	-107.4	-71.6	-35.8	0	35.8	71.6	107.4	143.2	179	
Edge Criterion (mg/l)		0.005	0	0.000257	0.000297	0.000333	0.0003611	0.0003792	0.0003854	0.0003792	0.0003611	0.0003329	0.000297	0.000257	
Higest modeled conc.		0.00039	-3.9	0.000257	0.000297	0.000333	0.0003611	0.0003792	0.0003854	0.0003792	0.0003611	0.0003329	0.000297	0.000257	
			-7.8	0.000257	0.000297	0.000333	0.0003611	0.0003792	0.0003854	0.0003792	0.0003611	0.0003329	0.000297	0.000257	
SURFACE WATER LOADING GRID			-11.7	0.000257	0.000297	0.000333	0.0003611	0.0003792	0.0003854	0.0003792	0.0003611	0.0003329	0.000297	0.000257	
Distance to Stream (ft)		963	-15.6	0.000257	0.000297	0.000333	0.0003611	0.0003792	0.0003854	0.0003792	0.0003611	0.0003329	0.000297	0.000257	
Plume View Width (ft)		358	-19.5	0.000257	0.000297	0.000333	0.0003611	0.0003792	0.0003854	0.0003792	0.0003611	0.0003329	0.000297	0.000257	
Plume View Depth (ft)		39	-23.4	0.000257	0.000297	0.000333	0.0003611	0.0003792	0.0003854	0.0003792	0.0003611	0.0003329	0.000297	0.000257	
			-27.3	0.000257	0.000297	0.000333	0.0003611	0.0003792	0.0003854	0.0003792	0.0003611	0.0003329	0.000297	0.000257	
			-31.2	0.000257	0.000297	0.000333	0.0003611	0.0003792	0.0003854	0.0003792	0.0003611	0.0003329	0.000297	0.000257	
PENTOX NOT NEEDED			-35.1	0.000257	0.000297	0.000333	0.0003611	0.0003792	0.0003854	0.0003792	0.0003611	0.0003329	0.000297	0.000257	
			-39	0.000128	0.0001485	0.000166	0.0001805	0.0001896	0.0001927	0.0001896	0.0001805	0.0001664	0.000149	0.000128	
				Average Groundwater Concentration				#DIV/0!	mg/l						
				Plume Flow				0.00000	cfs	0 MGD					
				Mass Loading to Stream			#DIV/0!		mg/day						

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Figure F.33
AOI 6
Appendix F
1,2,4-Trimethylbenzene at B-144

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER															
Project:	AOI 6 PES Facility														
Date:	8/28/2013														
Contaminant:	1,2,4-Trimethylbenzene at B-144			Prepared by:		TS									
SOURCE															
CONC	Ax	Ay	Az	LAMBDA	SOURCE	SOURCE									
(units)	(ft)	(ft)	(ft)		WIDTH	THICKNESS	Time								
mg/l	>.0001	>.0001	>=.0001	day-1	(ft)	(ft)	(days)								
0.212	200	20	1.00E-04	1.23E-02	100	39	1.00E+99								
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	0.005	0.35	1.7225	2200	5.00E-03	55.13571	0.0062132								
				-50	-40	-30	-20	-10	0	10	20	30	40	50	
Edge Criterion (mg/l)		0.033	0	9.79E-43	9.898E-43	9.99E-43	1.005E-42	1.009E-42	1.01E-42	1.009E-42	1.005E-42	9.986E-43	9.9E-43	9.79E-43	
Higest modeled conc.		1E-42	-3.9	9.79E-43	9.898E-43	9.99E-43	1.005E-42	1.009E-42	1.01E-42	1.009E-42	1.005E-42	9.986E-43	9.9E-43	9.79E-43	
			-7.8	9.79E-43	9.898E-43	9.99E-43	1.005E-42	1.009E-42	1.01E-42	1.009E-42	1.005E-42	9.986E-43	9.9E-43	9.79E-43	
SURFACE WATER LOADING GRID			-11.7	9.79E-43	9.898E-43	9.99E-43	1.005E-42	1.009E-42	1.01E-42	1.009E-42	1.005E-42	9.986E-43	9.9E-43	9.79E-43	
Distance to Stream (ft)		963	-15.6	9.79E-43	9.898E-43	9.99E-43	1.005E-42	1.009E-42	1.01E-42	1.009E-42	1.005E-42	9.986E-43	9.9E-43	9.79E-43	
Plume View Width (ft)		100	-19.5	9.79E-43	9.898E-43	9.99E-43	1.005E-42	1.009E-42	1.01E-42	1.009E-42	1.005E-42	9.986E-43	9.9E-43	9.79E-43	
Plume View Depth (ft)		39	-23.4	9.79E-43	9.898E-43	9.99E-43	1.005E-42	1.009E-42	1.01E-42	1.009E-42	1.005E-42	9.986E-43	9.9E-43	9.79E-43	
			-27.3	9.79E-43	9.898E-43	9.99E-43	1.005E-42	1.009E-42	1.01E-42	1.009E-42	1.005E-42	9.986E-43	9.9E-43	9.79E-43	
			-31.2	9.79E-43	9.898E-43	9.99E-43	1.005E-42	1.009E-42	1.01E-42	1.009E-42	1.005E-42	9.986E-43	9.9E-43	9.79E-43	
PENTOX NOT NEEDED			-35.1	9.79E-43	9.898E-43	9.99E-43	1.005E-42	1.009E-42	1.01E-42	1.009E-42	1.005E-42	9.986E-43	9.9E-43	9.79E-43	
			-39	4.89E-43	4.949E-43	4.99E-43	5.025E-43	5.044E-43	5.051E-43	5.044E-43	5.025E-43	4.993E-43	4.95E-43	4.89E-43	
				Average Groundwater Concentration				#DIV/0!	mg/l						
				Plume Flow				0.00000	cfs	0 MGD					
				Mass Loading to Stream			#DIV/0!		mg/day						

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Figure F.36
AOI 6
Appendix F
Benzene at B-169

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER															
Project:	AOI 6 PES Facility														
Date:	8/28/2013														
Contaminant:	Benzene at B-169			Prepared by:		TS									
SOURCE															
CONC	Ax	Ay	Az	LAMBDA	SOURCE	SOURCE									
(units)	(ft)	(ft)	(ft)		WIDTH	THICKNESS	Time								
mg/l	>.0001	>.0001	>=.0001	day-1	(ft)	(ft)	(days)								
0.0064	200	20	1.00E-04	9.59E-04	100	39	1.00E+99								
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)								
2.38E-01	0.062	0.35	1.7225	58	5.00E-03	2.427214	0.0173697								
				-28	-22.4	-16.8	-11.2	-5.6	0	5.6	11.2	16.8	22.4	28	
Edge Criterion (mg/l)		0.005	0	0.00296	0.0031367	0.003279	0.0033836	0.0034473	0.0034687	0.0034473	0.0033836	0.0032791	0.003137	0.00296	
Higest modeled conc.		0.00347	-3.9	0.00296	0.0031367	0.003279	0.0033836	0.0034473	0.0034687	0.0034473	0.0033836	0.0032791	0.003137	0.00296	
			-7.8	0.00296	0.0031367	0.003279	0.0033836	0.0034473	0.0034687	0.0034473	0.0033836	0.0032791	0.003137	0.00296	
SURFACE WATER LOADING GRID			-11.7	0.00296	0.0031367	0.003279	0.0033836	0.0034473	0.0034687	0.0034473	0.0033836	0.0032791	0.003137	0.00296	
Distance to Stream (ft)		31	-15.6	0.00296	0.0031367	0.003279	0.0033836	0.0034473	0.0034687	0.0034473	0.0033836	0.0032791	0.003137	0.00296	
Plume View Width (ft)		56	-19.5	0.00296	0.0031367	0.003279	0.0033836	0.0034473	0.0034687	0.0034473	0.0033836	0.0032791	0.003137	0.00296	
Plume View Depth (ft)		39	-23.4	0.00296	0.0031367	0.003279	0.0033836	0.0034473	0.0034687	0.0034473	0.0033836	0.0032791	0.003137	0.00296	
			-27.3	0.00296	0.0031367	0.003279	0.0033836	0.0034473	0.0034687	0.0034473	0.0033836	0.0032791	0.003137	0.00296	
			-31.2	0.00296	0.0031367	0.003279	0.0033836	0.0034473	0.0034687	0.0034473	0.0033836	0.0032791	0.003137	0.00296	
PENTOX NOT NEEDED			-35.1	0.00296	0.0031367	0.003279	0.0033836	0.0034473	0.0034687	0.0034473	0.0033836	0.0032791	0.003137	0.00296	
			-39	0.00148	0.0015683	0.00164	0.0016918	0.0017237	0.0017344	0.0017237	0.0016918	0.0016395	0.001568	0.00148	
				Average Groundwater Concentration				0.00311	mg/l						
				Plume Flow				0.00037	cfs	0.00024	MGD				
				Mass Loading to Stream			2.84	mg/day							

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Figure F.34
AOI 6
Appendix F
1,3,5-Trimethylbenzene at B-144

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER															
Project:	AOI 6 PES Facility														
Date:	8/28/2013														
Contaminant:	1,3,5-Trimethylbenzene at B-144			Prepared by:		TS									
SOURCE															
CONC	Ax	Ay	Az	LAMBDA	SOURCE	SOURCE									
(units)	(ft)	(ft)	(ft)		WIDTH	THICKNESS	Time								
mg/l	>.0001	>.0001	>=.0001	day-1	(ft)	(ft)	(days)								
0.0644	200	20	1.00E-04	0.00E+00	100	39	1.00E+99								
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	0.005	0.35	1.7225	660	5.00E-03	17.24071	0.0198865								
				-50	-40	-30	-20	-10	0	10	20	30	40	50	
Edge Criterion (mg/l)		0.071	0	0.012545	0.0126896	0.012803	0.0128845	0.0129337	0.0129502	0.0129337	0.0128845	0.012803	0.01269	0.012545	
Higest modeled conc.		0.01295	-3.9	0.012545	0.0126896	0.012803	0.0128845	0.0129337	0.0129502	0.0129337	0.0128845	0.012803	0.01269	0.012545	
			-7.8	0.012545	0.0126896	0.012803	0.0128845	0.0129337	0.0129502	0.0129337	0.0128845	0.012803	0.01269	0.012545	
SURFACE WATER LOADING GRID			-11.7	0.012545	0.0126896	0.012803	0.0128845	0.0129337	0.0129502	0.0129337	0.0128845	0.012803	0.01269	0.012545	
Distance to Stream (ft)		963	-15.6	0.012545	0.0126896	0.012803	0.0128845	0.0129337	0.0129502	0.0129337	0.0128845	0.012803	0.01269	0.012545	
Plume View Width (ft)		100	-19.5	0.012545	0.0126896	0.012803	0.0128845	0.0129337	0.0129502	0.0129337	0.0128845	0.012803	0.01269	0.012545	
Plume View Depth (ft)		39	-23.4	0.012545	0.0126896	0.012803	0.0128845	0.0129337	0.0129502	0.0129337	0.0128845	0.012803	0.01269	0.012545	
			-27.3	0.012545	0.0126896	0.012803	0.0128845	0.0129337	0.0129502	0.0129337	0.0128845	0.012803	0.01269	0.012545	
			-31.2	0.012545	0.0126896	0.012803	0.0128845	0.0129337	0.0129502	0.0129337	0.0128845	0.012803	0.01269	0.012545	
PENTOX NOT NEEDED			-35.1	0.012545	0.0126896	0.012803	0.0128845	0.0129337	0.0129502	0.0129337	0.0128845	0.012803	0.01269	0.012545	
			-39	0.006273	0.0063448	0.006401	0.0064423	0.0064669	0.0064751	0.0064669	0.0064423	0.0064015	0.006345	0.006273	
				Average Groundwater Concentration				0.01221	mg/l						
				Plume Flow				0.00541	cfs	0.00349	MGD				
				Mass Loading to Stream			161.78	mg/day							

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Figure F.35
AOI 6
Appendix F
Benzene at B-145

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER

Project: AOI 6 PES Facility
Date: 8/28/2013
Contaminant: Benzene at B-145
Prepared by: TS

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SOURCE CONC (units)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days)
mg/l	>.0001	>.0001	>=.0001	day-1			
0.018	200	20	1.00E-04	9.59E-04	100	39	1.00E+99

Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^{3})	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.006	0.35	1.7225	58	5.00E-03	2.427214	0.1693652

Edge Criterion (mg/l) 0.005
Higest modeled conc. 9.6E-05

SURFACE WATER LOADING GRID
Distance to Stream (ft) 1060
Plume View Width (ft) 100
Plume View Depth (ft) 39

PENTOX NOT NEEDED

	-50	-40	-30	-20	-10	0	10	20	30	40	50
0	9.34E-05	9.437E-05	9.51E-05	9.569E-05	9.602E-05	9.613E-05	9.602E-05	9.569E-05	9.514E-05	9.44E-05	9.34E-05
-3.9	9.34E-05	9.437E-05	9.51E-05	9.569E-05	9.602E-05	9.613E-05	9.602E-05	9.569E-05	9.514E-05	9.44E-05	9.34E-05
-7.8	9.34E-05	9.437E-05	9.51E-05	9.569E-05	9.602E-05	9.613E-05	9.602E-05	9.569E-05	9.514E-05	9.44E-05	9.34E-05
-11.7	9.34E-05	9.437E-05	9.51E-05	9.569E-05	9.602E-05	9.613E-05	9.602E-05	9.569E-05	9.514E-05	9.44E-05	9.34E-05
-15.6	9.34E-05	9.437E-05	9.51E-05	9.569E-05	9.602E-05	9.613E-05	9.602E-05	9.569E-05	9.514E-05	9.44E-05	9.34E-05
-19.5	9.34E-05	9.437E-05	9.51E-05	9.569E-05	9.602E-05	9.613E-05	9.602E-05	9.569E-05	9.514E-05	9.44E-05	9.34E-05
-23.4	9.34E-05	9.437E-05	9.51E-05	9.569E-05	9.602E-05	9.613E-05	9.602E-05	9.569E-05	9.514E-05	9.44E-05	9.34E-05
-27.3	9.34E-05	9.437E-05	9.51E-05	9.569E-05	9.602E-05	9.613E-05	9.602E-05	9.569E-05	9.514E-05	9.44E-05	9.34E-05
-31.2	9.34E-05	9.437E-05	9.51E-05	9.569E-05	9.602E-05	9.613E-05	9.602E-05	9.569E-05	9.514E-05	9.44E-05	9.34E-05
-35.1	9.34E-05	9.437E-05	9.51E-05	9.569E-05	9.602E-05	9.613E-05	9.602E-05	9.569E-05	9.514E-05	9.44E-05	9.34E-05
-39	4.67E-05	4.719E-05	4.76E-05	4.784E-05	4.801E-05	4.807E-05	4.801E-05	4.784E-05	4.757E-05	4.72E-05	4.67E-05

Average Groundwater Concentration #DIV/0! mg/l

Plume Flow 0.00000 cfs 0 MGD

Mass Loading to Stream #DIV/0! mg/day

Figure F.37
AOI 6
Appendix F
Benzo(a)pyrene at B-169

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER															
Project:	AOI 6 PES Facility														
Date:	8/28/2013														
Contaminant:	Benzo(a)pyrene at B-169			Prepared by:		TS									
SOURCE															
CONC	Ax	Ay	Az	LAMBDA	SOURCE	SOURCE									
(units)	(ft)	(ft)	(ft)		WIDTH	THICKNESS	Time								
mg/l	>.0001	>.0001	>=.0001	day-1	(ft)	(ft)	(days)								
0.000223	200	20	1.00E-04	6.58E-04	100	39	1.00E+99								
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)								
2.38E-01	0.062	0.35	1.7225	910000	5.00E-03	22393.5	1.883E-06								
				-50	-40	-30	-20	-10	0	10	20	30	40	50	
Edge Criterion (mg/l)		0.00007	0	1.94E-22	2.364E-22	2.74E-22	3.039E-22	3.227E-22	3.292E-22	3.227E-22	3.039E-22	2.742E-22	2.36E-22	1.94E-22	
Higest modeled conc.		3.3E-22	-3.9	1.94E-22	2.364E-22	2.74E-22	3.039E-22	3.227E-22	3.292E-22	3.227E-22	3.039E-22	2.742E-22	2.36E-22	1.94E-22	
			-7.8	1.94E-22	2.364E-22	2.74E-22	3.039E-22	3.227E-22	3.292E-22	3.227E-22	3.039E-22	2.742E-22	2.36E-22	1.94E-22	
SURFACE WATER LOADING GRID			-11.7	1.94E-22	2.364E-22	2.74E-22	3.039E-22	3.227E-22	3.292E-22	3.227E-22	3.039E-22	2.742E-22	2.36E-22	1.94E-22	
Distance to Stream (ft)		31	-15.6	1.94E-22	2.364E-22	2.74E-22	3.039E-22	3.227E-22	3.292E-22	3.227E-22	3.039E-22	2.742E-22	2.36E-22	1.94E-22	
Plume View Width (ft)		100	-19.5	1.94E-22	2.364E-22	2.74E-22	3.039E-22	3.227E-22	3.292E-22	3.227E-22	3.039E-22	2.742E-22	2.36E-22	1.94E-22	
Plume View Depth (ft)		39	-23.4	1.94E-22	2.364E-22	2.74E-22	3.039E-22	3.227E-22	3.292E-22	3.227E-22	3.039E-22	2.742E-22	2.36E-22	1.94E-22	
			-27.3	1.94E-22	2.364E-22	2.74E-22	3.039E-22	3.227E-22	3.292E-22	3.227E-22	3.039E-22	2.742E-22	2.36E-22	1.94E-22	
			-31.2	1.94E-22	2.364E-22	2.74E-22	3.039E-22	3.227E-22	3.292E-22	3.227E-22	3.039E-22	2.742E-22	2.36E-22	1.94E-22	
PENTOX NOT NEEDED			-35.1	1.94E-22	2.364E-22	2.74E-22	3.039E-22	3.227E-22	3.292E-22	3.227E-22	3.039E-22	2.742E-22	2.36E-22	1.94E-22	
			-39	9.7E-23	1.182E-22	1.37E-22	1.519E-22	1.614E-22	1.646E-22	1.614E-22	1.519E-22	1.371E-22	1.18E-22	9.7E-23	
				Average Groundwater Concentration				#DIV/0!	mg/l						
				Plume Flow				0.00000	cfs	0 MGD					
				Mass Loading to Stream			#DIV/0!		mg/day						

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Figure F.38
AOI 6
Appendix F
Benzene at B-126

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER															
Project:	AOI 6 PES Facility														
Date:	8/28/2013														
Contaminant:	Benzene at B-126			Prepared by:		TS									
SOURCE															
CONC	Ax	Ay	Az	LAMBDA	SOURCE	SOURCE									
(units)	(ft)	(ft)	(ft)		WIDTH	THICKNESS	Time								
mg/l	>.0001	>.0001	>=.0001	day-1	(ft)	(ft)	(days)								
0.189	200	20	1.00E-04	9.59E-04	100	39	1.00E+99								
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	0.005	0.35	1.7225	58	5.00E-03	2.427214	0.1411377								
				-210	-168	-126	-84	-42	0	42	84	126	168	210	
Edge Criterion (mg/l)		0.005	0	0.001499	0.0019892	0.002478	0.0028996	0.003186	0.0032877	0.003186	0.0028996	0.0024783	0.001989	0.001499	
Higest modeled conc.		0.00329	-3.9	0.001499	0.0019892	0.002478	0.0028996	0.003186	0.0032877	0.003186	0.0028996	0.0024783	0.001989	0.001499	
			-7.8	0.001499	0.0019892	0.002478	0.0028996	0.003186	0.0032877	0.003186	0.0028996	0.0024783	0.001989	0.001499	
SURFACE WATER LOADING GRID			-11.7	0.001499	0.0019892	0.002478	0.0028996	0.003186	0.0032877	0.003186	0.0028996	0.0024783	0.001989	0.001499	
Distance to Stream (ft)		681	-15.6	0.001499	0.0019892	0.002478	0.0028996	0.003186	0.0032877	0.003186	0.0028996	0.0024783	0.001989	0.001499	
Plume View Width (ft)		420	-19.5	0.001499	0.0019892	0.002478	0.0028996	0.003186	0.0032877	0.003186	0.0028996	0.0024783	0.001989	0.001499	
Plume View Depth (ft)		39	-23.4	0.001499	0.0019892	0.002478	0.0028996	0.003186	0.0032877	0.003186	0.0028996	0.0024783	0.001989	0.001499	
			-27.3	0.001499	0.0019892	0.002478	0.0028996	0.003186	0.0032877	0.003186	0.0028996	0.0024783	0.001989	0.001499	
			-31.2	0.001499	0.0019892	0.002478	0.0028996	0.003186	0.0032877	0.003186	0.0028996	0.0024783	0.001989	0.001499	
PENTOX NOT NEEDED			-35.1	0.001499	0.0019892	0.002478	0.0028996	0.003186	0.0032877	0.003186	0.0028996	0.0024783	0.001989	0.001499	
			-39	0.00075	0.0009946	0.001239	0.0014498	0.001593	0.0016438	0.001593	0.0014498	0.0012391	0.000995	0.00075	
				Average Groundwater Concentration				0.0024	mg/l						
				Plume Flow				0.02224	cfs	0.01437	MGD				
				Mass Loading to Stream			131.06	mg/day							

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Figure F.39
AOI 6
Appendix F
Benzene at B-125

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER															
Project:	AOI 6 PES Facility														
Date:	8/28/2013														
Contaminant:	Benzene at B-125			Prepared by:		TS									
SOURCE															
CONC	Ax	Ay	Az	LAMBDA	SOURCE	SOURCE									
(units)	(ft)	(ft)	(ft)		WIDTH	THICKNESS	Time								
mg/l	>.0001	>.0001	>=.0001	day-1	(ft)	(ft)	(days)								
0.173	200	20	1.00E-04	9.59E-04	100	39	1.00E+99								
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	0.004	0.35	1.7225	58	5.00E-03	2.427214	0.1129102								
				-208.5	-166.8	-125.1	-83.4	-41.7	0	41.7	83.4	125.1	166.8	208.5	
Edge Criterion (mg/l)		0.005	0	0.000815	0.0010664	0.001315	0.0015274	0.0016708	0.0017216	0.0016708	0.0015274	0.001315	0.001066	0.000815	
Higest modeled conc.		0.00172	-3.9	0.000815	0.0010664	0.001315	0.0015274	0.0016708	0.0017216	0.0016708	0.0015274	0.001315	0.001066	0.000815	
			-7.8	0.000815	0.0010664	0.001315	0.0015274	0.0016708	0.0017216	0.0016708	0.0015274	0.001315	0.001066	0.000815	
SURFACE WATER LOADING GRID			-11.7	0.000815	0.0010664	0.001315	0.0015274	0.0016708	0.0017216	0.0016708	0.0015274	0.001315	0.001066	0.000815	
Distance to Stream (ft)		705	-15.6	0.000815	0.0010664	0.001315	0.0015274	0.0016708	0.0017216	0.0016708	0.0015274	0.001315	0.001066	0.000815	
Plume View Width (ft)		417	-19.5	0.000815	0.0010664	0.001315	0.0015274	0.0016708	0.0017216	0.0016708	0.0015274	0.001315	0.001066	0.000815	
Plume View Depth (ft)		39	-23.4	0.000815	0.0010664	0.001315	0.0015274	0.0016708	0.0017216	0.0016708	0.0015274	0.001315	0.001066	0.000815	
			-27.3	0.000815	0.0010664	0.001315	0.0015274	0.0016708	0.0017216	0.0016708	0.0015274	0.001315	0.001066	0.000815	
			-31.2	0.000815	0.0010664	0.001315	0.0015274	0.0016708	0.0017216	0.0016708	0.0015274	0.001315	0.001066	0.000815	
PENTOX NOT NEEDED			-35.1	0.000815	0.0010664	0.001315	0.0015274	0.0016708	0.0017216	0.0016708	0.0015274	0.001315	0.001066	0.000815	
			-39	0.000407	0.0005332	0.000658	0.0007637	0.0008354	0.0008608	0.0008354	0.0007637	0.0006575	0.000533	0.000407	
				Average Groundwater Concentration				0.00143	mg/l						
				Plume Flow				0.01298	cfs	0.00839	MGD				
				Mass Loading to Stream			45.52	mg/day							

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Figure F.40
AOI 6
Appendix F
Benzo(a)pyrene at B-125

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER															
Project:	AOI 6 PES Facility														
Date:	8/28/2013														
Contaminant:	Benzo(a)pyrene at B-125			Prepared by:		TS									
SOURCE															
CONC	Ax	Ay	Az	LAMBDA	SOURCE	SOURCE									
(units)	(ft)	(ft)	(ft)		WIDTH	THICKNESS	Time								
mg/l	>.0001	>.0001	>=.0001	day-1	(ft)	(ft)	(days)								
0.000262	200	20	1.00E-04	6.58E-04	100	39	1.00E+99								
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	0.004	0.35	1.7225	910000	5.00E-03	22393.5	1.224E-05								
				-50	-40	-30	-20	-10	0	10	20	30	40	50	
Edge Criterion (mg/l)		0.00007	0	6.9E-163	7.02E-163	7.1E-163	7.16E-163	7.2E-163	7.21E-163	7.2E-163	7.16E-163	7.1E-163	7E-163	6.9E-163	
Higest modeled conc.		7E-163	-3.9	6.9E-163	7.02E-163	7.1E-163	7.16E-163	7.2E-163	7.21E-163	7.2E-163	7.16E-163	7.1E-163	7E-163	6.9E-163	
			-7.8	6.9E-163	7.02E-163	7.1E-163	7.16E-163	7.2E-163	7.21E-163	7.2E-163	7.16E-163	7.1E-163	7E-163	6.9E-163	
SURFACE WATER LOADING GRID			-11.7	6.9E-163	7.02E-163	7.1E-163	7.16E-163	7.2E-163	7.21E-163	7.2E-163	7.16E-163	7.1E-163	7E-163	6.9E-163	
Distance to Stream (ft)		705	-15.6	6.9E-163	7.02E-163	7.1E-163	7.16E-163	7.2E-163	7.21E-163	7.2E-163	7.16E-163	7.1E-163	7E-163	6.9E-163	
Plume View Width (ft)		100	-19.5	6.9E-163	7.02E-163	7.1E-163	7.16E-163	7.2E-163	7.21E-163	7.2E-163	7.16E-163	7.1E-163	7E-163	6.9E-163	
Plume View Depth (ft)		39	-23.4	6.9E-163	7.02E-163	7.1E-163	7.16E-163	7.2E-163	7.21E-163	7.2E-163	7.16E-163	7.1E-163	7E-163	6.9E-163	
			-27.3	6.9E-163	7.02E-163	7.1E-163	7.16E-163	7.2E-163	7.21E-163	7.2E-163	7.16E-163	7.1E-163	7E-163	6.9E-163	
			-31.2	6.9E-163	7.02E-163	7.1E-163	7.16E-163	7.2E-163	7.21E-163	7.2E-163	7.16E-163	7.1E-163	7E-163	6.9E-163	
PENTOX NOT NEEDED			-35.1	6.9E-163	7.02E-163	7.1E-163	7.16E-163	7.2E-163	7.21E-163	7.2E-163	7.16E-163	7.1E-163	7E-163	6.9E-163	
			-39	3.5E-163	3.51E-163	3.6E-163	3.58E-163	3.6E-163	3.61E-163	3.6E-163	3.58E-163	3.55E-163	3.5E-163	3.5E-163	
				Average Groundwater Concentration				#DIV/0!	mg/l						
				Plume Flow				0.00000	cfs	0 MGD					
				Mass Loading to Stream			#DIV/0!		mg/day						

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Figure F.41
AOI 6
Appendix F
Benzene at B-39

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER															
Project:	AOI 6 PES Facility														
Date:	8/28/2013														
Contaminant:	Benzene at B-39			Prepared by:		TS									
SOURCE CONC (units)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days)								
mg/l	>.0001	>.0001	>=.0001	day-1											
0.044	200	20	1.00E-04	9.59E-04	100	39	1.00E+99								
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^{3})	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)								
2.83E-01	0.009	0.35	1.7225	58	5.00E-03	2.427214	0.0029981								
				-69	-55.2	-41.4	-27.6	-13.8	0	13.8	27.6	41.4	55.2	69	
Edge Criterion (mg/l)		0.005	0	5.35E-05	6.064E-05	6.68E-05	7.156E-05	7.459E-05	7.562E-05	7.459E-05	7.156E-05	6.679E-05	6.06E-05	5.35E-05	
Higest modeled conc.		7.6E-05	-3.9	5.35E-05	6.064E-05	6.68E-05	7.156E-05	7.459E-05	7.562E-05	7.459E-05	7.156E-05	6.679E-05	6.06E-05	5.35E-05	
			-7.8	5.35E-05	6.064E-05	6.68E-05	7.156E-05	7.459E-05	7.562E-05	7.459E-05	7.156E-05	6.679E-05	6.06E-05	5.35E-05	
SURFACE WATER LOADING GRID			-11.7	5.35E-05	6.064E-05	6.68E-05	7.156E-05	7.459E-05	7.562E-05	7.459E-05	7.156E-05	6.679E-05	6.06E-05	5.35E-05	
Distance to Stream (ft)		150	-15.6	5.35E-05	6.064E-05	6.68E-05	7.156E-05	7.459E-05	7.562E-05	7.459E-05	7.156E-05	6.679E-05	6.06E-05	5.35E-05	
Plume View Width (ft)		138	-19.5	5.35E-05	6.064E-05	6.68E-05	7.156E-05	7.459E-05	7.562E-05	7.459E-05	7.156E-05	6.679E-05	6.06E-05	5.35E-05	
Plume View Depth (ft)		39	-23.4	5.35E-05	6.064E-05	6.68E-05	7.156E-05	7.459E-05	7.562E-05	7.459E-05	7.156E-05	6.679E-05	6.06E-05	5.35E-05	
			-27.3	5.35E-05	6.064E-05	6.68E-05	7.156E-05	7.459E-05	7.562E-05	7.459E-05	7.156E-05	6.679E-05	6.06E-05	5.35E-05	
			-31.2	5.35E-05	6.064E-05	6.68E-05	7.156E-05	7.459E-05	7.562E-05	7.459E-05	7.156E-05	6.679E-05	6.06E-05	5.35E-05	
PENTOX NOT NEEDED			-35.1	5.35E-05	6.064E-05	6.68E-05	7.156E-05	7.459E-05	7.562E-05	7.459E-05	7.156E-05	6.679E-05	6.06E-05	5.35E-05	
			-39	2.68E-05	3.032E-05	3.34E-05	3.578E-05	3.729E-05	3.781E-05	3.729E-05	3.578E-05	3.34E-05	3.03E-05	2.68E-05	
				Average Groundwater Concentration				#DIV/0!	mg/l						
				Plume Flow				0.00000	cfs	0 MGD					
				Mass Loading to Stream			#DIV/0!		mg/day						

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Figure F.42
AOI 6
Appendix F
Benzo(a)pyrene at B-39

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER															
Project:	AOI 6 PES Facility														
Date:	8/28/2013														
Contaminant:	Benzo(a)pyrene at B-39			Prepared by:		TS									
SOURCE															
CONC	Ax	Ay	Az	LAMBDA	SOURCE	SOURCE									
(units)	(ft)	(ft)	(ft)		WIDTH	THICKNESS	Time								
mg/l	>.0001	>.0001	>=.0001	day-1	(ft)	(ft)	(days)								
0.00603	200	20	1.00E-04	6.58E-04	100	39	1.00E+99								
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)								
2.83E-01	0.009	0.35	1.7225	910000	5.00E-03	22393.5	3.25E-07								
				-50	-40	-30	-20	-10	0	10	20	30	40	50	
Edge Criterion (mg/l)		0.00007	0	2.2E-210	2.35E-210	2.5E-210	2.56E-210	2.61E-210	2.63E-210	2.61E-210	2.56E-210	2.47E-210	2.3E-210	2.2E-210	
Higest modeled conc.		3E-210	-3.9	2.2E-210	2.35E-210	2.5E-210	2.56E-210	2.61E-210	2.63E-210	2.61E-210	2.56E-210	2.47E-210	2.3E-210	2.2E-210	
			-7.8	2.2E-210	2.35E-210	2.5E-210	2.56E-210	2.61E-210	2.63E-210	2.61E-210	2.56E-210	2.47E-210	2.3E-210	2.2E-210	
SURFACE WATER LOADING GRID			-11.7	2.2E-210	2.35E-210	2.5E-210	2.56E-210	2.61E-210	2.63E-210	2.61E-210	2.56E-210	2.47E-210	2.3E-210	2.2E-210	
Distance to Stream (ft)		150	-15.6	2.2E-210	2.35E-210	2.5E-210	2.56E-210	2.61E-210	2.63E-210	2.61E-210	2.56E-210	2.47E-210	2.3E-210	2.2E-210	
Plume View Width (ft)		100	-19.5	2.2E-210	2.35E-210	2.5E-210	2.56E-210	2.61E-210	2.63E-210	2.61E-210	2.56E-210	2.47E-210	2.3E-210	2.2E-210	
Plume View Depth (ft)		39	-23.4	2.2E-210	2.35E-210	2.5E-210	2.56E-210	2.61E-210	2.63E-210	2.61E-210	2.56E-210	2.47E-210	2.3E-210	2.2E-210	
			-27.3	2.2E-210	2.35E-210	2.5E-210	2.56E-210	2.61E-210	2.63E-210	2.61E-210	2.56E-210	2.47E-210	2.3E-210	2.2E-210	
			-31.2	2.2E-210	2.35E-210	2.5E-210	2.56E-210	2.61E-210	2.63E-210	2.61E-210	2.56E-210	2.47E-210	2.3E-210	2.2E-210	
PENTOX NOT NEEDED			-35.1	2.2E-210	2.35E-210	2.5E-210	2.56E-210	2.61E-210	2.63E-210	2.61E-210	2.56E-210	2.47E-210	2.3E-210	2.2E-210	
			-39	1.1E-210	1.17E-210	1.2E-210	1.28E-210	1.31E-210	1.32E-210	1.31E-210	1.28E-210	1.23E-210	1.2E-210	1.1E-210	
				Average Groundwater Concentration				#DIV/0!	mg/l						
				Plume Flow				0.00000	cfs	0 MGD					
				Mass Loading to Stream			#DIV/0!		mg/day						

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Figure F.43
AOI 6
Appendix F
Benzo(a)anthracene at B-39

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER															
Project:	AOI 6 PES Facility														
Date:	8/28/2013														
Contaminant:	Benzo(a)anthracene at B-39			Prepared by:		TS									
SOURCE CONC (units)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days)								
mg/l	>.0001	>.0001	>=.0001												
0.00827	200	20	1.00E-04	5.21E-04	100	39	1.00E+99								
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^{3})	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)								
2.83E-01	0.009	0.35	1.7225	350000	5.00E-03	8613.5	8.449E-07								
				-50	-40	-30	-20	-10	0	10	20	30	40	50	
Edge Criterion (mg/l)		4.1E-05	0	2.2E-117	2.35E-117	2.5E-117	2.57E-117	2.62E-117	2.64E-117	2.62E-117	2.57E-117	2.48E-117	2.4E-117	2.2E-117	
Higest modeled conc.		3E-117	-3.9	2.2E-117	2.35E-117	2.5E-117	2.57E-117	2.62E-117	2.64E-117	2.62E-117	2.57E-117	2.48E-117	2.4E-117	2.2E-117	
			-7.8	2.2E-117	2.35E-117	2.5E-117	2.57E-117	2.62E-117	2.64E-117	2.62E-117	2.57E-117	2.48E-117	2.4E-117	2.2E-117	
SURFACE WATER LOADING GRID			-11.7	2.2E-117	2.35E-117	2.5E-117	2.57E-117	2.62E-117	2.64E-117	2.62E-117	2.57E-117	2.48E-117	2.4E-117	2.2E-117	
Distance to Stream (ft)		150	-15.6	2.2E-117	2.35E-117	2.5E-117	2.57E-117	2.62E-117	2.64E-117	2.62E-117	2.57E-117	2.48E-117	2.4E-117	2.2E-117	
Plume View Width (ft)		100	-19.5	2.2E-117	2.35E-117	2.5E-117	2.57E-117	2.62E-117	2.64E-117	2.62E-117	2.57E-117	2.48E-117	2.4E-117	2.2E-117	
Plume View Depth (ft)		39	-23.4	2.2E-117	2.35E-117	2.5E-117	2.57E-117	2.62E-117	2.64E-117	2.62E-117	2.57E-117	2.48E-117	2.4E-117	2.2E-117	
			-27.3	2.2E-117	2.35E-117	2.5E-117	2.57E-117	2.62E-117	2.64E-117	2.62E-117	2.57E-117	2.48E-117	2.4E-117	2.2E-117	
			-31.2	2.2E-117	2.35E-117	2.5E-117	2.57E-117	2.62E-117	2.64E-117	2.62E-117	2.57E-117	2.48E-117	2.4E-117	2.2E-117	
PENTOX NOT NEEDED			-35.1	2.2E-117	2.35E-117	2.5E-117	2.57E-117	2.62E-117	2.64E-117	2.62E-117	2.57E-117	2.48E-117	2.4E-117	2.2E-117	
			-39	1.1E-117	1.18E-117	1.2E-117	1.28E-117	1.31E-117	1.32E-117	1.31E-117	1.28E-117	1.24E-117	1.2E-117	1.1E-117	
				Average Groundwater Concentration				#DIV/0!	mg/l						
				Plume Flow				0.00000	cfs	0 MGD					
				Mass Loading to Stream			#DIV/0!		mg/day						

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Figure F.44
AOI 6
Appendix F
Benzo(g,h,i)perylene at B-39

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER															
Project:	AOI 6 PES Facility														
Date:	8/28/2013														
Contaminant:	Benzo(g,h,i)perylene at B-39			Prepared by:		TS									
SOURCE															
CONC	Ax	Ay	Az	LAMBDA	SOURCE	SOURCE									
(units)	(ft)	(ft)	(ft)		WIDTH	THICKNESS	Time								
mg/l	>.0001	>.0001	>=.0001	day-1	(ft)	(ft)	(days)								
0.00289	200	20	1.00E-04	5.21E-04	100	39	1.00E+99								
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)								
2.83E-01	0.009	0.35	1.7225	2800000	5.00E-03	68901	1.056E-07								
				-50	-40	-30	-20	-10	0	10	20	30	40	50	
Edge Criterion (mg/l)		0.00026	0	0	0	0	0	0	0	0	0	0	0	0	
Higest modeled conc.		0	-3.9	0	0	0	0	0	0	0	0	0	0	0	
			-7.8	0	0	0	0	0	0	0	0	0	0	0	
SURFACE WATER LOADING GRID			-11.7	0	0	0	0	0	0	0	0	0	0	0	
Distance to Stream (ft)		150	-15.6	0	0	0	0	0	0	0	0	0	0	0	
Plume View Width (ft)		100	-19.5	0	0	0	0	0	0	0	0	0	0	0	
Plume View Depth (ft)		39	-23.4	0	0	0	0	0	0	0	0	0	0	0	
			-27.3	0	0	0	0	0	0	0	0	0	0	0	
			-31.2	0	0	0	0	0	0	0	0	0	0	0	
PENTOX NOT NEEDED			-35.1	0	0	0	0	0	0	0	0	0	0	0	
			-39	0	0	0	0	0	0	0	0	0	0	0	
				Average Groundwater Concentration				#DIV/0!	mg/l						
				Plume Flow				0.00000	cfs	0 MGD					
				Mass Loading to Stream			#DIV/0!		mg/day						

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Figure F.45
AOI 6
Appendix F
Benzo(b)fluoranthene at B-39

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER															
Project:	AOI 6 PES Facility														
Date:	8/28/2013														
Contaminant:	Benzo(b)fluoranthene at B-39			Prepared by:		TS									
SOURCE															
CONC	Ax	Ay	Az	LAMBDA	SOURCE	SOURCE									
(units)	(ft)	(ft)	(ft)		WIDTH	THICKNESS	Time								
mg/l	>.0001	>.0001	>=.0001	day-1	(ft)	(ft)	(days)								
0.006	200	20	1.00E-04	5.75E-04	100	39	1.00E+99								
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)								
2.83E-01	0.009	0.35	1.7225	550000	5.00E-03	13534.93	5.377E-07								
				-50	-40	-30	-20	-10	0	10	20	30	40	50	
Edge Criterion (mg/l)		5.7E-05	0	7.2E-154	7.72E-154	8.1E-154	8.42E-154	8.61E-154	8.67E-154	8.61E-154	8.42E-154	8.12E-154	7.7E-154	7.2E-154	
Higest modeled conc.		9E-154	-3.9	7.2E-154	7.72E-154	8.1E-154	8.42E-154	8.61E-154	8.67E-154	8.61E-154	8.42E-154	8.12E-154	7.7E-154	7.2E-154	
			-7.8	7.2E-154	7.72E-154	8.1E-154	8.42E-154	8.61E-154	8.67E-154	8.61E-154	8.42E-154	8.12E-154	7.7E-154	7.2E-154	
SURFACE WATER LOADING GRID			-11.7	7.2E-154	7.72E-154	8.1E-154	8.42E-154	8.61E-154	8.67E-154	8.61E-154	8.42E-154	8.12E-154	7.7E-154	7.2E-154	
Distance to Stream (ft)		150	-15.6	7.2E-154	7.72E-154	8.1E-154	8.42E-154	8.61E-154	8.67E-154	8.61E-154	8.42E-154	8.12E-154	7.7E-154	7.2E-154	
Plume View Width (ft)		100	-19.5	7.2E-154	7.72E-154	8.1E-154	8.42E-154	8.61E-154	8.67E-154	8.61E-154	8.42E-154	8.12E-154	7.7E-154	7.2E-154	
Plume View Depth (ft)		39	-23.4	7.2E-154	7.72E-154	8.1E-154	8.42E-154	8.61E-154	8.67E-154	8.61E-154	8.42E-154	8.12E-154	7.7E-154	7.2E-154	
			-27.3	7.2E-154	7.72E-154	8.1E-154	8.42E-154	8.61E-154	8.67E-154	8.61E-154	8.42E-154	8.12E-154	7.7E-154	7.2E-154	
			-31.2	7.2E-154	7.72E-154	8.1E-154	8.42E-154	8.61E-154	8.67E-154	8.61E-154	8.42E-154	8.12E-154	7.7E-154	7.2E-154	
PENTOX NOT NEEDED			-35.1	7.2E-154	7.72E-154	8.1E-154	8.42E-154	8.61E-154	8.67E-154	8.61E-154	8.42E-154	8.12E-154	7.7E-154	7.2E-154	
			-39	3.6E-154	3.86E-154	4.1E-154	4.21E-154	4.3E-154	4.33E-154	4.3E-154	4.21E-154	4.06E-154	3.9E-154	3.6E-154	
				Average Groundwater Concentration				#DIV/0!	mg/l						
				Plume Flow				0.00000	cfs	0 MGD					
				Mass Loading to Stream			#DIV/0!		mg/day						

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Figure F.46
AOI 6
Appendix F
Chrysene at B-39

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER

Project:	AOI 6 PES Facility														
Date:	8/28/2013														
Contaminant:	Chrysene at B-39			Prepared by:		TS									
SOURCE CONC (units)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days)								
mg/l	>.0001	>.0001	>=.0001												
0.00678	200	20	1.00E-04	3.56E-04	100	39	1.00E+99								
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^{3})	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)								
2.83E-01	0.009	0.35	1.7225	490000	5.00E-03	12058.5	6.035E-07								

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		-50	-40	-30	-20	-10	0	10	20	30	40	50
Edge Criterion (mg/l)	0.00048	0	4.9E-115	5.25E-115	5.5E-115	5.73E-115	5.86E-115	5.9E-115	5.86E-115	5.73E-115	5.53E-115	5.3E-115	4.9E-115
Higest modeled conc.	6E-115	-3.9	4.9E-115	5.25E-115	5.5E-115	5.73E-115	5.86E-115	5.9E-115	5.86E-115	5.73E-115	5.53E-115	5.3E-115	4.9E-115
		-7.8	4.9E-115	5.25E-115	5.5E-115	5.73E-115	5.86E-115	5.9E-115	5.86E-115	5.73E-115	5.53E-115	5.3E-115	4.9E-115
SURFACE WATER LOADING GRID		-11.7	4.9E-115	5.25E-115	5.5E-115	5.73E-115	5.86E-115	5.9E-115	5.86E-115	5.73E-115	5.53E-115	5.3E-115	4.9E-115
Distance to Stream (ft)	150	-15.6	4.9E-115	5.25E-115	5.5E-115	5.73E-115	5.86E-115	5.9E-115	5.86E-115	5.73E-115	5.53E-115	5.3E-115	4.9E-115
Plume View Width (ft)	100	-19.5	4.9E-115	5.25E-115	5.5E-115	5.73E-115	5.86E-115	5.9E-115	5.86E-115	5.73E-115	5.53E-115	5.3E-115	4.9E-115
Plume View Depth (ft)	39	-23.4	4.9E-115	5.25E-115	5.5E-115	5.73E-115	5.86E-115	5.9E-115	5.86E-115	5.73E-115	5.53E-115	5.3E-115	4.9E-115
		-27.3	4.9E-115	5.25E-115	5.5E-115	5.73E-115	5.86E-115	5.9E-115	5.86E-115	5.73E-115	5.53E-115	5.3E-115	4.9E-115
		-31.2	4.9E-115	5.25E-115	5.5E-115	5.73E-115	5.86E-115	5.9E-115	5.86E-115	5.73E-115	5.53E-115	5.3E-115	4.9E-115
PENTOX NOT NEEDED		-35.1	4.9E-115	5.25E-115	5.5E-115	5.73E-115	5.86E-115	5.9E-115	5.86E-115	5.73E-115	5.53E-115	5.3E-115	4.9E-115
		-39	2.5E-115	2.63E-115	2.8E-115	2.87E-115	2.93E-115	2.95E-115	2.93E-115	2.87E-115	2.76E-115	2.6E-115	2.5E-115

Average Groundwater Concentration	#DIV/0!	mg/l	
Plume Flow	0.00000	cfs	0 MGD
Mass Loading to Stream	#DIV/0!	mg/day	

Figure F.47
AOI 6
Appendix F
Benzene at B-164

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER															
Project:	AOI 6 PES Facility														
Date:	8/28/2013														
Contaminant:	Benzene at B-164			Prepared by:		TS									
SOURCE															
CONC	Ax	Ay	Az	LAMBDA	SOURCE	SOURCE									
(units)	(ft)	(ft)	(ft)		WIDTH	THICKNESS	Time								
mg/l	>.0001	>.0001	>=.0001	day-1	(ft)	(ft)	(days)								
0.0991	200	20	1.00E-04	9.59E-04	100	39	1.00E+99								
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)								
2.83E-01	0.009	0.35	1.7225	58	5.00E-03	2.427214	0.0029981								
				-93.5	-74.8	-56.1	-37.4	-18.7	0	18.7	37.4	56.1	74.8	93.5	
Edge Criterion (mg/l)		0.005	0	0.000787	0.0011219	0.001475	0.0017922	0.0020132	0.0020926	0.0020132	0.0017922	0.0014754	0.001122	0.000787	
Higest modeled conc.		0.00209	-3.9	0.000787	0.0011219	0.001475	0.0017922	0.0020132	0.0020926	0.0020132	0.0017922	0.0014754	0.001122	0.000787	
			-7.8	0.000787	0.0011219	0.001475	0.0017922	0.0020132	0.0020926	0.0020132	0.0017922	0.0014754	0.001122	0.000787	
SURFACE WATER LOADING GRID			-11.7	0.000787	0.0011219	0.001475	0.0017922	0.0020132	0.0020926	0.0020132	0.0017922	0.0014754	0.001122	0.000787	
Distance to Stream (ft)		89	-15.6	0.000787	0.0011219	0.001475	0.0017922	0.0020132	0.0020926	0.0020132	0.0017922	0.0014754	0.001122	0.000787	
Plume View Width (ft)		187	-19.5	0.000787	0.0011219	0.001475	0.0017922	0.0020132	0.0020926	0.0020132	0.0017922	0.0014754	0.001122	0.000787	
Plume View Depth (ft)		39	-23.4	0.000787	0.0011219	0.001475	0.0017922	0.0020132	0.0020926	0.0020132	0.0017922	0.0014754	0.001122	0.000787	
			-27.3	0.000787	0.0011219	0.001475	0.0017922	0.0020132	0.0020926	0.0020132	0.0017922	0.0014754	0.001122	0.000787	
			-31.2	0.000787	0.0011219	0.001475	0.0017922	0.0020132	0.0020926	0.0020132	0.0017922	0.0014754	0.001122	0.000787	
PENTOX NOT NEEDED			-35.1	0.000787	0.0011219	0.001475	0.0017922	0.0020132	0.0020926	0.0020132	0.0017922	0.0014754	0.001122	0.000787	
			-39	0.000394	0.000561	0.000738	0.0008961	0.0010066	0.0010463	0.0010066	0.0008961	0.0007377	0.000561	0.000394	
				Average Groundwater Concentration				0.00164	mg/l						
				Plume Flow				0.00016	cfs	0.0001	MGD				
				Mass Loading to Stream			0.64	mg/day							

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Figure F.48
AOI 6
Appendix F
Benzene at URS-4

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER															
Project:	AOI 6 PES Facility														
Date:	8/28/2013														
Contaminant:	Benzene at URS-4			Prepared by:		TS									
SOURCE															
CONC	Ax	Ay	Az	LAMBDA	SOURCE	SOURCE									
(units)	(ft)	(ft)	(ft)		WIDTH	THICKNESS	Time								
mg/l	>.0001	>.0001	>=.0001	day-1	(ft)	(ft)	(days)								
0.0468	200	20	1.00E-04	9.59E-04	100	39	1.00E+99								
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)								
2.83E-01	0.009	0.35	1.7225	58	5.00E-03	2.427214	0.0029981								
				-70	-56	-42	-28	-14	0	14	28	42	56	70	
Edge Criterion (mg/l)		0.005	0	0.0051	0.0122816	0.021067	0.0277811	0.0309664	0.0317442	0.0309664	0.0277811	0.0210674	0.012282	0.0051	
Higest modeled conc.		0.03174	-3.9	0.0051	0.0122816	0.021067	0.0277811	0.0309664	0.0317442	0.0309664	0.0277811	0.0210674	0.012282	0.0051	
			-7.8	0.0051	0.0122816	0.021067	0.0277811	0.0309664	0.0317442	0.0309664	0.0277811	0.0210674	0.012282	0.0051	
SURFACE WATER LOADING GRID			-11.7	0.0051	0.0122816	0.021067	0.0277811	0.0309664	0.0317442	0.0309664	0.0277811	0.0210674	0.012282	0.0051	
Distance to Stream (ft)		10	-15.6	0.0051	0.0122816	0.021067	0.0277811	0.0309664	0.0317442	0.0309664	0.0277811	0.0210674	0.012282	0.0051	
Plume View Width (ft)		140	-19.5	0.0051	0.0122816	0.021067	0.0277811	0.0309664	0.0317442	0.0309664	0.0277811	0.0210674	0.012282	0.0051	
Plume View Depth (ft)		39	-23.4	0.0051	0.0122816	0.021067	0.0277811	0.0309664	0.0317442	0.0309664	0.0277811	0.0210674	0.012282	0.0051	
			-27.3	0.0051	0.0122816	0.021067	0.0277811	0.0309664	0.0317442	0.0309664	0.0277811	0.0210674	0.012282	0.0051	
			-31.2	0.0051	0.0122816	0.021067	0.0277811	0.0309664	0.0317442	0.0309664	0.0277811	0.0210674	0.012282	0.0051	
PENTOX NEEDED			-35.1	0.0051	0.0122816	0.021067	0.0277811	0.0309664	0.0317442	0.0309664	0.0277811	0.0210674	0.012282	0.0051	
			-39	0.00255	0.0061408	0.010534	0.0138905	0.0154832	0.0158721	0.0154832	0.0138905	0.0105337	0.006141	0.00255	
				Average Groundwater Concentration				0.01962	mg/l						
				Plume Flow				0.00016	cfs	0.0001	MGD				
				Mass Loading to Stream			7.73	mg/day							

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Modified to Include Retardation

Figure F.49
Quick Domenico
Fate and Transport Model Input and Output
B-154
AOI 6 PES
Philadelphia, Pennsylvania

Project	AOI 6 PES
Prepared by	TS
Date Prepared	8/28/2013

Generic Input Parameters				Data Source
Source Identification (or Well ID)			B-154	
Sample Date			Jan-13	
Source Width		ft	100	100' default if no plume present
Source Thickness		ft	39	Maximum thickness of alluvium/fill
Longitudinal Dispersivity	A_x	ft	200	From CCR QD Simulations
Transverse Dispersivity	A_y	ft	20.0	Quick Domenico User's Guide
Vertical Dispersivity	A_z	ft	0.0001	Quick Domenico User's Guide
Hydraulic Conductivty	k	ft/day	23.98	Highest K URS 2002 Aquifer testing
Hydraulic Gradient		ft/ft	0.009	December 2012 Groundwater Gauging
Porosity		decimal fraction	0.35	Site soil analysis
Soil Bulk Density	p_b	g/cm3	1.7225	Quick Domenico User's Guide
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005	Quick Domenico User's Guide
Time		days	1.00E+99	Steady-state conditions

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	238.000000
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			Toluene
Source Concentration (mg/l)		mg/l	1.100000
Lambda (per day)		day^{-1}	0.0247
KOC			130

Output

Contaminant	Starting Concentration (mg/l)	Screening Criteria (mg/l)	Predicted Concentration (mg/l)	Distance to Meet Screening Criteria (ft)
Sim 1 - Benzene	238.000000	0.005000	8.725436	731.000000
Sim 2 - Toluene	1.100000	1.000000	0.000000	731

Figure F.49
SIM 1

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzene

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

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
238.000000	2.00E+02	2.00E+01	1.00E-04	9.589E-04	100	39	1E+99

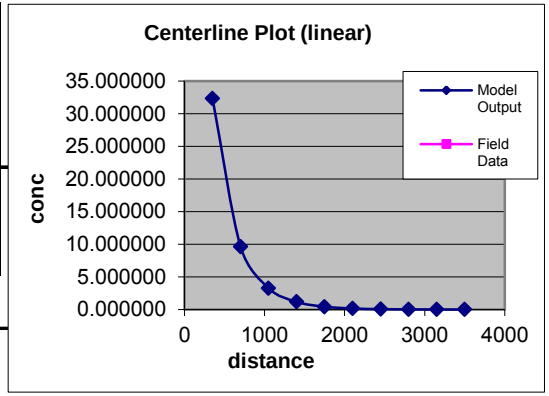
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.009	0.35	1.72	58.00	5.00E-03	2.427214286	0.25404785

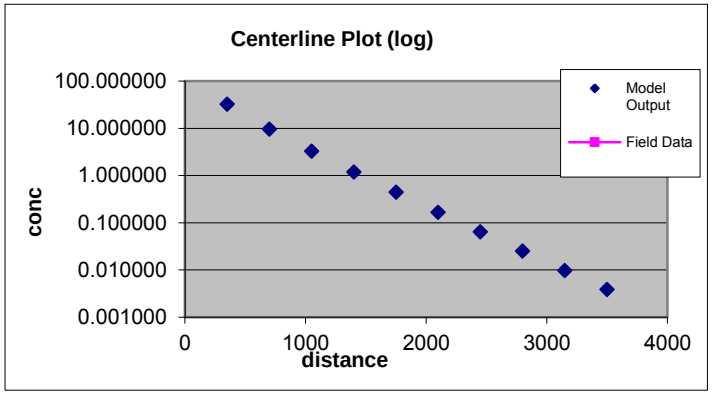
Point Concentration

x(ft)	y(ft)	z(ft)
731.000000	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	731	0	0
at	1E+99	days =	

8.725436 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	3500
Width (ft)	100

	350	700	1050	1400	1750	2100	2450	2800	3150	3500
100	23.102340	8.099800	2.919334	1.082675	0.409607	0.157180	0.060952	0.023828	0.009374	0.003707
50	29.734322	9.224235	3.186377	1.156512	0.431875	0.164283	0.063309	0.024633	0.009656	0.003807
0	32.343200	9.632710	3.280713	1.182227	0.439563	0.166722	0.064115	0.024907	0.009751	0.003841
-50	29.734322	9.224235	3.186377	1.156512	0.431875	0.164283	0.063309	0.024633	0.009656	0.003807
-100	23.102340	8.099800	2.919334	1.082675	0.409607	0.157180	0.060952	0.023828	0.009374	0.003707
Field Data:	**Centerline C Concentration**									
	Distance from Source									

Figure F.49
SIM 2

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES
Date: 8/28/2013 Prepared by: TS
Contaminant: Toluene

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

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
1.100000	2.00E+02	2.00E+01	1.00E-04	2.470E-02	100	39	1E+99

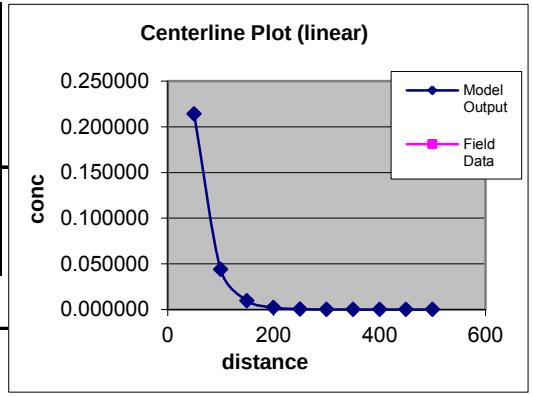
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.009	0.35	1.72	130.00	5.00E-03	4.198928571	0.146853789

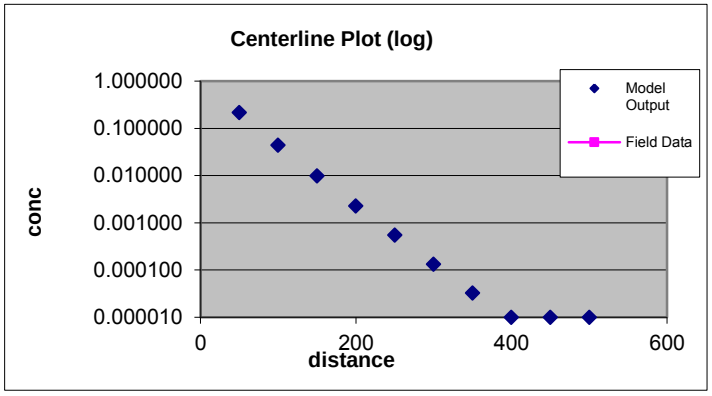
Point Concentration

x(ft)	y(ft)	z(ft)
731.000000	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	731	0	0
at	1E+99	days =	

0.000000 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	500
Width (ft)	100

	50	100	150	200	250	300	350	400	450	500
100	0.038208	0.015819	0.004734	0.001297	0.000343	0.000090	0.000023	0.000006	0.000002	0.000000
50	0.141725	0.034068	0.008165	0.001979	0.000485	0.000120	0.000030	0.000007	0.000002	0.000000
0	0.214175	0.043888	0.009786	0.002278	0.000544	0.000132	0.000033	0.000010	0.000010	0.000010
-50	0.141725	0.034068	0.008165	0.001979	0.000485	0.000120	0.000030	0.000007	0.000002	0.000000
-100	0.038208	0.015819	0.004734	0.001297	0.000343	0.000090	0.000023	0.000006	0.000002	0.000000

Field Data:	Centerline C Concentration								
	Distance from Source								

Figure F.50
Quick Domenico
Fate and Transport Model Input and Output
B-154 Step 2
AOI 6 PES
Philadelphia, Pennsylvania

Project	AOI 6 PES
Prepared by	TS
Date Prepared	8/28/2013

Generic Input Parameters				**Data Source**
Source Identification (or Well ID)			B-154	
Sample Date			Jan-13	
Source Width		ft	1340	100' default if no plume present
Source Thickness		ft	39	Maximum thickness of alluvium/fill
Longitudinal Dispersivity	A_x	ft	200	From CCR QD Simulations
Transverse Dispersivity	A_y	ft	20.0	Quick Domenico User's Guide
Vertical Dispersivity	A_z	ft	0.0001	Quick Domenico User's Guide
Hydraulic Conductivty	k	ft/day	0.283	Highest K URS 2002 Aquifer testing
Hydraulic Gradient		ft/ft	0.009	December 2012 Groundwater Gauging
Porosity		decimal fraction	0.35	Site soil analysis
Soil Bulk Density	p_b	g/cm3	1.7225	Quick Domenico User's Guide
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005	Quick Domenico User's Guide
Time		days	1.00E+99	Steady-state conditions

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	8.725436
Lambda (per day)		day^{-1}	0.000958904
KOC			58

Output

Contaminant	Starting Concentration (mg/l)	Screening Criteria (mg/l)	Predicted Concentration (mg/l)	Distance to Meet Screening Criteria (ft)
Sim 1 - Benzene	8.725436	0.005000	0.005000	198.696843

Figure F.50
SIM 1

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzene

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

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
8.725436	2.00E+02	2.00E+01	1.00E-04	9.589E-04	1340	39	1E+99

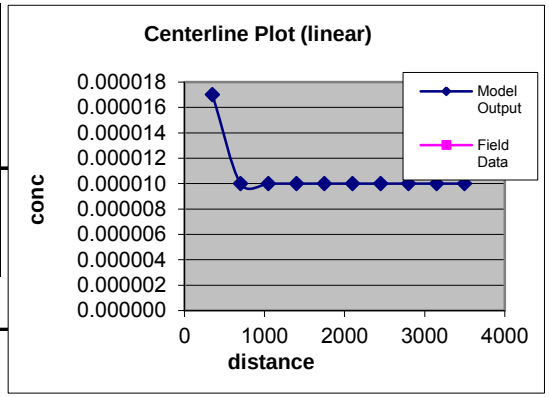
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.83E-01	0.009	0.35	1.72	58.00	5.00E-03	2.427214286	0.002998146

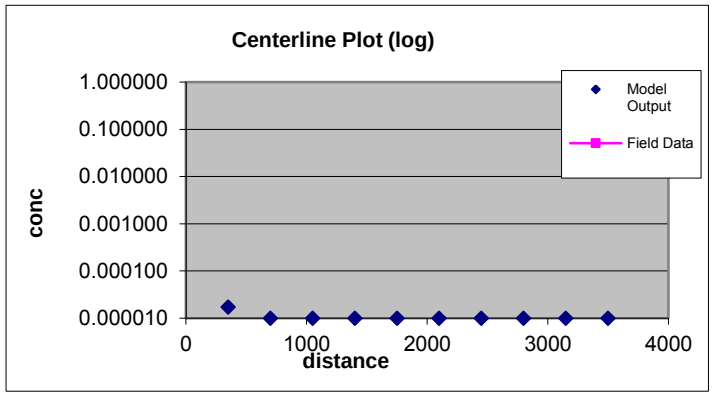
Point Concentration

x(ft)	y(ft)	z(ft)
198.696843	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	198.6968433	0	0
at	1E+99	days =	

0.005000 mg/l





AREAL MODEL CALCULATION DOMAIN
Length (ft) 3500
Width (ft) 100

	350	700	1050	1400	1750	2100	2450	2800	3150	3500
100	0.000017	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	0.000017	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0	0.000017	0.000010	0.000010	0.000010	0.000010	0.000010	0.000010	0.000010	0.000010	0.000010
-50	0.000017	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
-100	0.000017	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Field Data:	**Centerline C Concentration**									
	Distance from Source									

Figure F.51
Quick Domenico
Fate and Transport Model Input and Output
B-155
AOI 6 PES Facility
Philadelphia, Pennsylvania

Project	AOI 6 PES Facility
Prepared by	TS
Date Prepared	8/28/2013

Generic Input Parameters				Data Source
Source Identification (or Well ID)			B-155	
Sample Date			Jan-13	
Source Width		ft	100	100' default if no plume present
Source Thickness		ft	39	Maximum thickness of alluvium/fill
Longitudinal Dispersivity	A_x	ft	200	From CCR QD Simulations
Transverse Dispersivity	A_y	ft	20.0	Quick Domenico User's Guide
Vertical Dispersivity	A_z	ft	0.0001	Quick Domenico User's Guide
Hydraulic Conductivty	k	ft/day	23.98	Highest K URS 2002 Aquifer testing
Hydraulic Gradient		ft/ft	0.007	December 2012 Groundwater Gauging
Porosity		decimal fraction	0.35	Site soil analysis
Soil Bulk Density	p_b	g/cm3	1.7225	Quick Domenico User's Guide
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005	Quick Domenico User's Guide
Time		days	1.00E+99	Steady-state conditions

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	77.800000
Lambda (per day)		day^{-1}	0.000958904
KOC			58

Output

Contaminant	Starting Concentration (mg/l)	Screening Criteria (mg/l)	Predicted Concentration (mg/l)	Distance to Meet Screening Criteria (ft)
Sim 1 - Benzene	77.800000	0.005000	1.976619	729.000000

Figure F.51
SIM 1

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzene

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

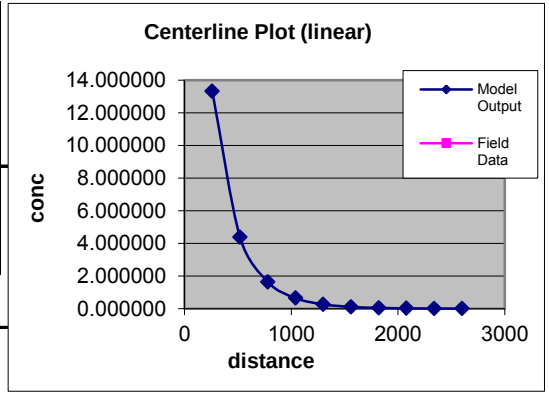
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
77.800000	2.00E+02	2.00E+01	1.00E-04	9.589E-04	100	39	1E+99

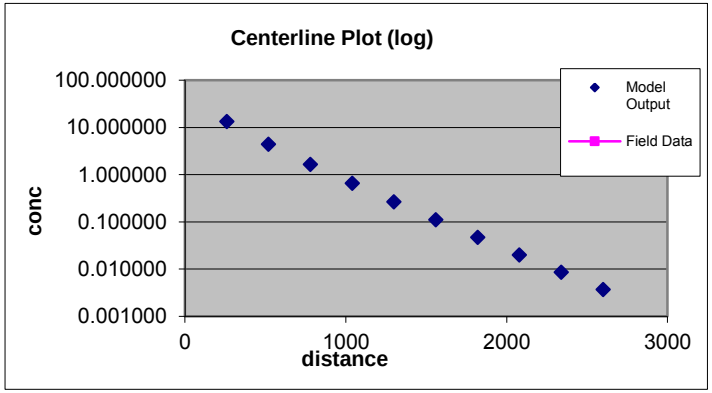
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^{3})	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.007	0.35	1.72	58.00	5.00E-03	2.427214286	0.197592772

Point Concentration

x(ft)	y(ft)	z(ft)
729.000000	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	729	0	0
at	1E+99	days =	1.976619 mg/l





AREAL MODEL — **CALCULATION DOMAIN**

Length (ft) 2600
Width (ft) 100

	260	520	780	1040	1300	1560	1820	2080	2340	2600
100	8.552215	3.475499	1.402494	0.576775	0.241003	0.101931	0.043514	0.018713	0.008094	0.003518
50	11.929809	4.132717	1.576602	0.630054	0.258728	0.108158	0.045788	0.019567	0.008422	0.003646
0	13.328754	4.378311	1.639313	0.648886	0.264921	0.110317	0.046572	0.019860	0.008534	0.003690
-50	11.929809	4.132717	1.576602	0.630054	0.258728	0.108158	0.045788	0.019567	0.008422	0.003646
-100	8.552215	3.475499	1.402494	0.576775	0.241003	0.101931	0.043514	0.018713	0.008094	0.003518
Field Data:	**Centerline C Concentration**									
	Distance from Source									

Figure F.52
Quick Domenico
Fate and Transport Model Input and Output
B-155
AOI 6 PES Facility
Philadelphia, Pennsylvania

Project	AOI 6 PES Facility
Prepared by	TS
Date Prepared	8/28/2013

Generic Input Parameters				Data Source
Source Identification (or Well ID)			B-155	
Sample Date			Jan-13	
Source Width		ft	1200	100' default if no plume present
Source Thickness		ft	39	Maximum thickness of alluvium/fill
Longitudinal Dispersivity	A_x	ft	200	From CCR QD Simulations
Transverse Dispersivity	A_y	ft	20.0	Quick Domenico User's Guide
Vertical Dispersivity	A_z	ft	0.0001	Quick Domenico User's Guide
Hydraulic Conductivty	k	ft/day	0.283	Highest K URS 2002 Aquifer testing
Hydraulic Gradient		ft/ft	0.007	December 2012 Groundwater Gauging
Porosity		decimal fraction	0.35	Site soil analysis
Soil Bulk Density	p_b	g/cm3	1.7225	Quick Domenico User's Guide
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005	Quick Domenico User's Guide
Time		days	1.00E+99	Steady-state conditions

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	1.976619
Lambda (per day)		day^{-1}	0.000958904
KOC			58

Output

Contaminant	Starting Concentration (mg/l)	Screening Criteria (mg/l)	Predicted Concentration (mg/l)	Distance to Meet Screening Criteria (ft)
Sim 1 - Benzene	1.976619	0.005000	0.005000	139.345756

Figure F.52
SIM 1

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: AOI 6 PES Facility
Date: 8/28/2013 Prepared by: TS
Contaminant: Benzene

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

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
1.976619	2.00E+02	2.00E+01	1.00E-04	9.589E-04	1200	39	1E+99

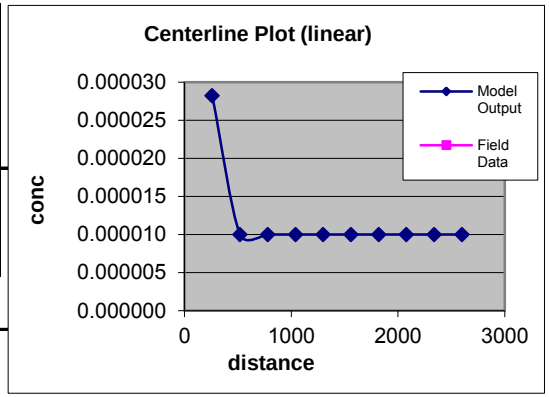
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.83E-01	0.007	0.35	1.72	58.00	5.00E-03	2.427214286	0.002331891

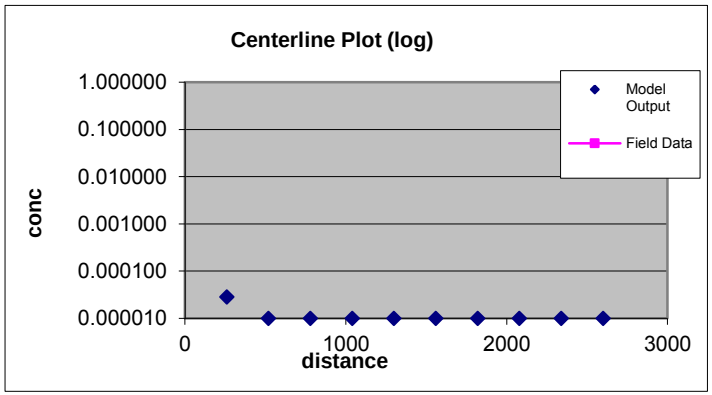
Point Concentration

x(ft)	y(ft)	z(ft)
139.345756	0.000000	0.000000

	x(ft)	y(ft)	z(ft)
Conc. At	139.3457565	0	0
at	1E+99	days =	

0.005000 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	2600
Width (ft)	100

	260	520	780	1040	1300	1560	1820	2080	2340	2600
100	0.000028	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	0.000028	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0	0.000028	0.000010	0.000010	0.000010	0.000010	0.000010	0.000010	0.000010	0.000010	0.000010
-50	0.000028	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
-100	0.000028	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

Field Data:	Centerline C Concentration								
	Distance from Source								

Figure F.53
AOI 6
Appendix F
Benzene at B-154
Step 1

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER															
Project:	AOI 6 PES Facility														
Date:	8/28/2013														
Contaminant:	Benzene at B-154			Prepared by:		TS									
SOURCE															
CONC	Ax	Ay	Az	LAMBDA	SOURCE	SOURCE									
(units)	(ft)	(ft)	(ft)		WIDTH	THICKNESS	Time								
mg/l	>.0001	>.0001	>=.0001	day-1	(ft)	(ft)	(days)								
238	200	20	1.00E-04	9.59E-04	100	39	1.00E+99								
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	0.009	0.35	1.7225	58	5.00E-03	2.427214	0.2540479								
				-670	-536	-402	-268	-134	0	134	268	402	536	670	
Edge Criterion (mg/l)		0.005	0	0.004981	0.0734122	0.594242	2.6443711	6.4742574	8.7254362	6.4742574	2.6443711	0.5942424	0.073412	0.004981	
Higest modeled conc.		8.72544	-3.9	0.004981	0.0734122	0.594242	2.6443711	6.4742574	8.7254362	6.4742574	2.6443711	0.5942424	0.073412	0.004981	
			-7.8	0.004981	0.0734122	0.594242	2.6443711	6.4742574	8.7254362	6.4742574	2.6443711	0.5942424	0.073412	0.004981	
SURFACE WATER LOADING GRID			-11.7	0.004981	0.0734122	0.594242	2.6443711	6.4742574	8.7254362	6.4742574	2.6443711	0.5942424	0.073412	0.004981	
Distance to Stream (ft)		731	-15.6	0.004981	0.0734122	0.594242	2.6443711	6.4742574	8.7254362	6.4742574	2.6443711	0.5942424	0.073412	0.004981	
Plume View Width (ft)		1340	-19.5	0.004981	0.0734122	0.594242	2.6443711	6.4742574	8.7254362	6.4742574	2.6443711	0.5942424	0.073412	0.004981	
Plume View Depth (ft)		39	-23.4	0.004981	0.0734122	0.594242	2.6443711	6.4742574	8.7254362	6.4742574	2.6443711	0.5942424	0.073412	0.004981	
			-27.3	0.004981	0.0734122	0.594242	2.6443711	6.4742574	8.7254362	6.4742574	2.6443711	0.5942424	0.073412	0.004981	
			-31.2	0.004981	0.0734122	0.594242	2.6443711	6.4742574	8.7254362	6.4742574	2.6443711	0.5942424	0.073412	0.004981	
PENTOX NEEDED			-35.1	0.004981	0.0734122	0.594242	2.6443711	6.4742574	8.7254362	6.4742574	2.6443711	0.5942424	0.073412	0.004981	
			-39	0.00249	0.0367061	0.297121	1.3221855	3.2371287	4.3627181	3.2371287	1.3221855	0.2971212	0.036706	0.00249	
				Average Groundwater Concentration				2.45648	mg/l						
				Plume Flow				0.13032	cfs	0.08423	MGD				
				Mass Loading to Stream			784633.60	mg/day							

PA DEPARTMENT
OF ENVIRONMENTAL PROTECTION
SWLOAD5B.XLS
A METHOD FOR ESTIMATING
COMTAMINANT LOADING TO SURFACE
WATER
based on
P.A. Domenico (1987)
Modified to Include Retardation

Figure F.54
AOI 6
Appendix F
Benzene at B-154
Step 2

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER															
Project:	AOI 6 PES Facility														
Date:	8/28/2013														
Contaminant:	Benzene at B-154			Prepared by:		TS									
SOURCE															
CONC	Ax	Ay	Az	LAMBDA	SOURCE	SOURCE									
(units)	(ft)	(ft)	(ft)		WIDTH	THICKNESS	Time								
mg/l	>.0001	>.0001	>=.0001	day-1	(ft)	(ft)	(days)								
8.725436	200	20	1.00E-04	9.59E-04	1340	39	1.00E+99								
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)								
2.83E-01	0.009	0.35	1.7225	58	5.00E-03	2.427214	0.0029981								
				-747.5	-598	-448.5	-299	-149.5	0	149.5	299	448.5	598	747.5	
Edge Criterion (mg/l)		0.005	0	0.004938	0.0256591	0.031085	0.0311514	0.0311514	0.0311514	0.0311514	0.0311514	0.0310853	0.025659	0.004938	
Higest modeled conc.		0.03115	-3.9	0.004938	0.0256591	0.031085	0.0311514	0.0311514	0.0311514	0.0311514	0.0311514	0.0310853	0.025659	0.004938	
			-7.8	0.004938	0.0256591	0.031085	0.0311514	0.0311514	0.0311514	0.0311514	0.0311514	0.0310853	0.025659	0.004938	
SURFACE WATER LOADING GRID			-11.7	0.004938	0.0256591	0.031085	0.0311514	0.0311514	0.0311514	0.0311514	0.0311514	0.0310853	0.025659	0.004938	
Distance to Stream (ft)		150	-15.6	0.004938	0.0256591	0.031085	0.0311514	0.0311514	0.0311514	0.0311514	0.0311514	0.0310853	0.025659	0.004938	
Plume View Width (ft)		1495	-19.5	0.004938	0.0256591	0.031085	0.0311514	0.0311514	0.0311514	0.0311514	0.0311514	0.0310853	0.025659	0.004938	
Plume View Depth (ft)		39	-23.4	0.004938	0.0256591	0.031085	0.0311514	0.0311514	0.0311514	0.0311514	0.0311514	0.0310853	0.025659	0.004938	
			-27.3	0.004938	0.0256591	0.031085	0.0311514	0.0311514	0.0311514	0.0311514	0.0311514	0.0310853	0.025659	0.004938	
			-31.2	0.004938	0.0256591	0.031085	0.0311514	0.0311514	0.0311514	0.0311514	0.0311514	0.0310853	0.025659	0.004938	
PENTOX NEEDED			-35.1	0.004938	0.0256591	0.031085	0.0311514	0.0311514	0.0311514	0.0311514	0.0311514	0.0310853	0.025659	0.004938	
			-39	0.002469	0.0128295	0.015543	0.0155757	0.0155757	0.0155757	0.0155757	0.0155757	0.0155427	0.01283	0.002469	
				Average Groundwater Concentration				0.02422	mg/l						
				Plume Flow				0.00172	cfs	0.00111	MGD				
				Mass Loading to Stream			101.87	mg/day							

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OF ENVIRONMENTAL PROTECTION
SWLOAD5B.XLS
A METHOD FOR ESTIMATING
COMTAMINANT LOADING TO SURFACE
WATER
based on
P.A. Domenico (1987)
Modified to Include Retardation

Figure F.55
AOI 6
Appendix F
Benzene at B-155
Step 1

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER															
Project:	AOI 6 PES Facility														
Date:	8/28/2013														
Contaminant:	Benzene at B-155			Prepared by:		TS									
SOURCE CONC (units)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days)								
mg/l	>.0001	>.0001	>=.0001	day-1											
77.8	200	20	1.00E-04	9.59E-04	100	39	1.00E+99								
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^{3})	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)								
2.40E+01	0.007	0.35	1.7225	58	5.00E-03	2.427214	0.1975928								
				-600	-480	-360	-240	-120	0	120	240	360	480	600	
Edge Criterion (mg/l)		0.005	0	0.00488	0.0424265	0.227908	0.7569066	1.5549455	1.9766188	1.5549455	0.7569066	0.2279079	0.042426	0.00488	
Higest modeled conc.		1.97662	-3.9	0.00488	0.0424265	0.227908	0.7569066	1.5549455	1.9766188	1.5549455	0.7569066	0.2279079	0.042426	0.00488	
			-7.8	0.00488	0.0424265	0.227908	0.7569066	1.5549455	1.9766188	1.5549455	0.7569066	0.2279079	0.042426	0.00488	
SURFACE WATER LOADING GRID			-11.7	0.00488	0.0424265	0.227908	0.7569066	1.5549455	1.9766188	1.5549455	0.7569066	0.2279079	0.042426	0.00488	
Distance to Stream (ft)		729	-15.6	0.00488	0.0424265	0.227908	0.7569066	1.5549455	1.9766188	1.5549455	0.7569066	0.2279079	0.042426	0.00488	
Plume View Width (ft)		1200	-19.5	0.00488	0.0424265	0.227908	0.7569066	1.5549455	1.9766188	1.5549455	0.7569066	0.2279079	0.042426	0.00488	
Plume View Depth (ft)		39	-23.4	0.00488	0.0424265	0.227908	0.7569066	1.5549455	1.9766188	1.5549455	0.7569066	0.2279079	0.042426	0.00488	
			-27.3	0.00488	0.0424265	0.227908	0.7569066	1.5549455	1.9766188	1.5549455	0.7569066	0.2279079	0.042426	0.00488	
			-31.2	0.00488	0.0424265	0.227908	0.7569066	1.5549455	1.9766188	1.5549455	0.7569066	0.2279079	0.042426	0.00488	
PENTOX NEEDED			-35.1	0.00488	0.0424265	0.227908	0.7569066	1.5549455	1.9766188	1.5549455	0.7569066	0.2279079	0.042426	0.00488	
			-39	0.00244	0.0212132	0.113954	0.3784533	0.7774727	0.9883094	0.7774727	0.3784533	0.113954	0.021213	0.00244	
Average Groundwater Concentration								0.62052	mg/l						
Plume Flow								0.09077	cfs	0.05867	MGD				
Mass Loading to Stream							138051.75	mg/day							

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SWLOAD5B.XLS
A METHOD FOR ESTIMATING
COMTAMINANT LOADING TO SURFACE WATER
based on
P.A. Domenico (1987)
Modified to Include Retardation

Figure F.56
AOI 6
Appendix F
Benzene at B-155
Step 2

METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER

PA DEPARTMENT
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SWLOAD5B.XLS
A METHOD FOR ESTIMATING
COMTAMINANT LOADING TO SURFACE
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Modified to Include Retardation

Project:	AOI 6 PES Facility														
Date:	8/28/2013														
Contaminant:	Benzene at B-155			Prepared by:		TS									
SOURCE CONC (units)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days)								
mg/l	>.0001	>.0001	>=.0001												
1.976619	200	20	1.00E-04	9.59E-04	1200	39	1.00E+99								
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^{3})	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)								
2.83E-01	0.007	0.35	1.7225	58	5.00E-03	2.427214	0.0023319								
				-5	-4	-3	-2	-1	0	1	2	3	4	5	
Edge Criterion (mg/l)		0.005	0	0.003165	0.0031653	0.003165	0.0031653	0.0031653	0.0031653	0.0031653	0.0031653	0.0031653	0.003165	0.003165	
Higest modeled conc.		0.00317	-3.9	0.003165	0.0031653	0.003165	0.0031653	0.0031653	0.0031653	0.0031653	0.0031653	0.0031653	0.003165	0.003165	
			-7.8	0.003165	0.0031653	0.003165	0.0031653	0.0031653	0.0031653	0.0031653	0.0031653	0.0031653	0.003165	0.003165	
SURFACE WATER LOADING GRID			-11.7	0.003165	0.0031653	0.003165	0.0031653	0.0031653	0.0031653	0.0031653	0.0031653	0.0031653	0.003165	0.003165	
Distance to Stream (ft)		150	-15.6	0.003165	0.0031653	0.003165	0.0031653	0.0031653	0.0031653	0.0031653	0.0031653	0.0031653	0.003165	0.003165	
Plume View Width (ft)		10	-19.5	0.003165	0.0031653	0.003165	0.0031653	0.0031653	0.0031653	0.0031653	0.0031653	0.0031653	0.003165	0.003165	
Plume View Depth (ft)		39	-23.4	0.003165	0.0031653	0.003165	0.0031653	0.0031653	0.0031653	0.0031653	0.0031653	0.0031653	0.003165	0.003165	
			-27.3	0.003165	0.0031653	0.003165	0.0031653	0.0031653	0.0031653	0.0031653	0.0031653	0.0031653	0.003165	0.003165	
			-31.2	0.003165	0.0031653	0.003165	0.0031653	0.0031653	0.0031653	0.0031653	0.0031653	0.0031653	0.003165	0.003165	
PENTOX NOT NEEDED			-35.1	0.003165	0.0031653	0.003165	0.0031653	0.0031653	0.0031653	0.0031653	0.0031653	0.0031653	0.003165	0.003165	
			-39	0.001583	0.0015826	0.001583	0.0015826	0.0015826	0.0015826	0.0015826	0.0015826	0.0015826	0.001583	0.001583	
				Average Groundwater Concentration				0.00302	mg/l						
				Plume Flow				0.00001	cfs	5.8E-06	MGD				
				Mass Loading to Stream				0.07	mg/day						

PENTOXSD

Modeling Input Data

Stream Code	RMI	Elevation (ft)	Drainage Area (sq mi)	Slope	PWS With (mgd)	Apply FC
833	1.60	0.75	1910.00	0.00000	0.00	☑

Stream Data

	LFY (cfsm)	Trib Flow (cfs)	Stream Flow (cfs)	WD Ratio	Rch Width (ft)	Rch Depth (ft)	Rch Velocity (fps)	Rch Trav Time (days)	Tributary Hard (mg/L)	Tributary pH	Stream Hard (mg/L)	Stream pH	Analysis Hard (mg/L)	Analysis pH
Q7-10	0.1	0	10.1	0	0	0	0	0	100	7	0	0	0	0
Qh		0	81.1	0	0	0	0	0	100	7	0	0	0	0

Discharge Data

Name	Permit Number	Existing Disc Flow (mgd)	Permitted Disc Flow (mgd)	Design Disc Flow (mgd)	Reserve Factor	AFC PMF	CFC PMF	THH PMF	CRL PMF	Disc Hard (mg/L)	Disc pH
AOI 6 B-154 Ben	2574601	0.08926	0	0	0	0	0	0	0	100	7

Parameter Data

Parameter Name	Disc Conc (µg/L)	Trib Conc (µg/L)	Disc Daily CV	Disc Hourly CV	Steam Conc (µg/L)	Stream CV	Fate Coef	FOS	Crit Mod	Max Disc Conc (µg/L)
BENZENE	238000	0	0.5	0.5	0	0	0	0	1	0

Stream Code	RMI	Elevation (ft)	Drainage Area (sq mi)	Slope	PWS With (mgd)	Apply FC
833	0.00	0.50	1912.00	0.00000	0.00	☑

Stream Data

	LFY (cfsm)	Trib Flow (cfs)	Stream Flow (cfs)	WD Ratio	Rch Width (ft)	Rch Depth (ft)	Rch Velocity (fps)	Rch Trav Time (days)	Tributary Hard (mg/L)	Tributary pH	Stream Hard (mg/L)	Stream pH	Analysis Hard (mg/L)	Analysis pH
Q7-10	0.1	0	0	0	0	0	0	0	100	7	0	0	0	0
Qh		0	0	0	0	0	0	0	100	7	0	0	0	0

Discharge Data

Name	Permit Number	Existing Disc Flow (mgd)	Permitted Disc Flow (mgd)	Design Disc Flow (mgd)	Reserve Factor	AFC PMF	CFC PMF	THH PMF	CRL PMF	Disc Hard (mg/L)	Disc pH
		0	0	0	0	0	0	0	0	100	7

Parameter Data

Parameter Name	Disc Conc (µg/L)	Trib Conc (µg/L)	Disc Daily CV	Disc Hourly CV	Steam Conc (µg/L)	Stream CV	Fate Coef	FOS	Crit Mod	Max Disc Conc (µg/L)
BENZENE	0	0	0.5	0.5	0	0	0	0	1	0

PENTOXSD Analysis Results

Hydrodynamics

SWP Basin	Stream Code:	Stream Name:
03F	833	SCHUYLKILL RIVER

RMI	Stream Flow (cfs)	PWS With (cfs)	Net Stream Flow (cfs)	Disc Analysis Flow (cfs)	Reach Slope	Depth (ft)	Width (ft)	WD Ratio	Velocity (fps)	Reach Trav Time (days)	CMT (min)
Q7-10 Hydrodynamics											
1.600	10.1	0	10.1	0.13808	3E-05	1.0991	86.892	79.058	0.1072	0.9115	1000+
0.001	10.3	0	10.3	NA	0	0	0	0	0	0	NA
Qh Hydrodynamics											
1.600	81.1	0	81.1	0.13808	3E-05	2.7342	86.892	31.78	0.3419	0.2858	419.212
0.001	82.069	0	82.069	NA	0	0	0	0	0	0	NA

PENTOXSD Analysis Results

Wasteload Allocations

RMI	Name	Permit Number
1.60	**AOI 6 B-154 Ben**	**2574601**

AFC

Q7-10: **CCT (min)** 15 **PMF** 0.096 **Analysis pH** 7 **Analysis Hardness** 100

Parameter	Stream Conc (µg/L)	Stream CV	Trib Conc (µg/L)	Fate Coef	WQC (µg/L)	WQ Obj (µg/L)	WLA (µg/L)
BENZENE	0	0	0	0	640	640	5163.688

CFC

Q7-10: **CCT (min)** 720 **PMF** 0.669 **Analysis pH** 7 **Analysis Hardness** 100

Parameter	Stream Conc. (µg/L)	Stream CV	Trib Conc. (µg/L)	Fate Coef	WQC (µg/L)	WQ Obj (µg/L)	WLA (µg/L)
BENZENE	0	0	0	0	130	130	6496.146

THH

Q7-10: **CCT (min)** 720 **PMF** NA **Analysis pH** NA **Analysis Hardness** NA

Parameter	Stream Conc (µg/L)	Stream CV	Trib Conc (µg/L)	Fate Coef	WQC (µg/L)	WQ Obj (µg/L)	WLA (µg/L)
BENZENE	0	0	0	0	NA	NA	NA

CRL

Qh: **CCT (min)** 419.212 **PMF** 1

Parameter	Stream Conc (µg/L)	Stream CV	Trib Conc (µg/L)	Fate Coef	WQC (µg/L)	WQ Obj (µg/L)	WLA (µg/L)
BENZENE	0	0	0	0	1.2	1.2	705.982

PENTOXSD Analysis Results

Wasteload Allocations

RMI	Name	Permit Number
1.60	**AOI 6 B-154 Ben**	**2574601**

PENTOXSD

Modeling Input Data

Stream Code	RMI	Elevation (ft)	Drainage Area (sq mi)	Slope	PWS With (mgd)	Apply FC
833	1.60	0.75	1910.00	0.00000	0.00	☑

Stream Data

	LFY (cfsm)	Trib Flow (cfs)	Stream Flow (cfs)	WD Ratio	Rch Width (ft)	Rch Depth (ft)	Rch Velocity (fps)	Rch Trav Time (days)	Tributary Hard (mg/L)	Tributary pH	Stream Hard (mg/L)	Stream pH	Analysis Hard (mg/L)	Analysis pH
Q7-10	0.1	0	10.1	0	0	0	0	0	100	7	0	0	0	0
Qh		0	81.1	0	0	0	0	0	100	7	0	0	0	0

Discharge Data

Name	Permit Number	Existing Disc Flow (mgd)	Permitted Disc Flow (mgd)	Design Disc Flow (mgd)	Reserve Factor	AFC PMF	CFC PMF	THH PMF	CRL PMF	Disc Hard (mg/L)	Disc pH
AOI 6 B-155 Ben	2574601	0.06111	0	0	0	0	0	0	0	100	7

Parameter Data

Parameter Name	Disc Conc (µg/L)	Trib Conc (µg/L)	Disc Daily CV	Disc Hourly CV	Steam Conc (µg/L)	Stream CV	Fate Coef	FOS	Crit Mod	Max Disc Conc (µg/L)
BENZENE	77800	0	0.5	0.5	0	0	0	0	1	0

Stream Code	RMI	Elevation (ft)	Drainage Area (sq mi)	Slope	PWS With (mgd)	Apply FC
833	0.00	0.50	1912.00	0.00000	0.00	☑

Stream Data

	LFY (cfsm)	Trib Flow (cfs)	Stream Flow (cfs)	WD Ratio	Rch Width (ft)	Rch Depth (ft)	Rch Velocity (fps)	Rch Trav Time (days)	Tributary Hard (mg/L)	Tributary pH	Stream Hard (mg/L)	Stream pH	Analysis Hard (mg/L)	Analysis pH
Q7-10	0.1	0	0	0	0	0	0	0	100	7	0	0	0	0
Qh		0	0	0	0	0	0	0	100	7	0	0	0	0

Discharge Data

Name	Permit Number	Existing Disc Flow (mgd)	Permitted Disc Flow (mgd)	Design Disc Flow (mgd)	Reserve Factor	AFC PMF	CFC PMF	THH PMF	CRL PMF	Disc Hard (mg/L)	Disc pH
		0	0	0	0	0	0	0	0	100	7

Parameter Data

Parameter Name	Disc Conc (µg/L)	Trib Conc (µg/L)	Disc Daily CV	Disc Hourly CV	Steam Conc (µg/L)	Stream CV	Fate Coef	FOS	Crit Mod	Max Disc Conc (µg/L)
BENZENE	0	0	0.5	0.5	0	0	0	0	1	0

PENTOXSD Analysis Results

Hydrodynamics

SWP Basin	Stream Code:	Stream Name:
03F	833	SCHUYLKILL RIVER

RMI	Stream Flow (cfs)	PWS With (cfs)	Net Stream Flow (cfs)	Disc Analysis Flow (cfs)	Reach Slope	Depth (ft)	Width (ft)	WD Ratio	Velocity (fps)	Reach Trav Time (days)	CMT (min)
Q7-10 Hydrodynamics											
1.600	10.1	0	10.1	0.09453	3E-05	1.0987	86.759	78.965	0.1069	0.9137	1000+
0.001	10.3	0	10.3	NA	0	0	0	0	0	0	NA
Qh Hydrodynamics											
1.600	81.1	0	81.1	0.09453	3E-05	2.7377	86.759	31.690	0.3418	0.2859	417.574
0.001	82.069	0	82.069	NA	0	0	0	0	0	0	NA

PENTOXSD Analysis Results

Wasteload Allocations

RMI	Name	Permit Number
1.60	**AOI 6 B-155 Ben**	**2574601**

AFC

Q7-10: **CCT (min)** 15 **PMF** 0.096 **Analysis pH** 7 **Analysis Hardness** 100

Parameter	Stream Conc (µg/L)	Stream CV	Trib Conc (µg/L)	Fate Coef	WQC (µg/L)	WQ Obj (µg/L)	WLA (µg/L)
BENZENE	0	0	0	0	640	640	7227.716

CFC

Q7-10: **CCT (min)** 720 **PMF** 0.667 **Analysis pH** 7 **Analysis Hardness** 100

Parameter	Stream Conc. (µg/L)	Stream CV	Trib Conc. (µg/L)	Fate Coef	WQC (µg/L)	WQ Obj (µg/L)	WLA (µg/L)
BENZENE	0	0	0	0	130	130	9400.835

THH

Q7-10: **CCT (min)** 720 **PMF** NA **Analysis pH** NA **Analysis Hardness** NA

Parameter	Stream Conc (µg/L)	Stream CV	Trib Conc (µg/L)	Fate Coef	WQC (µg/L)	WQ Obj (µg/L)	WLA (µg/L)
BENZENE	0	0	0	0	NA	NA	NA

CRL

Qh: **CCT (min)** 417.574 **PMF** 1

Parameter	Stream Conc (µg/L)	Stream CV	Trib Conc (µg/L)	Fate Coef	WQC (µg/L)	WQ Obj (µg/L)	WLA (µg/L)
BENZENE	0	0	0	0	1.2	1.2	1030.636

PENTOXSD Analysis Results

Wasteload Allocations

RMI	Name	Permit Number
1.60	**AOI 6 B-155 Ben**	**2574601**

PENTOXSD

Modeling Input Data

Stream Code	RMI	Elevation (ft)	Drainage Area (sq mi)	Slope	PWS With (mgd)	Apply FC
833	1.60	0.75	1910.00	0.00000	0.00	☑

Stream Data

	LFY (cfsm)	Trib Flow (cfs)	Stream Flow (cfs)	WD Ratio	Rch Width (ft)	Rch Depth (ft)	Rch Velocity (fps)	Rch Trav Time (days)	Tributary Hard (mg/L)	Tributary pH	Stream Hard (mg/L)	Stream pH	Analysis Hard (mg/L)	Analysis pH
Q7-10	0.1	0	10.1	0	0	0	0	0	100	7	0	0	0	0
Qh		0	81.1	0	0	0	0	0	100	7	0	0	0	0

Discharge Data

Name	Permit Number	Existing Disc Flow (mgd)	Permitted Disc Flow (mgd)	Design Disc Flow (mgd)	Reserve Factor	AFC PMF	CFC PMF	THH PMF	CRL PMF	Disc Hard (mg/L)	Disc pH
AOI 6 URS-4 Ben	2574601	0.0001	0	0	0	0	0	0	0	100	7

Parameter Data

Parameter Name	Disc Conc (µg/L)	Trib Conc (µg/L)	Disc Daily CV	Disc Hourly CV	Steam Conc (µg/L)	Stream CV	Fate Coef	FOS	Crit Mod	Max Disc Conc (µg/L)
BENZENE	46.8	0	0.5	0.5	0	0	0	0	1	0

Stream Code	RMI	Elevation (ft)	Drainage Area (sq mi)	Slope	PWS With (mgd)	Apply FC
833	0.00	0.50	1912.00	0.00000	0.00	☑

Stream Data

	LFY (cfsm)	Trib Flow (cfs)	Stream Flow (cfs)	WD Ratio	Rch Width (ft)	Rch Depth (ft)	Rch Velocity (fps)	Rch Trav Time (days)	Tributary Hard (mg/L)	Tributary pH	Stream Hard (mg/L)	Stream pH	Analysis Hard (mg/L)	Analysis pH
Q7-10	0.1	0	0	0	0	0	0	0	100	7	0	0	0	0
Qh		0	0	0	0	0	0	0	100	7	0	0	0	0

Discharge Data

Name	Permit Number	Existing Disc Flow (mgd)	Permitted Disc Flow (mgd)	Design Disc Flow (mgd)	Reserve Factor	AFC PMF	CFC PMF	THH PMF	CRL PMF	Disc Hard (mg/L)	Disc pH
		0	0	0	0	0	0	0	0	100	7

Parameter Data

Parameter Name	Disc Conc (µg/L)	Trib Conc (µg/L)	Disc Daily CV	Disc Hourly CV	Steam Conc (µg/L)	Stream CV	Fate Coef	FOS	Crit Mod	Max Disc Conc (µg/L)
BENZENE	0	0	0.5	0.5	0	0	0	0	1	0

PENTOXSD Analysis Results

Hydrodynamics

SWP Basin	Stream Code:	Stream Name:
03F	833	SCHUYLKILL RIVER

RMI	Stream Flow (cfs)	PWS With (cfs)	Net Stream Flow (cfs)	Disc Analysis Flow (cfs)	Reach Slope	Depth (ft)	Width (ft)	WD Ratio	Velocity (fps)	Reach Trav Time (days)	CMT (min)
Q7-10 Hydrodynamics											
1.600	10.1	0	10.1	0.00015	3E-05	1.0979	86.471	78.763	0.1064	0.9185	1000+
0.001	10.3	0	10.3	NA	0	0	0	0	0	0	NA
Qh Hydrodynamics											
1.600	81.1	0	81.1	0.00015	3E-05	2.7455	86.471	31.496	0.3416	0.2860	414.016
0.001	82.069	0	82.069	NA	0	0	0	0	0	0	NA

PENTOXSD Analysis Results

Wasteload Allocations

RMI	Name	Permit Number
1.60	**AOI 6 URS-4 Ben**	**2574601**

AFC

Q7-10: **CCT (min)** 15 **PMF** 0.095 **Analysis pH** 7 **Analysis Hardness** 100

Parameter	Stream Conc (µg/L)	Stream CV	Trib Conc (µg/L)	Fate Coef	WQC (µg/L)	WQ Obj (µg/L)	WLA (µg/L)
BENZENE	0	0	0	0	640	640	4000000

CFC

Q7-10: **CCT (min)** 720 **PMF** 0.663 **Analysis pH** 7 **Analysis Hardness** 100

Parameter	Stream Conc. (µg/L)	Stream CV	Trib Conc. (µg/L)	Fate Coef	WQC (µg/L)	WQ Obj (µg/L)	WLA (µg/L)
BENZENE	0	0	0	0	130	130	5620000

THH

Q7-10: **CCT (min)** 720 **PMF** NA **Analysis pH** NA **Analysis Hardness** NA

Parameter	Stream Conc (µg/L)	Stream CV	Trib Conc (µg/L)	Fate Coef	WQC (µg/L)	WQ Obj (µg/L)	WLA (µg/L)
BENZENE	0	0	0	0	NA	NA	NA

CRL

Qh: **CCT (min)** 414.016 **PMF** 1

Parameter	Stream Conc (µg/L)	Stream CV	Trib Conc (µg/L)	Fate Coef	WQC (µg/L)	WQ Obj (µg/L)	WLA (µg/L)
BENZENE	0	0	0	0	1.2	1.2	629089.8

PENTOXSD Analysis Results

Wasteload Allocations

RMI	Name	Permit Number
1.60	**AOI 6 URS-4 Ben**	**2574601**

PENTOXSD Analysis Results

Hydrodynamics

SWP Basin	Stream Code:	Stream Name:
03F	833	SCHUYLKILL RIVER

RMI	Stream Flow (cfs)	PWS With (cfs)	Net Stream Flow (cfs)	Disc Analysis Flow (cfs)	Reach Slope	Depth (ft)	Width (ft)	WD Ratio	Velocity (fps)	Reach Trav Time (days)	CMT (min)
Q7-10 Hydrodynamics											
1.600	10.1	0	10.1	0.00171	3E-05	1.09788	86.4758	78.7663	0.10640	0.91838	1000+
0.001	10.3	0	10.3	NA	0	0	0	0	0	0	NA
Qh Hydrodynamics											
1.600	81.1	0	81.1	0.00171	3E-05	2.74532	86.4758	31.4993	0.34162	0.28604	414.075
0.001	82.0693	0	82.0693	NA	0	0	0	0	0	0	NA

PENTOXSD

Modeling Input Data

Stream Code	RMI	Elevation (ft)	Drainage Area (sq mi)	Slope	PWS With (mgd)	Apply FC
833	1.60	0.75	1910.00	0.00000	0.00	☑

Stream Data

	LFY (cfsm)	Trib Flow (cfs)	Stream Flow (cfs)	WD Ratio	Rch Width (ft)	Rch Depth (ft)	Rch Velocity (fps)	Rch Trav Time (days)	Tributary Hard (mg/L)	Tributary pH	Stream Hard (mg/L)	Stream pH	Analysis Hard (mg/L)	Analysis pH
Q7-10	0.1	0	10.1	0	0	0	0	0	100	7	0	0	0	0
Qh		0	81.1	0	0	0	0	0	100	7	0	0	0	0

Discharge Data

Name	Permit Number	Existing Disc Flow (mgd)	Permitted Disc Flow (mgd)	Design Disc Flow (mgd)	Reserve Factor	AFC PMF	CFC PMF	THH PMF	CRL PMF	Disc Hard (mg/L)	Disc pH
AOI 6 B-154 Ben	2574601	0.00111	0	0	0	0	0	0	0	100	7

Parameter Data

Parameter Name	Disc Conc (µg/L)	Trib Conc (µg/L)	Disc Daily CV	Disc Hourly CV	Steam Conc (µg/L)	Stream CV	Fate Coef	FOS	Crit Mod	Max Disc Conc (µg/L)
BENZENE	8725.44	0	0.5	0.5	0	0	0	0	1	0

Stream Code	RMI	Elevation (ft)	Drainage Area (sq mi)	Slope	PWS With (mgd)	Apply FC
833	0.00	0.50	1912.00	0.00000	0.00	☑

Stream Data

	LFY (cfsm)	Trib Flow (cfs)	Stream Flow (cfs)	WD Ratio	Rch Width (ft)	Rch Depth (ft)	Rch Velocity (fps)	Rch Trav Time (days)	Tributary Hard (mg/L)	Tributary pH	Stream Hard (mg/L)	Stream pH	Analysis Hard (mg/L)	Analysis pH
Q7-10	0.1	0	0	0	0	0	0	0	100	7	0	0	0	0
Qh		0	0	0	0	0	0	0	100	7	0	0	0	0

Discharge Data

Name	Permit Number	Existing Disc Flow (mgd)	Permitted Disc Flow (mgd)	Design Disc Flow (mgd)	Reserve Factor	AFC PMF	CFC PMF	THH PMF	CRL PMF	Disc Hard (mg/L)	Disc pH
		0	0	0	0	0	0	0	0	100	7

Parameter Data

Parameter Name	Disc Conc (µg/L)	Trib Conc (µg/L)	Disc Daily CV	Disc Hourly CV	Steam Conc (µg/L)	Stream CV	Fate Coef	FOS	Crit Mod	Max Disc Conc (µg/L)
BENZENE	0	0	0.5	0.5	0	0	0	0	1	0

PENTOXSD Analysis Results

Wasteload Allocations

RMI	Name	Permit Number
1.60	**AOI 6 B-154 Ben**	**2574601**

AFC

Q7-10: **CCT (min)** 15 **PMF** 0.095 **Analysis pH** 7 **Analysis Hardness** 100

Parameter	Stream Conc (µg/L)	Stream CV	Trib Conc (µg/L)	Fate Coef	WQC (µg/L)	WQ Obj (µg/L)	WLA (µg/L)
BENZENE	0	0	0	0	640	640	360993.9

CFC

Q7-10: **CCT (min)** 720 **PMF** 0.663 **Analysis pH** 7 **Analysis Hardness** 100

Parameter	Stream Conc. (µg/L)	Stream CV	Trib Conc. (µg/L)	Fate Coef	WQC (µg/L)	WQ Obj (µg/L)	WLA (µg/L)
BENZENE	0	0	0	0	130	130	507252.9

THH

Q7-10: **CCT (min)** 720 **PMF** NA **Analysis pH** NA **Analysis Hardness** NA

Parameter	Stream Conc (µg/L)	Stream CV	Trib Conc (µg/L)	Fate Coef	WQC (µg/L)	WQ Obj (µg/L)	WLA (µg/L)
BENZENE	0	0	0	0	NA	NA	NA

CRL

Qh: **CCT (min)** 414.075 **PMF** 1

Parameter	Stream Conc (µg/L)	Stream CV	Trib Conc (µg/L)	Fate Coef	WQC (µg/L)	WQ Obj (µg/L)	WLA (µg/L)
BENZENE	0	0	0	0	1.2	1.2	56675.85

PENTOXSD Analysis Results

Wasteload Allocations

RMI	Name	Permit Number
1.60	**AOI 6 B-154 Ben**	**2574601**

APPENDIX G

Development of Site-Specific Standards and Risk Assessment

APPENDIX G
DEVELOPMENT OF SITE-SPECIFIC STANDARDS
AOI 6: PES FACILITY
PHILADELPHIA, PENNSYLVANIA

Based on the current and future intended non-residential site use, an exposure assessment was conducted for any compounds in shallow soils (0-2 feet bgs) or deep soils (2-15 feet bgs) that exceeded the non-residential statewide health soil medium specific standard (MSC). Potential human health exposures for the Facility are for an industrial worker scenario.

Direct contact exposure pathways to shallow soil, groundwater, and light non-aqueous phase liquid (LNAPL) is being evaluated under the industrial use scenario because Sunoco has well documented standards for personal protective equipment (PPE) and procedures for soil excavation and handling. However, because direct contact to soils could occur outside of excavation activities, soil samples were collected to further evaluate the potential for unacceptable risk of exposure.

Based on the data collected between 2002 and 2012, concentrations of benzene, benzo(a)pyrene, lead, naphthalene, toluene, ethylbenzene, ethylene dibromide, 1,2,4-trimethylbenzene (TMB) and 1,3,5-TMB were detected in shallow soils above the non-residential soil MSC and concentrations of benzene, lead, naphthalene, toluene, ethylbenzene, isopropylbenzene, 1,2,4-TMB, and 1,3,5-TMB were detected in deep soils above the non-residential soil MSC. To refine the list of compounds carried forward in the risk assessment, the compounds listed above were further screened against the EPA Region III Risk-Based Concentrations (aka, EPA Regional Screening Levels [RSLs]) in accordance with Section IV of the PADEP's Technical Guidance Manual (TGM) (dated June 8, 2002). Based on this screening, concentrations of 1,3,5-TMB, toluene, ethylene dibromide and isopropylbenzene were below the EPA RSLs for industrial soil and were, therefore, eliminated from the risk assessment. Concentrations of benzene, lead naphthalene, benzo(a)pyrene, ethylbenzene and 1,2,4-TMB were above the EPA RSLs and were, therefore, further evaluated as outlined in the January 2013 Soil Screening Procedure for Philadelphia Energy Solutions memorandum (Sunoco 2013).

As described in the January 2013 memorandum, the compounds that exceeded both the non-residential statewide health standards and EPA RSLs were compared to the PADEP's Non-Residential Direct Contact MSC. To maintain conservatism, all soil samples (surface and subsurface) were screened against the more stringent 0-2 feet below grade direct contact criteria regardless of sample depth in the event that soils are re-used elsewhere on the Facility. Based on this screening, concentrations of naphthalene, ethylbenzene, and 1,2,4-TMB were eliminated from the risk assessment. The compounds identified for further risk assessment are benzene, benzo(a)pyrene, and lead. Benzene and benzo(a)pyrene are carcinogenic compounds and will be evaluated together. Since most lead-based human health effects data are based on blood-lead concentrations instead of external dose, the traditional approach for risk assessment is not applied to characterize exposure to lead. Consequently, exposure to lead is evaluated based on the predicted concentration of lead in the blood and is evaluated separately.

The total cumulative excess cancer risk is the combined risk of exposure to the exposure point concentrations (EPCs) of any carcinogenic compounds that fail the initial screening: for AOI-6 these compounds include benzene and benzo(a)pyrene. The EPC is the representative concentration that is expected to be contacted by a receptor and is assumed to be universally present throughout the exposure area. Because soil at the Facility may be moved, the exposure area is understood to extend from the surface to 15 feet bgs. As described in the January 2013 memorandum, the 95 upper confidence level (UCL) was used as the EPC except in cases where the 95UCL is higher than the maximum concentrations (USEPA 1989). If the maximum concentration is lower than the calculated 95UCL then the maximum concentration is used as the EPC. The 95UCL for benzene and benzo(a)pyrene in soil samples collected from 0 to 15 feet bgs was derived using USEPA's ProUCL Version 4.1 software. The ProUCL output is provided as Attachment A.

Using the 95UCL, incremental cancer risk attributable to benzene was calculated to be 6E-06 and incremental cancer risk attributable to benzo(a)pyrene was calculated to be 5E-06 (Table G-1). The total cumulative excess cancer risk is the combined risk of

exposure to benzene and benzo(a)pyrene and, in accordance with the TGM, should not exceed 10^{-4}. As presented in Table G-1, the total cumulative risk of exposure to the carcinogenic compounds benzene and benzo(a)pyrene is 1E-05 and within the PADEP's acceptable threshold; therefore, no remedies are required to address carcinogenic risks.

Lead

A site-specific screening level for lead was calculated based on ingestion as presented in 25 Pa. Code § 250.306(e), Appendix A, Table 7. As described in 25 Pa. Code § 250.306(e), the non-residential soil screening value for lead is based on the method presented in the report 'The Society for Environmental Geochemistry and Health (SEGH) Task Force Approach to the Assessment of Lead in Soil' (Wixson, 1991). The model used by the PADEP and developed by SEGH was also used to calculate the site specific criterion for the Facility. Based on the SEGH model and PADEP's default parameters, PADEP's non-residential direct contact MSC default value for lead in shallow soil is 1,000 milligrams per kilograms (mg/kg). To develop a site-specific criteria for lead, the values used by PADEP for the target blood lead concentration (T) and geometric mean background blood lead concentration (B) were revised in consideration of site-specific conditions and updated lead data collected by the US Center for Disease Control and Prevention (CDC). Revised values for these parameters have been approved by PADEP in previous Site Characterization Reports for the Sunoco Philadelphia Refinery and are discussed below:

Target blood lead concentration (T) – The default target blood lead concentration used by the PADEP to develop the non-residential MSC is 20 micrograms per deciliter (ug/dL); however, the Center for Disease Control (CDC) recommends that worker blood lead levels be maintained below 25 ug/dL (NIOSH, 2008) to prevent adverse health effects for most workers from exposure to lead throughout a working lifetime. Based on conversations between representatives of Sunoco and EPA, the target lead blood level identified by the CDC is the level used in the site-specific calculations in Table G-2.

Geometric mean background blood lead concentration (B) – B is the background blood lead concentration in the target population from sources other than soil and dust. The PADEP's default value for B is 4 ug/dL and, as summarized in PADEPs reference document (Wixson, 1991), is based on data gathered in the United Kingdom from young children. The CDC has monitored blood lead levels in US children and adults since 1976 and, based on the most recent results published by the National Center for Environmental Health of the CDC (NCEH, Page I-3 2005), the mean blood lead concentration for an adult 20 years of age or older is 1.56 ug/dL. Based on the more recent study by the US CDC, the value used for B in the site specific calculation has been revised to 1.56 ug/dL.

As presented in Table G-2, based on the revised parameters, the derived site-specific standard for lead in soil is 1,708 mg/kg for a Facility worker. Two shallow soil samples (BH-29-06 and BH-30-09) two tank samples(GPU677-SR-31-4 and GPU677-SR-31-5) and one deep soil sample (BH-12-110) have concentrations of lead above the site specific criteria and will be delineated and remediated as described in the Clean-up Plan.

Conclusions

Concentrations of benzene, benzo(a)pyrene, and lead detected in shallow and subsurface soil samples collected in AOI-6 were above their respective non-residential soil MSCs, EPA RSLs and non-residential direct contact MSCs, and therefore, required additional review. Following completion of a risk evaluation, the following conclusions are supported:

- No unacceptable cancer risks from exposure to soil are posted to the non-residential worker at AOI-6.
- Only two shallow soil sample locations, two tank sample locations and one deep soil sample location had concentrations above the site-specific screening level for lead. Concentrations in the remaining soil samples were detected below the calculated site-specific screening level. Soil sample locations with concentrations above the site-specific screening levels will be delineated and remediated as described in the Clean-up Plan.

References

NCEH. (2005). Third National Report on Human Exposure to Environmental Chemicals. Centers for Disease Control and Prevention, National Center for Environmental Health, Division of Laboratory Sciences. Atlanta, Georgia. NCEH. Pub. No. 05-0570.

NIOSH (2008). Adult Blood Lead Epidemiology and Surveillance (ABLES). http://www.cdc.gov/niosh/topics/ABLES

Sunoco (2013). Soil Screening Procedure for Philadelphia Energy Solutions, Philadelphia Refinery.

USEPA (United States Environmental Protection Agency). 1989. Risk Assessment Guidance for Superfund. Volume I, Human Health Evaluation Manual (Part A). Interim Final. EPA/540/1-89/002. Office of Emergency and Remedial Response. Washington, DC.

USEPA. 2010. ProUCL Version 4.1 User Guide. EPA/600/R-07/041. Office of Research and Development.

Wixson, B.G., (1991). The Society of Environmental Geochemistry and Health (SEGH) Task Force Approach to the Assessment of Lead in Soil. Trace Substances in Environmental Health. 11-20.

TABLES

Table G-1:
Risk / Exposure Evaluation

					Benzene		Lead		Benzo(a)pyrene	
					71-43-2		7439-92-1		50-32-8	
Location ID	Sample ID	Sample Top (ft)	Sample Bottom (ft)	Sample Date	Reported Result (mg/kg)	Calculated Risk	Reported Result (mg/kg)	Target Blood Lead Level	Reported Result (mg/kg)	Calculated Risk
AST-250-SS-1	AST-250-SS-1	0	0.5	5/15/2007	ND	--	940	15.0	NA	--
AST-250-SS-2	AST-250-SS-2	0	0.5	5/15/2007	ND	--	30	3.1	NA	--
AST-250-SS-3	AST-250-SS-3	0	0.5	5/15/2007	ND	--	100	4.0	NA	--
AST-250-SS-4	AST-250-SS-4	0	0.5	5/15/2007	ND	--	2.8	2.7	NA	--
AST-250-SS-5	AST-250-SS-5	0	0.5	5/15/2007	ND	--	190	5.2	NA	--
AST-250-SS-6	AST-250-SS-6	0	0.5	5/15/2007	ND	--	1500	22.3	NA	--
AST-250-SS-7	AST-250-SS-7	0	0.5	5/15/2007	ND	--	140	4.5	NA	--
AST-250-SS-8	AST-250-SS-8	0	0.5	5/15/2007	ND	--	13	2.9	NA	--
B-151	BH-B151-030106-0.5-1	0.5	1	3/1/2006	ND	--	198	5.3	1.7	2E-06
B-152	BH-B152-030106-1.5-2	1.5	2	3/1/2006	0.46	2E-08	27	3.1	ND	--
B-153	BH-B153-030106-1.5-2	1.5	2	3/1/2006	ND	--	66.3	3.6	ND	--
B-154	BH-B154-030106-1-1.5	1	1.5	3/1/2006	3.6	1E-07	410	8.1	ND	--
B-155	BH-B155-032006-1.5-2	1.5	2	3/20/2006	ND	--	618	10.8	0.78	7E-07
B-156	BH-B156-032006-1-1.5	1	1.5	3/20/2006	0.009	3E-10	1070	16.7	0.82	7E-07
B-157	BH-B157-030106-1-1.5	1	1.5	3/1/2006	ND	--	178	5.0	1.5	1E-06
B-160	BH-B160-030106-1-1.5	1	1.5	3/1/2006	ND	--	30.8	3.1	ND	--
B-161	BH-B161-030106-1.5-2	1.5	2	3/1/2006	ND	--	70.1	3.6	2.2	2E-06
B-162	BH-B162-030106-1-1.5	1	1.5	3/1/2006	ND	--	584	10.3	0.22	2E-07
B-164	BH-B164-030106-1.5-2	1.5	2	3/1/2006	ND	--	18.5	3.0	0.41	4E-07
B-165	C-165_1.5-2'	1.5	2	12/5/2012	ND	--	286	6.4	0.576	5E-07
B-166	B-166_2'	1.5	2	12/13/2012	ND	--	744	12.4	0.33	3E-07
B-166	B-166_3'	2.5	3	12/13/2012	ND	--	1020	16.0	0.0956	5E-11
B-167	B-167_2'	1.5	2	12/13/2012	0.0638	2E-09	253	6.0	0.13	1E-07
B-167	B-167_4'	3.5	4	12/13/2012	0.136	4E-09	204	5.4	2.07	1E-09
B-168	C-168_1.5-2'	1.5	2	12/5/2012	ND	--	273	6.3	0.223	2E-07
B-169	C-169_1.5-2'	1.5	2	12/5/2012	ND	--	127	4.4	0.0624	6E-08
B-170	B-170_2'	1.5	2	12/13/2012	ND	--	66.9	3.6	0.659	6E-07
BH-02-06	BH-02-06-032206-1.5-2	1.5	2	3/22/2006	NA	--	1260	19.1	NA	--
BH-03-06	BH-03-06-032206-1.5-2	1.5	2	3/22/2006	NA	--	1650	24.2	NA	--
BH-12-101	BH-12-101_2-3'	2	3	12/4/2012	0.121	4E-09	56.3	3.4	0.112	6E-11
BH-12-102	BH-12-102_2-2.5'	2	2.5	12/4/2012	ND	--	283	6.4	0.246	1E-10
BH-12-104	BH-12-104_0.5-1'	0.5	1	12/4/2012	ND	--	161	4.8	0.063	6E-08
BH-12-105	BH-12-105_2-2.5'	2	2.5	12/3/2012	5.21	2E-07	341	7.2	1.55	8E-10
BH-12-106	BH-12-106_1-1.5'	1	1.5	12/3/2012	88.2	3E-06	897	14.4	4.06	4E-06
BH-12-106	BH-12-106_2-2.5'	2	2.5	12/3/2012	0.0011	3E-11	960	15.2	11.6	6E-09
BH-12-107	BH-12-107_1-1.5'	1	1.5	12/3/2012	0.0124	4E-10	221	5.6	2.61	2E-06
BH-12-107	BH-12-107_2.5-3'	2.5	3	12/3/2012	ND	--	546	9.8	3.59	2E-09
BH-12-108	BH-12-108_1'	0.5	1	12/3/2012	23.6	8E-07	380	7.7	4.83	4E-06
BH-12-108	BH-12-108_2-2.5'	2	2.5	12/3/2012	11.2	3E-07	383	7.7	5.93	3E-09
BH-12-109	BH-12-109_3'	2.5	3	12/3/2012	0.476	1E-08	954	15.2	10.5	6E-09
BH-12-110	BH-12-110_3-3.5'	3	3.5	12/3/2012	4.09	1E-07	2930	**40.9**	20.6	1E-08
BH-12-111	BH-12-111_0.5-1'	0.5	1	12/3/2012	ND	--	163	4.8	1.43	1E-06
BH-12-111	BH-12-111_1-1.5'	1	1.5	12/3/2012	0.404	1E-08	34.6	3.2	ND	--
BH-12-112	BH-12-112_0.5-1'	0.5	1	12/3/2012	0.0016	6E-11	427	8.3	0.484	4E-07
BH-12-114	BH-12-114_1-1.5'	1	1.5	12/3/2012	ND	--	49.1	3.4	0.0748	7E-08
BH-12-114	BH-12-114_3-3.5'	3	3.5	12/3/2012	0.245	7E-09	34.7	3.2	0.653	3E-10
BH-12-115	BH-12-115_1-2'	1	2	12/3/2012	0.0013	5E-11	126	4.4	0.783	7E-07
BH-12-116	BH-12-116_3.5'	3	3.5	12/3/2012	0.068	2E-09	1070	16.7	0.269	1E-10
BH-12-117	BH-12-117_2-2.5'	2	2.5	12/3/2012	0.157	5E-09	350	7.3	0.534	3E-10
BH-12-118	BH-12-118_2-2.5'	2	2.5	12/4/2012	ND	--	93.1	3.9	0.602	3E-10
BH-12-119	BH-12-119_0.5-1'	0.5	1	12/4/2012	ND	--	237	5.8	0.32	3E-07
BH-12-120	BH-12-120_0-1'	0	1	12/4/2012	ND	--	309	6.7	0.118	1E-07
BH-12-121	BH-12-121_2-2.5'	2	2.5	12/3/2012	0.01	3E-10	199	5.3	9.39	5E-09
BH-12-122	BH-12-122_1-1.5'	1	1.5	12/3/2012	0.0034	1E-10	75.2	3.7	0.816	7E-07
BH-12-122	BH-12-122_2.5-3'	2.5	3	12/3/2012	1.83	6E-08	173	5.0	1.06	6E-10
BH-12-123	BH-12-123_1-1.5'	1	1.5	12/4/2012	ND	--	224	5.6	2.11	2E-06
BH-12-123	BH-12-123_2-2.5'	2	2.5	12/4/2012	2.07	6E-08	133	4.4	7.91	4E-09
BH-12-124	BH-12-124_3-3.5'	3	3.5	12/4/2012	1380	4E-05	5.5	2.8	ND	--
BH-12-125	BH-12-125_2.5-3'	2.5	3	12/4/2012	ND	--	11.4	2.9	ND	--
BH-12-126	BH-12-126_2.5-3'	2.5	3	12/4/2012	87.2	3E-06	8.7	2.8	ND	--
BH-12-127	BH-12-127_2.5-3'	2.5	3	12/4/2012	149	5E-06	13.8	2.9	ND	--
BH-12-128	BH-12-128_3-3.5'	3	3.5	12/4/2012	535	2E-05	6.5	2.8	ND	--
BH-12-129	BH-12-129_1.5-2'	1.5	2	12/4/2012	91.6	3E-06	48	3.3	0.0627	6E-08
BH-12-129	BH-12-129_2.5-3'	2.5	3	12/4/2012	1850	6E-05	107	4.1	0.121	6E-11
BH-12-130	BH-12-130_1-2'	1	2	12/4/2012	ND	--	84.4	3.8	6.52	6E-06
BH-12-131	BH-12-131_1-2'	1	2	12/4/2012	0.11	4E-09	111	4.2	0.116	1E-07
BH-12-135	BH-12-135_1-1.5'	1	1.5	12/5/2012	ND	--	106	4.1	0.0757	7E-08
BH-12-135	BH-12-135_2-2.5'	2	2.5	12/5/2012	ND	--	311	6.8	1.33	7E-10
BH-12-136	BH-12-136_1-1.5'	1	1.5	12/5/2012	ND	--	853	13.8	0.234	2E-07
BH-12-137	BH-12-137_0-1'	0	1	12/5/2012	ND	--	137	4.5	0.296	3E-07
BH-12-138	BH-12-138_0-1'	0	1	12/5/2012	ND	--	483	9.0	0.168	2E-07
BH-12-138	BH-12-138_2-2.5'	2	2.5	12/5/2012	ND	--	1150	17.7	0.414	2E-10
BH-12-139	BH-12-139_1-1.5'	1	1.5	12/5/2012	ND	--	1120	17.3	0.221	2E-07
BH-12-140	BH-12-140_0-0.5'	0	0.5	12/5/2012	ND	--	766	12.7	0.0915	8E-08
BH-12-144	BH-12-144_0-0.5'	0	0.5	12/5/2012	ND	--	17.1	2.9	0.0397	4E-08
BH-12-146	BH-12-146_0-1'	0	1	12/5/2012	ND	--	184	5.1	1.02	9E-07
BH-12-147	BH-12-147_1-1.5'	1	1.5	12/5/2012	ND	--	286	6.4	0.065	6E-08
BH-12-148	BH-12-148_0-1'	0	1	12/5/2012	ND	--	745	12.4	0.327	3E-07
BH-12-149	BH-12-149_1-1.5'	1	1.5	12/4/2012	ND	--	27.9	3.1	0.0576	5E-08
BH-12-149	BH-12-149_2.5-3'	2.5	3	12/4/2012	517	2E-05	127	4.4	0.452	2E-10
BH-13-06	BH-13-06-032206-1-1.5	1	1.5	3/22/2006	NA	--	283	6.4	NA	--

Table G-1:
Risk / Exposure Evaluation

					Benzene		Lead		Benzo(a)pyrene	
					71-43-2		7439-92-1		50-32-8	
Location ID	Sample ID	Sample Top (ft)	Sample Bottom (ft)	Sample Date	Reported Result (mg/kg)	Calculated Risk	Reported Result (mg/kg)	Target Blood Lead Level	Reported Result (mg/kg)	Calculated Risk
BH-14-06	BH-14-06-032306-0.5-1	0.5	1	3/23/2006	NA	--	1040	16.3	NA	--
BH-20-06	BH-20-06-032006-1-1.5	1	1.5	3/20/2006	0.29	1E-08	145	4.6	4.9	4E-06
BH-21-06	BH-21-06-032006-1.5-2	1.5	2	3/20/2006	0.34	1E-08	286	6.4	ND	--
BH-22-06	BH-22-06-032106-1.5-2	1.5	2	3/21/2006	ND	--	165	4.9	0.35	3E-07
BH-23-06	BH-23-06-032106-1-1.5	1	1.5	3/21/2006	ND	--	417	8.2	1.1	1E-06
BH-24-06	BH-24-06-032106-1-1.5	1	1.5	3/21/2006	ND	--	233	5.8	ND	--
BH-25-06	BH-25-06-032106-1-1.5	1	1.5	3/21/2006	2.3	8E-08	231	5.7	6	5E-06
BH-26-06	BH-26-06-032406-0.5-1	0.5	1	3/24/2006	180	6E-06	32.6	3.1	ND	--
BH-27-06	BH-27-06-032306-1-1.5	1	1.5	3/23/2006	2.2	8E-08	167	4.9	ND	--
BH-27-09	BH-27-09	0	2	4/8/2009	NA	--	463	8.8	NA	--
BH-28-06	BH-28-06-032306-1-1.5	1	1.5	3/23/2006	1.3	5E-08	200	5.3	4.2	4E-06
BH-28-09	BH-28-09	0	2	4/8/2009	NA	--	993	15.7	NA	--
BH-29-06	BH-29-06-032106-1.5-2	1.5	2	3/21/2006	0.41	1E-08	2520	**35.6**	59	5E-05
BH-29-09	BH-29-09	0	2	4/8/2009	NA	--	409	8.0	NA	--
BH-30-09	BH-30-09	0	2	4/8/2009	NA	--	2310	**32.8**	NA	--
GP 797-HA-1	HA-1 (1-1.5)	1	1.5	8/29/2002	920	3E-05	NA	--	NA	--
GP 797-HA-2	HA-2 (1-1.5)	1	1.5	5/24/2002	28	1E-06	NA	--	NA	--
GP 797-HA-3	HA-3 (1-1.5)	1	1.5	5/24/2002	310	1E-05	NA	--	NA	--
GP 797-HA-3	HA-3 (2)	1.5	2	5/24/2002	170	6E-06	NA	--	NA	--
GP 797-HA-4	HA-4 (1-1.5)	1	1.5	5/24/2002	190	7E-06	NA	--	NA	--
GP 797-MW-1	MW-1(1-1.5)_09/17/2002	1	1.5	9/17/2002	2.6	9E-08	NA	--	NA	--
GP 797-MW-2	MW-2(1-1.5)_09/17/2002	1	1.5	9/17/2002	6.5	2E-07	NA	--	NA	--
GP 797-MW-3	MW-3(1-1.5)_09/16/2002	1	1.5	9/16/2002	610	2E-05	NA	--	NA	--
GP U 677-1	GP U 677-1_06/08/2011	1.5	2	6/8/2011	0.06	2E-09	453	8.6	1.2	1E-06
GP U 677-2	GP U 677-2_06/08/2011	0.8	1.3	6/8/2011	ND	--	67	3.6	0.12	1E-07
GP U 677-3	GP U 677-3_06/08/2011	1.5	2	6/8/2011	ND	--	451	8.6	1.2	1E-06
GP U 677-4	GP U 677-4_06/08/2011	0.3	0.8	6/8/2011	ND	--	47.8	3.3	0.05	5E-08
GP U 677-5	GP U 677-5_06/08/2011	0.8	1.3	6/8/2011	ND	--	18.5	3.0	0.62	6E-07
GP U 677-SR-31-1	SR-31-1(1.3-1.8)_06/07/2011	1.3	1.8	6/7/2011	0.044	2E-09	1120	17.3	0.64	6E-07
GP U 677-SR-31-2	SR-31-2(0.9-1.4)_06/07/2011	0.9	1.4	6/7/2011	0.002	7E-11	898	14.4	2.8	3E-06
GP U 677-SR-31-3	SR-31-3(0.8-1.3)_06/07/2011	0.8	1.3	6/7/2011	0.003	1E-10	774	12.8	0.81	7E-07
GP U 677-SR-31-4	SR-31-4(0.9-1.4)_06/07/2011	0.9	1.4	6/7/2011	0.001	3E-11	2210	**31.5**	0.22	2E-07
GP U 677-SR-31-5	SR-31-5(0.8-1.3)_06/07/2011	0.8	1.3	6/7/2011	ND	--	1890	**27.4**	0.42	4E-07
GP U 677-SR-31-6	SR-31-6(1.0-1.5)_06/07/2011	1	1.5	6/7/2011	ND	--	780	12.9	1.8	2E-06
GP U 677-SR-31-7	SR-31-7(1.1-1.6)_06/07/2011	1.1	1.6	6/7/2011	0.001	3E-11	1370	20.6	0.44	4E-07
GP U 677-SR-31-8	SR-31-8(0.5-1.0)_06/07/2011	0.5	1	6/7/2011	0.005	2E-10	1560	23.1	0.47	4E-07
GP U 677-SR-31-9	SR-31-9(1.2-1.7)_06/07/2011	1.2	1.7	6/7/2011	ND	--	830	13.5	0.77	7E-07
	95% UCL				170.1	6E-06	NA	NA	5.188	5E-06

Total Cumulative Risk for Carcinogens Using EPC: **1E-05** *< 1 in 10,000*
Total Hazard Index for Non-Carcinogens Using EPC: **NA** *< 1*

Notes:
ND - Not Detected Above Lab Reporting Limit
(1) All soil samples collected and analyzed were unsaturated.
(2) All samples are located outside SWMU areas.
(3) Total Cumulative Risk is the combined risk of exposure to the Exposure Point Concentration of carcinogenic compound, and should be less than or equal to 1 in 10,000.
(4) 95% UCL = 95% Kaplan-Meier Chebyshev Upper Confidence Limit of the mean sample concentration for benzene and B(a)P.
(5) Calculated based on site specific parameters provided in Table F-4. The CDC (NIOSH, 2008) recommends that blood lead levels be maintained below 25 ug/dL. EPC - Exposure Point Concentration

Table G-2
Derivation of Site-Specific Soil Value
for Lead[1]

Parameter	Abbreviation	Assumption	Units	Source[2]
Blood lead target concentration	T	25	ug/dL	CDC - ABLES (NIOSH, 2008)
Geometric standard deviation of the blood lead distribution	G	1.4	unitless	25 Pa. Code § 250, Appendix A Table 7
Background blood lead concentration in the population from sources other than soil or dust	B	1.56	ug/dL	NCEH Pub. No. 05-0570 (NCEH, 2005)
Number of standard deviations corresponding to the degree of protection required for the population at risk	n	1.645	unitless	25 Pa. Code § 250, Appendix A Table 7
Response of the blood lead versus soil lead relationship	δ	7.5	ug/dL blood / ug/g soil	25 Pa. Code § 250, Appendix A Table 7

Site-Specific, Non-Residential (Onsite Worker) Screening Value **1,708** **ug/g (mg/kg)**

Notes:

1. The site specific screening value for lead was calculated for ingestion based on the SEGH model as specified by 25 Pa. Code 250.306(e)

$$MSC\ (mg/kg) = \frac{[(T/G^{n}) - B] \times 1000}{\delta}$$

2. Sources for blood lead target level (T) based on conversation between James Oppenheim of Sunoco and Hon Lee of EPA in November 2010.

NIOSH (2008). Adult Blood Lead Epidemiology and Surveillance (ABLES). http://www.cdc.gov/niosh/topics/ABLES

NCEH (2005). Third National Report on Human Exposure to Environmental Chemicals. Centers for Disease Control and Prevention, National Center for Environmental Health, Division of Laboratory Sciences. Atlanta, Georgia. NCEH. Pub. No. 05-0570.

ATTACHMENT A

Attachment A: ProUCL v4.1 Output

General UCL Statistics for Data Sets with Non-Detects

User Selected Options

From File	Sheet1.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Benzo(a)pyrene

General Statistics

Number of Valid Data	94	Number of Detected Data	80
Number of Distinct Detected Data	78	Number of Non-Detect Data	14
		Percent Non-Detects	14.89%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.0397	Minimum Detected	-3.226
Maximum Detected	59	Maximum Detected	4.078
Mean of Detected	2.534	Mean of Detected	-0.433
SD of Detected	7.163	SD of Detected	1.584
Minimum Non-Detect	0.032	Minimum Non-Detect	-3.442
Maximum Non-Detect	5.8	Maximum Non-Detect	1.758

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	85
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	9
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	90.43%

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Lilliefors Test Statistic	0.364	Lilliefors Test Statistic	0.0662
5% Lilliefors Critical Value	0.0991	5% Lilliefors Critical Value	0.0991
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	

Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	2.239	Mean	-0.661
SD	6.647	SD	1.71
95% DL/2 (t) UCL	3.378	95% H-Stat (DL/2) UCL	3.819
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	-0.757
		SD in Log Scale	1.725
		Mean in Original Scale	2.179
		SD in Original Scale	6.657
		95% t UCL	3.319
		95% Percentile Bootstrap UCL	3.401
		95% BCA Bootstrap UCL	4.3
		95% H-UCL	3.589

Attachment A: ProUCL v4.1 Output

Gamma Distribution Test with Detected Values Only	
k star (bias corrected)	0.461
Theta Star	5.495
nu star	73.79
A-D Test Statistic	3.683
5% A-D Critical Value	0.826
K-S Test Statistic	0.826
5% K-S Critical Value	0.106
Data not Gamma Distributed at 5% Significance Level	
Assuming Gamma Distribution	
Gamma ROS Statistics using Extrapolated Data	
Minimum	0.000001
Maximum	59
Mean	2.171
Median	0.446
SD	6.66
k star	0.243
Theta star	8.927
Nu star	45.73
AppChi2	31.21
95% Gamma Approximate UCL (Use when n >= 40)	3.181
95% Adjusted Gamma UCL (Use when n < 40)	3.2

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only	
Data appear Lognormal at 5% Significance Level	
Nonparametric Statistics	
Kaplan-Meier (KM) Method	
Mean	2.192
SD	6.62
SE of Mean	0.687
95% KM (t) UCL	3.334
95% KM (z) UCL	3.323
95% KM (jackknife) UCL	3.332
95% KM (bootstrap t) UCL	4.986
95% KM (BCA) UCL	3.616
95% KM (Percentile Bootstrap) UCL	3.445
95% KM (Chebyshev) UCL	**5.188**
97.5% KM (Chebyshev) UCL	6.484
99% KM (Chebyshev) UCL	9.03
Potential UCLs to Use	
97.5% KM (Chebyshev) UCL	6.484

Attachment A: ProUCL v4.1 Output

Benzene

General Statistics

Number of Valid Data	110	Number of Detected Data	54
Number of Distinct Detected Data	53	Number of Non-Detect Data	56
		Percent Non-Detects	50.91%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.001	Minimum Detected	-6.908
Maximum Detected	1850	Maximum Detected	7.523
Mean of Detected	132.9	Mean of Detected	0.0479
SD of Detected	347.1	SD of Detected	4.33
Minimum Non-Detect	0.0005	Minimum Non-Detect	-7.601
Maximum Non-Detect	2.5	Maximum Non-Detect	0.916

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	88
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	22
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	80.00%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Lilliefors Test Statistic	0.359	Lilliefors Test Statistic	0.106
5% Lilliefors Critical Value	0.121	5% Lilliefors Critical Value	0.121
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	65.27	Mean	-2.656
SD	251.1	SD	4.428
95% DL/2 (t) UCL	105	95% H-Stat (DL/2) UCL	20327
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	-4.799
		SD in Log Scale	5.809
		Mean in Original Scale	65.24
		SD in Original Scale	251.1
		95% t UCL	105
		95% Percentile Bootstrap UCL	108.4
		95% BCA Bootstrap UCL	121.6
		95% H-UCL	19441105

Attachment A: ProUCL v4.1 Output

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.161
Theta Star	824.4
nu star	17.41
A-D Test Statistic	2.274
5% A-D Critical Value	0.938
K-S Test Statistic	0.938
5% K-S Critical Value	0.136

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data	
Minimum	0.000001
Maximum	1850
Mean	65.24
Median	0.000001
SD	251.1
k star	0.0791
Theta star	824.7
Nu star	17.4
AppChi2	8.961
95% Gamma Approximate UCL (Use when n >= 40)	126.7
95% Adjusted Gamma UCL (Use when n < 40)	127.8

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data appear Lognormal at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method

Mean	65.24
SD	249.9
SE of Mean	24.05
95% KM (t) UCL	105.1
95% KM (z) UCL	104.8
95% KM (jackknife) UCL	105
95% KM (bootstrap t) UCL	134
95% KM (BCA) UCL	108.4
95% KM (Percentile Bootstrap) UCL	110.4
95% KM (Chebyshev) UCL	**170.1**
97.5% KM (Chebyshev) UCL	215.5
99% KM (Chebyshev) UCL	304.6

Potential UCLs to Use

97.5% KM (Chebyshev) UCL	215.5

APPENDIX H

LNAPL Modeling Procedures and Results

APPENDIX H
LNAPL MODELING PROCEDURES
AOI 6: PHILADELPHIA ENERGY SOLUTIONS FACILITY
PHILADELPHIA, PENNSYLVANIA

H.1 INTRODUCTION AND OVERVIEW

Models which assess volume, mobility, and recoverability of light non-aqueous phase liquid (LNAPL) contamination have progressed beyond simply extrapolating LNAPL monitoring well thicknesses into the surrounding geologic materials. Instead, these models incorporate the physical properties of groundwater, LNAPL, and soil, in conjunction with an improved understanding of how fluids interact with each other and the surrounding geologic materials, and provide better estimates of LNAPL volume, mobility, and recoverability. These scientific improvements have allowed more realistic endpoints to be set during the remediation process.

For the LNAPL modeling in AOI 6 at the PES Facility in Philadelphia, PA (the Facility), 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, mobility, and recoverability. The parameters discussed in subsequent sections are presented in API Publication 4682 as the significant variables and parameters needed to evaluate the nature and extent of free LNAPL. An updated version of the API model found in the API publication "API Interactive LNAPL Guide," version 2.0.4, dated July 2004, was used. These parameters and the API model were utilized to estimate the specific volume and mobility of LNAPL at the Facility.

H.2 INPUT PARAMETERS

Representative values obtained from the API's LNAPL and Environment Canada's Reference Database were used to identify input parameters. Table H.2 of this attachment summarizes the LNAPL modeling input parameters used for this phase of the project. The individual input parameters used for the LNAPL models are described in detail below.

H.3 FLUID PROPERTIES

The fluids of concern in LNAPL modeling are LNAPL, groundwater, and air. Key physical properties of these fluids are density (ρ), interfacial tension (σ) and viscosity (μ). Chromatographic and mass spectroscopic hydrocarbon LNAPL characterization analyses were

conducted on collected LNAPL samples in an attempt to identify and categorize LNAPLs on site.

H.3.1 Fluid Density and Specific Gravity

Fluid density,ρ, is the mass of fluid per unit volume. Specific gravity, ρ_r, is the relative density of LNAPL with respect to the density of water. The density of LNAPL is related to its specific gravity through the following relationship:

$$\rho_r = \rho_o/\rho_w \qquad \text{(H.1)}$$

where ρ_o and ρ_w are the LNAPL and water densities, respectively.

Density estimates for LNAPL samples collected from wells within the Facility were determined from LNAPL and groundwater density data. If a density value was not available for the LNAPL in a particular monitoring well, a value was assigned based on the physical characteristics of the LNAPL observed in neighboring wells.

H.3.2 LNAPL Viscosity

Viscosity is the measure of friction between molecules within a given fluid. The dynamic (or absolute) viscosity, μ, is defined as the ratio of the shear stress to the strain rate for a Newtonian fluid (Newtonian fluids have constant viscosity and flow immediately on the application of a force). The kinematic viscosity (ν) is the ratio of the dynamic viscosity to the density of a fluid.

If a kinematic viscosity value was not available for the LNAPL within a monitoring well, a value was assigned based on the physical characteristics of the LNAPL in relation to neighboring monitor wells, or a representative viscocity value was selected from the API or Environment Canada Database chosen based upon other LNAPL physical characteristics.

H.4 FORMATION PHYSICAL PROPERTIES

Where available, site-specific geologic and hydrogeologic data were obtained from site soil boring investigations, monitoring and recovery wells installation and sampling activities, and

aquifer characteristic testing. All remaining physical property input values were obtained from reference literature.

Variations in soil type were noted from boring log descriptions. For the purpose of determining modeling parameters, generalizations of the geologic characteristics were made based on the occurrence and distribution of soil types within the LNAPL wetted screen interval of monitoring wells. Consistent with the API guidance publication, the geologic parameters of interest include: soil texture, porosity, bulk density, fluid saturation, capillary pressure relationships, and total organic carbon (TOC). These parameters are discussed in detail below.

H.4.1 Formation Texture

One of the most important parameters in determining the properties of porous media is the size range of particles in a soil, which is referred to as soil texture. Grain size is closely related to soil texture, and a grain size distribution gives the relative percentage of grain sizes within a formation.

Where available, historic site-specific grain size distribution data were used to describe the relative percentage of grain size within the various geologic units at the Facility. Regions with similar grain size distributions were grouped together, and representative values were selected. Soil within the historic maximum LNAPL wetted interval was used for this selection. Note, however, that in any given boring log, the soil type spanning the LNAPL wetted interval may actually include a range of soil types. In addition to the grain size analyses, the soil Atterberg Limits were referenced for select soil types. The Atterberg limits were used to correlate and characterize the fine-grained soil (i.e., silt and clay) in conjunction with the grain size distribution analyses.

H.4.2 Porosity

The ratio of the volume of void space in a soil to the total volume is defined as the porosity (n), which is usually written as a fraction or a percent of void space. Generally, wider variations in particle sizes result in smaller porosity values, as the void space between the larger particles are filled by smaller particles. The effective porosity (or kinematic porosity) refers to the volume of interconnected pore spaces through which fluids can flow.

H.4.3 Bulk Density

Bulk density is a measure of the weight of the soil per unit volume, usually given on an oven-dry (110° C) basis. Variation in bulk density is attributable to the relative proportion and specific gravity of solid organic and inorganic particles and to the porosity of the soil. Most mineral soils have bulk densities between 1.0 and 2.0.

H.4.4 Fluid Saturation

According to the API guidance documents, the void space of a natural porous medium affected by an LNAPL release is filled with water, air and LNAPL. The fraction of the pore space of a representative volume of material that is occupied by a particular fluid is called the fluid saturation. The fluid saturation of each phase can range from 0 to 1, and the sum of the three phases must equal 1.

H.4.5 Capillary Pressure Relationships

According to the API guidance document, molecules located near the interface between two fluids (i.e. water and LNAPL) in one void space have a greater energy than molecules of the same fluid located within the bulk volume due to cohesive forces between the molecules. The excess energy associated with a fluid interface results in interfacial tension between the fluids, and surface tension between the liquid and vapor.

These relationships are incorporated into the API model for determining formation specific volume under vertical equilibrium.

H.5 LNAPL EFFECTIVE PERMEABILITY

Water, air, and LNAPL are in competition for the interstitial spaces within the formation. Relative permeability describes the ability of one fluid to flow in the presence of other fluids, compared to the ability of the fluid to flow if it were the only fluid present. Typically, these differences in permeability between water and LNAPL are observed as LNAPL reaches the water table in sufficient quantities, pools, and spreads laterally as a floating layer.

The API modeling approach is to predict the LNAPL saturation and relative permeability distributions under vertical equilibrium conditions. The effective saturation and relative

permeability values depend on the LNAPL thicknesses within the formation, for which the apparent monitoring well LNAPL thicknesses serve as a useful measure. The modeling objective is to replace the layer with varying saturation and relative permeability with an equivalent layer with vertically uniform characteristics.

For each well with reported apparent LNAPL thickness, the API model was run to determine the effective relative permeability of LNAPL within that well. As a first approximation, the residual saturation of LNAPL (the portion of LNAPL that is adhered to soil and not recoverable) was considered to be zero for the calculation of effective relative permeability. The residual saturation of LNAPL will be determined based on the soil grain size, fluid saturation and capillary curves for the recoverability analysis.

H.6 SOIL INTRINSIC PERMEABILITY

The intrinsic permeability of the soil was estimated using the following equation:

$$k_{soil} = \frac{K_W \mu_W}{\rho_W g} \qquad \text{(H.2)}$$

where,

k_{soil} = permeability of soil

K_w = hydraulic conductivity of groundwater for fill horizon

μ_w = dynamic viscosity of water

p_w = density of water

g = gravity

The estimates of the ground water density and viscosity were used to determine the intrinsic soil permeability. The gravity constant was assumed to be 32.2 feet/s^2 (9.81 m/s^2).

H.7 LNAPL HYDRAULIC CONDUCTIVITY AT SATURATION

To estimate the seepage velocity of the free-phase LNAPL, the hydraulic conductivity of the formation with respect to LNAPL must be known. The hydraulic conductivity of LNAPL is first calculated at 100% saturation at the LNAPL phase. Then it is corrected from the effective LNAPL relative permeability. This corrected hydraulic conductivity of LNAPL is the hydraulic

conductivity of LNAPL in the formation at the estimated saturation of LNAPL. This can be estimated based on the following equation:

$$K_{oil} = k_{ro} \frac{k_{soil} \rho_{oil} g}{\mu_{oil}} \quad \text{(H.3)}$$

where,

K_{oil} = hydraulic conductivity of LNAPL in the soil at saturation

k_{ro} = effective LNAPL relative permeability

k_{soil} = permeability of soil relative to groundwater (Equation H.2)

μ_{oil} = dynamic viscosity of LNAPL

p_{oil} = density of LNAPL

g = gravity

H.8 LNAPL SPECIFIC DISCHARGE

The result of the corrected hydraulic conductivity for LNAPL saturation (Equation H.3) was used to calculate the specific velocity of the LNAPL based on hydraulic gradient of the groundwater using the following equation:

$$q_{oil} = K_{oil} \times i_w \quad \text{(H.4)}$$

where,

q_{oil} = LNAPL specific velocity of LNAPL discharge

K_{oil} = hydraulic conductivity of LNAPL in the soil at the corrected saturation

i_w = water table gradient

The water table gradient was assumed to be similar to the LNAPL table gradient. Based on the groundwater monitoring data collected to date, average water table gradients were selected.

The seepage velocity or mobility of the LNAPL was calculated based on the specific velocity calculated in Equation H.4, and correcting it for the effective porosity of the formation as follows:

$$v_{oil} = \frac{q_{oil}}{\phi_{eff}} \quad \text{(H.5)}$$

where,

v_{oil} = LNAPL seepage velocity

q_{oil} = LNAPL specific velocity of LNAPL discharge

ϕ_{eff} = effective porosity

The specific velocity of the LNAPL discharge from the previous calculation was divided by the effective porosity to determine the seepage velocity of LNAPL for all wells. For this calculation, total porosity values associated with each soil type were reduced for use as an effective porosity for LNAPL mobility.

Located in Tables H.3 are the output results of the LNAPL modeling. Located in Table H.1 of this attachment is the LNAPL characterization data provided by Torkelson Laboratories.

H.9 LNAPL MODELING RESULTS

As described in Appendix E of the CCR, Sunoco previously evaluated LNAPL mobility across the site using the API LNAPL model. In the CCR, LNAPL in wells WP9-2 and B-124 were identified as having high mobility (greater than 1x10-7 cm/sec). These wells are associated with the pumping at the 27 Pump House area, and the LNAPL in this location does not pose a risk for migration. Based on the quarterly recovery well gauging, as part of the recovery system performance monitoring program, the 27 Pump House Remedial System was taken off-line in September of 2010 due to the absence of recoverable LNAPL.

Based on the 2012 well gauge data, no new wells in AOI 6 have LNAPL as compared to the 2006 SCR data. Apparent LNAPL thickness in wells has generally either remained the same or decreased, with the exception of a slight increase in thickness in well B-129. The API model for well B-129 was updated by inputting the December 2012 apparent LNAPL thickness of 5.19 feet. A seepage velocity of 9.85 x 10-8 cm/sec was calculated for B-129, which is below the mobility threshold of 1 x 10-7 cm/sec referenced in the CCR; therefore the LNAPL in this well is not considered mobile.

TABLES

Table H.1
LNAPL Characterization Results Summary
AOI 6 Repackaged SCR/RIR
PES Facility
Philadelphia, Pennsyvlania

Characterization Results Compiled for Current Conditions Report Interpretation of Product Type(s), Proportions and Weathering					
Well ID	**Density (gm/ml @ 60ºF)**	**LNAPL Type(s)**	**Torkleson LNAPL Type(s)**	**Proportions**	**Weathering**
B-129	0.8654	Middle Distillate	Gasoline Heavier Material	5 20	Severe Extreme
			Middle Distillate	75	Extreme
B-130	0.9306	Middle Distillate Residual Oil	Middle Distillate Residual Oil	20 80	Severe Extreme
B-144	0.8654	Gasoline	Gasoline	90	Severe
			Residual Oil	10	Severe
B-39	0.8734	Middle Distillate	Gasoline Middle Distillate	2 98	Severe Severe
B-43	0.9161	Middle Distillate	Middle Distillate	100	Extreme
WP 9-2	0.8114	Gasoline	Aviation Gasoline Middle Distillate	80 20	Severe Severe
Characterization Results Compiled for AOI 6 Site Characterization Interpretation of Product Type(s), Proportions and Weathering					
Well ID	**Density (gm/ml @ 60ºF)**	**LNAPL Type(s)**	**Torkleson LNAPL Type(s)**	**Proportions**	**Weathering**
B-47	0.9796	Residual Oil	Residual Oil	100	Extreme
			Unknown Aromatics	Trace	Extreme
B-150	0.8668	Gasoline	Unknown Aromatics	100	Unknown

Notes:
1. Characterization Data Provided by Torkelson Geochemistry of Tulsa, OK

Table H.2
API Model Input Parameters
B-129
AOI 6 Repackaged SCR/RIR
PES Facility
Philadelphia, Pennsylvania

Well ID	Apparent LNAPL Thickness Field Measurement[1]		API Database							LNAPL Density (Torkelson Geochemistry) (gm/cc)	LNAPL Type or Source of Surrogate LNAPL Type (Torkelson Geochemistry)	API or Environment Canada Database		
	meter	feet	Porosity Well ID (unitless)	USCS Soil Type Surrounding Well Screen[2]	Source of Soil Type	van Genuchten "N" (unitless)	van Genuchten "a" [m^{-1}]	van Genuchten "a" [ft^{-1}]	Irreducible Water Saturation[3] (unitless)			Air/Water Surface Tension[4] (dynes/cm)	Air/LNAPL Surface Tension (dynes/cm)	LNAPL/Water Surface Tension (dynes/cm)
B-129	1.58	5.19	0.444	ML	B-129	1.840	1.040	3.412	0.408	0.87	Middle Distillate	65.000	26.900	22.300

NOTES:
(1) Groundwater/LNAPL gauging event December 2012.
(2) Unified Soil Classification System

USCS Symbol	API Database/Folk Description
ML	Silt/Clay

(3) Residual LNAPL saturation in the saturated and vadose zones are considered to be negligible.
(4) SPL Interfacial Tensions:

NAPL Type	Source
Middle Distillate	Environment Canada (Diesel)

Table H.3
API Model Output
AOI 6 Repackaged SCR/RIR
B-129
PES Facility
Philadelphia, Pennsylvania

Well ID	Apparent LNAPL Thickness Field Measurement[(1)]		API Model Results		
			Specific Volume	Specific Volume	Relative Permeabilty
	meter	feet	meters	feet	unitless
B-129	1.582	5.190	3.456E-02	0.113	5.030E-02

NOTES:
(1) Groundwater/LNAPL guaging event December 2012.

Table H.4
Seepage Velocity Calculations
B-129
AOI 6 Repackaged SCR/RIR
PES Facility
Philadelphia, Pennsylvania

Well ID	API Database USCS Soil Type Equivalent	LNAPL Density	Dominant LNAPL Type at Each Well Location	API Model Calculated LNAPL Relative Permeabilty	Effective Porosity	Groundwater Density @ 60F (kg/m^3)	Groundwater Dynamic Viscosity ($N{\cdot}s/m^2$)	Soil Permeabililty (m^2)	Kro (%)	Groundwater Gradient	Dynamic Viscosity of LNAPL (N·s/m2)	LNAPL Density (kg/m3)	LNAPL K @ 100% Saturation (m/day)	Corrected LNAPL K (m/day)	LNAPL Specific Discharge (m/day)	LNAPL Seepage Velocity (m/year)	LNAPL Seepage Velocity (cm/sec)
		(gm/cc)		Unitless	API Database	CRC	API Database	API Database	API Model	December 2012 AOI-6 Contour Map	API/Env. Canada Databases	Torkelson Geochemistry Inc.	Calculated	Calculated	Calculated	Calculated	Calculated
B-129	ML	0.8654	Middle Distillate	5.030E-02	0.444	999.19	1.124E-03	8.65E-14	5.03%	0.048	4.000E-03	865.40	1.59E-02	7.98E-04	3.80E-05	3.12E-02	9.85E-08

API MODEL FOR WELL B-129

Figure H.1
AOI 6 Site Characterization/Remedial Investigation Report
Philadelphia Energy Solutions Facility
Specific Volume Calculations
Well ID = B-129
Soil Type = ML
Fluid Type = Middle Distillate

8/14/2013

van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

Enter Data in Yellow Region	B-129

Maximum Monitoring Well LNAPL Thickness (meters)		
b_o =	1.582	5.19 ft

Soil Characteristic		
n =	0.444	porosity
N =	1.840	van Genuchten "N"
α =	1.040	van Genuchten "α" [m^{-1}]
S_{wr} =	0.408	irreducible water saturation
S_{orv} =	0.000	residual LNAPL saturation (saturated)
S_{ors} =	0.000	residual LNAPL saturation (vadose)

Fluid Characteristics:			
ρ_o =	0.865	LNAPL density (gm/cc)	Mid Dist
σ_{aw} =	65.000	air/water surface tension (cp)	
σ_{ao} =	26.900	LNAPL/water surface tension (cp)	
σ_{ow} =	22.300	air/LNAPL surface tension (cp)	

Calculated Parameters		
M =	0.457	van Genuchten "M"
α_{ao} =	2.175	air/LNAPL "α"
α_{ow} =	0.408	LNAPL/water "α"
z_{ao} =	0.213	elevation of air-LNAPL interface
z_{ow} =	-1.369	elevation of LNAPL-water interface
z_{max} =	0.583	maximum free-product elevation
λ =	0.656	pore-size distribution index
Ψ_b =	0.600	B-C displacement pressure head [m]

Press Ctrl+Shift+S to calculate sheet

Figure H.1
AOI 6 Site Characterization/Remedial Investigation Report
Philadelphia Energy Solutions Facility
Specific Volume Calculations
Well ID = B-129
Soil Type = ML
Fluid Type = Middle Distillate

8/14/2013

b_o	D_o	k_{ro}	α	β	ξ	η		
0.000	0.000	0.000						
0.190	0.000	0.000	0.0000	0.000554	0.0000	0.001553		
0.823	0.006	0.012	0.1791	0.009799	0.1736	0.018197	0.01	Eps-Do
1.582	0.035	0.050	0.6532	0.037210	0.5896	0.050685	0.01	Eps-kro

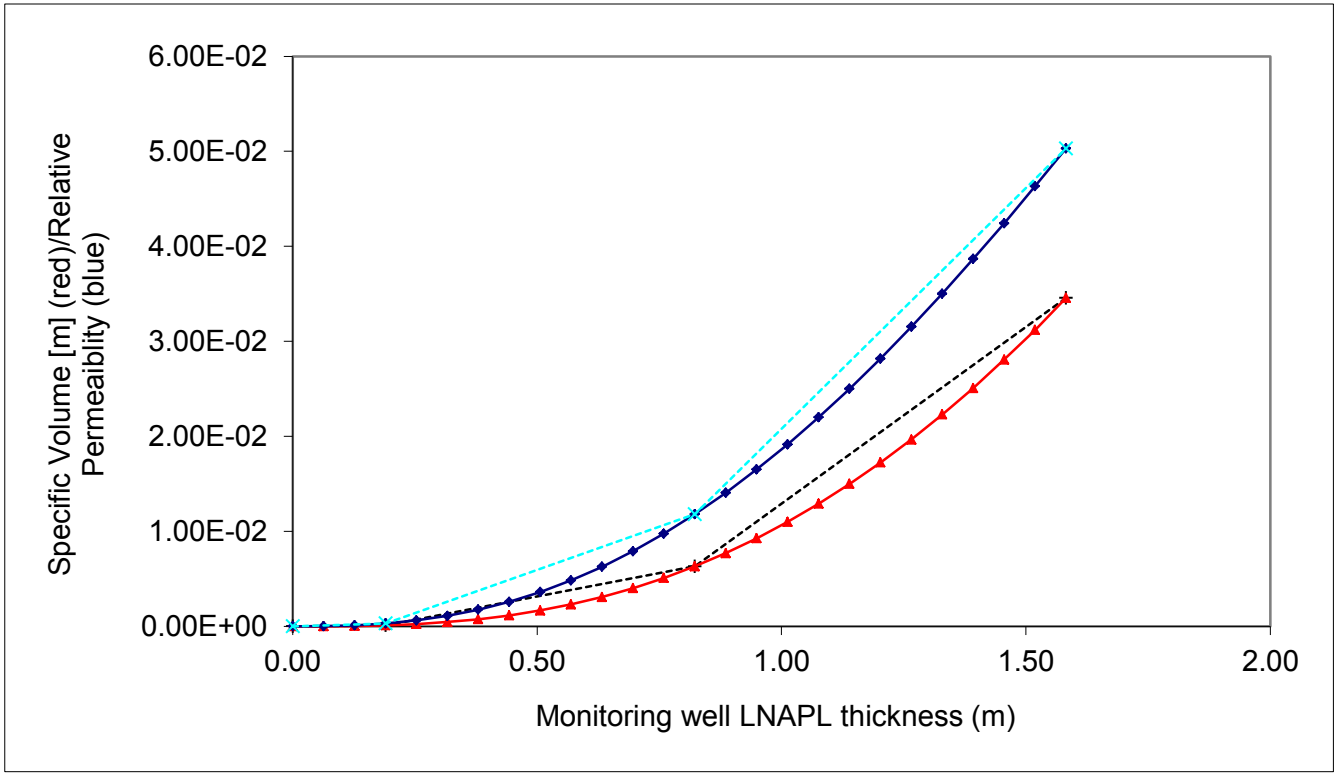
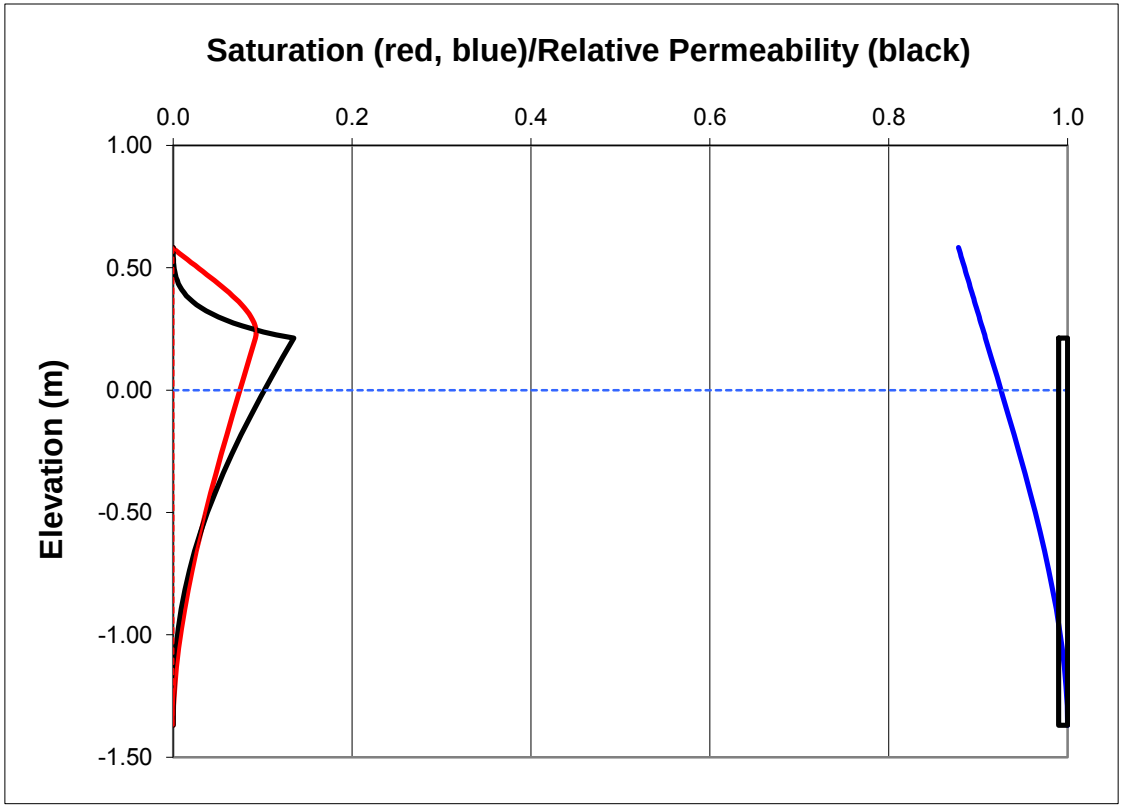


Figure H.1
AOI 6 Site Characterization/Remedial Investigation Report
Philadelphia Energy Solutions Facility
Specific Volume Calculations
Well ID = B-129
Soil Type = ML
Fluid Type = Middle Distillate

8/14/2013

Monitoring Well LNAPL Thickness b_o (m) =			1.582
	D_o = 3.456E-02	k_{ro} =	5.030E-02

Press Ctrl+Shift+S to calculate sheet



APPENDIX I

Stantec Indoor Air Assessment Report

Evaluation of Specific Volatile Organic Compounds in Occupied Buildings at the former Sunoco Philadelphia Refinery

Sunoco, Inc. (R&M) Philadelphia Refinery Remediation Program

Philadelphia, Pennsylvania

Prepared for:

Sunoco, Inc. (R&M)
10 Industrial Highway MS4
Lester, Pennsylvania 19029

March 22, 2013

Project Number: 213402094

Stantec

Stantec Consulting Services Inc.
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March 20, 2013

EVALUATION OF SPECIFIC VOLATILE ORGANIC COMPOUNDS IN OCCUPIED BUILDINGS AT THE FORMER SUNOCO PHILADELPHIA REFINERY

SUNOCO, INC. (R&M) PHILIDELPHIA
REFINERY REMEDIATION PROGRAM

Prepared For:

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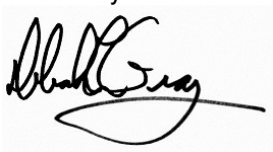
Project Number: 213402094

Written by:



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Executive Summary

On Wednesday, October 24 and Thursday, October 25, 2012, Stantec Consulting Services Inc. (Stantec) conducted a comprehensive study of airborne volatile organic compounds (VOCs) in occupied buildings at the former Sunoco, Inc. (R&M) Philadelphia Refinery, now Philadelphia Energy Solutions (PES) Refining and Marketing (R&M) LLC, located at 3144 Passyunk Avenue, Philadelphia, Pennsylvania (the refinery). The study was conducted as part of Sunoco's participation in a real estate and refinery operation transaction. The study was performed to document the concentration of a number of specific chemicals which may be present inside occupied buildings from refinery activities or related refinery conditions.

Methodology

An initial site visit was conducted on September 18 and 19, 2012 by Stantec and Sunoco to select the occupied buildings to be evaluated and to determine the tentative number and locations of samples to be collected during the study. Based on the initial site visit, a sampling plan was subsequently developed which specified collection of air samples inside occupied buildings on the refinery property for analysis of petroleum-related VOCs in air utilizing United States Environmental Protection Agency (US EPA) Method TO-15 for analysis. This method calls for the collection of air samples into specially prepared vacuum SUMMA canisters (or cans). The sampling plan also specified collection of these air samples over a four (4) hour period to accommodate the possible variability in ambient VOC concentrations.

Samples were collected inside occupied areas of the selected buildings and outdoor air samples were collected for comparison. Thirty-four (34) samples were collected inside buildings and seven (7) samples outdoors. Three (3) trip blanks were also submitted for analysis. Compounds of interest for this study were consistent with the Pennsylvania Department of Environmental Protection's (PADEP) Short List of Petroleum Products, specifically: methyl tert-butyl ether (MTBE), 1,2-dichloroethane, benzene, toluene, 1,2-dibromoethane (ethylene dibromide), ethylbenzene, xylenes, isopropylbenzene (cumene), 1,2,4-trimethylbenzene (1,2,4-TMB), and 1,3,5-trimethylbenzene (1,3,5-TMB). The concentrations of VOCs detected in each sample of indoor and outdoor air were compared to occupational exposure limits (OELs) and risk-based screening levels published by US EPA and PADEP. Summary statistics were calculated to compare the ranges of concentrations of VOCs found in indoor air to concentrations in outdoor air.

Results

The concentrations of all compounds detected in indoor and outdoor air were many orders of magnitude less than the Occupational Safety and Health Administration (OSHA) Permissible

Exposure Limit (PEL) time-weighted averages (TWAs) and the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs®) TWA.

The maximum concentrations of all compounds detected in all samples were equal to (benzene only) or less than the corresponding risk-based US EPA Regional Screening Levels (RSLs) and the PADEP Indoor Air Quality (IAQ) criteria for exposure in industrial environments. Note that the US EPA RSL concentrations for chemicals with cancer health effects (MTBE, benzene, and ethylbenzene) were multiplied by a factor of ten (10) to reflect a target cancer risk of 1 in 100,000 or 1E-05 which is consistent with the Pennsylvania risk-based standards.

There were notable differences in the concentrations of most of the compounds detected inside the individual buildings that are not evident from the arithmetic means of the analytical results for all indoor air samples. Specifically, the highest concentrations of benzene were found in the Point Breeze Lab samples (11 and 8.4 µg/m^3) and the 440 Building samples (9 and 7.2 µg/m^3). The highest concentrations of toluene (88 and 330 µg/m^3), ethylbenzene (11 and 6 µg/m^3), total xylenes (51.1 and 31.6 µg/m^3) were found in the PB Lab samples (west lab and 2nd floor office, respectively). The highest concentrations of 1,3,5-TMB (3.9 µg/m^3) and 1,2,4-TMB (11 µg/m^3) were found in the PB Lab, 2nd floor office sample although the PB Lab, west lab sample was not significantly different than other indoor air sample locations.

The concentrations of benzene, toluene, ethylbenzene, xylenes, and trimethylbenzenes in buildings other than the 440 Building and the PB Lab were comparable to the concentrations in outdoor air.

Conclusions

The findings of this evaluation indicate that the indoor and outdoor concentrations of VOCs associated with refinery operations were orders of magnitude lower than occupational exposure limits, and lower than or equal to (benzene only) conservative risk-based screening levels published by US EPA and PADEP for long-term exposures in industrial settings. Note that the US EPA RSL concentrations for chemicals with cancer health effects were adjusted to be consistent with the Pennsylvania risk-based standards. Assuming that the concentrations of petroleum-related VOCs found inside the occupied buildings in late October 2012 are representative of long-term conditions, there do not appear to be health concerns for people who work inside the buildings from exposure to these chemicals.

Table of Contents

1.0 Introduction

Stantec Consulting Services Inc. (Stantec) conducted a comprehensive study of airborne volatile organic compounds (VOCs) in occupied buildings at the former Sunoco, Inc. (R&M) Philadelphia Refinery, now Philadelphia Energy Solutions (PES) Refining and Marketing (R&M) LLC, located at 3144 Passyunk Avenue, Philadelphia, Pennsylvania (the refinery). The study was conducted as part of Sunoco's participation in a real estate and refinery operation transaction. The study was performed to document the concentration of a number of specific chemicals that may be present inside occupied buildings from refinery activities or related refinery conditions.

During a real estate and operational transition involving a facility such as this refinery, the potential for residual chemical exposure in occupied buildings exists and it is reasonable to assess the potential adverse health risk.

This facility refines, processes, and blends transportation fuels. The chemicals of interest for this study were consistent with the Pennsylvania Department of Environmental Protection (PADEP) Table IV-9 Short List of Petroleum Products (PADEP 2004), specifically: methyl tertiary-butyl ether (MTBE), 1,2-dichloroethane, benzene, toluene, 1,2-dibromoethane (ethylene dibromide), ethylbenzene, xylenes, isopropylbenzene (cumene), 1,2,4-trimethylbenzene (1,2,4-TMB), and 1,3,5-trimethylbenzene (1,3,5-TMB). Although the PADEP Table IV-9 Short List is for analysis of soil and water samples, all of the compounds listed for water except naphthalene, are volatile compounds of interest in air.

An initial site visit was conducted on Tuesday, September 18, and Wednesday, September 19, 2012 by Jim Oppenheim (Sunoco), Jennifer Menges (Stantec), and John Reiter (Stantec) to select the occupied buildings where sampling would be conducted and to determine the tentative number and locations of samples to be collected during the study. The sampling plan developed based on this initial site visit, and subsequently implemented by Stantec field staff in cooperation with refinery personnel in October 2012, specified collection of air samples inside occupied buildings on the refinery property for analysis of concentrations of VOCs in air by United States Environmental Protection Agency (US EPA) Method TO-15 (US EPA 1999).

US EPA Method TO-15 calls for the collection of air samples into specially prepared vacuum SUMMA canisters (or cans). The sampling plan specified collection of these air samples over a four (4) hour period of time to accommodate the possible variability in ambient VOC concentrations. Samples were collected inside occupied areas of the buildings and outside samples were collected for comparison. Thirty-four (34) samples were collected inside of buildings and seven (7) samples were collected outdoors. Three (3) trip blanks were also submitted for laboratory analysis.

Analytical results were compared to occupational exposure limits (OELs), specifically the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs) and the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values

(TLVs®). Results were also compared to current (November 2012) US EPA risk-based Regional Screening Levels (RSL) for industrial occupancies and PADEP Indoor Air Quality (IAQ) criteria for industrial occupancies. Additionally, PADEP-referenced odor thresholds were cited.

2.0 Chemical Constituents and Applicable Exposure Limits

The facility is a refinery that processes and blends large quantities of petroleum-based transportation fuels. The refining and blending processes generate the volatile petroleum-based organic compounds of interest for this investigation. In addition to being flammable, these volatile compounds may cause adverse health effects ranging from upper respiratory tract irritation at lower concentrations of exposure to more severe effects such as central nervous system depression or intoxication at high concentrations of exposure. Benzene is also considered to be a human carcinogen based on epidemiologic studies demonstrating an increased risk for acute myelogenous leukemia in occupational cohorts exposed to high concentrations (e.g. exceeding approximately 10 parts per million (ppm)) over many years (ATSDR 2007). The potential for adverse health effects correlates with increasing concentrations and duration of exposure.

All of the compounds monitored in this study have relevant occupational standards and risk-based screening levels. The OELs were developed based on the precept that nearly all persons may be exposed to a concentration of the chemical at or below the exposure limit, day after day, week after week, for a working lifetime, without experiencing any adverse health effects due to the chemical exposure.

Risk-based screening levels are concentrations of chemicals in environmental media (soil, ambient air, and drinking water) that correspond to pre-determined levels of cancer risk and/or non-cancer hazard, under the assumption that an individual will be exposed daily over thirty (30) years (residential) or twenty-five (25) years working life-time. Two sources of risk-based screening concentrations are presented in this report: US EPA RSLs and PADEP IAQ criteria. All screening concentrations used to evaluate sampling results were developed for exposures in industrial settings.

The US EPA RSLs have been harmonized across US EPA Regions and are generally accepted as a quick and conservative method for initial evaluation of constituents found in environmental media. RSLs are presented by the US EPA as being protective for members of the general population (including sensitive groups) over a lifetime. Thus concentrations of chemicals in environmental media that are less than the RSLs are believed to be of no concern for public health. Concentrations of chemicals above conservative RSLs do not necessarily mean that health effects will occur as a result of exposure, but that further evaluation of the situation should be considered. There are carcinogenic target risk (TR) screening concentrations and non-carcinogenic hazard index (HI) screening concentrations. All chemicals produce non-cancer health effects at some level of exposure and some may also be carcinogenic. Screening concentrations generally (although not always) reflect the more sensitive outcome and lowest associated concentration.

Although the non-residential PADEP IAQ criteria were developed under the Pennsylvania Land Recycling Program to assist in the evaluation of vapor intrusion into non-residential buildings, these risk-based concentrations are analogous to US EPA RSLs and provide additional references for evaluating the results of the samples collected during this study.

3.0 Sampling Methodology

3.1 COLLECTION OF AMBIENT AIR SAMPLES

Ambient air samples were prepared by first checking the laboratory-provided SUMMA canister vacuum using a digital gauge and documenting the pre-sample pressure. Flow regulators with integral pressure gauges were attached to the canisters and tightened by hand. Sampling was initiated by opening the SUMMA canister valve to its fully open position.

Samples were collected at breathing zone height by placing the SUMMA canisters on elevated surfaces so that the sample collection intake ports were approximately three (3) to six (6) feet above the ground or floor surface. Samples were collected for approximately four (4) hours. While grab samples may have been sufficient, sample durations were intentionally longer to provide some assurance that if the concentration of the compound(s) were variable, the sample would be representative.

Samples were collected at indoor and outdoor locations previously selected and discussed during the initial site visit and sampling plan development. However, since sample conditions are dynamic and may have been different at the time of sample collection, the field technicians used their best judgment in sample location selection and, as a result, some locations may be different than originally planned. Three (3) trip blanks were provided to the lab for analysis.

3.2 QUALITY ASSURANCE PROCEDURES FOR SAMPLE COLLECTION

Sample quality assurance encompasses procedures used for pre-sample preparation; handling of samples before, during, and after collection; elimination of potential cross contamination; and elimination of collection of interfering compounds or materials. The need for some of these is unnecessary when using SUMMA canisters due the inherent relatively failsafe technology.

Flow rate and volume are not critical since the sample methodology is for whole air (i.e., a prescribed total volume) regardless of the rate of sampling or total volume of air collected. The flow regulators provide an approximate canister fill time. Following sample completion the final pressure is recorded for assurance that air was indeed collected into the canister.

Contemporary sampling media provides little opportunity for cross-contamination or external contamination. SUMMA canisters were cleaned and prepared by the analytical laboratory in a manner consistent and appropriate for re-use and the methodology and compounds selected for analysis.

Onsite recordkeeping included SUMMA can serial number, flow controller serial number, start time, stop time, total sample time, location of sample, pre-sample pressure, post-sample pressure, and notes pertaining to the location of the sample. This information is provided in Table 1.

The laboratory received the samples according to their strict receipt requirements and documentation. A *Sample Acceptance Check Form* is provided with the laboratory analytical reports provided in Appendix A.

4.0 Sampling Locations

Figure 1 illustrates the locations of buildings in which samples were collected and outside sample locations. The indoor sample locations were selected during the initial site visit by Jim Oppenheim (Sunoco), Jennifer Menges (Stantec), and John Reiter (Stantec). The indoor sample locations were selected based on the current and anticipated occupancy and use of the buildings, populations in the buildings, and locations of occupants within the buildings. The number and locations of indoor air samples per building were selected to be representative of conditions and potential exposure to the building occupants. Outdoor sample locations were selected based on the proximity to buildings in which samples were collected, and in some instances, proximity to pumping and product handling equipment. The number and locations of outdoor air samples were selected to be representative of petroleum-related compounds in ambient air that may contribute to the presence of the same compounds in indoor air.

Samples were collected in building locations identified in Table 1 and shown on Figure 1. Indoor air samples were collected in the following locations:

- Blending & Shipping (B&S) Office
- 24 Gate Building
- Girard Point (GP) Training Building
- GP Main Office Building
- 440 Building
- 15 Pump House
- North Yard Scale House
- Schuylkill River Tank Farm (SRTF) Propane Loading
- SRTF Main Pump House
- Point Breeze (PB) Main Office Building
- PB Lab
- PB Refinery Hall
- PB Maintenance Shop

Duplicate samples were collected in the 24 Gate Building (1st floor), the GP Main Office Building (2nd floor east), and the PB Refinery Hall (2nd floor east wing).

Outdoor samples were collected in the following locations:

- near the B&S Office
- outside the GP Main Office Building
- outside 15 Pump House, under the equipment roof at grade
- outside 15 Pump House, under the equipment roof approximately eight (8) to ten (10) feet below grade
- outside the North Yard Scale House
- outside the SRTF Main Pump House
- outside in the PB gate area, near the PB buildings

5.0 Analytical Results

Table 1 lists the sample location, date of sampling, start time, stop time, total sample duration, canister ID, regulator ID, pre-sample pressure, and post-sample pressure. Table 2 presents the analytical results for each indoor and outdoor sample location. Summary statistics for indoor and outdoor air samples are presented in Table 3 along with occupational exposure standards and risk-based screening concentrations. Laboratory analytical reports are provided in Appendix A.

The table below presents the arithmetic mean for all compounds detected in two (2) or more samples, or the only concentration detected. The maximum detected concentrations are shown below the means in bold, italic font. Two (2) of the compounds of interest, 1,2-dichloroethane and 1,2-dibromoethane were not detected in any of the samples and are not included on this summary table. The three (3) duplicate samples corresponding to sample numbers 3, 15, and 40 on Table 2 yielded analytical results that were virtually identical to the results of the corresponding "sample" and are not factored into the summary statistics.

Summary of Air Sampling Results [1)]

Compound	OSHA PEL [2)]	ACGIH TLV [3)]	RSL Ind. [4)]	PADEP Ind. [5)]	Indoor		Outdoor	
					Freq. Detect	Concentration (mean / ***max***)	Freq. Detect	Concentration (mean / ***max***)
MTBE [6)]	—	1.8E+05	4.7E+02	3.1E+02	2/34	1.28E+00 ***1.6E+00***	0/7	—
Benzene	3.19E+03	1.6E+03	1.6E+01	1.1E+01	34/34	2.9E+00 ***1.1E+01***	6/7	2.62E+00 ***4.9E+00***
Ethylbenzene	4.34E+05	8.68E+04	4.90E+01	7.30E+01	30/34	1.77E+00 ***1.1E+01***	2/7	1.97E+00 ***3.1E+00***
Toluene	7.54E+05	7.54E+05	2.20E+04	1.20E+03	34/34	1.88E+01 ***3.3E+02***	7/7	7.61E+00 ***1.9E+01***
Xylenes	4.34E+05	4.34E+05	4.40E+02	3.00E+02	34/34	7.50E+00 ***5.11E+01***	5/7	6.55E+00 ***1.71E+01***
Cumene	2.46E+05	2.46E+05	1.80E+03	1.10E+03	17/34	1.42E+00 ***2.6E+00***	1/7	2.0E+00 ***2.0E+00***
1,3,5-TMB [7)]	—	1.23E+05	3.10E+01	1.70E+01	7/34	1.53E+00 ***3.9E+00***	1/7	1.6E+00 ***1.6E+00***
1,2,4-TMB [8)]	—	1.23E+05	3.10E+01	1.70E+01	31/34	1.96E+00 ***1.1E+01***	4/7	1.69E+00 ***3.6E+00***

Footnotes:

1) All concentrations, including those for occupational standards are given in µg/m^3
2) OSHA Permissible Exposure Limit (PEL)
3) ACGIH Threshold Limit Value (TLV)
4) EPA Regional Screening Level (RSL) for industrial exposure
5) Pennsylvania Department of Environmental Protection IAQ criteria for industrial exposure
6) methyl tert-butyl ether
7) 1,3,5-trimethylbenzene (RSL for 1,2,4-trimethylbenzene)
8) 1,2,4-trimethylbenzene

The analytical results are discussed in the following sections with concentrations provided in micrograms per cubic meter (µg/m^3).

5.1 COMPARISON OF INDOOR AIR SAMPLES

5.1.1 Indoor Air Samples

Of the ten (10) compounds analyzed (m,p-xylenes and o-xylene were combined into total xylenes), 1,2-dichloroethane and 1,2-dibromoethane were not detected in any sample and MTBE was detected only in two (2) samples, both on the second floor of the PB Refinery Hall. Benzene, toluene, and xylene were detected in the majority of the indoor and outdoor samples. No compounds were detected in the trip blanks.

There were notable differences in the concentrations of most of the compounds detected inside the individual buildings that are not evident from the arithmetic means of the analytical results for all indoor air samples. Specifically, the highest concentrations of benzene were found in the PB Lab samples (11 and 8.4 µg/m^3) and the 440 Building samples (9 and 7.2 µg/m^3). The highest concentrations of toluene (88 and 330 µg/m^3), ethylbenzene (11 and 6 µg/m^3), total xylenes (51.1 and 31.6 µg/m^3) were found in the PB Lab samples (west lab and 2nd floor office, respectively). The highest concentrations of 1,3,5-TMB (3.9 µg/m^3) and 1,2,4-TMB (11 µg/m^3) were found in the PB Lab, 2nd floor office sample although the PB Lab, west lab sample was not significantly different than other indoor air sample locations.

MTBE was detected only in samples collected in the PB Refinery Hall building (2nd floor, both conference room and east wing) and was undetected in any other inside or outside sample.

The concentrations of benzene, toluene, ethylbenzene, xylenes, and trimethylbenzenes in buildings other than the 440 Building and the PB Lab were similar to the concentrations in outdoor air. As shown in the table below, the range of concentrations detected in air samples from the 440 Building and the PB Lab are compared to the range of concentrations found in all of the other buildings (as a group; not including non-detects) from which samples were collected.

Range of Concentrations Detected in Indoor Air by Building [1)]

Compound	440 Building		PB Lab		All Other Buildings		Outdoor	
	low	high	low	high	low	high	low	high
MTBE [2)]	—	—	—	—	0.96	1.6	—	—
Benzene	7.2	9.0	8.4	11	0.94	4.3	1.2	4.9
Ethylbenzene	0.97	1.8	6.0	11	0.74	2.9	0.83	3.1
Toluene	8.2	8.3	88	330	3.6	14	2.0	19
Xylenes	4.4	5.8	31.6	51.1	2.5	14.7	2.0	17.1
Cumene	1.9	2.5	1.3	2.6	0.77	2.1	2.0	2.0
1,3,5-TMB [3)]	—	—	1.4	3.9	0.87	1.3	1.6	1.6
1,2,4-TMB [4)]	1.2	1.3	3.9	11	0.78	4.0	0.92	3.6

Footnotes:

1) All concentrations are given in µg/m^3
2) methyl tert-butyl ether
3) 1,3,5-trimethylbenzene
4) 1,2,4-trimethylbenzene

It is apparent that the concentrations of VOCs found indoors on the second floor of the PB Lab were higher than in the other buildings and higher than outdoor air. In particular, the lowest concentrations of ethylbenzene, toluene, and total xylenes detected in the PB Lab were higher than the highest concentrations of those same compounds found in all other buildings combined. These results indicate that sources in the PB Lab were likely contributing to the concentrations of VOCs in this space.

5.1.2 Outdoor Ambient Air Samples

From the discussion above, it can be seen that the range of VOC concentrations detected in samples of outdoor air overlap the range of the same compounds detected in air from all of the buildings except for the PB Lab. While benzene, toluene, xylenes, and 1,2,4-TMB were found in more than 50% of the outdoor air samples as shown in Table 3, MTBE, cumene, and 1,3,5-TMB were less prevalent in outdoor air than in indoor air.

With the exceptions of the 440 Building and the PB Lab noted previously, the range of concentrations of VOCs were similar in indoor and outdoor air.

6.0 Comparison of Inside Samples to Applicable Exposure Limits

6.1 OCCUPATIONAL EXPOSURE LIMITS

OELs published as OSHA PELs and ACGIH TLVs® are presented in Table 3 for all constituents for which these were available. ACGIH TLVs are health-based values and refer to concentrations of chemicals to which it is believed nearly all workers may be repeatedly exposed, day after day, over a working lifetime, without adverse health effects. The majority of OSHA PELs are based on 1969 TLVs with the exception that some have been updated as chemical-specific standards to reflect more current toxicological data and research (e.g., benzene).

As shown by Table 3, the concentrations of all detected compounds inside the buildings and in outdoor air samples are more than 100 times lower than the lowest OEL (benzene).

6.2 RISK-BASED SCREENING LEVELS

US EPA RSLs and PADEP IAQ criteria concentrations for exposure to constituents in air in industrial settings are presented on Table 3 and discussed briefly below.

6.2.1 US EPA RSLs

US EPA RSLs for carcinogenic chemicals are derived to correspond to an excess lifetime cancer risk of 1 in 1,000,000 (1 in 1 million or 1E-06) for a person (receptor) who is assumed to be exposed to that concentration over an extended period of time (twenty-five (25) years for industrial). The RSL concentrations for cancer health effects (MTBE, benzene, and ethylbenzene) were multiplied by a factor of 10 to correspond to the Pennsylvania target risk of 1 in 100,000 (1 in one hundred thousand or 1E-05). To put the conservatism of the risk-based screening levels for cancer health effects into perspective, between 1 in 4 and 1 in 3 people in the United States develop some type of cancer during their lifetime.

RSLs for chemicals that produce adverse non-cancer effects are concentrations that are very unlikely to produce health effects in people who are exposed over many years. Concentrations of constituents below applicable RSL concentrations are generally not considered to be of concern for public health. Concentrations above RSLs do not necessarily mean that adverse health effects will occur, but do indicate that additional evaluation may be appropriate. All RSL concentrations for non-cancer health effects (toluene, all xylene isomers, cumene and both trimethylbenzene isomers) correspond to a Hazard Quotient (HQ) of 1.0. The HQ is the ratio of the potential exposure to the chemical on a daily basis to the level of exposure at which no non-cancer adverse health effects would be expected to occur. Like the risk-based screening levels for cancer as a health outcome, screening levels for non-cancer health effects are also extremely conservative (protective). No adjustments to non-cancer screening level concentrations were required because both the EPA RSLs and PADEP IAQ criteria were derived to correspond to HQ of 1.0.

6.2.2 PADEP Indoor Air Quality Criteria

Similar to the US EPA RSLs, the PADEP IAQ criteria for evaluating vapor intrusion into non-residential buildings are derived using risk-based algorithms. The concentrations correspond to a target cancer risk of 1E-05 and HQ of 1.0. These values were developed as guidelines for remediation and were published in the Land Recycling Program Technical Guidance Manual (January 24, 2004). For the majority of the compounds found in this investigation, the US EPA RSLs and PADEP IAQ criteria values are similar. The most notable exception is toluene, where the EPA RSL is approximately ten (10) times higher than the PADEP IAQ criteria. It should also be noted that the PADEP criteria were published in 2004 and the EPA RSLs are current as of November 2012.

The PADEP odor thresholds are also shown on Table 3. None of the petroleum-related compounds selected for analysis in indoor or outdoor samples were detected in concentrations approaching or exceeding these published odor thresholds.

6.2.3 Comparison of Results to Risk-Based Screening Levels

As can be seen from Table 3, none of the concentrations of VOCs detected in either samples of indoor air or outdoor air were higher than the corresponding risk-based screening levels for long-term exposure in an industrial setting. The highest concentration of benzene found in the second floor of the PB Lab (11 µg/m^3) was equal to the PADEP industrial (non-residential) IAQ criteria, but slightly less than the current (November 2012) EPA RSL (16 µg/m^3) adjusted to a cancer risk of 1E-05.

7.0 Summary and Conclusions

With the exception of the concentrations of all chemicals found in the air of the PB Lab, and for benzene in the 440 Building, the average indoor concentrations of VOCs were similar to the average outdoor concentrations.

The concentrations of all chemicals detected in indoor and outdoor air were several orders of magnitude less than the OSHA PEL TWAs and the ACGIH TLV® TWAs. No concentration of any chemical remotely approached the corresponding odor threshold listed by PADEP.

The maximum concentrations of all chemicals detected in all samples were equal to (benzene in the PB Lab) or less than the corresponding conservative risk-based US EPA RSL and the PADEP IAQ criteria for exposure in industrial environments. Note that the US EPA RSL concentrations for chemicals with cancer health effects (MTBE, benzene, and ethylbenzene) were multiplied by a factor of ten (10) to reflect a target cancer risk of 1 in 100,000 or 1E-05 which is consistent with the Pennsylvania risk-based standards. US EPA RSLs are derived to correspond to a target cancer risk of 1 in 1,000,000 or 1E-06. Non-cancer screening criteria (toluene, xylenes, 1,3,5-TMB and 1,2,4-TMB) correspond to a HQ of 1.0.

In general, the concentrations of petroleum-related VOCs found in the air inside and outside of the buildings were low, considering that the facility is a petroleum refinery. The concentrations of individual VOCs found during this investigation can be put into perspective by comparing the results to regional ambient air concentrations reported by PADEP.

Regional ambient air quality in the Philadelphia area where the refinery is located is best represented by data from the Marcus Hook monitoring station (latitude 39.8178, longitude -75.4142). The table below shows the arithmetic mean indoor and outdoor concentrations of benzene, toluene, ethylbenzene, xylenes (m-, p- isomers), 1,3,5-trimethylbenzene, and 1,2,4-trimethylbenzene documented at the facility alongside regional outdoor air concentrations from the Marcus Hook monitoring station (PADEP 2003).

Comparison of Concentrations Detected to Regional Air [1)]

Compound	***Facility Results [2)]***		***Marcus Hook [3)]***
	Indoors	***Outdoors***	
Benzene	2.9 (±2.45)	2.62 (±1.48)	2.84
Ethylbenzene	1.77 (±1.99)	1.97 (±1.61)	0.91
Toluene	18.77 (±56.76)	7.61 (±5.65)	5.46
Xylenes (m,p)	5.67 (±7.44)	4.86 (±4.59)	2.91
1,3,5-TMB [4)]	1.53 (±1.06)	1.6	0.34
1,2,4-TMB [5)]	1.96 (±1.91)	1.69 (±1.29)	0.88

Footnotes:

1) All concentrations are given in µg/m^3
2) *Mean (Standard Deviation)* values from Table 3
3) From PADEP 2003
4) 1,3,5-trimethylbenzene
5) 1,2,4-trimethylbenzene

As would be expected, the concentrations of petroleum-related compounds in the outdoor air at the facility were somewhat higher than regional background. However, the average concentrations of benzene in both indoor and outdoor air at the facility were similar to the annual average concentration reported for the Marcus Hook monitoring station in 2000 (PADEP 2003). As discussed previously, the arithmetic mean of the toluene concentrations from all of the indoor air samples is highly influenced by the concentrations detected in the PB Lab.

In conclusion, the findings of this study show that the concentrations of volatile organic compounds associated with refinery operations found in indoor and outdoor air were orders of magnitude lower than occupational exposure standards, and lower than or equal to (benzene only) conservative risk-based screening levels published by US EPA and PADEP for long-term exposures in industrial (non-residential) settings. The concentrations of petroleum-related compounds detected in the air inside occupied buildings on the former Sunoco Philadelphia Refinery are not anticipated to pose an adverse health risk for persons working in those buildings.

8.0 References

Agency for Toxic Substances and Disease Registry (ATSDR), Toxicological Profile for Benzene, August, 2007.

American Conference of Governmental Industrial Hygienists, Threshold Limit Values for Chemical Substances, ACGIH Publication No. 0113, 2013.

Pennsylvania Department of Environmental Protection (PADEP), Bureau of Land Recycling and Land Management, Technical Guidance Manual-Section IV.A.4 Vapor Intrusion into Buildings from Groundwater and Soil under the Act 2 Statewide Health Standard. Table 3-Indoor Air Criteria, January 24, 2004.

Pennsylvania Department of Environmental Protection, Southern Delaware County Air Monitoring Project, Third Interim Report. Table 2.3, July 31, 2003. (http://www.dep.state.pa.us/dep/deputate/airwaste/aq/toxics/projects/sdel/sdelrpt3.pdf)

Code of Federal Regulations Chapter 29 Part 1910, Occupational Safety and Health Standards, Subpart Z – Toxic and Hazardous Substances, Table Z-1 Limits for Air Contaminants. (http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9992)

US EPA Regional Screening Levels Table, November 2012.

US EPA, Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition. Compendium Method TO-15. Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially-Prepared Canisters and Analyzed by Gas Chromatography/ Mass Spectrometry (GC/MS). January 1999.

FIGURE

SOURCE: BASEMAP PROVIDED BY LANGAN ENGINEERING AND ENVIRONMENTAL SERVICES

N

LEGEND

- OUTDOOR AIR SAMPLING LOCATION
- AREA OF INTEREST
- BUILDING LOCATION FOR INDOOR AIR SAMPLING

FIGURE 1

SITE PLAN

FOR SUNOCO

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

0 250 500 FEET

SCALE: AS SHOWN
DATE: 8/29/2013
DRN: TFB
CHD: JLM

TABLES

Table 1: Sample Locations and Parameters - Sunoco Philadelphia Refinery									
Sample No.	**Location/Description**	**Date**	**Start Time**	**Stop Time**	**Sample Duration (hr:min)**	**Canister ID**	**Regulator ID**	**Pre-Sample Pressure, (PSI) [1]**	**Post-Sample Pressure, (PSI) [1]**
1	B&S Office	10/24/2012	10:35	14:35	4:00	AC01003	FCA00317	29.5	8.0
2	B&S Office (outside)	10/24/2012	10:37	14:39	4:02	AC00760	FCA00595	29.5	13.0
3	24 Gate Building (1st floor)	10/24/2012	10:50	14:50	4:00	AC01853	FCA00134	29.5	7.0
4	24 Gate Building (2nd floor)	10/24/2012	10:52	14:52	4:00	AC01010	FCA00188	29.6	7.3
5	GP Training Building (1st floor vending area)	10/24/2012	11:07	15:07	4:00	AC01928	FCA00161	29.5	9.0
6	GP Training Building (1st floor west)	10/24/2012	11:10	15:10	4:00	AC01669	FCA00564	29.5	9.0
7	GP Training Building (3rd floor gym)	10/24/2012	11:12	15:13	4:01	AC00641	FCA00023	29.5	6.5
8	GP Training Building (basement)	10/24/2012	11:10	15:16	4:06	AC00747	FCA00604	29.5	7.5
9	GP Main Office Building (basement west)	10/24/2012	12:26	16:26	4:00	AC01113	FCA00575	29.5	7.0
10	GP Main Office Building (basement center)	10/24/2012	12:31	16:31	4:00	AC01436	FCA00521	29.4	10.0
11	GP Main Office Building (basement east)	10/24/2012	12:33	16:33	4:00	AC01376	FCA00349	29.4	8.0
12	GP Main Office Building (1st floor entrance)	10/24/2012	12:36	16:37	4:01	AC00672	FCA00198	29.4	4.8
13	GP Main Office Building (1st floor west)	10/24/2012	12:48	16:48	4:00	AC00475	FCA00402	29.5	3.5
14	GP Main Office Building (2nd floor west)	10/24/2012	12:54	16:54	4:00	AC01263	FCA00516	29.4	9.5
15	GP Main Office Building (2nd floor east)	10/24/2012	12:40	16:40	4:00	AC01145	FCA00374	29.4	6.5
16	GP Main Office Building (outside west)	10/24/2012	12:44	16:44	4:00	AC00782	FCA00298	29.6	0.0
17	440 Building (2nd floor Room 221, inspection)	10/24/2012	13:10	17:10	4:00	AC01215	FCA00365	29.5	8.0
18	440 Building (2nd floor meeting room)	10/24/2012	13:13	17:13	4:00	AC01670	FCA00319	29.6	5.5
19	15 Pump House (inside)	10/24/2012	13:27	17:27	4:00	AC01930	FCA00016	29.5	7.0
20	15 Pump House (under roof w/ pump equipment, approximately 8-10' below grade)	10/24/2012	13:30	17:30	4:00	AC01420	FCA00397	29.5	6.3
21	15 Pump House (outside, at grade)	10/24/2012	13:35	17:35	4:00	AC01464	FCA00034	29.5	3.0
22	North Yard Scale House (inside)	10/24/2012	13:51	17:51	4:00	AC00590	FCA00168	29.5	7.8
23	North Yard Scale House (outside)	10/25/2012	8:17	12:18	4:01	AC01664	FCA00422	29.0	11.0
24	“Trip blank,” regulator attached, unopened	10/25/2012	---	---	---	AC01830	FCA00480	29.4	29.4

Table 1: Sample Locations and Parameters - Sunoco Philadelphia Refinery

Sample No.	Location/Description	Date	Start Time	Stop Time	Sample Duration (hr:min)	Canister ID	Regulator ID	Pre-Sample Pressure, (PSI) [1]	Post-Sample Pressure, (PSI) [1]
25	"Trip blank," regulator attached, unopened	10/25/2012	---	---	---	AC01093	FCA00058	29.5	29.5
26	SRTF Propane Loading (inside)	10/25/2012	8:59	12:59	4:00	AC00540	FCA00482	29.3	8.5
27	SRTF Main Pump House (inside)	10/25/2012	9:07	13:08	4:01	AC01810	FCA00609	29.4	8.0
28	SRTF Main Pump House (outside)	10/25/2012	9:10	13:10	4:00	AC01350	FCA00454	29.5	5.0
29	PB Main Office Building, (safety office)	10/25/2012	8:23	12:23	4:00	AC00716	FCA00239	29.5	0.0
30	PB Main Office Building, (medical area)	10/25/2012	8:29	12:29	4:00	AC00501	FCA00015	29.5	6.0
31	PB Main Office Building, (1st floor lobby)	10/25/2012	8:34	12:34	4:00	AC00765	FCA00303	29.5	5.8
32	PB Main Office Building,(1st floor east wing)	10/25/2012	8:37	12:37	4:00	AC01403	FCA00432	29.5	10.0
33	PB Main Office Building, (1st floor west wing)	10/25/2012	8:41	12:41	4:00	AC01573	FCA00449	29.5	3.0
34	PB Main Office Building, (2nd floor west wing)	10/25/2012	8:44	12:44	4:00	AC00947	FCA00632	29.5	5.0
35	PB Main Office Building, (2nd floor center file room)	10/25/2012	8:48	12:48	4:00	AC00033	FCA00473	29.5	4.0
36	PB Main Office Building, (2nd floor east conference room)	10/25/2012	8:51	12:51	4:00	AC01790	FCA00538	29.5	3.5
37	PB Lab (west lab)	10/25/2012	9:00	13:00	4:00	AC01886	FCA00274	29.5	5.0
38	PB Lab (2nd floor office)	10/25/2012	9:08	13:08	4:00	AC01487	FCA00418	29.5	4.5
39	PB Refinery Hall (2nd floor conference room)	10/25/2012	9:40	13:40	4:00	AC01115	FCA00563	29.6	6.5
40	PB Refinery Hall (2nd floor east wing)	10/25/2012	9:43	13:43	4:00	AC01243	FCA00603	29.4	2.0
41	PB Maintenance Shop (break room)	10/25/2012	9:51	13:51	4:00	AC01218	FCA00405	29.6	9.0
42	PB Maintenance Shop (office)	10/25/2012	9:55	13:55	4:00	AC01179	FCA00040	29.6	4.8
43	PB buildings (adjacent gate area)	10/25/2012	10:00	14:00	4:00	AC00870	FCA00215	29.5	6.0
44	"Trip blank," regulator attached, unopened	10/25/2012	---	---	---	AC00993	FCA00619	29.5	29.5

1. PSI = pounds per square inch

Table 2: Laboratory Analytical Results – Select Volatile Organic Compounds (VOCs) - Sunoco Philadelphia Refinery [1,2,3]

Sample	Type[4]	Location/Description	Methyl Tertiary Butyl Ether (MTBE)	1,2-dichloroethane	Benzene	Toluene	1,2 Dibromoethane	Ethylbenzene	m,p-Xylene	o-Xylene	total Xylene	Cumene	1,3,5-Trimethyl benzene	1,2,4-Trimethyl benzene
1	I	B&S Office	ND[5]	ND	4.3	7.4	ND	1.3	4.5	1.6	6.1	2.1	ND	1.5
3	I	24 Gate Building (1st floor)	ND	ND	2.1	7.0	ND	1.5	4.0	1.5	5.5	1.0	ND	1.7
4	I	24 Gate Building (2nd floor)	ND	ND	1.8	6.8	ND	1.2	3.8	1.4	5.2	ND	ND	1.5
5	I	GP Training Building (1st floor vending area)	ND	ND	3.5	7.2	ND	1.3	3.7	1.4	5.1	1.0	ND	1.6
6	I	GP Training Building (1st floor west)	ND	ND	4.2	7.5	ND	2.2	4.6	1.7	6.3	1.3	ND	1.8
7	I	GP Training Building (3rd floor gym)	ND	ND	4.2	12	ND	1.8	6.3	2.2	8.5	2.0	1.2	4.0
8	I	GP Training Building (basement)	ND	ND	3.1	7.8	ND	1.5	4.9	1.8	6.7	1.5	0.97	3.2
9	I	GP Main Office Building (basement west)	ND	ND	2.3	6.9	ND	1.3	4.2	1.5	5.7	1.4	ND	1.6
10	I	GP Main Office Building (basement center)	ND	ND	2.2	6.9	ND	1.2	3.6	1.3	4.9	1.0	ND	1.3
11	I	GP Main Office Building (basement east)	ND	ND	1.6	6.1	ND	0.86	2.7	1.0	3.7	ND	ND	0.93
12	I	GP Main Office Building (1st floor entrance)	ND	ND	1.7	6.2	ND	0.99	2.9	1.1	4.0	ND	ND	1.0
13	I	GP Main Office Building (1st floor west)	ND	ND	1.5	5.6	ND	0.86	2.6	0.96	3.56	ND	ND	ND
14	I	GP Main Office Building (2nd floor west)	ND	ND	1.6	6	ND	1.1	3.0	1.1	4.1	0.79	ND	1.0
15	I	GP Main Office Building (2nd floor east)	ND	ND	1.9	6.4	ND	1.2	3.4	1.2	4.6	1.0	ND	1.2
17	I	440 Building (2nd floor Room 221, inspection)	ND	ND	9.0	8.3	ND	1.8	4.3	1.5	5.8	2.5	ND	1.3
18	I	440 Building (2nd floor meeting room)	ND	ND	7.2	8.2	ND	0.97	3.2	1.2	4.4	1.9	ND	1.2
19	I	15 Pump House (inside)	ND	ND	3.6	14	ND	2.9	11	3.7	14.7	0.77	1.3	3.3
22	I	North Yard Scale House (inside)	ND	ND	1.7	9.2	ND	1.7	4.6	1.5	6.1	0.85	ND	1.2
26	I	SRTF Propane Loading (inside)	ND	ND	2.1	4.0	ND	0.99	3.8	1.3	5.1	1.1	ND	1.4
27	I	SRTF Main Pump House (inside)	ND	ND	2.3	3.6	ND	ND	3	1.1	4.1	ND	ND	ND
29	I	PB Main Office Building, (safety office)	ND	ND	1.6	6.5	ND	0.95	3.3	1.1	4.4	ND	ND	0.99
30	I	PB Main Office Building, (medical area)	ND	ND	1.2	4.4	ND	ND	2.3	0.87	3.17	ND	ND	1.1
31	I	PB Main Office Building, (1st floor lobby)	ND	ND	1.3	4.8	ND	ND	2.5	0.91	3.41	ND	ND	0.94
32	I	PB Main Office Building,(1st floor east wing)	ND	ND	1.3	5.2	ND	ND	2.5	ND	2.5	ND	ND	ND
33	I	PB Main Office Building, (1st floor west wing)	ND	ND	1.4	5	ND	0.93	3.5	1.1	4.6	ND	ND	0.97
34	I	PB Main Office Building, (2nd floor west wing)	ND	ND	1.3	4.9	ND	0.89	3.3	1.3	4.6	ND	ND	1.1

Table 2: Laboratory Analytical Results – Select Volatile Organic Compounds (VOCs) - Sunoco Philadelphia Refinery [1,2,3]

Sample	Type[4]	Location/Description	Methyl Tertiary Butyl Ether (MTBE)	1,2-dichloroethane	Benzene	Toluene	1,2 Dibromoethane	Ethylbenzene	m,p-Xylene	o-Xylene	total Xylene	Cumene	1,3,5-Trimethyl benzene	1,2,4-Trimethyl benzene
35	I	PB Main Office Building, (2nd floor center file room)	ND	ND	1.2	5.9	ND	1.0	3.7	1.4	5.1	ND	ND	0.95
36	I	PB Main Office Building, (2nd floor east conf. room)	ND	ND	0.94	4.0	ND	0.74	2.5	0.97	3.47	ND	ND	0.78
37	I	PB Lab (west lab)	ND	ND	11	88	ND	11	42	9.1	51.1	1.3	1.4	3.9
38	I	PB Lab (2nd floor office)	ND	ND	8.4	330	ND	6.0	24	7.6	31.6	2.6	3.9	11
39	I	PB Refinery Hall (2nd floor conference room)	0.96	ND	1.4	6.4	ND	1.1	3.9	1.4	5.3	ND	ND	1.1
40	I	PB Refinery Hall (2nd floor east wing)	1.6	ND	2.0	8.8	ND	1.4	5.4	1.8	7.2	ND	ND	1.5
41	I	PB Maintenance Shop (break room)	ND	ND	1.8	9.0	ND	1.3	5.2	1.9	7.1	ND	1.1	3.1
42	I	PB Maintenance Shop (office)	ND	ND	1.7	8.2	ND	1.1	4.6	1.7	6.3	ND	0.87	2.5
2	O	B&S Office (outside)	ND	ND	3.9	6.5	ND	ND	3.7	1.4	5.1	2.0	ND	1.3
16	O	GP Main Office Building (outside west)	ND	ND	1.3	4.6	ND	ND	2.0	ND	2.0	ND	ND	ND
20	O	15 Pump House (under roof w/ pump equipment, approximately 8-10' below grade)	ND	ND	2.1	7.4	ND	0.83	2.8	1.1	3.9	ND	ND	0.92
21	O	15 Pump House (outside, at grade)	ND	ND	4.9	19	ND	3.1	13	4.1	17.1	ND	1.6	3.6
23	O	North Yard Scale House (outside)	ND	ND	ND	3.8	ND	ND	ND	ND	ND	ND	ND	ND
28	O	SRTF Main Pump House (outside)	ND	ND	2.3	2	ND	ND	ND	ND	ND	ND	ND	ND
43	O	PB buildings (adjacent gate area)	ND	ND	1.2	10	ND	ND	2.8	0.99	3.79	ND	ND	0.93
24	TB	"Trip blank" - not opened	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
25	TB	"Trip blank" - not opened	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
44	TB	"Trip blank" - not opened	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

1. All units are in micrograms per cubic meter of air (ug/m^3) by volume
2. All samples were analyzed utilizing EPA Method TO-15.
3. Copies of Laboratory Analytical Results are provided as Appendix A.
4. "I"=Indoor air sample; "O"=Outdoor air sample; "TB"= Trip Blank, SUMMA canisters which were not opened, used for QA/QC.
5. "ND"=Non-Detect

Table 3: Summary Statistics – Select Volatile Organic Compounds (VOCs) - Sunoco Philadelphia Refinery [1,2,3]

	Analytes	Methyl Tertiary Butyl Ether (MTBE)	1,2-dichloroethane	Benzene	Toluene	1,2 Dibromoethane	Ethyl benzene	mp-Xylene	o-Xylene	total Xylene	Cumene	1,3,5-Trimethyl benzene	1,2,4-Trimethyl benzene
	Health Effects [4,5]	c	c	c	nc	c	c	nc	nc	nc	nc	nc	nc
Occupational and Risk-Based Screening Criteria													
	OSHA PELs [6]	--	2.02E+05	3.19E+03	7.54E+05	1.54E+05	4.34E+05	4.34E+05	4.34E+05	4.34E+05	2.46E+05	--	--
	ACGIH TLVs® [6]	1.80E+05	4.05E+04	1.60E+03	7.54E+04	--	8.68E+04	4.34E+05	4.34E+05	4.34E+05	2.46E+05	1.23E+05	1.23E+05
	EPA RSLs Industrial[7]	4.70E+02	7.70E+01	1.60E+01	2.20E+04	2.00E-01	4.90E+01	4.40E+02	4.40E+02	4.40E+02	1.80E+03	3.10E+01	3.10E+01
	PADEP IAQ Industrial [8]	3.10E+02	3.10E+00	1.10E+01	1.20E+03	3.70E-01	7.30E+01	3.00E+02	3.00E+02	3.00E+02	1.10E+03	1.70E+01	1.70E+01
	PADEP Odor	1.90E+02	2.40E+04	2.70E+03	6.40E+02	1.92E+05	6.08E+05	2.00E+03	2.00E+03	2.00E+03	6.00E+01	--	--
Summary Statistics for Indoor Samples													
Indoor	Number - total	34	34	34	34	34	34	34	34	34	34	34	34
	Non-Detects	32	34	0	0	34	4	0	1	0	17	27	3
	Detects	2	0	34	34	0	30	34	33	34	17	7	31
	Minimum	0.96	--	0.94	3.6	--	0.74	2.3	0.87	3.17	0.77	0.87	0.78
	Maximum	1.6	--	11	330	--	11	42	9.1	51.1	2.6	3.9	11
	Median	1.28	--	1.85	6.85	--	1.2	3.75	1.4	5.1	1.3	1.2	1.3
	Mean	1.28	--	2.90	18.77	--	1.77	5.67	1.85	7.50	1.42	1.53	1.96
	Std. Deviation	0.45	--	2.45	56.76	--	1.99	7.44	1.76	9.15	0.59	1.06	1.91
Summary Statistics for Outdoor Samples													
Outdoor	Number - total	7	7	7	7	7	7	7	7	7	7	7	7
	Non-Detects	7	7	1	0	7	5	2	3	2	6	6	3
	Detects	0	0	6	7	0	2	5	4	5	1	1	4
	Minimum	.	.	1.2	2	.	0.83	2	0.99	2.85	2	1.6	0.92
	Maximum	.	.	4.9	19	.	3.1	13	4.1	17.1	2	1.6	3.6
	Median	.	.	2.2	6.5	.	1.965	2.8	1.25	3.9	2	1.6	1.115
	Mean	.	.	2.62	7.61	.	1.97	4.86	1.90	6.55	2.00	1.60	1.69
	Std. Deviation	.	.	1.48	5.65	.	1.61	4.59	1.48	5.95	.	.	1.29

1. All units are in micrograms per cubic meter of air (ug/m^3)
2. All samples were analyzed utilizing EPA Method TO-15.
3. VOCs were not detected in any of the three "Trip Blank" SUMMA canisters.
4. "c" – EPA classifies as Carcinogen
5. "nc" – EPA classifies as Non-Carcinogen.
6. Occupational Safety and Health Permissible Exposure Limits (OSHA PELs) and American Conference of Industrial Hygienists Threshold Limit Values (TLVs®) were converted from parts per billion (ppb) to ug/m^3 using the following formula: ug/m^3=(ppb*MW)/24.45.
7. US EPA Regional Screening Levels, November 2012, adjusted to 1E-05 for carcinogens; HI of 1.0 for non-carcinogens.
8. Pennsylvania Department of Environmental Protection (PADEP), Bureau of Land Recycling and Land Management, Technical Guidance Manual-Section IV.A.4 Vapor Intrusion into buildings from Groundwater and Soil under the Act 2 Statewide Health Standard. January 24, 2004 (Table 3-Indoor Air Criteria).

APPENDIX A

LABORATORY REPORT

November 8, 2012

John Reiter
Stantec Consulting Services, Inc.
12075 Corporate Pkwy, Ste. 200
Mequon, WI 53092

RE: Sunoco IH Air Testing / 213402094

Dear John:

Enclosed are the results of the samples submitted to our laboratory on October 31, 2012. For your reference, these analyses have been assigned our service request number P1204493.

All analyses were performed according to our laboratory's NELAP and DoD-ELAP-approved quality assurance program. The test results meet requirements of the current NELAP and DoD-ELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP and DoD-ELAP-accredited analytes, refer to the certifications section at www.caslab.com. Results are intended to be considered in their entirety and apply only to the samples analyzed and reported herein.

Columbia Analytical Services, Inc. dba ALS Environmental (ALS) is certified by the California Department of Health Services, NELAP Laboratory Certificate No. 02115CA; Arizona Department of Health Services, Certificate No. AZ0694; Florida Department of Health, NELAP Certification E871020; New Jersey Department of Environmental Protection, NELAP Laboratory Certification ID #CA009; New York State Department of Health, NELAP NY Lab ID No: 11221; Oregon Environmental Laboratory Accreditation Program, NELAP ID: CA200007; The American Industrial Hygiene Association, Laboratory #101661; United States Department of Defense Environmental Laboratory Accreditation Program (DoD-ELAP), Certificate No. L11-203; Pennsylvania Registration No. 68-03307; TX Commission of Environmental Quality, NELAP ID T104704413-12-3; Minnesota Department of Health, NELAP Certificate No. 362188; Washington State Department of Ecology, ELAP Lab ID: C946, State of Utah Department of Health, NELAP Certificate No. CA01527Z012-Z; Los Angeles Department of Building and Safety, Approval No: TA00001. Each of the certifications listed above have an explicit Scope of Accreditation that applies to specific matrices/methods/analytes; therefore, please contact me for information corresponding to a particular certification.

If you have any questions, please call me at (805) 526-7161.

Respectfully submitted,

ALS | Environmental

Samantha Henningsen
Project Manager

Client: Stantec Consulting Services, Inc. Service Request No: P1204493
Project: Sunoco IH Air Testing / 213402094

CASE NARRATIVE

The samples were received intact under chain of custody on October 31, 2012 and were stored in accordance with the analytical method requirements. Please refer to the sample acceptance check form for additional information. The results reported herein are applicable only to the condition of the samples at the time of sample receipt.

Volatile Organic Compound Analysis

The samples were analyzed for selected volatile organic compounds in accordance with EPA Method TO-15 from the Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition (EPA/625/R-96/010b), January, 1999. The analytical system was comprised of a gas chromatograph / mass spectrometer (GC/MS) interfaced to a whole-air preconcentrator.

DETAIL SUMMARY REPORT

Client: Stantec Consulting Services, Inc.
Service Request: P1204493
Project ID: Sunoco IH Air Testing / 213402094

Date Received: 10/31/2012
Time Received: 09:10

Client Sample ID	Lab Code	Matrix	Date Collected	Time Collected	Container ID	Pi1 (psig)	Pf1 (psig)	TO-15 - VOC Cans
Sample 1	P1204493-001	Air	10/24/2012	14:35	AC01003	-3.85	3.67	X
Sample 2	P1204493-002	Air	10/24/2012	14:39	AC00760	-6.54	3.79	X
Sample 3	P1204493-003	Air	10/24/2012	14:50	AC01853	-3.60	3.61	X
Sample 4	P1204493-004	Air	10/24/2012	14:52	AC01010	-3.29	3.63	X
Sample 5	P1204493-005	Air	10/24/2012	15:07	AC01928	-3.21	3.60	X
Sample 6	P1204493-006	Air	10/24/2012	15:10	AC01669	-4.20	3.70	X
Sample 7	P1204493-007	Air	10/24/2012	15:13	AC00641	-3.08	3.75	X
Sample 8	P1204493-008	Air	10/24/2012	15:16	AC00747	-3.67	3.78	X
Sample 9	P1204493-009	Air	10/24/2012	16:26	AC01113	-3.10	3.67	X
Sample 10	P1204493-010	Air	10/24/2012	16:31	AC01436	-5.08	3.56	X
Sample 11	P1204493-011	Air	10/24/2012	16:33	AC01376	-3.84	3.74	X
Sample 12	P1204493-012	Air	10/24/2012	16:37	AC00672	-2.29	3.58	X
Sample 13	P1204493-013	Air	10/24/2012	16:40	AC01145	-4.00	3.75	X
Sample 14	P1204493-014	Air	10/24/2012	16:44	AC00782	0.31	3.62	X
Sample 15	P1204493-015	Air	10/24/2012	16:48	AC00475	-1.47	3.55	X
Sample 16	P1204493-016	Air	10/24/2012	16:54	AC01263	-3.77	3.76	X
Sample 17	P1204493-017	Air	10/24/2012	17:10	AC01215	-2.97	3.72	X
Sample 18	P1204493-018	Air	10/24/2012	17:13	AC01670	-2.52	3.64	X
Sample 19	P1204493-019	Air	10/24/2012	17:27	AC01930	-2.75	3.57	X
Sample 20	P1204493-020	Air	10/24/2012	17:30	AC01420	-3.07	3.72	X
Sample 21	P1204493-021	Air	10/24/2012	17:35	AC01464	-1.69	3.65	X
Sample 22	P1204493-022	Air	10/24/2012	17:51	AC00590	-2.29	3.77	X
Sample 24 TB	P1204493-023	Air	10/24/2012	00:00	AC01830	-14.50	3.68	X

Columbia Analytical Services

2655 Park Center Drive, Suite A
Simi Valley, California 93065
Phone (805) 526-7161
Fax (805) 526-7270

Air - Chain of Custody Record & Analytical Service Request

Requested Turnaround Time in Business Days (Surcharges) please circle
1 Day (100%) 2 Day (75%) 3 Day (50%) 4 Day (35%) 5 Day (25%) 10 Day-Standard

CAS Project No. P1204493

Company Name & Address (Reporting Information)	Stantec 12075 Corporate Pkwy Mequon, WI 53092
Project Manager	John Reiter
Phone	262-643-9154
Fax	262-241-4901
Email Address for Result Reporting	John.Reiter@Stantec.com
Project Name	Sunoco IH Airtesting
Project Number	21340294
P.O. # / Billing Information	John Reiter
Sampler (Print & Sign)	
CAS Contact:	

Client Sample ID	Laboratory ID Number	Date Collected	Time Collected	Canister ID (Bar code # - AC, SC, etc.)	Flow Controller ID (Bar code #- FC #)	Canister Start Pressure "Hg	Canister End Pressure "Hg/psig	Sample Volume	Analysis Method	Comments e.g. Actual Preservative or specific instructions
Sample 1	1-3.54	10/24/12	10:35 14:35	AC01003	FCA00317	29.5	8			
Sample 2	2-6.55	10/24/12	10:37 14:39	AC00760	FCA00595	29.5	13.0			
Sample 3	3-3.63	10/24/12	10:50 14:50	AC01853	FCA00134	29.5	7.0			
Sample 4	4-3.33	10/24/12	10:53 14:53	AC01010	FCA00188	29.6	7.25			
Sample 5	5-3.14	10/24/12	11:07 15:07	AC01928	FCA00161	29.5	9.0			
Sample 6	6-4.21	10/24/12	11:10 15:10	AC01689	FCA00564	29.5	9.0			
Sample 7	7-3.57	10/24/12	11:13 15:13	AC00641	FCA00023	29.5	6.5			
Sample 8	8-3.67	10/24/12	11:16 15:16	AC00747	FCA00604	29.5	7.5			
Sample 9	9-3.14	10/24/12	12:26 16:26	AC01113	FCA00575	29.5	7.0			
Sample 10	10-5.11	10/24/12	12:31 16:31	AC01436	FCA00521	29.4	10.0			
Sample 11	11-3.87	10/24/12	12:33 16:33	AC01376	FCA00344	29.4	8.0			
Sample 12	12-2.33	10/24/12	12:36 16:37	AC00672	FCA00198	29.4	4.75			
Sample 13	13-4.03	10/24/12	12:40 16:40	AC00[redacted]145	FCA00374	29.4	6.5			
Sample 14	14-0.85	10/24/12	12:39 16:44	AC00782	FCA00298	29.6	0.0			

Report Tier Levels - please select

Tier I - Results (Default if not specified) _____
Tier II (Results + QC Summaries) _____
Tier III (Results + QC & Calibration Summaries) _____
Tier IV (Data Validation Package) 10% Surcharge _____

EDD required Yes / No
Type: _____

Project Requirements (MRLs, QAPP)

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:
	10/24/12	1830		10/25/12	0910
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:

Cooler / Blank Temperature ___ °C

Columbia Analytical Services
2655 Park Center Drive, Suite A
Simi Valley, California 93065
Phone (805) 526-7161
Fax (805) 526-7270

Air - Chain of Custody Record & Analytical Service Request

Requested Turnaround Time in Business Days (Surcharges) please circle
1 Day (100%) 2 Day (75%) 3 Day (50%) 4 Day (35%) 5 Day (25%) 10 Day-Standard

CAS Project No. R12-344493

CAS Contact:

Analysis Method

Company Name & Address (Reporting Information)
Stantec
12075 Corporate Pkwy
Mequon, WI 53092

Project Name: Sunoco IH Air Testing

Project Number: 2134102094

Project Manager: John Reiter

P.O. # / Billing Information: John Reiter

Phone: 262-643-9154 Fax: 262-241-4901

Email Address for Result Reporting: John.reiter@stantec.com

Sampler (Print & Sign): Richard Page

Comments e.g. Actual Preservative or specific instructions

Client Sample ID	Laboratory ID Number	Date Collected	Time Collected	Canister ID (Bar code # - AC, SC, etc.)	Flow Controller ID (Bar code #- FC #)	Canister Start Pressure "Hg	Canister End Pressure "Hg/psig	Sample Volume			Comments
Sample 15	(15)-1.53	10/24/12	12:48 16:49	AC00475	FCA00402	29.5	3.5				
Sample 16	(16)-3.82	10/24/12	12:58 16:54	AC01263	FCA00516	29.4	9.5				
Sample 17	(17)-3.04	10/24/12	13:10 17:10	AC01215	FCA00365	29.5	8.0				
Sample 18	(18)-2.63	10/24/12	13:13 17:13	AC01670	FCA00319	29.6	5.5				
Sample 19	(19)-2.77	10/24/12	13:27 17:27	AC01930	FCA00016	29.5	7.0				
Sample 20	(20)-3.14	10/24/12	13:38 17:38	AC01420	FCA00397	29.5	6.25				
Sample 21	(21)-1.76	10/24/12	13:35 17:35	AC01464	FAC00034	29.5	3.0				
Sample 22	(22)-2.34	10/24/12	13:51 17:51	AC00590	FCA00168	29.8	7.75				
~~Sample 23~~		~~10/24/12~~	~~13:54~~	~~AC01664~~	~~FCA00422~~	~~29.5~~					Not Collected
Sample 24TB	(23)-14.47	10/24/12	—	AC01830	—	29.4	29.4				

Report Tier Levels - please select
Tier I - Results (Default if not specified) _____
Tier II (Results + QC Summaries) _____
Tier III (Results + QC & Calibration Summaries) _____
Tier IV (Data Validation Package) 10% Surcharge _____
EDD required Yes / No
Type: _____

Project Requirements (MRLs, QAPP)

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:
	10/24/12	18:30		10/25/12	0910
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:

Cooler / Blank Temperature ____ °C

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Sample Acceptance Check Form

Client: Stantec Consulting Services, Inc. Work order: P1204493

Project: Sunoco IH Air Testing / 213402094

Sample(s) received on: 10/31/12 Date opened: 10/31/12 by: MZAMORA

Note: This form is used for all samples received by CAS. The use of this form for custody seals is strictly meant to indicate presence/absence and not as an indication of compliance or nonconformity. Thermal preservation and pH will only be evaluated either at the request of the client and/or as required by the method/SOP.

		Yes	No	N/A
1	Were **sample containers** properly marked with client sample ID?	☒	☐	☐
2	Container(s) **supplied by CAS**?	☒	☐	☐
3	Did **sample containers** arrive in good condition?	☒	☐	☐
4	Were **chain-of-custody** papers used and filled out?	☒	☐	☐
5	Did **sample container labels** and/or tags agree with custody papers?	☒	☐	☐
6	Was **sample volume** received adequate for analysis?	☒	☐	☐
7	Are samples within specified holding times?	☒	☐	☐
8	Was proper **temperature** (thermal preservation) of cooler at receipt adhered to?	☐	☐	☒
9	Was a **trip blank** received?	☐	☒	☐
10	Were **custody seals** on outside of cooler/Box?	☐	☒	☐
	Location of seal(s)? _____ Sealing Lid?	☐	☐	☒
	Were signature and date included?	☐	☐	☒
	Were seals intact?	☐	☐	☒
	Were custody seals on outside of sample container?	☐	☒	☐
	Location of seal(s)? _____ Sealing Lid?	☐	☐	☒
	Were signature and date included?	☐	☐	☒
	Were seals intact?	☐	☐	☒
11	Do containers have appropriate **preservation**, according to method/SOP or Client specified information?	☐	☐	☒
	Is there a client indication that the submitted samples are **pH** preserved?	☐	☐	☒
	Were **VOA vials** checked for presence/absence of air bubbles?	☐	☐	☒
	Does the client/method/SOP require that the analyst check the sample pH and if necessary alter it?	☐	☐	☒
12	**Tubes:** Are the tubes capped and intact?	☐	☐	☒
	Do they contain moisture?	☐	☐	☒
13	**Badges:** Are the badges properly capped and intact?	☐	☐	☒
	Are dual bed badges separated and individually capped and intact?	☐	☐	☒

Lab Sample ID	Container Description	Required pH *	Received pH	Adjusted pH	VOA Headspace (Presence/Absence)	Receipt / Preservation Comments
P1204493-001.01	6.0 L Ambient Can					
P1204493-002.01	6.0 L Ambient Can					
P1204493-003.01	6.0 L Ambient Can					
P1204493-004.01	6.0 L Ambient Can					
P1204493-005.01	6.0 L Ambient Can					
P1204493-006.01	6.0 L Ambient Can					
P1204493-007.01	6.0 L Ambient Can					
P1204493-008.01	6.0 L Ambient Can					

Explain any discrepancies: (include lab sample ID numbers): _____

RSK - MEEPP, HCL (pH<2); RSK - CO2, (pH 5-8); Sulfur (pH>4)

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Sample Acceptance Check Form

Client: Stantec Consulting Services, Inc. Work order: P1204493

Project: Sunoco IH Air Testing / 213402094

Sample(s) received on: 10/31/12 Date opened: 10/31/12 by: MZAMORA

Lab Sample ID	Container Description	Required pH *	Received pH	Adjusted pH	VOA Headspace (Presence/Absence)	Receipt / Preservation Comments
P1204493-009.01	6.0 L Ambient Can					
P1204493-010.01	6.0 L Ambient Can					
P1204493-011.01	6.0 L Ambient Can					
P1204493-012.01	6.0 L Ambient Can					
P1204493-013.01	6.0 L Ambient Can					
P1204493-014.01	6.0 L Ambient Can					
P1204493-015.01	6.0 L Ambient Can					
P1204493-016.01	6.0 L Ambient Can					
P1204493-017.01	6.0 L Ambient Can					
P1204493-018.01	6.0 L Ambient Can					
P1204493-019.01	6.0 L Ambient Can					
P1204493-020.01	6.0 L Ambient Can					
P1204493-021.01	6.0 L Ambient Can					
P1204493-022.01	6.0 L Ambient Can					
P1204493-023.01	6.0 L Ambient Can					

Explain any discrepancies: (include lab sample ID numbers):

RSK - MEEPP, HCL (pH<2); RSK - CO2, (pH 5-8); Sulfur (pH>4)

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 1** CAS Project ID: P1204493
Client Project ID: **Sunoco IH Air Testing / 213402094** CAS Sample ID: P1204493-001

Test Code: EPA TO-15 Date Collected: 10/24/12
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9 Date Received: 10/31/12
Analyst: Wida Ang Date Analyzed: 11/3/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AC01003

Initial Pressure (psig): -3.85 Final Pressure (psig): 3.67

Canister Dilution Factor: 1.69

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.85	ND	0.23	
107-06-2	1,2-Dichloroethane	ND	0.85	ND	0.21	
71-43-2	Benzene	**4.3**	0.85	**1.3**	0.26	
108-88-3	Toluene	**7.4**	0.85	**2.0**	0.22	
106-93-4	1,2-Dibromoethane	ND	0.85	ND	0.11	
100-41-4	Ethylbenzene	**1.3**	0.85	**0.31**	0.19	
179601-23-1	m,p-Xylenes	**4.5**	1.7	**1.0**	0.39	
95-47-6	o-Xylene	**1.6**	0.85	**0.37**	0.19	
98-82-8	Cumene	**2.1**	0.85	**0.43**	0.17	
108-67-8	1,3,5-Trimethylbenzene	ND	0.85	ND	0.17	
95-63-6	1,2,4-Trimethylbenzene	**1.5**	0.85	**0.30**	0.17	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 2** CAS Project ID: P1204493
Client Project ID: **Sunoco IH Air Testing / 213402094** CAS Sample ID: P1204493-002

Test Code: EPA TO-15 Date Collected: 10/24/12
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9 Date Received: 10/31/12
Analyst: Wida Ang Date Analyzed: 11/3/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AC00760

Initial Pressure (psig): -6.54 Final Pressure (psig): 3.79

Canister Dilution Factor: 2.27

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	1.1	ND	0.31	
107-06-2	1,2-Dichloroethane	ND	1.1	ND	0.28	
71-43-2	Benzene	**3.9**	1.1	**1.2**	0.36	
108-88-3	Toluene	**6.5**	1.1	**1.7**	0.30	
106-93-4	1,2-Dibromoethane	ND	1.1	ND	0.15	
100-41-4	Ethylbenzene	ND	1.1	ND	0.26	
179601-23-1	m,p-Xylenes	**3.7**	2.3	**0.86**	0.52	
95-47-6	o-Xylene	**1.4**	1.1	**0.32**	0.26	
98-82-8	Cumene	**2.0**	1.1	**0.40**	0.23	
108-67-8	1,3,5-Trimethylbenzene	ND	1.1	ND	0.23	
95-63-6	1,2,4-Trimethylbenzene	**1.3**	1.1	**0.26**	0.23	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 3**
Client Project ID: **Sunoco IH Air Testing / 213402094**

CAS Project ID: P1204493
CAS Sample ID: P1204493-003

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AC01853

Date Collected: 10/24/12
Date Received: 10/31/12
Date Analyzed: 11/3/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -3.60 Final Pressure (psig): 3.61

Canister Dilution Factor: 1.65

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.83	ND	0.23	
107-06-2	1,2-Dichloroethane	ND	0.83	ND	0.20	
71-43-2	Benzene	**2.1**	0.83	**0.66**	0.26	
108-88-3	Toluene	**7.0**	0.83	**1.9**	0.22	
106-93-4	1,2-Dibromoethane	ND	0.83	ND	0.11	
100-41-4	Ethylbenzene	**1.5**	0.83	**0.35**	0.19	
179601-23-1	m,p-Xylenes	**4.0**	1.7	**0.93**	0.38	
95-47-6	o-Xylene	**1.5**	0.83	**0.35**	0.19	
98-82-8	Cumene	**1.0**	0.83	**0.21**	0.17	
108-67-8	1,3,5-Trimethylbenzene	ND	0.83	ND	0.17	
95-63-6	1,2,4-Trimethylbenzene	**1.7**	0.83	**0.35**	0.17	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 4** CAS Project ID: P1204493
Client Project ID: **Sunoco IH Air Testing / 213402094** CAS Sample ID: P1204493-004

Test Code: EPA TO-15 Date Collected: 10/24/12
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9 Date Received: 10/31/12
Analyst: Wida Ang Date Analyzed: 11/3/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AC01010

Initial Pressure (psig): -3.29 Final Pressure (psig): 3.63

Canister Dilution Factor: 1.61

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.81	ND	0.22	
107-06-2	1,2-Dichloroethane	ND	0.81	ND	0.20	
71-43-2	Benzene	**1.8**	0.81	**0.56**	0.25	
108-88-3	Toluene	**6.8**	0.81	**1.8**	0.21	
106-93-4	1,2-Dibromoethane	ND	0.81	ND	0.10	
100-41-4	Ethylbenzene	**1.2**	0.81	**0.28**	0.19	
179601-23-1	m,p-Xylenes	**3.8**	1.6	**0.88**	0.37	
95-47-6	o-Xylene	**1.4**	0.81	**0.33**	0.19	
98-82-8	Cumene	ND	0.81	ND	0.16	
108-67-8	1,3,5-Trimethylbenzene	ND	0.81	ND	0.16	
95-63-6	1,2,4-Trimethylbenzene	**1.5**	0.81	**0.31**	0.16	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 5**
Client Project ID: **Sunoco IH Air Testing / 213402094**

CAS Project ID: P1204493
CAS Sample ID: P1204493-005

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AC01928

Date Collected: 10/24/12
Date Received: 10/31/12
Date Analyzed: 11/3/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -3.21 Final Pressure (psig): 3.60

Canister Dilution Factor: 1.59

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.80	ND	0.22	
107-06-2	1,2-Dichloroethane	ND	0.80	ND	0.20	
71-43-2	Benzene	**3.5**	0.80	**1.1**	0.25	
108-88-3	Toluene	**7.2**	0.80	**1.9**	0.21	
106-93-4	1,2-Dibromoethane	ND	0.80	ND	0.10	
100-41-4	Ethylbenzene	**1.3**	0.80	**0.31**	0.18	
179601-23-1	m,p-Xylenes	**3.7**	1.6	**0.86**	0.37	
95-47-6	o-Xylene	**1.4**	0.80	**0.32**	0.18	
98-82-8	Cumene	**1.0**	0.80	**0.21**	0.16	
108-67-8	1,3,5-Trimethylbenzene	ND	0.80	ND	0.16	
95-63-6	1,2,4-Trimethylbenzene	**1.6**	0.80	**0.33**	0.16	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 6**
Client Project ID: **Sunoco IH Air Testing / 213402094**

CAS Project ID: P1204493
CAS Sample ID: P1204493-006

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AC01669

Date Collected: 10/24/12
Date Received: 10/31/12
Date Analyzed: 11/3/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -4.20 Final Pressure (psig): 3.70

Canister Dilution Factor: 1.75

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.88	ND	0.24	
107-06-2	1,2-Dichloroethane	ND	0.88	ND	0.22	
71-43-2	Benzene	**4.2**	0.88	**1.3**	0.27	
108-88-3	Toluene	**7.5**	0.88	**2.0**	0.23	
106-93-4	1,2-Dibromoethane	ND	0.88	ND	0.11	
100-41-4	Ethylbenzene	**2.2**	0.88	**0.50**	0.20	
179601-23-1	m,p-Xylenes	**4.6**	1.8	**1.1**	0.40	
95-47-6	o-Xylene	**1.7**	0.88	**0.38**	0.20	
98-82-8	Cumene	**1.3**	0.88	**0.26**	0.18	
108-67-8	1,3,5-Trimethylbenzene	ND	0.88	ND	0.18	
95-63-6	1,2,4-Trimethylbenzene	**1.8**	0.88	**0.37**	0.18	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 7**
Client Project ID: **Sunoco IH Air Testing / 213402094**

CAS Project ID: P1204493
CAS Sample ID: P1204493-007

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AC00641

Date Collected: 10/24/12
Date Received: 10/31/12
Date Analyzed: 11/3/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -3.08 Final Pressure (psig): 3.75

Canister Dilution Factor: 1.59

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.80	ND	0.22	
107-06-2	1,2-Dichloroethane	ND	0.80	ND	0.20	
71-43-2	Benzene	**4.2**	0.80	**1.3**	0.25	
108-88-3	Toluene	**12**	0.80	**3.1**	0.21	
106-93-4	1,2-Dibromoethane	ND	0.80	ND	0.10	
100-41-4	Ethylbenzene	**1.8**	0.80	**0.41**	0.18	
179601-23-1	m,p-Xylenes	**6.3**	1.6	**1.4**	0.37	
95-47-6	o-Xylene	**2.2**	0.80	**0.51**	0.18	
98-82-8	Cumene	**2.0**	0.80	**0.41**	0.16	
108-67-8	1,3,5-Trimethylbenzene	**1.2**	0.80	**0.25**	0.16	
95-63-6	1,2,4-Trimethylbenzene	**4.0**	0.80	**0.82**	0.16	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 8** CAS Project ID: P1204493
Client Project ID: **Sunoco IH Air Testing / 213402094** CAS Sample ID: P1204493-008

Test Code: EPA TO-15 Date Collected: 10/24/12
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9 Date Received: 10/31/12
Analyst: Wida Ang Date Analyzed: 11/3/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AC00747

Initial Pressure (psig): -3.67 Final Pressure (psig): 3.78

Canister Dilution Factor: 1.68

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.84	ND	0.23	
107-06-2	1,2-Dichloroethane	ND	0.84	ND	0.21	
71-43-2	Benzene	**3.1**	0.84	**0.97**	0.26	
108-88-3	Toluene	**7.8**	0.84	**2.1**	0.22	
106-93-4	1,2-Dibromoethane	ND	0.84	ND	0.11	
100-41-4	Ethylbenzene	**1.5**	0.84	**0.34**	0.19	
179601-23-1	m,p-Xylenes	**4.9**	1.7	**1.1**	0.39	
95-47-6	o-Xylene	**1.8**	0.84	**0.42**	0.19	
98-82-8	Cumene	**1.5**	0.84	**0.30**	0.17	
108-67-8	1,3,5-Trimethylbenzene	**0.97**	0.84	**0.20**	0.17	
95-63-6	1,2,4-Trimethylbenzene	**3.2**	0.84	**0.65**	0.17	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 9** CAS Project ID: P1204493
Client Project ID: **Sunoco IH Air Testing / 213402094** CAS Sample ID: P1204493-009

Test Code: EPA TO-15 Date Collected: 10/24/12
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9 Date Received: 10/31/12
Analyst: Wida Ang Date Analyzed: 11/3/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AC01113

Initial Pressure (psig): -3.10 Final Pressure (psig): 3.67

Canister Dilution Factor: 1.58

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.79	ND	0.22	
107-06-2	1,2-Dichloroethane	ND	0.79	ND	0.20	
71-43-2	Benzene	**2.3**	0.79	**0.72**	0.25	
108-88-3	Toluene	**6.9**	0.79	**1.8**	0.21	
106-93-4	1,2-Dibromoethane	ND	0.79	ND	0.10	
100-41-4	Ethylbenzene	**1.3**	0.79	**0.29**	0.18	
179601-23-1	m,p-Xylenes	**4.2**	1.6	**0.97**	0.36	
95-47-6	o-Xylene	**1.5**	0.79	**0.36**	0.18	
98-82-8	Cumene	**1.4**	0.79	**0.28**	0.16	
108-67-8	1,3,5-Trimethylbenzene	ND	0.79	ND	0.16	
95-63-6	1,2,4-Trimethylbenzene	**1.6**	0.79	**0.32**	0.16	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 10** CAS Project ID: P1204493
Client Project ID: **Sunoco IH Air Testing / 213402094** CAS Sample ID: P1204493-010

Test Code: EPA TO-15 Date Collected: 10/24/12
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9 Date Received: 10/31/12
Analyst: Wida Ang Date Analyzed: 11/3/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AC01436

Initial Pressure (psig): -5.08 Final Pressure (psig): 3.56

Canister Dilution Factor: 1.90

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.95	ND	0.26	
107-06-2	1,2-Dichloroethane	ND	0.95	ND	0.23	
71-43-2	Benzene	**2.2**	0.95	**0.69**	0.30	
108-88-3	Toluene	**6.9**	0.95	**1.8**	0.25	
106-93-4	1,2-Dibromoethane	ND	0.95	ND	0.12	
100-41-4	Ethylbenzene	**1.2**	0.95	**0.27**	0.22	
179601-23-1	m,p-Xylenes	**3.6**	1.9	**0.83**	0.44	
95-47-6	o-Xylene	**1.3**	0.95	**0.31**	0.22	
98-82-8	Cumene	**1.0**	0.95	**0.20**	0.19	
108-67-8	1,3,5-Trimethylbenzene	ND	0.95	ND	0.19	
95-63-6	1,2,4-Trimethylbenzene	**1.3**	0.95	**0.26**	0.19	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 11**
Client Project ID: **Sunoco IH Air Testing / 213402094**

CAS Project ID: P1204493
CAS Sample ID: P1204493-011

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AC01376

Date Collected: 10/24/12
Date Received: 10/31/12
Date Analyzed: 11/5/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -3.84 Final Pressure (psig): 3.74

Canister Dilution Factor: 1.70

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.85	ND	0.24	
107-06-2	1,2-Dichloroethane	ND	0.85	ND	0.21	
71-43-2	Benzene	**1.6**	0.85	**0.50**	0.27	
108-88-3	Toluene	**6.1**	0.85	**1.6**	0.23	
106-93-4	1,2-Dibromoethane	ND	0.85	ND	0.11	
100-41-4	Ethylbenzene	**0.86**	0.85	**0.20**	0.20	
179601-23-1	m,p-Xylenes	**2.7**	1.7	**0.63**	0.39	
95-47-6	o-Xylene	**1.0**	0.85	**0.24**	0.20	
98-82-8	Cumene	ND	0.85	ND	0.17	
108-67-8	1,3,5-Trimethylbenzene	ND	0.85	ND	0.17	
95-63-6	1,2,4-Trimethylbenzene	**0.93**	0.85	**0.19**	0.17	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 12**
Client Project ID: **Sunoco IH Air Testing / 213402094**

CAS Project ID: P1204493
CAS Sample ID: P1204493-012

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AC00672

Date Collected: 10/24/12
Date Received: 10/31/12
Date Analyzed: 11/5/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -2.29 Final Pressure (psig): 3.58

Canister Dilution Factor: 1.47

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.74	ND	0.20	
107-06-2	1,2-Dichloroethane	ND	0.74	ND	0.18	
71-43-2	Benzene	**1.7**	0.74	**0.54**	0.23	
108-88-3	Toluene	**6.2**	0.74	**1.6**	0.20	
106-93-4	1,2-Dibromoethane	ND	0.74	ND	0.096	
100-41-4	Ethylbenzene	**0.99**	0.74	**0.23**	0.17	
179601-23-1	m,p-Xylenes	**2.9**	1.5	**0.67**	0.34	
95-47-6	o-Xylene	**1.1**	0.74	**0.25**	0.17	
98-82-8	Cumene	ND	0.74	ND	0.15	
108-67-8	1,3,5-Trimethylbenzene	ND	0.74	ND	0.15	
95-63-6	1,2,4-Trimethylbenzene	**1.0**	0.74	**0.21**	0.15	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 13**
Client Project ID: **Sunoco IH Air Testing / 213402094**

CAS Project ID: P1204493
CAS Sample ID: P1204493-013

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AC01145

Date Collected: 10/24/12
Date Received: 10/31/12
Date Analyzed: 11/6/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -4.00 Final Pressure (psig): 3.75

Canister Dilution Factor: 1.72

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.86	ND	0.24	
107-06-2	1,2-Dichloroethane	ND	0.86	ND	0.21	
71-43-2	Benzene	**1.5**	0.86	**0.47**	0.27	
108-88-3	Toluene	**5.6**	0.86	**1.5**	0.23	
106-93-4	1,2-Dibromoethane	ND	0.86	ND	0.11	
100-41-4	Ethylbenzene	**0.86**	0.86	**0.20**	0.20	
179601-23-1	m,p-Xylenes	**2.6**	1.7	**0.60**	0.40	
95-47-6	o-Xylene	**0.96**	0.86	**0.22**	0.20	
98-82-8	Cumene	ND	0.86	ND	0.18	
108-67-8	1,3,5-Trimethylbenzene	ND	0.86	ND	0.18	
95-63-6	1,2,4-Trimethylbenzene	ND	0.86	ND	0.18	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 14** CAS Project ID: P1204493
Client Project ID: **Sunoco IH Air Testing / 213402094** CAS Sample ID: P1204493-014

Test Code: EPA TO-15 Date Collected: 10/24/12
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9 Date Received: 10/31/12
Analyst: Wida Ang Date Analyzed: 11/5/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AC00782

Initial Pressure (psig): 0.31 Final Pressure (psig): 3.62

Canister Dilution Factor: 1.22

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.61	ND	0.17	
107-06-2	1,2-Dichloroethane	ND	0.61	ND	0.15	
71-43-2	Benzene	**1.6**	0.61	**0.51**	0.19	
108-88-3	Toluene	**6.0**	0.61	**1.6**	0.16	
106-93-4	1,2-Dibromoethane	ND	0.61	ND	0.079	
100-41-4	Ethylbenzene	**1.1**	0.61	**0.26**	0.14	
179601-23-1	m,p-Xylenes	**3.0**	1.2	**0.70**	0.28	
95-47-6	o-Xylene	**1.1**	0.61	**0.26**	0.14	
98-82-8	Cumene	**0.79**	0.61	**0.16**	0.12	
108-67-8	1,3,5-Trimethylbenzene	ND	0.61	ND	0.12	
95-63-6	1,2,4-Trimethylbenzene	**1.0**	0.61	**0.20**	0.12	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 15** CAS Project ID: P1204493
Client Project ID: **Sunoco IH Air Testing / 213402094** CAS Sample ID: P1204493-015

Test Code: EPA TO-15 Date Collected: 10/24/12
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9 Date Received: 10/31/12
Analyst: Wida Ang Date Analyzed: 11/5/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AC00475

Initial Pressure (psig): -1.47 Final Pressure (psig): 3.55

Canister Dilution Factor: 1.38

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.69	ND	0.19	
107-06-2	1,2-Dichloroethane	ND	0.69	ND	0.17	
71-43-2	Benzene	**1.9**	0.69	**0.61**	0.22	
108-88-3	Toluene	**6.4**	0.69	**1.7**	0.18	
106-93-4	1,2-Dibromoethane	ND	0.69	ND	0.090	
100-41-4	Ethylbenzene	**1.2**	0.69	**0.28**	0.16	
179601-23-1	m,p-Xylenes	**3.4**	1.4	**0.78**	0.32	
95-47-6	o-Xylene	**1.2**	0.69	**0.29**	0.16	
98-82-8	Cumene	**1.0**	0.69	**0.21**	0.14	
108-67-8	1,3,5-Trimethylbenzene	ND	0.69	ND	0.14	
95-63-6	1,2,4-Trimethylbenzene	**1.2**	0.69	**0.25**	0.14	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 16** CAS Project ID: P1204493
Client Project ID: **Sunoco IH Air Testing / 213402094** CAS Sample ID: P1204493-016

Test Code: EPA TO-15 Date Collected: 10/24/12
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9 Date Received: 10/31/12
Analyst: Wida Ang Date Analyzed: 11/5/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AC01263

Initial Pressure (psig): -3.77 Final Pressure (psig): 3.76

Canister Dilution Factor: 1.69

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.85	ND	0.23	
107-06-2	1,2-Dichloroethane	ND	0.85	ND	0.21	
71-43-2	Benzene	**1.3**	0.85	**0.42**	0.26	
108-88-3	Toluene	**4.6**	0.85	**1.2**	0.22	
106-93-4	1,2-Dibromoethane	ND	0.85	ND	0.11	
100-41-4	Ethylbenzene	ND	0.85	ND	0.19	
179601-23-1	m,p-Xylenes	**2.0**	1.7	**0.46**	0.39	
95-47-6	o-Xylene	ND	0.85	ND	0.19	
98-82-8	Cumene	ND	0.85	ND	0.17	
108-67-8	1,3,5-Trimethylbenzene	ND	0.85	ND	0.17	
95-63-6	1,2,4-Trimethylbenzene	ND	0.85	ND	0.17	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 17**
Client Project ID: **Sunoco IH Air Testing / 213402094**

CAS Project ID: P1204493
CAS Sample ID: P1204493-017

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AC01215

Date Collected: 10/24/12
Date Received: 10/31/12
Date Analyzed: 11/5/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -2.97 Final Pressure (psig): 3.72

Canister Dilution Factor: 1.57

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.79	ND	0.22	
107-06-2	1,2-Dichloroethane	ND	0.79	ND	0.19	
71-43-2	Benzene	**9.0**	0.79	**2.8**	0.25	
108-88-3	Toluene	**8.3**	0.79	**2.2**	0.21	
106-93-4	1,2-Dibromoethane	ND	0.79	ND	0.10	
100-41-4	Ethylbenzene	**1.8**	0.79	**0.41**	0.18	
179601-23-1	m,p-Xylenes	**4.3**	1.6	**0.98**	0.36	
95-47-6	o-Xylene	**1.5**	0.79	**0.34**	0.18	
98-82-8	Cumene	**2.5**	0.79	**0.50**	0.16	
108-67-8	1,3,5-Trimethylbenzene	ND	0.79	ND	0.16	
95-63-6	1,2,4-Trimethylbenzene	**1.3**	0.79	**0.25**	0.16	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 18** CAS Project ID: P1204493
Client Project ID: **Sunoco IH Air Testing / 213402094** CAS Sample ID: P1204493-018

Test Code: EPA TO-15 Date Collected: 10/24/12
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9 Date Received: 10/31/12
Analyst: Wida Ang Date Analyzed: 11/5/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AC01670

Initial Pressure (psig): -2.52 Final Pressure (psig): 3.64

Canister Dilution Factor: 1.51

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.76	ND	0.21	
107-06-2	1,2-Dichloroethane	ND	0.76	ND	0.19	
71-43-2	Benzene	**7.2**	0.76	**2.2**	0.24	
108-88-3	Toluene	**8.2**	0.76	**2.2**	0.20	
106-93-4	1,2-Dibromoethane	ND	0.76	ND	0.098	
100-41-4	Ethylbenzene	**0.97**	0.76	**0.22**	0.17	
179601-23-1	m,p-Xylenes	**3.2**	1.5	**0.75**	0.35	
95-47-6	o-Xylene	**1.2**	0.76	**0.28**	0.17	
98-82-8	Cumene	**1.9**	0.76	**0.39**	0.15	
108-67-8	1,3,5-Trimethylbenzene	ND	0.76	ND	0.15	
95-63-6	1,2,4-Trimethylbenzene	**1.2**	0.76	**0.24**	0.15	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 19** CAS Project ID: P1204493
Client Project ID: **Sunoco IH Air Testing / 213402094** CAS Sample ID: P1204493-019

Test Code: EPA TO-15 Date Collected: 10/24/12
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9 Date Received: 10/31/12
Analyst: Wida Ang Date Analyzed: 11/5/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AC01930

Initial Pressure (psig): -2.75 Final Pressure (psig): 3.57

Canister Dilution Factor: 1.53

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.77	ND	0.21	
107-06-2	1,2-Dichloroethane	ND	0.77	ND	0.19	
71-43-2	Benzene	**3.6**	0.77	**1.1**	0.24	
108-88-3	Toluene	**14**	0.77	**3.6**	0.20	
106-93-4	1,2-Dibromoethane	ND	0.77	ND	0.10	
100-41-4	Ethylbenzene	**2.9**	0.77	**0.66**	0.18	
179601-23-1	m,p-Xylenes	**11**	1.5	**2.6**	0.35	
95-47-6	o-Xylene	**3.7**	0.77	**0.85**	0.18	
98-82-8	Cumene	**0.77**	0.77	**0.16**	0.16	
108-67-8	1,3,5-Trimethylbenzene	**1.3**	0.77	**0.27**	0.16	
95-63-6	1,2,4-Trimethylbenzene	**3.3**	0.77	**0.68**	0.16	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 20**
Client Project ID: **Sunoco IH Air Testing / 213402094**

CAS Project ID: P1204493
CAS Sample ID: P1204493-020

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AC01420

Date Collected: 10/24/12
Date Received: 10/31/12
Date Analyzed: 11/6/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -3.07 Final Pressure (psig): 3.72

Canister Dilution Factor: 1.58

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.79	ND	0.22	
107-06-2	1,2-Dichloroethane	ND	0.79	ND	0.20	
71-43-2	Benzene	**2.1**	0.79	**0.65**	0.25	
108-88-3	Toluene	**7.4**	0.79	**2.0**	0.21	
106-93-4	1,2-Dibromoethane	ND	0.79	ND	0.10	
100-41-4	Ethylbenzene	**0.83**	0.79	**0.19**	0.18	
179601-23-1	m,p-Xylenes	**2.8**	1.6	**0.65**	0.36	
95-47-6	o-Xylene	**1.1**	0.79	**0.24**	0.18	
98-82-8	Cumene	ND	0.79	ND	0.16	
108-67-8	1,3,5-Trimethylbenzene	ND	0.79	ND	0.16	
95-63-6	1,2,4-Trimethylbenzene	**0.92**	0.79	**0.19**	0.16	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 21** CAS Project ID: P1204493
Client Project ID: **Sunoco IH Air Testing / 213402094** CAS Sample ID: P1204493-021

Test Code: EPA TO-15 Date Collected: 10/24/12
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9 Date Received: 10/31/12
Analyst: Wida Ang Date Analyzed: 11/5/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AC01464

Initial Pressure (psig): -1.69 Final Pressure (psig): 3.65

Canister Dilution Factor: 1.41

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.71	ND	0.20	
107-06-2	1,2-Dichloroethane	ND	0.71	ND	0.17	
71-43-2	Benzene	**4.9**	0.71	**1.5**	0.22	
108-88-3	Toluene	**19**	0.71	**5.0**	0.19	
106-93-4	1,2-Dibromoethane	ND	0.71	ND	0.092	
100-41-4	Ethylbenzene	**3.1**	0.71	**0.70**	0.16	
179601-23-1	m,p-Xylenes	**13**	1.4	**3.0**	0.32	
95-47-6	o-Xylene	**4.1**	0.71	**0.94**	0.16	
98-82-8	Cumene	ND	0.71	ND	0.14	
108-67-8	1,3,5-Trimethylbenzene	**1.6**	0.71	**0.33**	0.14	
95-63-6	1,2,4-Trimethylbenzene	**3.6**	0.71	**0.74**	0.14	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 22** CAS Project ID: P1204493
Client Project ID: **Sunoco IH Air Testing / 213402094** CAS Sample ID: P1204493-022

Test Code: EPA TO-15 Date Collected: 10/24/12
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9 Date Received: 10/31/12
Analyst: Wida Ang Date Analyzed: 11/5/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AC00590

Initial Pressure (psig): -2.29 Final Pressure (psig): 3.77

Canister Dilution Factor: 1.49

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.75	ND	0.21	
107-06-2	1,2-Dichloroethane	ND	0.75	ND	0.18	
71-43-2	Benzene	**1.7**	0.75	**0.53**	0.23	
108-88-3	Toluene	**9.2**	0.75	**2.4**	0.20	
106-93-4	1,2-Dibromoethane	ND	0.75	ND	0.097	
100-41-4	Ethylbenzene	**1.7**	0.75	**0.39**	0.17	
179601-23-1	m,p-Xylenes	**4.6**	1.5	**1.1**	0.34	
95-47-6	o-Xylene	**1.5**	0.75	**0.34**	0.17	
98-82-8	Cumene	**0.85**	0.75	**0.17**	0.15	
108-67-8	1,3,5-Trimethylbenzene	ND	0.75	ND	0.15	
95-63-6	1,2,4-Trimethylbenzene	**1.2**	0.75	**0.24**	0.15	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 24 TB**
Client Project ID: **Sunoco IH Air Testing / 213402094**

CAS Project ID: P1204493
CAS Sample ID: P1204493-023

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AC01830

Date Collected: 10/24/12
Date Received: 10/31/12
Date Analyzed: 11/5/12
Volume(s) Analyzed: 1.00 Liter(s)

Canister Dilution Factor: 1.00

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.50	ND	0.14	
107-06-2	1,2-Dichloroethane	ND	0.50	ND	0.12	
71-43-2	Benzene	ND	0.50	ND	0.16	
108-88-3	Toluene	ND	0.50	ND	0.13	
106-93-4	1,2-Dibromoethane	ND	0.50	ND	0.065	
100-41-4	Ethylbenzene	ND	0.50	ND	0.12	
179601-23-1	m,p-Xylenes	ND	1.0	ND	0.23	
95-47-6	o-Xylene	ND	0.50	ND	0.12	
98-82-8	Cumene	ND	0.50	ND	0.10	
108-67-8	1,3,5-Trimethylbenzene	ND	0.50	ND	0.10	
95-63-6	1,2,4-Trimethylbenzene	ND	0.50	ND	0.10	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Method Blank** CAS Project ID: P1204493
Client Project ID: **Sunoco IH Air Testing / 213402094** CAS Sample ID: P121103-MB

Test Code: EPA TO-15 Date Collected: NA
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9 Date Received: NA
Analyst: Wida Ang Date Analyzed: 11/3/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:

Canister Dilution Factor: 1.00

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.50	ND	0.14	
107-06-2	1,2-Dichloroethane	ND	0.50	ND	0.12	
71-43-2	Benzene	ND	0.50	ND	0.16	
108-88-3	Toluene	ND	0.50	ND	0.13	
106-93-4	1,2-Dibromoethane	ND	0.50	ND	0.065	
100-41-4	Ethylbenzene	ND	0.50	ND	0.12	
179601-23-1	m,p-Xylenes	ND	1.0	ND	0.23	
95-47-6	o-Xylene	ND	0.50	ND	0.12	
98-82-8	Cumene	ND	0.50	ND	0.10	
108-67-8	1,3,5-Trimethylbenzene	ND	0.50	ND	0.10	
95-63-6	1,2,4-Trimethylbenzene	ND	0.50	ND	0.10	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Method Blank** CAS Project ID: P1204493
Client Project ID: **Sunoco IH Air Testing / 213402094** CAS Sample ID: P121105-MB

Test Code: EPA TO-15 Date Collected: NA
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9 Date Received: NA
Analyst: Wida Ang Date Analyzed: 11/5/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:

Canister Dilution Factor: 1.00

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.50	ND	0.14	
107-06-2	1,2-Dichloroethane	ND	0.50	ND	0.12	
71-43-2	Benzene	ND	0.50	ND	0.16	
108-88-3	Toluene	ND	0.50	ND	0.13	
106-93-4	1,2-Dibromoethane	ND	0.50	ND	0.065	
100-41-4	Ethylbenzene	ND	0.50	ND	0.12	
179601-23-1	m,p-Xylenes	ND	1.0	ND	0.23	
95-47-6	o-Xylene	ND	0.50	ND	0.12	
98-82-8	Cumene	ND	0.50	ND	0.10	
108-67-8	1,3,5-Trimethylbenzene	ND	0.50	ND	0.10	
95-63-6	1,2,4-Trimethylbenzene	ND	0.50	ND	0.10	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Method Blank** CAS Project ID: P1204493
Client Project ID: **Sunoco IH Air Testing / 213402094** CAS Sample ID: P121106-MB

Test Code: EPA TO-15 Date Collected: NA
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9 Date Received: NA
Analyst: Wida Ang Date Analyzed: 11/6/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:

Canister Dilution Factor: 1.00

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.50	ND	0.14	
107-06-2	1,2-Dichloroethane	ND	0.50	ND	0.12	
71-43-2	Benzene	ND	0.50	ND	0.16	
108-88-3	Toluene	ND	0.50	ND	0.13	
106-93-4	1,2-Dibromoethane	ND	0.50	ND	0.065	
100-41-4	Ethylbenzene	ND	0.50	ND	0.12	
179601-23-1	m,p-Xylenes	ND	1.0	ND	0.23	
95-47-6	o-Xylene	ND	0.50	ND	0.12	
98-82-8	Cumene	ND	0.50	ND	0.10	
108-67-8	1,3,5-Trimethylbenzene	ND	0.50	ND	0.10	
95-63-6	1,2,4-Trimethylbenzene	ND	0.50	ND	0.10	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

SURROGATE SPIKE RECOVERY RESULTS

Client: **Stantec Consulting Services, Inc.**
Client Project ID: **Sunoco IH Air Testing / 213402094** CAS Project ID: P1204493

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9 Date(s) Collected: 10/24/12
Analyst: Wida Ang Date(s) Received: 10/31/12
Sample Type: 6.0 L Summa Canister(s) Date(s) Analyzed: 11/3 - 11/6/12
Test Notes:

Client Sample ID	CAS Sample ID	1,2-Dichloroethane-d4 Percent Recovered	Toluene-d8 Percent Recovered	Bromofluorobenzene Percent Recovered	Acceptance Limits	Data Qualifier
Method Blank	P121103-MB	**97**	**98**	**102**	70-130	
Method Blank	P121105-MB	**96**	**102**	**104**	70-130	
Method Blank	P121106-MB	**94**	**100**	**106**	70-130	
Lab Control Sample	P121103-LCS	**99**	**101**	**104**	70-130	
Lab Control Sample	P121105-LCS	**97**	**98**	**106**	70-130	
Lab Control Sample	P121106-LCS	**97**	**100**	**108**	70-130	
Sample 1	P1204493-001	**97**	**99**	**104**	70-130	
Sample 2	P1204493-002	**101**	**98**	**102**	70-130	
Sample 3	P1204493-003	**100**	**98**	**104**	70-130	
Sample 3	P1204493-003DUP	**98**	**95**	**103**	70-130	
Sample 4	P1204493-004	**102**	**96**	**105**	70-130	
Sample 5	P1204493-005	**97**	**98**	**106**	70-130	
Sample 6	P1204493-006	**98**	**98**	**105**	70-130	
Sample 7	P1204493-007	**98**	**96**	**107**	70-130	
Sample 8	P1204493-008	**96**	**100**	**108**	70-130	
Sample 9	P1204493-009	**99**	**98**	**107**	70-130	
Sample 10	P1204493-010	**97**	**100**	**105**	70-130	
Sample 11	P1204493-011	**98**	**98**	**106**	70-130	
Sample 12	P1204493-012	**95**	**101**	**106**	70-130	
Sample 13	P1204493-013	**96**	**97**	**107**	70-130	
Sample 14	P1204493-014	**96**	**101**	**107**	70-130	
Sample 15	P1204493-015	**97**	**100**	**103**	70-130	
Sample 15	P1204493-015DUP	**94**	**104**	**110**	70-130	
Sample 16	P1204493-016	**97**	**97**	**105**	70-130	
Sample 17	P1204493-017	**99**	**98**	**109**	70-130	
Sample 18	P1204493-018	**96**	**100**	**106**	70-130	
Sample 19	P1204493-019	**96**	**101**	**107**	70-130	
Sample 20	P1204493-020	**95**	**101**	**108**	70-130	
Sample 21	P1204493-021	**98**	**98**	**102**	70-130	
Sample 22	P1204493-022	**97**	**99**	**100**	70-130	
Sample 24 TB	P1204493-023	**94**	**105**	**103**	70-130	

Surrogate percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly from the on-column percent recovery.

LABORATORY CONTROL SAMPLE SUMMARY

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Lab Control Sample** CAS Project ID: P1204493
Client Project ID: **Sunoco IH Air Testing / 213402094** CAS Sample ID: P121103-LCS

Test Code: EPA TO-15 Date Collected: NA
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9 Date Received: NA
Analyst: Wida Ang Date Analyzed: 11/03/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 0.125 Liter(s)
Test Notes:

CAS #	Compound	Spike Amount µg/m³	Result µg/m³	% Recovery	CAS Acceptance Limits	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	204	**231**	**113**	67-116	
107-06-2	1,2-Dichloroethane	208	**220**	**106**	70-118	
71-43-2	Benzene	208	**214**	**103**	66-121	
108-88-3	Toluene	208	**211**	**101**	67-111	
106-93-4	1,2-Dibromoethane	208	**228**	**110**	73-122	
100-41-4	Ethylbenzene	206	**217**	**105**	71-117	
179601-23-1	m,p-Xylenes	412	**427**	**104**	70-116	
95-47-6	o-Xylene	200	**212**	**106**	70-116	
98-82-8	Cumene	196	**210**	**107**	70-116	
108-67-8	1,3,5-Trimethylbenzene	208	**230**	**111**	71-121	
95-63-6	1,2,4-Trimethylbenzene	200	**228**	**114**	73-127	

Laboratory Control Sample percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly.

LABORATORY CONTROL SAMPLE SUMMARY

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Lab Control Sample** CAS Project ID: P1204493
Client Project ID: **Sunoco IH Air Testing / 213402094** CAS Sample ID: P121105-LCS

Test Code: EPA TO-15 Date Collected: NA
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9 Date Received: NA
Analyst: Wida Ang Date Analyzed: 11/05/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 0.125 Liter(s)
Test Notes:

CAS #	Compound	Spike Amount µg/m³	Result µg/m³	% Recovery	CAS Acceptance Limits	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	204	**210**	**103**	67-116	
107-06-2	1,2-Dichloroethane	208	**199**	**96**	70-118	
71-43-2	Benzene	208	**199**	**96**	66-121	
108-88-3	Toluene	208	**191**	**92**	67-111	
106-93-4	1,2-Dibromoethane	208	**211**	**101**	73-122	
100-41-4	Ethylbenzene	206	**205**	**100**	71-117	
179601-23-1	m,p-Xylenes	412	**407**	**99**	70-116	
95-47-6	o-Xylene	200	**202**	**101**	70-116	
98-82-8	Cumene	196	**198**	**101**	70-116	
108-67-8	1,3,5-Trimethylbenzene	208	**216**	**104**	71-121	
95-63-6	1,2,4-Trimethylbenzene	200	**213**	**107**	73-127	

Laboratory Control Sample percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly.

LABORATORY CONTROL SAMPLE SUMMARY

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Lab Control Sample** CAS Project ID: P1204493
Client Project ID: **Sunoco IH Air Testing / 213402094** CAS Sample ID: P121106-LCS

Test Code: EPA TO-15 Date Collected: NA
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9 Date Received: NA
Analyst: Wida Ang Date Analyzed: 11/06/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 0.125 Liter(s)
Test Notes:

CAS #	Compound	Spike Amount µg/m³	Result µg/m³	% Recovery	CAS Acceptance Limits	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	204	**221**	**108**	67-116	
107-06-2	1,2-Dichloroethane	208	**209**	**100**	70-118	
71-43-2	Benzene	208	**203**	**98**	66-121	
108-88-3	Toluene	208	**202**	**97**	67-111	
106-93-4	1,2-Dibromoethane	208	**221**	**106**	73-122	
100-41-4	Ethylbenzene	206	**210**	**102**	71-117	
179601-23-1	m,p-Xylenes	412	**416**	**101**	70-116	
95-47-6	o-Xylene	200	**206**	**103**	70-116	
98-82-8	Cumene	196	**206**	**105**	70-116	
108-67-8	1,3,5-Trimethylbenzene	208	**226**	**109**	71-121	
95-63-6	1,2,4-Trimethylbenzene	200	**223**	**112**	73-127	

Laboratory Control Sample percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly.

LABORATORY DUPLICATE SUMMARY RESULTS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 3**
Client Project ID: **Sunoco IH Air Testing / 213402094**

CAS Project ID: P1204493
CAS Sample ID: P1204493-003DUP

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AC01853

Date Collected: 10/24/12
Date Received: 10/31/12
Date Analyzed: 11/3/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -3.60 Final Pressure (psig): 3.61

Canister Dilution Factor: 1.65

Compound	Sample Result µg/m³	Sample Result ppbV	Duplicate Sample Result **µg/m³**	Duplicate Sample Result ppbV	Average µg/m³	**% RPD**	RPD Limit	**Data Qualifier**
Methyl tert-Butyl Ether	ND	ND	ND	ND	-	-	25	
1,2-Dichloroethane	ND	ND	ND	ND	-	-	25	
Benzene	2.12	0.663	2.30	0.721	2.21	**8**	25	
Toluene	6.97	1.85	6.97	1.85	6.97	**0**	25	
1,2-Dibromoethane	ND	ND	ND	ND	-	-	25	
Ethylbenzene	1.53	0.352	1.58	0.364	1.555	**3**	25	
m,p-Xylenes	4.03	0.928	4.16	0.957	4.095	**3**	25	
o-Xylene	1.51	0.348	1.54	0.356	1.525	**2**	25	
Cumene	1.02	0.209	1.03	0.210	1.025	**1**	25	
1,3,5-Trimethylbenzene	ND	ND	ND	ND	-	-	25	
1,2,4-Trimethylbenzene	1.73	0.352	1.78	0.362	1.755	**3**	25	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.

LABORATORY DUPLICATE SUMMARY RESULTS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 15**
Client Project ID: **Sunoco IH Air Testing / 213402094**

CAS Project ID: P1204493
CAS Sample ID: P1204493-015DUP

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AC00475

Date Collected: 10/24/12
Date Received: 10/31/12
Date Analyzed: 11/5/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -1.47 Final Pressure (psig): 3.55

Canister Dilution Factor: 1.38

Compound	Sample Result µg/m³	Sample Result ppbV	Duplicate Sample Result µg/m³	Duplicate Sample Result ppbV	Average µg/m³	% RPD	RPD Limit	Data Qualifier
Methyl tert-Butyl Ether	ND	ND	ND	ND	-	-	25	
1,2-Dichloroethane	ND	ND	ND	ND	-	-	25	
Benzene	1.95	0.609	2.06	0.645	2.005	**5**	25	
Toluene	6.44	1.71	6.80	1.80	6.62	**5**	25	
1,2-Dibromoethane	ND	ND	ND	ND	-	-	25	
Ethylbenzene	1.21	0.279	1.21	0.279	1.21	**0**	25	
m,p-Xylenes	3.40	0.784	3.41	0.785	3.405	**0.3**	25	
o-Xylene	1.25	0.288	1.28	0.294	1.265	**2**	25	
Cumene	1.01	0.205	1.08	0.220	1.045	**7**	25	
1,3,5-Trimethylbenzene	ND	ND	ND	ND	-	-	25	
1,2,4-Trimethylbenzene	1.24	0.251	1.28	0.261	1.26	**3**	25	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.

LABORATORY REPORT

November 8, 2012

John Reiter
Stantec Consulting Services, Inc.
12075 Corporate Pkwy, Ste. 200
Mequon, WI 53092

RE: Sunoco IH Air Testing / 213402094

Dear John:

Enclosed are the results of the samples submitted to our laboratory on October 31, 2012. For your reference, these analyses have been assigned our service request number P1204494.

All analyses were performed according to our laboratory's NELAP and DoD-ELAP-approved quality assurance program. The test results meet requirements of the current NELAP and DoD-ELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP and DoD-ELAP-accredited analytes, refer to the certifications section at www.caslab.com. Results are intended to be considered in their entirety and apply only to the samples analyzed and reported herein.

Columbia Analytical Services, Inc. dba ALS Environmental (ALS) is certified by the California Department of Health Services, NELAP Laboratory Certificate No. 02115CA; Arizona Department of Health Services, Certificate No. AZ0694; Florida Department of Health, NELAP Certification E871020; New Jersey Department of Environmental Protection, NELAP Laboratory Certification ID #CA009; New York State Department of Health, NELAP NY Lab ID No: 11221; Oregon Environmental Laboratory Accreditation Program, NELAP ID: CA200007; The American Industrial Hygiene Association, Laboratory #101661; United States Department of Defense Environmental Laboratory Accreditation Program (DoD-ELAP), Certificate No. L11-203; Pennsylvania Registration No. 68-03307; TX Commission of Environmental Quality, NELAP ID T104704413-12-3; Minnesota Department of Health, NELAP Certificate No. 362188; Washington State Department of Ecology, ELAP Lab ID: C946, State of Utah Department of Health, NELAP Certificate No. CA01527Z012-Z; Los Angeles Department of Building and Safety, Approval No: TA00001. Each of the certifications listed above have an explicit Scope of Accreditation that applies to specific matrices/methods/analytes; therefore, please contact me for information corresponding to a particular certification.

If you have any questions, please call me at (805) 526-7161.

Respectfully submitted,

ALS | Environmental

Samantha Henningsen
Project Manager

Client: Stantec Consulting Services, Inc. Service Request No: P1204494
Project: Sunoco IH Air Testing / 213402094

CASE NARRATIVE

The samples were received intact under chain of custody on October 31, 2012 and were stored in accordance with the analytical method requirements. Please refer to the sample acceptance check form for additional information. The results reported herein are applicable only to the condition of the samples at the time of sample receipt.

Volatile Organic Compound Analysis

The samples were analyzed for selected volatile organic compounds in accordance with EPA Method TO-15 from the Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition (EPA/625/R-96/010b), January, 1999. The analytical system was comprised of a gas chromatograph / mass spectrometer (GC/MS) interfaced to a whole-air preconcentrator.

DETAIL SUMMARY REPORT

Client: Stantec Consulting Services, Inc.
Service Request: P1204494
Project ID: Sunoco IH Testing / 213402094

Date Received: 10/31/2012
Time Received: 09:10

Client Sample ID	Lab Code	Matrix	Date Collected	Time Collected	Container ID	Pi1 (psig)	Pf1 (psig)	TO-15 - VOC Cans
Sample 23	P1204494-001	Air	10/25/2012	12:17	AC01664	-6.14	3.79	X
Sample 25	P1204494-002	Air	10/25/2012	00:00	AC01093	-14.50	3.74	X
Sample 26	P1204494-003	Air	10/25/2012	12:59	AC00540	-3.15	3.59	X
Sample 27	P1204494-004	Air	10/25/2012	13:08	AC01810	-4.85	3.59	X
Sample 28	P1204494-005	Air	10/25/2012	13:10	AC01350	-2.60	3.71	X
Sample 29	P1204494-006	Air	10/25/2012	12:23	AC00716	-0.41	4.20	X
Sample 30	P1204494-007	Air	10/25/2012	12:29	AC00501	-2.50	3.61	X
Sample 31	P1204494-008	Air	10/25/2012	12:34	AC00765	-3.73	3.68	X
Sample 32	P1204494-009	Air	10/25/2012	12:37	AC01403	-5.30	3.76	X
Sample 33	P1204494-010	Air	10/25/2012	12:41	AC01573	-0.55	3.66	X
Sample 34	P1204494-011	Air	10/25/2012	12:44	AC00947	-2.79	3.49	X
Sample 35	P1204494-012	Air	10/25/2012	12:48	AC00033	-2.24	3.50	X
Sample 36	P1204494-013	Air	10/25/2012	12:51	AC01790	-2.23	3.48	X
Sample 37	P1204494-014	Air	10/25/2012	13:00	AC01886	-3.04	3.62	X
Sample 38	P1204494-015	Air	10/25/2012	13:08	AC01487	-2.38	3.62	X
Sample 39	P1204494-016	Air	10/25/2012	13:40	AC01115	-3.59	3.71	X
Sample 40	P1204494-017	Air	10/25/2012	13:43	AC01243	-0.40	3.96	X
Sample 41	P1204494-018	Air	10/25/2012	13:51	AC01218	-3.00	3.67	X
Sample 42	P1204494-019	Air	10/25/2012	13:55	AC01179	-1.52	3.71	X
Sample 43	P1204494-020	Air	10/25/2012	14:00	AC00870	-3.27	3.76	X
Sample 44	P1204494-021	Air	10/25/2012	10:05	AC00993	-14.47	3.72	X

Columbia Analytical Services

Air - Chain of Custody Record & Analytical Service Request

2655 Park Center Drive, Suite A
Simi Valley, California 93065
Phone (805) 526-7161
Fax (805) 526-7270

Requested Turnaround Time in Business Days (Surcharges) please circle
1 Day (100%) 2 Day (75%) 3 Day (50%) 4 Day (35%) 5 Day (25%) 10 Day-Standard

CAS Project No.: P1204494

CAS Contact:

Company Name & Address (Reporting Information): Stantec, 12075 Corporate Pky, Mequon, WI 53092

Project Name: Sunoco IH Testing

Project Number: 21340294

Project Manager: John Reiter

P.O. # / Billing Information: John Reiter

Phone: 262-

Fax: 262-241-4901

Email Address for Result Reporting: John.REITER@Stantec.com

Sampler (Print & Sign): Richard Pager

Analysis Method

Client Sample ID	Laboratory ID Number	Date Collected	Time Collected	Canister ID (Bar code # - AC, SC, etc.)	Flow Controller ID (Bar code # - FC #)	Canister Start Pressure "Hg	Canister End Pressure "Hg/psig	Sample Volume	Comments e.g. Actual Preservative or specific instructions
Sample 23	①-6.16	10/25/12	8:17 12:17	AC01664	FCA00422	29.0	11.0		
Sample 25	②-14.45	10/25/12		AC01093	FCA00058	29.5	—		Field Blank
Sample 26	③-3.18	10/25/12	8:59 12:59	AC00540	FCA00482	29.3	8.5		
Sample 27	④-4.58	10/25/12	9:07 13:07 ok	AC01830	FCA00609	29.4	8.0		
Sample 28	⑤-2.65	10/25/12	9:19 13:19	AC01350	FCA00454	29.5	5.0		
Sample 29	⑥-0.47	10/25/12	8:23 12:23	AC00716	FCA00239	29.5	0.0		
Sample 30	⑦-2.59	10/25/12	8:29 12:29	AC00501	FCA00015	29.5	6.0		
Sample 31	⑧-3.74	10/25/12	8:34 12:34	AC00765	FCA00303	29.5	5.75		
Sample 32	⑨-5.62	10/25/12	8:37 12:37	AC01403	FCA00432	29.5	10.0		
Sample 33	⑩-0.55	10/25/12	8:41 12:41	AC01573	FCA00449	29.5	3.0		
Sample 34	⑪-2.74	10/25/12	8:44 12:44	AC00947	FCA00632	29.5	5.0		
Sample 35	⑫-2.27	10/25/12	8:48 12:48	AC00933	FCA00473	29.5	4.0		
Sample 36	⑬-2.23	10/25/12	8:51 12:51	AC01790	FCA00538	29.5	3.5		
Sample 37	⑭-3.03	10/25/12	9:00 13:00	AC01886	FCA00275	29.5	5.0		

Report Tier Levels - please select

Tier I - Results (Default if not specified) _____
Tier II (Results + QC Summaries) _____
Tier III (Results + QC & Calibration Summaries) _____
Tier IV (Data Validation Package) 10% Surcharge _____

EDD required Yes / No
Type: _____

Project Requirements (MRLs, QAPP)

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:
Richard Pager	10/25	15:09		10/26/12	0910
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:

Cooler / Blank Temperature ____ °C

Columbia Analytical Services™

2655 Park Center Drive, Suite A
Simi Valley, California 93065
Phone (805) 526-7161
Fax (805) 526-7270

Air - Chain of Custody Record & Analytical Service Request

Requested Turnaround Time in Business Days (Surcharges) please circle
1 Day (100%) 2 Day (75%) 3 Day (50%) 4 Day (35%) 5 Day (25%) 10 Day-Standard

CAS Project No. R1204494

Company Name & Address (Reporting Information)	Project Name	CAS Contact:	Comments e.g. Actual Preservative or specific instructions
	Project Number	**Analysis Method**	
Project Manager	P.O. # / Billing Information		
Phone / Fax			
Email Address for Result Reporting	Sampler (Print & Sign) Richard Pager Richard Pager		

Client Sample ID	Laboratory ID Number	Date Collected	Time Collected	Canister ID (Bar code # - AC, SC, etc.)	Flow Controller ID (Bar code # - FC #)	Canister Start Pressure "Hg	Canister End Pressure "Hg/psig	Sample Volume
Sample 38	(15)-2.26	10/25/12	9:08 13:08	AC01487	FCA00418	29.5	4.5	
Sample 39	(16)-3.56	10/25/12	9:40 13:40	AC01115	FCA00503	29.6	6.5	
Sample 40	(17)-0.45	10/25/12	9:43 13:43	AC01243	FCA00603	29.4	2.0	
Sample 41	(18)-3.00	10/25/12	9:51 13:51	AC01218	FCA00405	29.6	9.0	
Sample 42	(19)-1.55	10/25/12	9:55 13:55	AC01179	FCA00040	29.6	4.75	
Sample 43	(20)-3.31	10/25/12	10:00 14:00	AC00870	FCA00215	29.5	6.0	
Sample 44	(21)-14.40	10/25/12	10:05	AC00993	FCA00619	29.3	~~Ref~~ Field	Blank
	-1941(3)							

Report Tier Levels - please select
Tier I - Results (Default if not specified) ____
Tier II (Results + QC Summaries) ____
Tier III (Results + QC & Calibration Summaries) ____
Tier IV (Data Validation Package) 10% Surcharge ____
EDD required Yes / No
Type: ____

Project Requirements (MRLs, QAPP)

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:
Richard Pager	10/25	15:09	[illegible]	10/26/12	0940
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:

Cooler / Blank Temperature ____ °C

Columbia Analytical Services
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Sample Acceptance Check Form

Client: Stantec Consulting Services, Inc. Work order: P1204494

Project: Sunoco IH Testing / 213402094

Sample(s) received on: 10/31/12 Date opened: 10/31/12 by: MZAMORA

Note: This form is used for all samples received by CAS. The use of this form for custody seals is strictly meant to indicate presence/absence and not as an indication of compliance or nonconformity. Thermal preservation and pH will only be evaluated either at the request of the client and/or as required by the method/SOP.

		Yes	No	N/A
1	Were **sample containers** properly marked with client sample ID?	☐	☒	☐
2	Container(s) **supplied by CAS**?	☒	☐	☐
3	Did **sample containers** arrive in good condition?	☒	☐	☐
4	Were **chain-of-custody** papers used and filled out?	☒	☐	☐
5	Did **sample container labels** and/or tags agree with custody papers?	☐	☒	☐
6	Was **sample volume** received adequate for analysis?	☒	☐	☐
7	Are samples within specified holding times?	☒	☐	☐
8	Was proper **temperature** (thermal preservation) of cooler at receipt adhered to?	☐	☐	☒
9	Was a **trip blank** received?	☐	☒	☐
10	Were **custody seals** on outside of cooler/Box?	☐	☒	☐
	Location of seal(s)? _____ Sealing Lid?	☐	☐	☒
	Were signature and date included?	☐	☐	☒
	Were seals intact?	☐	☐	☒
	Were custody seals on outside of sample container?	☐	☒	☐
	Location of seal(s)? _____ Sealing Lid?	☐	☐	☒
	Were signature and date included?	☐	☐	☒
	Were seals intact?	☐	☐	☒
11	Do containers have appropriate **preservation**, according to method/SOP or Client specified information?	☐	☐	☒
	Is there a client indication that the submitted samples are **pH** preserved?	☐	☐	☒
	Were **VOA vials** checked for presence/absence of air bubbles?	☐	☐	☒
	Does the client/method/SOP require that the analyst check the sample pH and if necessary alter it?	☐	☐	☒
12	**Tubes:** Are the tubes capped and intact?	☐	☐	☒
	Do they contain moisture?	☐	☐	☒
13	**Badges:** Are the badges properly capped and intact?	☐	☐	☒
	Are dual bed badges separated and individually capped and intact?	☐	☐	☒

Lab Sample ID	Container Description	Required pH *	Received pH	Adjusted pH	VOA Headspace (Presence/Absence)	Receipt / Preservation Comments
P1204494-001.01	6.0 L Ambient Can					
P1204494-002.01	6.0 L Ambient Can					
P1204494-003.01	6.0 L Ambient Can					
P1204494-004.01	6.0 L Ambient Can					
P1204494-005.01	6.0 L Ambient Can					
P1204494-006.01	6.0 L Ambient Can					
P1204494-007.01	6.0 L Ambient Can					
P1204494-008.01	6.0 L Ambient Can					

Explain any discrepancies: (include lab sample ID numbers):

Sample -002 has an ID of "Sample 25" on the COC, and "Sample 28" on the canister tag.

Sample -004 has canister SN AC01830, we received canister AC01810.

Sample -018 has an ID of "Sample 41" on the COC, and "Sample 40" on the canister tag.

RSK - MEEPP, HCL (pH<2); RSK - CO2, (pH 5-8); Sulfur (pH>4)

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Sample Acceptance Check Form

Client: Stantec Consulting Services, Inc. Work order: P1204494

Project: Sunoco IH Testing / 213402094

Sample(s) received on: 10/31/12 Date opened: 10/31/12 by: MZAMORA

Lab Sample ID	Container Description	Required pH *	Received pH	Adjusted pH	VOA Headspace (Presence/Absence)	Receipt / Preservation Comments
P1204494-009.01	6.0 L Ambient Can					
P1204494-010.01	6.0 L Ambient Can					
P1204494-011.01	6.0 L Ambient Can					
P1204494-012.01	6.0 L Ambient Can					
P1204494-013.01	6.0 L Ambient Can					
P1204494-014.01	6.0 L Ambient Can					
P1204494-015.01	6.0 L Ambient Can					
P1204494-016.01	6.0 L Ambient Can					
P1204494-017.01	6.0 L Ambient Can					
P1204494-018.01	6.0 L Ambient Can					
P1204494-019.01	6.0 L Ambient Can					
P1204494-020.01	6.0 L Ambient Can					
P1204494-021.01	6.0 L Ambient Can					

Explain any discrepancies: (include lab sample ID numbers):

RSK - MEEPP, HCL (pH<2); RSK - CO2, (pH 5-8); Sulfur (pH>4)

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 23** CAS Project ID: P1204494
Client Project ID: **Sunoco IH Testing / 213402094** CAS Sample ID: P1204494-001

Test Code: EPA TO-15 Date Collected: 10/25/12
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16 Date Received: 10/31/12
Analyst: Lusine Hakobyan Date Analyzed: 11/2/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AC01664

Initial Pressure (psig): -6.14 Final Pressure (psig): 3.79

Canister Dilution Factor: 2.16

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	1.1	ND	0.30	
107-06-2	1,2-Dichloroethane	ND	1.1	ND	0.27	
71-43-2	Benzene	ND	1.1	ND	0.34	
108-88-3	Toluene	**3.8**	1.1	**1.0**	0.29	
106-93-4	1,2-Dibromoethane	ND	1.1	ND	0.14	
100-41-4	Ethylbenzene	ND	1.1	ND	0.25	
179601-23-1	m,p-Xylenes	ND	2.2	ND	0.50	
95-47-6	o-Xylene	ND	1.1	ND	0.25	
98-82-8	Cumene	ND	1.1	ND	0.22	
108-67-8	1,3,5-Trimethylbenzene	ND	1.1	ND	0.22	
95-63-6	1,2,4-Trimethylbenzene	ND	1.1	ND	0.22	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 25**
Client Project ID: **Sunoco IH Testing / 213402094**

CAS Project ID: P1204494
CAS Sample ID: P1204494-002

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16
Analyst: Lusine Hakobyan
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AC01093

Date Collected: 10/25/12
Date Received: 10/31/12
Date Analyzed: 11/2/12
Volume(s) Analyzed: 1.00 Liter(s)

Canister Dilution Factor: 1.00

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.50	ND	0.14	
107-06-2	1,2-Dichloroethane	ND	0.50	ND	0.12	
71-43-2	Benzene	ND	0.50	ND	0.16	
108-88-3	Toluene	ND	0.50	ND	0.13	
106-93-4	1,2-Dibromoethane	ND	0.50	ND	0.065	
100-41-4	Ethylbenzene	ND	0.50	ND	0.12	
179601-23-1	m,p-Xylenes	ND	1.0	ND	0.23	
95-47-6	o-Xylene	ND	0.50	ND	0.12	
98-82-8	Cumene	ND	0.50	ND	0.10	
108-67-8	1,3,5-Trimethylbenzene	ND	0.50	ND	0.10	
95-63-6	1,2,4-Trimethylbenzene	ND	0.50	ND	0.10	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 26** CAS Project ID: P1204494
Client Project ID: **Sunoco IH Testing / 213402094** CAS Sample ID: P1204494-003

Test Code: EPA TO-15 Date Collected: 10/25/12
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16 Date Received: 10/31/12
Analyst: Lusine Hakobyan Date Analyzed: 11/2/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AC00540

Initial Pressure (psig): -3.15 Final Pressure (psig): 3.59

Canister Dilution Factor: 1.58

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.79	ND	0.22	
107-06-2	1,2-Dichloroethane	ND	0.79	ND	0.20	
71-43-2	Benzene	**2.1**	0.79	**0.67**	0.25	
108-88-3	Toluene	**4.0**	0.79	**1.1**	0.21	
106-93-4	1,2-Dibromoethane	ND	0.79	ND	0.10	
100-41-4	Ethylbenzene	**0.99**	0.79	**0.23**	0.18	
179601-23-1	m,p-Xylenes	**3.8**	1.6	**0.87**	0.36	
95-47-6	o-Xylene	**1.3**	0.79	**0.31**	0.18	
98-82-8	Cumene	**1.1**	0.79	**0.22**	0.16	
108-67-8	1,3,5-Trimethylbenzene	ND	0.79	ND	0.16	
95-63-6	1,2,4-Trimethylbenzene	**1.4**	0.79	**0.29**	0.16	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 27** CAS Project ID: P1204494
Client Project ID: **Sunoco IH Testing / 213402094** CAS Sample ID: P1204494-004

Test Code: EPA TO-15 Date Collected: 10/25/12
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16 Date Received: 10/31/12
Analyst: Lusine Hakobyan Date Analyzed: 11/2/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AC01810

Initial Pressure (psig): -4.85 Final Pressure (psig): 3.59

Canister Dilution Factor: 1.86

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.93	ND	0.26	
107-06-2	1,2-Dichloroethane	ND	0.93	ND	0.23	
71-43-2	Benzene	**2.3**	0.93	**0.71**	0.29	
108-88-3	Toluene	**3.6**	0.93	**0.96**	0.25	
106-93-4	1,2-Dibromoethane	ND	0.93	ND	0.12	
100-41-4	Ethylbenzene	ND	0.93	ND	0.21	
179601-23-1	m,p-Xylenes	**3.0**	1.9	**0.69**	0.43	
95-47-6	o-Xylene	**1.1**	0.93	**0.26**	0.21	
98-82-8	Cumene	ND	0.93	ND	0.19	
108-67-8	1,3,5-Trimethylbenzene	ND	0.93	ND	0.19	
95-63-6	1,2,4-Trimethylbenzene	ND	0.93	ND	0.19	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 28** CAS Project ID: P1204494
Client Project ID: **Sunoco IH Testing / 213402094** CAS Sample ID: P1204494-005

Test Code: EPA TO-15 Date Collected: 10/25/12
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16 Date Received: 10/31/12
Analyst: Lusine Hakobyan Date Analyzed: 11/2/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AC01350

Initial Pressure (psig): -2.60 Final Pressure (psig): 3.71

Canister Dilution Factor: 1.52

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.76	ND	0.21	
107-06-2	1,2-Dichloroethane	ND	0.76	ND	0.19	
71-43-2	Benzene	**2.3**	0.76	**0.70**	0.24	
108-88-3	Toluene	**2.0**	0.76	**0.54**	0.20	
106-93-4	1,2-Dibromoethane	ND	0.76	ND	0.099	
100-41-4	Ethylbenzene	ND	0.76	ND	0.18	
179601-23-1	m,p-Xylenes	ND	1.5	ND	0.35	
95-47-6	o-Xylene	ND	0.76	ND	0.18	
98-82-8	Cumene	ND	0.76	ND	0.15	
108-67-8	1,3,5-Trimethylbenzene	ND	0.76	ND	0.15	
95-63-6	1,2,4-Trimethylbenzene	ND	0.76	ND	0.15	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 29** CAS Project ID: P1204494
Client Project ID: **Sunoco IH Testing / 213402094** CAS Sample ID: P1204494-006

Test Code: EPA TO-15 Date Collected: 10/25/12
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16 Date Received: 10/31/12
Analyst: Lusine Hakobyan Date Analyzed: 11/2/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AC00716

Initial Pressure (psig): -0.41 Final Pressure (psig): 4.20

Canister Dilution Factor: 1.32

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.66	ND	0.18	
107-06-2	1,2-Dichloroethane	ND	0.66	ND	0.16	
71-43-2	Benzene	**1.6**	0.66	**0.50**	0.21	
108-88-3	Toluene	**6.5**	0.66	**1.7**	0.18	
106-93-4	1,2-Dibromoethane	ND	0.66	ND	0.086	
100-41-4	Ethylbenzene	**0.95**	0.66	**0.22**	0.15	
179601-23-1	m,p-Xylenes	**3.3**	1.3	**0.76**	0.30	
95-47-6	o-Xylene	**1.1**	0.66	**0.25**	0.15	
98-82-8	Cumene	ND	0.66	ND	0.13	
108-67-8	1,3,5-Trimethylbenzene	ND	0.66	ND	0.13	
95-63-6	1,2,4-Trimethylbenzene	**0.99**	0.66	**0.20**	0.13	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 30** CAS Project ID: P1204494
Client Project ID: **Sunoco IH Testing / 213402094** CAS Sample ID: P1204494-007

Test Code: EPA TO-15 Date Collected: 10/25/12
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16 Date Received: 10/31/12
Analyst: Lusine Hakobyan Date Analyzed: 11/2/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AC00501

Initial Pressure (psig): -2.50 Final Pressure (psig): 3.61

Canister Dilution Factor: 1.50

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.75	ND	0.21	
107-06-2	1,2-Dichloroethane	ND	0.75	ND	0.19	
71-43-2	Benzene	**1.2**	0.75	**0.36**	0.23	
108-88-3	Toluene	**4.4**	0.75	**1.2**	0.20	
106-93-4	1,2-Dibromoethane	ND	0.75	ND	0.098	
100-41-4	Ethylbenzene	ND	0.75	ND	0.17	
179601-23-1	m,p-Xylenes	**2.3**	1.5	**0.53**	0.35	
95-47-6	o-Xylene	**0.87**	0.75	**0.20**	0.17	
98-82-8	Cumene	ND	0.75	ND	0.15	
108-67-8	1,3,5-Trimethylbenzene	ND	0.75	ND	0.15	
95-63-6	1,2,4-Trimethylbenzene	**1.1**	0.75	**0.23**	0.15	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 31** CAS Project ID: P1204494
Client Project ID: **Sunoco IH Testing / 213402094** CAS Sample ID: P1204494-008

Test Code: EPA TO-15 Date Collected: 10/25/12
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16 Date Received: 10/31/12
Analyst: Lusine Hakobyan Date Analyzed: 11/2/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AC00765

Initial Pressure (psig): -3.73 Final Pressure (psig): 3.68

Canister Dilution Factor: 1.68

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.84	ND	0.23	
107-06-2	1,2-Dichloroethane	ND	0.84	ND	0.21	
71-43-2	Benzene	**1.3**	0.84	**0.41**	0.26	
108-88-3	Toluene	**4.8**	0.84	**1.3**	0.22	
106-93-4	1,2-Dibromoethane	ND	0.84	ND	0.11	
100-41-4	Ethylbenzene	ND	0.84	ND	0.19	
179601-23-1	m,p-Xylenes	**2.5**	1.7	**0.57**	0.39	
95-47-6	o-Xylene	**0.91**	0.84	**0.21**	0.19	
98-82-8	Cumene	ND	0.84	ND	0.17	
108-67-8	1,3,5-Trimethylbenzene	ND	0.84	ND	0.17	
95-63-6	1,2,4-Trimethylbenzene	**0.94**	0.84	**0.19**	0.17	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 32** CAS Project ID: P1204494
Client Project ID: **Sunoco IH Testing / 213402094** CAS Sample ID: P1204494-009

Test Code: EPA TO-15 Date Collected: 10/25/12
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16 Date Received: 10/31/12
Analyst: Lusine Hakobyan Date Analyzed: 11/2/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AC01403

Initial Pressure (psig): -5.30 Final Pressure (psig): 3.76

Canister Dilution Factor: 1.96

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.98	ND	0.27	
107-06-2	1,2-Dichloroethane	ND	0.98	ND	0.24	
71-43-2	Benzene	**1.3**	0.98	**0.41**	0.31	
108-88-3	Toluene	**5.2**	0.98	**1.4**	0.26	
106-93-4	1,2-Dibromoethane	ND	0.98	ND	0.13	
100-41-4	Ethylbenzene	ND	0.98	ND	0.23	
179601-23-1	m,p-Xylenes	**2.5**	2.0	**0.58**	0.45	
95-47-6	o-Xylene	ND	0.98	ND	0.23	
98-82-8	Cumene	ND	0.98	ND	0.20	
108-67-8	1,3,5-Trimethylbenzene	ND	0.98	ND	0.20	
95-63-6	1,2,4-Trimethylbenzene	ND	0.98	ND	0.20	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 33** CAS Project ID: P1204494
Client Project ID: **Sunoco IH Testing / 213402094** CAS Sample ID: P1204494-010

Test Code: EPA TO-15 Date Collected: 10/25/12
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16 Date Received: 10/31/12
Analyst: Lusine Hakobyan Date Analyzed: 11/2/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AC01573

Initial Pressure (psig): -0.55 Final Pressure (psig): 3.66

Canister Dilution Factor: 1.30

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.65	ND	0.18	
107-06-2	1,2-Dichloroethane	ND	0.65	ND	0.16	
71-43-2	Benzene	**1.4**	0.65	**0.45**	0.20	
108-88-3	Toluene	**5.0**	0.65	**1.3**	0.17	
106-93-4	1,2-Dibromoethane	ND	0.65	ND	0.085	
100-41-4	Ethylbenzene	**0.93**	0.65	**0.21**	0.15	
179601-23-1	m,p-Xylenes	**3.5**	1.3	**0.81**	0.30	
95-47-6	o-Xylene	**1.1**	0.65	**0.26**	0.15	
98-82-8	Cumene	ND	0.65	ND	0.13	
108-67-8	1,3,5-Trimethylbenzene	ND	0.65	ND	0.13	
95-63-6	1,2,4-Trimethylbenzene	**0.97**	0.65	**0.20**	0.13	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 34** CAS Project ID: P1204494
Client Project ID: **Sunoco IH Testing / 213402094** CAS Sample ID: P1204494-011

Test Code: EPA TO-15 Date Collected: 10/25/12
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16 Date Received: 10/31/12
Analyst: Lusine Hakobyan Date Analyzed: 11/3/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AC00947

Initial Pressure (psig): -2.79 Final Pressure (psig): 3.49

Canister Dilution Factor: 1.53

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.77	ND	0.21	
107-06-2	1,2-Dichloroethane	ND	0.77	ND	0.19	
71-43-2	Benzene	**1.3**	0.77	**0.41**	0.24	
108-88-3	Toluene	**4.9**	0.77	**1.3**	0.20	
106-93-4	1,2-Dibromoethane	ND	0.77	ND	0.10	
100-41-4	Ethylbenzene	**0.89**	0.77	**0.21**	0.18	
179601-23-1	m,p-Xylenes	**3.3**	1.5	**0.75**	0.35	
95-47-6	o-Xylene	**1.3**	0.77	**0.30**	0.18	
98-82-8	Cumene	ND	0.77	ND	0.16	
108-67-8	1,3,5-Trimethylbenzene	ND	0.77	ND	0.16	
95-63-6	1,2,4-Trimethylbenzene	**1.1**	0.77	**0.23**	0.16	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 35** CAS Project ID: P1204494
Client Project ID: **Sunoco IH Testing / 213402094** CAS Sample ID: P1204494-012

Test Code: EPA TO-15 Date Collected: 10/25/12
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16 Date Received: 10/31/12
Analyst: Lusine Hakobyan Date Analyzed: 11/3/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AC00033

Initial Pressure (psig): -2.24 Final Pressure (psig): 3.50

Canister Dilution Factor: 1.46

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.73	ND	0.20	
107-06-2	1,2-Dichloroethane	ND	0.73	ND	0.18	
71-43-2	Benzene	**1.2**	0.73	**0.39**	0.23	
108-88-3	Toluene	**5.9**	0.73	**1.6**	0.19	
106-93-4	1,2-Dibromoethane	ND	0.73	ND	0.095	
100-41-4	Ethylbenzene	**1.0**	0.73	**0.24**	0.17	
179601-23-1	m,p-Xylenes	**3.7**	1.5	**0.84**	0.34	
95-47-6	o-Xylene	**1.4**	0.73	**0.31**	0.17	
98-82-8	Cumene	ND	0.73	ND	0.15	
108-67-8	1,3,5-Trimethylbenzene	ND	0.73	ND	0.15	
95-63-6	1,2,4-Trimethylbenzene	**0.95**	0.73	**0.19**	0.15	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 36** CAS Project ID: P1204494
Client Project ID: **Sunoco IH Testing / 213402094** CAS Sample ID: P1204494-013

Test Code: EPA TO-15 Date Collected: 10/25/12
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16 Date Received: 10/31/12
Analyst: Lusine Hakobyan Date Analyzed: 11/5/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AC01790

Initial Pressure (psig): -2.23 Final Pressure (psig): 3.48

Canister Dilution Factor: 1.46

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.73	ND	0.20	
107-06-2	1,2-Dichloroethane	ND	0.73	ND	0.18	
71-43-2	Benzene	**0.94**	0.73	**0.29**	0.23	
108-88-3	Toluene	**4.0**	0.73	**1.1**	0.19	
106-93-4	1,2-Dibromoethane	ND	0.73	ND	0.095	
100-41-4	Ethylbenzene	**0.74**	0.73	**0.17**	0.17	
179601-23-1	m,p-Xylenes	**2.5**	1.5	**0.59**	0.34	
95-47-6	o-Xylene	**0.97**	0.73	**0.22**	0.17	
98-82-8	Cumene	ND	0.73	ND	0.15	
108-67-8	1,3,5-Trimethylbenzene	ND	0.73	ND	0.15	
95-63-6	1,2,4-Trimethylbenzene	**0.78**	0.73	**0.16**	0.15	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 37** CAS Project ID: P1204494
Client Project ID: **Sunoco IH Testing / 213402094** CAS Sample ID: P1204494-014

Test Code: EPA TO-15 Date Collected: 10/25/12
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16 Date Received: 10/31/12
Analyst: Lusine Hakobyan Date Analyzed: 11/5/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AC01886

Initial Pressure (psig): -3.04 Final Pressure (psig): 3.62

Canister Dilution Factor: 1.57

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.79	ND	0.22	
107-06-2	1,2-Dichloroethane	ND	0.79	ND	0.19	
71-43-2	Benzene	**11**	0.79	**3.6**	0.25	
108-88-3	Toluene	**88**	0.79	**23**	0.21	
106-93-4	1,2-Dibromoethane	ND	0.79	ND	0.10	
100-41-4	Ethylbenzene	**11**	0.79	**2.5**	0.18	
179601-23-1	m,p-Xylenes	**42**	1.6	**9.7**	0.36	
95-47-6	o-Xylene	**9.1**	0.79	**2.1**	0.18	
98-82-8	Cumene	**1.3**	0.79	**0.26**	0.16	
108-67-8	1,3,5-Trimethylbenzene	**1.4**	0.79	**0.28**	0.16	
95-63-6	1,2,4-Trimethylbenzene	**3.9**	0.79	**0.79**	0.16	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 38**
Client Project ID: **Sunoco IH Testing / 213402094**

CAS Project ID: P1204494
CAS Sample ID: P1204494-015

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16
Analyst: Lusine Hakobyan
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AC01487

Date Collected: 10/25/12
Date Received: 10/31/12
Date Analyzed: 11/5/12
Volume(s) Analyzed: 1.00 Liter(s)
0.10 Liter(s)

Initial Pressure (psig): -2.38 Final Pressure (psig): 3.62

Canister Dilution Factor: 1.49

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.75	ND	0.21	
107-06-2	1,2-Dichloroethane	ND	0.75	ND	0.18	
71-43-2	Benzene	**8.4**	0.75	**2.6**	0.23	
108-88-3	Toluene	**330**	7.5	**87**	2.0	**D**
106-93-4	1,2-Dibromoethane	ND	0.75	ND	0.097	
100-41-4	Ethylbenzene	**6.0**	0.75	**1.4**	0.17	
179601-23-1	m,p-Xylenes	**24**	1.5	**5.5**	0.34	
95-47-6	o-Xylene	**7.6**	0.75	**1.8**	0.17	
98-82-8	Cumene	**2.6**	0.75	**0.52**	0.15	
108-67-8	1,3,5-Trimethylbenzene	**3.9**	0.75	**0.80**	0.15	
95-63-6	1,2,4-Trimethylbenzene	**11**	0.75	**2.2**	0.15	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
D = The reported result is from a dilution.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 39** CAS Project ID: P1204494
Client Project ID: **Sunoco IH Testing / 213402094** CAS Sample ID: P1204494-016

Test Code: EPA TO-15 Date Collected: 10/25/12
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16 Date Received: 10/31/12
Analyst: Lusine Hakobyan Date Analyzed: 11/5/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AC01115

Initial Pressure (psig): -3.59 Final Pressure (psig): 3.71

Canister Dilution Factor: 1.66

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	**0.96**	0.83	**0.27**	0.23	
107-06-2	1,2-Dichloroethane	ND	0.83	ND	0.21	
71-43-2	Benzene	**1.4**	0.83	**0.45**	0.26	
108-88-3	Toluene	**6.4**	0.83	**1.7**	0.22	
106-93-4	1,2-Dibromoethane	ND	0.83	ND	0.11	
100-41-4	Ethylbenzene	**1.1**	0.83	**0.25**	0.19	
179601-23-1	m,p-Xylenes	**3.9**	1.7	**0.89**	0.38	
95-47-6	o-Xylene	**1.4**	0.83	**0.32**	0.19	
98-82-8	Cumene	ND	0.83	ND	0.17	
108-67-8	1,3,5-Trimethylbenzene	ND	0.83	ND	0.17	
95-63-6	1,2,4-Trimethylbenzene	**1.1**	0.83	**0.23**	0.17	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 40** CAS Project ID: P1204494
Client Project ID: **Sunoco IH Testing / 213402094** CAS Sample ID: P1204494-017

Test Code: EPA TO-15 Date Collected: 10/25/12
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16 Date Received: 10/31/12
Analyst: Lusine Hakobyan Date Analyzed: 11/5/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AC01243

Initial Pressure (psig): -0.40 Final Pressure (psig): 3.96

Canister Dilution Factor: 1.30

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	**1.6**	0.65	**0.43**	0.18	
107-06-2	1,2-Dichloroethane	ND	0.65	ND	0.16	
71-43-2	Benzene	**2.0**	0.65	**0.64**	0.20	
108-88-3	Toluene	**8.8**	0.65	**2.3**	0.17	
106-93-4	1,2-Dibromoethane	ND	0.65	ND	0.085	
100-41-4	Ethylbenzene	**1.4**	0.65	**0.33**	0.15	
179601-23-1	m,p-Xylenes	**5.4**	1.3	**1.2**	0.30	
95-47-6	o-Xylene	**1.8**	0.65	**0.42**	0.15	
98-82-8	Cumene	ND	0.65	ND	0.13	
108-67-8	1,3,5-Trimethylbenzene	ND	0.65	ND	0.13	
95-63-6	1,2,4-Trimethylbenzene	**1.5**	0.65	**0.31**	0.13	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 41** CAS Project ID: P1204494
Client Project ID: **Sunoco IH Testing / 213402094** CAS Sample ID: P1204494-018

Test Code: EPA TO-15 Date Collected: 10/25/12
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16 Date Received: 10/31/12
Analyst: Lusine Hakobyan Date Analyzed: 11/5/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AC01218

Initial Pressure (psig): -3.00 Final Pressure (psig): 3.67

Canister Dilution Factor: 1.57

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.79	ND	0.22	
107-06-2	1,2-Dichloroethane	ND	0.79	ND	0.19	
71-43-2	Benzene	**1.8**	0.79	**0.55**	0.25	
108-88-3	Toluene	**9.0**	0.79	**2.4**	0.21	
106-93-4	1,2-Dibromoethane	ND	0.79	ND	0.10	
100-41-4	Ethylbenzene	**1.3**	0.79	**0.31**	0.18	
179601-23-1	m,p-Xylenes	**5.2**	1.6	**1.2**	0.36	
95-47-6	o-Xylene	**1.9**	0.79	**0.44**	0.18	
98-82-8	Cumene	ND	0.79	ND	0.16	
108-67-8	1,3,5-Trimethylbenzene	**1.1**	0.79	**0.22**	0.16	
95-63-6	1,2,4-Trimethylbenzene	**3.1**	0.79	**0.64**	0.16	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 42** CAS Project ID: P1204494
Client Project ID: **Sunoco IH Testing / 213402094** CAS Sample ID: P1204494-019

Test Code: EPA TO-15 Date Collected: 10/25/12
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16 Date Received: 10/31/12
Analyst: Lusine Hakobyan Date Analyzed: 11/5/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AC01179

Initial Pressure (psig): -1.52 Final Pressure (psig): 3.71

Canister Dilution Factor: 1.40

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.70	ND	0.19	
107-06-2	1,2-Dichloroethane	ND	0.70	ND	0.17	
71-43-2	Benzene	**1.7**	0.70	**0.53**	0.22	
108-88-3	Toluene	**8.2**	0.70	**2.2**	0.19	
106-93-4	1,2-Dibromoethane	ND	0.70	ND	0.091	
100-41-4	Ethylbenzene	**1.1**	0.70	**0.25**	0.16	
179601-23-1	m,p-Xylenes	**4.6**	1.4	**1.1**	0.32	
95-47-6	o-Xylene	**1.7**	0.70	**0.38**	0.16	
98-82-8	Cumene	ND	0.70	ND	0.14	
108-67-8	1,3,5-Trimethylbenzene	**0.87**	0.70	**0.18**	0.14	
95-63-6	1,2,4-Trimethylbenzene	**2.5**	0.70	**0.50**	0.14	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 43** CAS Project ID: P1204494
Client Project ID: **Sunoco IH Testing / 213402094** CAS Sample ID: P1204494-020

Test Code: EPA TO-15 Date Collected: 10/25/12
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16 Date Received: 10/31/12
Analyst: Lusine Hakobyan Date Analyzed: 11/5/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AC00870

Initial Pressure (psig): -3.27 Final Pressure (psig): 3.76

Canister Dilution Factor: 1.62

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.81	ND	0.22	
107-06-2	1,2-Dichloroethane	ND	0.81	ND	0.20	
71-43-2	Benzene	**1.2**	0.81	**0.37**	0.25	
108-88-3	Toluene	**10**	0.81	**2.7**	0.22	
106-93-4	1,2-Dibromoethane	ND	0.81	ND	0.11	
100-41-4	Ethylbenzene	ND	0.81	ND	0.19	
179601-23-1	m,p-Xylenes	**2.8**	1.6	**0.65**	0.37	
95-47-6	o-Xylene	**0.99**	0.81	**0.23**	0.19	
98-82-8	Cumene	ND	0.81	ND	0.16	
108-67-8	1,3,5-Trimethylbenzene	ND	0.81	ND	0.16	
95-63-6	1,2,4-Trimethylbenzene	**0.93**	0.81	**0.19**	0.16	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 44**
Client Project ID: **Sunoco IH Testing / 213402094**

CAS Project ID: P1204494
CAS Sample ID: P1204494-021

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16
Analyst: Lusine Hakobyan
Sample Type: 6.0 L Summa Canister
Test Notes:
Container ID: AC00993

Date Collected: 10/25/12
Date Received: 10/31/12
Date Analyzed: 11/5/12
Volume(s) Analyzed: 1.00 Liter(s)

Canister Dilution Factor: 1.00

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.50	ND	0.14	
107-06-2	1,2-Dichloroethane	ND	0.50	ND	0.12	
71-43-2	Benzene	ND	0.50	ND	0.16	
108-88-3	Toluene	ND	0.50	ND	0.13	
106-93-4	1,2-Dibromoethane	ND	0.50	ND	0.065	
100-41-4	Ethylbenzene	ND	0.50	ND	0.12	
179601-23-1	m,p-Xylenes	ND	1.0	ND	0.23	
95-47-6	o-Xylene	ND	0.50	ND	0.12	
98-82-8	Cumene	ND	0.50	ND	0.10	
108-67-8	1,3,5-Trimethylbenzene	ND	0.50	ND	0.10	
95-63-6	1,2,4-Trimethylbenzene	ND	0.50	ND	0.10	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Method Blank** CAS Project ID: P1204494
Client Project ID: **Sunoco IH Testing / 213402094** CAS Sample ID: P121102-MB

Test Code: EPA TO-15 Date Collected: NA
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16 Date Received: NA
Analyst: Lusine Hakobyan Date Analyzed: 11/2/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:

Canister Dilution Factor: 1.00

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.50	ND	0.14	
107-06-2	1,2-Dichloroethane	ND	0.50	ND	0.12	
71-43-2	Benzene	ND	0.50	ND	0.16	
108-88-3	Toluene	ND	0.50	ND	0.13	
106-93-4	1,2-Dibromoethane	ND	0.50	ND	0.065	
100-41-4	Ethylbenzene	ND	0.50	ND	0.12	
179601-23-1	m,p-Xylenes	ND	1.0	ND	0.23	
95-47-6	o-Xylene	ND	0.50	ND	0.12	
98-82-8	Cumene	ND	0.50	ND	0.10	
108-67-8	1,3,5-Trimethylbenzene	ND	0.50	ND	0.10	
95-63-6	1,2,4-Trimethylbenzene	ND	0.50	ND	0.10	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Method Blank** CAS Project ID: P1204494
Client Project ID: **Sunoco IH Testing / 213402094** CAS Sample ID: P121105-MB

Test Code: EPA TO-15 Date Collected: NA
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16 Date Received: NA
Analyst: Lusine Hakobyan Date Analyzed: 11/5/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:

Canister Dilution Factor: 1.00

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	ND	0.50	ND	0.14	
107-06-2	1,2-Dichloroethane	ND	0.50	ND	0.12	
71-43-2	Benzene	ND	0.50	ND	0.16	
108-88-3	Toluene	ND	0.50	ND	0.13	
106-93-4	1,2-Dibromoethane	ND	0.50	ND	0.065	
100-41-4	Ethylbenzene	ND	0.50	ND	0.12	
179601-23-1	m,p-Xylenes	ND	1.0	ND	0.23	
95-47-6	o-Xylene	ND	0.50	ND	0.12	
98-82-8	Cumene	ND	0.50	ND	0.10	
108-67-8	1,3,5-Trimethylbenzene	ND	0.50	ND	0.10	
95-63-6	1,2,4-Trimethylbenzene	ND	0.50	ND	0.10	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

SURROGATE SPIKE RECOVERY RESULTS

Client: **Stantec Consulting Services, Inc.**
Client Project ID: **Sunoco IH Testing / 213402094** CAS Project ID: P1204494

Test Code: EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16 Date(s) Collected: 10/25/12
Analyst: Lusine Hakobyan Date(s) Received: 10/31/12
Sample Type: 6.0 L Summa Canister(s) Date(s) Analyzed: 11/2 - 11/5/12
Test Notes:

Client Sample ID	CAS Sample ID	1,2-Dichloroethane-d4 Percent Recovered	Toluene-d8 Percent Recovered	Bromofluorobenzene Percent Recovered	Acceptance Limits	Data Qualifier
Method Blank	P121102-MB	**101**	**99**	**96**	70-130	
Method Blank	P121105-MB	**102**	**100**	**97**	70-130	
Lab Control Sample	P121102-LCS	**99**	**99**	**100**	70-130	
Lab Control Sample	P121105-LCS	**99**	**100**	**99**	70-130	
Sample 23	P1204494-001	**101**	**101**	**95**	70-130	
Sample 25	P1204494-002	**101**	**101**	**95**	70-130	
Sample 26	P1204494-003	**101**	**101**	**97**	70-130	
Sample 27	P1204494-004	**102**	**100**	**97**	70-130	
Sample 28	P1204494-005	**101**	**100**	**96**	70-130	
Sample 29	P1204494-006	**101**	**100**	**97**	70-130	
Sample 30	P1204494-007	**101**	**100**	**97**	70-130	
Sample 31	P1204494-008	**101**	**99**	**96**	70-130	
Sample 32	P1204494-009	**102**	**99**	**97**	70-130	
Sample 33	P1204494-010	**101**	**99**	**97**	70-130	
Sample 34	P1204494-011	**102**	**100**	**97**	70-130	
Sample 35	P1204494-012	**101**	**100**	**97**	70-130	
Sample 36	P1204494-013	**100**	**101**	**97**	70-130	
Sample 37	P1204494-014	**100**	**101**	**97**	70-130	
Sample 38	P1204494-015	**99**	**100**	**98**	70-130	
Sample 39	P1204494-016	**101**	**100**	**98**	70-130	
Sample 40	P1204494-017	**101**	**100**	**97**	70-130	
Sample 40	P1204494-017DUP	**100**	**100**	**96**	70-130	
Sample 41	P1204494-018	**101**	**101**	**97**	70-130	
Sample 42	P1204494-019	**100**	**102**	**96**	70-130	
Sample 43	P1204494-020	**101**	**101**	**98**	70-130	
Sample 44	P1204494-021	**100**	**101**	**96**	70-130	

Surrogate percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly from the on-column percent recovery.

LABORATORY CONTROL SAMPLE SUMMARY

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Lab Control Sample** CAS Project ID: P1204494
Client Project ID: **Sunoco IH Testing / 213402094** CAS Sample ID: P121102-LCS

Test Code: EPA TO-15 Date Collected: NA
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16 Date Received: NA
Analyst: Lusine Hakobyan Date Analyzed: 11/02/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 0.125 Liter(s)
Test Notes:

CAS #	Compound	Spike Amount µg/m³	Result µg/m³	% Recovery	CAS Acceptance Limits	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	204	**187**	**92**	67-116	
107-06-2	1,2-Dichloroethane	208	**180**	**87**	70-118	
71-43-2	Benzene	208	**187**	**90**	66-121	
108-88-3	Toluene	208	**172**	**83**	67-111	
106-93-4	1,2-Dibromoethane	208	**182**	**88**	73-122	
100-41-4	Ethylbenzene	206	**170**	**83**	71-117	
179601-23-1	m,p-Xylenes	412	**328**	**80**	70-116	
95-47-6	o-Xylene	200	**163**	**82**	70-116	
98-82-8	Cumene	196	**160**	**82**	70-116	
108-67-8	1,3,5-Trimethylbenzene	208	**169**	**81**	71-121	
95-63-6	1,2,4-Trimethylbenzene	200	**165**	**83**	73-127	

Laboratory Control Sample percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly.

LABORATORY CONTROL SAMPLE SUMMARY

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Lab Control Sample** CAS Project ID: P1204494
Client Project ID: **Sunoco IH Testing / 213402094** CAS Sample ID: P121105-LCS

Test Code: EPA TO-15 Date Collected: NA
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16 Date Received: NA
Analyst: Lusine Hakobyan Date Analyzed: 11/05/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 0.125 Liter(s)
Test Notes:

CAS #	Compound	Spike Amount µg/m³	Result µg/m³	% Recovery	CAS Acceptance Limits	Data Qualifier
1634-04-4	Methyl tert-Butyl Ether	204	**191**	**94**	67-116	
107-06-2	1,2-Dichloroethane	208	**184**	**88**	70-118	
71-43-2	Benzene	208	**190**	**91**	66-121	
108-88-3	Toluene	208	**178**	**86**	67-111	
106-93-4	1,2-Dibromoethane	208	**189**	**91**	73-122	
100-41-4	Ethylbenzene	206	**174**	**84**	71-117	
179601-23-1	m,p-Xylenes	412	**338**	**82**	70-116	
95-47-6	o-Xylene	200	**167**	**84**	70-116	
98-82-8	Cumene	196	**164**	**84**	70-116	
108-67-8	1,3,5-Trimethylbenzene	208	**173**	**83**	71-121	
95-63-6	1,2,4-Trimethylbenzene	200	**171**	**86**	73-127	

Laboratory Control Sample percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly.

LABORATORY DUPLICATE SUMMARY RESULTS

Client: **Stantec Consulting Services, Inc.**
Client Sample ID: **Sample 40** CAS Project ID: P1204494
Client Project ID: **Sunoco IH Testing / 213402094** CAS Sample ID: P1204494-017DUP

Test Code: EPA TO-15 Date Collected: 10/25/12
Instrument ID: Tekmar AUTOCAN/Agilent 5975Cinert/6890N/MS16 Date Received: 10/31/12
Analyst: Lusine Hakobyan Date Analyzed: 11/5/12
Sample Type: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: AC01243

Initial Pressure (psig): -0.40 Final Pressure (psig): 3.96

Canister Dilution Factor: 1.30

Compound	Sample Result µg/m³	Sample Result ppbV	Duplicate Sample Result µg/m³	Duplicate Sample Result ppbV	Average µg/m³	% RPD	RPD Limit	Data Qualifier
Methyl tert-Butyl Ether	1.55	0.431	1.57	0.436	1.56	**1**	25	
1,2-Dichloroethane	ND	ND	ND	ND	-	-	25	
Benzene	2.03	0.637	2.03	0.634	2.03	**0**	25	
Toluene	8.79	2.33	8.75	2.32	8.77	**0.5**	25	
1,2-Dibromoethane	ND	ND	ND	ND	-	-	25	
Ethylbenzene	1.45	0.333	1.43	0.329	1.44	**1**	25	
m,p-Xylenes	5.39	1.24	5.35	1.23	5.37	**0.7**	25	
o-Xylene	1.83	0.422	1.82	0.419	1.825	**0.5**	25	
Cumene	ND	ND	ND	ND	-	-	25	
1,3,5-Trimethylbenzene	ND	ND	ND	ND	-	-	25	
1,2,4-Trimethylbenzene	1.54	0.314	1.53	0.311	1.535	**0.7**	25	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.

APPENDIX J

Current and Historic Use Figures

N
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Legend

- Sheet Pile Wall
- Current Uses
- Occupied Buildings Not Under Positive Pressure
- Occupied Buildings Under Positive Pressure
- AOIs

Notes:
1. Bing Maps aerial imagery provided by © 2010 Microsoft Corporation and its data suppliers and obtained under the licensing agreement with ESRI.

Appendix J-1: Current Use
AOI-6 Site Characterization/
Remedial Investigation Report
PES Facility
Philadelphia, Pennsylvania

SUNOCO
PHILADELPHIA ENERGY SOLUTIONS

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

0 150 300 Feet

SCALE: 1" = 150'
DATE: June 5, 2013
DRN. BY: MH
CKD. BY: PT
JOB#: 2574601

Path: \\langan.com\data\DT\data6\2574601\ArcGIS\MapDocuments\AOI 6 Repackaged SCR\Appendix J-1 - Current Use_6-11-13.mxd

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Legend

- Sheet Pile Wall
- Historic Uses
- AOIs

Notes:
1. Bing Maps aerial imagery provided by © 2010 Microsoft Corporation and its data suppliers and obtained under the licensing agreement with ESRI.

Appendix J-2: Historic Use
AOI-6 Site Characterization/
Remedial Investigation Report
PES Facility
Philadelphia, Pennsylvania

SUNOCO
PHILADELPHIA ENERGY SOLUTIONS

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

0 150 300 Feet

SCALE: 1" = 150'
DATE: June 5, 2013
DRN. BY: MH
CKD. BY: PT
JOB#: 2574601

Path: \\langan.com\data\DT\data6\2574601\ArcGIS\MapDocuments\AOI 6 Repackaged SCR\Appendix J-2 - Historic Use_6-11-13.mxd

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Legend

- Sheet Pile Wall
- Impervious Surfaces
- AOIs

Notes:
1. Bing Maps aerial imagery provided by © 2010 Microsoft Corporation and its data suppliers and obtained under the licensing agreement with ESRI.

Appendix J-3: Impervious Surfaces
AOI-6 Site Characterization/
Remedial Investigation Report
PES Facility
Philadelphia, Pennsylvania

SUNOCO
PHILADELPHIA ENERGY SOLUTIONS

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

0 150 300 Feet

SCALE: 1" = 150'
DATE: August 29, 2013
DRN. BY: MH
CKD. BY: PT
JOB# 2574601

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APPENDIX K
Field Procedures

APPENDIX K
FIELD PROCEDURES
AOI 6 WORK PLAN FOR SITE CHARACTERIZATION
SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

K.1. LIQUID LEVEL ACQUISITION

Responsible Personnel: Technicians and Geologists

Training Qualifications:

All field personnel involved in liquid level acquisition shall have, as a minimum, completed OSHA 40 HOUR HAZWOPER training, PSM training, and obtained a TWIC Card as well as completing the 3-day minimum field training requirements as specified within the Corporate Health and Safety Plan. Prior to solo performance of liquid levels, all field personnel will have performed a minimum of three site visits under the direct supervision of experienced personnel.

Health and Safety Requirements:

Personal Protective Equipment (PPE) Required:

Level D attire including steel toe/steel shank boots, NOMEX coveralls, and an H2S meter are required to be worn. Based on site conditions, Level C attire may be required. The PPE required to upgrade to Level C may include: nitrile gloves, disposable outerboots, Tyvek coveralls, and a respirator. Safety glasses or hard hats may also be required in certain areas.

Site Controls:

Safety cones and or caution tape should be used in high traffic areas. The "Buddy System" may also be employed in high traffic areas.

Potential Hazards:

Traffic, pinch and trip, chemical (airborne and physical contact) and biological are all likely hazards to be encountered on-site. Additional hazards are mentioned in the site-specific HASP.

Materials and Equipment Necessary for Task Completion:

Electronic oil/water interface probe or conductivity water line, decontamination supplies (liquinox, deionized-distilled water, appropriate containers, scrub brush, and sorbent pads or paper towels), and air monitoring instruments (optional, based on previous site visits).

Methodology:

The task involves the deployment of a liquid sensing probe into a well (in most cases), recording the reading, and decontaminating the probe. The recorded field readings can then be utilized for one of several applications including: well sampling, water table gradient mapping, separate-phase hydrocarbon occurrence, thickness, and or gradient mapping, and various testing procedures.

The proper procedure for liquid level acquisition from a well is as follows:

1) The wells should be gauged in order of least to most contaminated based on existing sampling data or separate-phase hydrocarbon occurrence.
2) The gauging instrument is decontaminated prior to initial deployment and after each well to prevent cross contamination between wells.
3) Decontamination procedures include the following steps:
    a) Remove gross contaminants with sorbent pad or towel.
    b) Rinse/scrub equipment with water.
    c) Scrub equipment in Liquinox®/deionized-distilled water solution.
    d) Double rinse with deionized-distilled water.
    e) Air dry.
4) The well(s) to be gauged may need to be marked off with safety cones and or caution tape in order to protect personnel from auto traffic; the "Buddy System" may also be employed.
5) The manhole cover is then lifted off of the well head. A pry bar may be needed to prevent personal injury in the case of large manhole covers.
6) The probe is lowered into the well until the instrument signals contact with liquid.
7) The corresponding reading is recorded when the instrument signals either water or product. A clear bailer may be used to verify the existence or approximate amount and appearance of product.

8) The probe is then retracted from the well and decontaminated accordingly.

9) The well is then secured appropriately.

10) Note the start and stop time for gauging round in the field book.

K.2. GROUNDWATER MONITORING PROCEDURES

Responsible Personnel: Technicians and Geologists

Health and Safety Requirements:

Site specific HASP must be completed and reviewed by field personnel. Ambient air monitoring will be performed quarterly at all treatment areas to determine the necessity of PPE upgrade. As a minimum, level "D" attire will be worn.

Training Qualifications:

All field personnel involved in groundwater monitoring shall have, as a minimum completed OSHA 40 HOUR HAZWOPER training and completed the 3 day minimum field training requirements. Prior to groundwater monitoring, all field personnel will have sampled a minimum of three sites under the direct supervision of experienced personnel. Field personnel will also have experience in vapor monitoring techniques and sampling equipment decontamination.

Materials and Equipment Necessary for Task Completion:

A list of equipment required to access, gauge, purge, and sample site monitoring wells is presented below. Also listed are materials necessary to store, label, preserve, and transport groundwater samples.

- Current site map detailing well locations;
- Field data book for recording site data;
- Liquid level gauging device (graduated, optical interface probe);
- Keys and tools to provide well access;
- Appropriate sample containers and labels: volatile samples will be collected in laboratory provided 40 milliliter (ml) glass vials with plastic caps fitted with Teflon ® lined septa; all sample bottles will be laboratory sterilized and will contain the appropriate preservative, if applicable;

- Appropriate well purging apparatus as determined by volume of groundwater to be purged and compounds to be analyzed;
- Teflon ® (or equivalent) bottom-loading bailer to extract groundwater sample;
- Clean nylon or polypropylene bailer cord;
- Disposable nitrile sampling gloves;
- Decontamination supplies;
- Calibrated five-gallon bucket and watch or stopwatch to determine discharge rate during purging;
- Blank chain-of-custody forms; and
- Cooler and ice for sample preservation.

Methodology for Three Well Volume Sampling:

Prior to actual site visitation for the groundwater sampling event, the following data will be reviewed to ensure proper preparation for field activities:

- Most recent liquid level data from all wells;
- Most recent analytical data from all wells to determine gauging and sampling sequence; and
- Well construction characteristics.

Each monitoring well to be sampled will be gauged to obtain liquid level data immediately prior to initiation of the sampling process. Refer to Liquid Level Gauging SOP for appropriate well gauging procedures. Liquid level data will be recorded in a field book. Should free-phase petroleum product be detected by the gauging process and verified through inspection in a pre-cleaned acrylic bailer, groundwater sampling will not be conducted at that location.

The sampling procedure will be initiated by purging from the well a minimum of three well volumes, except in cases where the well is pumped dry, as referenced below. Well purging is performed to remove stagnant water and to draw representative water from the aquifer into the well for subsequent sampling and analysis for the established parameters. In extreme cases where a well is pumped dry and/or shows little recharge capacity, the well will be evacuated once prior to sample procurement. Well volume calculations will be based on total

well depth as determined during well installation and depth-to-water measurements obtained immediately prior to sampling.

Down-hole pre-purge, post-purge, and sampling water quality readings will be collected. The parameters to be monitored and recorded will include dissolved oxygen, turbidity, pH, specific conductance, redox potential, and temperature.

Well purging can be performed with various equipment including: a dedicated bailer for hand bailing low volumes of water; a surface mounted electric centrifugal pump with dedicated polyethylene tubing; and/or submersible pump (when the depth to water is greater than 20 feet) with dedicated polyethylene tubing. During pumping, the intake will be placed directly below the static water surface and slowly lowered during the purging process. This procedure may not prove necessary in low-yielding wells but is important in high-yielding, permeable strata where an intake initially placed deep in a well may draw laterally and have little influence in exchanging water from shallower depths within the well bore.

Flow rate during well purging will be approximated by the bucket and stop watch method. The duration of pumping required to remove three well volumes will be calculated directly from this flow rate. All fluids removed during purging will be treated on-site with activated carbon.

The sequence of obtaining site groundwater samples will be based upon available historical site data for existing wells and soil organic vapor analyzer (OVA) readings for newly installed wells. Site wells will be sampled in order from the lowest to highest concentration of water quality indicator parameters based upon the most recent available set of laboratory analyses to reduce the potential for sample cross-contamination. Groundwater samples will not be obtained for analysis from any well containing measurable free product.

The following sequence of procedures will be implemented for the collection of groundwater samples from monitoring wells.

1) Establish a clean work area where sampling equipment will not come in contact with the ground or any potentially contaminated surfaces.
2) Use a laboratory, pre-cleaned Teflon® sampling bailer for each well.
3) Use a clean pair of nitrile gloves.

4) Attach an appropriate length of unused, clean nylon or polypropylene cord to the designated sampling bailer.

5) Select appropriate laboratory-sterilized sample containers.

6) Slowly lower sampling bailer into well until water surface is encountered; continue to lower the sampling bailer into the standing water column to one foot below the water surface.

7) Retrieve bailer at a steady rate to avoid excess agitation.

8) Visually inspect bailed sample to ensure that no free product or organic detritus has been collected.

9) Uncap first designated sample vial and fill from bailer as rapidly as possible but minimizing agitation; secure septum and lid.

10) Inspect sealed sample for entrapped air; if air is present within sample vial. Remove lid and repeat vial filling, sealing and inspection process until no air is present.

11) Repeat Steps 9 and 10 for the second designated vial; all volatile parameter samples will be collected in duplicate.

12) Complete and attach labels to sample containers noting sample collector, date, time, and location of sample; record same data in field book.

13) Place samples in ice-filled cooler in such a manner as to avoid breakage. Samples collected for VOC analysis will be maintained at a temperature of 4°C.

Discard gloves and bailer cord and move to next sample location.

Methodology for Low-Flow Purging and Sampling:

For wells that will be Low-Flow purged and sampled, the USEPA Region III Bulletin QAD023: *Procedure for Low-Flow Purging and Sampling of Groundwater Monitoring Wells* will be followed. The following data will be reviewed for each well in order to set the pump intake for the low flow sampling:

- Soil boring (lithologic) log and continuous soil sample PID;
- Well construction log showing the screened interval;
- Identification of the most permeable zone screened by the well;
- Approximate depth to static water;
- Proposed pump intake setting; and

- Technical rationale for the pump intake setting, preferably across from the most impacted/contaminated subsurface interval.

Equipment

Adjustable rate, submersible, bladder pumps in conjunction with Teflon® or Teflon-lined polyethylene tubing for purging and sampling will be used. An alternate set up would include a stainless steel submersible Hurricane Pump with Teflon-lined tubing. The tubing diameter will be between 3/16-inch to ½-inch inner diameter and the length of the tubing extended outside the well will be minimized. Flow through cells will be used to evaluate parameters during sampling. Monitoring well information, equipment specifications, water level measurements, parameter readings, and other pertinent information will be recorded during monitoring well purging and sampling.

Sampling Procedure

The following protocol details the low-flow sampling procedure that will be used for sampling the monitoring wells.

1. PID Screening of Well. A PID measurement will be collected at the rim of the well immediately after the well cap will be removed and recorded on the sampling form.
2. Depth to Water Measurement. A depth to water measurement will be collected and recorded. To avoid disturbing accumulated sediment and to prevent the inadvertent mixing of stagnant water, measuring the total depth of the well will be done at the completion of sampling on an annual basis.
3. Low Stress Purging Startup. Water pumping will commence at a rate of 100 to 400 milliliters per minute (mL/min). This pumping should cause very little drawdown in the well (less than 0.2-0.3 feet) and the water level should stabilize. Water level measurements are made continuously and will be recorded in milliliters per minute on the sampling form.
4. Low Stress Purging and Sampling. The water level and pumping rate will be monitored and recorded every five minutes during purging, and any pumping rate adjustments will be recorded. During the early phase of purging, emphasis will be placed on minimizing and stabilizing pumping stress, and recording any necessary adjustments. Adjustments, when necessary, will be made in the first 15 minutes of purging. If necessary, pumping rates will be reduced to the minimum capabilities of the pump to avoid well dewatering. If the minimal drawdown exceeds 0.3 feet, but the water level stabilizes above the pump intake setting, purging will continue until indicator field parameters stabilized, as detailed in Step 5

below. If the water level drops below the pump intake setting at the absolute minimum purge rate, the pump will remain in place and the water level will be allowed to recover repeatedly until there will be sufficient water volume in the well to permit the collection of samples.

5. Indicator Field Parameters Monitoring. During well purging, indicator field parameters (DO, turbidity, pH, specific conductance, and redox potential) will be monitored every five minutes (or less frequently, if appropriate). Purging will be considered complete and sampling began when all the aforementioned indicator field parameters had stabilized. Stabilization will be achieved when three consecutive readings, taken at five (5) minute intervals (or less frequently, if appropriate), are within the following limits:

    - DO (±10 percent);
    - turbidity (±10 percent);
    - specific conductance (±3 percent);
    - pH (± 0.1 unit); and
    - redox potential [Eh] ±10 mv).

    Temperature and depth to water will be also monitored during purging. Should any of the parameter-reading components of the flow-through meter fail during sampling; the sampling team will attempt to locate a replacement flow-through meter. If none is available, the sampling team will measure that parameter with an individual criteria meter. Any other field observations relating to sample quality, such as odor, foaming, effervescence, and sheens, will also be recorded on the sampling form.

6. Collection of Ground Water Samples. Water samples for laboratory analyses will be collected before the groundwater had passed through the flow-through cell by either using a by-pass assembly or by temporarily disconnecting the flow-through cell. All sample containers will be filled by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence. During purging and sampling, the tubing remains filled with water in order to minimize possible changes in water chemistry upon contact with the atmosphere. Methods employed to ensure that the outlet tubing will be filled include (i) adjusting the tubing angle upward to completely fill the tubing and (ii) restricting the diameter of the tubing near the outlet of the tubing.

The order in which samples will be collected is as follows:

- Volatile organics;
- Gas sensitive (e.g., Fe^{+2}, CH_4, H_2S/HS);
- Base/Neutrals or PAHs;
- Total Petroleum Hydrocarbons;
- Total metals;
- Dissolved metals;
- Cyanide;
- Sulfate and chloride;
- Nitrate and ammonia;
- Preserved inorganic;
- Non-preserved inorganic; and
- Bacteria.

Decontamination Requirements:

Numerous practices are employed throughout the processes of site investigation and sampling to assure the integrity of the resulting data. Of particular significance to the procedures of groundwater measurement and sampling is the limitation, whenever possible, of materials inserted into a well bore and, even more importantly, of materials transferred from well to well.

Many items can be discarded between well sampling and/or gauging locations without significantly impacting project costs. Dedicated sampling equipment which can be discarded between well sampling locations without significantly impacting project costs, will be used whenever possible to preclude decontamination requirements. Sampling equipment included in this category are Teflon ® bailers, nitrile gloves, and bailer cord. However, other investigative and sampling equipment, including such items as liquid level probes, must be reused from well to well.

The danger in multi-well equipment applications lies in the potential of cross-contamination. While the threat of cross-contamination is always present, it can be minimized through the

implementation of a consistent decontamination program during sensitive site measurement and data collection activities. The decontamination procedure is outlined below:

All site equipment used in a multi-well capacity will be decontaminated immediately prior to initial use and between each well. Standard site decontamination procedures for the optical interface probes between wells will be performed according to the following schedule:

- Initial rinse with clean tap water to remove excess residuals;
- Scrub equipment with sponge or clean, soft cloth in a distilled water/Liquinox@ (or equivalent) solution; and
- Double rinse with deionized/distilled water.

Rinse water generated during decontamination procedures will be treated on-site by passing the water through a bucket filled with activated carbon prior to disposal.

K.3. SOIL SAMPLING & WELL INSTALLATION

Responsible Personnel: Geologist

Training Qualifications: All field personnel supervising drilling activities shall have completed OSHA 40-Hour training, and three days of field training. Personnel supervising the well installation shall have observed drilling procedures for a minimum of three under the direct supervision of experienced personnel. Field personnel will have experience in operating the following field equipment: interface probe and photo-ionization detector (PID). Personnel should be able to describe soils encountered during drilling for generation of well logs.

Health and Safety Requirements:

A site specific HASP must be completed and reviewed by all field personnel. Prior to deploying a rig to the site, a utility call must be made (i.e. Pennsylvania One-Call) to allow mark-out of known subsurface utilities and associated laterals proximal to the site. Site plans, if available, should be reviewed to document and avoid the location of on-site utilities. No drilling should occur on retails sites within the exclusion zone. This zone is defined as the area between the pumps, the tank field and the station building. The area is excluded from drilling activities due to the likely occurrence of subsurface petroleum distribution lines. After review of all known mapped and marked utilities, a site reconnaissance will be performed to document the location of utility meters and storm sewer drains. In addition, the location of overhead utilities must be

documented. After completing the subsurface and overhead utility review, the area to drill may be observed as clear or the location may be adjusted to a "clear" location.

Once the drilling location is established, the area must be marked with cones to alert area traffic of the work area. Other health and safety concerns include slip/trip hazards, working with heavy equipment and overhead work hazards. During drilling activities, a minimum of protective work gloves, steel toed boots, hard hats, and safety goggles must be worn.

A final health and safety requirement includes hand clearing the borehole, prior to advancing the borehole with the drill rig. To ensure the safety of workers, the borehole will be cleared by hand or air knife, to depth of 5 feet below ground surface. This will serve to clear the area of utilities, prior to drilling.

Decontamination Requirements:

All down-hole equipment must be steam cleaned prior to drilling at each boring/well location. All soil sampling equipment must be cleaned with detergent and rinsed with distilled water prior to deployment into the borehole. All well construction materials (i.e. PVC well casing, PVC well screen, sand pack, bentonite seal) should be clean and dedicated to each hole.

Methodology for Borings Outside RCRA Areas in AOI 6:

1) Borehole Advancement

During soil sampling or well installation activities, a borehole is advanced into the unconsolidated subsurface materials or bedrock via a drill rig (or similar). Various types of drilling methods could be deployed to advance the hole. A description of each drilling method is included below:

a) Hollow Stem Auger

A spiral tool form is used to move material from the subsurface to the surface. A bit at the bottom cuts into the subsurface material. Spiral augers on outside convey the material to the surface while spinning. The center of the auger is hollow like a straw when the inner drive rods and plug are removed. During drilling or formation cutting, the center is filled with rods connected to a plug at the bottom bit. Once the desired drilling depth is reached, the center plug and rods can be pulled out, leaving the hollow augers in place. The hollow augers hold the borehole to remain open for sediment sampling and well installation.

b) Air Rotary

A drill bit at the bottom of rods is used to cut into the subsurface material. Air injected into the drill rods escapes through small holes in the drill bit and conveys the drill cuttings to the surface.

c) Geoprobe®

The geoprobe® sampling allows collection of soil by directly pushing (through hydraulic hammering) a sampling device lined with a plastic macrocore into the soil column.

d) Hand Auger

A stainless steel or aluminum hand auger will be physically advanced to the desired soil sampling depth.

2) Soil Sampling

Soil samples will be obtained for lithologic logging and laboratory analysis for chemical contaminants with one of three different sampling devices: Split barrel spoon sampler, hand auger or Geoprobe® soil sampler. For either method, the sampling devices are lowered through the hollow-stem augers or open borehole to allow sampling of the undisturbed sediments below the auger bit. Soil samples will be collected at intervals which appear to be visually impacted or from intervals which exhibit the highest deflections on the screening device (PID or similar).

a) Split barrel spoon sampler (split spoon)

The split spoon sampler will be driven into the soil column in accordance with ASTM Standard Method D1586 (Reference A6, Appendix E). Soil sampling by split barrel spoon will entail drilling a borehole with a hollow-stem auger to the desired sampling depth (standard five foot intervals). After augering to the desired depth, slowly and carefully lower the split barrel spoon sampler attached to the drill rod extension into the borehole. Drive the sampler into the soil by repeated blows from a 140 Lb. hammer with 30 inch travel. Record the blow counts required to drive the split spoon sampler each successive six inch interval. Remove sampler for borehole, split barrel open, remove soil sample utilizing a stainless steel knife to trim the top and edges of the sample and containerize sample in appropriate sample jar.

b) Geoprobe®

The geoprobe® liner is dedicated to each soil sampling interval. After retrieval of the sample, the liner may be sliced open and the soil sample can be logged and containerized in the appropriate sample jar. During shallow soil sampling from fine-grained sediments, the geoprobe® can advance the sampler directly into the ground, without the advance of an augered borehole.

c) Hand Auger

The hand auger allows for soil from the desired interval to be collected directly by removing the soil column that is contained in the auger portion of the device.

Methodology for Well Installations:

1) Well Construction

After drilling to the desired depth or the desired interval, permanent monitoring wells can be installed to allow groundwater sampling. In general, wells are constructed with slotted screen, which allows groundwater to flow into the well at the desired monitored interval and well casing, which restricts groundwater flow into the well from undesired interval. In most cases the well materials are constructed of PVC. In conditions where the shallowest groundwater interval is monitored, a single case construction monitoring well is installed. In conditions where multiple water bearing units occur and deep groundwater conditions are selected for monitoring, a double cased well is installed.

a) Single Casing Construction

The construction details of a monitoring well are determined by soil type, depth to groundwater and relative fluctuation of groundwater level. After drilling to the desired depth, a monitoring well is constructed for installation into the evacuated borehole. The well consists of a bottom cap, a length of screen and length of well casing. To determine the length of screen used, seasonal groundwater table or tidal fluctuations should be considered to allow the water table to intercept the well screen throughout the year. The assembled well is then inserted into the borehole.

The annular space between the well screen and subsurface is filled with a sand pack, which consists of clean, sorted sand. The sand pack allows water flow into the well but acts as a filter to prevent subsurface sediments from silting in the well. The sand pack extends one to two feet above the top of well screen. Above the sand pack, a seal is installed in the

annular space between the well casing and the subsurface. The seal is comprised of hydrated bentonite and prevents surface water from infiltrating the well screen. Above the well seal, the annular space is backfilled with drill cuttings or cement. A cap is placed on the top of the well to further prevent infiltration of the surface water. The top of the well is protected with either a stand-up pipe or a locking, flush mount box.

b) Double Casing Construction

In cases where multiple water bearing zones occur, a double case well is installed to allow monitoring of the deeper water bearing zones. Construction of a double cased well is similar to that of a single case well; however, to prevent groundwater infiltration from shallower water bearing zones, a second casing is installed. This type of construction requires drilling two different diameter boreholes.

During drilling through the shallower groundwater zones, large diameter augers/bits are used to create a large diameter borehole. The borehole is advanced through the shallower water bearing area which will not be monitored. An outer casing is installed to seal the deeper monitoring well from infiltration from the shallow water bearing zones. After the outer casing is installed, the borehole is advanced deeper with smaller diameter auger/bit. The outside diameter of second augers fit within the inside diameter of the outer casing. The borehole is advanced to allow monitoring of the deeper water bearing zone. Once the desired depth is obtained, a monitoring well is installed within the outer casing, using similar methods as described in the single casing construction (3a, above). The outside casing prevents shallow groundwater infiltration into the well. The inside casing prevents surface water infiltration into the well.

2) Soil Cutting Handling

Cuttings generated from drilling will be containerized or stock-piled, undercover, until appropriate disposal is determined. In the case the soils are not impacted, the cuttings may remain on-site. Impacted soils will be removed using appropriate hazardous waste handling procedures and disposed of with an approved hazardous waste handler.

3) Well Development

After installation, monitoring wells are developed to remove residual sediments within the well and annular space. Water is pumped from the well a low flow rate (to minimize turbulence

within the well and associated sand pack) until groundwater flowing from the well appears relatively free of sediments.

Documentation:

All site activities should be detailed in the site investigators fieldbook. The entry shall include the date, time, weather, address, and persons present on-site. In addition, data required to create well construction logs or boring logs (if no well is constructed) should be collected. This data includes soil type, relative moisture content, depth of water table, observed impact, soil screening measurements (if PID is used), blow counts (if split spoon samples are collected), sample recovery, depth of borehole, length of well screen, length of well casing(s), sand pack interval, well seal interval. The site investigator should identify the relative location and number.

K.4. NON-AQUEOUS PHASE LIQUID (NAPL) SAMPLING PROCEDURES

Responsible Personnel: Technicians and Geologists

Training Qualifications:

All field personnel involved must have completed OSHA 40 HOUR HAZWOPER training. Prior to NAPL sampling, all field personnel will have worked a minimum of three sites under the direct supervision of experienced personnel. Field personnel will also have experience in sampling and vapor monitoring techniques and sampling equipment decontamination.

Materials and Equipment Necessary for Task Completion:

A list of equipment required to sample NAPL from a monitoring well is presented below:

- Current site map detailing well locations;
- Field data book for recording site data;
- Liquid level gauging device (graduated, optical interface probe);
- Keys and tools to provide well access;
- Appropriate sample containers and labels. NAPL samples will be collected in laboratory provided 40 milliliter (ml) glass vials with plastic caps fitted with Teflon ® lined septa; all sample bottles will be laboratory sterilized and will contain the appropriate preservative, if applicable. A minimum of 10 ml is required for laboratory

analysis. In the case that sufficient volume is not obtained, a swabbing technique (described below) will be used;

- Sorbent pads (required for swabbing technique);
- Teflon ® (or equivalent) bottom-loading bailer to obtain NAPL sample;
- Clean nylon or polypropylene bailer cord;
- Decontamination supplies;
- H&S supplies (tyvek, nitrile gloves, safety goggles);
- Blank chain-of-custody forms; and
- Cooler and ice for sample preservation.

Health and Safety Requirements:

Site specific HASP must be completed and reviewed by field personnel. As a minimum, modified Level "D" attire will be worn. Individuals performing NAPL sampling are required to wear safety goggles, tyvek suit, and nitrile sampling gloves.

Decontamination Requirements:

During NAPL sampling activities, dedicated sampling equipment (i.e. Teflon ® bailers, nitrile gloves, and bailer cord) are utilized; thereby, eliminating decontamination requirements. The interface probe, used to record the presence of NAPL and relative thickness prior to sampling, does require decontamination between sampling locations.

All site equipment used in a multi-well capacity will be decontaminated immediately prior to initial use and between each well. Standard site decontamination procedures for the optical interface probes between wells will be performed according to the following schedule:

- Initial rinse with clean tap water to remove excess residuals;
- Scrub equipment with sponge or clean, soft cloth in a distilled water/Liquinox® (or equivalent) solution; and
- Double rinse with deionized/distilled water.

Methodology:

Each monitoring well to be sampled will be gauged to obtain liquid level and relative NAPL thickness immediately prior to initiation of the sampling process. Refer to SOP No. 1 for appropriate well gauging procedures. Liquid level data will be recorded in a field book.

Sampling of the NAPL will occur via two different methods: direct sample or swabbing.

The following sequence of procedures will be implemented for the collection of groundwater samples from monitoring wells.

1) Establish a clean work area where sampling equipment will not come in contact with the ground or any potentially contaminated surfaces.
2) Use a laboratory, pre-cleaned Teflon® sampling bailer for each well.
3) Don an unused, clean pair of nitrile gloves.
4) Attach an appropriate length of unused, clean nylon or polypropylene cord to the designated sampling bailer.
5) Select appropriate laboratory-sterilized sample containers.
6) Slowly lower sampling bailer into well until water surface is encountered; continue to lower the sampling bailer into the standing water column to one foot below the water surface.
7) Retrieve bailer at a steady rate to avoid excess agitation.
8) Visually inspect bailed sample to ensure for relative thickness of NAPL. If sufficient volume is present (>10 ml) place a direct sample of the NAPL into the laboratory vial. If less than 10 ml of NAPL is present, use a sorbent pad to absorb the NAPL from the surface of the groundwater sample. Place is swab sample into the laboratory vial.
9) Complete and attach labels to sample containers noting sample collector and date, time, and location of sample; record same data in field book.
10) Place samples in ice-filled cooler in such a manner as to avoid breakage. Samples collected for VOC analysis will be maintained at a temperature of 4°C.
11) Discard gloves and bailer cord and move to next sample location.

Documentation:

All site activities should be detailed in the site investigators fieldbook. The entry shall include the date, time, weather, address, persons present on-site, and the aforementioned parameters. Only relevant observations should be recorded. The nature of the work being performed is also appropriate.

APPENDIX L

Data Usability Assessment

APPENDIX L
DATA USABILITY ASSESSMENT
AOI 6 WORK PLAN FOR SITE CHARACTERIZATION
PES FACILITY
PHILADELPHIA, PENNSYLVANIA

The purpose and objective of the data usability assessment is to determine if the specific goals of the project were achieved by evaluating the sensitivity, validity, reliability, representativeness, comparability, and completeness of the collected data. The process documents that analytical results used for decision-making are accurate, precise, and representative of environmental conditions. The Data Usability Assessment includes an examination of the reported laboratory analytical data, the supporting data, and field notes, when necessary. A review of the deficiencies identified in the data, appended data qualifiers, identification of biases and unreliable data, and assessments of field and laboratory performance are completed and reconciled with project data quality objectives. Reported results may be considered be sufficiently valid when the sampling and method performance criteria were achieved or, alternatively, the results may be considered estimates and qualified by the laboratory or data validator. In the case or organic analyses, these flags include "J" qualifiers to indicate a reported result is estimated below the laboratory reporting limit; "UJ" qualifiers to indicate estimated laboratory detection limits; and "B" qualifiers to indicate a reported result may be affected by blank contamination. For inorganic analyses, laboratory-applied "J" and "B" qualifiers are typically defined inversely.

For the purposes of this investigation, groundwater and soil results summarized in twenty laboratory sample delivery groups (SDGs) provided by The Washington Group, Lancaster Laboratories, Pace Analytical, and Accutest Laboratories are evaluated in the sections below for usability. These samples were collected from December 2002 through January 2013 by Langan, Stantec, Secor, and AquaTerra Tech. on behalf of Sunoco, Inc. Samples were analyzed for volatile organic compounds (VOC), semi-volatile organic compounds (SVOC), ethylene dibromide (EDB), metals and wet chemistry parameters. Copies of the laboratory reports are provided in this appendix for reference. Any analytical data, data qualifiers, and QA/QC results provided in these

reports were evaluated to determine the reliability and validity of the data and its appropriateness for use in the decision-making process. The criteria used in the data usability summary are presented in the following sections.

A complete list of SDGs included in the AOI 6 evaluation is as follows:

Laboratory	***Year***	***SDGs***
The Washington Group	2002	68562
Lancaster Laboratories	2002	827419, 827401, 831613, 823334
	2008	1083613
Pace Analytical	2007	07-5326, 07-3770
Accutest Laboratories	2012	JB23816, JB22962, JB22822, JB23100
	2013	JB25728, JB25729, JB25834, JB25963, JB26465, JB26467, JB25835, JB25964

Data Quality Indicators

Data quality indicators (DQIs) are qualitative and quantitative measures of data quality "attributes," which are descriptors used to express various properties of analytical data. Thus, DQIs are the various measures of the individual data characteristics that collectively comprise the general, all-encompassing term "data quality." Quality attributes used to assess the data usability include:

- Method selectivity/specificity
- Method sensitivity
- Accuracy (bias, validity)
- Precision (reliability)
- Representativeness
- Comparability
- Completeness

These indicators, as they relate to the data collected during the site characterization, are described in more detail below.

Method Selectivity/Specificity

Method selectivity/specificity is defined as the compound type or class that can be detected by the instrument or detector. Instruments that are used to detect a compound class (i.e., hydrocarbons) are said to be selective. Instruments that are used to detect a specific element group (e.g., halogens) are said to be specific. Groundwater, and soil samples, as well as trip blanks, were analyzed for the following parameters using the listed specific methods:

- GC/MS Volatile via SW-846 Method 8260B,
- GC/MS Semi-volatiles in water via SW-846 Methods 8270C, 8270C with SIM, 8270D, 8270D with SIM, and 8310,
- Ethylene Dibromide via SW-846 Method 8011,
- Metals via SW-846 Method 7471A, SW-846 Method 7470A SW-846 Method 6010B, 6010C, and SW-846 Method 6020, and
- Wet Chemistry via SW-846 Method 9045C modified and Standard Method SM20 2540G.

Method Sensitivity

Method sensitivity is the degree to which an analyte can be detected above a statistically derived method detection limit and the associated laboratory reporting limit. Method sensitivity permits decision-making when data are reported at or near state and federal benchmarks.

The following non-detect soil sample results should not be used for the purpose of delineation because reporting limits initially exceeded screening criteria (e.g., the PADEP Soil MSCs), or samples required dilution factors that raised laboratory reporting limits above the corresponding screening criteria. Specifically, EDB associated with the SW-846 8260B volatile analysis for samples B-167_2', B-167_4', BH-12-104_0.5-1;, BH-12-106_1-1.5', BH-12-108_1', BH-12-111_0.5-1', BH-12-111_1-1.5, BH-12-129_1.5-2', BH-12-130_1-2', BH-12-131_1-2', BH-12-149_1-1.5_C-165_1.5-2', BH-12-101_2-3', BH-12-102_2-2.5', BH-12-105_2-2.5', BH-12-108_2-2.5', BH-12-109-3', BH-12-110_3-3.5',

BH-12-114_3-3.5', BH-12-116_3.5', BH-12-117_2-2.5', BH-12-122_2.5-3', BH-12-123_2-2.5', BH-12-124_3-3.5', BH-12-125_2.5-3', BH-12-126_2.5-3', BH-12-127_2.5-3', BH-12-128_3-3.5', BH-12-129_2.5-3', BH-12-149_2.5-3'; 1,3,5-trimethylbenzene, benzene, and MTBE associated with the result for BH-12-125_2.5-3'.

The following non-detect groundwater sample results should not be used for the purpose of delineation because reporting limits initially exceeded screening criteria (i.e., the PADEP Groundwater MSCs) or samples required dilution factors that raised the laboratory reporting limits above the corresponding criteria. Specifically, benzo(g,h,i)perylene for samples B115_010413, B162_010413, B160_010713, and B48_010413; benzo(a)pyrene for samples B115_010413, B160_010713, B48_010413, and B162_010413; chrysene for sample B160_010713; benzo(a)anthracene for sample B160_010713; benzo(b)fluoranthene for sample B160_010713; 1,2,4-trimethylbenzene for samples B149_010713, B154_010713, B155_010713; 1,2-dichloroethane for samples B149_010713, B154_010713, B155_010713; ethylbenzene for sample B154_010713; 1,3,5-trimethylbenzene for samples B149_010713, B154_010713, and B155_010713; MTBE for samples B154_010713 and B155_010713.

Accuracy (Bias)

Accuracy is the degree of the bias in a measurement system, and can be defined as the agreement between a measurement and an accepted reference or true value. Bias can be positive or negative, which means that the "true" concentration is likely higher or lower (respectively) than the reported laboratory result. While bias direction can be estimated for data quality impacts, the degree to which bias affects the laboratory result cannot be quantified.

Indicators of accuracy include, but are not limited to, sample hold times and preservation, surrogate spike recoveries, laboratory control sample (LCS) and LCS duplicate recoveries, and matrix spike sample (MS) and spike duplicate (SD) recoveries. The acceptable ranges of accuracy for each of the above listed indicators are method and matrix specific, and are defined within the published analytical test methods specified in the section above. Laboratory recovery limits may differ from those

identified in the methods. For the purposes of this assessment, accuracy [or bias] was evaluated by reviewing the following indicators, and deficiencies are identified in the Summary of Findings:

- *Sample hold times* to determine if samples were extracted and analyzed within method-specific timeframes. *Sample preservation* to determine that samples were properly stored on ice at 4°C ± 2°, and method-specific adjustment in pH occurred. If hold times are exceeded or preservation requirements were not met, reported concentrations may be biased low.

- *Laboratory method, equipment, and trip blank samples* to determine if sample results are potentially affected by contamination resulting from laboratory procedures, sampling equipment decontamination, or sample transport.

- *Percent recovery of surrogate spikes* (system monitoring compounds) injected into each sample prior to sample extraction or preparation to determine that these compounds were recovered within the laboratory acceptance limits. Because surrogate compounds are added to each sample at known concentrations, a measure of accuracy can be established based upon a comparison of the measured concentration to the actual amount spiked into a sample. If surrogates are recovered below this range then concentrations reported for the target analytes may be biased low: similarly, if surrogates are recovered above this range then concentrations reported for the target analytes may be biased high.

- *Percent recovery of each compound analyzed in the laboratory QA/QC samples [Laboratory Control Spike (LCS) and Laboratory Control Spike Duplicate (LCSD)] and field QC samples [Matrix Spike (MS) and Matrix Spike Duplicate (SD)].*

LCS and LCSD samples are samples of reagent water or suitable reference matrix spiked with known concentrations of the target analytes. LCS and LCSD samples are run at a rate of one per sample batch (approximately 20 samples) and are indicators of method performance. If compounds within the LCS or LCSD are recovered above or below the acceptable ranges than concentrations of those compounds may be biased in each of the normal environmental samples within the corresponding batch.

MS and SD samples are normal environmental samples collected at the project site and spiked with known concentrations of the target analytes. MS and SD samples are typically run at the same frequency as LCS and LCSD samples, and are indicators of potential bias based on the sampling matrix. If analytes in the MS or SD are recovered above or below the acceptable ranges, then reported results may be biased in each of the normal environmental samples within the corresponding batch.

Internal and external instrument calibration and verification are a central part of the analytical process, and are reviewed to determine that the procedures stipulated within a particular analytical method are followed. For the purpose of this Data Usability Assessment, calibration information was not provided and not specifically reviewed unless a nonconformance was noted in the laboratory data package.

Precision

Precision is defined as the ability to reproduce analytical results, and is the measure of variability between individual sample measurements under prescribed conditions. Precision is assessed by the analysis of duplicate samples and expressed in terms of relative percent difference (RPD). For this project, analytical variability was measured as the relative percent difference (RPD) between 1) analytical laboratory duplicates (LCS and LCSD), and 2) the matrix spike (MS) and matrix spike duplicate (SD). Field duplicate samples are not required under the sampling guidelines and were not collected.

Each laboratory sample delivery group listed in the section above was evaluated for precision. Generally, the LCS/LCSD and MS/SD in each of these laboratory SDGs for each parameter group [VOCs, SVOCs, metals, EDB and wet chemistry] are below the

maximum allowable RPD and meet the criteria for precision. Exceptions are listed by method in the Summary of Findings.

Representativeness

Representativeness is the degree to which data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter most concerned with the proper design of the sampling program. The representativeness criteria may be satisfied by making certain the sampling locations are selected properly and that a sufficient number of samples are collected to fulfill program objectives.

Groundwater and soil samples were collected from locations biased to potential source areas and/or sensitive receptors (surface water bodies, occupied buildings, and residential properties). The analytes analyzed in groundwater and soil samples include those currently identified in the Pennsylvania Corrective Action Process (CAP) Regulation Amendments effective December 1, 2001; provided in Chapter VI, Section E of PADEP's Closure Requirements for Underground Storage Tank Systems (with exception for the waste oil parameters since waste oil is only stored in small tanks within the facility maintenance garages).

The data collected during this investigation is considered representative of groundwater and soil in AOI 6 based on the distribution of the monitoring wells and soil boring sampling locations within the sampling program, the frequency of sample collection, and the suite of parameters analyzed.

Comparability

Comparability is the degree to which data from one study can be compared with data from other similar studies, reference values (such as background), reference materials, and screening values. This goal was achieved by using standard techniques to collect and analyze representative samples and reporting analytical results in appropriate units. The sample collection methods used were based on the PADEP's guidelines summarized in the Groundwater Monitoring Guidance Manual dated December 1, 2001

and the Groundwater Sampling and Analysis Plan, dated January 17, 2008. The analytical methods used are EPA solid waste methods or Standard Methods.

Based on this data quality analysis, the data are considered comparable to other groundwater and soil data collected as part of other sampling programs.

Completeness

Completeness is defined as the percentage of usable data in the total data population generated. Completeness was calculated for each analyte where data were qualified as rejected. Completeness is determined as the difference between the total number of data points and the number of rejected data points divided by the total number of results. For soil and groundwater results associated with AOC 6, 100% percent of the data is considered complete.

Summary of Findings (by Method)

VOCs by SW-846 Method 8260B:

Poor surrogate recoveries were indicated for samples MW-1(1-1.5), MW-2(1-1.5) and MW-3(1-1.5) (grab soil samples). The direction and magnitude of the poor recoveries were not provided in the 2002 data package and an assessment of bias could not be made.

The pH of sample B160_010713 was greater than the field preservation requirements (i.e., 2) at 5. The sample was properly preserved on ice and analyzed within the method holdtime. The results may be biased low.

Samples B-167_2' and B-167_4' displayed surrogate recoveries greater than the upper control limit for toluene-d8 (132% and 198%, respectively) and 4-bromofluorobenzene (276% and 320%, respectively). The reported positive detections for benzene, toluene, ethylbenzene, total xylenes, isopropylbenzene, and 1,2,4-trimethylbenzene may be biased high.

MS/SD sample JB23096 (SDG JB22962) displayed recoveries greater than the upper control limit for MTBE at 154% and 154%, respectively. The spiked sample did not originate from AOI 6; data quality is not assessed on this basis.

The MS/SD RPD for 1,2-dibromoethane associated with spiked sample JB22876 (SDG JB22822) was greater than the control limit at 22%. The spiked sample did not originate from AOI 6; data quality is not assessed on this basis.

MS/SD sample JB23763-1 (SDG JB22822) displayed recoveries greater than the upper control limit for naphthalene at 583% and 558%, respectively. The spiked sample did not originate from AOI 6; data quality is not assessed on this basis.

Sample BH-12-108_2-2.5' displayed surrogate recoveries greater than the upper control limit for toluene-d8 and 4-bromofluorobenzene at 130% and 147%, respectively. The positive results for benzene and toluene were reported from this analysis and may be biased high.

SVOCs by SW-846 Method 8270C, 8270C with SIM, and 8270D:

Sample BH-12-101_2-3' displayed recoveries less than the lower control limit for surrogates nitrobenzene-d5 and 2-fluorobiphenyl at 16% and 19%, respectively. The sample was reanalyzed and nitrobenzene-d5 recovered below the lower control limit at 25%. The associated positive detections for benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, chrysene, phenanthrene, and pyrene may be biased low. In addition, the non-detect results for anthracene and fluorene may be biased low.

Sample BH-94_10713 displayed recoveries less than the lower control limit for nitrobenzene-d5 during initial and reanalysis at 5% and 9%, respectively. The reported analytes are not target compounds of nitrobenzene-d5 and the remaining two surrogates (i.e., 2-fluorobiphenyl and terphenyl-d14) recovered within control.

MS/SD sample B-151_010713 displayed recoveries less than the lower control limit for benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, and chrysene. Bias is not assessed on the basis of spike recoveries alone.

Samples B-152_010713 and URS-4_010913 displayed surrogate recoveries of nitrobenzene-d5 less than the lower control limit at 5% and 12%, respectively. The reported analytes are not associated with nitrobenzene-d5 and the remaining two surrogates recovered within control.

MS/SD sample JB25976-3 displayed recoveries less than the lower control limit for benzo(g,h,i)perylene at 18% and 21%, respectively. In addition, the MS/SD RPDs for anthracene, benzo(a)anthracene, chrysene, phenanthrene, and pyrene were greater than the control limit at 26%, 26%, 25%, 27%, and 25%, respectively. The spiked sample did not originate from AOI-6; accuracy and precision are not assessed on this basis.

EDB by SW-846 Method 8011:

Samples B-126_010713, B-149_010713, B-151_010713, B-152_010713, B-154_010713, B-155_010713, B-156_010713, B-158_010713, B-163_010713, and B-45_010713 were extracted one day outside of holdtime. The sample results may be biased low but are not expected to be significantly impacted.

Sample B123_010813 was analyzed one day outside of holdtime and samples B133_010913 and U4_010913 were analyzed two days outside of holdtime. The sample results may be biased low nut are not expected to be significantly impacted.

Samples B133_010913 and U4_010913 displayed surrogate recoveries less than the lower control limit and were reanalyzed two days outside of holdtime. The non-detect sample results may be biased low.

Lead by SW-846 Method 6010B and 6010C:

The aqueous serial dilution associated with sample batch MP68466 was greater than the control limit (i.e., 10%) at 11%. Soil sample results were reported from the affected sample batch; bias is not assessed on this basis.

MS/SD sample JB23763-1 displayed recoveries less than the lower control limit at 71.0% and 53.3%, respectively. In addition, the MS/SD RPD was greater than the control limit at 23.5%. The spiked sample did not originate from AOI-6; accuracy and precision are not assessed on this basis.

The serial dilutions analyzed in conjunction with sample batches MP69063 and MP69158 displayed %Ds greater than the control limit (i.e., 10%) at 13.7% and 100%, respectively. The initial sample results were less than 50X the IDL; bias is not assessed on this basis.

Summary and Conclusions

For the purposes of this investigation, sample results were summarized in twenty sample delivery groups provided by Lancaster Laboratories, Pace Analytical, Accutest Laboratories and Washington Group. Results were evaluated in the sections above for usability. Copies of the laboratory reports are provided in this appendix for reference.

The laboratory performed quality assurance and quality control (QA/QC) analyses, including analysis of LCS/LCSDs, MS/SDs, surrogate spikes, and method blanks. Laboratory QA/QC summaries are provided in each data package, where available. The analytical data, data qualifiers, and QA/QC results provided in these reports were evaluated to determine whether AOC 6 groundwater and soil data met data quality objectives and could be used in the decision-making process.

Several trip blank samples were collected during the soil and groundwater sampling events, and were non-detect for target analytes. All samples were properly preserved and were extracted/prepared, and analyzed within sample hold times with the

exceptions noted above. Target compounds were not detected above the reporting limit in the laboratory method blanks, and recoveries in LCS/LCSDs were within acceptable recovery control limits, limiting potential bias. Multiple surrogates and MS/SDs recovered outside of the acceptable range as described in detail above.

On the basis of this evaluation, the analytical laboratories appear to have followed the specified analytical methods according to the provisions of the methods, with the exception of the errors discussed above. If a given fraction or SDG is not mentioned above, that indicates that all specified criteria were met. All data are usable for characterizing the site and identifying compounds of concern. As described above, non-detect sample results with reporting limits in exceedance of the associated screening level are not usable for delineating potential impacts.

APPENDIX M

PNDI Report Summary

June 12, 2013

PA Game Commission
Bureau of Wildlife Habitat Management
Division of Environmental Planning and Habitat Protection
2001 Elmerton Avenue
Harrisburg, PA 17110-9797

Re: Potential PNDI Conflict
Philadelphia Energy Solutions Refining and Marketing LLC Facility
Philadelphia AOI-6
PNDI Search ID: 201315386608
City of Philadelphia, Philadelphia County, Pennsylvania
Langan Project No.: 002574601

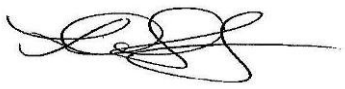
Dear Sir/Madam:

As environmental and regulatory compliance agent for Sunoco R&M (applicant), Langan Engineering & Environmental Services (Langan) submits this request for potential conflicts associated with a search of the Pennsylvania Natural Diversity Inventory (PNDI) database. According to the PNDI search (PNDI 201315386608), potential impacts may exist within the project site under the jurisdiction of the Pennsylvania Game Commission.

AOI 6 is located in the southern portion of the Philadelphia Energy Solutions Refining and Marketing LLC (PES) Facility in Philadelphia, Pennsylvania and is known as the Girard Point Chemicals Processing Area (Figure 1). AOI 6 is bordered to the North and East by industrial facility, the South by Penrose Avenue and the George Platt (formerly Penrose Avenue) Bridge, and to the West by the Schuylkill River. AOI 6 encompasses approximately 117 acres. No surface water features are located in AOI 6. The nearest surface water body to AOI 6 is the Schuylkill River which comprises the western boundary. A sheet pile bulkhead extends along the entire western boundary of the AOI 6 along the Schuylkill River. The extent of the sheet pile wall/bulkhead is shown in Figure 2. Groundwater interaction with surface water/sediment is limited by the sheet pile wall.

The project is currently in the Act 2 reporting process and information related to threatened/endangered species or their habitats is required. We request information as to whether the project is determined to affect species of special concern under your jurisdiction, specifically addressing Act 2 reporting. If you have any questions on the enclosed materials or require any additional materials to make your determination, please feel free to contact me at (215) 491-6559.

Sincerely,
Langan Engineering and Environmental Services, Inc.



Linda Kenney, PWS, CWB
Senior Project Manager

Enclosure(s): As discussed

\\langan.com\data\DT\data6\2574601\Engineering Data\Natural Resources\2013 PNDIs\AOI-6\PAGC AOI-6 PNDI Initial Conflict Letter.docx

June 12, 2013

PA Fish and Boat Commission
Division of Environmental Services
450 Robinson Lane
Bellefonte, PA 16823-7437

Re: Potential PNDI Conflict
Philadelphia Energy Solutions Refining and Marketing LLC Facility
Philadelphia AOI-6
PNDI Search ID: 201315386608
City of Philadelphia, Philadelphia County, Pennsylvania
Langan Project No.: 002574601

Dear Sir/Madam:

As environmental and regulatory compliance agent for Sunoco R&M (applicant), Langan Engineering & Environmental Services (Langan) submits this request for potential conflicts associated with a search of the Pennsylvania Natural Diversity Inventory (PNDI) database. According to the PNDI search (PNDI 201315386608), potential impacts may exist within the project site under the jurisdiction of the Pennsylvania Fish and Boat Commission. A SIR is enclosed for your reference.

AOI 6 is located in the southern portion of the Philadelphia Energy Solutions Refining and Marketing LLC (PES) Facility in Philadelphia, Pennsylvania and is known as the Girard Point Chemicals Processing Area (Figure 1). AOI 6 is bordered to the North and East by industrial facility, the South by Penrose Avenue and the George Platt (formerly Penrose Avenue) Bridge, and to the West by the Schuylkill River. AOI 6 encompasses approximately 117 acres. No surface water features are located in AOI 6. The nearest surface water body to AOI 6 is the Schuylkill River which comprises the western boundary. A sheet pile bulkhead extends along the entire western boundary of the AOI 6 along the Schuylkill River. The extent of the sheet pile wall/bulkhead is shown in Figure 2. Groundwater interaction with surface water/sediment is limited by the sheet pile wall.

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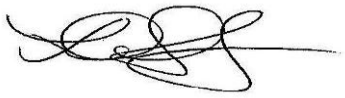

Linda Kenney, PWS, CWB
Senior Project Manager

Enclosure(s): As discussed

\\langan.com\data\DT\data6\2574601\Engineering Data\Natural Resources\2013 PNDIs\AOI-6\PAFBC AOI-6 PNDI Initial Conflict Letter.docx

SENDER: COMPLETE THIS SECTION

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

PA Game Commission
Bureau of Wildlife Habitat Management
Division of Environmental Planning and
Habitat Protection
2001 Elmerton Avenue
Harrisburg, PA 17110-9797

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X [signature] ☐ Agent ☐ Addressee

B. Received by (Printed Name) | C. Date of Delivery: 6-14-13

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☑ Certified Mail ☐ Express Mail
☐ Registered ☑ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (Extra Fee) ☐ Yes

2. Article Number (Transfer from service label) 7012 2210 0000 1980 4265

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

U.S. Postal Service™
CERTIFIED MAIL™ RECEIPT
(Domestic Mail Only; No Insurance Coverage Provided)
For delivery information visit our website at www.usps.com®
OFFICIAL USE

Postage	$ .46
Certified Fee	3.10
Return Receipt Fee (Endorsement Required)	2.55
Restricted Delivery Fee (Endorsement Required)	
Total Postage & Fees	$ 6.31

Postmark Here JUN 12 2013

Sent To: PA Fish and Boat Commission
Street, Apt. No., or PO Box No.: Division of Environmental Services
City, State, ZIP+4: 450 Robinson Lane
Bellefonte, PA 16823-7437

PS Form 3800, August 2006 See Reverse for Instructions

7012 2210 0000 1980 4272

U.S. Postal Service™
CERTIFIED MAIL™ RECEIPT
(Domestic Mail Only; No Insurance Coverage Provided)
For delivery information visit our website at www.usps.com®
OFFICIAL USE

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- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

PA Fish and Boat Commission
Division of Environmental Services
450 Robinson Lane
Bellefonte, PA 16823-7437

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X Brittany N. Bell ☐ Agent ☐ Addressee

B. Received by (Printed Name) | C. Date of Delivery: 6/17

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☑ Certified Mail ☐ Express Mail
☐ Registered ☑ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (Extra Fee) ☐ Yes

2. Article Number (Transfer from service label) 7012 2210 0000 1980 4272

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

PFBC-NESU-1 (5/2/03)

COMMONWEALTH OF PENNSYLVANIA
FISH AND BOAT COMMISSION
NATURAL DIVERSITY SECTION

SPECIES IMPACT REVIEW (SIR) REQUEST FORM

A. This form provides the site information necessary to perform a computer database search for species of special concern listed under the Endangered Species Act of 1973, the Wild Resource Conservation Act, the Pennsylvania Fish and Boat Code or the Wildlife Code.

B. Use only ***one form*** for each proposed project or location. Complete the information below and **mail** form to:

Natural Diversity Section
PA Fish and Boat Commission
450 Robinson Lane
Bellefonte, PA 16823
Fax: (814) 359-5153

C. This form, a cover letter including a project narrative, and accompanying maps should be sent to the above address for environmental reviews that ***only*** concern ***reptiles, amphibians, fishes and aquatic invertebrates***. Reviews for other natural resources must be submitted to other appropriate agencies.

D. The absence of recorded information from our databases and files does not necessarily imply actual conditions on site. Future field investigations could alter this determination. The information contained in our files is routinely updated. A review is valid for one year.

E. ***Please send us only one (1) copy of your request*** – either by fax or by mail – not both. Mail is preferred to improve legibility of maps. Facsimile submission will not improve our response turn-around time.

F. ***Allow 30 days for completion of the review from the date of PFBC-NESU receipt.*** Large projects and workload may extend this review timeframe.

G. ***In any future correspondence with us following your receipt of the SIR response, please refer to the assigned SIR number at the top left of our cover letter.***

H. **FORMS THAT ARE NOT COMPLETED IN FULL WILL NOT BE REVIEWED.**

PLEASE PRINT OR TYPE: If available, provide the potential conflict **PNDI Search Number**: 20130115386608

PFBC response should be sent to:

Company/Agency: Langan Engineering & Environmental Services Form Preparer: Linda Kenney

Address: P.O. Box 1569, Doylestown, PA 18901-0219

Phone: (8:00 AM – 4:00 PM): 215-491-6500

Project Description: The project consists of approximately 117 acres. The project is currently in the Act 2 reporting process and information related to threatened/endangered species or their habitats is required.

Indicate if the project is: Transportation ☐ or Non-transportation ☒ (check one)

Will the proposed project encroach directly or indirectly (e.g., runoff) upon wetlands or waterways? Circle one for each:

Wetlands: Yes **No** Unknown Waterways: **Yes** No Unknown

County: Philadelphia Township/Municipality: City of Philadelphia

Name of the United States Geological Survey (U.S.G.S.) 7.5 Minute Quadrangle Map where project is located:

Philadelphia, PA Project size (in acres): 117

Attach an 8.5" by 11" photocopy (**DO NOT REDUCE**) of the section of the U.S.G.S. Quadrangle Map which identifies the project location. On this map, indicate the location of the project center (if linear, depict both ends) and outline the appropriate boundaries of the project area.

Specify latitude/longitude of the project center. **Latitude**: 39° / 54' / 6.7" **N**

Indicate latitude/longitude in degrees-minutes-seconds format only. **Longitude**: 75° / 12' / 21.5" **W**

Three steps are needed to convert from decimal to degrees-minutes-seconds: (1) Degrees will be the whole number. (2) To get minutes, multiply the decimal degree portion by 60. (3) Multiply the decimal minute portion by 60 to get seconds.

Example: (Latitude) 40.93748 = **40**° ; 0.93748 x 60 = 56.2488' = **56**' ; 0.2488 x 60 = 14.928 = **15**" = **40°56'15"N**

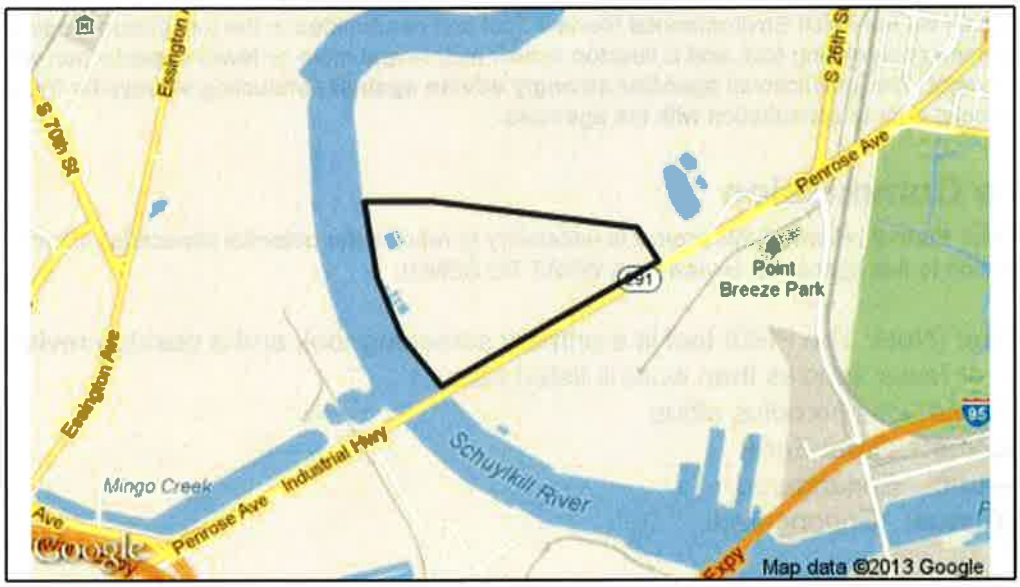
(Longitude) 75.94740 = **75**° ; 0.94740 x 60 = 56.844' = **56**' ; 0.844 x 60 = 50.64 = **51**' = **75°56'51"W**

FOR PFBC USE ONLY

SIR#	Quad Name	Data Source	Search Results-Potential Species Conflict	Action

1. PROJECT INFORMATION

Project Name: **Sunoco AOI-6**
Date of review: **1/15/2013 9:21:30 PM**
Project Category: **Hazardous Waste Clean-up, Site Remediation, and Reclamation,Other**
Project Area: **117.5** acres
County: **Philadelphia** Township/Municipality: **Philadelphia**
Quadrangle Name: **PHILADELPHIA** ~ ZIP Code: **19145**
Decimal Degrees: **39.901868 N, -75.205965 W**
Degrees Minutes Seconds: **39° 54' 6.7" N, -75° 12' 21.5" W**



2. SEARCH RESULTS

Agency	Results	Response
PA Game Commission	**Potential Impact**	**FURTHER REVIEW IS REQUIRED, See Agency Response**
PA Department of Conservation and Natural Resources	No Known Impact	No Further Review Required
PA Fish and Boat Commission	**Potential Impact**	**FURTHER REVIEW IS REQUIRED, See Agency Response**
U.S. Fish and Wildlife Service	No Known Impact	No Further Review Required

As summarized above, Pennsylvania Natural Diversity Inventory (PNDI) records indicate there may be potential impacts to threatened and endangered and/or special concern species and resources within the project area. If the response above indicates "No Further Review Required" no additional communication with the respective agency is required. If the response is "Further Review Required" or "See Agency Response," refer to the appropriate agency comments below. Please see the DEP Information Section of this receipt if a PA Department of Environmental Protection Permit is required.

3. AGENCY COMMENTS

Regardless of whether a DEP permit is necessary for this proposed project, any potential impacts to threatened and endangered species and/or special concern species and resources must be resolved with the appropriate jurisdictional agency. In some cases, a permit or authorization from the jurisdictional agency may be needed if adverse impacts to these species and habitats cannot be avoided.

These agency determinations and responses are **valid for two years** (from the date of the review), and are based on the project information that was provided, including the exact project location; the project type, description, and features; and any responses to questions that were generated during this search. If any of the following change: 1) project location, 2) project size or configuration, 3) project type, or 4) responses to the questions that were asked during the online review, the results of this review are not valid, and the review must be searched again via the PNDI Environmental Review Tool and resubmitted to the jurisdictional agencies. The PNDI tool is a primary screening tool, and a desktop review may reveal more or fewer impacts than what is listed on this PNDI receipt. The jursidictional agencies **strongly advise against** conducting surveys for the species listed on the receipt prior to consultation with the agencies.

PA Game Commission

RESPONSE: Further review of this project is necessary to resolve the potential impacts(s). Please send project information to this agency for review (see WHAT TO SEND).

PGC Species: (Note: The PNDI tool is a primary screening tool, and a desktop review may reveal more or fewer species than what is listed below.)
Scientific Name: Casmerodius albus
Common Name: Great Egret
Current Status: Endangered
Proposed Status: Endangered

PA Department of Conservation and Natural Resources

RESPONSE: No Impact is anticipated to threatened and endangered species and/or special concern species and resources.

PA Fish and Boat Commission

RESPONSE: Further review of this project is necessary to resolve the potential impacts(s). Please send project information to this agency for review (see WHAT TO SEND).

PFBC Species: (Note: The PNDI tool is a primary screening tool, and a desktop review may reveal more or fewer species than what is listed below.)
Scientific Name: Sensitive Species**
Common Name:
Current Status: Threatened
Proposed Status: Special Concern Species*

U.S. Fish and Wildlife Service

RESPONSE: No impacts to **federally** listed or proposed species are anticipated. Therefore, no further consultation/coordination under the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.* is required. Because no take of federally listed species is anticipated, none is authorized. This response does not reflect potential Fish and Wildlife Service concerns under the Fish and Wildlife Coordination Act or other authorities.

* Special Concern Species or Resource - Plant or animal species classified as rare, tentatively undetermined or candidate as well as other taxa of conservation concern, significant natural communities, special concern populations (plants or animals) and unique geologic features.
** Sensitive Species - Species identified by the jurisdictinal agency as collectible, having economic value, or being susceptible to decline as a result of visitation.

WHAT TO SEND TO JURISDICTIONAL AGENCIES

If project information was requested by one or more of the agencies above, send the following information to the agency(s) seeking this information (see AGENCY CONTACT INFORMATION).

Check-list of *Minimum* Materials to be submitted:

____**SIGNED** copy of this Project Environmental Review Receipt
____Project narrative with a description of the overall project, the work to be performed, current physical characteristics of the site and acreage to be impacted.
____Project location information (name of USGS Quadrangle, Township/Municipality, and County)
____USGS 7.5-minute Quadrangle with project boundary clearly indicated, and quad name on the map

The inclusion of the following information may expedite the review process.
____A basic site plan(particularly showing the relationship of the project to the physical features such as wetlands, streams, ponds, rock outcrops, etc.)
____Color photos keyed to the basic site plan (i.e. showing on the site plan where and in what direction each photo was taken and the date of the photos)
____Information about the presence and location of wetlands in the project area, and how this was determined (e.g., by a qualified wetlands biologist), if wetlands are present in the project area, provide project plans showing the location of all project features, as well as wetlands and streams

4. DEP INFORMATION

The Pa Department of Environmental Protection (DEP) requires that a signed copy of this receipt, along with any required documentation from jurisdictional agencies concerning resolution of potential impacts, be submitted with applications for permits requiring PNDI review. For cases where a "Potential Impact" to threatened and endangered species has been identified before the application has been submitted to DEP, the application should not be submitted until the impact has been resolved. For cases where "Potential Impact" to special concern species and resources has been identified before the application has been submitted, the application should be submitted to DEP along with the PNDI receipt. The PNDI Receipt should also be submitted to the appropriate agency according to directions on the PNDI Receipt. DEP and the jurisdictional agency will work together to resolve the potential impact(s). See the DEP PNDI policy at http://www.naturalheritage.state.pa.us.

5. ADDITIONAL INFORMATION

The PNDI environmental review website is a **preliminary** screening tool. There are often delays in updating species status classifications. Because the proposed status represents the best available information regarding the conservation status of the species, state jurisdictional agency staff give the proposed statuses at least the same consideration as the current legal status. If surveys or further information reveal that a threatened and endangered and/or special concern species and resources exist in your project area, contact the appropriate jurisdictional agency/agencies immediately to identify and resolve any impacts.

For a list of species known to occur in the county where your project is located, please see the species lists by county found on the PA Natural Heritage Program (PNHP) home page (www.naturalheritage.state.pa.us). Also note that the PNDI Environmental Review Tool only contains information about species occurrences that have actually been reported to the PNHP.

6. AGENCY CONTACT INFORMATION

PA Department of Conservation and Natural Resources
Bureau of Forestry, Ecological Services Section
400 Market Street, PO Box 8552, Harrisburg, PA. 17105-8552
Fax:(717) 772-0271

U.S. Fish and Wildlife Service
Endangered Species Section
315 South Allen Street, Suite 322, State College, PA. 16801-4851
NO Faxes Please.

PA Fish and Boat Commission
Division of Environmental Services
450 Robinson Lane, Bellefonte, PA. 16823-7437
NO Faxes Please

PA Game Commission
Bureau of Wildlife Habitat Management
Division of Environmental Planning and Habitat Protection
2001 Elmerton Avenue, Harrisburg, PA. 17110-9797
Fax:(717) 787-6957

7. PROJECT CONTACT INFORMATION

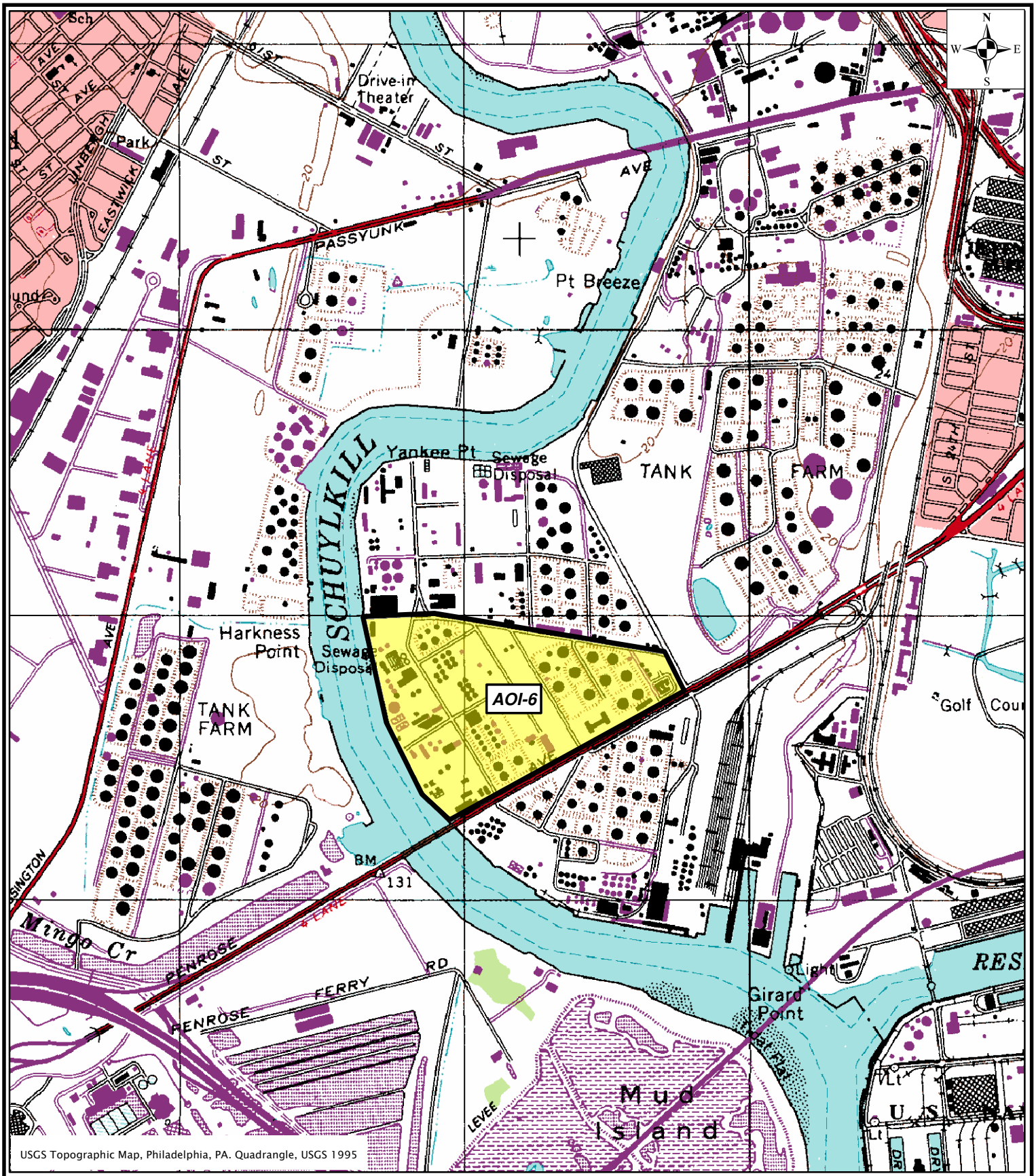
Name: Linda Kenney
Company/Business Name: Langan Engineering
Address: PO Box 1569
City, State, Zip: Doylestown PA 18901
Phone:(215) 491-6500 Fax:(215) 491-6501
Email: LKenney@Langan.com

8. CERTIFICATION

I certify that ALL of the project information contained in this receipt (including project location, project size/configuration, project type, answers to questions) is true, accurate and complete. In addition, if the project type, location, size or configuration changes, or if the answers to any questions that were asked during this online review change, I agree to re-do the online environmental review.

applicant/project proponent signature

1/15/13
date



SUNOCO

PHILADELPHIA ENERGY SOLUTIONS

Sunoco, Inc. (R&M)

PES Facility

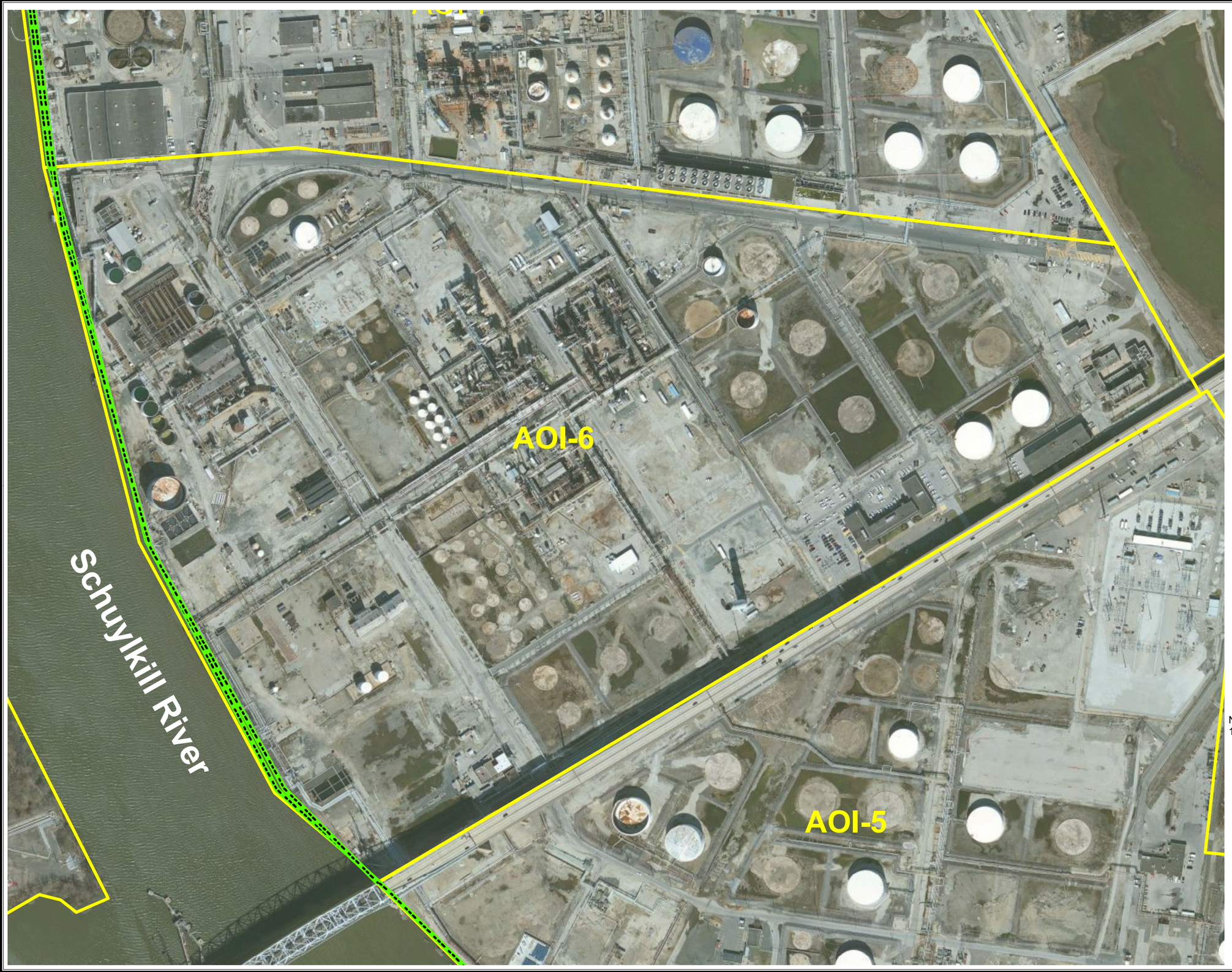
3144 Passyunk Avenue
Philadelphia, PA. 19145

Figure 1: Site Location Map
AOI-6
PES Facility

Philadelphia Pennsylvania

Job Number	Scale: 1" = 1,500'	Date
2574601	0 750 1,500 Feet	June 6, 2013

Path: \\langan.com\data\DT\data6\2574601\ArcGIS\MapDocuments\AOI 4 Repackaged SCR\Figure 1- Site Location Map_6-5-13.mxd



N
W E
S

Legend

Sheet Pile Wall/Bulkhead

AOI Boundary

Notes:
1. Bing Maps aerial imagery provided by © 2010 Microsoft Corporation and its data suppliers and obtained under the licensing agreement with ESRI.

Figure 2: Extent of Sheet Pile Wall/Bulkhead
AOI-6
PES Facility
Philadelphia, Pennsylvania

SUNOCO
PHILADELPHIA ENERGY SOLUTIONS

Sunoco, Inc. (R&M)
PES Facility

3144 Passyunk Avenue
Philadelphia, PA. 19145

0 300 600
Feet

SCALE: 1" = 300'
DATE: June 7, 2013
DRN. BY: MH
CKD. BY: DW
JOB#: 2574601

Path: \\langan.com\data\DT\data6\2574601\ArcGIS\MapDocuments\AOI 6 Repackaged SCR\Figure 2 - AOI-6 Extent of Sheet Pile Wall.mxd